

PI: SWARD, KATHERINE ANN	Title: Prisms Informatics Platform - Federated Integration Architecture	
Received: 06/01/2015	FOA: EB15-003	Council: 08/2015
Competition ID: FORMS-C	FOA Title: PEDIATRIC RESEARCH USING INTEGRATED SENSOR MONITORING SYSTEMS (PRISMS) NETWORK (U54)	
1 U54 EB021973-01	Dual: OD	Accession Number: 3824694
IPF: 514002	Organization: UNIVERSITY OF UTAH	
Former Number:	Department: COLLEGE OF NURSING	
IRG/SRG: ZRG1 HDM-Z (52)R	AIDS: N	Expedited: N
<u>Subtotal Direct Costs</u> <u>(excludes consortium F&A)</u> Year 1: 953,675 Year 2: 957,429 Year 3: 957,429 Year 4: 957,429 Year 5: 0	Animals: N Humans: Y Clinical Trial: N Current HS Code: 30 HESC: N	New Investigator: N Early Stage Investigator: N
<i>Senior/Key Personnel:</i> <i>Organization:</i> <i>Role Category:</i>		
KATHERINE SWARD	University of Utah	PD/PI

APPLICATION FOR FEDERAL ASSISTANCE
SF 424 (R&R)

			3. DATE RECEIVED BY STATE	State Application Identifier
			4.a. Federal Identifier	
<input type="radio"/> Pre-application <input type="radio"/> Application <input checked="" type="radio"/> Changed/Corrected Application			b. Agency Routing Number	
2. DATE SUBMITTED 2015-06-01	Application Identifier		c. Previous Grants.gov Tracking Number GRANT11919455	
5. APPLICANT INFORMATION			Organizational DUNS*: 009095365	
Legal Name*: University of Utah Department: Division: Street1*: 75 South 2000 East Street2: City*: Salt Lake City County: Salt Lake State*: UT: Utah Province: Country*: USA: UNITED STATES ZIP / Postal Code*: 84112-8930				
Person to be contacted on matters involving this application Prefix: First Name*: BRENDAMiddle Name: Last Name*: MALDONADO Suffix: Position>Title: Sponsored Project Officier Street1*: 75 South 2000 East, RM 211 Street2: City*: SALT LAKE CITY County: SALT LAKE State*: UT: Utah Province: Country*: USA: UNITED STATES ZIP / Postal Code*: 84112-8930				
Phone Number*: 801-581-4798		Fax Number: 801-585-5749	Email: brenda.maldonado@osp.utah.edu	
6. EMPLOYER IDENTIFICATION NUMBER (EIN) or (TIN)* 1-876000525-A1				
7. TYPE OF APPLICANT* H: Public/State Controlled Institution of Higher Education				
Other (Specify): <input type="checkbox"/> Small Business Organization Type <input type="radio"/> Women Owned <input type="radio"/> Socially and Economically Disadvantaged				
8. TYPE OF APPLICATION*		If Revision, mark appropriate box(es). <input checked="" type="radio"/> New <input type="radio"/> Resubmission <input type="radio"/> A. Increase Award <input type="radio"/> B. Decrease Award <input type="radio"/> C. Increase Duration <input type="radio"/> Renewal <input type="radio"/> Continuation <input type="radio"/> Revision <input type="radio"/> D. Decrease Duration <input type="radio"/> E. Other (specify):		
Is this application being submitted to other agencies?*		<input type="radio"/> Yes	<input checked="" type="radio"/> No	What other Agencies?
9. NAME OF FEDERAL AGENCY* National Institutes of Health		10. CATALOG OF FEDERAL DOMESTIC ASSISTANCE NUMBER TITLE:		
11. DESCRIPTIVE TITLE OF APPLICANT'S PROJECT* Prisms Informatics Platform - Federated Integration Architecture				
12. PROPOSED PROJECT Start Date* 09/30/2015		13. CONGRESSIONAL DISTRICTS OF APPLICANT Ending Date* 09/29/2019		

SF 424 (R&R) APPLICATION FOR FEDERAL ASSISTANCE**14. PROJECT DIRECTOR/PRINCIPAL INVESTIGATOR CONTACT INFORMATION**

Prefix: Dr. First Name*: KATHERINE Middle Name: A Last Name*: SWARD Suffix:
 Position>Title: Assistant Professor
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 Division: COLLEGE OF NURSING
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 County: SALT LAKE
 State*: UT: Utah
 Province:
 Country*: USA: UNITED STATES
 ZIP / Postal Code*: 84112-5880
 Phone Number*: 801/585-1481 Fax Number: Email*: kathy.sward@nurs.utah.edu

15. ESTIMATED PROJECT FUNDING

a. Total Federal Funds Requested*	\$5,700,683.00
b. Total Non-Federal Funds*	\$0.00
c. Total Federal & Non-Federal Funds*	\$5,700,683.00
d. Estimated Program Income*	\$0.00

16. IS APPLICATION SUBJECT TO REVIEW BY STATE EXECUTIVE ORDER 12372 PROCESS?*

- a. YES THIS PREAPPLICATION/APPLICATION WAS MADE AVAILABLE TO THE STATE EXECUTIVE ORDER 12372 PROCESS FOR REVIEW ON:
 DATE:
- b. NO PROGRAM IS NOT COVERED BY E.O. 12372; OR
 PROGRAM HAS NOT BEEN SELECTED BY STATE FOR REVIEW

17. By signing this application, I certify (1) to the statements contained in the list of certifications* and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances * and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 18, Section 1001)

I agree*

* The list of certifications and assurances, or an Internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

18. SFLLL or OTHER EXPLANATORY DOCUMENTATION

File Name:

19. AUTHORIZED REPRESENTATIVE

Prefix: First Name*: Brent Middle Name: Last Name*: Brown Suffix:
 Position>Title: Director
 Organization Name*: University of Utah
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 Division: VP FOR RESEARCH
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Signature of Authorized Representative*

Brent Brown

Date Signed*

06/01/2015

20. PRE-APPLICATION File Name:**21. COVER LETTER ATTACHMENT** File Name:CoverLetter1013416814.pdf

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**Component
Summary**

Components	Component Project Title	Organization Name	Contact PD/PI Name or Project Lead Name
Overall	Prisms Informatics Platform - Federated Integration Architecture	University of Utah	SWARD, KATHERINE A
Admin-Core-001 (001)	Prisms Informatics Platform - Federated Integration Architecture	University of Utah	SWARD, KATHERINE A
Project-001 (002)	Prisms Informatics Platform - Federated Integration Architecture	University of Utah	Patwari, Neal
Project-002 (003)	Prisms Informatics Platform - Federated Integration Architecture	University of Utah	Gouripeddi, Ramkiran
Project-003 (004)	Prisms Informatics Platform - Federated Integration Architecture	University of Utah	SWARD, KATHERINE A

**Project/Performance
Site Location(s) Summary**

Applicant Organization	City	State/Province	Country
University of Utah	Salt Lake City	UT	UNITED STATES

Organization Name	City	State/Province	Country	Component
UNIVERSITY OF UTAH	SALT LAKE CITY	UT	UNITED STATES	Admin-Core-001 (001)
UNIVERSITY OF UTAH	SALT LAKE CITY	UT	UNITED STATES	Overall
UNIVERSITY OF UTAH	SALT LAKE CITY	UT	UNITED STATES	Project-001 (002)
University of Utah	Salt Lake City	UT	UNITED STATES	Project-002 (003)
UNIVERSITY OF UTAH	SALT LAKE CITY	UT	UNITED STATES	Project-003 (004)

Human Subjects
Clinical Trial
Human Embryonic Stem Cells
Vertebrate Animals
Summary

Components	Human Subjects	Clinical Trial	HESC Involved	Vertebrate Animals
Overall	Y	N	N	N
Admin-Core-001 (001)	N		N	N
Project-001 (002)	Y	N	N	N
Project-002 (003)	Y	N	N	N
Project-003 (004)	Y	N	N	N

Composite Application Budget Summary

Categories	Budget Period 1	Budget Period 2	Budget Period 3	Budget Period 4	Budget Period 5	TOTALS
Salary, Wages and Fringe Benefits	909,819	909,819	909,819	909,819	0	3,639,276
Equipment	0	0	0	0	0	0
Travel	13,656	29,010	29,010	29,010	0	100,686
Participant/Trainee Support Costs	0	0	0	0	0	0
Other Direct Costs (excluding Consortium)	30,200	18,600	18,600	18,600	0	86,000
Consortium Costs	0	0	0	0	0	0
Direct Costs	953,675	957,429	957,429	957,429	0	3,825,962
Indirect Costs	467,301	469,140	469,140	469,140	0	1,874,721
Total Direct and Indirect Costs	1,420,976	1,426,569	1,426,569	1,426,569	0	5,700,683

Total Direct Costs less Consortium F&A

NIH policy (NOT-OD-05-004) allows applicants to exclude consortium/contractual F&A costs when determining if an application falls at or beneath any applicable direct cost limit. When a direct cost limit is specified in an FOA, the following table can be used to determine if your application falls within that limit.

Category	Budget Period 1	Budget Period 2	Budget Period 3	Budget Period 4	Budget Period 5	TOTALS
Total Direct Costs less Consortium F&A	953,675	957,429	957,429	957,429	0	3,825,962

Component Budget Summary

Components	Categories	Budget Period 1	Budget Period 2	Budget Period 3	Budget Period 4	Budget Period 5	TOTALS
Admin-Core-001 (001)	Salary, Wages and Fringe Benefits	117,882	117,882	117,882	117,882	0	471,528
	Equipment	0	0	0	0	0	0
	Travel	13,656	29,010	29,010	29,010	0	100,686
	Participant/Trainee Support Costs	0	0	0	0	0	0
	Other Direct Costs (excluding Consortium)	30,200	18,600	18,600	18,600	0	86,000
	Consortium Costs	0	0	0	0	0	0
	Direct Costs	161,738	165,492	165,492	165,492	0	658,214
	Indirect Costs	79,252	81,091	81,091	81,091	0	322,525
TOTALS	Total Direct and Indirect Costs	240,990	246,583	246,583	246,583	0	980,739
Project-001 (002)	Salary, Wages and Fringe Benefits	222,703	222,703	222,703	222,703	0	890,812
	Equipment	0	0	0	0	0	0
	Travel	0	0	0	0	0	0
	Participant/Trainee Support Costs	0	0	0	0	0	0
	Other Direct Costs (excluding Consortium)	0	0	0	0	0	0
	Consortium Costs	0	0	0	0	0	0
	Direct Costs	222,703	222,703	222,703	222,703	0	890,812
	Indirect Costs	109,124	109,124	109,124	109,124	0	436,496
TOTALS	Total Direct and Indirect Costs	331,827	331,827	331,827	331,827	0	1,327,308

Project-002 (003)	Salary, Wages and Fringe Benefits	344,885	344,885	344,885	344,885	0	1,379,540
	Equipment	0	0	0	0	0	0
	Travel	0	0	0	0	0	0
	Participant/Trainee Support Costs	0	0	0	0	0	0
	Other Direct Costs (excluding Consortium)	0	0	0	0	0	0
	Consortium Costs	0	0	0	0	0	0
	Direct Costs	344,885	344,885	344,885	344,885	0	1,379,540
	Indirect Costs	168,994	168,994	168,994	168,994	0	675,976
TOTALS	Total Direct and Indirect Costs	513,879	513,879	513,879	513,879	0	2,055,516
Project-003 (004)	Salary, Wages and Fringe Benefits	224,349	224,349	224,349	224,349	0	897,396
	Equipment	0	0	0	0	0	0
	Travel	0	0	0	0	0	0
	Participant/Trainee Support Costs	0	0	0	0	0	0
	Other Direct Costs (excluding Consortium)	0	0	0	0	0	0
	Consortium Costs	0	0	0	0	0	0
	Direct Costs	224,349	224,349	224,349	224,349	0	897,396
	Indirect Costs	109,931	109,931	109,931	109,931	0	439,724
TOTALS	Total Direct and Indirect Costs	334,280	334,280	334,280	334,280	0	1,337,120
TOTALS		1,420,976	1,426,569	1,426,569	1,426,569	0	5,700,683

Categories Budget Summary

Categories	Components	Budget Period 1	Budget Period 2	Budget Period 3	Budget Period 4	Budget Period 5	TOTALS
R&R Budget - Senior/Key Person Funds Requested	Admin-Core-001 (001)	85,159	85,159	85,159	85,159	0	340,636
	Project-001 (002)	111,279	111,279	111,279	111,279	0	445,116
	Project-002 (003)	142,167	142,167	142,167	142,167	0	568,668
	Project-003 (004)	189,249	189,249	189,249	189,249	0	756,996
TOTALS		527,854	527,854	527,854	527,854	0	2,111,416
R&R Budget - Other Personnel Funds Requested	Admin-Core-001 (001)	32,723	32,723	32,723	32,723	0	130,892
	Project-001 (002)	111,424	111,424	111,424	111,424	0	445,696
	Project-002 (003)	202,718	202,718	202,718	202,718	0	810,872
	Project-003 (004)	35,100	35,100	35,100	35,100	0	140,400
TOTALS		381,965	381,965	381,965	381,965	0	1,527,860
R&R Budget - Section A & B. Total Salary, Wages and Fringe Benefits (A+B)	Admin-Core-001 (001)	117,882	117,882	117,882	117,882	0	471,528
	Project-001 (002)	222,703	222,703	222,703	222,703	0	890,812
	Project-002 (003)	344,885	344,885	344,885	344,885	0	1,379,540
	Project-003 (004)	224,349	224,349	224,349	224,349	0	897,396
TOTALS		909,819	909,819	909,819	909,819	0	3,639,276
R&R Budget - Section C. Total Equipment	Admin-Core-001 (001)	0	0	0	0	0	0
	Project-001 (002)	0	0	0	0	0	0

	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		0	0	0	0	0	0	0
R&R Budget - Domestic Travel	Admin-Core-001 (001)	13,656	29,010	29,010	29,010	0	100,686	
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		13,656	29,010	29,010	29,010	0	100,686	
R&R Budget - Foreign Travel	Admin-Core-001 (001)	0	0	0	0	0	0	0
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		0	0	0	0	0	0	0
R&R Budget - Section D. Total Travel	Admin-Core-001 (001)	13,656	29,010	29,010	29,010	0	100,686	
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		13,656	29,010	29,010	29,010	0	100,686	
R&R Budget - Tuition/Fees/Health Insurance	Admin-Core-001 (001)	0	0	0	0	0	0	0
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0

	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		0	0	0	0	0	0	0
R&R Budget - Stipends	Admin-Core-001 (001)	0	0	0	0	0	0	0
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		0	0	0	0	0	0	0
R&R Budget - Trainee Travel	Admin-Core-001 (001)	0	0	0	0	0	0	0
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		0	0	0	0	0	0	0
R&R Budget - Subsistence	Admin-Core-001 (001)	0	0	0	0	0	0	0
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		0	0	0	0	0	0	0
R&R Budget - Other Participants/Trainee Support Costs	Admin-Core-001 (001)	0	0	0	0	0	0	0
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0

TOTALS		0	0	0	0	0	0	0
R&R Budget - Section E. Total Participants/Trainee Support Costs	Admin-Core-001 (001)	0	0	0	0	0	0	0
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		0	0	0	0	0	0	0
R&R Budget - Materials and Supplies	Admin-Core-001 (001)	30,200	15,600	15,600	15,600	0	0	77,000
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		30,200	15,600	15,600	15,600	0	0	77,000
R&R Budget - Publication Costs	Admin-Core-001 (001)	0	3,000	3,000	3,000	0	0	9,000
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		0	3,000	3,000	3,000	0	0	9,000
R&R Budget - Consultant Services	Admin-Core-001 (001)	0	0	0	0	0	0	0
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		0	0	0	0	0	0	0

R&R Budget - ADP/Computer Services	Admin-Core-001 (001)	0	0	0	0	0	0	0
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		0	0	0	0	0	0	0
R&R Budget - Subawards/Consortium/Contractual Costs	Admin-Core-001 (001)	0	0	0	0	0	0	0
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		0	0	0	0	0	0	0
R&R Budget - Equipment or Facility Rental User Fees	Admin-Core-001 (001)	0	0	0	0	0	0	0
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		0	0	0	0	0	0	0
R&R Budget - Alterations and Renovations	Admin-Core-001 (001)	0	0	0	0	0	0	0
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		0	0	0	0	0	0	0

R&R Budget - Other Direct Cost 1	Admin-Core-001 (001)	0	0	0	0	0	0	0
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		0	0	0	0	0	0	0
R&R Budget - Other Direct Cost 2	Admin-Core-001 (001)	0	0	0	0	0	0	0
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		0	0	0	0	0	0	0
R&R Budget - Other Direct Cost 3	Admin-Core-001 (001)	0	0	0	0	0	0	0
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		0	0	0	0	0	0	0
R&R Budget - Section F. Total Other Direct Cost	Admin-Core-001 (001)	30,200	18,600	18,600	18,600	0	0	86,000
	Project-001 (002)	0	0	0	0	0	0	0
	Project-002 (003)	0	0	0	0	0	0	0
	Project-003 (004)	0	0	0	0	0	0	0
TOTALS		30,200	18,600	18,600	18,600	0	0	86,000

R&R Budget - Section G. Total Direct Cost (A thru F)	Admin-Core-001 (001)	161,738	165,492	165,492	165,492	0	658,214
	Project-001 (002)	222,703	222,703	222,703	222,703	0	890,812
	Project-002 (003)	344,885	344,885	344,885	344,885	0	1,379,540
	Project-003 (004)	224,349	224,349	224,349	224,349	0	897,396
TOTALS		953,675	957,429	957,429	957,429	0	3,825,962
R&R Budget - Section H. Indirect Costs	Admin-Core-001 (001)	79,252	81,091	81,091	81,091	0	322,525
	Project-001 (002)	109,124	109,124	109,124	109,124	0	436,496
	Project-002 (003)	168,994	168,994	168,994	168,994	0	675,976
	Project-003 (004)	109,931	109,931	109,931	109,931	0	439,724
TOTALS		467,301	469,140	469,140	469,140	0	1,874,721
R&R Budget - Section I. Total Direct and Indirect Costs (G +H)	Admin-Core-001 (001)	240,990	246,583	246,583	246,583	0	980,739
	Project-001 (002)	331,827	331,827	331,827	331,827	0	1,327,308
	Project-002 (003)	513,879	513,879	513,879	513,879	0	2,055,516
	Project-003 (004)	334,280	334,280	334,280	334,280	0	1,337,120
TOTALS		1,420,976	1,426,569	1,426,569	1,426,569	0	5,700,683

**Senior/Key Personnel
Summary**

Name	Organization	Role on Project	Components
SWARD, KATHERINE A	University of Utah	PD/PI(Contact)	Overall
CUMMINS, MOLLIE REBECCA	University of Utah	Other: Project Lead	Project-003 (004)
FACELLI, JULIO CESAR	University of Utah	Other: Core Lead	Admin-Core-001 (001)
FACELLI, JULIO CESAR	University of Utah	Other: Project Lead	Project-002 (003)
Gouripeddi, Ramkiran	University of Utah	Other: Project Lead	Project-002 (003)
HOREL, JOHN D	University of Utah	Co-Investigator	Project-002 (003)
KELLY, KERRY E.	University of Utah	Co-Investigator	Project-002 (003)
Meyer, Erin L	University of Utah	Co-Investigator	Project-003 (004)
MEYER, MIRIAH DAWN	University of Utah	Other: Project Lead	Project-001 (002)
Nkoy, Flory L.	University of Utah	Other: Project Lead	Project-003 (004)
Patwari, Neal	University of Utah	Other: Project Lead	Project-001 (002)
STONE, BRYAN L	University of Utah	Co-Investigator	Project-003 (004)
SWARD, KATHERINE A	University of Utah	Other: Core Lead	Admin-Core-001 (001)
SWARD, KATHERINE A	University of Utah	Other: Project Lead	Project-003 (004)
WONG, BOB GAR	University of Utah	Co-Investigator	Project-003 (004)

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.

Follow this format for each person. DO NOT EXCEED FIVE PAGES.

NAME: SWARD, KATHERINE

eRA COMMONS USER NAME (agency login): KATHYSWARD

POSITION TITLE: Associate Professor

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Lutheran Hospital School for Nurses, Moline, IL	RN	1981	Nursing
Westminster College, Salt Lake City, UT	BS	1990	Nursing
University of Utah, Salt Lake City, UT	MS	1998	Nursing informatics
University of Utah, Salt Lake City, UT	PHD	2007	Nursing, Informatics

A. PERSONAL STATEMENT

The goal for the proposed *PRISMS Informatics Platform - Federated Integration Architecture* (U54 cooperative agreement) is to develop a flexible, open-source, standards-based informatics platform, which will enable research of environmental, physiological, and behavioral factors, measured through a variety of sensors, in epidemiological studies of asthma and other chronic diseases in the pediatric population. Our approach embraces the theme of *right information to the right person in the right format*; we believe that the infrastructure needs to be flexible and configurable, and that trials data need to *move and have meaning*. We build on contemporary informatics principles related to standards-based interoperability and health information exchange.

I have the expertise, leadership, training, motivation and enthusiasm necessary to succeed as PI for the informatics platform. I have a broad background spanning clinical nursing, research, and biomedical informatics, which allows me to fluidly bridge the multiple departments involved in this proposal. I have specific training, employment research experience, and expertise in clinical research informatics; user interactions with health IT; health IT standards; and software design, development, and implementation. I have strong leadership and team skills. I served as the Assistant Dean for information and technology in the College of Nursing, as PI or co-I on multiple research projects, and have collaborated with research networks including the pediatric-focused PALISI and CPCCRN networks. I successfully administered projects, conducted individual and team-based research, and produced peer-reviewed publications. I have supervised more than 50 graduate student committees (14 PhD, 11 DNP, 32 MS) and routinely mentor post-doctoral fellows and new faculty.

I have established strong collaborative ties to clinical researchers and clinicians who care for children with asthma, sensor developers, software engineers and mobile application developers, and experts in environmental data that will make it possible to recruit and maintain professional subject matter experts as participants in our user-centered design process. Thus the current application builds logically on my experience and prior research.

The skills and experience of the investigative team are complementary to mine; with senior-level and highly experienced mid-level personnel. Building on a long history of inter-departmental cooperation, we have developed a strong collaborative bond between the individuals involved in this project. We are committed to the goals of the PRISMS program and enthusiastic about the proposed informatics center.

Selected Publications relevant to Personal Statement

1. Sorenson D, Grissom CK, Carpenter L, Austin A, **Sward** K, Napoli L, Warner HR, Morris AH. A frame-based representation for a bedside ventilator weaning protocol. *J Biomed Inform.* 2008 Jun;41(3):461-8. PubMed PMID: [18358789](#).
2. **Sward** K, Orme J Jr, Sorenson D, Baumann L, Morris AH. Reasons for declining computerized insulin protocol recommendations: application of a framework. *J Biomed Inform.* 2008 Jun;41(3):488-97. PubMed PMID: [18499528](#); PubMed Central PMCID: [PMC2490709](#).
3. Newth CJ, Meert KL, Clark AE, Moler FW, Zuppa AF, Berg RA, Pollack MM, **Sward** KA, Berger JT, Wessel DL, Harrison RE, Reardon J, Carcillo JA, Shanley TP, Holubkov R, Dean JM, Doctor A, Nicholson CE. Fatal and near-fatal asthma in children: the critical care perspective. *J Pediatr.* 2012 Aug;161(2):214-21.e3. PubMed PMID: [22494876](#); PubMed Central PMCID: [PMC3402707](#).
4. Frey LJ, **Sward** KA, Newth CJ, Khemani RG, Cryer ME, Thelen JL, Enriquez R, Shaoyu S, Pollack MM, Harrison RE, Meert KL, Berg RA, Wessel DL, Shanley TP, Dalton H, Carcillo J, Jenkins TL, Dean JM. Virtualization of Open-Source Secure Web Services to Support Data Exchange in a Pediatric Critical Care Research Network. *J Am Med Inform Assoc.* 2015 Mar 21;PubMed PMID: [25796596](#).

B. POSITIONS AND HONORS

Positions and Employment

- 1980 - 1990 Registered Nurse, University Hospitals and Clinics, Salt Lake City, UT
1990 - 1992 Education Coordinator, Pioneer Valley Hospital, West Valley, UT
1993 - 1997 Senior Knowledge Engineer, Applied Medical Informatics/Mosby Consumer Health, Salt Lake City, UT
1997 - 1998 Teaching/Research Assistant, University of Utah, College of Nursing, Salt Lake City, UT
1998 - 2001 Computer Professional, University of Utah, College of Nursing, Salt Lake City, UT
1999 - 2007 Clinical Instructor, University of Utah, College of Nursing, Salt Lake City, UT
2007 - 2014 Assistant Professor, University of Utah, College of Nursing; Department of Biomedical Informatics (adjunct), Salt Lake City, UT
2014 - Associate Professor, University of Utah, College of Nursing/Department of Biomedical Informatics (adjunct), Salt Lake City, UT

Other Experience and Professional Memberships

- 1981 - Member; vice president Gamma Rho chapter 2008-2009, Sigma Theta Tau International Honor Society for Nursing
1981 - Member, American Nurses Association
1997 - Member, American Medical Informatics Association (AMIA)
1998 - Member, Utah Nursing Informatics Network (UNIN). Past roles included President, Treasurer, Board Member
2000 - Member, Health Information Management Systems Society (HIMSS)
2000 - Member, American Thoracic Society (ATS)
2011 - 2014 Ad hoc reviewer, Agency for Healthcare Research and Quality (AHRQ) Healthcare Information Technology Research (HITR) Study Section
2014 - 2014 Grant Application Reviewer, Patient-centered outcomes research institute (PCORI)

Honors

- 2006 Excellence in Teaching Award, University of Utah College of Nursing
2007 Outstanding Doctoral Student, University of Utah College of Nursing
2008 Award for Excellence in Teaching, Sigma Theta Tau International, Gamma Rho Chapter
2013 Award for Excellence in Mentoring, Sigma Theta Tau International, Gamma Rho Chapter
2014 Excellence in Scholarship and Research, University of Utah College of Nursing

C. Contribution to Science

1. Clinical research is a complex, resource intensive endeavor comprised of a multitude of actors, workflows, processes, and information resources. **Clinical research informatics (CRI)**, one of my research areas, is an emerging subdomain of biomedical informatics, focused on tools and methods that support and enable clinical research. Beginning even before my doctoral studies, I contributed to several papers on the development and evaluation of clinical decision support (CDS) tools, computer protocols, and similar tools as used to support pediatric and adult clinical research, particularly within networks of researchers. I served as the clinical informatics and CDS expert on network research teams. Our papers have raised awareness about unnecessary variability in clinical research and potential benefits of using informatics tools such as CDS and national standards to support research in pediatrics and adult care.
 - a. Thompson BT, Orme JF, Zheng H, Luckett PM, Truwit JD, Willson DF, Duncan Hite R, Brower RG, Bernard GR, Curley MA, Steingrub JS, Sorenson DK, Sward K, Hirshberg E, Morris AH. Multicenter validation of a computer-based clinical decision support tool for glucose control in adult and pediatric intensive care units. *J Diabetes Sci Technol.* 2008 May;2(3):357-68. PubMed PMID: [19885199](#); PubMed Central PMCID: [PMC2769731](#).
 - b. Khemani RG, Sward K, Morris A, Dean JM, Newth CJ. Variability in usual care mechanical ventilation for pediatric acute lung injury: the potential benefit of a lung protective computer protocol. *Intensive Care Med.* 2011 Nov;37(11):1840-8. PubMed PMID: [21965099](#); PubMed Central PMCID: [PMC3589567](#).
 - c. Jung CY, Sward KA, Haug PJ. Executing medical logic modules expressed in ArdenML using Drools. *J Am Med Inform Assoc.* 2012 Jul-Aug;19(4):533-6. PubMed PMID: [22180871](#); PubMed Central PMCID: [PMC3384109](#).
 - d. Blagev DP, Hirshberg EL, Sward K, Thompson BT, Brower R, Truwit J, Hite D, Steingrub J, Orme JF Jr, Clemmer TP, Weaver LK, Thomas F, Grissom CK, Sorenson D, Sittig DF, Wallace CJ, East TD, Warner HR, Morris AH. The evolution of eProtocols that enable reproducible clinical research and care methods. *J Clin Monit Comput.* 2012 Aug;26(4):305-17. PubMed PMID: [22491960](#).
2. Given that my training and experience combines clinical care, research, informatics, and software development, it is probably not surprising that I have explored the unique human-computer interaction that arises with health IT. My employment at Applied Medical Informatics/Mosby Consumer Health focused on consumer health informatics and I have subsequently supervised several PhD students who are researching consumer health informatics topics. However, my dissertation research, and subsequent research and publications in this area, focused on **the clinician's interaction with health IT**. Our findings emphasized the importance of contextual factors and the need to tailor interface designs so that they are appropriate for and meet the needs of those who will actually be using the software.
 - a. Roemer LK, Richardson SJ, **Sward K**, Tilley C. Redundancy in a computer-generated order list: meeting the needs of nurses at various levels of practice expertise. *Comput Inform Nurs.* 2005 Mar-Apr;23(2):73-82; quiz 83-4. PubMed PMID: [15772507](#).
 - b. Phansalkar S, **Sward KA**, Weir CR, Morris AH. Mapping clinicians' perceptions about computerized protocol use to an IT implementation framework. *Stud Health Technol Inform.* 2007;129(Pt 2):1098-101. PubMed PMID: [17911885](#).
 - c. **Sward K**, Orme J Jr, Sorenson D, Baumann L, Morris AH. Reasons for declining computerized insulin protocol recommendations: application of a framework. *J Biomed Inform.* 2008 Jun;41(3):488-97. PubMed PMID: [18499528](#); PubMed Central PMCID: [PMC2490709](#).
 - d. **Abstract**
Sward KA, Newth C, Page K, Dean J. Pediatric intensivist attitudes about a ventilator management computer protocol. In:ATS, editor. American Thoracic Society Annual Meeting; 2015 May; Denver, CO, United States. 2015.

3. In addition to the contributions described above, I have worked with collaborators to conduct and evaluate multiple types of **health IT implementations**. These studies examined pragmatic implementation issues that will inform our evaluation efforts for this project.
 - a. Staggers N, Lyons A, **Sward** K. Implementation of a new e-mail application in a health sciences center. Case study. *Comput Nurs.* 2000 Mar-Apr;18(2):59-61. PubMed PMID: [10740911](#).
 - b. Gassert CA, **Sward** KA. Phase I implementation of an academic medical record for integrating information management competencies into a nursing curriculum. *Stud Health Technol Inform.* 2007;129(Pt 2):1392-5. PubMed PMID: [17911942](#).
 - c. Morris AH, Hirshberg E, **Sward** KA. Computer protocols: how to implement. *Best Pract Res Clin Anaesthesiol.* 2009 Mar;23(1):51-67. PubMed PMID: [19449616](#).
 - d. Iribarren SJ, **Sward** KA, Beck SL, Pearce PF, Thurston D, Chirico C. Qualitative evaluation of a text messaging intervention to support patients with active tuberculosis: implementation considerations. *JMIR Mhealth Uhealth.* 2015 Feb 27;3(1):e21. PubMed PMID: [25802968](#); PubMed Central PMCID: [PMC4376194](#).

Complete List of Published Work in My Bibliography:

<http://www.ncbi.nlm.nih.gov/myncbi/katherine.sward.2/bibliography/41244085/public/?sort=date&direction=asc>
[ending](#)

D. RESEARCH SUPPORT

Ongoing Research Support

2014/12/01-2019/11/30

2U01HD049934-11, Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD)

DEAN, J MICHAEL (PI)

Data Coordinating Center of Collaborative Pediatric Critical Care Research Network

This center provides central data management and statistical resources for the Collaborative Pediatric Critical Care Research Network (CPCCRN); including network data collection, data management, data analysis guidelines and assistance with study publication. As informaticist and co-investigator I am responsible for computerized decision support (CDS) tools to support research activities, and supervision of informatics activities in the CPCCRN

Role: Co-Investigator

Completed Research Support

2009/12/01-2014/11/30

5U01HD049934-06, Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD)

DEAN, J MICHAEL (PI)

Data Coordinating Center of Collaborative Pediatric Critical Care Research Network

Central data management and statistical resources for the Collaborative Pediatric Critical Care Research Network (CPCCRN). As informaticist and co-I, I co-led a network project that developed and evaluated a platform for standards-based federated data, built on the caBIG infrastructure.

Role: Co-Investigator

2011/03/05-2014/02/28

R21 HD061870-02, Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD)

NEWTH, CHRISTOPHER & SWARD, KATHERINE ANN (PI)

Translating an Adult Ventilator Computer Protocol to Pediatric Critical Care

This multiple PI (Newth/Sward) study examined a standardized approach (protocol) for managing ventilators in the pediatric intensive care unit; and the changes to an adult protocol that are needed to make the decisions suitable for use in pediatric care. The study took place within the CPCCRN network. Statistical analyses are ongoing.

Role: MPI

2012/08/01-2013/07/01

N/A, U of Utah College of Nursing/Deseret Health Group

Towsley, G; Sward, K (PI)

Nursing home quality improvement: Assessing the process

This multi-PI (Towsley/Sward) study examined structure, processes, and information exchange related to quality improvement within a set of small rural nursing homes in the Midwest and Intermountain West; including the role that technology and information management play in nursing home QAPI activities.

Role: CPI

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.

Follow this format for each person. DO NOT EXCEED FIVE PAGES.

NAME: Cummins, Mollie R. (nee Poynton)

eRA COMMONS USER NAME (agency login): MOLLIEPOYNTON

POSITION TITLE: Associate Professor (tenured)

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
University of Illinois, Chicago, Illinois	BSN	05/1994	Nursing
Northern Kentucky University, Highland Heights, Kentucky	MSN	05/2000	Family Nurse Practitioner
Indiana University, Bloomington, Indiana	PHD	05/2005	Nursing Science, Information Science
University of Illinois, Urbana-Champaign, IL	Other training	05/1992	Pre-nursing
Santa Fe Institute, Santa Fe, New Mexico	Other training	07/2008	Complex Systems Summer School

A. PERSONAL STATEMENT

I'm a health informaticist and faculty member in the informatics programs of both the College of Nursing and School of Medicine at University of Utah. I study informatics approaches to improving the surveillance and treatment of poisoning, especially information management and health information exchange in the poison control center setting. My methodology blends applied clinical informatics with big data analytics, and has been funded by the Agency for Healthcare Research & Quality (AHRQ), the Department of Veterans Affairs, and other agencies. I've mentored a number of students and authored over 60 articles, book chapters, scientific papers, and abstracts. I studied both nursing science and information science in my doctoral training program. In 2007, I studied methods of complexity science including agent-based modeling and network analysis at the Santa Fe Institute. Prior to my career in informatics, I was as an emergency nurse and family nurse practitioner.

My doctoral study focused on the application of machine learning methods to induce predictive models from health care data. I began to focus on problems in the poison control setting when I joined the University of Utah in 2005. Initially I collaborated with others to develop an R01 proposal funded by the National Institute of Nursing Research, "Predictive Modeling of Poison Control Outcomes." I led an arm of this study in which I applied data mining methods to induce predictive models of poisoning outcomes. My involvement in this study led to multiple related studies of poison center information management, including terminology use, information requirements, and specialist decision making. I led an interdisciplinary team to conceive and obtain funding for a preliminary study related to health information exchange between emergency departments and poison control centers, funded by AHRQ (R21). Currently, I lead a five year R01 funded by AHRQ, "Electronic Exchange of Poisoning Information", in which we are developing, implementing and evaluating a health information exchange supported communication process between emergency departments and poison control centers. In a co-investigator role, I continue to lead predictive modeling efforts for two Department of Veterans Affairs funded studies, and I actively mentor students in applying big data analytics to clinical problems and questions.

I hold a number of leadership roles in biomedical informatics. I serve in a nationally elected position on the steering committee of the Alliance for Nursing Informatics, coordinating the efforts of fifteen national and regional informatics organizations to influence policy, education, and practice. I'm President of the Utah Nursing Informatics Network and an active member of the American Medical Informatics Association (AMIA).

and several of its working groups. I've previously served on the leadership team of two AMIA working groups. I'm an associate editor for the nursing informatics journal "CIN: Computers, Informatics, Nursing". I also serve on the Board of Scientific Counselors at the Lister Hill National Center for Biomedical Communications, the intramural research division of the National Library of Medicine.

1. Cummins MR, Crouch BI, Gesteland P, Staggers N, Wyckoff A, Wong BG. Electronic information exchange between emergency departments and poison control centers: a Delphi study. *Clin Toxicol (Phila)*. 2012 Jul;50(6):503-13. PubMed PMID: [22612793](#).
2. Caravati EM, Latimer S, Reblin M, Bennett HK, Cummins MR, Crouch BI, Ellington L. High call volume at poison control centers: identification and implications for communication. *Clin Toxicol (Phila)*. 2012 Sep;50(8):781-7. PubMed PMID: [22889059](#).
3. Cummins MR, Crouch B, Gesteland P, Wyckoff A, Allen T, Muthukutty A, Palmer R, Peelay J, Repko K. Inefficiencies and vulnerabilities of telephone-based communication between U. S. poison control centers and emergency departments. *Clin Toxicol (Phila)*. 2013 Jun;51(5):435-43. PubMed PMID: [23697459](#).
4. Del Fiol G, Crouch BI, Cummins MR. Data standards to support health information exchange between poison control centers and emergency departments. *J Am Med Inform Assoc*. 2014 Oct 23;PubMed PMID: [25342180](#).

B. POSITIONS AND HONORS

Positions and Employment

1993 - 1994	Student Nurse Assistant, Emergency Department, University of Illinois Hospital, Chicago, IL
1994 - 1997	Staff Nurse/ Travel Nurse, Emergency Department, Multiple Health Care Organizations
1997 - 1998	Clinical Instructor, Northern Kentucky University, Highland Heights, KY
1998 - 2000	Graduate Assistant, Northern Kentucky University, Highland Heights, KY
2001 - 2003	Pre-doctoral Fellow, Indiana University, Bloomington, IN
2004 - 2005	Research Associate, University of Utah, Salt Lake City, UT
2004 - 2005	Assistant Professor (Clinical), University of Utah College of Nursing, Salt Lake City, UT
2005 - 2012	Assistant Professor, University of Utah, Salt Lake City, UT
2006 - 2012	Adjunct Assistant Professor, University of Utah, Department of Biomedical Informatics, Salt Lake City, UT
2012 -	Associate Professor (tenured), University of Utah, College of Nursing, Salt Lake City, UT
2013 -	Adjunct Associate Professor, University of Utah, Department of Biomedical Informatics, Salt Lake City, UT
2013 -	Affiliate Investigator, Salt Lake VA IDEAS (Informatics, Decision Enhancement, and Surveillance) Center, Salt Lake City, UT

Other Experience and Professional Memberships

2000 -	Member, American Medical Informatics Association
2013 -	Elected Member, Steering Committee, Alliance for Nursing Informatics
2014 -	Member, Board of Scientific Counselors, Lister Hill National Center for Biomedical Communications
2014 -	President, Utah Nursing Informatics Network
2015 -	Associate Editor, CIN: Computers, Informatics, Nursing

Honors

1994	Dean's Research Award, Third Prize, University of Illinois at Chicago
1994	Induction, Phi Kappa Phi Honor Society
1994	Induction, Sigma Theta Tau International Honor Society of Nursing
1994	Sigma Theta Tau Award, Alpha Lambda Chapter of Sigma Theta Tau, International
1994	Alumni Award, University of Illinois College of Nursing Alumni Association

1994	Chancellor's Student Service Award, University of Illinois at Chicago
2000	National Research Service Award (Institutional), National Institute of Nursing Research/ Indiana University
2000	University Graduate Fellowship, Indiana University
2000	MSN Research Excellence Award, Northern Kentucky University
2005	Emily Holmquist Award, Indiana University School of Nursing
2006	Summer Scholarship Institute, University of Utah College of Nursing
2007	Santa Fe Institute Complex Systems Summer School, Full Scholarship, National Science Foundation/ Santa Fe Institute
2008	Service Award, American Medical Informatics Association, Nursing Informatics Working Group
2012	Excellence in Scholarship & Research Award, University of Utah College of Nursing
2014	Excellence in Research Award, Gamma Rho Chapter of Sigma Theta Tau International
2014	Alumni Legacy Leader Award, Indiana University School of Nursing
2014	Fellow, American Academy of Nursing
2014	Harriet H. Werley Award, American Medical Informatics Association
2014	Distinguished Paper Award Nominee, American Medical Informatics Association

C. Contribution to Science

1. I described and analyzed the unique workflow and information management characteristics of poison control centers as the basis for innovation and advancement. Despite the ever-growing toll of poison exposure, currently the leading cause of unintentional injury death in the United States, U.S. poison control centers use rudimentary, non-interoperable information systems and rely on telephone calls to exchange information during poisoning emergencies. U.S. poison control centers are consistently underfunded and lack sufficient IT resources for innovation. Further, they are not subject to meaningful use incentive payments and penalties tied to medicare and medicaid. Our work set the stage for poison control centers to advance their systems of information management to better support health outcomes and simultaneously enable enhanced surveillance and toxicology research.
 - a. Poynton MR, Bennett HK, Ellington L, Crouch BI, Caravati EM, Jasti S. Specialist discrimination of toxic exposure severity at a poison control center. *Clin Toxicol (Phila)*. 2009 Aug;47(7):678-82. PubMed PMID: [19656011](#).
 - b. Cummins MR, Crouch BI, Gesteland P, Staggers N, Wyckoff A, Wong BG. Electronic information exchange between emergency departments and poison control centers: a Delphi study. *Clin Toxicol (Phila)*. 2012 Jul;50(6):503-13. PubMed PMID: [22612793](#).
 - c. Caravati EM, Latimer S, Reblin M, Bennett HK, Cummins MR, Crouch BI, Ellington L. High call volume at poison control centers: identification and implications for communication. *Clin Toxicol (Phila)*. 2012 Sep;50(8):781-7. PubMed PMID: [22889059](#).
 - d. Cummins MR, Crouch B, Gesteland P, Wyckoff A, Allen T, Muthukutty A, Palmer R, Peelay J, Repko K. Inefficiencies and vulnerabilities of telephone-based communication between U. S. poison control centers and emergency departments. *Clin Toxicol (Phila)*. 2013 Jun;51(5):435-43. PubMed PMID: [23697459](#).
2. I've leveraged big data analytics to yield insight and informatics tools in multiple domains of health care. In my doctoral dissertation, I used artificial neural networks to induce predictive models of smoking cessation from health survey data. In a subsequent co-investigator role, I designed and led a predictive modeling study of adherence to poison control center referral recommendations, part of an NINR R01. I have collaborated with multiple colleagues and students to apply methods of knowledge discovery and data mining to a variety of clinical challenges, ranging from pharmacokinetic/ pharmacodynamic modeling challenges to survival rates after kidney transplant to MRSA colonization and homelessness. I've developed coursework and written book chapters on these methods, even as I conduct research and mentor.
 - a. Poynton MR, McDaniel AM. Classification of smoking cessation status with a backpropagation neural network. *J Biomed Inform*. 2006 Dec;39(6):680-6. PubMed PMID: [16624625](#).

- b. Kang SH, Poynton MR, Kim KM, Lee H, Kim DH, Lee SH, Bae KS, Linares O, Kern SE, Noh GJ. Population pharmacokinetic and pharmacodynamic models of remifentanil in healthy volunteers using artificial neural network analysis. *Br J Clin Pharmacol.* 2007 Jul;64(1):3-13. PubMed PMID: [17324247](#); PubMed Central PMCID: [PMC2000605](#).
 - c. Poynton MR, Ellington L, Caravati EM, Crouch BI, Bennett H. Building knowledge for poison control: the novel pairing of communication analysis with data mining methods. *Stud Health Technol Inform.* 2009;146:207-13. PubMed PMID: [19592836](#).
 - d. Poynton MR, Choi BM, Kim YM, Park IS, Noh GJ, Hong SO, Boo YK, Kang SH. Machine learning methods applied to pharmacokinetic modelling of remifentanil in healthy volunteers: a multi-method comparison. *J Int Med Res.* 2009 Nov-Dec;37(6):1680-91. PubMed PMID: [20146865](#).
3. I pioneered and advanced the use of informatics approaches and tools in poison control. I've produced critically important informatics tools that enable optimal use of clinical data and information for medical decision-making, for poison exposures and beyond. I developed a novel model for workflow-integrated health information exchange, a model that leverages technology to minimize interruptions and maximize access to relevant patient information at the point of decision making. I led my team in developing a standards-based approach for bidirectional, near real-time health information exchange between emergency departments and poison control centers. Additionally, we developed an HL7 CCDA consultation note template for poisoning and conducted substantial mapping between public health and clinical terminologies in support of interoperability.
- a. Del Fiol G, Crouch BI, Cummins MR. Data standards to support health information exchange between poison control centers and emergency departments. *J Am Med Inform Assoc.* 2014 Oct 23;PubMed PMID: [25342180](#).

Complete List of Published Work in My Bibliography:

<http://www.ncbi.nlm.nih.gov/myncbi/1F3ZwydPrFNkl/bibliography/47180916/public/?sort=date&direction=ascending>

D. RESEARCH SUPPORT

Ongoing Research Support

2013/09/30-2018/09/29

R01 HS021472-01A1, Agency for Health Care Research and Quality

CUMMINS, MOLLIE R. (PI)

Electronic Exchange of Poisoning Information

The objectives of this project are to develop a replicable, scalable process for ED-PCC health information exchange (HIE) and develop informatics tools that enable emergency departments and poison control centers to engage in HIE. The effect of the prototype process on workflow and clinical outcomes will be evaluated.

Role: PI

2013/01/01-2016/01/01

IIR 12-084-3, U. S. Department of Veterans Affairs, HSR&D

Gundlapalli, Adi (PI)

Current Evidence and Early Warning Indicators of Homelessness Risk Among Veterans

The objective of this proposal is to support the VA's commitment to end homelessness among Veterans by developing predictive models of homelessness among Veterans using all available data from the VA electronic record.

Role: Co-Investigator

2010/01/01-2015/09/30

VAHIR10-001, U.S. Department of Veterans Affairs, HSR&D

Samore, Matthew (PI)

ProWATCH Protecting Warfighters Using Algorithms for Text Processing to Capture Health Events
The goal of this project is to use information extraction and machine learning techniques to develop an automated algorithm to identify OEF/OIF veterans with medically unexplained symptoms and syndromes.
Role: Co-Investigator

Completed Research Support

2010/03/01-2012/02/28

R21 HS018773-01, Agency for Health Care Research and Quality

CUMMINS, MOLLIE R. (PI)

Supporting Continuity of Care for Poisonings with Electronic Information Exchange

This study assessed teh information requirements for health information exchange between poison control centers and emergency departments in support of individual patient care and care transitions. It also identified the clinical, operational, and legal considerations important for heath information exchange between emergency departments and poison control centers.

Role: PI

2011/01/01-2012/01/01

Basic Agreement 11RT0150, U.S. Department of Veterans Affairs

Meystre, Stephane (PI)

Syndrome Surveillance Tools

This project was a contract with the Department of Veterans Affairs to provide scientific services in support of the study "ProWATCH Protecting Warfighters Using Algorithms for Text Processing to Capture Health Events". The contract includes four CLINS: Information Modeling and Ontologies, Information Extraction / Machine Learning, Predictive Modeling, and Visual Analytics. Dr. Cummins is the lead for CLIN 003, Predictive Modeling, in which Dr. Cummins and her team built predictive models to infer the presence or absence of medically unexplained syndromes among individual OEF/ OIF veterans.

Role: Co-Investigator

2007/01/01-2011/01/01

NR0101119-01, National Institute for Nursing Research

Ellington, Lee (PI)

Predictive Modeling of Call Outcomes to Poison Control Center Recommendations

This focus of this application was the development of an evidence base for PCCs and their staff to use in responding to the increasing national problem of poisoning. Using data from a regional PCC, developed and tested multivariate models of call outcomes to PCC recommendations using behavioral science and informatics-based methodology.

Role: Co-Investigator

BIOGRAPHICAL SKETCH

NAME Facelli, Julio C	POSITION TITLE Professor and Vice Chair, of Biomedical Informatics, School of Medicine, University of Utah
eRA COMMONS USER NAME (credential, e.g., agency login) JULIOFACELLI	

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	MM/YY	FIELD OF STUDY
University of Buenos Aires, Argentina	Licenciado	01/77	Physics
University of Buenos Aires, Argentina	PhD	01/81	Physics

A. Personal Statement

Dr. Facelli is a Professor and Vice-Chair of the Department of Biomedical Informatics and Director of Biomedical Informatics for the Center for Clinical and Translational Science. He has significant expertise in research computing, molecular simulations and distributed computing. His interest in this proposal relates to his long term goal of training individuals in using the most advanced computing techniques to solve important biomedical problems. Dr. Facelli has taught classes in Physics, Chemistry, Computational Sciences, Telecommunications and Medicine. His research interests are in parallel and distributed computing applications in biomedical informatics and currently he has eight graduate students working under his supervision, pursuing degrees from Chemistry and Biomedical Informatics (University of Utah) and Physics/Computer Science (University of Buenos Aires).

Dr. Facelli has expertise in Big Data approaches applied to high-resolution datasets. He has developed and adapted text mining, data extraction, data mining, chemometrics and molecular modeling techniques to address important questions in nanomedicine with emphasis on drug delivery systems for cancer treatment.

Dr. Facelli is an accomplished and personal mentor for faculty as well as students. He will serve as a Principal Investigator for the proposed PRISMS informatics center, and will mentor and advise the contact PI, Dr. Sward. They have offices next to each other and interact on a daily basis. Dr. Facelli excels at integrating technical and healthcare concerns; he has placed particular emphasis on bringing to our field students with computational backgrounds who hunger to apply the techniques they have studied to problems of societal import. He has also established fruitful pipelines for training students of under-represented minorities in informatics. He focuses on the individual with a vision of how to improve and enrich our field. Examples of publication related to his personnel statement are:

1. Jones DE, Igo S, Hurdle J, **Facelli JC** (2014) Automatic Extraction of Nanoparticle Properties Using Natural Language Processing: NanoSifter an Application to Acquire PAMAM Dendrimer Properties. *PLoS ONE* 9(1): e83932. doi:10.1371/journal.pone.0083932. PMCID: PMC3879259.
2. Maojo V, Fritts M, Martin-Sanchez F, De la Iglesia D, Cachau RE, Garcia-Remesal M, Crespo J, Mitchell JA, Anguita A, Baker N, Barreiro JM, Benitez SE, De la Calle G, **Facelli JC**, Ghazal P, Geissbuhler A, Gonzalez-Nilo F, Graf N, Grangeat P, Hermosilla I, Hussein R, Kern J, Koch S, Legre Y, Lopez-Alonso V, Lopez-Campos G, Milanesi L, Moustakis V, Munteanu C, Otero P, Pazos A, Perez-Rey D, Potamias G, Sanz F, Kulikowski C (2012). Nanoinformatics: developing new computing applications for nanomedicine. *Comput Sci Eng*, 94(6), 521-539. PMCID: PMC3430140.
3. Jaspers MW, Demiris G, **Facelli JC**, Gatewood L, Hoerbst A, Li J, Pfeifer D, Wetter T (2013). International collaborations in health informatics education: globalizing health and biomedical informatics curricula. *Stud Health Technol Inform*, 192, 1249. No PMCID available.
4. **Facelli JC**, Hurdle JF, Mitchell JA (2012). Medical Informatics and Bioinformatics. In Abu-Faraj Z (Ed.), *Handbook of Research on Biomedical Engineering Education and Advanced Bioengineering Learning: Interdisciplinary Concepts* (1st, pp. 577-604). Hershey, PA, US: IGI Global. No PMCID available.

B. Positions and Honors

1976	Undergraduate Assistant, Modern Physics at the Physics Department of the University of Buenos Aires, Buenos Aires
1977 - 1978	Graduate Assistant, Modern Physics and Statistical Mechanics at the Physics Department of the University of Buenos Aires, Buenos Aires
1979	Graduate Assistant, University of Buenos Aires, Physics Department, Buenos Aires
1980	Graduate Assistant, University of Buenos Aires, Buenos Aires
1981	Graduate Assistant, Statistical and Quantum Mechanics at the Physics Department of the University of Buenos Aires, Buenos Aires
1982	Graduate Assistant, University of Buenos Aires, Physics Department, Buenos Aires
1983	Research Associate, Department of Chemistry, University of Arizona, with Professor M. Barfield, Tucson, Arizona
1984 - 1986	Research Associate, Department of Chemistry, University of Utah, with Professor D.M. Grant, SLC, UT
1986 - 1990	Research Assistant Professor, Department of Chemistry, University of Utah, Salt Lake City, UT
1987 - 1992	Associate Professor, Ad Honoren, Department of Physics, University of Buenos, Buenos Aires
1990 - 1996	Adjunct Associate Professor, Department of Chemistry, University of Utah, SLC, UT
1992	Visiting Professor, Departamento de Física, Universidad de Buenos Aires, Buenos Aires
1995 - 2000	PNL Affiliate Staff Scientist, Pacific Northwest Laboratory, Richland, WA
1996 - 2001	Research Professor, Department of Physics, University of Utah, SLC, UT
1996 - Present	Adjunct Professor, Department of Chemistry, University of Utah, SLC, UT
1996 - 2013	Director Center for High Performance Computing, University of Utah, Salt Lake City, Utah
2002 - Present	Adjunct Professor, Department of Physics, University of Utah, SLC, UT
2002 - 2007	Adjunct Professor, Department of Biomedical Informatics, University of Utah, SLC, UT
2007 - Present	Professor, Department of Biomedical Informatics, University of Utah, SLC, UT
2007 - Present	Vice-Chair Biomedical Informatics, University of Utah, Salt Lake City Utah
2009 - Present	Faculty Member, Institute for Clean and Safe Energy, University of Utah, SLC, UT
2010 - Present	Faculty Member, Nano Institute of Utah, University of Utah, SLC, UT
2012 - 2013	Interim Chair Biomedical Informatics, University of Utah, Salt Lake City, Utah
2012 - Present	Director Biomedical Informatics Core, Center for Clinical and Translational Science, University of Utah, SLC, UT

Honors

1990	Listed in Who's Who in the West, Who's Who in Science and Engineering and Who's Who in American Education
2012	Reed M. Gardner award for Faculty Excellence
2014	Elected Fellow of the American College of Medical Informatics (ACMI)

C. Contributions to Science (NEW SECTION)

Facelli's research interests have been centered in the application of advance computing techniques to solve important problems in multiple domains including the biomedical sciences. The projects in his research group use similar computational infrastructure and tools to maximize the synergy among projects, benefiting the students, postdocs and faculty in the group who are exposed to a variety of biomedical problems that are addressed by a common set of computational approaches. Dr. Facelli is co-author of more than 190 international per review publications, which have published in the in the most prestigious journals in their corresponding fields, including Nature, Physical Review, J. American Chemical Society, J. American Medical Informatics, Acta Crystallography, BNC Bioinformatics. His research has been funded by NSF, NIH and DOE. Examples of the areas in which Dr. Facelli has made substantial scientific contributions are:

Dr. Facelli early work in solid state NMR has led to the development of the emerging field of NMR Crystallography. Examples of seminal papers in these area are:

- a) **Facelli JC**, Grant DM (1993). Determination of molecular symmetry in crystalline naphthalene using solid-state NMR. *Nature*, 365(6444), 325-327. PMID: 8377823.
- b) **Facelli JC**, Gu Z, McDermott A (1995). Carbon-13 Chemical Shift Tensors of Carboxylic Acids. GIAO calculations in the Acetic Acid-methylamine dimer. *Mol Phys*, 86, 865-872. No PMCID available.

- c) **Facelli JC**, Pugmire RJ, Grant DM (1996). Effects of Hydrogen Bonding in the Calculation of Nitrogen-15 Chemical Shift Tensors: Benzamide. *J Am Chem Soc*, 118, 5488-5489. No PMID available.

Facelli and his collaborators have developed one of the most advanced computer software systems for crystal and cluster structure prediction addressing a critical problem in the pharmaceutical industry: polymorphism in drug formulation and manufacturing. Examples of his work in this area are:

- a) Kim S, Orendt AM, Ferraro MB, **Facelli JC** (2009). Crystal Structure Prediction (CSP) of Flexible Molecules using Parallel Genetic Algorithms with a Standard Force Field. *J Comput Chem*, 30, 1973-1985. PMID: 19130496.
- b) Bazterra VE, Oña O, Caputo MC, Ferraro MB, Fuentealba P, **Facelli JC** (2004). Modified genetic algorithms to model atomic cluster structures in medium size silicon clusters. *Phys Rev*, 69, 053202.1-053202.7. No PMID available.
- c) Lund AM, Orendt AM, Pagola GI, Ferraro MB, **Facelli JC** (2013). Optimization of Crystal Structures of Archetypical Pharmaceutical Compounds: A Plane-Wave DFT-D Study Using Quantum Espresso. *Crystal Growth Des*, 13(5), 2181-2189. No PMID available.
- d) Bardwell DA, Adjiman CS, Arnaudova YA, Bartashevich E, Boerrigter SX, Braun DE, Cruz-Cabeza AJ, Day GM, Della Valle RG, Desiraju GR, van Eijck BP, **Facelli JC**, Ferraro MB, Grillo D, Habgood M, Hofmann DW, Hofmann F, Jose KV, Karamertzanis PG, Kazantsev AV, Kendrick J, Kuleshova LN, Leusen FI, Maleev AV, Misquitta AJ, Mohamed S, Needs RJ, Neumann MA, Nikylov D, Orendt AM, Pal R, Pantelides CC, Pickard CJ, Price LS, Price SL, Scheraga HA, van de Streek J, Thakur TS, Tiwari S, Venuti E, Zhitkov IK (2011). Towards crystal structure prediction of complex organic compounds--a report on the fifth blind test. *Acta Crystallogr B*, 67(Pt 6), 535-51. PMID: 22101543.

Dr. Facelli has been a pioneer in the developing of efficient, modern and modular infrastructures to facilitate biomedical information and computational sciences. During his tenure of 20 years as Director of the University of Utah Center for High Performance Computing he lead the development of infrastructure that increased the use of the facility from essentially none to several hundred users from the Health Science Center. Examples of his contribution are:

- a) Bradford W, Hurdle JF, LaSalle B, **Facelli JC** (2014). Development of a HIPAA-compliant environment for translational research data and analytics. *J Am Med Inform Assoc*, 21(1), 185-9. PMID: 23911553.
- b) Thibault JC, **Facelli JC**, Cheatham TE 3rd (2013). iBIOMES: managing and sharing biomolecular simulation data in a distributed environment. *J Chem Inf Model*, 53(3), 726-36. PMID: 23413948.
- c) He S, Narus SP, **Facelli JC**, Lau LM, Botkin JR, Hurdle JF (2014). A Domain Analysis Model for eIRB Systems: Addressing the Weak Link in Clinical Research Informatics. LID - S1532-0464(14)00120-8 [pii]LID - 10.1016/j.jbi.2014.05.003 [doi]. *J Biomed Inform*. PMID: 24929181.
- d) Staes CJ, Wu Xu W, R. Price, LeFevre SD, Narus SP, Gundlapalli A, Rolfs R, Nangle B, Samore M, **Facelli JC** (2009). A case for using grid architecture in state public health informatics: the Utah perspective. *BMC Med Informat Decis Making*, 9(32), 1-9.

Dr. Facelli and his students have used a variety of modern data mining and simulation techniques to address important biomedical problems; in doing so he has been able to engage in research collaborations with experts from multiple biomedical domains, including public health, infectious disease, cancer research and neurology among others. Examples of his work in this area are:

- a) Davis K, Staes C, Duncan J, Igo S, **Facelli JC** (2012). Identification of pneumonia and influenza deaths using the Death Certificate Pipeline. *BMC Med Informat Decis Making*, 12(1), 37. PMID: 22569097.

- b) Walton NA, Poynton MR, Gesteland PH, Maloney C, Staes C, **Facelli JC** (2010). Predicting the start week of respiratory syncytial virus outbreaks using real time weather variables. *BMC Med Informat Decis Making*, 10, 68. PMID: 21044325.
- c) Ebbert MT, Bastien RR, Boucher KM, Martin M, Carrasco E, Caballero R, Stijleman IJ, Bernard PS, **Facelli JC** (2011). Characterization of uncertainty in the classification of multivariate assays: application to PAM50 centroid-based genomic predictors for breast cancer treatment plans. *J Clin Bioinforma*, 1(1), 37. PMCID: PMC3275466.
- d) Wen J, Scoles DR, Facelli JC. Structure prediction of polyglutamine disease proteins: comparison of methods. *BMC Bioinformatics*. 2014;15 Suppl 7:S11. doi: 10.1186/1471-2105-15-S7-S11. Epub 2014 May 28. PMID: 25080018.

His NCBI My Bibliography is at: <http://www.ncbi.nlm.nih.gov/sites/myncbi/10e5ckjecip5-/bibliography/47360786/public/?sort=date&direction=ascending>.

D. Research Support

ACTIVE

1R25GM083755 (Facelli) 08/01/2008 - 07/31/2015

NIH/NIGMS

Title: Utah – Texas Bridge to Biomedical informatics Doctorate

Goal: To establish a partnership between the University of Texas at Brownsville and the University of Utah to provide an interactive Masters program and develop a path for students from UTB toward a doctoral degree in the University of Utah biomedical informatics program.

1R01HD067731 Korenberg (PI) 08/10/2011 – 05/31/2016

NIH/NICHD

Title: Down's Syndrome: Bridging Brain, Genes, and Cognition

The goal of this project to apply a cross-disciplinary approach including genetics, neuroanatomy (MRI), neural circuitry (DTI), neurotransmitter (MRS) and neurocognitive features to the study of Down syndrome. Findings from these studies will provide new insights into the genetics and development of the human brain, and into treatment strategies including new drug targets for prevention, recovery and ultimately cure of mental disability.

5UL1TR001067 Byington (PI) 05/01/2014 – 04/30.2018

NIH/NCRR

Title: Center for Clinical and Translational Science (CCTS)

Goal: Providing resources and services to support and speed the planning and implementation of clinical and translational research across the entire range of research and communities.

Facelli (PI) 10/01/2013 – 09/30/2015

Utah Department of Health

Title: Enhancing Utah APCD for Healthcare Cost Transparency

Goal: The Utah Department of Health (UDOH) Center for Health Data and Informatics, partnering with Utah Insurance Department (UID), University of Utah (UU) and two non-profit organizations of *HealthInsight* and Utah Health Information Network (UHIN), propose to enhance the existing capacity and functionality of the Utah All Payers Claims Database (APCD) to produce online pricing/cost transparency reports for consumers, employers, researchers, and the general public in Utah.

1338155 Ricci (PI) 10/01/2013-09/30/2017 .6 calendar months
NSF \$1,906,855

Title: MRI: Development of Apt, A Testbed Instrument with Adaptable Profiles for Network and Computational Science

Goal: The instrument is expected to be a national resource for computer science and other computing-based fields, Internet-accessible and to contribute to the nation's cyberinfrastructure. The broad and diverse targeted research communities include strong empirical and experimental components. The proposed instrument is highly suitable for training and education.

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.

Follow this format for each person. DO NOT EXCEED FIVE PAGES.

NAME: Gouripeddi, Ramkiran

era COMMONS USER NAME (agency login): RGOURIPEDDI

POSITION TITLE: Assistant Professor

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Stanley Medical College, M.G.R. Medical University, Chennai	MBBS	06/2004	Medicine
Arizona State University, Phoenix, AZ	MS	06/2009	Biomedical Informatics
State Government Hospital, Chennai, TN	Resident	06/2005	

A. Personal Statement

I have lead and participated in multiple data federation and integration projects. I lead the research and development of the OpenFurther project which is an open source informatics solution for data integration and federation [1]. To support environmental and biomedical research, I have extended the capabilities of OpenFurther to federate air quality data [2]. As the PHIS+ Informatics Principal Investigator, I have led the data federation and integration from the six contributing children's hospitals. This includes harmonizing the data from the six hospital systems, its standardization using biomedical terminologies, assessing the data's quality and validation [3], [4]. I am also responsible in helping with the selection and inclusion of clinical data needed for performing comparative effectiveness research study analyses that are currently underway as a part of the PHIS+ grant. As the Senior Biomedical Informatics Scientist, I lead the provisioning of biomedical data needed for different clinical studies undertaken at the University of Utah. My experience and training as a physician and biomedical informaticist and my lead involvement with multi-site large data projects (PHIS+, Center for Clinical and Translational Science, and the National Center for the Advancement of Translational Science) make me uniquely qualified to lead this ambitious project.

1. Narus SP, Srivastava R, Gouripeddi R, Livne OE, Mo P, Bickel JP, de Regt D, Hales JW, Kirkendall E, Stepanek RL, Toth J, Keren R. Federating clinical data from six pediatric hospitals: process and initial results from the PHIS+ Consortium. AMIA Annu Symp Proc. 2011;2011:994-1003. PubMed PMID: [22195159](#); PubMed Central PMCID: [PMC3243196](#).
2. Gouripeddi R, Warner PB, Mo P, Levin JE, Srivastava R, Shah SS, de Regt D, Kirkendall E, Bickel J, Korgenski EK, Precourt M, Stepanek RL, Mitchell JA, Narus SP, Keren R. Federating clinical data from six pediatric hospitals: process and initial results for microbiology from the PHIS+ consortium. AMIA Annu Symp Proc. 2012;2012:281-90. PubMed PMID: [23304298](#); PubMed Central PMCID: [PMC3540481](#).
3. Gouripeddi R, Facelli JC, Bradshaw RL, Schultz D, LaSalle B, Warner PB, Butcher R, Madsen R, Mo P. FURTHER: An Infrastructure for Clinical, Translational and Comparative Effectiveness Research. AMIA Annual Fall Symposium; 2013; Washington, DC, United States.
4. Gouripeddi R, Rajan N, Madsen R, Warner P, Facelli JC. Federating Air Quality Data with Clinical Data. AMIA Annual Fall Symposium; 2014; Washington, DC, United States.

B. Positions and Honors

Positions and Employment

2005 - 2006 Consultant Physician, Ganesh Clinic, Chennai, TN

2006 - 2007 Consultant Physician, Prasanthi Nilayam, AP

2007 - 2008 Teaching and Research Assistant, Center for Decision Making and Cognition, Arizona State

	University and College of Medicine, Phoenix, AZ
2008 - 2010	Research Assistant, Center for Cognitive Ubiquitous Computing, Arizona State University, Phoenix, AZ
2010 -	Health Information Systems Business Analyst, Sai Systems International, Shelton, CT
2010 - 2011	Health-Care Terminologist, University of Utah, Salt Lake City, UT
2012 -	Assistant Professor, University of Utah, Department of Biomedical Informatics, Salt Lake City, UT
2012 - 2012	Research Associate, University of Utah, Department of Biomedical Informatics, Salt Lake City, UT

Other Experience and Professional Memberships

Honors

C. Contribution to Science

1. Biomedical Data Federation/Federation: Biomedical Research often requires federation and integration of data from heterogeneous data sources to provide a holistic picture of an individual. Also, it could require federation or integration of data from disparate sources to provide sufficient sample sizes. OpenFurther [a-d] is an open-source informatics infrastructure that federates and integrates data in real time using native data and not requiring its transformation but at the same time providing semantic and syntactic interoperability between different data source. OpenFurther has been deployed at the University of Utah since 2010, at the Children's Hospitals Association for the PHIS+ project, at the University of North Carolina and the Utah Department of Health. As the senior biomedical informatics scientist, I lead the research and development of the OpenFurther project.
 - a. Gouripeddi R, Facelli JC, Bradshaw RL, Schultz D, LaSalle B, Warner PB, Butcher R, Madsen R, Mo P. FURTHER: An Infrastructure for Clinical, Translational and Comparative Effectiveness Research. AMIA Annual Fall Symposium; 2013; Washington, DC, United States.
 - b. Gouripeddi R, Schultz D, Butcher R, Mo P, Bradshaw RL, Madsen R, Warner PB, LaSalle BA, Facelli JC. OpenFurther: Federating and Generating OMOP Datasets. OMOP-IMEDS 2013 Symposium; 2013; Bethesda, MD, United States.
 - c. Mo P, Bradshaw RL, Schultz D, Butcher RB, LaSalle BA, Gouripeddi R, Facelli JC. Federating caTissue with FURTHER. AMIA Annual Fall Symposium; 2013; Washington, DC, United States.
 - d. Gouripeddi R. openfurther.org. [Internet]. 2014.
2. Integration of Environmental Data for Biomedical Research: Air quality has multiple effects on health conditions. This is especially true in Salt Lake City, Utah which is prone to winter inversions and summer ozone levels. In order to understand the relations between air quality and health, biomedical research requires the integration of heterogeneous air quality data with clinical data. OpenFurther provides such capabilities and was successfully for such integrate [a], [b]. Current on-going work includes integration of data from multiple mathematical models [c] to generate an air quality exposome [d]. I lead this project as the Principal Investigator.
 - a. Gouripeddi R, Rajan N, Madsen R, Warner P, Facelli JC. Federating Air Quality Data with Clinical Data. AMIA Annual Fall Symposium; 2014; Washington, DC, United States.
 - b. Gouripeddi R, Burnett N, Rajan N, Madsen R, Mo P, Facelli J. Informatics Resources for Supporting Biomedical and Environmental Research. Air Quality Competition - Summer to Fall 2014, Big Data Utah; 2014 October; Salt Lake City, UT, United States.
 - c. Burnett N, Gouripeddi R, Rajan N, Madsen R, Mo P, Facelli J. A Framework for Validating Modeled Air Quality Data for use in Biomedical Research. Air Quality in Utah: Science for Solutions; 2015; Salt Lake City, UT, United States.

- d. Gouripeddi R, Burnett N, Rajan N, Madsen P, Mo P, Facelli J. Defining an Air Quality Exposome: Data, Modeling, Uncertainty and Integration. Air Quality in Utah: Science for Solutions; 2015; Salt Lake City, UT, United States.
- 3. Infrastructure for Comparative Effectiveness Research: One of the current biomedical research agenda is to derive real-world evidence by performing comparative effectiveness research. In order to assemble large enough cohorts, OpenFurther was used to integrate clinical data with administrative data in the PHIS+ project [a-d]. OpenFurther has successfully integrated data from six pediatric hospitals which includes a population of 1.8 million children inclusive of about 160 million laboratory results, 0.5 microbiology culture results and 2 million imaging result. I lead this project as the informatics principal investigator.
 - a. Narus SP, Srivastava R, Gouripeddi R, Livne OE, Mo P, Bickel JP, de Regt D, Hales JW, Kirkendall E, Stepanek RL, Toth J, Keren R. Federating clinical data from six pediatric hospitals: process and initial results from the PHIS+ Consortium. AMIA Annu Symp Proc. 2011;2011:994-1003. PubMed PMID: [22195159](#); PubMed Central PMCID: [PMC3243196](#).
 - b. Gouripeddi R, Warner PB, Mo P, Levin JE, Srivastava R, Shah SS, de Regt D, Kirkendall E, Bickel J, Korgenski EK, Precourt M, Stepanek RL, Mitchell JA, Narus SP, Keren R. Federating clinical data from six pediatric hospitals: process and initial results for microbiology from the PHIS+ consortium. AMIA Annu Symp Proc. 2012;2012:281-90. PubMed PMID: [23304298](#); PubMed Central PMCID: [PMC3540481](#).
 - c. Gouripeddi R, Warner PB, Butcher R, Mo P, Mitchell J. Automating Terminology Mappings in FURTheR for Building Federated Databases. AMIA 2013 Summit on Clinical Research Informatics; 2013; San Francisco, CA, United States.
 - d. Gouripeddi R, Butcher R, Warner P, Mo P. Minimizing Data-Transformational Information Loss in Comparative Effectiveness Research Infrastructure. 4th Annual EDM Forum Stakeholder Symposium Evidence, Data, & Methods to Build Learning Health Systems of the Future; 2014 June; San Diego, CA, United States.
- 4. Other contributions to Clinical Research Informatics: Other contributions to the field of clinical research informatics include sharing data characteristics with clinical researchers to support their research decision making (a), resolving identities of individuals when integrating data from disparate data sources (b), clinical and biospecimen data integration (c) and clinical research user interfaces (d).
 - a. Madsen R, Bradshaw RL, Schultz ND, Butcher R, Gouripeddi R, Hulse N, Narus SP, Jackson M, Mitchell J. Federating Clinical and Biospecimen Data Using FURTheR. AMIA Annual Fall Symposium; 2012; Chicago, IL, United States.
 - b. Gouripeddi R, Madsen R, Bradshaw R, Schultz ND, Butcher R, Warner P, Mo P, LaSalle BA, Facelli JC. Initial Lessons for Developing a User-Interface for Querying Federated Heterogeneous Data Sources. Workshop on Interactive Systems in Healthcare (WISH); 2013; Washington, DC, United States.
 - c. Rajan NS, Gouripeddi R, Facelli JC. A Service Oriented Framework to Assess the Quality of Electronic Health Data for Clinical Research. 2013 IEEE International Conference on Healthcare Informatics (ICHI); 2013; Philadelphia, PA, United States.
 - d. Warner PB, Gouripeddi R, Mo P, Duncan J, Schultz ND, Facelli JC. "VIRGO: Virtual Identity Resolution on the Go. IEEE International Conference on Healthcare Informatics 2014 (ICHI 2014; 2014 September; Verona, Italy.

Complete List of Published Work in My Bibliography:

<http://www.ncbi.nlm.nih.gov/myncbi/ramkiran.gouripeddi.1/bibliography/48049073/public/?sort=date&direction=ascending>

D. Research Support

Ongoing Research Support

2012/01/01-2015/10/31

R01HS019862, AHRQ

Ron Keren (PI)

PHIS+: Augmenting the Pediatric Health Information System with Clinical Data

The construction of the PHIS+ database proposed in this application will provide academic clinicians with a rich data source to study large proportions of the Pediatric population and answer in real time the comparative effectiveness questions that affect hospitalized children. With this enhanced database, researchers will be able to predict outcomes, evaluate treatment strategies, select appropriate interventions, evaluate cost effectiveness, and measure quality of care. The research conducted with the PHIS+ database will improve the health status of hospitalized children including those in AHRQ identified priority populations such as minorities, those with multiple co-morbidities, and those from lower socioeconomic status.

Role: CPI

2013/10/01-2015/09/30

142489, Utah Department of Health

Julio C. Facelli (PI)

Enhancing Utah APCD for Healthcare Cost Transparency

The Utah Department of Health (UDOH) Center for Health Data and Informatics, partnering with Utah Insurance Department (UID), University of Utah (UU) and two non-profit organizations of HealthInsight and Utah Health Information Network (UHIN), propose to enhance the existing capacity and functionality of the Utah All Payers Claims Database (APCD) to produce online pricing/cost transparency reports for consumers, employers, researchers, and the general public in Utah.

Role: Co-Investigator

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Horel, John D.

ERA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE: Professor of Atmospheric Sciences

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.*)

INSTITUTION AND LOCATION	DEGREE <i>(if applicable)</i>	Completion Date MM/YYYY	FIELD OF STUDY
San Jose State University	B.S	05/1977	Meteorology
University of Washington	Ph.D.	05/1982	Atmospheric Sciences

A. Personal Statement

I have been involved in research related to the atmosphere for three decades and lead a research team of ~15 individuals (undergraduate and graduate students, and postdoctoral and staff research associates). My research is centered on the observation and analysis of weather and climate processes in mountainous regions. My current research activities include further development of MesoWest (<http://mesowest.utah.edu>), which provides access to surface weather observations for operational, research, and educational applications. MesoWest also provides a foundation from which to conduct research to improve data assimilation techniques over complex terrain and evaluate the cost effectiveness of surface observing networks. I also am involved in research and development related to fire weather applications, the Great Salt Lake, and Utah regional climate issues.

During the past five years, my research has increasingly focused on the atmospheric conditions associated with episodes of poor air quality during winter and summer. This research has involved field studies, novel environmental data collection from public transportation (e.g., sensors mounted on light rail cars in the Salt Lake Valley), and numerical modeling studies.

The proposed study will develop an informatics infrastructure to support epidemiological studies of pediatric asthma and other conditions that are affected by environmental factors. I will contribute my extensive expertise regarding air quality data and use of sensors in clinical research.

B. Positions and Honors

Positions and Employment

- 1982-1986 Assistant Research Professor, Scripps Institution of Oceanography, La Jolla CA
- 1986-1990 Assistant Professor, Meteorology, University of Utah, Salt Lake City, UT
- 1990-1996 Associate Professor, Meteorology, University of Utah, Salt Lake City, UT
- 1996- Professor, Atmospheric Sciences, University of Utah, Salt Lake City, UT
- 2002-2006 Director, NOAA Cooperative Institute for Regional Prediction, Salt Lake City, UT

Professional Memberships

- 1977- Member, American Meteorological Society
- 1990- Member, American Geophysical Union

Honors

1994	College of Mines and Earth Sciences Outstanding Teacher Award
2002	Fellow of the American Meteorological Society 2002
2002	Outstanding Service Award, National Weather Service Western Region

Recent Other Experience

2015	NSF Advisory Committee for Workshop on Intelligent Systems for Geosciences
2014	Co-Chair of the 2014 AMS/AGU Heads and Chair Meeting, 2014
2013-	Steering Committee, Program for Air Quality, Health, and Society, University of Utah
2013-	AMS Committee on Open Environmental Information Services. 2013-
2013-2015	Chair, AMS Board of Higher Education. 2013-2015
2012	External Reviewer. Department of Meteorology. San Jose State University
2011	Southwest Climate Assessment contributor
2009-2015	AMS Board of Higher Education
2008-2011	AMS IIPS Committee
2010	Co-Chair. Mountain Meteorology AMS Conference

C. Contribution to Science

1. During the past five years my research has increasingly focused on winter cold-air pools along the Wasatch Front and in the Uintah Basin associated with poor air quality. During summer 2015, we are leading a field project to diagnose the spatial and temporal evolution of ozone over and near the Great Salt Lake using a novel mix of fixed sensors, sensors onboard light-rail cars, and sensors carried aloft by UAVs, balloons, and commercial copters.
 - a. Neemann, E., E. Crosman, J. Horel, L. Avey (2015). Simulations of a cold-air pool associated with elevated wintertime ozone in the Uintah Basin, Utah. *Atmos. Chem. Phys.*, 15, 135-151.
 - b. Lareau, N., and J. Horel (2015). Turbulent erosion of cold-air pools. *J. Atmos. Sci.*, 72, 1409-1427.
 - c. Lareau, N., and J. Horel (2015) Dynamically induced displacements of a persistent cold-air pool. *Boundary-Layer Meteorology*, 154, 291-316.
 - d. Whiteman, C. D., S. W. Hoch, J. D. Horel, and A. Charland (2014): Relationship between particulate air pollution and meteorological variables in Utah's Salt Lake Valley. *Atmospheric Environment*. 94, 742-753.
 - e. Lareau, N., E. Crosman, C. Whiteman, J. Horel, S. Hoch, W. Brown, T. Horst (2013). The Persistent Cold-Air Pool Study. *Bull Amer. Meteor. Soc.* 94, 51–63.
2. Since the mid-1990's and continuing through the present, considerable effort in my research group has been placed on accessing, archiving, and disseminating environmental observations from over 30,000 sensor platforms from hundreds of networks. This effort, MesoWest (<http://mesowest.utah.edu>), is used for numerous applications including for protection of life and property, research, and education. Air quality applications of MesoWest have grown over time. This work involves increasingly applying new methods for quality control, data analytics, and visualization software development.
 - a. Horel, J., M. Splitt, L. Dunn, J. Pechmann, B. White, C. Ciliberti, S. Lazarus, J. Slemmer, D. Zaff, J. Burks (2002) MesoWest: Cooperative Mesonet in the Western United States. *Bull. Amer. Meteor. Soc.*, 83, 211-226.
 - b. Lammers, M., and J. Horel, (2014) Verification of National Weather Service spot forecasts using surface observations. *J. Operational Meteor*, 2, 246–264.
 - c. Horel, J., R. Ziel, C. Galli, J. Pechmann, X. Dong (2014). An evaluation of fire danger and behavior indices in the Great Lakes region calculated from station and gridded weather information. *International Journal of Wildland Fire*. 23, 202–214.
 - d. Tyndall, D., and J. Horel (2013). Impacts of mesonet observations on meteorological surface analyses. *Wea. Forecasting*. 28, 254-269.
 - e. Horel, John D., and X. Dong (2010) An evaluation of the distribution of Remote Automated Weather Stations (RAWS). *Journal of Appl. Meteor. and Clim.*, 49, 1563-1578.

3. From the late-1990's through 2002, considerable effort was spent helping to lead research and development and weather support for the 2002 Winter Olympics in Salt Lake City.
 - a. Horel, J., T. Potter, L. Dunn, W. J. Steenburgh, M. Eubank, M. Splitt, and D. J. Onton (2002). Weather support for the 2002 Winter Olympic and Paralympic Games. Bull. Amer. Meteor. Soc., 83, 227-240.
4. My early research was focused on climate variability, climate dynamics, and air-sea interactions. A total of seventeen publications resulted from this research over roughly a decade. The following publication is one of the most cited in the field:
 - a. Horel, John D., Wallace, John M. (1981). Planetary-Scale Atmospheric Phenomena Associated with the Southern Oscillation. Mon. Wea. Rev. 109, 813-829.

Complete List of Published Work Available From: <http://home.chpc.utah.edu/~u0035056/home/>

D. Research Support

Ongoing Research Support

Utah Division of Air Quality Horel (PI) 07/01/12-01/31/16
Improve Air Quality Modeling for the Wasatch Front & Cache Valley Winter Air Pollution Episodes
Apply state-of-the-art numerical weather models for air pollution applications in Utah.
Role: PI

Utah Division of Air Quality Horel (PI) 07/01/12-01/31/16
2015 Great Salt Lake Summer Ozone Study
Investigate spatial and temporal distribution of ozone distribution over and near the Great Salt Lake during summer
Role: PI

NOAA Lin (PI) 08-01/14-07/31/17
The Uintah Basin Greenhouse Gas Study
Improve understanding of the impact of emissions of CO₂ and CH₄ from oil and gas fields.
Role: co-PI

National Weather Service Horel (PI) 09/01/12-08/31/15
National Mesonet Expansion Project.
Subcontract with Global Science and Technology. Support collection, storage and dissemination of environmental observations including air quality observations.
Role: PI

Department of Interior Horel (PI) 09/01/14-03/31/16
Alaska Fire and Fuels System
Develop software system for fire weather applications in Alaska.
Role: PI

National Science Foundation Horel (PI) 03/01/13-02/28/16
Perturbation Pressure Variations Deduced from Earthscope's US Array
Investigate pressure variations associated with weather disturbance in the central and eastern U.S.
Role: PI

National Science Foundation Li (PI) 07/01/13-06/30/16
BIGDATA: Building the Mergeable and Interactive Distributed Data Layer for Big Data Summarization Systems
Develop new methodologies to access large volumes of environmental information
Role: Co-PI

NOAA Steenburgh (PI) 10/01/13-09/30/16
CSTAR: Advancing Analysis, Forecast, and Warning Decision Support Capabilities for High-Impact Weather Events.
Conduct research to improve public safety and protection of property.
Role: Co-PI

Completed Research Support Relevant to the Proposed Project

State of Utah Mansfield (PI) 03/01/14-02/28/15
Computer Modeling of Winter Ozone Formation in the Uintah Basin.
Improve numerical simulations of the atmospheric conditions associated with elevated ozone concentrations in
the Uintah Basin, Utah.
Role: Co-PI

National Science Foundation Whiteman(PI) 01/01/10-12/31/13
Persistent Wintertime Temperature Inversions in the Salt Lake Basin. Agency.
Conduct field program in the Salt Lake Valley, analyze the data, and perform numerical modeling experiments
associated with episodes of poor wintertime air quality.
Role: Co-PI

State of Utah Horel (PI) 10/01/12-09/30/13
Uintah Basin 2012/13 Winter Ozone Study
Participate in a field program, collect and analyze data collected, and perform numerical modeling experiments related to elevated ozone concentrations in the Uintah Basin.

BIOGRAPHICAL SKETCH

NAME Kelly, Kerry E.	POSITION TITLE Research Assistant Professor		
eRA COMMONS USER NAME (credential, e.g., agency login) KERRYKELLY			
EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.)			
INSTITUTION AND LOCATION	DEGREE (if applicable)	MM/YY	FIELD OF STUDY
Purdue University, West Lafayette, IN	BS	12/88	Chemical Engineering
University of North Carolina, Chapel Hill NC	MS	05/92	Environmental Engineering
University of Utah, Salt Lake City, UT	PhD	05/15	Environmental Engineering

A. Personal Statement

I am a chemical and environmental engineer broadly interested in the links between energy, air quality and human health, with a particular emphasis on aerosol formation and characterization. My research employs well-characterized combustion systems (including gasoline and diesel engines, gas turbine engines, boilers and flames), conditions, and fuels to understand aerosol formation and reduction strategies. I have participated in studies that examine the effect of fuel switching, fuel additives, and tailpipe control strategies on aerosol emissions. I have also coordinated several field campaigns to characterize aerosols from a variety of challenging sources including jet aircraft, rocket motors, diesel and gasoline engines, and agricultural burns. For the past 15 years, I have been research staff in the Department of Chemical Engineering and Institute for Combustion & Energy Studies (now the Institute for Clean and Secure Energy), and as a part-time student I recently completed my PhD.

My research activities are motivated by local and regional air-quality challenges. The Wasatch Front, the home of the University of Utah, experiences periodic high-levels of fine particulate matter. Two-years ago, I co-founded the University of Utah's Program for Air Quality, Health and Society with a goal of bringing together researchers from across the university to understand and address local air quality challenges. The Program particularly focuses on facilitating collaborations between health sciences, and the colleges of engineering and science, and it has given me an opportunity to begin to build collaborations with a number of health scientists.

B. Positions and Honors

Professional Experience:

- 1994-1996 Scientist, Fraunhofer Institute for Atmospheric Environmental Research, Garmisch-Partenkirchen, Germany.
- 1996-2000 Research Engineer, Center for Clean Products and Clean Technologies, University of Tennessee, Knoxville, TN.
- 2000-2010 Research Engineer, Institute for Combustion & Energy Studies, University of Utah, Salt Lake City, UT.
- 2002-2010 Associate Director, Institute for Combustion & Energy Studies, University of Utah, Salt Lake City, UT.
- 2013-pres. Associate Director, University of Utah Program for Air Quality, Health and Society, University of Utah, Salt Lake City, UT.
- 2015-pres. Research Assistant Professor, Department of Chemical Engineering, University of Utah, Salt Lake City, UT.

Appointments and Service:

- Vice Chair, Utah Air Quality Board (2009 – present)
- EPA Review Committee for Air Pollution Monitoring for Communities (2015)

Utah DEQ Clean Utah Partners Advisory Board (2007 – present)
University of Utah Clean Air Task Force (2013 – present)
Air & Waste Management Association, Great Basin Chapter Advisory Board (2007 – 2011)
Utah Division of Air Quality Carbon Capture Advisory Committee (2008-2010)
University of Utah Office of Sustainability Advisory Committee (2008 – 2010)
Reviewer for *Atmospheric Environment, Environmental Science & Technology, Energy & Fuels, International Journal of Greenhouse Gas Control*

C. Contributions to Science

- 1) Study of the source contributions, spatial and temporal distributions of particulate matter. The studies focus Utah's Wasatch Front area and the US-Mexico Border. These regions do not meet national ambient air quality standards (NAAQS) for particulate matter (fine and coarse). This Utah work led to numerous presentations to state legislators, community groups, and the state air quality board, and the source attribution study identified wood burning as a more important contributor to fine particulate matter during the winter season than the Division of Air Quality had previously believed. Along with updated EPA guidance, this study led to improved government practice on how "no-burn days" are determined and to legislation to assist sole-source wood burning households to convert to less-polluting methods of heating.

K.E. Kelly, R. Kotchenruther, R. Kuprov, G.D. Silcox (2013) Receptor model source attributions for Utah's Salt Lake City airshed and the impacts of wintertime secondary ammonium nitrate and ammonium chloride aerosol, *Journal of the Air & Waste Management Association*, 63:5, 575-590.

G.D. Silcox, **K.E. Kelly**, E.T. Crosman, C. D. Whiteman, B.L. Allen (2012) Wintertime PM_{2.5} concentrations during persistent, multi-day cold-air pools in a mountain valley, *Atmospheric Environment*, 46 17-24.

K.E. Kelly, I.C. Jaramillo, M. Quintero-Núñez, D.A. Wagner, K. Collins, H.L.C. Meuzeelar, J.S. Lighty (2010) Low-wind/high particulate matter episodes in the Calexico/Mexicali region, *J. Air & Waste Management Assoc.* 59:1173-1185.

J.G. Staniswalis, H. Yang, W.-W. Li, **K.E. Kelly** (2009) Using a continuous time lag to determine the associations between ambient PM_{2.5} hourly levels and daily mortality: indication of the importance of the total number of particles, *J. Air & Waste Management Assoc.* 59:1173-1185.

- 2) Characterizing aerosols from a variety of sources and fuel types including wood smoke, diesel engines, gasoline vehicles, and aircraft. These studies evaluated several approaches to characterizing aerosols with an emphasis on real-time measurements. As part of this work, validation data for a new photoacoustic analyzer for measuring black carbon was collected, and this analyzer is now being used by research groups throughout the world. The work also evaluated the effect of diesel particulate filters on particle size distribution, and these types of filters have gained widespread acceptance for control of diesel emissions.

A. Braun, F.E. Huggins, A. Kubátová, S. Wirick, M.M. Maricq, B.S. Mun, J.D. McDonald, **K.E. Kelly**, N. Shah, G.P. Huffman (2008) Toward distinguishing wood smoke and diesel exhaust in ambient particulate matter, *Environ. Sci. Technol.* 42(2):374-380.

K.E. Kelly, D.A. Wagner, B. Bretecher, B. Holden, K. Sahay, Z. Nardi, J.S. Lighty, A.S. Sarofim, N. Helgeson (2004) Evaluation of catalyzed and electrically heated soot filters for removal of particulate emissions from diesel and JP-8 fueled engines, *J. Air & Waste Management Assoc.* 54:83-92.

B. Zielinska, J. Sagebiel, W.P. Arnott, C.F. Rogers, **K.E. Kelly**, D.A. Wagner, J.S. Lighty, A.F. Sarofim, G. Palmer (2004) Phase and size distribution of polycyclic aromatic hydrocarbons in diesel and gasoline vehicle emissions, *Environ. Sci. Technol.* 38, 2557-2567.

K.E. Kelly, D.A. Wagner, J. S. Lighty, A.F. Sarofim, C.F. Rogers, J. Sagebiel, B. Zielinska, W.P. Arnott, and G. Palmer (2003) Characterization of exhaust particles from military vehicles fueled with diesel, gasoline, and JP-8, *J. Air & Waste Management Assoc.* 53: 273-282.

- 3) Studies of emerging energy technologies and their life-cycle environmental impacts. These studies examined the feasibility and potential barriers to emerging energy technologies, with an emphasis on

greenhouse gas emissions. The work on ex situ, industrial-scale CO₂ mineralization revealed the limited potential for use of this process as at a large scale, and as a result of this and other studies, interest in and funding for CO₂ mineralization commercialization has decreased.

K.E. Kelly, J.E. Wilkey, J.P. Spinti, T.A. Ring, D.W. Pershing (2014) Oxyfiring with CO₂ capture to meet low-carbon fuel standards for unconventional fuels from Utah, *International Journal of Greenhouse Gas Control* 22 189–199.

K.E. Kelly, G.D. Silcox, A.F. Sarofim, D.W. Pershing (2011), An evaluation of ex situ, industrial-scale, aqueous CO₂ mineralization, *International Journal of Greenhouse Gas Control Technologies*, 5, 1587–1595.

- 4) Development and application of image-processing techniques to characterize flames at a variety of scales. These techniques were developed to understand flame structure and stability at laboratory and pilot scales, and they have facilitated studies on the effect of coal composition, oxy-firing and species compositions on flame stability and structure. The University of Utah has focused on further enhancing these techniques in a variety of combustion studies.

D. Rezaei, Y. Zhou, J. Zhang, **K.E. Kelly**, E. Eddings, R. Pugmire, M. Ronald, Solum, J. Wendt (2013) The effect of coal composition on ignition and flame stability in coaxial flames, *Energy & Fuels* 27 (8), 4935–4945.

J. Zhang, **K.E. Kelly**, E.G. Eddings, J.O.L. Wendt (2011) Ignition in 40 kW co-axial turbulent diffusion oxy-coal jet flames, *Proceedings of the Combustion Institute*, Volume 33, Issue 2, Pages 3375-3382.

M. Gawlowski, **K.E. Kelly**, L.A. Marcotte, A. Schönbucher (2009) Determining the effect of species composition on temperature fields of tank flames using real-time holographic interferometry, *Applied Optics* 48(23), 4625- 4636.

- 5) My research is motivated by local and regional air-quality challenges. The Wasatch Front, the home of the University of Utah, does not meet National Ambient Air Quality Standards for fine particulate matter, and in 2013 Salt Lake County violated these standards on more than 30 days. In response to this, I co-founded the University of Utah's Program for Air Quality, Health and Society. This multidisciplinary program brings together investigators from across the university (including mechanistic biology, population sciences, engineering, bioinformatics, atmospheric sciences and public policy) to better understand and address the consequences of air pollution for human health and welfare, using the distinctive air quality environment in Utah as a laboratory. In the two years of its existence this program has had a major role in supporting the activities of junior investigators in studies related to air pollution. I am also committed to the translation of science to air quality policy on a local level, and I serve on the State Air Quality Board. For the past two years, I have given more than 25 presentations annually to community groups and high-school classrooms to discuss local air quality challenges and potential solutions.

BadAirDay: Play it Like UCAIR (BadAirDay.org). I led the grant and a team of students from the University of Utah's Engineering Arts and Entertainment Program in the development of this air quality video game aimed at teaching high-school and junior-high students about how policy and individual decisions affect local air quality.

**D. Research Support
Ongoing Support:**

NSF 10023049

Kelly

NSF

09/2011 – 8/15

Investigation of Fragmentation During Soot Oxidation

I assumed the PI role for this project when Dr. Lighty, the original PI, took a temporary leave from the university to serve as a Division Director at the National Science Foundation. Soot formation and oxidation are important because of soot's adverse health effects, role in climate forcing, and importance to ambient air quality and

visibility. This project investigates (a) under what conditions, i.e. temperatures, equivalence ratios, radical pool, etc. does fragmentation occur for ethylene flames at both low burnout and high burnout? (b) Whether "bridges between particles" exist that have different structure and might oxidize more effectively than primary particles? (c) For high, and potentially low, burnout conditions, do the primary particles behave such that percolation theory, which suggests that once a critical porosity is reached, particles will fragment, might explain the break-up of particles? (d) Are the results transferable to liquid fuels, and what is the role of aromatic versus aliphatic components?

Role: PI (0.5 calendar month)

Kelly 01/2015 – 12/16

Utah Division of Air Quality

Understanding the geospatial distribution of air toxics

Recently analyzed toxics data from the Wasatch Front showed that several toxic compounds regularly exceed the public health risk thresholds. This project aims to examine (a) signature-like patterns in individual species concentrations and ratios of different compounds, which may help identify sources of the toxic compounds. (b) associations between individual compounds and wind speed, wind direction and other meteorological variables. (c) geospatial and temporal concentration patterns at the three monitoring sites. (d) comparison between current and historical data.

Role: PI (1 calendar month)

Kelly 01/2014 – 12/15

Utah Division of Air Quality

Using 14C signatures to resolve wood smoke from cooking emissions

Using 14C signatures, this project aims to resolve the contributions from wood burning and cooking at the Hawthorne monitoring station in Salt Lake City. It includes collection of multiple filter samples during winter-time high PM days ($PM_{2.5}$ concentrations $> 25 \text{ ug/m}^3$) as well as samples collected during winter-time low PM days ($PM_{2.5}$ concentrations $< 25 \text{ ug/m}^3$). These samples will be analyzed at the University of California Irvine accelerator mass spectrometer.

Role: PI (0.5 calendar month)

Kelly 01/2014 – 12/15

UCAIR Foundation

Gaming for Air Quality

This project developed an air quality video game to teach middle and high-school students about the contributors the Wasatch Front's poor winter-time air quality. It allows students to see how individual and public-policy decisions affect air quality, and all choices are linked to real-world estimates of the effect of these decisions on the pollution burden to the region. A preliminary version of this game is available at BadAirDay.org, and it is being tested in schools. The project included a team of University of Utah Engineering Arts and Entertainment graduate students, the Utah Division of Air Quality, the Utah Health Department, community organizations, and environmental and science educators.

Role: PI (0 calendar months, student support only)

Kelly 01/2014 – 12/16

Educational Research Development Council and Lawrence T. and Janet T. Dee Foundation

Gaming for Air Quality

This project develops low-cost air quality to detect ozone, NO₂, particulate matter, temperature, and humidity with have integrated wireless communication. This project addresses the poor spatial and temporal distribution of air quality data.

Role: PI (0 calendar months, materials and student support only)

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME Erin Meyer	POSITION TITLE Research Associate BioLab Coordinator		
eRA COMMONS USER NAME (credential, e.g., agency login) ERMEYER			
EDUCATION/TRAINING (<i>Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.</i>)			
INSTITUTION AND LOCATION	DEGREE (if applicable)	MM/YY	FIELD OF STUDY
University of California, Santa Barbara, CA	BA with Honors	06/91	Biology/Pharmacology
Georgetown University, School of Medicine, Washington, DC	PhD	03/98	Pharmacology
University of Utah, Salt Lake City, UT	Postdoctoral Fellow	09/98-07/04	Cellular Neurobiology/ Human Molecular Biology and Genetics

A. Personal Statement

As a co-investigator, I will serve as a “basic science” content expert for this project, a position for which I am highly qualified. I have a PhD in pharmacology and I am a member of the Society for Neuroscience. I have worked in “basic bench” research for more than 25 years as a research pharmacologist in both academic and industry settings. My research has largely focused on ion channel receptors, including nicotinic receptors and glutamate receptors found in lung and immune cells that potentially play a role in respiratory inflammatory diseases including asthma. As a research assistant professor in the Department of Biology at the University of Utah, I worked with colleagues on cono-peptide compounds to learn about and possibly treat asthma. My work in the nicotinic receptor field includes research on tobacco smoking, a known contributor to asthma. My research has also involved examining the regulation of ganglia in the autonomic nervous system and adrenal glands by elucidating the subtypes of nicotinic receptors expressed there. These nicotinic receptors effect the downstream adrenergic receptors, some of which are involved in asthma. In addition, I have worked on sympathetic outflow from the brain to the cardio-respiratory system.

I am currently a research associate in the College of Nursing at the University of Utah and in this capacity, I have collaborated closely with Drs. Sward, Cummins and Wong on proposal submissions and funded studies. I am also the biolab coordinator in the College of Nursing at the University of Utah and in this position I maintain the function and integrity of the laboratory use.

I have coordinated multiple research teams on long-term projects including hiring and training personnel, managing fiscal matters, ordering research supplies and equipment, scheduling and directing team meetings and establishing collaborator networks. In addition, I have more than twenty years of experience acting as a liaison with federal regulatory agencies and ensuring compliance to Institutional Review Board protocols, animal use, radiation safety, environmental health and safety, standard operating procedures and Center for Disease Control protocols. With this experience, I will be able to assist the administrative core.

- a. Hone, A.J.; Whiteaker, P.; Christensen, S.; Xiao, Y.; **Meyer, E.L.**; McIntosh, J.M. **(2009)** A novel fluorescent α -conotoxin for the study of $\alpha 7$ nicotinic acetylcholine receptors. *J. Neurochem.* **111**(1), 80-9.
- b. Gahring, L.C.; **Meyer, E.L.**; Rogers, S.W. **(2003)** Nicotine-induced neuroprotection against N-methyl-D-aspartic acid or β -amyloid peptide occur through independent mechanisms distinguished by pro-inflammatory cytokines, *J. Neurochem.* **87**, 1125-1136.

- c. Xiao, Y.; **Meyer, E.**; Houghtling, R.; Thompson J.; Kellar, K.J. (1998) Generation of mammalian cell lines which stably express rat neuronal nicotinic acetylcholine receptor subtypes; *Proceedings of the 10th World Conference on Tobacco or Health*; Springer-Verlag; Editors: Rushan, L.; Niu, S.; Mackay, J.; Peto, R.
- d. Dickerson, L.; Panico, W.; Kuhn, F.; Willis, A.; FitzGerald, J.; **Meyer, E.**; Norman, W.; Gillis, R. (1997) Stimulation of canine rostral ventrolateral medulla and A5 area changes sympathetic outflow to vascular beds without effects on the heart; *American Journal of Physiology*, **41**, R821- R839.

B. Positions and Honors

Positions and Employment

9/12-present	Research Associate, University of Utah College of Nursing, Salt Lake City, UT
9/12-present	Bio-Laboratory Coordinator, University of Utah College of Nursing, Salt Lake City, UT
3/14-3/15	Program Manager, "Maternal SSRI Use, Placental Serotonin Synthesis and Protein Transporters, and Newborn Serotonin Levels," Center for Clinical and Translational Science grant, Gwen Latendresse (PI) University of Utah College of Nursing, Salt Lake City, UT
9/13-9/14	Program Manager, "Electronic Exchange of Poisoning Information," Agency for Healthcare Research and Quality R01, Mollie Cummins (PI) University of Utah College of Nursing, Salt Lake City, UT
9/04-6/12	Adjunct Faculty, University of Utah Department of Psychiatry, Salt Lake City, UT
3/12-9/12	Pharmacology Research Consultant, University of Utah Department of Medicinal Chemistry, Salt Lake City, UT
2004-11	Research Assistant Professor, University of Utah Department of Biology, Salt Lake City, UT
2009-present	Science Faculty, In Body Academy School of Yoga Therapy
2007-07	Adjunct Instructor, Utah Valley University Department of Biology, Orem, Utah
1998-04	Postdoctoral Fellow, University of Utah Department of Neurobiology and Anatomy and Department of Human Molecular Biology and Genetics, Salt Lake City, UT
1992-98	Graduate Student Research Fellow, Georgetown University school of Medicine Department of Pharmacology, Washington, DC.
1991-92	Research Technician, Sandoz Pharma, LTD., Drug Metabolism Division, Department of Drug Safety, Basel, Switzerland
1987-91	Research Assistant, University of California, Santa Barbara, Department of Biology, Santa Barbara, CA.

Honors and Memberships

1987-1991	University of California Regents College Scholarship
1988 and 1990	College of Creative Studies Undergraduate Research Fellowship, University of California, Santa Barbara
1987-1991	Julius Levine Memorial Merit Scholarship, Veterans of Foreign Wars, University of California, Santa Barbara
1991- present	Golden Key Honor Society Lifetime Member
1993- present	Society for Neuroscience, Member

C. Contributions to Science

1. My research has focused on elucidating the expression, function and regulation of ligand-gated ion channels. To this end, I have found that nicotinic receptor subtypes expressed striatum differentially modulate dopamine release based on tonic and phasic firing of neurons. These findings have implications on the mechanisms of reward and addiction as well as contributing to the knowledge of the functioning of the neurons involved in Parkinson's disease. In addition, I have shown strain-specific nicotinic receptor expression in mouse hippocampus. Moreover, my work shows that nicotinic receptors, pro-inflammatory cytokines, immune cell secretions and proteases regulate glutamate

receptor function. Glutamate receptors are the major excitatory receptors playing key roles in seizure disorders, learning, memory, stroke and neurodegenerative diseases.

Meyer, E.L.; Yoshikami, D.; McIntosh, J.M. (2008) The neuronal nicotinic acetylcholine receptors $\alpha 4^*$ and $\alpha 6^*$ differentially modulate dopamine release in mouse striatal slices. *J. Neurochem.* **105(5)**, 1761-1769.

Meyer, E.L.; Strutz, N.; Gahring, L.C.; Rogers, S.W. (2003) Glutamate receptor subunit 3 is modified by site-specific limited proteolysis including cleavage by gamma-secretase; *J. Biol. Chem.* **278**, 23786-23796.

Meyer, E.L.; Gahring, L.C.; Rogers, S.W. (2002) Nicotine preconditioning antagonizes activity-dependent caspase proteolysis of a glutamate receptor; *J. Biol. Chem.* **277**, 10869-10875.

Gahring, L.C.; **Meyer, E.L.**; Rogers, S.W. (2003) Nicotine-induced neuroprotection against N-methyl-D-aspartic acid or β -amyloid peptide occur through independent mechanisms distinguished by pro-inflammatory cytokines, *J. Neurochem.* **87**, 1125-1136.

2. I have a long standing history in my career of traveling to learn basic research assays and techniques or lifting techniques from the literature and successfully establishing them in my own laboratories. I have been able to do this with a wide variety of procedures including electrochemistry, immunoassays, pain assays and radioactive ion efflux methods to name a few. This has allowed me to enrich the science and research environments for faculty, postdoctoral fellows and students of the laboratories in which I worked. The new assays contributed to studies that were more complete, modern and relevant to the field.

Meyer, E.L.; Xiao, Y.; Kellar, K.J. (1999) Pharmacological properties and regulation of the rat neuronal nicotinic acetylcholine receptor $\alpha 3\beta 4$ subtype expressed in the KX $\alpha 3\beta 4$ R2 Cell Line; *Mol. Pharmacol.* **60-3**, 568-576.

Meyer, E.L.; Yoshikami, D.; McIntosh, J.M. (2008) The neuronal nicotinic acetylcholine receptors $\alpha 4^*$ and $\alpha 6^*$ differentially modulate dopamine release in mouse striatal slices. *J. Neurochem.* **105(5)**, 1761-1769.

Xiao, Y.; **Meyer, E.L.**; Thompson, J.M.; Surin, A.; Wroblewski, J.; and Kellar, K.J. (1997) Rat $\alpha 3\beta 4$ subtype of neuronal nicotinic acetylcholine receptor stably expressed in a transfected cell line: pharmacology of ligand binding and function; *Mol. Pharmacol.* **54**, 322-333.

Dickerson, L.; Panico, W.; Kuhn, F.; Willis, A.; FitzGerald, J.; **Meyer, E.**; Norman, W.; Gillis, R. (1997) Stimulation of canine rostral ventrolateral medulla and A5 area changes sympathetic outflow to vascular beds without effects on the heart; *American Journal of Physiology*, **41**, R821-R839.

Complete List of Published Work in My Bibliography:

<http://www.ncbi.nlm.nih.gov/myncbi/1Rs3vxCBDq9Aa/bibliography/47017881/public/?sort=date&direction=ascending>

D. Research Support

Completed Research Support

2014/03/01-2015/ 02/29

Center for Clinical and Translational Science, University of Utah

Gwen Latendresse (PI)

The Impact of Prenatal Depression and Antidepressants on Placental Gene Expression and

Serotonin Metabolism

Role: Project Manager

2013/09/30-2018/09/29

HS021472-01

AHRQ

Mollie R. Cummins (PI)

Electronic Exchange of Poisoning Information: Process, Tools, and Workflow Integration

The major goals of this project are to: 1) Develop a model process for HIE supported ED-PCC collaboration, (2) Develop and implement informatics tools for HIE supported ED-PCC collaboration, and (3) Evaluate the effects of the model HIE process and informatics tools on workflow, communication, efficiency, and utilization.

Role: Project Manager for year 1

2008/04/01-2013/03/31

P01 GM48677

NIH

Baldomero Olivera (PI)

Conus Peptides and their receptor targets

The goal of this program is to investigate the biochemistry, biotic interactions and phylogeny of Conus and Terebra.

Role: Co-Investigator, 2008-2011

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Miriah Meyer

ERA COMMONS USER NAME (credential, e.g., agency login): MIRIAHMEYER

POSITION TITLE: Assistant Professor of Computer Science

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.*)

INSTITUTION AND LOCATION	DEGREE <i>(if applicable)</i>	Completion Date	FIELD OF STUDY
Pennsylvania State University, University Park	B.S.	12/99	Astronomy & Astrophysics
University of Utah	Ph.D.	8/08	Computer Science
Harvard University	Postdoctoral	7/11	Computer Science

A. Personal Statement

In my research I design visualization systems that support exploratory, complex data analysis tasks for scientific research. These systems allow scientists to validate their computational models, to understand their underlying data in detail, and to develop new hypotheses and insights. I take a problem-driven approach to research, relying on both a detailed understanding of the needs of, and a close collaboration with, domain experts to guide the design of algorithms, visual encodings, and interaction mechanisms. Based on the success of my research and approach I have been named a TED Fellow and a PopTech Science Fellow, as well as awarded a NSF CAREER grant and a Microsoft Research Faculty Fellowship. In this proposal I will lend my expertise in visualization collaboration as well as in developing interactive, visualization techniques for biomedical applications.

Peer-reviewed Publications in Area of Project

1. McKenna S., Mazur D., Agutter J., **Meyer M.** (2014) Design Activity Framework. IEEE Transactions on Visualization and Computer Graphics, 20(12):2191-2200.
2. Kirby, R., **Meyer M.** (2013). Visualization Collaborations: What Works and Why. IEEE Computer Graphics and Applications, 33(6):82-88.
3. Sedlmair M., **Meyer M.**, Munzner T (2012). Design Study Methodology: Reflections from the Trenches and the Stacks. IEEE Transactions on Visualization and Computer Graphics, 18(12):2431-2440.
4. **Meyer M.**, Munzner T., DePace A., Pfister H. (2010). MulteeSum: a tool for comparative spatial and temporal gene expression data. IEEE Transactions on Visualization and Computer Graphics, 16(6):908-917.
5. **Meyer M.**, Wong B., Munzner T., Styczynski M., Pfister H. (2010). Pathline: a tool for comparative functional genomics. Computer Graphics Forum, 29(3):1043-1052.
6. **Meyer M.**, Munzner T., Pfister H. (2009). MizBee: a multiscale synteny browser. IEEE Transactions on Visualization and Computer Graphics, 15(6):897-904.

B. Positions and HonorsPositions

- University of Utah, School of Computing

<p><i>Assistant Professor</i></p> <ul style="list-style-type: none"> • Broad Institute of Harvard and MIT <i>Visiting Scientist</i> • Harvard University, School of Engineering and Applied Sciences <i>Postdoctoral Research Fellow</i> • Raytheon Corporation <i>Software Engineer</i> 	2011 - present 2010 – 2011 2008 – 2011 2000 – 2002
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Honors

<ul style="list-style-type: none"> • Outstanding Teaching Award, School of Computing • NSF CAREER Award • ACM AVI Best Paper Award • PopTech Science Fellow • TED Fellow • Microsoft Research Faculty Fellowship • MIT Technology Review TR35 Award • NSF/CRA Computing Innovations Fellowship • AAAS Mass Media Fellowship 	2015 2014 2014 2013 2013 2012 2011 2009 2006
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C. Contribution to Science

1. Visualization of Biological Data

Taking a problem-driven approach to research, I have developed several interactive visualization tools specifically for researchers in the biological sciences. These tools target a range of biological fields, from genomics to systems biology, and combine multiple different visualizations through interaction to support exploration. The tools were developed in collaboration with biologists, and resulted in both computer science publications as well as biological publications. For this work I was awarded one of seven Microsoft Research Faculty Fellowships in 2012, as well as listed on the MIT Technology Review's list of the top innovators in 2011.

- Fowlkes C., Eckenrode K., Bragdon M., **Meyer M.**, Wunderlich Z., Simirenko L., Luengo C., Keranen S., Henriquez C., Knowles D., Biggin M., Eisen M., DePace A. (2011). A conserved development patterning network produces quantitatively different output in multiple species of drosophila. PLoS Genetics, 7(10).
- **Meyer M.**, Munzner T., DePace A., Pfister H. (2010). MulteeSum: a tool for comparative spatial and temporal gene expression data. IEEE Transactions on Visualization and Computer Graphics, 16(6):908-917.
- **Meyer M.**, Wong B., Munzner T., Styczynski M., Pfister H. (2010). Pathline: a tool for comparative functional genomics. Computer Graphics Forum, 29(3):1043-1052.
- Grabherr M., Russell P., **Meyer M.**, Mauceli E., Alfoldi J., DiPalma F., Lindbald-Toh K. (2010). Genome-wide synteny through highly sensitive sequence alignment: Satsuma. Bioinformatics, 26(9):1145-1151.
- **Meyer M.**, Munzner T., Pfister H. (2009). MizBee: a multiscale synteny browser. IEEE Transactions on Visualization and Computer Graphics, 15(6):897-904.

2. User-centered Visualization Design

The core of my research focuses on developing and describing a user-centered design methodology for conducting visualization research. The methodology supports collaboration between visualization researchers and domain experts, and provides guidance for designing, building, and evaluating a visualization system. This is the first such methodology for visualization design, and the main paper for this work has already received over 100 citations in the two years since publication.

- **Meyer M.**, Sedlmair M., Quinan, P. S., Munzner T. (2015). The Nested Blocks and Guidelines Model. Information Visualization Journal, in press.
- McKenna S., Mazur D., Agutter J., **Meyer M.** (2014) Design Activity Framework. IEEE Transactions on Visualization and Computer Graphics, 20(12):2191-2200.

- Kirby, R., **Meyer M.** (2013). Visualization Collaborations: What Works and Why. *IEEE Computer Graphics and Applications*, 33(6):82-88.
- Sedlmair M., **Meyer M.**, Munzner T (2012). Design Study Methodology: Reflections from the Trenches and the Stacks. *IEEE Transactions on Visualization and Computer Graphics*, 18(12):2431-2440.

URL for Public Database of Published Work

My Google Scholar Profile: <https://scholar.google.com/citations?user=JAHNN7AAAAAJ>
All publications are publicly available, and a link to my website is given in my Scholar profile.

D. Research Support

1. NEH: Poemage Prototype

This is a three year project for which I am the PI. We are developing an open-source visualization tool to support poets and poetry scholars in their close reading practice. My role in the project is to design and evaluate novel visualization techniques in collaboration with several poets.

2. NSF: CAREER: Design Decision Patterns for Visualizing Multivariate Graphs

This is a five year project for which I am the PI. The goal is to develop a set of techniques for visualizing complex graphs that contain multiple variables at each node. The project is grounded in three collaborative projects with researchers at the University of Utah: cancer biology, urban transportation, and particle physics. My role is design and deploy novel visualization systems in each collaboration, and to generalize the results in order to provide guidelines for visualizing multivariate graphs.

3. NSF: Large: Collaborative Research: Modeling, Display, and Understanding Uncertainty in Simulations for Policy Decision Making

This is a four year grant for which I am a co-PI. The grant includes researchers at four institutions. The goal is the development of methods for quantifying and visualizing uncertainty in simulation data and the analysis of perceptual and cognitive efficacy of such displays in the context of public policy decision making – including basic scientific development, technology and software development and dissemination/outreach. My role is to develop several visualization systems in collaboration with meteorologists in wildfire predication and air quality.

4. DARPA: The Visualization Design Environment

This is a four year project for which I am the PI at the University of Utah. The grant includes researchers at five institutions. We are developing an open source, web-based system to allow data analysts to quickly and intuitively explore data and create visualizations. My role is evaluate the needs of analysts and translate those needs into design requirements.

5. NIH: Predictive Modeling of Bioelectric Activity on Mammalian Multilayered Neuronal Structures in the Presence of Supraphysiologic

This is a five year project for which I am a co-PI. The grant includes researchers at two institutions. The goal of the project is to gain a better understanding of the electrical circuitry of mammalian brains using simulation and visualization. My role is to develop a visualization tool for exploring simulation results.

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: **Flory L. Nkoy**ERA COMMONS USER NAME (credential, e.g., agency login): **FLORYNKOY**

POSITION TITLE: Associate Research Professor & Research Director, Pediatric Inpatient Medicine/Adjunct Associate Professor, Biomedical Informatics

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
University of Kinshasa, Kinshasa, RDC	BS	07/1984	Biomedical Sciences
University of Kinshasa, Kinshasa, RDC	MD	07/1988	General Medicine
University of Kinshasa, Kinshasa, RDC	Fellowship	10/1989	Internal Medicine
Intermountain Healthcare, Institute for Healthcare Delivery Research, Salt Lake City, UT	Fellowship	10/2001	Health Services Research
University of Utah, Salt Lake City, UT	MS	05/2005	Biomedical Informatics
University of Utah, Salt Lake City, UT	MPH	11/2005	Public Health

A. Personal Statement

The goal for the proposed *PRISMS Informatics Platform - Federated Integration Architecture* (U54 cooperative agreement) is to develop a flexible, open-source, standards-based informatics platform, which will enable research of environmental, physiological, and behavioral factors, measured through a variety of sensors, in epidemiological studies of asthma and other chronic diseases in the pediatric population.

I have the expertise, leadership, training, and motivation necessary to successfully carry out the proposed research project. I am an Associate Research Professor at the University of Utah, Department of Pediatrics and an Adjunct Associate Professor in the Department of Biomedical Informatics. I also serve as the Research Director for the Division of Pediatric Inpatient Medicine and have been a grant reviewer for the following study sections, including the NIH/NHLBI R18, NIH/NINR and AHRQ/HITR review panels. In addition to clinical medicine, my background includes training in public health, medical informatics, and quality improvement with an emphasis on implementation and dissemination research. My research utilizes these skills to pioneer innovative approaches to improve long-term care for children with chronic diseases.

I will contribute across projects and will co-lead the development of the Research platform (project 3). As principal investigator (PI) on multiple research projects, I laid groundwork that will directly contribute to the proposed research. Through an AHRQ grant, I developed and validated the paper-AsthmaTracker, an innovative tool for engaging parents in their child asthma self-management. I also published a manuscript demonstrating longitudinal validation of weekly asthma control test (ACT) for ongoing monitoring asthma control within the Asthma Tracker. Through another AHRQ grant, I developed and tested the electronic version of the Asthma Tracker (e-AT) to address limitation of the paper-AsthmaTracker and support asthma care continuity. Further, I have an existing PCORI grant, through which I disseminated the e-AT to 12 primary care clinics in Utah. I have conducted further research on cultural adaptation of this self-management tool, for effective use in low-income Latino children with asthma. The current project capitalizes on our prior experience in implementing evidence-based interventions to support use of best asthma evidence in routine care, engage

parents in their child asthma self-management and improve asthma control and thereby reduce ED and hospital admissions. We will conduct initial assessment of needs, capability, and socio-cultural preferences for asthma self-management, using focus groups. We will then use results from focus groups and interviews to develop and test our informatics platform; to incorporate parent, child and researcher suggestions, and enhance user acceptance and performance of the application.

- a. Nkoy F, Stone B, Fassl B, Koopmeiners K, Halbern S, Kim U, Poll J, Hales J, Lee D, Maloney C. *Development of a Novel Tool for Engaging Children and Parents in Asthma Self-Management.* AMIA Annu Symp Proc. 2012: 663-72.
- b. Nkoy F, Stone B, Fassl B, Uchida D, Koopmeiners K, Halbern S, Kim E, Wilcox A, Greene T, Mosen D, Schatz M, Maloney C. *Longitudinal Validation of a Tool for Asthma Self-Monitoring.* Pediatrics. 2013 Dec; 132 (6): e1554-61.

B. Positions and Honors

Positions and Employment

1986-1988	Research Assistant (part-time), Pediatric Department, University of Kinshasa, RDC
1988-1989	Fellow, Internal Medicine, University of Kinshasa, Kinshasa, RDC
1989-1994	Attending Physician, General Medicine, Epharza Medical Center, Kinshasa, RDC
1989-1994	Attending Physician, Internal Medicine, Kitambo Hospital, Kinshasa, RDC
1996-1999	Research Associate, Department of Neonatology, Utah Valley Medical Center, Provo, UT
1999-2001	Fellow, Institute for Health Care Delivery Research, Intermountain Healthcare, SLC, UT
2001-2006	Outcomes Research Leader, Oncology Clinical Program, Intermountain Healthcare, SLC, UT
2006-	Research Director, Division of Pediatric Inpatient Medicine, University of Utah, SLC, UT
2007-	Assistant Research Professor, Division of Pediatric Inpatient Medicine, Department of Pediatrics, University of Utah (Primary Children's Medical Center—PCMC), SLC, UT
2008-	Adjunct Assistant Professor, Biomedical Informatics Department, University of Utah, SLC, UT
2012-	Adjunct Associate Professor, Biomedical Informatics Department, University of Utah, SLC, UT
2012-	Associate Research Professor, Division of Pediatric Inpatient Medicine, Department of Pediatrics, University of Utah (Primary Children's Medical Center—PCMC), SLC, UT

Other Experience and Professional Membership

2002-2005	Member, International Society for Quality of Life Research (ISOQOL)
2005-2006	Member, Healthcare Quality Indicators Panel, National Committee of Quality Assurance
2006-	Member, American Medical Informatics Association
2006-	Member, American Federation of Medical Research
2009-	Member, Academy Health
2009-	Ad hoc Reviewer, International Journal of Medical Informatics
2009-	Reviewer, AMIA Annual Symposium
2010-	Ad hoc Reviewer, Journal of Healthcare Quality
2010-	Member, Academy for Healthcare Improvement
2011-	Reviewer of <i>Pediatrics</i> journal.
2011-	Grant Reviewer, NIH/NHLBI Special Emphasis Panel (ZHL1 CSR-K) Study Section
2011-	Grant Reviewer, AHRQ/ Health Information Technology Research (HITR) study section
2012-	Grant Reviewer, NIH, National Institute of Nursing Research (NINR) study section
2012-	Member, Academic Pediatric Association (APA)

Honors

2007	Distinguished Paper Award for paper entitled A Tool for Improving Patient Discharge Process and Hospital Communication Practices: The "Patient Tracker", American Medical Informatics Association Annual Symposium Proceedings
2008	Distinguished Paper Award for paper entitled Validation of an Electronic System for Recording Medical Student Patient Encounters, American Medical Informatics Association Annual Symposium Proceedings
2011	Western American Federation for Medical Research/Western Society for Clinical Investigation, Subspecialty Award Winner. Camel, California, USA.

C. Contribution to Science

1. My early research in asthma directly addressed gaps in inpatient care for children hospitalized with asthma. In fact, each year, asthma in children accounts for 679,000 emergency department (ED) and hospital admissions, a high readmission rate, and significant increased healthcare costs. A recognized reason of this burden is the persisting gap between asthma care evidence and the actual care children hospitalized with asthma receives. To address this gap, my initial work used RAND appropriateness method to identify key quality indicators of inpatient asthma care, which helped to highlight poor inpatient care quality and several opportunities for improvement. Results were presented at the Pediatric Academic Societies Annual Meeting and published in *Pediatrics*, resulting in a call for organizational changes to help providers to adhere to asthma guideline recommendations.
 - a. Nkoy FL, Fassl BA, Simon TD, Stone BL, Srivastava R, Gesteland PH, Fletcher GM, Maloney CG (2008). *Quality of care for children hospitalized with asthma*. *Pediatrics* 122(5):1055-63.
2. The findings that the quality of inpatient asthma care was poor led my colleagues and I to develop and implement an evidence-based asthma care process model (CPM) aimed at standardizing care and facilitating provider compliance not only with key quality measures of inpatient asthma care that we developed but also the Joint Commission asthma care core measures. Using implementation research techniques, we obtained provider buy-in, overcame logistic challenges, addressed provider barriers to CPM use and added decision support tools to facilitate the CPM integration into clinical workflow. This study was the first to demonstrate a significant and sustained reduction in asthma readmissions and to provide evidence that interventions initiated during a short hospital stay can have long lasting effect following hospitalization.
 - a. Fassl B, Nkoy F, Stone B, Srivastava R, Simon T, Uchida D, Koopmeiners K, Greene T, Cook L, Maloney C (2012). *The Joint Commission Children's Asthma Care quality measures and asthma readmissions*. *Pediatrics* 130(3):482-91. PMCID: PMC4074621
3. Due to suboptimal baseline asthma care quality findings at community hospitals and the desire to improve care throughout the region, through an AHRQ grant, we disseminated the CPM to 7 community hospitals. We have a paper accepted for publication in *Pediatrics* to report: 1) the 5 year impact post-CPM implementation at an academic children's hospital, and 2) the impact of the CPM dissemination to 7 community hospitals. This is the first study to report long-term impact of an evidence-based asthma intervention at a tertiary care hospital and the impact following its dissemination to community hospitals, with demonstrated improvement in inpatient asthma care quality and outcomes. Because of positive results, our CPM has been adopted for use in a large multi-center grant in preparation to support dissemination across 18 children's hospitals.
 - a. Nkoy F, Fassl B, Stone B, Uchida D, Johnson J, Reynolds C, Valentine K, Koopmeiners K, Kim EH, Savitz L, Maloney C. *Improving Pediatric Asthma Care and Outcomes across Multiple Hospitals*. (In Press)
4. After successful inpatient interventions, our effort has recently focused in addressing ambulatory asthma care. In fact, poor ambulatory asthma control is associated with increased asthma exacerbations and frequent ED/hospital admissions. To address this problem and through multiple grants, we developed, implemented and disseminated an innovative application to support asthma self-management in children, the AsthmaTracker. The AsthmaTracker changes asthma care from the current reactive model focusing on treating exacerbations to a new proactive model that is proactive and focusing on preventing them. This effort led to 3 projects for which I have been the Principal Investigator:
 1. *Paper-based Asthma Tracker (paper-AT)*: The paper-AT is a novel, patient-centered and user-friendly tool that we developed to engage parents in weekly self-assessment and monitoring of their child asthma control coupled with decision support to help parents respond timely and appropriately to early signs of deteriorations to avoid asthma exacerbations. This project was supported by an AHRQ grant.
 2. *Electronic-AsthmaTracker (e-AT)*: The e-AT was designed to address limitations of the paper-AT by adding: 1) real-time prompts/reminders/alerts for parents to improve compliance and to act early when their child's asthma control is deteriorating, and 2) real-time alerts and decision support for primary care providers (PCPs) to assess the effectiveness of or guide adjustment of asthma therapy. This project

was supported by another AHRQ grant. We involved parents/patients throughout, from the development and testing of the paper-AT to the development and testing of the e-AT. Also, the eAT care model has sparked interest beyond Utah, in Alaska, North Dakota, Spain, and France, with multiple projects being developed.

3. *Redesigning Ambulatory Asthma Care to Improve Asthma Control in Children:* Through a PCORI grant, we disseminated the eAT to 12 primary care clinics and have currently over 300 patients/parents using the e-AT for self-management in a weekly basis.
 - a. Nkoy F, Stone B, Fassl B, Koopmeiners K, Halbern S, Kim U, Poll J, Hales J, Lee D, Maloney C. *Development of a Novel Tool for Engaging Children and Parents in Asthma Self-Management.* AMIA Annu Symp Proc. 2012: 663-72.
 - b. Nkoy F, Stone B, Fassl B, Uchida D, Koopmeiners K, Halbern S, Kim E, Wilcox A, Greene T, Mosen D, Schatz M, Maloney C. *Longitudinal Validation of a Tool for Asthma Self-Monitoring.* Pediatrics. 2013 Dec; 132 (6): e1554-61.
 - c. Nkoy F, Stone B, Fassl B, Koopmeiners K, Halbern S, Mosen D, Maloney C, Schatz M. *A Self-Monitoring Tool for Improving Ambulatory Asthma Care in Children.* AcademyHealth 2012 Annual Conference 2012. (Abstract)
5. In addition to our efforts to improving asthma care, my colleagues and I have studied the effects of genetic variations on the safety and effectiveness of commonly prescribed medications, and enrolled >1500 children with persistent asthma. We found that genetic variations in drug metabolizing enzymes affect the efficacy and safety of inhaled glucocorticoid (IGC) therapies for patients with asthma. We published a paper demonstrating that children with an inactivating mutation in CYP3A4 experienced markedly improved asthma symptoms when they were treated with IGC fluticasone propionate, which is primarily metabolized by CYP3A4. We also found a similar association between an inactivating mutation in CYP3A5 and improved asthma control in children treated with the inhaled glucocorticoid beclomethasone dipropionate.
 - a. Stockmann C, Fassl B, Gaedigk R, Nkoy F, Uchida D, Monson S, Reilly C, Leeder S, Yost G, Ward R. *Fluticasone propionate pharmacogenetics: CYP3A4*22 polymorphism and pediatric asthma control.* J Pediatr. 2013. 162(6):1222-7, 1227.e1-2. PMCID: PMC3620714
 - b. Stockmann C, Reilly C, Fassl B, Gaedigk R, Nkoy F, Stone B, Roberts J, Uchida D, Leeder J, Sherwin C, Spigarelli M, Yost G, Ward R. *Effect of CYP3A5*3 on asthma control among children treated with inhaled beclomethasone.* J Allergy Clin Immunol. 2015. pii: S0091-6749(15)00229-8.
6. In addition to above studies, I have led several projects and published papers demonstrating benefits of new approaches to improving health care delivery processes, improving study recruitment efficiencies and reducing wastes.
 - a. Nkoy F, Fassl B, Wolfe D, Colling D, Hales J, Maloney C. *Sustaining compliance with pediatric asthma inpatient quality measures.* AMIA Annual Symposium Proc. 2010: 547-51.
 - b. Maloney C, Wolfe D, Gesteland P, Hales J, Nkoy F. *A tool for improving patient discharge process and hospital communication practices: The "Patient Tracker".* AMIA Annu Symp Proc. 2007 Oct 11:493-7.
 - c. Nkoy F, Wolfe D, Hales J, Lattin G, Rackham M, Maloney C. *Enhancing an existing clinical information system to improve study recruitment and census gathering efficiency.* AMIA Annu Symp Proc. 2009:476-80.

Complete List of Published Work in MyBibliography:

<http://www.ncbi.nlm.nih.gov/sites/myncbi/1fWRsrRXaOs/bibliography/40432334/public/?sort=date&direction=ascending>

D. Research Support

Ongoing Research Support

AHRQ (R18 HS018678)

Nkoy (PI)

04/01/11-11/30/14

Improving Post-Hospital Transitions and Ambulatory Care for Children with Asthma

The major goals of this project are to develop 2 information technology (IT) applications to improve post-hospital care transitions and ambulatory care; evaluate the attitudes, acceptability and use of the new IT tools by Hospital providers, Primary care providers (PCPs) and Patients; determine (implementation, organizational,

individual, acceptance and technical) factors associated with use of the IT tools by hospital providers, PCPs, and patients; and evaluate the effect of the IT tools.

Role: Principal Investigator

NIH (R01 HD060559) Reilly (PI) 01/02/09-01/31/15
 Cytochrome p-450 Metabolism of Glucocorticoids in Lungs of Pediatric Asthmatics
 The goal of the project is: 1) characterize the metabolites and metabolic pathways of the five most frequently used therapeutically relevant GCs by each of the three major CYP3A enzymes; 2) evaluate the induction of the 3A genes in lung and liver cells; 3) correlate GC-induced P450 3A transcripts to increased metabolism of the steroids and establish developmental patterns of P450 3A gene expression in pediatric pulmonary cells from tracheal suctioning samples; and 4) correlate CYP3A5 and CYP3A7 polymorphisms with GC resistance or hypersensitivity from a cohort of pediatric asthma patients.

Role: Consultant

PCORI (5330) Nkoy (PI) 07/31/13-07/31/16
 Redesigning Ambulatory Care Delivery to Enhance Asthma Control in Children
 The goal of the proposed project is to test the effectiveness of a new ambulatory care model supported by the electronic-AsthmaTracker (e-AT), an innovative, patient centered web-based application designed to 1) engage patients with self-monitoring and self-management of chronic asthma control to prompt compliance with therapy and appropriate and timely visits to his/her physician, and 2) support physicians with longitudinal data to assess the effectiveness of asthma therapy and prompt adjustments. This project will also help identify factors critical to sustained parent engagement in asthma self-management that can be applied to other pediatric chronic diseases.

Role: Principal Investigator

Completed Research Support

R18 HS018166 Nkoy (PI) 09/01/10-06/30/13
 Organizational Factors Associated With Improved Inpatient Pediatric Asthma Care
 The major goals of this project are to implement an evidence-based care process model (EB-CPM) at 3 urban and 3 rural community hospitals; determine organizational factors associated with successful implementation of the EB-CPM at these hospitals; evaluate the impact of implementing the EB-CPM by measuring change in 1) hospital length of stay, 2) cost, and 3) ED/hospital readmission rates; and evaluate the extent to which use of the self-monitoring scorecard improves post-hospitalization ambulatory asthma care and reduces ED/hospital readmissions.

Role: Principal Investigator

Older than 3 years but relevant to this proposal

Primary Children's Foundation Nkoy (PI) 12/01/08-12/01/09
 Title: Risk factors associated with readmission in children with asthma
 The goal of this project is: 1) to determine inpatient clinical risk factors associated with time to first hospital or ED readmission in children hospitalized with asthma; 2) to develop a composite score to summarize the quality of asthma inpatient care; and 3) to determine the predictive ability of the AIQI for hospital and ED readmission.
 Role: Principal Investigator

University of Utah Medical Grant Harlan (PI) 05/31/08-05/31/09
 Improving discharge communication process between pediatric hospitalists and primary care providers
 The goal of this project is: 1) to use QI techniques and tools (for example: flow chart, fishbone diagram, etc.) to evaluate and understand the current discharge processes including factors associated with sub-optimal communication between hospitalists and primary care providers; 2) to identify key aspects of the discharge processes in which opportunities for improvement in communication exist; 3) to implement a new discharge process, and 4) will assess the impact of this improvement strategy on the quality of communication at discharge between hospitalists and primary care providers.

Role: Co-Investigator

Primary Children's Foundation Simon (PI) 01/16/07-12/31/08
 Clinical risks factors associated with cerebral spinal fluid (CSF) shunt infection
 The goal of this project is: 1) to determine clinical risk factors associated with initial CSF shunt infection and re-infection; 2) to determine the costs of treating initial CSF shunt infection and re-infection; and 3) to develop standard data collection tools for potential covariates in CSF shunt infection and re-infection to be used for future research at multiple study centers.

Role: Co-Investigator

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Neal Patwari

ERA COMMONS USER NAME (credential, e.g., agency login): ID: NPATWARI

POSITION TITLE: Associate Professor

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Virginia Tech, Blacksburg VA	B.S.	05/1997	Electrical Engineering
Virginia Tech, Blacksburg VA	M.S.	05/1999	Electrical Engineering
University of Michigan, Ann Arbor MI	Ph.D.	9/2005	Electrical Engineering
University of Michigan, Ann Arbor MI	postdoc	7/2006	Electrical Engineering

A. Personal Statement

My expertise is in building working, real-time monitoring systems that are deployed in buildings to monitor human activities and update a database with the human context information and alert a user if any alarming condition develops. I have had several projects in this general area, and I continue to develop, deploy, and test systems. In particular, I have developed sensor networks used for fall detection, non-contact breathing monitoring, and for person localization and tracking. I have built up an expertise in sensor networking at multiple levels, and using multiple types of sensors.

In addition to my academic efforts, I have also co-founded Xandem Technology LLC (<http://xandem.com>), a company which develops and sells wireless sensors in the building automation and security markets. The continued success of Xandem points to the fact that the systems I build are not simply one-off demonstrations – instead, I focus on sensors, technologies, networks, and systems that are reliable and work in the real world.

Peer-reviewed Publications in Area of Project

- [1] N. Patwari, L. Brewer, Q. Tate, O. Kaltiokallio, and M. Bocca, "Breathfinding: a wireless network that monitors and locates breathing in a home", *IEEE Journal on Selected Topics in Signal Processing*, Feb. 2014, vol. 8, no. 1, pp. 30-42.
- [2] B. Mager, N. Patwari, and M. Bocca, "Fall detection using RF sensor networks", in *2013 IEEE Personal, Indoor and Mobile Radio Communications Conference (PIMRC 2013)*, London, 9 Sept. 2013.
- [3] O. Kaltiokallio, M. Bocca, and N. Patwari, "Follow @grandma: long-term device-free localization for residential monitoring", in *7th IEEE International Workshop on Practical Issues in Building Sensor Network Applications (SenseApp 2012)*, October 25, 2012, (Selective: 20% acceptance rate). **Best Paper Award.**
- [4] N. Patwari and J. Wilson, "RF sensor networks for device-free localization and tracking," *Proceedings of the IEEE*, vol. 98, no. 11, pp. 1961–1973, Nov. 2010.

B. Positions and Honors

Positions

- University of Utah, Department of Electrical & Computer Engineering
Associate Professor 2012 - present
Assistant Professor 2006 - 2012
- University of Utah, Sensing and Processing Across Networks (SPAN) Lab
Director 2006 - present
- Xandem Technology L.L.C.
Director of Research 2010 – present
- University of Michigan, Laboratory of Prof. Alfred O. Hero III
Graduate Research Assistant 2001 – 2005
Postdoctoral Research Fellow 2005 – 2006
- Motorola Labs, Florida Communications Research Lab
Research Engineer 1999 - 2001
- Virginia Tech, Mobile & Portable Radio Research Group
Graduate Research Assistant 1996 – 1999

Honors

- Information Processing in Sensor Networks (IPSN) 2014 Best Paper Award April 2014
- Top 15% of College of Engineering Teaching Evaluations Spring 2013
- IEEE SenseApp 2012 Best Paper Award Oct. 2012
- EVAAL 2012 Tracking Competition Highest Accuracy Award Sept. 2012
- 2012 ECE Department Teaching Award Aug. 2012
- University of Utah Early Career Teaching Award Spring 2011
- Top 15% of College of Engineering Teaching Evaluations Fall 2010
- Top 15% of College of Engineering Teaching Evaluations Spring 2010
- 2009 IEEE Signal Processing Society Best Magazine Paper Award Dec. 2009
- Co-advisor of Best Student Poster Finalist Sriram Nandha Premnath, ACM MOBICOM Sept. 2009
- Mentor of Student Research Demo Competition Winner Joey Wilson, ACM MOBICOM Sept. 2008
- Mentor of Best Presentation Award Winner Paul Pryor, at ECE Technical Open House April 2008
- NSF CAREER Award Feb. 2008
- Top 15% of College of Engineering Teaching Evaluations Spring 2007
- Michigan Teaching Fellow, U.M. Center for Research on Learning and Teaching June 2005
- Top 20% of Grad. Student Instructors, U.M. College of Engineering Dec. 2004
- Outstanding Mentor Award, Siemens Westinghouse Science & Technology Competition Oct. 2004
- Best Student Paper Award Finalist, IEEE ICASSP'04 May 2004
- Best Graduate Student Instructor Award Nominee, U.M. Dept. of EECS Dec. 2003
- Best Paper Award, Motorola Systems Symposium May 2000
- National Science Foundation Graduate Research Fellow 1997-2002

C. Contribution to Science

1. Localization of Wireless Devices in a Wireless Network

In this application, we estimate the location of a transceiver tag based on the signals it produces (or receives). I was the first to present received signal strength (RSS)-based sensor localization error bounds, and I presented a variety of centralized and distributed localization algorithms. I won the 2009 IEEE Signal Processing Society Best Magazine Paper Award for my 2005 paper on this topic. I have continued to develop improved RSS localization statistical models and novel sensor localization algorithms, which have found application in the commercially deployed sensor location systems of Awarepoint Inc. My sensor localization work is highly cited, with over 1400 citations for two of my papers in this area and over 140 citations for three more of my papers in this area (according to Google Scholar).

- J. A. Costa, N. Patwari, A. O. Hero, [Distributed Weighted Multidimensional Scaling for Node Localization in Sensor Networks](#), *ACM Transactions on Sensor Networks*, Feb. 2006, vol. 2, no. 1, pp. 39-64.
- N. Patwari, J. Ash, S. Kyerountas, A. O. Hero, R. L. Moses, N. S. Correal, [Locating the Nodes: Cooperative Localization in Wireless Sensor Networks](#), *IEEE Signal Processing Magazine*, vol. 22, no. 4, July 2005, pp. 54-69.
- N. Patwari, A. O. Hero, [Using Proximity and Quantized RSS for Sensor Localization in Wireless Networks](#), in Proc. 2nd Int'l ACM Workshop on Wireless Sensor Networks and Applications (WSNA'03), San Diego, CA, Sept. 19, 2003, pp. 20-29. Selective: 25% acceptance rate.
- N. Patwari, A. O. Hero, M. Perkins, N. S. Correal, R. J. O'Dea, [Relative Location Estimation in Wireless Sensor Networks](#), *IEEE Transactions on Signal Processing*, vol. 51, no. 8, August 2003, pp. 2137-2148.

2. Device-Free Location Sensing Networks

In this application, we estimate the location of moving people who are not carrying any kind of radio device, based on the changes in received signal strength (RSS) measured on the links of a static deployed wireless network. I originated the term and area of "radio tomographic imaging" (RTI), which produces in real time an image of the change in attenuation or motion occurring in the area of the deployed network and have developed models for use in DFL. We received international popular press (including Wired, Discover, and The Economist) since Oct. 2009 for our through-wall RTI research, and a RTI demo won the 2008 ACM MOBICOM Student Research Demo Competition. Two RTI experiment videos have >150,000 views. I authored a DFL review article in the Nov. 2010 issue of the *Proceedings of the IEEE* and have given invited keynote lectures at ACM SenseApp 2010, IEEE NMMC 2012, IEEE RFID 2014, and IEEE SPAWC 2015. Our paper on home room-level tracking won the 2011 SenseApp Best Paper Award. I co-founded a spin-off company, Xandem Technology LLC, which has commercialized a motion sensing system based on the technology. *Inc. Magazine* called my technology one of "5 Ideas That Will Blow Your Mind" in Oct. 2012.

- N. Patwari and J. Wilson, [RF Sensor Networks for Device-Free Localization and Tracking](#), *Proceedings of the IEEE*, vol. 98, no. 11, November, 2010, pp. 1961-1973.
- J. Wilson and N. Patwari, [See Through Walls: Motion Tracking Using Variance-Based Radio Tomography Networks](#), *IEEE Transactions on Mobile Computing*, vol. 10, no. 5, pp. 612-621, May 2011.
- J. Wilson and N. Patwari, [Radio Tomographic Imaging with Wireless Networks](#), *IEEE Transactions on Mobile Computing*, vol. 9, no. 5, May 2010, pp. 621-632.
- N. Patwari and P. Agrawal, [Effects of Correlated Shadowing: Connectivity, Localization, and RF Tomography](#), in Proc. IEEE/ACM IPSN 2008, April 22-24, 2008, St. Louis. Selective: 24% acceptance rate.

3. New Non-contact Health Sensors

I have used my expertise in wireless sensor networks to develop two new sensors which are useful for the monitoring of the health of the residents of a home. I am the first to suggest and demonstrate a sensor network that uses measured received signal strength in a wireless network to accurately estimate 1) a person's breathing rate, 2) whether or not breathing is present in an area, and 3) where the breathing person is located. I am the first to suggest and demonstrate a sensor network deployed at different heights on the walls of a home that can locate a person in 3D, estimate their current pose, and detect if they have fallen.

- O. Kaltiokallio, H. Yiğitler, R. Jäntti, and N. Patwari, [Non-invasive Respiration Rate Monitoring Using a Single COTS TX-RX Pair](#), in Proc. IEEE/ACM Information Processing in Sensor Networks (IPSN-2014), April 2014. **Best Paper Award**.
- N. Patwari, L. Brewer, Q. Tate, O. Kaltiokallio, and M. Bocca, [Breathfinding: A Wireless Network that Monitors and Locates Breathing in a Home](#), *IEEE Journal on Selected Topics in Signal Processing*, vol. 8, no. 1, pp. 30-42, 2014.

- N. Patwari, J. Wilson, S. Ananthanarayanan, S. K. Kasera, D. Westenskow, [Monitoring Breathing via Signal Strength in Wireless Networks](#), *IEEE Transactions on Mobile Computing*, vol. 13, no. 8, Aug. 2014.
- B. Mager, N. Patwari, and M. Bocca, [Fall detection using RF sensor networks](#), in *Proc. IEEE Personal, Indoor and Mobile Radio Communications Conference (PIMRC 2013)*, London, 9 Sept. 2013, pp. 3472-3476.

4. Wireless Network Security and Privacy

In the area of secret key establishment (SKE), two radios generate a shared secret key from measurements of their reciprocal radio channel, and thus enable encryption without pre-existing shared keys or public-key encryption. The primary current limitation of SKE is its slow rate of secret key bit generation. We have developed robust signal processing methods for SKE which produce strong secret keys at an order of magnitude faster bit rate than any other published research; published extensive experimental evidence for when SKE from RSS measurements does (and does not) work; and proposed SKE methods for multiple collaborating devices (a poster on this latter topic was a Student Poster Competition finalist at MOBICOM 2009). In the area of location distinction, a receiver infers from a channel measurement whether or not a transmitter is at a different location, enabling detection of identity attacks. We were the first to propose and analyze the use of channel impulse response (CIR) measurements for location distinction. We have provided new means for real-time CIR measurement and been the first to experimentally study location distinction in MIMO channels.

- S. N. Premnath, J. Croft, N. Patwari, and S. K. Kasera, [Efficient high rate secret key extraction in wireless sensor networks using collaboration](#), *ACM Transactions on Sensor Networks*, vol. 11, no. 1, Aug. 2014.
- S. N. Premnath, S. Jana, J. Croft, P. L. Gowda, M. Clark, S. K. Kasera, N. Patwari, and S. Krishnamurthy, [Secret key extraction from wireless signal strength in real environments](#), *IEEE Transactions on Mobile Computing*, vol. 12, no. 5, pp. 917-930, May 2013.
- N. Patwari, J. Croft, S. Jana, and S. K. Kasera, [High Rate Uncorrelated Bit Extraction for Shared Secret Key Generation from Channel Measurements](#), *IEEE Transactions on Mobile Computing*, vol. 9, no. 1, Jan. 2010, pp. 17-30.
- N. Patwari and S. K. Kasera, [Robust Location Distinction using Temporal Link Signatures](#), in *Proc. of 13th Int. Conf. on Mobile Computing and Networking (Mobicom-07)*, pages 111-122, Montreal, QC, Sept 12, 2007. Highly Selective, 11% acceptance rate.

URL for Public Database of Published Work

My Google Scholar Profile:

<https://scholar.google.com/citations?hl=en&user=q9yhtN8AAAAJ>

All publications are publicly available, and link to my publication is given in my Scholar profile.

D. Research Support

1. CPS: Medium: Collaborative Research: Enabling and Advancing Human and Probabilistic Context Awareness for Smart Facilities and Elder Care

This is a nearly-ended NSF project for which I am the lead PI among four investigators, three at the U. of Utah, and one at CMU. The goal of this project is to use wireless sensor networks to locate and track people in buildings for the purposes of smart buildings and aging-in-place. We investigated new technologies for sensing the “human context” of where people are, what they are doing, and what state of health they might be in, and the application interfaces needed to make decisions with data that is sometimes unreliable or ambiguous. I have been responsible for project management as well as leading the sensor networking and sensing parts of this project.

2. CPS: Frontiers: Collaborative Research: ROSELINE: Enabling Robust, Secure, and Efficient Knowledge of Time Across the System Stack

This is a current NSF project, less than one year into a five-year grant. I am the PI at the U. of Utah, and this is a six-university large collaborative project, with UCLA as the lead institution. The goals are to improve the ability for wireless devices to be time synchronized with each other and other systems, even at low energy budgets, and to provide new means for the accuracy of time synchronization on different devices to communicate across networking layers so that the most can be made of the most accurate information. My role is to develop new sensor networking platforms to be used to demonstrate the potential gains in accuracy and energy.

3. Advanced RF-Based Environmental Monitoring Systems

This is a current NSF project less than one year into a three year grant. I am the PI at the U. of Utah, with one collaborator at Georgia Tech. We are developing new models for the changes to the channel caused by a human in an indoor environment, to be used to develop novel algorithms to monitor people in their homes using standard low cost wireless sensors.

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.

Follow this format for each person. DO NOT EXCEED FIVE PAGES.

NAME: Stone, Bryan

eRA COMMONS USER NAME (agency login): BRYANSTONE

POSITION TITLE: Associate Professor, Pediatrics

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
University of Utah, Salt Lake City, UT	BA	05/1982	Biology (cellular and molecular)
University of Utah School of Medicine, Salt Lake City, UT	MD	05/1986	Medicine
University of Utah, Salt Lake City, UT	MS	12/2010	Clinical investigation
Duke University, Durham, NC	Resident	06/1990	Internal medicine/pediatrics
University of Utah, Salt Lake City, UT	Postdoctoral Fellow	06/1993	Molecular developmental genetics
University of Utah Business School, Salt Lake City, UT	Other training	08/2008	Leadership development for physician executives
Intermountain Healthcare, Salt Lake City, UT	Other training	04/2011	Advanced training program in healthcare delivery improvement

A. PERSONAL STATEMENT

The PRISMS Program includes a robust health monitoring system combining research, clinical care, and patient self-management in the home. The inclusion into research studies of an array of integrated sensors could allow researchers to understand complex interactions between health outcomes and environmental, behavioral, and physiologic factors that influence outcomes in chronic pediatric illnesses such as asthma. The PRISMS Program infrastructure includes three components: (1) Sensors, (2) An informatics platform, and (3) A Data Coordinating Center.

This application includes 3 projects. The first creates a modular, secure, open standards platform for sensor data collection customizable to study requirements. It will include a phone app designer, development and testing of patient-user interfaces for various ages, and a test deployment in patient homes. The second project develops a freely available open-source integrated tool set for flexible, replicable, and scalable infrastructure for conducting multi-center epidemiological research as part of the PRISMS Program. It will include documentation of researchers needs, requirements, and workflow. The third project contributes to a data coordinating center and includes a sensor data harmonization framework, state of the art modeling, and data integration and storage.

I am a clinician in pediatrics and a clinical researcher. My involvement in this proposal will be to provide subject matter expertise for the 3 projects included in this proposal, particularly with the first and second projects described above. My background in pediatrics and pediatric research includes a significant experience in childhood asthma care and research, and has included projects integrating environmental data and clinical status. I have also been involved in three separate projects to develop software for patient, physician, and researcher use in managing and studying chronic diseases such as asthma. I completed a masters degree in clinical investigation and can provide expertise in clinical study design, recruitment of subjects, and conduct of the study. I am also an experienced member of the Institutional Review Board (IRB) at the University of Utah, which will contribute to human subjects in research compliance and study design in the areas of recruitment and consent. I also have a history of work with members of this unique interdisciplinary study team combining engineering, bioinformatics, and clinical medicine.

1. Nkoy FL, Stone BL, Fassl BA, Koopmeiners K, Halbern S, Kim EH, Poll J, Hales JW, Lee D, Maloney CG. Development of a novel tool for engaging children and parents in asthma self-management. AMIA Annu Symp Proc. 2012;2012:663-72. PubMed PMID: [23304339](#); PubMed Central PMCID: [PMC3540453](#).
2. Fassl BA, Nkoy FL, Stone BL, Srivastava R, Simon TD, Uchida DA, Koopmeiners K, Greene T, Cook LJ, Maloney CG. The Joint Commission Children's Asthma Care quality measures and asthma readmissions. Pediatrics. 2012 Sep;130(3):482-91. PubMed PMID: [22908110](#); PubMed Central PMCID: [PMC4074621](#).
3. Nkoy FL, Stone BL, Fassl BA, Uchida DA, Koopmeiners K, Halbern S, Kim EH, Wilcox A, Ying J, Greene TH, Mosen DM, Schatz MN, Maloney CG. Longitudinal validation of a tool for asthma self-monitoring. Pediatrics. 2013 Dec;132(6):e1554-61. PubMed PMID: [24218469](#); PubMed Central PMCID: [PMC4074668](#).

B. POSITIONS AND HONORS

Positions and Employment

1980 - 1982 Research assistant, University of Utah Biology Dept, Salt Lake City, UT
1982 - 1985 Instructor, Salt Lake Community College, UT
1993 - 2001 Private practice, internal medicine and pediatrics, Eastern Utah rural practice, Price, UT
2001 - 2003 Hospitalist, adult and pediatric, Castle view Hospital, Price, UT
2003 - Associate Professor, Pediatrics, University of Utah School of Medicine, UT

Other Experience and Professional Memberships

2003 - 2014 Member, American College of Physicians
2008 - Member, Academic Pediatric Association

Honors

1982 Phi Kappa Phi Honor Society, University of Utah
1982 Magna Cum Laude, University of Utah
2007 Excellence in teaching award, University of Utah Pediatric Residents
2008 Golden Apple award, University of Utah School of Medicine Pediatric Clerkship

C. Contribution to Science

1. Asthma is the most common chronic disease in childhood resulting in ED visits and hospital admissions. Our group took on the challenge of improving this several years ago. Our work has included definition of quality measures, development, dissemination, and outcome measurement of a care process model for inpatient asthma care, and a novel software approach to improving outpatient care of asthma. We have demonstrated improved inpatient asthma care, reduction in hospital readmissions of children with asthma, and greatly improved quality of life of children with asthma. Ongoing studies aim to determine if we have improved outpatient asthma care and what impact we will have on outcomes such as frequency of asthma exacerbations, ED visits, and hospitalization. Our care process model has been adopted as the "asthma bundle" in a large multi-center grant in preparation, and our software asthma self-management package has sparked interest in Alaska, North Dakota, Spain, and France. Future projects will include adaptation of the software to other languages/cultures, and development of a software package to assist parents in the care of children with medical complexity, following the model we developed for asthma care.
 - a. Nkoy FL, Fassl BA, Simon TD, Stone BL, Srivastava R, Gesteland PH, Fletcher GM, Maloney CG. Quality of care for children hospitalized with asthma. Pediatrics. 2008 Nov;122(5):1055-63. PubMed PMID: [18977987](#).
 - b. Nkoy FL, Stone BL, Fassl BA, Koopmeiners K, Halbern S, Kim EH, Poll J, Hales JW, Lee D, Maloney CG. Development of a novel tool for engaging children and parents in asthma self-management. AMIA Annu Symp Proc. 2012;2012:663-72. PubMed PMID: [23304339](#); PubMed Central PMCID: [PMC3540453](#).

- c. Fassl BA, Nkoy FL, Stone BL, Srivastava R, Simon TD, Uchida DA, Koopmeiners K, Greene T, Cook LJ, Maloney CG. The Joint Commission Children's Asthma Care quality measures and asthma readmissions. *Pediatrics*. 2012 Sep;130(3):482-91. PubMed PMID: [22908110](#); PubMed Central PMCID: [PMC4074621](#).
 - d. Nkoy FL, Stone BL, Fassl BA, Uchida DA, Koopmeiners K, Halbern S, Kim EH, Wilcox A, Ying J, Greene TH, Mosen DM, Schatz MN, Maloney CG. Longitudinal validation of a tool for asthma self-monitoring. *Pediatrics*. 2013 Dec;132(6):e1554-61. PubMed PMID: [24218469](#); PubMed Central PMCID: [PMC4074668](#).
2. I developed an interest in children with medical complexity (CMC) early in my career and have worked on a variety of projects over time that relate to this population. The projects include epidemiological studies, opinion pieces, efforts to improve quality of care, and comparative effectiveness research efforts in relation to children with severe neurologic impairment and a need for internal tube feeding (findings presented Spring 2015 at the Pediatric Academic Societies meeting San Diego; manuscript near completion). I continue this interest with ongoing studies addressing a clinical definition for this population and further large database comparative effectiveness studies to address clinical questions that do not lend themselves easily to randomized trial study design.
- a. Srivastava R, Stone BL, Murphy NA. Hospitalist care of the medically complex child. *Pediatr Clin North Am*. 2005 Aug;52(4):1165-87, x. PubMed PMID: [16009262](#).
 - b. Stone BL, Murphy NA, Mundorff MB, Parker HB, Peterson PR, Srivastava R. Children with chronic complex medical illnesses: Is inpatient care family-centered?. *J Pediatr Rehabil Med*. 2008;1(3):237-43. PubMed PMID: [19779597](#); PubMed Central PMCID: [PMC2749511](#).
 - c. Stone BL, Boehme S, Mundorff MB, Maloney CG, Srivastava R. Hospital admission medication reconciliation in medically complex children: an observational study. *Arch Dis Child*. 2010 Apr;95(4):250-5. PubMed PMID: [19948664](#).
 - d. Simon TD, Berry J, Feudtner C, Stone BL, Sheng X, Bratton SL, Dean JM, Srivastava R. Children with complex chronic conditions in inpatient hospital settings in the United States. *Pediatrics*. 2010 Oct;126(4):647-55. PubMed PMID: [20855394](#); PubMed Central PMCID: [PMC2962571](#).
3. I have had an interest in advancing the knowledge base in clinical care without association to a specific disease entity. These papers highlight the various areas I have addressed over time. My first clinical research project addressed the persistence of PCR positivity for *Bordetella pertussis* which resulted in contact with the CDC which expressed interest in repeating this pilot study in more rigorous form. I then addressed health systems issues studying reasons for delays in discharge from the hospital and the process of medication reconciliation during the period this was first mandated by The Joint Commission. I also became interested in large database studies at this time and was a founding member of a large database "users group" at my institution in which we collaboratively completed studies. My participation in the Macrophage Activation Syndrome study and a manuscript nearing completion addressing antibiotic treatment choice for aspiration pneumonia in children with neurologic impairment resulted. As my career progressed, I found my interests connected to chronic disease in childhood as evidenced by my more recent work in asthma and ongoing work with children with medical complexity.
- a. Srivastava R, Stone BL, Patel R, Swenson M, Davies A, Maloney CG, Young PC, James BC. Delays in discharge in a tertiary care pediatric hospital. *J Hosp Med*. 2009 Oct;4(8):481-5. PubMed PMID: [19824097](#).
 - b. Stone BL, Boehme S, Mundorff MB, Maloney CG, Srivastava R. Hospital admission medication reconciliation in medically complex children: an observational study. *Arch Dis Child*. 2010 Apr;95(4):250-5. PubMed PMID: [19948664](#).
 - c. Bennett TD, Fluchel M, Hersh AO, Hayward KN, Hersh AL, Brogan TV, Srivastava R, Stone BL, Korgenski EK, Mundorff MB, Casper TC, Bratton SL. Macrophage activation syndrome in children with systemic lupus erythematosus and children with juvenile idiopathic arthritis. *Arthritis Rheum*. 2012 Dec;64(12):4135-42. PubMed PMID: [22886474](#); PubMed Central PMCID: [PMC3505557](#).
 - d. Stone BL, Daly J, Srivastava R. Duration of *Bordetella pertussis* Polymerase Chain Reaction Positivity in Confirmed Pertussis Illness. *Journal of the Pediatric Infectious Disease Society*. 2014 February 20; 3(4):347.

4. In my early science career I completed several basic science projects in relation to *Conus* snail species neurotoxins and ecdysone-induced polytene chromosome puffing during metamorphosis in *Drosophila*. I mention these only to underscore the valuable lessons learned about rigorous science, including care in research design, data collection, and analysis/interpretation this entailed. This experience has also proven to be useful in collaborative research with basic scientists at this stage of my career. The research itself, over time, has proven to add detail to the understanding of the topics but has not advanced the fields significantly. I successfully published my work.
 - a. Stone BL, Gray WR. Occurrence of hydroxyproline in a toxin from the marine snail *Conus geographus*. *Arch Biochem Biophys*. 1982 Jul;216(2):765-7. PubMed PMID: [7114859](#).
 - b. Gray WR, Luque FA, Galyean R, Atherton E, Sheppard RC, Stone BL, Reyes A, Alford J, McIntosh M, Olivera BM. Conotoxin GI: disulfide bridges, synthesis, and preparation of iodinated derivatives. *Biochemistry*. 1984 Jun 5;23(12):2796-802. PubMed PMID: [6466616](#).
 - c. Stone BL, Thummel CS. The *Drosophila* 78C early late puff contains E78, an ecdysone-inducible gene that encodes a novel member of the nuclear hormone receptor superfamily. *Cell*. 1993 Oct 22;75(2):307-20. PubMed PMID: [8402914](#).

D. RESEARCH SUPPORT

Ongoing Research Support

2013/07/31-2016/07/31

5330, PCORI

Nkoy, Flory (PI)

Redesigning Ambulatory Care Delivery to Enhance Asthma Control in Children

The major goal of this project is to test the effectiveness of a new ambulatory care model supported by the electronic-AsthmaTracker (e-AT), an innovative, patient centered web-based application designed to 1) engage patients with self-monitoring and self-management of chronic asthma control to prompt compliance with therapy and appropriate and timely visits to his/her physician, and 2) support physicians with longitudinal data to assess the effectiveness of asthma therapy and prompt adjustments. This project will also help identify factors critical to sustained parent engagement in asthma self-management that can be applied to other pediatric chronic diseases.

Role: Co-Investigator

2011/04/01-2015/06/30

1R18HS018678-01A1, AHRQ

Nkoy, Flory (PI)

Improving Post-Hospital Transitions and Ambulatory Care for Children with Asthma

The major goals of this project are to develop 2 information technology (IT) applications to improve post-hospital care transitions and ambulatory care; evaluate the attitudes, acceptability and use of the new IT tools by Hospital providers, Primary care providers (PCPs) and Patients; determine (implementation, organizational, individual, acceptance and technical) factors associated with use of the IT tools by hospital providers, PCPs, and patients; and evaluate the effect of the IT tools.

Role: Co-Investigator

Completed Research Support

2010/07/01-2014/12/31

HHSP233201300017C, Centers for Medicare & Medicaid Services

Norlin, Ernest Charles (Chuck) (PI)

CHIPRA quality demonstration grant

Role: Co-Investigator

2010/09/30-2014/09/30

HS019862, Agency for Healthcare Research and Quality

Keren, Ron (PI)

PHIS+: Augmenting the Pediatric Health Information System with Clinical Data

Role: Co-Investigator

2010/09/28-2013/09/27

KM1 CA156723-01, National Cancer Institute (NCI)

BYINGTON, CARRIE L (PI)

Mentored Scholars Program for Translational Comparative Effectiveness Research

Role: TA

2010/09/01-2013/06/30

H5018678, Agency for Healthcare Research and Quality

Nkoy, Flory (PI)

Organizational Factors Associated with Improved Asthma Care

Role: Co-Investigator

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.

Follow this format for each person. DO NOT EXCEED FIVE PAGES.

NAME: Wong, Bob

eRA COMMONS USER NAME (agency login): BOBWONG

POSITION TITLE: Director of Applied Statistics

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Montana State University, Bozeman, MT	BS	06/1987	Engineering
University of Southern Maine, Gorham, ME	MS	05/2000	Counseling
University of Utah, Salt Lake City, UT	PHD	05/2006	Psychology

A. Personal Statement

In my present role as the Director of Applied Statistics for the College of Nursing I provide skills and knowledge in many facets of research including designing studies, implementing data collection systems, conducting statistical analyses, managing Masters prepared statisticians, and writing publications. In my current position, I was instrumental in bringing REDCap (Research Electronic Data Capture), a software toolset and workflow methodology for electronic collection and management of research and clinical trial data, to the University of Utah. REDCap offers secure and easy data manipulation with audit trails for reporting, monitoring and querying records, and an automated export mechanism to common statistical packages (SPSS, SAS, Stata, R/S-Plus) facilitating quicker time to analyses. As an applied statistician I have both depth and breadth of knowledge, publishing a multilevel growth curve analysis primer (Oncology Nursing Forum, 2009) with other collaborators and teaching the Statistics series for PhD students (6 credit hours). Below are four publications that I served as Co-investigator or statistician that illustrate my ability to work collaboratively with many investigators/teams as well as across different health-care related content areas. I currently serve as the primary statistician or Co-investigator on three funded NIH grants, and three intramural grants. My experience in data acquisition, data wrangling, and data analysis will dovetail nicely among the projects within this center grant.

1. Rothwell E, Wong B, Rose NC, Anderson R, Fedor B, Stark LA, Botkin JR. A randomized controlled trial of an electronic informed consent process. *J Empir Res Hum Res Ethics.* 2014 Dec;9(5):1-7. PubMed PMID: [25747685](#).
2. Kurnat-Thoma EL, Pangilinan F, Matteini AM, Wong B, Pepper GA, Stabler SP, Guralnik JM, Brody LC. Association of Transcobalamin II (TCN2) and Transcobalamin II-Receptor (TCblR) Genetic Variations With Cobalamin Deficiency Parameters in Elderly Women. *Biol Res Nurs.* 2015 Feb 5;PubMed PMID: [25657319](#).
3. Wright KD, Pepper GA, Caserta M, Wong B, Brunker CP, Morris DL, Burant CJ, Hazelett S, Kropp D, Allen KR. Factors that influence physical function and emotional well-being among Medicare-Medicaid enrollees. *Geriatr Nurs.* 2015 Mar-Apr;36(2 Suppl):S16-20. PubMed PMID: [25784082](#); PubMed Central PMCID: [PMC4393784](#).
4. Wilson BL, Passante T, Rauschenbach D, Yang R, Wong B. Bladder Management With Epidural Anesthesia: A Randomized Controlled Trial. *MCN Am J Matern Child Nurs.* 2015 Mar 20;PubMed PMID: [25798748](#).

B. Positions and Honors

Positions and Employment

2004 - Research Analyst, University of Utah, Department of Dermatology
 2006 - 2013 Assistant Professor, University of Utah, College of Nursing

- 2008 - Faculty, Hartford Center of Geriatric Nursing Excellence
2008 - 2010 Interim Director of Applied Statistics, University of Utah, College of Nursing
2010 - Director of Applied Statistics, University of Utah, College of Nursing
2013 - Associate Professor , University of Utah, College of Nursing

Other Experience and Professional Memberships

- 2009 - Member, REDCap Consortium
2014 - 2015 Co-Director, Annual Meeting, Park City, Ut, REDCap Consortium

Honors

- 2010 Excellence in Teaching Award, College of Nursing
2011 Best Presentation, REDCap Consortium Annual Conference
2014 Those Who Dare to Care, College of Nursing

C. Contribution to Science

1. It is apparent that as data keeps growing, novel methods of understanding complex data will need to be developed. Recently, with the rise of Big Data, I have been focusing on data visualization and different methods to present and understand data. My team and I have developed animation methods within the R statistical platform to visualize the rise and fall of fatigue in patients undergoing cancer treatment. We have developed visualizations of patterns of pain for those undergoing chemotherapy, using multiple visualization methods including Excel, and Tableau. Also, we have compared and contrasted visualization methods including: Excel, GGobi, Tableau, and Life-flow. Our team has been exploring more direct data visualization with R, Processing and d3 languages.
 - a. Latimer S, Wong B, Adams D. Animating geom tile visualizations by combining ggplot2 and animation reveals daily symptom variability and patterns within cycles of chemotherapy. The 8th International UserR Conference; 2012 June; Nashville, Tennessee, United States.
 - b. Beck SL, Mooney K, Wong B, Wujcik D, Dunson W. Patterns of Pain in Patients Receiving Colony-Stimulating Factors during Chemotherapy. International Congress on Cancer Nursing, International Society for Nurses in Cancer Care; 2012 September; Prague, Czech Republic.
 - c. Wong B. Tips for Working with Data: Collecting, Organizing and Visualizing Tools. College of Nursing Seminar Series; 2012 October; Salt Lake City, Utah, United States.
 - d. Wong B, Latimer S, Beck SL, Wujcik D, Dunson W, Mooney K. Advancing Symptom Science Through Data Visualization. Council for the Advancement of Nursing Science; 2013 October; Washington DC, Washington DC, United States.
2. As a former engineer I've always been drawn to data collection. With new wearable technology in its infancy, and likely to become wide spread, the amount of personalized data will be overwhelming. Luckily, I've been working with sensor data (actigraphy for sleep quality), as well as computer programming to interface information systems. I've been Co-investigator for studies that collected data nationally from discrepant sources (telephone, online survey, paper survey, and focus groups), and created computer programming to 1) condition legacy medical records database into query ready form 2) Developed SQL code to query for history of mental illness and 3) conducted survival analysis that showed higher recidivism rates for those with mental illness. Finally, our team has been developing methods of data wrangling to help facilitate quicker analysis.
 - a. Cloyes KG, Wong B, Latimer S, Abarca J. Time to Prison Return for Offenders With Serious Mental Illness Released From Prison: A Survival Analysis. Criminal justice and behavior. 2010; 37:175-87.
 - b. Beck SL, Berger AM, Barsevick AM, Wong B, Stewart KA, Dudley WN. Sleep quality after initial chemotherapy for breast cancer. Support Care Cancer. 2010 Jun;18(6):679-89. PubMed PMID: [19521723](#); PubMed Central PMCID: [PMC2874643](#).

- c. Wong B. API Really Stands for Always Please the Investigator: Using the API to Populate a REDCap Project From a Telephone System . REDCap Consortium Annual Meeting; 2011 July; Breckenridge, CO, United States.
 - d. Botkin JR, Rothwell E, Anderson R, Stark L, Goldenberg A, Lewis M, Burbank M, Wong B. Public attitudes regarding the use of residual newborn screening specimens for research. Pediatrics. 2012 Feb;129(2):231-8. PubMed PMID: [22250018](#); PubMed Central PMCID: [PMC3269111](#).
3. I have been the Director of Applied Statistics for the College of Nursing for the past 7 years. In that time I have worked with numerous investigators in a variety of disciplines. During my tenure I have been able to apply a multitude of statistical analyses and research design principles. Some statistical analyses that frequent my publication list include: Finite mixture modeling, General linear mixed regression, Negative binomial regression, Logistic regression, Ancova, Anova, RMANOVA, Factor analysis, t-test, and Chi-square. I have been Co-Investigator or Co-author for topics including longitudinal growth-curves, Delphi studies, and analysis of complex survey design (utilizing PRAMS data).
- a. Dudley WN, McGuire DB, Peterson DE, Wong B. Application of multilevel growth-curve analysis in cancer treatment toxicities: the exemplar of oral mucositis and pain. Oncol Nurs Forum. 2009 Jan;36(1):E11-9. PubMed PMID: [19136327](#).
 - b. Wong B, Machan M, Kreuger GG, Callis Duffin K. Increased Prevalence of Sleep Disorders and Medical Comorbidities in Psoriatic Arthritis Patients Compared with Patients With and Without Psoriasis. Psoriasis forum / National Psoriasis Foundation. 2011;
 - c. Cummins MR, Crouch BI, Gesteland P, Staggers N, Wyckoff A, Wong BG. Electronic information exchange between emergency departments and poison control centers: a Delphi study. Clin Toxicol (Phila). 2012 Jul;50(6):503-13. PubMed PMID: [22612793](#).
 - d. Latendresse G, Wong B, Dyer J, Wilson B, Baksh L, Hogue C. Increasing Duration of Maternal Stress and Depression are Predictors of Newborn Admissions to NICU and Postpartum Depression. Nursing research.

D. Research Support

Ongoing Research Support

2013/07/01-2016/06/30

5P20HG007249-02, NHGRI

Botkin (PI)

Utah Center for Excellence in ELSI Research

Role: Co-Investigator

2011/07/01-2015/06/30

1R01HG006266-01, NIH/NHGRI

Botkin (PI)

Early Education of Newborn Screening

Role: Co-Investigator

2010/07/01-2015/06/30

P01 CA138317, NIH/NCI

Mooney (PI)

Enhancing End-of-Life and Bereavement Outcomes Among Cancer Caregivers

Role: OP

Completed Research Support

2011/07/01-2014/06/30

n/a, AHRQ

Morse (PI)

Examining Biomechanics of Entering and Existing Hospital Beds

Role: OP

2009/07/01-2014/06/30

R01 AG031255, NIH National Institute On Aging

LaStayo (PI)

Reducing Falls With RENEW in Older Individuals Who Have Fallen

Role: CPI

2007/07/01-2014/06/30

R01 CA120558, NIH, NCI & NINR

Mooney (PI)

Telephone Linked Care: An IT Enabled Integrated System for Cancer Symptom Relief

Role: OP

2010/07/01-2012/06/30

n/a, Robert Wood Johnson Foundation

Beck (PI)

Implementing and Evaluating Innovative resources to guide Hospital Nurses in Pain Management

Role: Co-Investigator

Project/Performance Site Location(s)

Project/Performance Site Primary Location

I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name: UNIVERSITY OF UTAH

Duns Number: 009095365

Street1*: 10 S 2000 E RM 4200

Street2:

City*: SALT LAKE CITY

County: SALT LAKE

State*: UT: Utah

Province:

Country*: USA: UNITED STATES

Zip / Postal Code*: 84112-5880

Project/Performance Site Congressional District*: UT-002

File Name

Additional Location(s)

RESEARCH & RELATED Other Project Information

1. Are Human Subjects Involved?* Yes No

1.a. If YES to Human Subjects

Is the Project Exempt from Federal regulations? Yes No

If YES, check appropriate exemption number: — 1 — 2 — 3 — 4 — 5 — 6

If NO, is the IRB review Pending? Yes No

IRB Approval Date:

Human Subject Assurance Number 00003745

2. Are Vertebrate Animals Used?* Yes No

2.a. If YES to Vertebrate Animals

Is the IACUC review Pending? Yes No

IACUC Approval Date:

Animal Welfare Assurance Number

3. Is proprietary/privileged information included in the application?* Yes No**4.a. Does this project have an actual or potential impact - positive or negative - on the environment?*** Yes No

4.b. If yes, please explain:

4.c. If this project has an actual or potential impact on the environment, has an exemption been authorized or an environmental assessment (EA) or environmental impact statement (EIS) been performed?

4.d. If yes, please explain:

5. Is the research performance site designated, or eligible to be designated, as a historic place?* Yes No

5.a. If yes, please explain:

6. Does this project involve activities outside the United States or partnership with international collaborators?* Yes No

6.a. If yes, identify countries:

6.b. Optional Explanation:

Filename

7. Project Summary/Abstract* Abstract1013416620.pdf**8. Project Narrative*** ProjectNarrative1013416621.pdf**9. Bibliography & References Cited** ReferencesOverall1013416851.pdf**10. Facilities & Other Resources****11. Equipment**

ABSTRACT

Asthma is the most common pediatric chronic illness in the US and associated with significant health care burden. Despite advances in treatment, asthma control in children remains generally poor. Poor control is associated with physiological and behavioral factors as well as with environmental exposures. While research efforts have been devoted to studying the impact of physiological and behavioral factors on asthma, research on the effects of environmental exposures in children with asthma is limited. Recent advances in sensor technologies offer new ways to measure environmental exposures and improve asthma research. However, use of sensor data in research remains uncommon and multiple barriers exist. Sensor data are complex, being variable in structure from sensor to sensor, high volume and acquired at a high frequency (e.g. every minute or more), and multi-dimensional, with sensor data linked to geo-spatial location, time, and description of exposures. Further, sensors lack standards for data collection and data exchange of environmental exposures, lack common data elements, have inadequate interfaces for families, and lack of secure communication modalities for data transmission. Moreover, little effort has been made to integrate sensor data with clinical data, making it difficult to study the actual effects of the environment on asthma. **The proposed PRISMS – Informatics Federation Architecture Center** provides standard-based, open access architecture and standardized processes for acquisition, integration, and management of sensor data, along with clinical data from longitudinal assessments of asthma symptoms, quality of life, health care usage, and other asthma related outcome metrics. Specifically, we propose to develop three synergistic and tightly integrated projects that make up an innovative sensor monitoring system, including: **Project 1:** Develop infrastructure and software to facilitate data acquisition and information exchange. We will develop a platform for mobile apps to support data extraction from the child's home and environment sensors, and data processing and user-friendly interface for data presentation to the participants. **Project 2:** Develop a high-resolution data integration platform that will provide the common core, allowing sensor data to be integrated with clinical data, and mechanisms for securely transmitting data to the PRISMS data coordinating center. This project will leverage existing OpenFurther architecture, open source frameworks that promote code reusability and interoperability. **Project 3:** Develop a platform for researchers with flexible user interface to configure a variety of experimental designs. We will use user-centered design to develop both user and researcher interfaces. These projects are tightly integrated, linked by the architecture in project 2. Overall, these projects will standardize data collection from environmental various sensors, data integration with clinical data and presentation to enhance research to improve our knowledge of the impact of environmental exposures on children with asthma.

PROJECT NARRATIVE/RELEVANCE TO PUBLIC HEALTH

Asthma is one of the most common childhood illnesses in the U.S. and associated with significant health care burden. Findings from this project will provide an effective, flexible and open access approach to collecting and managing high-resolution data from sensors, based on logical data models for the clinically relevant exposome (environmental exposure) information that can be integrated with clinical data. This provides key infrastructure for the PRISMS program, which will support studies to evaluate environmental, physiological, and behavioral factors that influence pediatric asthma and other chronic conditions in children, thereby improving the management and treatment of those conditions.

RESEARCH & RELATED Senior/Key Person Profile (Expanded)

PROFILE - Project Director/Principal Investigator				
Prefix: Dr.	First Name*: KATHERINE	Middle Name A	Last Name*: SWARD	Suffix:
Position/Title*:	Assistant Professor			
Organization Name*:	University of Utah			
Department:	COLLEGE OF NURSING			
Division:	COLLEGE OF NURSING			
Street1*:	10 S 2000 E RM 4200			
Street2:				
City*:	SALT LAKE CITY			
County:	SALT LAKE			
State*:	UT: Utah			
Province:				
Country*:	USA: UNITED STATES			
Zip / Postal Code*:	84112-5880			
Phone Number*:	801/585-1481	Fax Number:	E-Mail*: kathy.sward@nurs.utah.edu	
Credential, e.g., agency login: KATHYSWARD				
Project Role*:	PD/PI			
Degree Type:	Other Project Role Category:			
	Degree Year:			
Attach Biographical Sketch*:	File Name Sward1013343000.pdf			
Attach Current & Pending Support:				

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OMB Number: 0925-0001

1. Project Director / Principal Investigator (PD/PI)

Prefix: Dr.
 First Name*: KATHERINE
 Middle Name: A
 Last Name*: SWARD
 Suffix:

2. Human Subjects

Clinical Trial? No Yes
 Agency-Defined Phase III Clinical Trial?* No Yes

3. Permission Statement*

If this application does not result in an award, is the Government permitted to disclose the title of your proposed project, and the name, address, telephone number and e-mail address of the official signing for the applicant organization, to organizations that may be interested in contacting you for further information (e.g., possible collaborations, investment)?

Yes No

4. Program Income*

Is program income anticipated during the periods for which the grant support is requested? Yes No

If you checked "yes" above (indicating that program income is anticipated), then use the format below to reflect the amount and source(s). Otherwise, leave this section blank.

Budget Period*	Anticipated Amount (\$)*	Source(s)*
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5. Human Embryonic Stem Cells

Does the proposed project involve human embryonic stem cells?* No Yes

If the proposed project involves human embryonic stem cells, list below the registration number of the specific cell line(s) from the following list: http://grants.nih.gov/stem_cells/registry/current.htm. Or, if a specific stem cell line cannot be referenced at this time, please check the box indicating that one from the registry will be used:

Cell Line(s): Specific stem cell line cannot be referenced at this time. One from the registry will be used.

6. Inventions and Patents (For renewal applications only)

Inventions and Patents*: Yes No

If the answer is "Yes" then please answer the following:

Previously Reported*: Yes No

7. Change of Investigator / Change of Institution Questions

Change of principal investigator / program director

Name of former principal investigator / program director:

Prefix:

First Name*:

Middle Name:

Last Name*:

Suffix:

Change of Grantee Institution

Name of former institution*:

PHS 398 Research Plan

Please attach applicable sections of the research plan, below.

OMB Number: 0925-0001

1. Introduction to Application (for RESUBMISSION or REVISION only)	
2. Specific Aims	SpecificAimsOverall1013416852.pdf
3. Research Strategy*	ResearchStrategyOverall1013416853.pdf
4. Progress Report Publication List	
Human Subjects Sections	
5. Protection of Human Subjects	Overall_PHS1013416938.pdf
6. Inclusion of Women and Minorities	Overall_IWM1013416939.pdf
7. Inclusion of Children	Overall_IC1013416942.pdf
Other Research Plan Sections	
8. Vertebrate Animals	
9. Select Agent Research	
10. Multiple PD/PI Leadership Plan	
11. Consortium/Contractual Arrangements	
12. Letters of Support	Morton1013416847.pdf
13. Resource Sharing Plan(s)	Resource_Sharing_Plan1013416854.pdf
Appendix (if applicable)	
14. Appendix	

Specific Aims

Asthma is the most common pediatric chronic illness in the US, affecting about 9% of children, and is associated with significant health care burden. Despite healthcare advances, asthma control remains generally poor. Accumulating evidence suggests that environmental exposures contribute to poor asthma control, as well as to other chronic health problems. Questions about how the environment affects child health remain unanswered, in part due to lack of detailed and readily available data for exposures. Recent technological advances include wearable and stationary sensors, offering unprecedented ability to collect and interpret data about environments, to measure the cumulative effect of which had been termed the *exposome*. To understand the influence of environmental and other factors on illness, sensor information needs to be integrated with clinical assessments of asthma control, quality of life measures, health care utilization, and other metrics. The *Pediatric Research using Integrated Sensor Monitoring Systems* (PRISMS) program will develop pediatric sensor-based health monitoring systems, with an initial focus on pediatric asthma. The program embraces a new paradigm; with a robust health monitoring system combining research, clinical care, and home management. The inclusion of an array of integrated sensors into clinical research could allow researchers to understand complex interactions between health outcomes and the environmental, behavioral, and physiological factors that influence outcomes; providing new insights regarding chronic pediatric illnesses such as asthma if this data becomes readily available to clinical researchers.

This U54 center (cooperative agreement) project proposes a multi-disciplinary research center, the ***PRISMS Informatics Platform Federated Integration Architecture***, to develop an **informatics platform** as a component of the PRISMS program. We envision a comprehensive, standards-based, open-source informatics platform that will allow sensor and environmental data and clinical data to be integrated in a clinically-meaningful manner. We will design and develop an architecture, data models, processes, and software to acquire, manage, process, and communicate high-resolution *clinically relevant exposome* information from environmental, physiological, and behavioral sensors. This infrastructure will support future clinical studies of pediatric asthma and other chronic conditions with short-term storage and aggregation of sensor data; integration with other clinical and research data; and secure transmittal of information to the PRISMS data coordinating center.

Three related projects make up the overall informatics platform. These projects will be tightly integrated, linked by the architecture and data models developed in project 2, which will provide an exemplar for integration of *exposome* with clinical data for translational research.

Project 1: Data acquisition pipeline. We will develop processes and tools to support how sensor data will be collected in the child's home and environment, and to configure how information will be presented to study participants and researchers.

Project 2: Central data federation/integration platform. This standards-based, open-access platform will provide the core infrastructure for data integration, allowing sensor data to be integrated with clinical information, and will include mechanisms for securely transmitting data to the data integration center.

Project 3: The lab/researcher platform. We will develop and analytical platform with tools and process that will allow clinical and translational researchers studying pediatric asthma a flexible means to configure and consume the data sources for a variety of experimental designs, and will provide analytic tools for study monitoring.

We believe that Utah provides a unique environment for this research center. Utah (Salt Lake City) is participating in the national Green and Healthy Homes Initiative, and the community has high interest in environmental exposure information. We have assembled a multidisciplinary research team with extensive experience in clinical care, asthma research, sensor development, and study management; in computer science, software engineering, and user interface design; and in informatics and standards development and implementation. Utah has long-standing history of inter-departmental cooperation that facilitates and supports the collaboration of the center investigators. The federation integration environment builds on and extends the successful work of the Utah Center for Clinical and Translational Science Biomedical Informatics Core (<http://medicine.utah.edu/ccts/bmic/index.php>), and leverages the computing capabilities of the Center for High Performance Computing (<https://www.chpc.utah.edu/>).

Research Strategy/Program Description

Many chronic conditions such as pediatric asthma are known to be heavily influenced by environmental, physiological, and behavioral factors. The proposed **PRISMS – Informatics Federation Architecture Center** is a multi-disciplinary informatics research center that will provide a standards-based, open access architecture and approach for acquisition, integration and management of high-resolution data from sensors. To be useful in pediatric asthma research, high-resolution sensor data will need to be integrated with clinical data including asthma control assessments, such as obtained through the eAsthma Tracker (1, 2), quality of life measures (3-5), health care usage, and other metrics.

Background

Pediatric Asthma and Disease Burden

Asthma is a common condition that affects approximately 7 million U.S. children, or about 9% of the population. The prevalence has been increasing worldwide over several decades (6-8). Although mortality is decreasing, the airway inflammation associated with this chronic condition causes exacerbation of symptoms and can lead to morbidity, significant lifestyle restrictions, high cost and caregiver burden, and other quality of life issues. Asthma is the third most common cause for childhood hospitalization and is a leading cause of school absenteeism and loss of time from work (8).

Environmental Exposures, Impact on Pediatric Asthma and Need for High Quality Environmental Data

A growing body of evidence suggests that environmental exposures, particularly smoking (but also traffic, poor air quality, pollutants in the home, pollen and other environmental triggers), contribute to the etiology and severity of many pediatric health problems, including asthma. Several known allergy and asthma genes have been found to be susceptible to epigenetic regulation (6-10). Significant disparities have been found among children with asthma, with evidence that these disparities reflect a complex relationship between ethnicity and genetics, socioeconomic status, behavioral factors such as low medication adherence and absence of asthma care, and exposure to asthma triggers in the environment. There are likely gene-environment and sociocultural interactions (7, 8, 11), but major questions remain unanswered due to insufficient metrics of exposures (6).

Exposome

People are exposed to hundreds (maybe thousands) of environmental factors throughout their life. The *exposome* is an emerging concept representing the total set of environmental factors to which a person is exposed, including the complex interplay between those factors, and between environmental, behavioral, and psychosocial factors that in turn, influence health and diseases (12, 13). Current scientific paradigms do not adequately capture the complexity of the relationships between environment, personal health and population level disparities, yet research suggests that up to 70-90% of certain chronic illnesses such as pediatric asthma may be influenced by environmental factors (12).

Opportunities with Expansion of Environmental Sensors to Measure the Exposome

New technologies in sensors and mobile applications provide the opportunity to collect unprecedented detailed, high quality information about the environment, and to correlate behavioral and physiological data with environmental factors, providing insights into mechanisms of causality. Such high-resolution data could be integrated with data recorded in electronic medical records and clinical research databases, tracking asthma over time; which would allow investigators to update asthma treatment guidelines and develop evidence based innovative disease management plans (14). These technologies will allow researchers to carefully assess risk factors for asthma development and better understand causative mechanisms for asthma exacerbations; and will improve the way we communicate this information in the healthcare system. This will allow parents, primary care providers, and asthma specialists to more effectively intervene in altering the course of asthma and further reduce asthma morbidity and mortality (15).

Significance

Barriers and Knowledge Gaps

Asthma is the most common pediatric chronic illness in the US and associated with significant health care burden. Poor asthma control is associated with multiple factors including environmental exposure. The PRISMS program has been developed to support epidemiological studies that include data from multiple environmental, physiological, and behavioral sensors. Our platform will facilitate integration and analysis of data across multiple environmental, physiological, and behavioral sensors, and between sensor data and clinical data such as asthma control assessments, quality of life metrics, or healthcare utilization data.

Sensor data are complex, and can vary in structure and form from sensor to sensor (16, 17). The data are high-resolution, being finely detailed and acquired at a high frequency (as often as every minute or more). Sensor data are multi-dimensional and may be linked with geo-spatial location, time, and identity information describing exposures. Although this high-resolution information is likely to be critical for understanding the influence of environmental exposures on pediatric asthma and other chronic conditions, use of sensor data in research is not common. Several barriers exist including lack of common standards for data collection and data exchange, lack of common data elements for data storage, inadequate interface, and lack of secure communication modalities for data transmission. Without addressing these integration issues the research value of these data is greatly diminished because it becomes too cumbersome to use by the average clinical and translational researcher. The use of sensors also includes social barriers such as concerns about privacy and need for the system to be non-intrusive, and technical barriers such as battery life (16-19).

Contributions to Science

The overall center will generate scientific knowledge that is important for the greater biomedical research community. While there are many possible standards on which we can draw, and new standards that are emerging to support mHealth, eHealth, and similar endeavors (18), there is currently no consensus on what standards are best to use for sensor data collection and data exchange; although a few, such as ISO/IEEE 11073, have shown promise (19, 20). Wearable and non-wearable sensors and mobile apps are emerging technologies and current standards may not fully accommodate this high-resolution data. We will identify and/or propose standards that are appropriate to use for data acquisition across the PRISMS pipeline, and will submit information to appropriate standards-development organizations when appropriate standards do not exist.

Our center will support technical capability for the PRISMS program. It provides a “middleware” layer of infrastructure that will allow sensor information to be integrated and linked prior to transmittal to the Data Coordinating Center. This informatics platform will support data quality analyses, pre-processing and analytics, and visualization of data as it is being gathered, and will support feedback to the users.

Ultimately, the clinical impact of this center will be as a component of the overall PRISMS program. Clinical studies supported by the PRISMS program will contribute to better understanding of asthma causative mechanisms and the complex interactions of environmental and contextual factors. The research will uncover mechanisms for asthma disparities and the complex relationships between factors that contribute to those disparities, which will in turn lead to development of innovative evidence based interventions that better contribute to pediatric asthma prevention and management.

Innovation

The PRISMS program is a new paradigm for epidemiological studies. Barriers to effective asthma management are complex and multifactorial, and include family, social, and medical history, lifestyle and self-management behaviors, and persistent environmental risk factors. Studying those multiple factors with the rich data provided by integration of sensor data and other data sources will provide new insights into asthma care. The program presents what is essentially a Big Data challenge – management of high-resolution high-volume

sensor data, integration across multiple sensors, and integration with clinical and outcomes data. Methods not commonly employed in clinical research will be needed for data quality assessments, data integration, and analysis. We will leverage the significant local experience and extend previously developed tools for managing complex, heterogeneous, high volume data. A primary innovation, then, is in applying big data and high-performance computing techniques and tools to the domain of pediatric clinical (asthma) research, in such way the systems developed here are extensible and generalizable to other pediatric conditions.

Most research of this sort, to date, has been custom, one of a kind development. Another important innovation is the use of a standards-based, open access approach to our platform development. The approach is modular and scalable. A major part of the PRISMS system (the informatics platform) can be designed once and then used for multiple studies and applications.

Finally, a third innovation is the design of bi-directional information exchange mechanisms and feedback that is user-specific and age-appropriate. This customization should support and facilitate parent and child engagement in clinical studies and clinical care, which has been shown to ultimately improve healthcare outcomes.

Research Team

We have a multi-disciplinary team with complementary, and diverse expertise relevant to this project. The PIs and project leads will work together as a leadership team. The team leaders experience includes biomedical informatics and nursing informatics, pediatric asthma research, and software and sensor development. The PRISMS program is anticipated to be highly collaborative across centers and sites; we have designed our team from the ground up to be collaborative. Here we provide an overview of key personnel; leadership plans are provided in more detail in the Admin Core description and the Multiple PD/PI leadership plan.

The study uses a multiple PD/PI leadership model. Dr. Katherine Sward is a tenured Associate Professor in the College of Nursing and adjunct Associate Professor in the Department of Biomedical Informatics. She has a broad-based experience and educational background including clinical nursing, informatics, software development, data and knowledge management, and clinical research informatics that allows her to fluidly work across the multiple disciplines in this center. She will serve as the contact PD/PI and will co-lead project 3 (Researcher Platform).

Dr. Julio Facelli is the senior informaticist and second PI. He is a full professor of Biomedical Informatics, a Fellow of the American College of Medical Informatics, vice-chair of the Department of Biomedical Informatics and director of the Biomedical Informatics Core of the Utah Center for Clinical and Translation Science (CCTS). His research includes data mining, complex analytics, and distributed information systems for clinical and translational informatics. Dr. Facelli will mentor and advise Dr. Sward in overall center management, and will be the final arbitrator for decisions about standards and the informatics architecture. He will be the Center's liaison with the CCTS (http://medicine.utah.edu/ccts/about_us.php) to facilitate access to resources available there and to integrate the PRISMS Informatics Federated Integration Architecture Center with the overall University of Utah strategy for research in translational sciences. He also will be the contact person with the Center for High Performance Computing, which he directed for more than 25 years.

The project leaders provide complementary expertise. Project 1 (data acquisition pipeline) is led by Dr. Neal Patwari and Dr. Miriah Meyer. Dr. Patwari is an Associate Professor in Electrical and Computer Engineering and directs the Sensing and Processing Across Networks (SPAN) Laboratory, which performs research at the intersection of statistical signal processing and wireless networking. Dr Meyer is an Assistant Professor in the School of Computing with particular expertise in visualization, complex data analytics, and in tailoring user interfaces. Dr. Patwari and Dr. Meyer have extensive experience designing sensors, sensor interfaces, and sensor monitoring systems, and in customizing those interfaces and monitoring systems.

Project 2 (data integration infrastructure) is led by Dr. Julio Facelli (PD/PI) and Dr. Ram Gouripeddi. Dr. Facelli provides extensive experience in high-performance computing and Big Data analytics. Dr. Gouripeddi is a Research Assistant Professor in Biomedical Informatics who was instrumental in development of the

OpenFurther project; he has experience managing pediatric information and helped to design the PHIS+ instantiation of OpenFurther. PHIS+ (http://155.97.150.189/research/phis_plus.html) augmented the long-standing Pediatric Health Information System (PHIS) database, a collaboration of more than 40 hospitals, adding laboratory and radiology information. Using similar approaches, we will extend the robust OpenFurther federation architecture for high-resolution high-volume sensor data and for integration of sensor data with clinical data.

Project 3 (lab/researcher analytics platform) is led by Dr. Sward (PD/PI), Dr. Mollie Cummins, and Dr. Flory Nkoy. Dr Cummins has engaged extensively in data modelling, clinical terminologies and standards. Her team collaborates and communicates with national organizations to ensure replicability and scalability of locally conducted standards efforts. We will use a user-centered design approach. This is an approach that is being successfully deployed by Dr. Cummins in her research regarding health information exchange between poison control centers and emergency departments. Dr. Nkoy is an Associate Research Professor at the University of Utah, Department of Pediatrics and an Adjunct Associate Professor in the Department of Biomedical Informatics. He also serves as the Research Director for the Division of Pediatric Inpatient Medicine and the lead of asthma research. Dr. Nkoy has experience in implementing and disseminating evidence-based interventions in both inpatient and ambulatory settings to improve asthma care and outcomes, and promote effective patient self-monitoring and management, as well as experience in health care redesign to improve health care efficiency. He leads, along with Dr. Stone (a co-investigator for this project) multiple grants which funded the development, testing and implementation of the electronic-Asthma Tracker (eAT) at 12 clinics in Utah. (Note: the e-AT is an innovative self-monitoring tool for support self-monitoring and management of children with asthma). Dr. Bryan Stone is a professor of pediatrics at University of Utah, Department of Pediatrics. He has more than 10 years of experience working as a primary care provider in underserved rural Utah. He has experience in health services research and has collaborated with Dr. Nkoy on multiple projects, including pediatric asthma and children with complex medical conditions.

The team is rounded out by a diverse group of subject matter experts including (but not limited to) clinical investigators, sensor developers, environmental monitoring experts, statisticians, and experts in study data management and analysis.

Preliminary Work

We will leverage and extend previous work. By building on demonstrated prototypes we increase the likelihood of success.

We have a set of locally-developed sensors and interfaces that can provide preliminary information about sensor data

Center faculty and investigators have developed (and are currently developing, outside of the scope of this U54 center application) environmental sensors, with interfaces that provide feedback to users and mobile apps. Most pertinent to this center research, they have a previously developed a sensor and interface to monitor smoking and other particulates, which was used for research on adult pulmonary diseases. In addition, they have a previously developed wearable identity module with accompanying network analysis software. These existing sensors and applications will provide our initial exemplars of sensor data, which we will use to inform our designs. We will augment this with information about other PRISMS program sensors as they are developed and become available, and with commercial sensors that are likely to be of high interest (such as sensors attached to inhalers).

In addition our collaborators have previously investigated the feasibility and information value of collecting environmental data for the National Children's Vanguard Study (21). Their experience will inform our design and approaches.

We have developed a preliminary platform that accommodates air quality data

The air quality federation platform (22) was built on the demonstrated success of the FURTHER (23) and OpenFurther (24-28) platforms. This platform utilizes logical and physical data models to integrate, on the fly if desired, heterogeneous data sets. It includes tools to easily query the data and design reports, as well as

modules for more advanced analytics and data quality assessments. We will extend the platform in several areas to accommodate the needs of the PRISMS program. We will create a standards based, logical model of the clinically relevant exposome, which provides the central data infrastructure that links the center projects together.

The central platform for short term data storage, integration across heterogeneous data sources, and the processing and analysis associated with monitoring studies (project 2) is designed around standards-based logical data models of the clinically relevant exposome. These data models provide the “glue” that links the projects. The platform is based on the OpenFurther architecture. It is designed to connect disparate data resources with a scalable federated query engine. OpenFurther technology translates data models on the fly; thus the data model is integral. OpenFurther is an open source informatics platform developed by the Biomedical Informatics Core of the University of Utah’s Center for Clinical and Translational Science that supports federation and integration of data from heterogeneous and disparate data sources (23-28). OpenFurther projects have been previously used to support collaborative pediatric research, in the PHIS+ program (25, 26). An preliminary edition that supports air quality data has been developed (22) and will be enhanced in project 2. Drs. Facelli and Gouripeddi are the co-leaders of the OpenFurther development team.

Project 1 extends the informatics infrastructure into the child and parent's home and environment. This project will design and develop the data acquisition pipeline, supporting the collection of sensor data and feedback to the child and/or parents. Project 3 extends the infrastructure to clinical researchers, with the design and development of a lab/research analytic platform supporting the flexible configuration of sensor-based trials and monitoring and analysis of trials data.

We have developed informatics tools to study pediatric asthma

Electronic-AsthmaTracker (eAT) development: The eAT was developed to facilitate asthma care continuity, including ongoing communication between patients/caregivers and healthcare providers (HCPs) to support early decision-making. The eAT (<http://asthmatracker.utah.edu>) includes a web-based platform and a mobile web form, designed by Drs. Nkoy, and Stone, to engage parents in their child asthma self-management through weekly scoring of asthma control, automated interpretation of results, and immediate prompts (pop-up, email and text messaging) when child asthma control is deteriorating to allow timely interventions (29). Weekly assessment surveys take only 1-2 minutes to complete.

The eAT integrates the HCP in the monitoring process through a secure web interface providing real-time patient status information, including graphic display and decision support to facilitate decision-making. After a parent completes the questionnaire, the total score is automatically calculated to determine whether asthma is 1) well- (Green), 2) not well- (Yellow), or 3) poorly- (Red) controlled. Each color on the graph is associated with specific, real-time recommendations for the patient (e.g. continue regular follow-up care and medications (Green zone), schedule an early follow-up visit with their HCP if 2 consecutive weeks in the Yellow zone, or schedule an early HCP follow-up visit in the next few days (Red zone)). Other information includes compliance with asthma therapy, logging clinic, and ED/hospital visits. Decision support logic alerts HCPs if the child's asthma control is deteriorating, guiding them to adjust asthma therapy based on NHLBI guidelines.

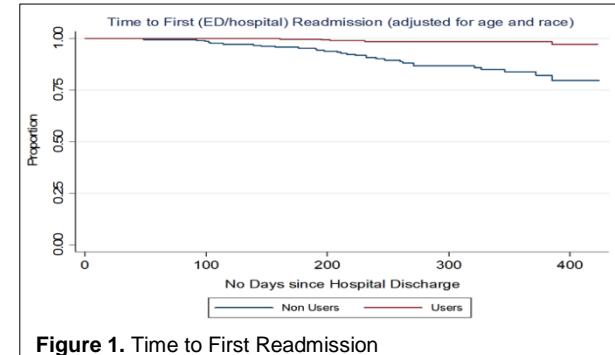


Figure 1. Time to First Readmission

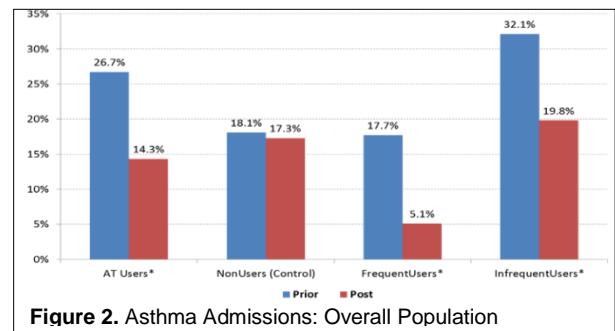


Figure 2. Asthma Admissions: Overall Population

Parent Incentive Mechanism: The eAT has an incentive mechanism using a leaderboard and built-in progress bar, which adds 25 points each time a user completes a weekly assessment. When the total points reach 100 (or 4 successful assessments), users receive a pop-up message congratulating their achievement and a \$10 gift certificate to a local or online store, then points are reset to 0, and the cycle restarts. A similar incentive approach could be used in PRISMS projects to facilitate parent engagement and consistent use of tools. Other features include automatic reminders (email or text) with an embedded link to the tool to allow easy access and consistent use. The eAT is configured to allow communication between parents and HCPs through a clinic care coordinator if appropriate for the study.

Usability and Effectiveness of the eAT: Development of the eAT involved a multidisciplinary team with clinical expertise and understanding of asthma care processes, and also solicited input from end users through focus groups and iterative usability testing cycles (29). Usability testing was used to identify and address issues with the eAT before implementation. Overall, participants were satisfied with the eAT and found it easy to use and acceptable (29). Our team also tested the eAT for effectiveness in a prospective study of children 2-12 years of age enrolled at time of hospitalization for asthma at PCH between March 2011 and December 2012. Of these children, 210 were eAT users vs. 353 non-users (controls). The tool was administered to parents during hospitalization and weekly over 6 months post-hospitalization. Overall, users had longer time to first admission compared to non-users (**Figure 1**). Also, frequent or consistent eAT users, those who completed > 60% of weekly assessments over the 6 months, had significantly lower ED/hospital admissions (**Figure 2**).⁽³⁰⁾ We also found a remarkable reduction in the child's ED/hospital readmissions (**Figure 3**) in a subanalysis of low-income Latino children with Medicaid insurance who used the eAT (n=27) vs control (n=44), providing preliminary evidence of the eAT (English version) use and effectiveness in low-income Latino children.

Redesigning Ambulatory Asthma Care to Improve Asthma Control in Children: Dr. Nkoy was awarded a PCORI grant to test the effectiveness of a new proactive ambulatory care model supported by the eAT in 12 primary care clinics. The eAT implementation was completed through training of medical, nursing, respiratory therapist and administrative staff, and ongoing support. Contrary to many studies showing high attrition rates with self-management support interventions,(31) our data (**Figure 4**) show high compliance, with sustained parent engagement and use of the eAT over time: At 39 weeks (~10 months) of enrollment >75% of patients are still frequently (consistently or weekly) using the e-AT.

Approach

Our approach is standards-based and embraces user-centered design, open source tools, and open access approaches, which will allow the infrastructure to be able to be easily disseminated and used for NIH studies. We use modern software development approaches with lightweight agile development methodologies. The projects in this U54 center will interact to provide a functional, scalable platform.

User-Centered Design

We will utilize a User-Centered Design (UCD) approach when designing interfaces and processes. UCD principles will be critical in the design and validation of sensors for the U01 sites (32). Similar UCD principles are also critical for the development of this U54 center informatics platform and tools. UCD is a diverse and wide-ranging set of methods and approaches that support the end-user experience. Software UCD is a

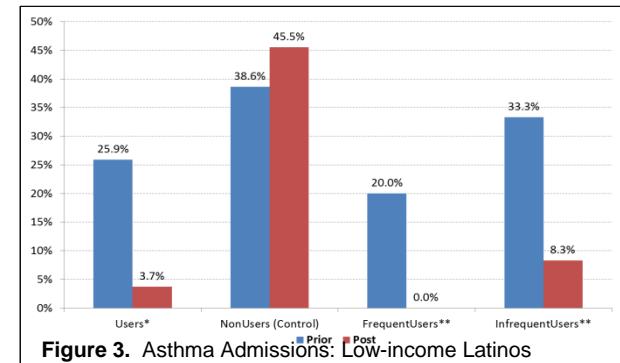


Figure 3. Asthma Admissions: Low-income Latinos

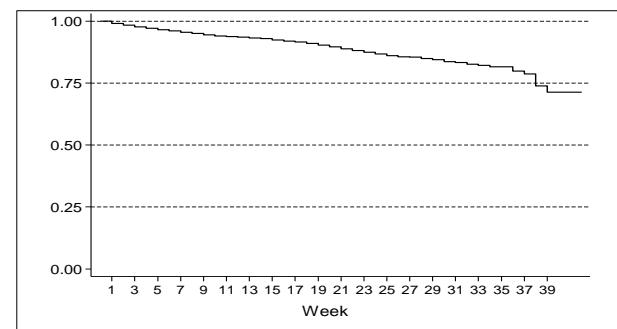


Figure 4. Proportion of Frequent Users: >60% Compliance

participatory design process requiring understanding and modeling of the users' goals, beliefs or attitudes, and their workflow and behaviors. The primary goal is on providing value to the end user (33). UCD methods are rooted in methods from the area of computer science, cognitive science, psychology, behavioral science, ethnography, and human-computer interaction (34). Dr. Sward is an expert in this area and will provide overall guidance in the UCD process.

First the types of users (stakeholders) are identified. For our center, the type of stakeholders **guided how we partitioned the center development into projects**. Obvious user types were parents/children (project 1); clinician researchers (project 3); and other PRIMSM sites, with sensor developers, the Data Coordinating Center, and other infrastructure awardees (project 2). Other stakeholders we identified were the funding agency, our organization, and the technical team that is developing the infrastructure.

User-centered design (UCD) focuses on the user needs, values, and goals. We will conduct focus groups and interviews with users to identify their needs, capability, and preferences regarding monitoring of environmental exposures with sensors. This will provide foundational information before we start in-depth analysis and development. We will apply standard task and workflow analysis methods to learn about user actions: what triggers an action, how tasks are completed (tasks, use cases) and the intent of the action (goal). Further detail can be captured through standard modeling techniques such as use cases, story boards, data flow diagrams, goal decomposition diagrams, and others models. It can be helpful to also conjecture with the users what would be their ultimate or most desirable set of triggers, processes and goals, to help with prioritization. Designs are based on the users' mental models of the domain, including their language (labels and definitions), concepts, beliefs and other factors. These models are synthesized and translated into software requirements, which are prioritized based on feasibility and value to the users (33).

Software Development Approach

UCD methods integrate well with agile and iterative software design principles, evolving from low-fidelity prototypes and screen mock-ups to increasingly functional and finally a fully functional system. Each prototype helps to further elucidate details of the system requirements as the prototype is evaluated. The purpose is to ensure that the system meets the user and program needs and goals. Gaps between what the users expect and what is actually supplied add to difficulties with ease-of-use. Therefore it is important to conduct an end-to-end analysis of the user experiences, stepping through every workflow (33).

UCD techniques focus on the user interfaces and workflows. For this project, the core infrastructure and architecture need to be scalable, flexible, and interoperable. Such interoperability requires the use of a standards based approach. Understanding the *exposome* requires measurement of clinically-relevant environmental exposures, with geospatial and temporal information, that is linked to clinical and outcomes data. The concept underlies the science that the PRISMS network intends to support. Exposure represent where people live, work, and play. There is increasing evidence that social and ecological factors must be addressed together to eliminate health disparities. Environmental information must be integrated with geospatial, temporal, and clinical health information if we are to understand and address these complex issues (12, 13).

As an emerging area of science, little is known about how to best capture and represent clinically relevant *exposome* information. We will need to create an infrastructure that appropriately stores and integrates diverse data sources, and that supports processing and visualization. The OpenFurther architecture that provides the core for our platform (18, 19) is a **next-generation federation architecture** that was designed from the ground up to connect disparate data resources with a scalable federated query engine. OpenFurther technology translates heterogeneous data models on the fly, empowering researchers to gain new knowledge easily and rapidly. An information model represents the information that needs to be communicated to facilitate interoperability within a particular domain. Data models and information models existing along a continuum depending on the level to which they represent the information abstractly (conceptual models) or as the data will appear in physical storage (physical data models). A *logical data model* shows a detailed representation of the data, described in business language but independent of a particular technology; it standardizes the way

concepts (people, places, things) are represented and standardizes the rules, relationships, and events that can occur between them.

Our approach to software design is based on lightweight agile methodologies. Agile software development is a group of software development methods in which requirements and solutions evolve through collaboration between self-organizing, cross-functional teams. The goal of agile development methods is to meet the expectations of the project users and sponsors by closing the communication gap between the domain experts (users) and the developers, managing expectations and the creative software design process, and managing increasingly detailed understanding of the software requirements (35). A goal of the software designs is to be lightweight, modular, interoperable, and extensible. **Dr. Facelli has more than forty years of experience in developing and deploying distributed and parallel computer systems** and he will coordinate the overall software development effort of the center.

Big Data Management and Analytics

The PRISMS program presents what is essentially a Big Data challenge. The ability to harvest the wealth of information contained in sensor and clinical data will advance our understanding of pediatric health and disease but challenges to managing this biomedical Big Data have been impediments to taking full advantage of sensor data. In biomedicine, the diverse, complex, massive and multimodal data generated by sensors, mobile devices, and clinical records present opportunities and challenges for combined analyses. Given the complexity and heterogeneity of asthma, use of high-throughput technology and advanced analytic approaches would enable systems biology approaches to examining the myriad interdependencies between environmental, behavioral, physiologic, and clinical factors.

Thus the program will benefit from use of Big Data and “nontraditional” analytic techniques to facilitate discovery and interpretation of new knowledge. Our team includes collaborators who have specialty experience in data visualization, management of heterogeneous data sets, distributed computing, and Big Data analytics. Big Data analytics employ a variety of tools and techniques to analyze heterogeneous data in search of insights, connections, and patterns, assisting researchers to construct knowledge in new ways. We will leverage the expertise and facilities at the Center for High Performance Computing to design example data visualizations and Big Data analytic approaches.

Guiding Principles

Our overall guiding principle for software development will be the integration, when possible, of existing modular and scalable components that will allow us agile development in response to the user feedback provided. To implement these principle we will collaborate with experts and the Center for High Performance Computing (CHPC) and the Biomedical Informatics Core (BMIC) as well as with Biomedical Informatics, computer science, and engineering faculty colleagues to identify relevant standards. We will leverage existing CHPC and BMIC infrastructure and processes regarding best practices for software design, development, documentation, testing, and implementation. We will collaborate with the other PRISMS sites and will adjust our project goals, timelines, and milestones as appropriate to meet the needs of the overall PRISMS program.

The goal for our platform is to demonstrate functionality, utility, and usability for targeted stakeholders. Our approach will create a standards based modular information integration and analysis platform that can control and accept data from multiple sensors. The platform will integrate the information into short-term storage and processing, with sensor analysis algorithms developed in project 2. Data will be uploaded at least daily into the data and software coordination and integration Center using secure, HIPAA compliant methods of data storage and transmission. The interface design UCD process should ensure that interfaces are developed in a way that promotes usability and data standardization, analysis and data visualization that only about problems, and that provides user and age-appropriate feedback. We will design a framework, with software development and content standards so that future mobile apps and interfaces can be seamlessly added to the PRISMS program as they are developed.

Environment



Between January 1–24, 2013, Salt Lake City's Hawthorne monitoring station exceeded fine particulate air quality standards on 15 days. This is based on available DAQ data as of February 15, 2013. Photo by K. Kelly.

We believe that Utah provides a unique environment for this research center. The University of Utah has outstanding computing and research facilities (see Facilities and Resources document). Utah (Salt Lake City) is participating in the national Green and Healthy Homes Initiative (<http://slco.org/green-healthy-homes/>), and the community has high interest in environmental exposure information. The University of Utah houses a Program for Air Quality, Health, and Safety (<http://www.airquality.utah.edu/about>) that facilitates multidisciplinary collaborations devoted to studies concerning air quality and the impact of environmental factors on health, with several of our collaborators serving on the Steering Committee for that endeavor. The Wasatch Front, the home of the University of Utah, experiences periodic high-levels of fine particulate matter; a characteristic that uniquely will allow us to differentially understand the different pathological effects of long term average exposure vs. acute exposure. This environment provides researchers with the opportunity to understand the health and economic impacts of air pollution, as well as the ability to develop optimal mitigation strategies. The Wasatch Front also experiences high summertime levels of ozone.

The research team brings extensive experience in clinical care, asthma research, sensor development, and study management; in computer science, software engineering, and user interface design; and in informatics and standards development and implementation. The University of Utah has long-standing history of inter-departmental cooperation that facilitates and supports the collaboration of the center investigators. Collaborators have a strong pediatric asthma research program, with long history of research collaborations across multiple organizations and a demonstrated ability to use informatics methods and tools to collect pediatric asthma outcomes (1, 5, 29). The federation integration environment builds on and extends the successful work of the Utah Center for Clinical and Translational Science Biomedical Informatics Core, and leverages the computing capabilities and expertise of the Center for High Performance Computing. We are experienced with the transmittal and protection of personal health information.

Collaboration

Commitment to collaboration with other members of the PRISMS Program

Our center will not operate in isolation; it will be one component of the larger PRISMS program (Figure 5). We will engage PRISMS sensor development investigators, to determine how to collect the sensor data. We will work closely with the Data and Software Coordinating Center, to determine how to securely transmit data to them, and for distribution of the developed software. We will collaborate with other U54 informatics centers to determine the standards that will support this work. We plan to include each of these groups as part of the key stakeholders in our user-centered design process; and as professional colleagues in standards determinations. The Admin Core and administrative executive committee for our center will provide the central point of communications between our center and other members of the PRISMS program and we believe that leveraging the extraordinary informatics intellectual capital available at the University of Utah we will be able to provide informatics leadership to the entire PRISM program.

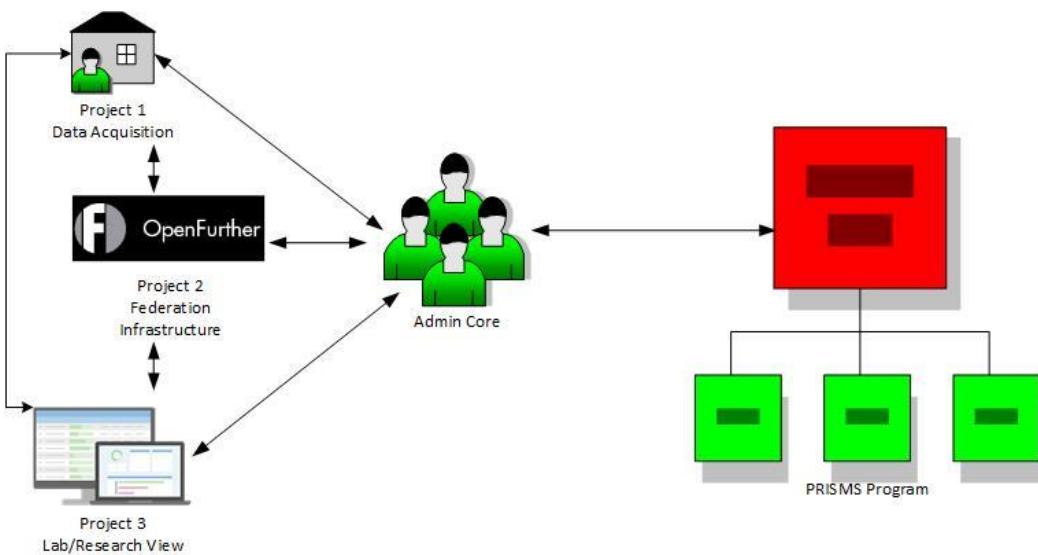


Figure 5. Collaboration within our center and with overall PRISMS Program

Collaboration within our Center

We are a highly collaborative multidisciplinary team. Key personnel interact closely on a daily basis. Personnel are physically located within walking distance of each other and there is easy access to meeting rooms, video and teleconferencing equipment, and organizational staff. Our departments have a long history of cooperation and many of the team members have adjunct appointments in at least one other relevant department, which facilitates inter-departmental cooperation. Our personalities are compatible and we are committed to, and enthusiastic about, the goals of the PRISMS program.

Although we have divided the platform into three projects, with different PDs for each, in reality the work will be accomplished in synchrony across the projects. Each project will draw on the expertise of all team members, to some extent. We have a robust set of subject matter experts that will augment expertise across projects. The overall center will be an engaged informatics research center that will have influence well beyond the three center projects; as a component of the overall PRISMS program and through the contributions to scientific knowledge important to the greater biomedical research community. The University of Utah has formal resource and rewards mechanisms that recognize the importance of team science both financially and in the tenure and promotion criteria, which greatly facilitate these type of collaborative projects. For instance Dr. David Pershing, the current president of the University, served as PI of one of the largest interdisciplinary simulation centers funded by the Department of Energy.

Strategy for Determining Projects

Our primary strategy for dividing the platform development among the proposed projects was based on the stakeholder groups. The purpose of this was to assist in keeping the project focus on the user's needs, goals, and values, as the usability and utility of the developed tools will be paramount to success of the overall PRISMS program. We then secondarily considered which team would lead the development of solutions this consolidation should make project management more efficient.

Limitations/Weakest Points of our Proposal

Identification of appropriate standards. The use of sensors and mobile apps is a relatively new approach. Established healthcare standards, such as HL7, may not be sufficient to represent the needs of the PRISMS platform. To mitigate this we will expand our evaluation to emerging healthcare standards such as FHIR (an HL7 initiative to support apps and web-based software), and other general industry and de-facto standards, such as the “lab of things” (<http://www.lab-of-things.com/>) platform from Microsoft Research. If no appropriate standard can be identified, we will identify the appropriate standards development organizations and work with those organizations to develop new standards or expand the existing standards. Dr. Facelli has experience in developing and utilizing standard data models for molecular simulations (36-38), an area in which also there were no standards available.

Scope. As we elucidate detail of requirements, goals, and workflows it may become apparent that the true scope of this platform may be greater than anticipated. No one center is likely to be able to address all the PRISMS program needs. To address scope changes, we will prioritize and categorize requirements, identifying those requirements that are essential for core functionality of the PRISMS platform and focusing initial efforts on those essential requirements. We will collaborate closely with other PRISMS sites and the PRISMS program steering committee; and re-focus goals and aims as agreed upon with them. It is likely that our program aims, goals, and milestones may be adjusted as the PRISMS program evolves. Our team is highly collaborative and committed to achieving the vision of the PRISMS program.

Please see the individual projects for the Protection of Human Subjects section related to the project.

Please see the individual projects for the Inclusion of Women and Minorities section related to the project.

Please see the individual projects for the Inclusion of Children section related to the project.

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May 21, 2015

Dr. William Heetderks
Acting Deputy Director and Associate Director of Extramural Sciences
Extramural Science Programs
National Institute of Biomedical Imaging and Bioengineering
BG 2DEM Rm 200 6707 Democracy Blvd
Bethesda MD 20817

Dear Dr. Heetderks:

I am writing to convey my enthusiastic support of Dr. Katherine Sward's proposed study titled: "PRISMS Informatics Platform – Federated Integration Architecture." Pediatric asthma is a serious and prevalent issue in the United States affecting more than 9% of children. The Centers for Disease Control and Prevention reported 1.8 million emergency room visits in 2011 with asthma as the primary diagnosis. Pediatric asthma is a complex health condition with numerous triggers resulting in a variety of symptoms. It is crucial that a reliable monitoring system be developed and used to provide optimal management of pediatric asthma and the best possible care for children with this chronic and sometime debilitating condition.

Dr. Sward's proposed informatics platform is an effective and unique approach to acquiring and integrating the high-resolution data from sensors, and integration of sensor data with clinical data. The identified outcomes and potential contributions of this proposal include a flexible, standards-based open source platform upon which future epidemiological studies can be built. In the broader context, Dr. Sward's proposed informatics center will become a key component of the new NIH PRISMS program that supports multi-center epidemiological studies of the effects of environmental, physiological, and behavioral factors on pediatric asthma and other illnesses, and as such will support knowledge discovery that is translatable to facilitate management and care for patients with other chronic diseases.

Dr. Sward is a tenured Associate Professor (100% FTE) in the College of Nursing engaged in research, teaching, and service activities. She is an emerging new investigator and we are committed to her development as a scientist. Dr. Sward has assembled an impressive team of experts for the conduct of this study and she and her team will have the full support of the College of Nursing and the considerable resources within our Emma Eccles Jones Research Center during the award period. These include: 1) private office space, 2) bio-specimens laboratory, 3) workspace for research assistants and graduate students, 4) project rooms, 5) office equipment, 6) computer and computer support, 7) clinical access to research participants and 8) grant, budget and statistical support staff. These resources are in addition to the substantial support provided by her colleagues in the Departments of Pediatrics, Biomedical Informatics and Electrical and Computer Engineering at the University of Utah, as well as the resources of the University's Center for High Performance Computing and the Biomedical Informatics Core.

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Dr. Swards' interprofessional work and program of research is informed by a vision and commitment to improving healthcare and supporting decision-making, through the application of informatics tools and methods. She is actively engaged in clinical informatics research, including longstanding service as informaticist for the Collaborative Pediatric Critical Care Research Network Data Coordinating Center. Given her clinical background as a nurse, and her extensive informatics background and experience, she understands the relevant technical and clinical scenarios, and is able to communicate effectively with all the stakeholders. Her interdisciplinary team includes nurse researchers, computer scientists/engineers, physicians, informaticists, environmental experts, and statisticians. Dr. Sward is the scientist ideally suited to lead this interprofessional team.

The College of Nursing fully supports this proposal and we are very confident that Dr. Sward will make significant contributions to the health and well-being of children with asthma as she continues her career as a nursing scientist.

Sincerely,



Patricia Goncze Morton, PhD, RN, FAAN
Dean and Professor
Louis H. Peery Endowed Chair
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Department of Medicinal Chemistry

CENTER FOR
HIGH PERFORMANCE COMPUTING
THE UNIVERSITY OF UTAH

Thomas E. Cheatham, III

May 25, 2015

Phone: (801) 587-9652
Fax: (801) 585-6208
tec3@utah.edu

Professors Kathy Sward and Julio C. Facelli
Department of Biomedical Informatics
University of Utah, Salt Lake City, UT. 84112

Dear Professors Sward and Facelli,

On behalf of the University of Utah's Center for High Performance Computing, I am writing to provide our research computing support for your pending NIH proposal, ***PRISMS Informatics Federated Integration Architecture Center***.

The Center for High Performance Computing (CHPC) provides access to large-scale compute systems, data resources, networking, and the expertise to optimize the use of these high-end technologies to support research at the University of Utah. Our goal is to enable academic disciplines where the computational requirements and needs likely exceed the resources available in individual colleges or departments. CHPC serves as an expert team, as part of the University Informational Technology services, to facilitate research computing for the campus. More information is available at: <http://www.chpc.utah.edu>.

Of particular relevance to this grant, CHPC operates high performance computing clusters including cluster with Hadoop capabilities and storage resources in both open and protected environments in a condominium style model in which you will be able to develop the software infrastructure that you are proposing. Additionally, if you decide to move the infrastructure to a production environment requiring additional resources we can accommodate these needs in our scalable infrastructure.

Please let me know if I can provide any further information in support of your research computing needs.

Sincerely,

A handwritten signature in black ink that reads "TEC".

Thomas E. Cheatham, III
Director, Center for High Performance Computing
Professor and Director of Graduate Studies, Department of Medicinal Chemistry
tec3@utah.edu

Department of Medicinal Chemistry
College of Pharmacy
L.S. Skaggs Pharmacy Research Institute
UNIVERSITY OF UTAH
30 South 2000 East, Skaggs 307, Office SRB 4914
Salt Lake City, Utah 84112-5820

Center for High Performance Computing
University Information Technology
UNIVERSITY OF UTAH
155 South 1432 East, INSCC 410
Salt Lake City, Utah 84112-0190

<http://www.chpc.utah.edu/~cheatham>



UNIVERSITY OF UTAH
SCHOOL OF MEDICINE

Department
of Pediatrics

Intermountain
Primary Children's Hospital

EDWARD B. CLARK, M.D.
Wilma T. Gibson Presidential Professor
Chairman, Department of Pediatrics
Chief Medical Officer, PCH

May 29, 2015

Dr. William Heetderks
Acting Deputy Director and Associate Director of Extramural Sciences
Extramural Science Programs
National Institute of Biomedical Imaging and Bioengineering
BG 2DEM Rm 200 6707 Democracy Blvd
Bethesda MD 20817

Dear Dr. Heetderks:

I am writing to convey my enthusiastic support of Dr. Katherine Sward and Dr. Julio Facelli's proposed study titled: "PRISMS Informatics Platform – Federated Integration Architecture." Pediatric asthma is a complex health condition that is affected by environmental exposures. It is crucial that a reliable monitoring system be developed and used to provide optimal management of pediatric asthma and the best possible care for children with this chronic and sometime debilitating condition. The proposed informatics platform developed by this center will be an effective and unique approach to acquiring and integrating the high-resolution data from sensors, and integration of sensor data with clinical data. The outcomes and potential contributions of this proposal include a flexible, standards-based open source platform upon which future epidemiological studies can be built. The platform will become a key component of the new NIH PRISMS program that supports multi-center epidemiological studies of the effects of environmental, physiological, and behavioral factors on pediatric asthma and other illnesses, and as such will support knowledge discovery that is translatable to facilitate management and care for patients with other chronic diseases.

This multi-disciplinary program of research is informed by a vision and commitment to improving healthcare and supporting decision-making, through the application of informatics tools and methods. The research aligns with the goals of the Department of Pediatrics and of the University's Program for Air Quality, Health, and Safety. The team includes nurse and physician researchers, clinicians, computer scientists/engineers, statisticians, biomedical informaticists, environmental and air quality experts, and experts in distributed computing and big data analytics.

I enthusiastically support this proposal and am confident that the team will make significant contributions to the health and well-being of children with asthma.

Sincerely,

A handwritten signature in blue ink that appears to read "Edward B. Clark".

Edward B. Clark, M.D.
Wilma T. Gibson Presidential Professor
Chair Department of Pediatrics
Chief Medical Officer Primary Children's Hospital

P.O. Box 581289
Salt Lake City, Utah 84158 (mailing)

295 Chipeta Way, 2S010
Salt Lake City, Utah 84108 (campus)
Phone: 801-587-7415
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Letters Of Support

Page 100



May 20, 2015

Katherine A. Sward, PhD, RN
Associate Professor, College of Nursing
Adjunct Associate Professor, Department of Biomedical Informatics
University of Utah
10S 2000 East
Salt Lake City, UT 84112

RE: Letter of Support—NIH NIBIB Funding Opportunity EB-15-003 Pediatric Research using Integrated Sensor Monitoring Systems (PRISMS): Informatics Platform Technologies for Asthma (U54)

Dear Kathy,

I'm pleased you are pursuing the NIBIB PRISMS Informatics funding opportunity. Having reviewed your project outline and participated in some of your proposal planning meetings, I am excited for the project you have planned and the excellent multidisciplinary team you have assembled. As an active member in the National Children's Study environmental monitoring team and the Co-I for two of the study's most successful study sites, I can tell you that the exposure science community clamored for the type of sensors, informatics and data center capabilities discussed in the PRISMS RFAs. Having worked with you and your teammates on sensor and informatics and data management relative to exposure estimation and health outcomes on a local level, I am enthusiastic about the innovation and success you can attain with appropriate funding and resources devoted to the task. Your devotion to multi-disciplinary science and research-to-practice are an ideal match for this project. I look forward to the scientific and practical results of these efforts.

Sincerely,

A handwritten signature in black ink that reads "Scott Collingwood".

Scott Collingwood, PhD
Director, Environmental Monitoring
Department of Pediatrics
University of Utah



Katherine Sward, PhD, RN
University of Utah
10 S 2000 East
Salt Lake City, UT 84112-5880

May 21, 2015

Dear Dr. Sward,

It is my pleasure to collaborate with you in “PRISMS Informatics Platform – Federated Integration Architecture.” I fully support this proposal and look forward to collaborating with your team. Pediatric asthma is a complex health problem associated with negative health outcomes and high health care costs. Advances in information and sensor technology have created unprecedented opportunity for gaining insight into the complex web of environmental, physiologic, social and behavioral factors that influence pediatric asthma. However, a robust informatics infrastructure must be created to effectively manage sensor data and integrate it with clinical data for scientific discovery. Further, the data, information, and knowledge must be structured in a way that facilitates large-scale translation of scientific insights.

My contributions to the PRISMS Informatics Platform will be a direct outgrowth of my research program, which focuses on informatics applications in poison control and emergency management of poison exposures. My interprofessional team is experienced in a variety of informatics methods and approaches, from workflow analysis to usability testing to software development and evaluation, as we seek to develop systems of information structure and management that are standards-based, open source, and support *both* individual patient care and population health. Our methods encompass both qualitative and quantitative approaches, which is characteristic of applied clinical informatics. Additionally, I contribute twelve years of experience in “big data” analytics to this study. I’m experienced in using data mining and machine learning methods with clinical data, and I actively mentor students in applying these methods.

The PRISMS Informatics Platform is both thoughtfully designed and critically important to realizing scientific discovery from sensor technology in pediatric asthma. The center will become a key component of the NIH PRISMS program that supports multi-center epidemiological studies of the effects of environmental, physiological, and behavioral factors on pediatric asthma and other illnesses, and as such will support knowledge discovery that is translatable to facilitate management and care for patients with other chronic diseases.

Sincerely,

A handwritten signature in black ink that reads "Mollie R. Cummins".

Mollie R. Cummins, PhD, RN, FAAN
Associate Professor, College of Nursing
Adjunct Associate Professor, Department of Biomedical Informatics
University of Utah

10 South 2000 East
Salt Lake City, Utah 84112-5880
Phone (801) 581-7728
Fax (801)581-4642



May 21, 2015

Dr. Katherine Sward
Associate Professor
University of Utah College of Nursing
10 S 2000 East
Salt Lake City UT 84112

Dear Dr. Sward:

I am writing to convey my enthusiastic support of your proposed study titled: "PRISMS Informatics Platform – Federated Integration Architecture." Pediatric asthma is a serious and prevalent issue in the United States and causes extensive burden to children and their families, including multiple emergency room visits and loss of time from school and work. Despite advances in treatment that have improved mortality, there is still considerable healthcare burden associated with pediatric asthma, and control of symptoms remains poor in many cases. Pediatric asthma is a complex health condition with numerous triggers. It is crucial that a reliable monitoring system be developed and used to provide optimal management of pediatric asthma and the best possible care for children with this chronic and sometime debilitating condition.

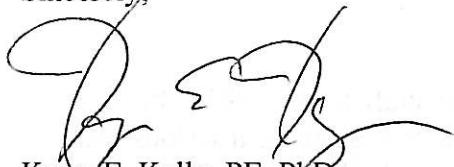
The proposed informatics platform is an effective and unique approach to acquiring and integrating the high-resolution data from sensors, and integration of sensor data with clinical data. The identified outcomes and potential contributions of this proposal include a flexible, standards-based open source platform upon which future epidemiological studies can be built. The proposed informatics center will become a key component of the new NIH PRISMS program that supports multi-center epidemiological studies of the effects of environmental, physiological, and behavioral factors on pediatric asthma and other illnesses, and as such will support knowledge discovery that is translatable to facilitate management and care for patients with other chronic diseases.

This proposal aligns closely the mission of the University of Utah's Program for Air Quality, Health and Society. Two-years ago, I co-founded the Program with a goal of bringing together researchers from across the university to understand and address local air quality challenges. The Program particularly focuses on facilitating collaborations between health sciences, and the colleges of engineering and science. The Wasatch Front, the home of the University of Utah, experiences periodic high-levels of fine particulate matter in the winter and ozone in the summer. As an example of the region's challenges, in 2013 Salt Lake County exceeded National Ambient Air Quality Standards on more than 30 days. This proposal is precisely the type of effort the Program envisions – bring together researchers from across the university to create an infrastructure that will support research to understand and address air quality. It is a collaboration between health sciences clinical and academic programs (medicine/pediatrics, nursing, biomedical informatics) and the colleges of engineering and science.

The proposal also aligns with my personal research vision to understand the contributions to and to mitigate the effects of fine PM levels along the Wasatch Front. I also serve as Vice-Chair of the State Air Quality Board, and this, along with my research, provides me with an excellent perspective on the quality and availability of existing air quality data, new research studies, and opportunities for leveraging data resources.

I fully support this proposal and am enthusiastic to be a part of the team of investigators. We are very confident our platform will be a key component of the PRISMS program, which will make significant contributions to the health and well being of children with asthma.

Sincerely,



Kerry E. Kelly, PE, PhD
Associate Director, Program for Air Quality, Health and Society
Assistant Professor, Chemical Engineering



May 21, 2015

Dr. Katherine Sward
Associate Professor
University of Utah College of Nursing
10 S 2000 East
Salt Lake City UT 84112

Dear Dr. Sward:

I am most enthusiastic to participate in your proposed study titled: “PRISMS Informatics Platform – Federated Integration Architecture.” Pediatric asthma is a chronic and often debilitating condition effecting nearly 9% of children in the United States. Triggers and symptoms are varied and complex making pediatric asthma difficult to treat efficiently and effectively. Your proposed study to address the critical need to develop a reliable monitoring system to be used in care of pediatric asthmatic patients is both timely and vital as the number of reported cases of asthma have been steadily increasing the United States since 1980.

The proposed informatics platform is an effective and unique approach to acquiring and integrating the high-resolution data from sensors, and integration of sensor data with clinical data. The identified outcomes and potential contributions of this proposal include a flexible, standards-based open source platform upon which future epidemiological studies can be built. The proposed informatics center will become a key component of the new NIH PRISMS program that supports multi-center epidemiological studies of the effects of environmental, physiological, and behavioral factors on pediatric asthma and other illnesses, and as such will support knowledge discovery that is translatable to facilitate management and care for patients with other chronic diseases.

As you know, I am research pharmacologist and “bench scientist” with more than 20 years of experience. My research has included studies of tobacco smoking and the immune system. I am well-positioned to assist you and your team with interpreting and integrating basic science research data into your platform.

I look forward to joining your team of investigators. Thank you for inviting me to be a part of your important study.

Sincerely,

A handwritten signature in blue ink that reads "Erin L. Meyer".

University of Utah
College of Nursing
10 South 2000 East
Salt Lake City, UT 84112-5880
801587-8553– Office
801-587-9838– Fax



Division of Inpatient Medicine

Christopher G. Maloney, M.D., Ph.D.
Division Chief and Professor

Mary Ann Rackham
Administrative Coordinator

Faculty:

Jennifer Brinton, M.D.
Frank Cipriano, M.D.
Eric Coon, M.D.
Joseph Cramer, MD
Ty Dickerson, M.D., M.P.H.
Bernhard Fassl, M.D.
Per Gesteland, M.D., M.S.
Tiffany Glasgow, M.D.
Brian Good, M.D.
Laura Nell Hodo, M.D., M.S.
Benjamin Kalm, M.D.
Irene Kocolas, M.D., M.S.
Christopher W. Miller, M.D.
Dominic Moore, M.D.
Kevin Nelson, M.D. PhD., M.S.
Flory Nkoy, M.D., M.S., M.P.H.
Research Director
Merium Saidi, M.D.
Raj Srivastava, M.D., M.P.H.
Adam Stevenson, M.D.
Bryan Stone, M.D., M.S.
Jeffrey Van Blarcom, M.D.
Elizabeth Vukin, M.D.
Victoria Wilkins, M.D.

Riverton Hospital Children's Unit:
Michelle Hofmann, M.D., M.P.H.
Medical Director
Scott Carleton, M.D.
Glen Huff, M.D.
Nicole Langston, M.D.
Lloyd Jensen, M.D.
Kristina McKinley, M.D.
Mary Shapiro, M.D.

Joint Faculty:

Sara Lamb, M.D.
Mary Joan Sheetz, M.D.

Pediatric Research Staff:
Eun Hea Kim
Heather Oldroyd
Clinical Research Coordinators

12 May 2015

Katherine Sward, PhD, RN
Associate Professor, College of Nursing
Adjunct Assistant Professor, Biomedical Informatics
University of Utah; Salt Lake City, Utah

Re: PRISMS Informatics Platform - Federated Integration Architecture (RFA-EB-15-003)

Dear Dr. Sward,

With support of Administration in the Department of Pediatrics and the Division of Inpatient Medicine at the University of Utah, I wish to confirm our collaborative interest in your proposed research project to develop the PRISMS platform including projects in 3 areas defined as integration of sensors in research, an informatics platform to facilitate research, and a data-coordinating center. The 3 projects include creation of a modular, secure, open standards platform for sensor data collection customizable to study requirements, a freely available open-source integrated tool set for flexible, replicable, and scalable infrastructure for conducting multi-center epidemiological research, and a data coordinating center to include a sensor data harmonization framework, state of the art modeling, and data integration and storage. The test case for this study will be environmental/clinical monitoring of children with asthma.

As a subject matter expert, my participation will be primarily in the areas of interface with patients/clinical research, and healthcare researcher interests. These areas of expertise lend themselves to the first and second projects. My training in clinical research and years of experience on the University of Utah IRB will serve me in helping to define the clinical test case, prepare for human subjects research, and interface with the research subjects. As a clinical researcher with interests in this area (clinical research involving sensors and diseases sensitive to environmental triggers), I can also contribute to the usability of both the patient-level interfaces and the researcher interface(s) in projects 1 and 2, and in helping to define data of interest for clinical research.

I am very excited about this project, as many children with asthma stand to benefit from a well-designed research and patient care platform that integrates data from environmental sensors, and clinical parameters to facilitate studies that have the potential of changing patient care. Please feel free to contact me for additional information if needed.

Sincerely,

A handwritten signature in black ink, appearing to read "Bryan L. Stone".

Bryan L. Stone, MD, MS; Associate Professor, Pediatrics

Division of Inpatient Medicine
100 Mario Capecchi Drive
Salt Lake City, Utah 84113
Phone (801) 662-3645
Fax (801) 662-3664

Located at
Intermountain
Primary Children's Hospital



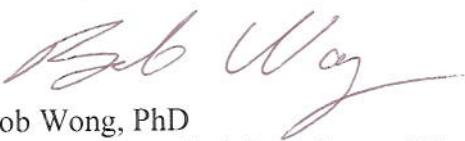
May 22, 2015

Dear Dr. Sward,

This letter is to officially and enthusiastically support your team's efforts in exploring The Pediatric Research using Integrated Sensor Monitoring Systems (PRISMS) program. This project, to develop pediatric sensor-based health monitoring systems, with an initial focus on pediatric asthma is incredibly innovative and will certainly expand the understanding of complex interactions between the person, environment, behavior, and physiological factors that influence health outcomes.

In my role as subject matter expert for data management, analytics and study design I will commit to helping all three projects. My experience as the Director of Statistics for the College of Nursing, for the past 7 years, will be valuable as my transdisciplinary approach to all things data will be essential for this U54 center project.

Sincerely yours,



Bob Wong, PhD
Director of Applied Statistics, and Research Associate Professor
College of Nursing
University of Utah

RESOURCE SHARING PLAN

Data Sharing

Our plan to share data and resource materials will adhere to all University of Utah policies and the NIH Grant Policy on Sharing of Unique Research Resources and the Sharing of Biomedical Research Resources Principles and Guidelines for Recipients of NIH Grants and Contracts issued in December, 1999 (http://www.ott.nih.gov/policy/rt_guide_final.html). Users must agree to conditions of use governing access to clinical data including: restrictions against attempting to identify study participants, tampering with the data, reporting responsibilities, restrictions on redistribution of the data to third parties, and proper acknowledgement of the data resource. Clinical information provided to users will not be used for commercial purposes, and will not be redistributed to third parties.

Data sharing is not expected to apply during center development, as no patient/participant data will be collected except for purposes of the design process and validation of the center. Once the center is actively supporting clinical studies, data sharing will be as per the policies of the PRISMS program and the PRISMS data coordinating center. All data and resources will be shared within the PRISMS program following the NIH and University of Utah policies.

Sharing Model Organisms : N/A

Genome Wide Association Studies (GWAS): N/A

Software Dissemination Plan

We will ensure that the technology (materials and data) remains widely available to the research community in accordance with the NIH Principles and Guidelines document. Our software platform will be built as an extension of the University of Utah's OpenFurther development. OpenFurther is built upon Maven, Spring, Hibernate, ServiceMix, and other open source frameworks that promote code reusability and interoperability. Like other OpenFurther projects, it will be a free open source project, with code stored on GitHub. PRISMS community members can request new features, report bugs, or fork the code and develop their own solutions.

OpenFurther was released Nov. 2013 as free and open source to the community under the Apache 2.0 license at github.com. The software can be modified, implemented and redistributed free of charge. In support of the platform the University of Utah Biomedical Informatics Core (BMIC) will continue to maintain code releases at github.com/openfurther, and release additional installation documentation at github.com/openfurther/further-open-doc/. Background information about the platform is published at the website openfurther.org. Current work and new information about updates will be updated at the website with corresponding releases of the software to the GitHub repository. As with existing components such as the MDR, VIRGO and QAF, the new developments created for the PRISMS center will made available as stand-alone products apart from being integral parts of OpenFurther. All software developed will be disseminated and released after evaluation following the timelines mentioned in Table 1.

The BMIC shares software information and development details with a hosted version of Atlassian's suite of development tools at openfurther.atlassian.net. These products include a wiki, issue tracker and build tool for community driven development and management of the project. Distribution of the software, community discussions and information sharing will be supported using google groups for up to date information for all aspects of the software. Additionally, the OpenFurther group actively participates in social media on Twitter to engage researchers and partners from other informatics domains.

The BMIC has also released the software as a demo virtual machine for researchers to explore for potential adoption. As part of the demonstration release the BMIC has produced and frequently provides informational webinars about the platform. Presentation slides and videos from the webinars will be released at

openfurther.org or openfurther.atlassian.net. Publications pertaining to the development and scientific research of the platform are listed at openfurther.org/publications/. In addition we plan to publish our development findings in various informatics and health information technology conferences and journals along with systems demonstration.

Publication and Intellectual Property

Data generated from this award will be published in scholarly journals. The authorship will be determined by the scientific and intellectual contributions of each investigator. Publications will be coordinated with the overall PRISMS program Steering Committee. We do not anticipate the generation of intellectual property that would potentially have significant financial value. However, if such intellectual property is developed through the award we will consult with our NIH program official and work with the University of Utah Technology Venture Development Office to define the ownership and to protect the intellectual property.

Table 1. Estimated Timeline for the proposed PRISMS Informatics Center.

	Year 1				Year 2				Year 3				Year 4			
	9/2015 - 9/2016				9/2016 - 9/2017				9/2017 - 9/2018				9/2018 - 9/2019			
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
PRISMS Program Establishment	X	X	X													
Admin Core SOPs, templates, procedures	X															
Publications/Dissemination					X	X			X	X			X	X		X
Project 1: Sensor and User Interface																
Initial Requirements identify/recruit participants	X	X	X	X												
Initial Requirements conduct focus groups and interviews		X	X	X	X											
Sensor data collection platform	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
Phone app designer	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
tailored user interfaces and information visualization methods					X	X	X		X	X	X	X		X		
evaluate project 1 system performance								X	X	X	X	X	X	X	X	X
Overall Center Platform End-to-EndEvaluation. ALL 3 PROJECTS													X	X	X	X
Project 2: OpenFurther																
Initial Requirements: Evaluate data from known sensors, air quality initiatives	X	X														
Initial Requirements: subject matter eXperts - heuristic review	X	X														
Logical data models	X	X	X	X												
Sensor Data Harmonization Framework			X	X	X	X										
Sensor - Environmental Mathematical Modeling	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Data Integration and Storage				X	X	X	X	X	X	X	X	X	X	X	X	X
Overall Center Platform End-to-EndEvaluation. ALL 3 PROJECTS													X	X	X	X
Project 3: Research Platform (Lab)																
Initial Requirements: all three projects	X	X	X	X												
identify/recruit participants	X	X	X	X												
conduct focus groups and interviews		X	X	X	X											
document requirements	X	X	X		X											
verify initial requirements	X	X	X		X											
Library of sensor metadata		X	X		X	X	X	X	X	X	X	X	X			
Research Analytics and Visualization	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
Overall Center Platform End-to-EndEvaluation. ALL 3 PROJECTS													X	X	X	X

APPLICATION FOR FEDERAL ASSISTANCE
SF 424 (R&R)

5. APPLICANT INFORMATION**Organizational DUNS*:** 009095365

Legal Name*: University of Utah
 Department:
 Division:
 Street1*: 75 South 2000 East
 Street2:
 City*: Salt Lake City
 County: Salt Lake
 State*: UT: Utah
 Province:
 Country*: USA: UNITED STATES
 ZIP / Postal Code*: 84112-8930

Person to be contacted on matters involving this application

Prefix:	First Name*:	Middle Name:	Last Name*:	Suffix:
	BRENDA		MALDONADO	

Position/Title: Sponsored Project Officer
 Street1*: 1471 EAST FEDERAL WAY
 Street2:
 City*: SALT LAKE CITY
 County: SALT LAKE
 State*: UT: Utah
 Province:
 Country*: USA: UNITED STATES
 ZIP / Postal Code*: 84112-8930

Phone Number*: 801-581-8019	Fax Number: 801-581-3007	Email: brenda.maldonado@osp.utah.edu
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7. TYPE OF APPLICANT*

H: Public/State Controlled Institution of Higher Education

Other (Specify):

Small Business Organization Type	<input type="radio"/> Women Owned	<input type="radio"/> Socially and Economically Disadvantaged
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11. DESCRIPTIVE TITLE OF APPLICANT'S PROJECT*

Prisms Informatics Platform - Federated Integration Architecture

12. PROPOSED PROJECT

Start Date*	Ending Date*
09/30/2015	09/29/2019

Project/Performance Site Location(s)

Project/Performance Site Primary Location

I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name: UNIVERSITY OF UTAH

Duns Number: 009095365

Street1*: 10 S 2000 E RM 4200

Street2:

City*: SALT LAKE CITY

County: SALT LAKE

State*: UT: Utah

Province:

Country*: USA: UNITED STATES

Zip / Postal Code*: 84112-5880

Project/Performance Site Congressional District*: UT-002

File Name

Additional Location(s)

RESEARCH & RELATED Other Project Information

1. Are Human Subjects Involved?* Yes No

1.a. If YES to Human Subjects

Is the Project Exempt from Federal regulations? Yes No

If YES, check appropriate exemption number: — 1 — 2 — 3 — 4 — 5 — 6

If NO, is the IRB review Pending? Yes No

IRB Approval Date:

Human Subject Assurance Number

2. Are Vertebrate Animals Used?* Yes No

2.a. If YES to Vertebrate Animals

Is the IACUC review Pending? Yes No

IACUC Approval Date:

Animal Welfare Assurance Number

3. Is proprietary/privileged information included in the application?* Yes No**4.a. Does this project have an actual or potential impact - positive or negative - on the environment?*** Yes No

4.b. If yes, please explain:

4.c. If this project has an actual or potential impact on the environment, has an exemption been authorized or an Yes No environmental assessment (EA) or environmental impact statement (EIS) been performed?

4.d. If yes, please explain:

5. Is the research performance site designated, or eligible to be designated, as a historic place?* Yes No

5.a. If yes, please explain:

6. Does this project involve activities outside the United States or partnership with international collaborators?* Yes No

6.a. If yes, identify countries:

6.b. Optional Explanation:

Filename

7. Project Summary/Abstract* Abstract_Filler1013416974.pdf**8. Project Narrative*****9. Bibliography & References Cited** References1013416626.pdf**10. Facilities & Other Resources** PRISMS_FACILITIES_AND_OTHER_RESOURCES1013416858.pdf**11. Equipment**

Please see the Abstract in the Overall component.

Facilities and Other Resources

University of Utah

The University of Utah (U of U) is ranked among the top 25 public research universities in the nation, according to the 2012 Top American Research Universities Report (mup.asu.edu/research.html). Among the nation's public research universities, the University of Utah ranks 29th in significant awards to faculty with \$450 million in research funding from all external sources in fiscal year 2010. The U of U is ranked first among all universities by the Association of University Technology Managers in the number of start-up companies created. Over 2,750 faculty members are involved in teaching, service, and research, reaching 31,000 students. The Health Sciences Center (UUHSC) campus is geographically located on the main campus and includes the College of Health, School of Medicine, College of Nursing, College of Pharmacy, and the Eccles Health Sciences Library.

The *mission* of the U of U is to serve the people of Utah and the world through the discovery, creation, and application of knowledge; through the dissemination of knowledge by teaching, publication, artistic presentation, and technology transfer; and through community engagement. As a preeminent research and teaching university with national and global reach, the University of Utah cultivates an academic environment in which the highest standards of intellectual integrity and scholarship are practiced. Students at the University learn from and collaborate with faculty who are at the forefront of their disciplines. The University faculty and staff are committed to helping students excel. We zealously preserve academic freedom, promote diversity and equal opportunity, and respect individual beliefs. We advance rigorous interdisciplinary inquiry, international involvement, and social responsibility.

University Of Utah Environment – Contribution to Success

The physical space and intellectual environment at University of Utah is exceptionally well suited to the performance of the informatics study. Health services research has been identified as a top priority for the University of Utah by the senior vice-president for health sciences and CEO of University Health Care. The Informatics programs are nationally and internationally recognized for contributions to clinical and public health information systems, computerized decision-making, evaluation of computer-aided patient care, high-performance computing, genetic epidemiology, informatics competencies, and translational genomics. Over 50 faculty members (regular and adjunct) are affiliated with the programs, many of them actively engaged in clinical informatics research. The Biomedical and Nursing Informatics programs are located in collaborative space on the fifth floor of the Eccles Health Sciences Education Building (HSEB). HSEB is a state-of-the-art, interdisciplinary, accessible five-story facility opened in 2005. The 60 student cubicles and 19 faculty offices of the Nursing and Biomedical Informatics programs are co-mingled, creating an interdisciplinary informatics center even though the two programs belong to different schools. The Informatics suite includes faculty and administrative office space, graduate student cubicles, formal conference rooms, and casual conference areas. The design and location of the physical space facilitates a high level of interdisciplinary intellectual engagement among faculty, staff, and graduate students.

Institutional Commitment and Support

Dr. Sward holds a full-time, 12-month appointment as a tenured associate professor. Approximately 50% of her time is devoted to research activities. The University of Utah has consistently protected 40-60% of Dr. Sward's time for research and scholarship.

- **Training:** The Office of Research provides extensive and free educational programming in the conduct of research, both pre-award and post-award. More than forty unique educational programs are offered each semester, with topics ranging from "Informed Consent" to "Data and Safety Monitoring." By working on teams with senior investigators like Professors Julio Facelli and Lee Ellington, Dr. Sward receives valuable informal training and mentoring in the conduct of research.
- **Mentoring:** Mentoring is a core mission of the University of Utah College of Nursing. Dr. Sward is formally mentored by senior investigator Lee Ellington through her participation in a College of Nursing pre-center research group focused on Communication, Decision Making, and Informatics.

The Women in Medicine group supports her leadership development within the School of Medicine, providing structured seminars and networking opportunities. By working on externally funded studies with senior investigators (Professors Julio Facelli and Lee Ellington), Dr. Sward receives valuable informal training and mentoring in the conduct of research. She also benefits from informal access to senior faculty members engaged in related research. Approximately 20 faculty members are actively engaged in clinical informatics research at the University of Utah. See Table 1 for a complete description of formal mentoring resources available to Dr. Sward. See Table 2 for a partial list of researchers engaged in complementary research.

Table 1. Mentoring Resources at the University of Utah

Resource	Description
Moving Along in Your Academic Career (MAAC) Group	College of Nursing mentoring program for tenure track faculty. Semi-structured monthly meetings.
Research Administration Training Series	Sponsors a wide range of free classes on research-related topics, including classes on grant-writing and a class on mentoring relationships. More than forty unique educational programs are offered each semester.
The Women in Medicine and Science Program of the School of Medicine	Offers an annual, full-day workshop on mentoring and several shorter programs during the year. These programs are open to anyone on campus on a space-available basis.
The Center for Teaching & Learning Excellence	Sponsors frequent short programs, more extensive courses, and printed/ on-line resources on a wide-range of teaching-related issues.
The Technology Assisted Curriculum (TAC) Center	Offers training workshops on various aspects of teaching with technology.
Human Resources' Training and Development	Offers short courses on basic skills in time management and personal productivity, presentation skills, stress mgmt, working with difficult people, etc.
The Associate Vice Presidents of Academic Affairs and Health Sciences	Co-sponsors an annual workshop on retention, promotion, and tenure procedures, with college-level break-out sessions each spring.
The Leadership Development Program	An eight-month program open to tenured/ tenure track faculty. The first semester provides participants with a broader understanding of the challenges facing the U of U and higher education generally. The second semester is devoted to personal career development and skill-building.

- Facilities and Administration Support:** The University of Utah has funded preliminary studies for Dr. Sward and provides ongoing research support at both the College of Nursing and university levels. At the College of Nursing level, a grants coordinator, three member statistical staff, and an informatics-related research affinity group provide support for grantsmanship and post-award grant management. Dr. Sward can also access a variety of research support services through the university-level research informatics core, including study design consultation, database design/maintenance, and statistical consultation. The Center for High Performance Computing (CHPC) configures servers and other computing resources for Dr. Sward and other faculty within a secure environment, designed specifically for working with identifiable patient information (see below for greater detail).

Computing resources and Office Space

Dr. Sward' Office Space: Dr. Sward' office is equipped with a workstation that features an Intel Core 2 Duo processor, 3.4Ghz, with 4GB RAM. The workstation is also equipped with a widescreen monitor and a

webcam with integrated microphone. Dr. Sward is also equipped with portable computing devices: a Macbook laptop computer, an iPad tablet, and a portable hard drive. Her software includes: Office 2010; a full suite of Java/Eclipse, Python, and web programming development environments; Visio, Enterprise Architect, Adobe Creative Suite, EndNote, Evernote, Box (cloud storage), Synology (cloud storage), Skype, SAS, SPSS, and other software that may be needed for this project.

In the Biomedical Informatics Building (421 Wakara) where Dr. Sward' office is located, wireless networking is supplemented by over 1,500 hardwired network connections. Dr. Sward' office has a hardwired network connection. At home or while traveling, Dr. Sward is able to remotely and securely access all files and materials stored on University of Utah servers using a VPN connection.

The U of U has a well-established computing network which also allows research teams to interconnect to laboratories and resources through a campus-wide network. A high-speed, fault-tolerant, fiber-optic/copper network is in place to permit access to internally sponsored databases, email, and worldwide data access. This network uses a multipoint Ethernet bus topology for network communications. It implements both IEEE 802.3 (standard Ethernet) and 802.11 (radio frequency) connectivity standards. Faculty investigators have powerful desktop computers and current licenses for many important software packages. The Information Technology Services department provides 24/7 support for users. Resident software on the CON network includes SPSS PC+, Sample Power and Precision, MS Office products, and internet access.

CHPC: The University of Utah provides a robust research IT infrastructure, including the University of Utah's **Center for High Performance Computing (CHPC)**. The CHPC is responsible for providing high-end computer services to advanced programs in computational sciences and simulations. For this proposed effort, CHPC resources will be utilized to host a server for development activities.

CHPC has core competencies in operating large scale computing resources, advanced networking, scientific computing and simulations, large databases, etc. The Center has several large computational clusters that are available to Dr. Sward. The Homer cluster environment provides computational and storage resources for research data that is protected and/or subject to regulatory access control such as HIPAA (see below for greater detail) or FERPA. This secure cluster has been approved for storing and processing clinical data by the University's Privacy Office.

CHPC routinely provides virtual machines, Web containers, and data base instantiation services in both the open and the HIPPA restricted environments for both faculty and trainees. Additional specialized servers are available for specific applications like large-scale statistics, molecular modeling, data mining, etc. CHPC is developing several cluster test beds on which to implement grid computing, and it is actively porting applications to the Globus environment. The University of Utah is a member of the Internet2 consortium and is connected to the backbone via multiple 10 Gigabit links, soon to be upgraded to 100 Gigabits. Its new data center in downtown Salt Lake City has access to 1.5 MW of power.

CHPC HIPAA controlled cluster

Physical infrastructure: The physical hardware resides in a datacenter with controlled room access. These hosts are racked in a locked cabinet and hosts have locked server bezels. Physical access to the data center is reviewed biannually and documented on an access-controlled departmental wiki. Backups are restricted to one specific backup server on one particular port. Backup data traffic is automatically encrypted (BLOWFISH) at the client side before traversing the network. Backup media are stored in locked cabinets in the access-restricted data center. All CHPC staff who interact with the protected environment (PE) take the University's HIPAA training courses, and many have completed the well-known CITI human subjects research training.⁷

HPC analytic environment: This space is for computationally intensive needs such as data mining, machine learning, natural language processing, statistics, and other operations across large datasets. This requires large (and secure) storage, high network-bandwidth capacity, and high performance compute clusters. For access to the environment, we chose a double authentication mechanism. The first level of authentication uses the campus VPN, and only pre-approved users may log into the VPN pool of IP addresses for the PE.

The second authentication level requires users to be listed in the CHPC Network Information Service (NIS) directory server in order to interact with the PE.

Access to the compute clusters is provided via front-end login servers. The login servers are restricted by router Access Control Lists to Remote Desktop Protocol for Windows hosts and Secure Shell for the Linux hosts. Public key, host, or RHOSTS based authentication are not allowed. The login servers also employ firewall services to limit access to VPN addresses.

All interactions between the login servers and the cluster file server, batch controller, and computing nodes takes place on an isolated back-end, high-speed Infiniband network. All Linux hosts in the cluster are automatically updated monthly basis using the Redhat Network update service, while the Windows hosts are updated using Microsoft update and use anti-virus software.

Virtual machine implementation: The VM environment is for scientists who need lightweight computing services that do not justify the expense or capabilities of a dedicated server. The VM Cluster consists of four servers (two VMware ESXs, one Windows, one Red Hat Linux) and a disk tray. One Windows server, runs VMware vCenter Server that coordinates the load-balancing and failover functions of the two ESX servers. This server does not process any protected data. One Red Hat Linux server acts as an administrative access point and it too does not process any protected data. The two VMware servers host the actual guest VMs. These servers *do* process protected data but do not store it internally (i.e., all transactions are RAM-based). The disk tray provides shared storage to the two VMware servers. These disks store the actual VMs, and thus all sensitive data in those VMs. We require all VMs to encrypt their disk. The VMs and applications are regularly scanned by the University ISO.

Administrative procedures: In order for a user to access the PE they must meet all the following requirements:

- Have an active account in the University of Utah's Kerberos authentication system, using the University's standard procedures (e.g., faculty and students are automatically added to Kerberos). This can be extended to external collaborators as well;
- Have an active CHPC departmental account, where sponsorship and approval of a Principal Investigator (PI) is required;
- Have an active CHPC account created in the Protective Environment's NIS (network information service) and be a member of the 'NIS group' that is listed in a security access configuration file. This requires verification and completion of the University's HIPAA privacy and security training courses.
- Be added to the HIPAA Virtual Private Network (VPN) pool, and use this VPN encrypted tunnel to access designated login nodes.

Permission to use a given dataset is governed by the approval of the University's Institutional Review Board (IRB). If the IRB approves a project that uses a PHI dataset, the researcher is given an IRB number, which is then shared with the CHPC. The researcher lists the users who will be permitted to access the data. That list is independently verified with the IRB and it forms the basis of the UNIX group defined for the project. At this point, the data may be transferred to CHPC and only the NIS group will have access to it.

Logical access is monitored by SYSLOG, a standard Linux logging solution, and PSACCT, a process monitoring utility. Logs are kept both locally and on a remote SYSLOG server, and they are routinely reviewed. Logs on the SYSLOG server are currently kept indefinitely. Log "watch reports" are emailed daily to designated administrator accounts. These daily log watch reports show the last 24 hours of accounts and IP addresses logging in, and importantly, those that fail to log in. Firewall configuration prevents 'brute force' login attempts. Access to view or manipulate other users/groups data is enforced using UNIX file and directory permission(s).

When an account is locked or disabled at the level of the campus, the VPN, or the local department, login to the PE is prevented. Account IRB authorization is periodically reviewed; e.g., each user's IRB status is periodically verified (scheduled biannually). IRB projects are the authoritative source for who has access to HIPAA data. If a person is not listed on an approved IRB project, then they are not allowed in the UNIX group

for access to that project's data. We are working on an automated Web service between the University's electronic IRB system and the CHPC with the aim of real time authorization.

Center for Clinical and Translational Science

The University of Utah Center for Clinical and Translational Science (CCTS), formerly the General Clinical Research Center (GCRC), has been continuously funded since 1986 by the NIH National Center for Research Resources (Public Health Services Research grant no. M01-RR00064). Dr. Dr. Carrie Byington is the Principal Investigator for the CCTS and the Program Director. The CCTS provides investigators with the resources to conduct patient-oriented studies. The CCTS offers an optimal setting for clinical research, hosting investigators funded by NIH, CDC, and other federal, state, or local agencies, and by the private sector. The CCTS is also available for investigators to perform pilot studies that may result in future funding. The Center is equipped with multiple resources to assist investigators with their research including inpatient and outpatient facilities, nursing support, dietary assistance, core laboratory facilities, biostatistical and computer systems support, as well as training in clinical research, clinical trials design, ethics, and related methodologies for medical professionals. In addition, the CCTS awards seed funding for new research.

The CCTS serves as an academic home for clinical and translational research in Utah. The CCTS partners including the University of Utah, Intermountain Healthcare, and the Utah Department of Health develop and support translational research that improves the health of the community and trains a new generation of investigators. The CCTS and its partners increase the visibility, volume, and quality of participatory research by connecting investigators at the University with other health care institutions, clinical practitioners, public health personnel, patients, and research participants. The CCTS also links research activities across systems that together provide health care coverage to ~80 percent of Utah's population (<http://www.ccts.utah.edu/>). The CCTS builds on the University's strengths in genetics and bioinformatics to translate promising bench science into practices that improve human health. The Center serves as an academic home for clinical and translational research, developing innovative health services for the community and health researchers, and training a new generation of clinical and translational investigators. The Center and its partners will increase the visibility, volume, and quality of participatory research by connecting investigators at the University with other health care institutions, clinical practitioners, public health personnel, patients, and research participants. The Center also will formally link research activities across systems that together provide health care coverage to 80 percent of Utah's population as well as patients in surrounding states.

CCTS CORE SERVICES:

- **CCTS Bioinformatics Core (BMIC)** provides information technology support to clinical and translational researchers through a variety of means, including Education, Innovation and Service. **The BMIC is directed by Dr. Julio Facelli, one of the PIs for this proposal.** Dr. Facelli also, until very recently, served as the director of the Center for High Performance Computing.

The Education component of the BMIC uses a mix of formal courses and informal approaches to education in biomedical informatics and clinical research informatics for translational research. The formal approach includes course work, lectures and seminars from the University of Utah's Department of Biomedical Informatics and the CCTS Masters of Science for Clinical Investigation (MSCI) program. Informal training and presentations are always available upon request from research groups, divisions and departments.

The Innovation component of the BMIC aims to provide universal access to data from our partner institutions (Intermountain Healthcare, Veteran's Administration Medical Center and the Utah Department of Health) through the use of open source tools and applications and customized development when required.

The Service component of the BMIC works across all CCTS cores to provide resources and services for the planning and implementation of translational research. This service focuses on a defined set of applications which are applied across multiple domains to more effectively support researchers.

- **CCTS Study Design and Biostatistics Center (SDBC)** is directed by Tom Greene, Ph.D. and currently employs 37 statisticians, epidemiologists and quantitative health scientists, including 24 at the PhD/MD level. The SDBC mission is to promote high quality research at the University of Utah by 1) providing general and specialized study design and analysis collaborations, 2) developing novel methods and software for advancing clinical/translational research, and 3) providing statistical and epidemiologic education to University researchers. The SDBC promotes development and growth of the research structure within the University of Utah by providing enhanced biostatistical collaboration, study design and analysis support, and biostatistical education to University researchers. It integrates existing biostatistical resources, including specialized biostatistical expertise at University Departments, into a core that provides researchers with access to both general study support and expertise specialized to specific research areas. It enhances collaboration between biostatisticians/epidemiologists within the University research community, as well as between researchers and the community across all steps of the research process. This collaboration fosters development of novel biostatistical methods, tools, and software applicable to clinical and translational research.

The SDBC specializes in a wide variety of methods including clinical trial and observational study design, survey design and questionnaire development, item response theory and computer adaptive testing, statistical genetics and genomics, longitudinal analysis, linear and nonlinear mixed models, survival analysis, multivariate methods, modern causal inference, methods for patient-centered research, Bayesian modeling, computational statistics, cost effectiveness analysis, and diagnostic testing. The SDBC collaborates on more than 500 projects with over 300 investigators each year, with biomedical focus areas including cancer, internal medicine, pediatrics, orthopedics, OBGYN, surgery, ophthalmology and biomedical informatics.

The biostatisticians of the SDBC work with investigators to clarify research hypotheses and study aims, assist in the selection of the most appropriate study design and outcome measurements, complete sample size/power calculations to evaluate tradeoffs among sample size, power, and the minimum detectable treatment effects, and advice regarding data collection methods. The SDBC also conducts statistical analyses on existing data sets, guide clinical and translational researchers who wish to carry out their own statistical analyses, interpret results of data analyses, and collaborate in writing statistical aspects of manuscripts.

- **CCTS Participant Recruitment, Retention, and Safety Core (RRS)** will support and engage research participants from recruitment, through participation, to post-participation. With the specific aim of creating a system wide approach to facilitate research volunteer recruitment. This core is charged with strengthening collaboration with participants to be more efficient, effective, and safer. By developing innovative information and engagement strategies for post-participation the RRS will enhance satisfaction of research volunteers.

The RRS is responsible for facing the challenge of adequate recruitment and retention of research participants. While furthering the development of our Participant Advocacy Program the RRS will help recruit specific population groups including minorities, low-income, and the elderly who are sometimes under-represented in the research process. The Participant Advocacy Program is also responsible for community outreach, attending various conferences and events throughout the year.

The Research Participant Advocacy Program maintains active consultation with research volunteers on the in-patient core. These meetings improve the participant experience by addressing questions and concerns and by recording reoccurring themes to improve the conduct of clinical research. This is aided by the enhancement of the Spanish Translation Services that rewrites important documents for Spanish-speaking participants.

The RRS will develop expectations and supporting tools for investigators to inform participants about the outcome of studies in which they participated. In addition, the RRS implements a post-participation survey to assess satisfaction, and suggestions regarding volunteer experience with clinical research.

- **CCTS Clinical Services Core (CSC)** is a dedicated facility for patient-oriented research, located on the fifth floor of the University of Utah Hospital. Our reputation for excellence in clinical research began here as the University of Utah General Clinical Research Center or GCRC, an academic home for “first in human” research performance that has been generously supported by the National Institutes of Health and the University of Utah since 1964. The CSC provides physical space and expert nursing support for both inpatient and ambulatory human subject research.

The fifth floor unit contains 14 participant bed and evaluation rooms, as well as dedicated space for endoscopy, procedures, sample processing, electrodiagnostic and body composition studies. A staff of 11 research nurses with specialized training, a dedicated nutritionist and research pharmacy staff facilitate research protocols that range from simple outpatient encounters to intensive studies requiring invasive procedures and multiple day hospital admission. Research nurses also provide research support to studies carried out elsewhere in the University Hospital and Primary Children’s Medical Center. Protocols are primarily initiated by the Investigator, and receive funding from the National Institutes of Health, research foundations, industry and University departments. The CSC works closely with other resources of the Center for Clinical and Translational Services to support the full range of translational research, personalized health care initiatives, community-based and preventative medicine.

- **CCTS Research Education, Training and Career Development Core** supports the Masters of Science in Clinical Investigation (MSCI) and the KL2 Scholars program. The Core is designed to enhance the development of future faculty members and to reengineer the training of future investigators in each step of clinical research, from the laboratory bench or basic population science research to the bedside and finally to practice in the community. The Core brings together faculty and trainees from basic science and clinical departments, the graduate and medical schools, academia, health care delivery, and the biopharmaceutical industry. The MSCI is a training program targeted specifically to physicians to provide mentorship and didactic coursework necessary to guide their development as clinical investigators. The Program trains fellows and junior faculty over two years in core health services research skills. Recent workshops include Decision Analysis, Survival Analysis, and Propensity Scores.
- **CCTS Community Outreach and Collaboration Core** serves as an academic home for clinical and translational research, developing innovative health services for the community and health researchers, and training a new generation of clinical and translational investigators.

Mission:

To support CCTS researchers and community leaders in becoming full partners in research projects that address researchers’ interests and priority communities’ health needs.

Objectives:

Promote, implement and support community-engaged translational and implementation science research, projects and scholarship by:

1. Building the long-term, trust-based community partnerships that are needed to expeditiously and effectively conduct community-engaged translational and implementation science research
2. Preparing community leaders and researchers to be full collaborators in research projects
3. Working with researchers and communities to increase the number of CCTS-associated research projects that focus on community-engaged research or include this as a substantial component
4. Providing a consultation service to researchers for proposal development and conducting research studies

- **CCTS Patient Centered Research Methods Core** was developed to meet the growing demand for research with focus on patient centered research methods (pragmatic trials, patient centered outcomes, patient reported outcomes measures, and comparative effectiveness research).

Our team is poised to work with National Center for Advancing Translational Sciences and the Patient Centered Outcomes Research Institute (**PCORI**) in advancing patient centered research methods. Our aims are to:

1. Provide members of the CCTS consultation and education in Patient Centered Research
2. Do so in a cost effective and cost efficient manner
3. Track and evaluate usage of the core and success of its users' outcomes

Advancing Methods for PCRM: We have been and will now increase our focus on the advancement in methods (i.e., pragmatic trials, clinical effectiveness, and mixed methods studies) and evolving expectations of patient centered outcomes and comparative effective research via targeted training, professional certification, and active engagement of trained *patient* representatives. To accomplish this aim, members of the PCRM Core are, and have been, represented on many different groups working in this area across the local, regional and national levels as well as with professional organizations, such as Academy Health.

Translating and Disseminating: The Core, with its wide reaching network of colleagues, professional, and academic organizations, is a natural source to disseminate research results. Active engagement of these stakeholders insures integrated research translation efforts. We also support targeted dissemination activities. The Core has assumed responsibility for organizing and hosting the annual Utah Health Services Conference, held in the early spring of each year (now in its 8th year). This conference provides the local academic and medical community information on the current efforts of health services researchers in the state of Utah.

- The Translational Technologies and Resources Core (TTR Core) Laboratory of the Center for Clinical and Translational Science (CCTS) provides specialized laboratory support for investigators with CCTS approved research protocols. Our primary mission is to provide technologies and instrumentation that are difficult to justify for individual research laboratories.

Our services are currently focused on the following:

1. DNA Extraction and Archiving
2. Establishment of EBV-transformed Cell Lines
3. Plasma or Serum Separation from peripheral blood

Other Core Shared Facilities

Eccles Health Science Library: The Eccles Health Sciences Library, is the Intermountain Regional Medical Library for the National Library of Medicine's National Network of Libraries of Medicine. All holdings are accessible by computer search on-site or online. This library will provide collections and information retrieval services related to poison control centers, toxicology, emergency department workflow, and other health care related topics.

Marriott Library: The Marriott Library will provide collections and information retrieval services related to information technology, processes, and other relevant topics that are not uniquely related to health care. The Marriott Library holds over 3 million volumes and hosts more than 100 unique digital collections containing 8 million photographs, maps, books, audio recordings, newspaper articles, and other items. In 2009, the Marriott Library completed a four-year, \$79 million renovation project to improve seismic stability, to create new spaces and services that meet the needs of modern students, and to manage collections and technology more effectively. The renovated building now encompasses over 516,000 square feet.

Hope Fox Eccles Clinical Library: The Hope Fox Eccles Clinical Library (<http://library.med.utah.edu/clinlibl>) offers "clinical tools for point of care" through on-line links to articles or literature; clinical guidelines, trials and calculators; coding; diagnosis and differential diagnosis; drug tools; evidence based practice; eBooks; lab resources including local labs such as ARUP; patient education; and policy and practice. The library also offers workshops in topics ranging from EndNote to Photoshop and others,

video services, and USpace, an institutional repository for scholarly works. The library encourages faculty to publish actively in Open Access journals and offers training on these options. Articles published in Open Access peer-reviewed journals are often freely accessible via the Internet. By removing financial and licensing barriers, Open Access journals further the progress of science by making new findings ubiquitously available and facilitating knowledge transfer from published research to evidence-based practice.

Biomedical Research Informatics Resources: Under the director of The Associate Vice-President for Health Sciences Center Information Technology, the Biomedical Research Informatics Service Core (BRISC) provides coordination and direction for the information technology resources for the health science academic mission in collaboration with the clinical and University information technology services. The BRISC provides fee for service IT/informatics support to researchers and access to key Health Sciences information technology resources. The following is a list of services BRISC provides:

Subsidized Service/Support:

- REDCap/REDCap Survey introduction and training
- Basic survey introduction and training
- Design/conceptualization support for grants and abstracts
- Data management consulting
- Statistical consulting (2 hours)
- Clinical study design (2 hours)
- IT Project Coordination consulting (2 hours)
- Data storage

Recharge Services:

- Custom Programming
 - Database
 - Web
- Statistical analyses
- Business intelligence data extraction
- Custom database modeling/design
- Manuscript preparation
- Multi-center clinical trials support

The University of Utah Health Sciences

The University of Utah Health Sciences (UUHS) anchors allied health science graduate schools including the College of Nursing, the College of Health Sciences, and the College of Pharmacy. In addition to education and the multitude of avenues and services that UUHS provides, faculty and staff conduct, collaborate, and initiate research aimed at advancing knowledge through innovative basic and clinical science that translate discoveries into applications that improve health. The University of Utah is ranked among the top 30 public research universities in the nation with particular distinctions in medicine and genetics. As a result of benchmarking research, in 2009, the University received over \$309 million in funding and ranked 15th in the nation for significant awards to faculty for research efforts. Buildings adjacent to the University Hospital and PCMC include the Eccles Institute of Human Genetics, the Nora Eccles Harrison Cardiovascular Research and Training Institute, the Wintrobe Research Building, the Moran Eye Institute, the Biopolymers Institute, the Animal Care facility, the State Department of Health Laboratory, and the Huntsman Cancer Institute. The proximity of PCMC to UUHS enables Departmental faculty to maintain productive collaborative relationships with investigators in several other key University departments and programs. University of Utah faculty members provide physician services to PCMC, including all pediatric cardiology, intensive care, and cardiothoracic surgery services. Research is a dedicated enterprise and supported by Intermountain Healthcare, PCMC, and the University of Utah. The well-established and ongoing collaboration between these two large institutions, both founding partners of the Utah Center for Clinical and Translational Science, facilitates multidisciplinary research interactions and optimizes recruitment for pediatric studies.

The University of Utah, College of Nursing (CoN) was founded in 1941 and achieved college status in 1948. The College completed a \$24 million dollar building renovation in August, 2010, including developing a \$6 million dollar simulation center and a \$2 million renovation to the research center. The CoN has seven endowed chairs, an active and extensive faculty practice, strong researchers, and VA Nursing Academy affiliation.

The Emma Eccles Jones Research Center (EEJRC), located on the 5th floor of the CoN supports the research, training, and practice grant projects in the College. The EEJRC was established in 2006 with a gift from the Emma Eccles Jones Foundation and expanded twofold with a gift in 2010. The Research Center now encompasses the entire 20,000 square feet of the 5th floor, and contains 42 private offices and 28 workstations for research assistants. Double locked shared file rooms, four small research project rooms, four conference rooms, and a qualitative lab are available in the Center. Research rooms, conference rooms and labs are all equipped with state-of-the art technology and distance conferencing technology, facilitating the interdisciplinary work of researchers.

EEJRC also houses a 220 sqft biospecimens processing and storage facility. This laboratory is equipped with a reagent and samples refrigerator, an Eppendorf refrigerated centrifuge, and a Thermo Scientific -80°C specimen freezer for long-term storage of tissue samples. The long-term storage freezer is key locked, connected to generator power, and has a 24 hour alarm system for optimal sample protection. The facility is available for principal investigators with IRB approved studies that include the collection of human samples (i.e. vaginal fluid, blood, saliva, soft tissues, hair, etc.), and allows the PI to appropriately process and store those specimens in accordance with pre-established lab protocols, until the time of assay. The lab is locked with monitored access via authorized electronic entry.

Within the EEJRC, researchers are co-located by research focus/area of interest. A Women's Health Research Affinity Group, Core Facilities, Oncology researchers, and the Hartford Center of Geriatric Nursing Excellence, are aggregated in quadrants of the Center. The Statistical Core is comprised of Director of Applied Statistics (Dr. Bob Wong), two master's-prepared Senior Research Analysts, two senior faculty statisticians including the Senior Strategic Statistician (Dr. Donaldson), and research assistants. The Grants Management Core is comprised of the Director of Research, a research assistant, and 4 full time administrative staff who assist with the preparation of research and training grants, and post-award management including reporting. The Administrative Assistant to the Associate Dean for Research and PhD program, a Research Assistant-at-large, and a Work Study student also support research activities such as data entry, literature searches, and article retrieval.

The Research Innovation Teams (RITe) are a CoN initiative to develop synergistic team science leading to formal research centers, provide research mentorship to faculty and trainees, and increase funded research. Responses to a request for applications including proposed theme, membership, and first year plans received competitive internal and external review. Beginning summer, 2012, four RITes were implemented with release time, seed funding, statistical and staff support, and designated workspace. Beginning Summer 2013, an additional RITe will have a maternal-newborn research focus.

REDCap: The home-base for data management will occur at the University of Utah's Emma Eccles Jones Nursing Research Center. Research Electronic Data Capture (REDCap) will be used for data collection and rely on a thorough study-specific data dictionary defined in an iterative self-documenting process by all members of the research team. REDCap supports the rapid setup of secure, Web-based study-specific database systems and associated forms. It includes a complete suite of features to support HIPAA compliance, including a full audit trail, user-based privileges, and integration with the university wide LDAP (authentication) server. REDCap is flexible enough to be used for a variety of types of research. It provides an intuitive interface for users to enter data, and it has real-time validation rules (with automated data type and range checks) at the time of entry. These systems offer easy data manipulation with audit trails and reporting for monitoring and querying patient records as well as an automated export mechanism to common statistical packages (e.g., SPSS, SAS, Stata, R/S-Plus). A feature of REDCap that is critical for this project is the ability to conduct and manage surveys, chart abstraction data and interface with software used to code digital iterations, thus housing all data for statistical analysis in one secure web-based accessible database.

The University of Utah School of Medicine has three major missions: education, research, and clinical service. The School's mission is "guided by the imperatives of affirmative action and by the needs of the surrounding states, which lack their own medical schools" and that it "emphasizes high quality programs that address national priorities, such as the need for generalist and academic physicians, rural practitioners, basic biomedical scientists, and selected medical subspecialists." Currently, the School of Medicine has approximately 400 medical students and offers residency and fellowship training to over 500 residents and fellows representing all major specialty and sub-specialty areas. The School is comprised of 22 departments (16 clinical and 6 basic science) with over 500 full-time faculty members. It educates 80-85 medical students per class and supports ACGME-accredited residency training programs in medicine, pediatrics, family medicine, neurology, psychiatry, physical medicine and rehabilitation, pathology, radiology, general surgery, and all surgical subspecialties. Increasing numbers of University of Utah students have chosen pediatrics for post-graduate education.

University Utah Department of Engineering and School of Computing encompasses extensive expertise and software development capabilities. The School has received numerous awards and recognitions; including their top-ranked Entertainment Arts and Engineering (EAE) program. The University of Utah's School of Computing, founded in 1965, has a long and distinguished record of high impact research. This started with pioneering work in computer graphics, computer architecture, and digital audio, plus being the fourth node on the ARPAnet, the predecessor of today's Internet. Current work include both classical computer science and a number of activities that lie between traditional areas and traditional disciplines. The school is conducting research on cybersecurity, next-generation computing, other cutting edge topics. The School of Computing has been the epicenter of cloud computing research and continues to be a leader in developing infrastructure to enable diverse applications of cloud technology; The school is building a new state-of-the-art facility for researchers studying cloud computing. The school is the home of the Scientific Computing and Imaging institute (SCI), an internationally-recognized center for visualization and scientific computing.

University of Utah Health Care is the Intermountain West's only academic health care system, combining excellence in patient care, the latest in medical research, and teaching to provide leading-edge medicine in a caring and personal setting. The system provides care for Utahan's and residents of five surrounding states in a referral area encompassing more than 10 percent of the continental United States.

As part of that system, University Health Care relies on more than 1,200 board-certified physicians who staff four University hospitals (University Hospital, Huntsman Cancer Hospital, University Orthopedic Center, and the University Neuropsychiatric Institute); **10 Community Health Clinics**; and several specialty centers including the John A. Moran Eye Center, the Cardiovascular Center, the Clinical Neurosciences Center, and the **Utah Diabetes Center**.

The Department of Pediatrics faculty provide clinical inpatient and outpatient services at the Primary Children's Hospital, located on the same campus as the University Hospital and Clinics and physically connected to the University hospital via enclosed walkways. The 289-bed hospital cares for children with complex illness and injury from across the western United States and is the only Level I Pediatric Trauma Center serving the Intermountain region. The hospital is part of Intermountain Healthcare, a non-profit healthcare system, and is the pediatric teaching hospital for the University of Utah School of Medicine.

RESEARCH & RELATED Senior/Key Person Profile (Expanded)

PROFILE - Project Director/Principal Investigator			
Prefix: Dr.	First Name*: KATHERINE	Middle Name A	Last Name*: SWARD
Suffix:			
Position/Title*:	Assistant Professor		
Organization Name*:	University of Utah		
Department:	COLLEGE OF NURSING		
Division:	COLLEGE OF NURSING		
Street1*:	10 S 2000 E RM 4200		
Street2:			
City*:	SALT LAKE CITY		
County:	SALT LAKE		
State*:	UT: Utah		
Province:			
Country*:	USA: UNITED STATES		
Zip / Postal Code*:	84112-5880		
Phone Number*:	801/585-1481	Fax Number:	E-Mail*: kathy.sward@nurs.utah.edu
Credential, e.g., agency login: KATHYSWARD			
Project Role*:	Other (Specify)	Other Project Role Category: Core Lead	
Degree Type:	Degree Year:		
	File Name		
Attach Biographical Sketch*:			
Attach Current & Pending Support:			

PROFILE - Senior/Key Person			
Prefix: Dr.	First Name*: JULIO	Middle Name CESAR	Last Name*: FACELLI
Suffix:			
Position/Title*:	Professor		
Organization Name*:	University of Utah		
Department:	BIOMEDICAL INFORMATICS		
Division:	SCHOOL OF MEDICINE		
Street1*:	421 S. Wakara Way		
Street2:	Suite 140		
City*:	SALT LAKE CITY		
County:	SALT LAKE		
State*:	UT: Utah		
Province:			
Country*:	USA: UNITED STATES		
Zip / Postal Code*:	841083514		
Phone Number*:	801/585-3791	Fax Number:	E-Mail*: julio.facelli@utah.edu
Credential, e.g., agency login: JULIOFACELLI			
Project Role*:	Other (Specify)	Other Project Role Category: Core Lead	
Degree Type:	PhD	Degree Year: 1981	
	File Name		
Attach Biographical Sketch*:	Facelli1013343166.pdf		
Attach Current & Pending Support:			

RESEARCH & RELATED BUDGET - SECTION A & B, BUDGET PERIOD 1

ORGANIZATIONAL DUNS*: 009095365

Budget Type*: ● Project ○ Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2015**End Date***: 09-29-2016**Budget Period:** 1

A. Senior/Key Person												
Prefix	First Name*	Middle Name	Last Name*	Suffix	Project Role*	Base	Calendar	Academic	Summer	Requested	Fringe	Funds Requested (\$)*
						Salary (\$)	Months	Months	Months	Salary (\$)*	Benefits (\$)*	
1. Dr.	KATHERINE	A	SWARD		Core Lead	102,000.00	3			25,500.00	9,435.00	34,935.00
2. Dr.	JULIO	CESAR	FACELLI		Core Lead	183,300.00	2.4			36,660.00	13,564.00	50,224.00

Total Funds Requested for all Senior Key Persons in the attached file

Additional Senior Key Persons:	File Name:	Total Senior/Key Person	85,159.00
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B. Other Personnel

Number of Personnel*	Project Role*	Calendar	Months	Academic	Months	Summer	Months	Requested Salary (\$)*	Fringe Benefits*	Funds Requested (\$)*
	Post Doctoral Associates									
	Graduate Students									
	Undergraduate Students									
	Secretarial/Clerical									
1	Project Manager/Reserach Coordinator		4.8					21,528.00	11,195.00	32,723.00
1	Total Number Other Personnel								Total Other Personnel	32,723.00
									Total Salary, Wages and Fringe Benefits (A+B)	117,882.00

RESEARCH & RELATED Budget {A-B} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION C, D, & E, BUDGET PERIOD 1**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2015**End Date***: 09-29-2016**Budget Period:** 1

C. Equipment Description		Funds Requested (\$)*
List items and dollar amount for each item exceeding \$5,000		
Equipment Item		
Total funds requested for all equipment listed in the attached file		
Total Equipment		
Additional Equipment: File Name:		

D. Travel		Funds Requested (\$)*
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)		13,656.00
2. Foreign Travel Costs		0.00
	Total Travel Cost	13,656.00

E. Participant/Trainee Support Costs		Funds Requested (\$)*
1. Tuition/Fees/Health Insurance		0.00
2. Stipends		0.00
3. Travel		0.00
4. Subsistence		0.00
5. Other: 0		0.00
Number of Participants/Trainees		Total Participant Trainee Support Costs
		0.00

RESEARCH & RELATED Budget {C-E} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTIONS F-K, BUDGET PERIOD 1**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2015**End Date***: 09-29-2016**Budget Period:** 1

F. Other Direct Costs	Funds Requested (\$)*
1. Materials and Supplies	30,200.00
2. Publication Costs	
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8. Patient Care Cost	0.00
9. None	0.00
10. None	0.00
	Total Other Direct Costs
	30,200.00

G. Direct Costs	Funds Requested (\$)*
	Total Direct Costs (A thru F)
	161,738.00

H. Indirect Costs	Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)*
	1. MTDC_Research	49	161,738.00	79,252.00
	Total Indirect Costs			
	DHHS, Wallace Chan, 415-437-7820			
Cognizant Federal Agency (Agency Name, POC Name, and POC Phone Number)				

I. Total Direct and Indirect Costs	Funds Requested (\$)*
	Total Direct and Indirect Institutional Costs (G + H)
	240,990.00

J. Fee	Funds Requested (\$)*

K. Budget Justification*	File Name: Budget_Justification_Admin_Core1013416815.pdf (Only attach one file.)
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RESEARCH & RELATED Budget {F-K} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION A & B, BUDGET PERIOD 2

ORGANIZATIONAL DUNS*: 009095365

Budget Type*: ● Project ○ Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2016**End Date***: 09-29-2017**Budget Period:** 2**A. Senior/Key Person**

	Prefix First Name*	Middle Name	Last Name*	Suffix	Project Role*	Base	Calendar	Academic	Summer	Requested	Fringe	Funds Requested (\$)*
						Salary (\$)	Months	Months	Months	Salary (\$)*	Benefits (\$)*	
1.	Dr. KATHERINE	A	SWARD		Core Lead	102,000.00	3			25,500.00	9,435.00	34,935.00
2.	Dr. JULIO	CESAR	FACELLI		Core Lead	183,300.00	2.4			36,660.00	13,564.00	50,224.00

Total Funds Requested for all Senior Key Persons in the attached file

Additional Senior Key Persons:	File Name:	Total Senior/Key Person	85,159.00
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B. Other Personnel

Number of Personnel*	Project Role*	Calendar	Months	Academic	Months	Summer	Months	Requested Salary (\$)*	Fringe Benefits*	Funds Requested (\$)*
	Post Doctoral Associates									
	Graduate Students									
	Undergraduate Students									
	Secretarial/Clerical									
1	Project Manager/Reserach Coordinator		4.8					21,528.00	11,195.00	32,723.00
1	Total Number Other Personnel								Total Other Personnel	32,723.00
									Total Salary, Wages and Fringe Benefits (A+B)	117,882.00

RESEARCH & RELATED Budget {A-B} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION C, D, & E, BUDGET PERIOD 2**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2016 **End Date***: 09-29-2017 **Budget Period: 2**

C. Equipment Description	
List items and dollar amount for each item exceeding \$5,000	
Equipment Item	Funds Requested (\$)*
Total funds requested for all equipment listed in the attached file	Total Equipment
Additional Equipment: File Name:	

D. Travel		Funds Requested (\$)*
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)		29,010.00
2. Foreign Travel Costs		0.00
Total Travel Cost		29,010.00

E. Participant/Trainee Support Costs		Funds Requested (\$)*
1. Tuition/Fees/Health Insurance		0.00
2. Stipends		0.00
3. Travel		0.00
4. Subsistence		0.00
5. Other: None		0.00
Number of Participants/Trainees		Total Participant Trainee Support Costs
		0.00

RESEARCH & RELATED Budget {C-E} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTIONS F-K, BUDGET PERIOD 2**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2016**End Date***: 09-29-2017**Budget Period:** 2

F. Other Direct Costs	Funds Requested (\$)*
1. Materials and Supplies	15,600.00
2. Publication Costs	3,000.00
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8. Patient Care Cost	0.00
9. None	0.00
10. None	0.00
	Total Other Direct Costs
	18,600.00

G. Direct Costs	Funds Requested (\$)*
	Total Direct Costs (A thru F)
	165,492.00

H. Indirect Costs	Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)*
	1. MTDC_Research	49	165,492.00	81,091.00
	Total Indirect Costs			
	DHHS, Wallace Chan, 415-437-7820			
Cognizant Federal Agency (Agency Name, POC Name, and POC Phone Number)				

I. Total Direct and Indirect Costs	Funds Requested (\$)*
	Total Direct and Indirect Institutional Costs (G + H)
	246,583.00

J. Fee	Funds Requested (\$)*

K. Budget Justification*	File Name: Budget_Justification_Admin_Core1013416815.pdf (Only attach one file.)
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RESEARCH & RELATED Budget {F-K} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION A & B, BUDGET PERIOD 3

ORGANIZATIONAL DUNS*: 009095365

Budget Type*: ● Project ○ Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2017**End Date***: 09-29-2018**Budget Period:** 3

A. Senior/Key Person												
Prefix	First Name*	Middle Name	Last Name*	Suffix	Project Role*	Base	Calendar	Academic	Summer	Requested	Fringe	Funds Requested (\$)*
						Salary (\$)	Months	Months	Months	Salary (\$)*	Benefits (\$)*	
1. Dr.	KATHERINE	A	SWARD		Core Lead	102,000.00	3			25,500.00	9,435.00	34,935.00
2. Dr.	JULIO	CESAR	FACELLI		Core Lead	183,300.00	2.4			36,660.00	13,564.00	50,224.00

Total Funds Requested for all Senior Key Persons in the attached file

Additional Senior Key Persons:	File Name:	Total Senior/Key Person	85,159.00
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B. Other Personnel

Number of Personnel*	Project Role*	Calendar	Months	Academic	Months	Summer	Months	Requested Salary (\$)*	Fringe Benefits*	Funds Requested (\$)*
	Post Doctoral Associates									
	Graduate Students									
	Undergraduate Students									
	Secretarial/Clerical									
1	Project Manager/Reserach Coordinator		4.8					21,528.00	11,195.00	32,723.00
1	Total Number Other Personnel								Total Other Personnel	32,723.00
									Total Salary, Wages and Fringe Benefits (A+B)	117,882.00

RESEARCH & RELATED Budget {A-B} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION C, D, & E, BUDGET PERIOD 3**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2017 **End Date***: 09-29-2018 **Budget Period:** 3

C. Equipment Description	
List items and dollar amount for each item exceeding \$5,000	
Equipment Item	Funds Requested (\$)*
Total funds requested for all equipment listed in the attached file	Total Equipment
Additional Equipment: File Name:	

D. Travel		Funds Requested (\$)*
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)		29,010.00
2. Foreign Travel Costs		0.00
	Total Travel Cost	29,010.00

E. Participant/Trainee Support Costs		Funds Requested (\$)*
1. Tuition/Fees/Health Insurance		0.00
2. Stipends		0.00
3. Travel		0.00
4. Subsistence		0.00
5. Other: None		0.00
Number of Participants/Trainees		Total Participant Trainee Support Costs
		0.00

RESEARCH & RELATED Budget {C-E} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTIONS F-K, BUDGET PERIOD 3**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2017**End Date***: 09-29-2018**Budget Period:** 3

F. Other Direct Costs	Funds Requested (\$)*
1. Materials and Supplies	15,600.00
2. Publication Costs	3,000.00
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8. Patient Care Cost	0.00
9. None	0.00
10. None	0.00
	Total Other Direct Costs
	18,600.00

G. Direct Costs	Funds Requested (\$)*
	Total Direct Costs (A thru F)
	165,492.00

H. Indirect Costs	Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)*
	1. MTDC_Research	49	165,492.00	81,091.00
	Total Indirect Costs			
	DHHS, Wallace Chan, 415-437-7820			
Cognizant Federal Agency (Agency Name, POC Name, and POC Phone Number)				

I. Total Direct and Indirect Costs	Funds Requested (\$)*
	Total Direct and Indirect Institutional Costs (G + H)
	246,583.00

J. Fee	Funds Requested (\$)*

K. Budget Justification*	File Name: Budget_Justification_Admin_Core1013416815.pdf (Only attach one file.)
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RESEARCH & RELATED Budget {F-K} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION A & B, BUDGET PERIOD 4

ORGANIZATIONAL DUNS*: 009095365

Budget Type*: ● Project ○ Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2018**End Date***: 09-29-2019**Budget Period:** 4**A. Senior/Key Person**

	Prefix First Name*	Middle Name	Last Name*	Suffix	Project Role*	Base	Calendar	Academic	Summer	Requested	Fringe	Funds Requested (\$)*
						Salary (\$)	Months	Months	Months	Salary (\$)*	Benefits (\$)*	
1.	Dr. KATHERINE	A	SWARD		Core Lead	102,000.00	3			25,500.00	9,435.00	34,935.00
2.	Dr. JULIO	CESAR	FACELLI		Core Lead	183,300.00	2.4			36,660.00	13,564.00	50,224.00

Total Funds Requested for all Senior Key Persons in the attached file

Additional Senior Key Persons:	File Name:	Total Senior/Key Person	85,159.00
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B. Other Personnel

Number of Personnel*	Project Role*	Calendar	Months	Academic	Months	Summer	Months	Requested Salary (\$)*	Fringe Benefits*	Funds Requested (\$)*
	Post Doctoral Associates									
	Graduate Students									
	Undergraduate Students									
	Secretarial/Clerical									
1	Project Manager/Reserach Coordinator		4.8					21,528.00	11,195.00	32,723.00
1	Total Number Other Personnel								Total Other Personnel	32,723.00
									Total Salary, Wages and Fringe Benefits (A+B)	117,882.00

RESEARCH & RELATED Budget {A-B} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION C, D, & E, BUDGET PERIOD 4**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2018 **End Date***: 09-29-2019 **Budget Period:** 4

C. Equipment Description	
List items and dollar amount for each item exceeding \$5,000	
Equipment Item	Funds Requested (\$)*
Total funds requested for all equipment listed in the attached file	Total Equipment
Additional Equipment: File Name:	

D. Travel		Funds Requested (\$)*
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)		29,010.00
2. Foreign Travel Costs		0.00
	Total Travel Cost	29,010.00

E. Participant/Trainee Support Costs		Funds Requested (\$)*
1. Tuition/Fees/Health Insurance		0.00
2. Stipends		0.00
3. Travel		0.00
4. Subsistence		0.00
5. Other: None		0.00
Number of Participants/Trainees		Total Participant Trainee Support Costs
		0.00

RESEARCH & RELATED Budget {C-E} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTIONS F-K, BUDGET PERIOD 4**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date*:** 09-30-2018**End Date*:** 09-29-2019**Budget Period:** 4

F. Other Direct Costs	Funds Requested (\$)*
1. Materials and Supplies	15,600.00
2. Publication Costs	3,000.00
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8. Patient Care Cost	0.00
9. None	0.00
10. None	0.00
	Total Other Direct Costs
	18,600.00

G. Direct Costs	Funds Requested (\$)*
	Total Direct Costs (A thru F)
	165,492.00

H. Indirect Costs	Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)*
	1. MTDC_Research	49	165,492.00	81,091.00
	Total Indirect Costs			
	DHHS, Wallace Chan, 415-437-7820			
Cognizant Federal Agency (Agency Name, POC Name, and POC Phone Number)				

I. Total Direct and Indirect Costs	Funds Requested (\$)*
	Total Direct and Indirect Institutional Costs (G + H)
	246,583.00

J. Fee	Funds Requested (\$)*

K. Budget Justification*	File Name: Budget_Justification_Admin_Core1013416815.pdf (Only attach one file.)
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RESEARCH & RELATED Budget {F-K} (Funds Requested)

Budget Justification

All person month calculations based on a twelve month calendar year appointment, unless otherwise noted.

Administrative Core**A. Key Personnel**

Katherine Sward, PhD, RN Overall and contact Principal Investigator [Effort for Admin Core: 25% FTE in years 1 through 4 (3 person months each year)], will oversee all aspects of the project. Dr. Sward will be responsible for directing all aspects of the project and have overall accountability for the timely implementation of the research. She will lead and organize the work of the interdisciplinary research team, hire, train and supervise project staff and coordinate the subcontract. She will have accountability for all fiscal matters. She will establish and monitor systems to ensure the scientific integrity of the study and its data. Dr. Sward will be accountable for preparation of each annual and final report. She will lead the broad interdisciplinary dissemination plan for publications and presentations. She will continue to foster the collaborations within her team and with the overall PRISMS program. Dr. Sward is also co-lead in project 3.

Julio Facelli, PhD. Principal Investigator, Senior Informaticist. [Effort for Admin Core: 20% FTE in years 1 through 4 (0.6 person months each year)]. He will advise and mentor Dr. Sward in overall grant oversight, and will be the final arbitrator for standards and technology decisions. Dr. Facelli is also co-lead in project 2.

B. Other Personnel

Heather Oldroyd, Project manager; Pediatrics Research Coordinator [Effort: 40% FTE in years 1 through 4 (4.8 person months each year)], will assist with project management. Will assist with recruitment of participants for the user centered design process and platform evaluation, will oversee participant consent, human subjects participation, and similar duties.

C. Supplies

Tablets. We will purchase two Android Tablets (\$229) in year 1 for testing and development of the mobile applications for project 1.

Sample Sensors. We will purchase 8 sample sensor sets in year 1 at \$1000 per set for evaluation of platform infrastructure and interfaces. The goal of the program is to integrate across multiple sensors and we need to be able to test and demonstrate that integration. We will need multiple “sets” with multiple sensors per set to appropriately design and test the infrastructure.

Computers. We will purchase two high end desktop computers in year 1 for programming and Big Data analyses for projects 2 and 3 (per Dell website: \$1500 each). We will also purchase two laptop computers with docking stations in year 1 for the Project Coordinator and the BMI RAs (\$1,500 each).

Encrypted Flash Drives. We will purchase 5 encrypted flash drives (\$80 each) in year 1 to be used by study personnel to securely transport data.

D. Travel

We are requesting funds for the two PD/PD (Dr. Sward and Dr. Facelli) and one additional team member to attend the yearly meetings of the full PRISMS program as well as 2 steering committee meetings (\$13,806 total per year for 3 people to attend 3 meetings; total includes airfare, 3-nights lodging, 4 days per diem costs and ground transportation costs).

We are requesting additional travel funds to support dissemination activities at national conferences such as the American Medical Informatics Association (AMIA), the American Thoracic Society, or similar appropriate venues, in years 2-4 (\$15,204 total per year for 2 people to attend 2 meetings; total includes meeting registrations fees, airfare, 3-nights lodging, 4 days per diem costs and ground transportation costs).

E. Center for High Performance Computing (CHPC). The CHPC provides distributed computing resources on HIPAA compliant servers. The CHPC budget includes the use of the physical equipment, and computer support services, training and expert consultation. In addition to deploying and operating high performance computational resources and software and providing advanced user support and training, CHPC serves as an expert team providing consultation and expertise for big data, big data movement, data analytics, security, protected environments for data mining and analysis of protected health information, and advanced networking (\$15,000 per year for years 1-4).

F. Other

Postage. We estimate \$100 per year in postage costs related to travel, dissemination, and the conduct of research (e.g., invitations to parent participants; postage costs to acquire sample sensors).

Printing/Copying. We estimate \$100 in year 1 and \$500 each year in years 2 through 4 for printing and copying. Years 2 through 4 include the cost of poster printing for dissemination.

Publication Costs. We estimate \$1500 per publication, for open-source and open-access journal publication related costs.

RESEARCH & RELATED BUDGET - Cumulative Budget

	Totals (\$)
Section A, Senior/Key Person	340,636.00
Section B, Other Personnel	130,892.00
Total Number Other Personnel	4
Total Salary, Wages and Fringe Benefits (A+B)	471,528.00
Section C, Equipment	
Section D, Travel	100,686.00
1. Domestic	100,686.00
2. Foreign	0.00
Section E, Participant/Trainee Support Costs	0.00
1. Tuition/Fees/Health Insurance	0.00
2. Stipends	0.00
3. Travel	0.00
4. Subsistence	0.00
5. Other	0.00
6. Number of Participants/Trainees	
Section F, Other Direct Costs	86,000.00
1. Materials and Supplies	77,000.00
2. Publication Costs	9,000.00
3. Consultant Services	0.00
4. ADP/Computer Services	0.00
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	0.00
7. Alterations and Renovations	0.00
8. Other 1	0.00
9. Other 2	0.00
10. Other 3	0.00
Section G, Direct Costs (A thru F)	658,214.00
Section H, Indirect Costs	322,525.00
Section I, Total Direct and Indirect Costs (G + H)	980,739.00
Section J, Fee	

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OMB Number: 0925-0001

1. Project Director / Principal Investigator (PD/PI)

Prefix: Dr.

First Name*: KATHERINE

Middle Name: A

Last Name*: SWARD

Suffix:

2. Human Subjects

Clinical Trial? No Yes

Agency-Defined Phase III Clinical Trial?* No Yes

3. Permission Statement*

If this application does not result in an award, is the Government permitted to disclose the title of your proposed project, and the name, address, telephone number and e-mail address of the official signing for the applicant organization, to organizations that may be interested in contacting you for further information (e.g., possible collaborations, investment)?

Yes No

4. Program Income*

Is program income anticipated during the periods for which the grant support is requested?

Yes No

If you checked "yes" above (indicating that program income is anticipated), then use the format below to reflect the amount and source(s). Otherwise, leave this section blank.

Budget Period* Anticipated Amount (\$)* Source(s)*

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5. Human Embryonic Stem Cells

Does the proposed project involve human embryonic stem cells?* No Yes

If the proposed project involves human embryonic stem cells, list below the registration number of the specific cell line(s) from the following list: http://grants.nih.gov/stem_cells/registry/current.htm. Or, if a specific stem cell line cannot be referenced at this time, please check the box indicating that one from the registry will be used:

Cell Line(s): Specific stem cell line cannot be referenced at this time. One from the registry will be used.

6. Inventions and Patents (For renewal applications only)

Inventions and Patents*: Yes No

If the answer is "Yes" then please answer the following:

Previously Reported*: Yes No

7. Change of Investigator / Change of Institution Questions

Change of principal investigator / program director

Name of former principal investigator / program director:

Prefix:

First Name*:

Middle Name:

Last Name*:

Suffix:

Change of Grantee Institution

Name of former institution*:

PHS 398 Research Plan

Please attach applicable sections of the research plan, below.

OMB Number: 0925-0001

1. Introduction to Application (for RESUBMISSION or REVISION only)	
2. Specific Aims	SpecificAims1013416628.pdf
3. Research Strategy*	ResearchStrategy1013416629.pdf
4. Progress Report Publication List	
Human Subjects Sections	
5. Protection of Human Subjects	
6. Inclusion of Women and Minorities	
7. Inclusion of Children	
Other Research Plan Sections	
8. Vertebrate Animals	
9. Select Agent Research	
10. Multiple PD/PI Leadership Plan	MultiplePI_LeadershipPlan1013416635.pdf
11. Consortium/Contractual Arrangements	
12. Letters of Support	
13. Resource Sharing Plan(s)	
Appendix (if applicable)	
14. Appendix	

Specific Aims

The PRISMS-Informatics Federated Integration Architecture Center (“PRISMS-Informatics Center”) is a multi-disciplinary collaboration. The purpose of the center is to develop a comprehensive, flexible, open-source, standards-based informatics platform, which will enable research of environmental, physiological, and behavioral factors, measured through a variety of sensors, in epidemiological studies of asthma and other chronic diseases in the pediatric population. The platform will allow sensor data to be integrated, both with other sensor data and with other important data sources, such as asthma control assessments, quality of life metrics, healthcare utilization, and others. Communication and collaboration will be key to the success of the center, as it will be for the overall PRISMS program. While diverse representation provides robust insight and well-rounded expertise, coordination could become complex. The PRISMS program is intended to be highly collaborative with extensive interaction between the program awardees.

The Administrative Core (Admin Core) for our PRISMS-Informatics Center is designed to facilitate collaboration, integration across projects, leadership, and center oversight, to support the safe, appropriate conduct of research within the center. Specific aims for the Administrative Core are:

1. To provide **administration, organizational oversight, and financial management** for the PRISMS-Informatics Center.
The benchmarks for this objective are formalized SOPs for the Admin Core. We anticipate that a suite of SOPs will be formally documented pre-award, with approval by the Administrative Executive team before the end of the first month.
2. To implement the **Leadership Plan** for the PRISMS-Informatics Center.
The main benchmark is monthly meetings with documented minutes.
3. To provide leadership in **coordinating and integrating the software infrastructure** for the center.
Benchmarks are procedures and documentation for software development best practices, code revision control, and integration. These will be developed in the first three months of the center, and compliance assessed at least quarterly.
4. To facilitate **internal evaluation and self-assessments**; guiding scientific conduct across the PRISMS-Informatics Center projects, including prioritization and incorporating modifications to timelines and project plans as the PRISMS Program evolves.
The main benchmarks are development of project self-assessment plans, and documented results from the self-assessments.

The Administrative Core personnel include support from the staff in the *Emma Eccles Jones Nursing Research Center*; a project manager and a research coordinator assigned to the PRISMS-Informatics Center; the center PIs and the project leaders who collectively constitute the Administrative Executive team; and other significant personnel and the subject matter experts who will provide expertise as needed across projects. The Administrative Core provides a central point of contact and communications for the PRISMS-Informatics Center. The Admin Core will collaborate with, and leverage the extensive expertise of, the University’s Center for High Performance Computing (CHPC) and the Biomedical Informatics Core (BMIC).

Research Strategy/Program Plan

Administrative and organizational structure

The *PRISMS-Informatics Federated Integration Architecture Center* (“PRISMS-Informatics Center”) Administrative Core (Admin Core) supports research and development activities of the PRISMS-Informatics Center. The Admin Core is responsible for assisting center investigators in the design and conduct of projects; and provides assistance with dissemination of project findings. In addition, the Admin Core is responsible for facilitating the logistics of project implementation, including administrative, operations and meeting support; and as needed, connection to the University’s business and legal expert staff. Admin Core staff work with the center PI, the project collaborators, and the funding agency throughout all phases of the center: planning, project development and documentation, data management, data sharing and software sharing plans including publication.

Many of the Admin core facilities and support will be housed in the University of Utah College of Nursing *Emma Eccles Jones Nursing Research Center* (EEJNRC) (1). The EEJNRC support staff provide technical assistance with grant management, purchasing, and financial planning; coordination with the overall University organization; as well as budgetary reporting and financial oversight, human resource support, and facilities and equipment coordination. The EEJNRC Applied Statistics Team is available to provide research design and statistical expertise as needed. Existing staff in each of the PI/PD and key personnel departments augment EEJNRC center support staff for travel and meeting logistics. Other staff that will be required to support the U54 PRISMS-Informatics center include a project manager and research coordinator assigned to the center.

Although we will not be collecting patient data as part of the center development, the center will eventually be supporting clinical trials and we will interact with key stakeholder representatives as part of our design and evaluation process. Therefore we will design to protect the security and privacy of Protected Health Information (PHI) while balancing the need for information exchange and interoperability (2). The software will be housed in the University of Utah (U of U) Center for High Performance Computing (CHPC), which has a HIPAA-compliant bank of servers (3) and a full suite of backup, support, and maintenance procedures (4). For materials not hosted at CHPC we will utilize a U of U hosted cloud storage platform (Box) that has been approved as HIPAA compliant by the Health Sciences Information Security Office (5).

Admin Core Executive Committee

The Admin Core Executive Committee (AEC) will be chaired by the PIs and composed of the Project Leaders and key personnel for the projects. The primary purpose of the AEC will be to share data and information, monitor progress, raise issues and solve problems, review publications arising from the research, and plan for collaborations within the PRISMS Program. The committee will make recommendations for policy/procedure additions or changes when necessary. The AEC will oversee decisions about authorship on publications, based on the relative contributions of personnel. Specific roles are identified below

Program Director/Principal Investigator (PD/PI). Responsible for oversight of PRISMS-Informatics center functions including but not limited to: organization, clinical knowledge; biostatistical and database expertise; software development and documentation; preparation of technical reports and progress reports; biomedical informatics standards, methods and tools; scientific publication; and center logistics.

Responsible for oversight of all activities relating to the daily operation of the PRISMS-Informatics center including but not limited to: project management, regulatory compliance, IRB submissions; oversee development, production and distribution of center related documents; provide center training; maintain frequent discussions and email correspondence with staff about progress of projects, clarification of project goals, problems encountered and refinement of due dates. Provide preplanning for and conduct of weekly (informal) and monthly (formal) meetings. Work closely with project directors to develop and revise the budget as needed and to facilitate overall direction of the center.

The center will utilize a multiple PD/PI leadership model (See also the Multiple PD/PI Leadership Plan).

Dr. Katherine Sward, PhD, RN will serve as the contact PI for the PRISMS-Informatics Federated Architecture Center (“PRISMS-Informatics Center”). Dr. Sward will devote at least 3 calendar months (25 % FTE effort) to study oversight in addition to her activities on the center projects. She will oversee the overall center activities, and will be the point of communication and coordination with the other Network PIs. She will chair the Admin Core Executive Committee. Dr. Sward has at her disposal access to the resources and personnel of the University of Utah College of Nursing *Emma Eccles Jones Nursing Research Center* (EEJNRC).

Dr. Julio Facelli, PhD is the senior informaticist. He will mentor and advise Dr Sward regarding center management and oversight, and will be the final arbitrator of decisions regarding standards and architecture.

Project Manager/Research Coordinator (PM – Oldroyd). The PM is responsible for, but not limited to, the following: logistical aspects of the study as designated by the PI, i.e., assisting the PI with document management, assembling and coordinating project working groups, scheduling meetings and teleconferences, documenting center workflow, assisting with preparing and maintaining regulatory documents and correspondence, responding to queries and emails, mailing material, and interfacing between center staff, project personnel, and the PRISMS-Informatics center investigators and staff. She will also assist with recruitment and consent for participants in the user-centered design process.

Project Leaders. Responsible for managing project-related activities including but not limited to milestones, deliverables, and documents. Oversees and monitors project timelines to ensure that target dates are met. Ensures that standards and processes are implemented and maintained. Identifies and establishes process optimization to improve efficiencies. Allocates resources, manages and develops staff for their project. Participates in the Admin Core Executive Committee. Project Leaders were assigned based on their primary area of expertise.

(Project 1) Patwari and Meyer. This project focuses on data acquisition and feedback to the parents and children.

(Project 2) Facelli and Gouripeddi. This project provides the architecture for high-resolution sensor data, integration of sensor data and clinical data, and secure transmission of data to the PRISMS data coordinating center.

(Project 3). Sward, Cummins, and Nkoy. This project focuses on the clinical research platform.

Other Significant Personnel

Key Personnel and Subject Matter Experts. Responsible for providing expertise in focused areas. These include clinical care of, and outcomes for, children with asthma (Stone); development and evaluation of environmental sensors (Kim, Collingwood); public health air quality and environmental data (Kelly); and study design, management, analyses, and data visualization (Wong). Project Directors Dr. Meyer and Dr. Nkoy provides expertise working with diverse populations.

Other experts are also accessible to us. We have pre-existing collaborations throughout the University of Utah, Intermountain Healthcare, and other locations. This provides access to expertise to standards organizations, experts in software development and engineering, human-computer interaction experts, biomedical informatics, and other areas. Dr. Facelli and Mr. Gouripeddi provide direct links to the U of U Center for High Performance Computing and the U of U Biomedical Informatics Core (BMIC), which, in turn, provides an avenue for us to access informatics experts throughout the national Centers for Clinical and Translational Science (CTSA) community.

Institutional Collaboration and Support

Letters of support are included in this submission indicating institutional commitment from the collaborating Departments at the University of Utah. Budgets will be allocated to each project as detailed in the budget sections. Budget oversight and re-allocation of funds will be determined by the Admin Core Executive Committee.

Leadership Plan

Communications and Coordination of Projects

Informal and semi-formal meetings will take place as necessary and appropriate to meet the aims of the projects and to ensure a strong collaborative bond. Regular formal meetings will take place, at least monthly. Agendas will be prepared in advance of each meeting and minutes will be recorded, circulated and maintained. Priorities for projects will be reviewed by the PI and AEC at these monthly meetings, as well as after PRISMS program face to face meetings and teleconferences, with modification as needed to ensure we stay aligned with the overall PRISMS program objectives.

The PI/PD's offices are within close proximity of each other, and project team members meet informally on a frequent basis-- at least weekly, usually every day or two. In addition to meetings, additional methods of communication will be used including e-mail, space within University's secure, password protected cloud storage (Box), teleconferences and videoconferences, and paper reports.

Coordination with the rest of the PRISMS Program

Two members of the Admin Core Executive Committee will attend the yearly PRISMS program face to face meeting. The PI and Project Directors will attend scheduled PRISMS program teleconferences. Priorities, progress, and adjustments to projects will be discussed after each of these meetings, as well as at regular monthly meetings of the AEC. The members of the PRISMS-Informatics Center are committed to remaining in alignment with the overall PRISMS program goals and objectives.

Conflict Resolution

We do not anticipate major disagreements, as all parties have been collaborating on other projects and have been in full agreement as to scope and direction for the center. However, if they arise, conflicts between members of the center will be addressed, first, by face to face communication between involved parties. The center PI or a designee will serve as facilitator/mediator as needed. Disagreements on larger scale will be resolved by a consensus building process. A formal vote of the Admin Core Executive Committee (AEC) will be used to make decisions if consensus cannot be achieved. All personnel will be expected to cooperate with the final decision. If the AEC is unable to resolve a conflict we will access University of Utah HR personnel who are expert conflict mediators.

For conflicts between center members and members of other PRISMS program sites, we will adhere to the PRISMS conflict resolution strategy. As per the FOA: "Any disagreements that may arise in scientific or programmatic matters (within the scope of the award) between award recipients and the NIH may be brought to arbitration. An Arbitration Panel composed of three members will be convened.... in accordance with PHS regulations 42 CFR Part 50, Subpart D and HHS regulations 45 CFR Part 16."

Changing PD/PIs or Project Leaders. If a PD/PI or project leader moves, attempts will be made to transfer the relevant portion of the project to the new institution. In the event that a PD/PI or project leader cannot continue to carry out his or her duties, a new PD/PI or project leader will be recruited as a replacement, subject to the approval of both the AEC, the overall PRISMS Program leadership, and the funding agency.

SEE ALSO: Multiple PD/PI leadership plan.

Processes and Approach for Admin Core Aims

The first three specific aims for the Admin core are

1. To provide **administration, organizational oversight, and financial management** for the PRISMS-Informatics Center.

The benchmarks for this objective are formalized standard operating procedures (SOP) for the Admin Core. We anticipate that a suite of SOPs will be formally documented pre-award, with approval by the Administrative Executive team before the end of the first month.

The Administrative Core role is affected by the federal regulations, requirements of the funding agency, the requests of the PI and Project Directors, and University requirements. Examples of responsibilities that the Admin Core staff may undertake based on the above factors include:

- Provide training as needed for staff and investigators
- Review documents from projects for completeness and readability.
- Track and assist with IRB approvals.
- Oversee and conduct assessments for projects at the direction of the funding agency.
- Assist with manuscript and document preparation

2. To implement the **Leadership Plan** for the PRISMS-Informatics Center. The main benchmark is monthly meetings with documented minutes. The plan for formal meetings was described above.
3. To provide **leadership in coordinating and integrating the software infrastructure** for the center. We will collaborate with the experts at the Center for High Performance Computing (CHPC) and the Biomedical Informatics Core (BMIC) to identify appropriate standards for our projects. We will use the existing CHPC infrastructure to implement software development best practices, establish mechanisms for code revision control, bug tracking/feature requests, and for software integration. Benchmarks are procedures and documentation for software development best practices, code revision control, and integration. These will be developed in the first three months of the center, and compliance assessed at least quarterly.

Center Evaluation and Self-Assessments

Admin Core Specific Aim 4 is: To facilitate **internal evaluation and self-assessments**; guiding scientific conduct across the PRISMS-Informatics Center projects, including prioritization and incorporating modifications to timelines and project plans as the PRISMS Program evolves. The main benchmark is internal progress reporting and review of milestones at the monthly meetings.

Expectations Regarding Monitoring

It is expected that the center projects may be monitored by sponsors and others responsible for oversight of clinical research. Investigators, research staff, and others involved in the projects will need to allocate adequate time for such monitoring. Investigators are required to ensure that the monitor or other compliance or quality assurance reviewer is given access to applicable documents and study related facilities, and has adequate space to conduct the monitoring.

The purpose of monitoring is to verify that:

- The rights and well-being of human subjects are protected.
- Reported data are accurate, complete, and verifiable (data quality assessments)
- Project activities are in compliance with the currently approved project plan/amendments and with applicable regulatory requirements.

Responsibility

Evaluation of the program will be a regular function of the AEC. The AEC is responsible to ensure that projects are adequately assessed and monitored. The nature and extent of such assessments will be based on the project plan and approach within each project. We will also assess and document any instances of non-compliance with applicable obligations.

Center Evaluation Activities

1. Project progress records will be kept in the Admin Core and reviewed at least quarterly.
2. Financial reports are routinely provided by the *Emma Eccles Jones Nursing Research Center* and will be reviewed monthly.
3. Priorities for projects, project tasks, and timelines will be reviewed at least monthly and after PRISMS program face to face meetings and teleconferences, with modification to project plans, priorities and timelines as needed to ensure we stay aligned with the overall program objectives.

Prioritization and incorporation of improvements into operations and software that enhance its utility for research:

- Project 1 includes assessment and anticipation of child/parent needs.
- Project 3 includes assessment and anticipation of researcher needs
- Project 2 includes assessment and anticipation of platform integration needs, both within our center and across the PRISMS program.

Individual Project Assessment Plans

Each project includes plans for validation, evaluation, and self-assessments in an iterative and agile development methodology. The focus of those evaluations is on formative validation of project components, summative evaluation of the project as a whole, and end-to-end evaluation of the project as integrated within the overall center. Evaluation plans will be accessible at all times to the Administrative Executive Committee (AEC). The Admin Core and the AEC will provide leadership and oversight to ensure that project assessments are conducted appropriately.

Multiple PD/PI Leadership Plan

The PRISMS Informatics Federated Integration Architecture Center will utilize a Multiple-PD/PI leadership model for our multi-disciplinary center.

Program Directors/Principal Investigators

Katherine Sward, PhD, RN is the contact PD/PI. She is an Associate Professor with extensive informatics experience. Through her more than 8 years of experience as the informaticist for the Collaborative Pediatric Critical Care Research Network (CPCCRN) she has gained extensive exposure to clinical research network administration and NIH expectations for research networks. She has a broad background that melds clinical informatics, clinical research informatics, and clinical decision support and can smoothly bridge the multiple disciplines involved in this center. Dr. Sward will oversee the day-to-day operations of the center, and will chair the Administrative Executive Committee.

Julio Facelli, PhD, FACMI is the senior informaticist. He is a full professor of Biomedical Informatics, a Fellow of the American College of Medical Informatics, vice-chair of the Department of Biomedical Informatics and director of the Biomedical Informatics Core of the Utah Center for Clinical and Translation Science (CCTS). His research includes data mining, complex analytics, and distributed information systems for clinical and translational informatics. Dr. Facelli will mentor and advise Dr. Sward in overall center management, and will be the final arbitrator for decisions about standards and the informatics architecture. He will be the Center's liaison with the CCTS to facilitate access to resources available there and to integrate the PRISMS Informatics Federated Integration Architecture Center with the overall University of Utah strategic research in translational sciences. He also will be the contact person with the Center for High Performance Computing, that he directed for more than 25 years.

Project Leaders

All team members will contribute across projects. However, each project has identified leaders who will oversee reporting, timelines, processes, and project goals/milestones.

Project 1 is focused on the data acquisition pipeline. Neal Patwari, PhD is the project leader. Dr Patwari has a PhD in Electrical and Computer Engineering and directs the University of Utah Sensing and Processing Across Networks (SPAN) Laboratory, which performs research at the intersection of statistical signal processing and wireless networking. Miriah Meyer, PhD will serve as the co-leader of this project. She is an Assistant Professor in the School of Computing who specializes in designing visualization systems that support exploratory, complex data analysis tasks for scientific research; she also has extensive experience in customizing user interfaces and in providing age-appropriate feedback.

Project 2 is the central federation architecture. This project is led by Ramkiran Gouripeddi, M.S., M.B.B.S. Dr Gouripeddi is a physician with training and expertise in Biomedical Informatics. He is an Assistant Research Professor in the Department of Biomedical Informatics with extensive experience in clinical informatics and clinical research informatics. He has experience with machine learning, knowledge discovery and Big Data analytics combined with experience with personalized medicine, data modeling, terminologies and ontologies. He played an instrumental role throughout the development of FURTHeR and OpenFurther and was the key developer for the OpenFurther architecture underlying the pediatric PHIS+ project. This central architecture is the core that links the PRISMS center projects together and that allows our center to interact with the other PRISMS sites, as well as providing a connection that can link PRISMS data with electronic health records, data warehouses, and unique resources such as the Utah Population Database (UPDB). Dr. Facelli will co-lead project 2 along with Dr. Gouripeddi.

Project 3 is the lab (researcher) platform. Dr. Sward, Dr. Mollie Cummins, and Dr Flory Nkoy will lead this project. Dr. Nkoy combines extensive experience in pediatric care with Biomedical Informatics experience. He leads, along with Dr. Bryan Stone, a clinical research program investigating pediatric asthma and other chronic childhood conditions, including home care, self-management, and outcomes reporting; and has experience tailoring eHealth interventions to be culturally/ethnically appropriate. Dr. Cummins is an Associate Professor in Nursing and Biomedical Informatics and has extensive experience with health information exchange, knowledge discovery & data mining, and with designing user interfaces that integrate with clinical workflows.

Administrative Executive Committee

The Admin core for the center includes an Administrative Executive Committee that consists of the two PD/PI's and the project leaders. The committee will meet monthly to oversee project progress, milestones, timelines and finances; and will arbitrate any disagreements between committee members (see the Admin Core plan).

External Advisory Committee

We plan to create an external advisory committee consisting of the NIH PRISMS program officer, the PI of the data coordinating center, and at least 1 subject matter expert. This committee will be advisory, helping to ensure we have input from the overall PRISMS program and the community at large. However this planned committee may be subsumed by overall PRISMS program committees. The NIH scientific or program staff are planning to be highly engaged and "will assist, guide, coordinate, or participate in project activities" (per FOA).

PRISMS Program Steering Committee

The three arms of the PRISMS program are expected to work very closely together. Dr. Sward and Dr. Facelli will represent our center on the PRISMS Program Steering Committee and participate in Steering Committee responsibilities. As per the FOA, "The Steering Committee will:

- Identify scientific and policy issues that need to be, or can benefit by being, addressed at the PRISMS Program level.
- Develop recommendations to the Project Team for addressing such issues.
- Steer common data structures, software and hardware to ensure interoperability.
- Coordinate the dissemination of the activities and products of the PRISMS Centers to the wider scientific community.
- Develop operational guidelines, including frequency of meetings, items requiring voting, number or proportion of votes required to pass any initiatives, etc.
- Coordinate any issues of joint relevance to the PRISMS Program relating to individual Center or U01 milestones or objectives between the Centers PD(s)/PI(s)."

References: Admin Core

1. University of Utah College of Nursing. Emma Eccles Jones Nursing Research Center 2015 [5/26/2015]. Available from: <http://nursing.utah.edu/research/emma-eccles-jones-research.php>.
2. Sheikh A, Sood HS, Bates DW. Leveraging Health Information Technology to Achieve the "Triple Aim" of Healthcare Reform. Journal of the American Medical Informatics Association : JAMIA. 2015.
3. Bradford W, Hurdle JF, LaSalle B, Facelli JC. Development of a HIPAA-compliant environment for translational research data and analytics. J Am Med Inform Assoc JAMIA. 2014;21(1):185-9.
4. University of Utah. CHPC - Research Computing Support for the University 2015. Available from: <https://www.chpc.utah.edu/>.
5. University of Utah. Information Security Office. Available from: <http://it.utah.edu/departments/iso/index.php>.

**APPLICATION FOR FEDERAL ASSISTANCE
SF 424 (R&R)**

5. APPLICANT INFORMATION

Organizational DUNS*: 009095365

Legal Name*: University of Utah
 Department:
 Division:
 Street1*: 75 South 2000 East
 Street2:
 City*: Salt Lake City
 County: Salt Lake
 State*: UT: Utah
 Province:
 Country*: USA: UNITED STATES
 ZIP / Postal Code*: 84112-8930

Person to be contacted on matters involving this application

Prefix:	First Name*:	Middle Name:	Last Name*:	Suffix:
	BRENDA		MALDONADO	

Position/Title: Sponsored Project Officer
 Street1*: 1471 EAST FEDERAL WAY
 Street2:
 City*: SALT LAKE CITY
 County: SALT LAKE
 State*: UT: Utah
 Province:
 Country*: USA: UNITED STATES
 ZIP / Postal Code*: 84112-8930

Phone Number*: 801-581-8019 Fax Number: 801-581-3007 Email: brenda.maldonado@osp.utah.edu

7. TYPE OF APPLICANT* H: Public/State Controlled Institution of Higher Education

Other (Specify):
 Small Business Organization Type Women Owned Socially and Economically Disadvantaged

11. DESCRIPTIVE TITLE OF APPLICANT'S PROJECT*

Prisms Informatics Platform - Federated Integration Architecture

12. PROPOSED PROJECT

Start Date*	Ending Date*
09/30/2015	09/29/2019

Project/Performance Site Location(s)

Project/Performance Site Primary Location

I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name: UNIVERSITY OF UTAH

Duns Number: 009095365

Street1*: 50 CENTRAL CAMPUS DR RM 3280

Street2:

City*: SALT LAKE CITY

County: SALT LAKE

State*: UT: Utah

Province:

Country*: USA: UNITED STATES

Zip / Postal Code*: 84132-2101

Project/Performance Site Congressional District*: UT-002

File Name

Additional Location(s)

RESEARCH & RELATED Other Project Information

1. Are Human Subjects Involved?* Yes No

1.a. If YES to Human Subjects

Is the Project Exempt from Federal regulations? Yes NoIf YES, check appropriate exemption number: 1 2 3 4 5 6If NO, is the IRB review Pending? Yes No

IRB Approval Date:

Human Subject Assurance Number 00003745

2. Are Vertebrate Animals Used?* Yes No

2.a. If YES to Vertebrate Animals

Is the IACUC review Pending? Yes No

IACUC Approval Date:

Animal Welfare Assurance Number

3. Is proprietary/privileged information included in the application?* Yes No**4.a. Does this project have an actual or potential impact - positive or negative - on the environment?*** Yes No

4.b. If yes, please explain:

4.c. If this project has an actual or potential impact on the environment, has an exemption been authorized or an Yes No environmental assessment (EA) or environmental impact statement (EIS) been performed?

4.d. If yes, please explain:

5. Is the research performance site designated, or eligible to be designated, as a historic place?* Yes No

5.a. If yes, please explain:

6. Does this project involve activities outside the United States or partnership with international collaborators?* Yes No

6.a. If yes, identify countries:

6.b. Optional Explanation:

Filename

7. Project Summary/Abstract* Abstract_Filler1013416976.pdf**8. Project Narrative*****9. Bibliography & References Cited** ReferencesProject11013416864.pdf**10. Facilities & Other Resources****11. Equipment**

Please see the Abstract in the Overall component.

RESEARCH & RELATED Senior/Key Person Profile (Expanded)

PROFILE - Project Director/Principal Investigator					
Prefix: Dr.	First Name*: Neal	Middle Name	Last Name*: Patwari	Suffix:	
Position/Title*:	Assistant Professor				
Organization Name*:	University of Utah				
Department:	ELECT & COMPUTER ENGINEERING				
Division:	COLLEGE OF ENGINEERING				
Street1*:	50 CENTRAL CAMPUS DR RM 3280				
Street2:					
City*:	SALT LAKE CITY				
County:	SALT LAKE				
State*:	UT: Utah				
Province:					
Country*:	USA: UNITED STATES				
Zip / Postal Code*:	84112-9206				
Phone Number*:	801/581-5917	Fax Number:	801-581-5281	E-Mail*:	npatwari@ece.utah.edu
Credential, e.g., agency login: NPATWARI					
Project Role*: Other (Specify)		Other Project Role Category: Project Lead			
Degree Type:		Degree Year:			
		File Name			
Attach Biographical Sketch*:		Patwari1013416617.pdf			
Attach Current & Pending Support:					

PROFILE - Senior/Key Person					
Prefix: Dr.	First Name*: MIRIAH	Middle Name DAWN	Last Name*: MEYER	Suffix:	
Position/Title*:	Assistant Professor				
Organization Name*:	University of Utah				
Department:	SCIENT COMP & IMAG INST				
Division:	SCIENT COMP & IMAG INST				
Street1*:	72 CENTRAL CAMPUS DR RM 3750				
Street2:					
City*:	SALT LAKE CITY				
County:	SALT LAKE				
State*:	UT: Utah				
Province:					
Country*:	USA: UNITED STATES				
Zip / Postal Code*:	84112-5880				
Phone Number*:	801/585-7045	Fax Number:	E-Mail*:		MIRIAH@CS.UTAH.EDU
Credential, e.g., agency login: MIRIAHMEYER					
Project Role*: Other (Specify)		Other Project Role Category: Project Lead			
Degree Type:		Degree Year:			
		File Name			
Attach Biographical Sketch*:		MiriahMeyer1013416618.pdf			
Attach Current & Pending Support:					

RESEARCH & RELATED BUDGET - SECTION A & B, BUDGET PERIOD 1

ORGANIZATIONAL DUNS*: 009095365

Budget Type*: ● Project ○ Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2015**End Date***: 09-29-2016**Budget Period:** 1**A. Senior/Key Person**

Prefix	First Name*	Middle Name	Last Name*	Suffix	Project Role*	Base	Calendar	Academic	Summer	Requested	Fringe	Funds Requested (\$)*
						Salary (\$)	Months	Months	Months	Salary (\$)*	Benefits (\$)*	
1.	Dr. Neal		Patwari		Project Lead	133,200.00	3.6			39,960.00	14,785.00	54,745.00
2.	Dr. MIRIAH	DAWN	MEYER		Project Lead	137,554.00	3.6			41,266.00	15,268.00	56,534.00

Total Funds Requested for all Senior Key Persons in the attached file

Additional Senior Key Persons:	File Name:	Total Senior/Key Person	111,279.00
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B. Other Personnel

Number of Personnel*	Project Role*	Calendar Months	Academic Months	Summer Months	Requested Salary (\$)*	Fringe Benefits*	Funds Requested (\$)*
	Post Doctoral Associates						
2	Graduate Students	12			54,600.00	4,368.00	58,968.00
	Undergraduate Students						
	Secretarial/Clerical						
1	Computer Science Sensor Developer	1.8			21,570.00	7,981.00	29,551.00
1	Pediatrics Sensor Developer	1.8			16,719.00	6,186.00	22,905.00
4	Total Number Other Personnel					Total Other Personnel	111,424.00
					Total Salary, Wages and Fringe Benefits (A+B)		222,703.00

RESEARCH & RELATED Budget {A-B} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION C, D, & E, BUDGET PERIOD 1**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2015**End Date***: 09-29-2016**Budget Period:** 1

C. Equipment Description		Funds Requested (\$)*
List items and dollar amount for each item exceeding \$5,000		
Equipment Item		Funds Requested (\$)*
Total funds requested for all equipment listed in the attached file		Total Equipment
Additional Equipment:	File Name:	

D. Travel		Funds Requested (\$)*
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)		
2. Foreign Travel Costs		
		Total Travel Cost

E. Participant/Trainee Support Costs		Funds Requested (\$)*
1. Tuition/Fees/Health Insurance		
2. Stipends		
3. Travel		
4. Subsistence		
5. Other:		
Number of Participants/Trainees	Total Participant Trainee Support Costs	0.00

RESEARCH & RELATED Budget {C-E} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTIONS F-K, BUDGET PERIOD 1**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2015**End Date***: 09-29-2016**Budget Period:** 1

F. Other Direct Costs	Funds Requested (\$)*
1. Materials and Supplies	
2. Publication Costs	
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8. Patient Care Cost	0.00
	Total Other Direct Costs
	0.00

G. Direct Costs	Funds Requested (\$)*
	Total Direct Costs (A thru F)
	222,703.00

H. Indirect Costs	Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)*
	1. MTDC_Research	49	222,703.00	109,124.00
	Total Indirect Costs			
	109,124.00			
Cognizant Federal Agency	DHHS, Wallace Chan, 415-437-7820			
(Agency Name, POC Name, and POC Phone Number)				

I. Total Direct and Indirect Costs	Funds Requested (\$)*
	Total Direct and Indirect Institutional Costs (G + H)
	331,827.00

J. Fee	Funds Requested (\$)*

K. Budget Justification*	File Name: Budget_Justification_Project_11013416816.pdf (Only attach one file.)
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RESEARCH & RELATED Budget {F-K} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION A & B, BUDGET PERIOD 2

ORGANIZATIONAL DUNS*: 009095365

Budget Type*: ● Project ○ Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2016**End Date***: 09-29-2017**Budget Period:** 2**A. Senior/Key Person**

Prefix	First Name*	Middle Name	Last Name*	Suffix	Project Role*	Base	Calendar	Academic	Summer	Requested	Fringe	Funds Requested (\$)*
						Salary (\$)	Months	Months	Months	Salary (\$)*	Benefits (\$)*	
1.	Dr. Neal		Patwari		Project Lead	133,200.00	3.6			39,960.00	14,785.00	54,745.00
2.	MS MIRIAH	DAWN	MEYER		Project Lead	137,554.00	3.6			41,266.00	15,268.00	56,534.00

Total Funds Requested for all Senior Key Persons in the attached file

Additional Senior Key Persons:	File Name:	Total Senior/Key Person	111,279.00
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B. Other Personnel

Number of Personnel*	Project Role*	Calendar Months	Academic Months	Summer Months	Requested Salary (\$)*	Fringe Benefits*	Funds Requested (\$)*
	Post Doctoral Associates						
2	Graduate Students	12			54,600.00	4,368.00	58,968.00
	Undergraduate Students						
	Secretarial/Clerical						
1	Computer Science Sensor Developer	1.8			21,570.00	7,981.00	29,551.00
1	Pediatrics Sensor Developer	1.8			16,719.00	6,186.00	22,905.00
4	Total Number Other Personnel					Total Other Personnel	111,424.00
					Total Salary, Wages and Fringe Benefits (A+B)		222,703.00

RESEARCH & RELATED Budget {A-B} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION C, D, & E, BUDGET PERIOD 2**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2016**End Date***: 09-29-2017**Budget Period:** 2

C. Equipment Description		Funds Requested (\$)*
List items and dollar amount for each item exceeding \$5,000		
Equipment Item		Funds Requested (\$)*
Total funds requested for all equipment listed in the attached file		Total Equipment
Additional Equipment:	File Name:	

D. Travel		Funds Requested (\$)*
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)		
2. Foreign Travel Costs		
		Total Travel Cost

E. Participant/Trainee Support Costs		Funds Requested (\$)*
1. Tuition/Fees/Health Insurance		
2. Stipends		
3. Travel		
4. Subsistence		
5. Other:		
Number of Participants/Trainees	Total Participant Trainee Support Costs	0.00

RESEARCH & RELATED Budget {C-E} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTIONS F-K, BUDGET PERIOD 2**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2016**End Date***: 09-29-2017**Budget Period:** 2

F. Other Direct Costs	Funds Requested (\$)*
1. Materials and Supplies	
2. Publication Costs	
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8. Patient Care Cost	0.00
	Total Other Direct Costs
	0.00

G. Direct Costs	Funds Requested (\$)*
	Total Direct Costs (A thru F)
	222,703.00

H. Indirect Costs	Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)*
	1. MTDC_Research	49	222,703.00	109,124.00
	Total Indirect Costs			
	109,124.00			
Cognizant Federal Agency	DHHS, Wallace Chan, 415-437-7820			
(Agency Name, POC Name, and POC Phone Number)				

I. Total Direct and Indirect Costs	Funds Requested (\$)*
	Total Direct and Indirect Institutional Costs (G + H)
	331,827.00

J. Fee	Funds Requested (\$)*

K. Budget Justification*	File Name: Budget_Justification_Project_11013416816.pdf (Only attach one file.)
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RESEARCH & RELATED Budget {F-K} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION A & B, BUDGET PERIOD 3

ORGANIZATIONAL DUNS*: 009095365

Budget Type*: ● Project ○ Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2017**End Date***: 09-29-2018**Budget Period:** 3**A. Senior/Key Person**

Prefix	First Name*	Middle Name	Last Name*	Suffix	Project Role*	Base	Calendar	Academic	Summer	Requested	Fringe	Funds Requested (\$)*
						Salary (\$)	Months	Months	Months	Salary (\$)*	Benefits (\$)*	
1.	Dr. Neal		Patwari		Project Lead	133,200.00	3.6			39,960.00	14,785.00	54,745.00
2.	MS MIRIAH	DAWN	MEYER		Project Lead	137,554.00	3.6			41,266.00	15,268.00	56,534.00

Total Funds Requested for all Senior Key Persons in the attached file

Additional Senior Key Persons:	File Name:	Total Senior/Key Person	111,279.00
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B. Other Personnel

Number of Personnel*	Project Role*	Calendar Months	Academic Months	Summer Months	Requested Salary (\$)*	Fringe Benefits*	Funds Requested (\$)*
	Post Doctoral Associates						
2	Graduate Students	12			54,600.00	4,368.00	58,968.00
	Undergraduate Students						
	Secretarial/Clerical						
1	Computer Science Sensor Developer	1.8			21,570.00	7,981.00	29,551.00
1	Pediatrics Sensor Developer	1.8			16,719.00	6,186.00	22,905.00
4	Total Number Other Personnel					Total Other Personnel	111,424.00
					Total Salary, Wages and Fringe Benefits (A+B)		222,703.00

RESEARCH & RELATED Budget {A-B} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION C, D, & E, BUDGET PERIOD 3**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2017**End Date***: 09-29-2018**Budget Period:** 3

C. Equipment Description		Funds Requested (\$)*
List items and dollar amount for each item exceeding \$5,000		
Equipment Item		Funds Requested (\$)*
Total funds requested for all equipment listed in the attached file		Total Equipment
Additional Equipment:	File Name:	

D. Travel		Funds Requested (\$)*
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)		
2. Foreign Travel Costs		
		Total Travel Cost

E. Participant/Trainee Support Costs		Funds Requested (\$)*
1. Tuition/Fees/Health Insurance		
2. Stipends		
3. Travel		
4. Subsistence		
5. Other:		
Number of Participants/Trainees		Total Participant Trainee Support Costs
		0.00

RESEARCH & RELATED Budget {C-E} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTIONS F-K, BUDGET PERIOD 3**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date*:** 09-30-2017**End Date*:** 09-29-2018**Budget Period:** 3

F. Other Direct Costs	Funds Requested (\$)*
1. Materials and Supplies	
2. Publication Costs	
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8. Patient Care Cost	0.00
	Total Other Direct Costs
	0.00

G. Direct Costs	Funds Requested (\$)*
	Total Direct Costs (A thru F)
	222,703.00

H. Indirect Costs	Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)*
	1. MTDC_Research	49	222,703.00	109,124.00
	Total Indirect Costs			
	109,124.00			
Cognizant Federal Agency	DHHS, Wallace Chan, 415-437-7820			
(Agency Name, POC Name, and POC Phone Number)				

I. Total Direct and Indirect Costs	Funds Requested (\$)*
	Total Direct and Indirect Institutional Costs (G + H)
	331,827.00

J. Fee	Funds Requested (\$)*

K. Budget Justification*	File Name: Budget_Justification_Project_11013416816.pdf (Only attach one file.)
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RESEARCH & RELATED Budget {F-K} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION A & B, BUDGET PERIOD 4

ORGANIZATIONAL DUNS*: 009095365

Budget Type*: ● Project ○ Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2018**End Date***: 09-29-2019**Budget Period:** 4**A. Senior/Key Person**

Prefix	First Name*	Middle Name	Last Name*	Suffix	Project Role*	Base	Calendar	Academic	Summer	Requested	Fringe	Funds Requested (\$)*
						Salary (\$)	Months	Months	Months	Salary (\$)*	Benefits (\$)*	
1.	Dr. Neal		Patwari		Project Lead	133,200.00	3.6			39,960.00	14,785.00	54,745.00
2.	MS MIRIAH	DAWN	MEYER		Project Lead	137,554.00	3.6			41,266.00	15,268.00	56,534.00

Total Funds Requested for all Senior Key Persons in the attached file

Additional Senior Key Persons:	File Name:	Total Senior/Key Person	111,279.00
---------------------------------------	------------	--------------------------------	-------------------

B. Other Personnel

Number of Personnel*	Project Role*	Calendar Months	Academic Months	Summer Months	Requested Salary (\$)*	Fringe Benefits*	Funds Requested (\$)*
	Post Doctoral Associates						
2	Graduate Students	12			54,600.00	4,368.00	58,968.00
	Undergraduate Students						
	Secretarial/Clerical						
1	Computer Science Sensor Developer	1.8			21,570.00	7,981.00	29,551.00
1	Pediatrics Sensor Developer	1.8			16,719.00	6,186.00	22,905.00
4	Total Number Other Personnel					Total Other Personnel	111,424.00
					Total Salary, Wages and Fringe Benefits (A+B)		222,703.00

RESEARCH & RELATED Budget {A-B} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION C, D, & E, BUDGET PERIOD 4**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2018**End Date***: 09-29-2019**Budget Period:** 4

C. Equipment Description	
List items and dollar amount for each item exceeding \$5,000	
Equipment Item	Funds Requested (\$)*
Total funds requested for all equipment listed in the attached file	Total Equipment
Additional Equipment: File Name:	

D. Travel		Funds Requested (\$)*
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)		0.00
2. Foreign Travel Costs		0.00
Total Travel Cost		0.00

E. Participant/Trainee Support Costs		Funds Requested (\$)*
1. Tuition/Fees/Health Insurance		0.00
2. Stipends		0.00
3. Travel		0.00
4. Subsistence		0.00
5. Other: None		0.00
Number of Participants/Trainees		Total Participant Trainee Support Costs
		0.00

RESEARCH & RELATED Budget {C-E} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTIONS F-K, BUDGET PERIOD 4**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2018**End Date***: 09-29-2019**Budget Period:** 4

F. Other Direct Costs	Funds Requested (\$)*
1. Materials and Supplies	
2. Publication Costs	
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8. Patient Care Cost	0.00
	Total Other Direct Costs
	0.00

G. Direct Costs	Funds Requested (\$)*
	Total Direct Costs (A thru F)
	222,703.00

H. Indirect Costs	Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)*
	1. MTDC_Research	49	222,703.00	109,124.00
	Total Indirect Costs			
	109,124.00			
Cognizant Federal Agency	DHHS, Wallace Chan, 415-437-7820			
(Agency Name, POC Name, and POC Phone Number)				

I. Total Direct and Indirect Costs	Funds Requested (\$)*
	Total Direct and Indirect Institutional Costs (G + H)
	331,827.00

J. Fee	Funds Requested (\$)*

K. Budget Justification*	File Name: Budget_Justification_Project_11013416816.pdf (Only attach one file.)
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RESEARCH & RELATED Budget {F-K} (Funds Requested)

Budget Justification

All person month calculations based on a twelve month calendar year appointment, unless otherwise noted.

PROJECT 1**A. Key Personnel**

Neal Patwari, PhD Co-Investigator [Effort: 30% FTE in years 1 through 4 (3.6 person months each year)] is an Associate Professor in the Department of Electrical & Computer Engineering at the University of Utah. Dr. Patwari has a PhD in Electrical and Computer Engineering and directs the University of Utah Sensing and Processing Across Networks (SPAN) Laboratory, which performs research at the intersection of statistical signal processing and wireless networking. He will serve as Project Lead and will oversee the development of the data acquisition infrastructure.

Miriah Meyer, PhD Co-Investigator [Effort: 30% FTE in years 1 through 4 (3.6 person months each year)] is an Assistant Professor in the School of Computing at the University of Utah. She specializes in designing visualization systems that support exploratory, complex data analysis tasks for scientific research; she also has extensive experience in customizing user interfaces and in providing age-appropriate feedback. Dr. Meyer will lead the development of appropriately tailored user interfaces for the data acquisition infrastructure.

B. Other Personnel

Hanseup Kim, PhD [Effort: 15% FTE in years 1 through 4 (1.8 person months each year)] is an Assistant Professor in the Department of Electrical and Computer Engineering at the University of Utah. He is a sensor developer who will serve as a content expert regarding the interfaces between sensors and our informatics infrastructure.

Scott C. Collingwood, PhD [Effort: 15% FTE in years 1 through 4 (1.8 person months each year)] is a Research Assistant Professor in the Department of Pediatrics at the University of Utah. Dr. Collingwood served as the Director of Environmental Monitoring for the University's National Children's Study vanguard sites, and conducts research on novel methods of exposure monitoring using direct reading instrumentation. He will serve as a content expert for environmental sensor data.

Graduate Research Assistants, two computer science graduate students will be hired [Effort for each: 50% FTE in years 1 through 4 (6 person months each year)], who will assist with the software development and validation efforts for the data acquisition platform.

RESEARCH & RELATED BUDGET - Cumulative Budget

	Totals (\$)
Section A, Senior/Key Person	445,116.00
Section B, Other Personnel	445,696.00
Total Number Other Personnel	16
Total Salary, Wages and Fringe Benefits (A+B)	890,812.00
Section C, Equipment	
Section D, Travel	0.00
1. Domestic	0.00
2. Foreign	0.00
Section E, Participant/Trainee Support Costs	0.00
1. Tuition/Fees/Health Insurance	0.00
2. Stipends	0.00
3. Travel	0.00
4. Subsistence	0.00
5. Other	0.00
6. Number of Participants/Trainees	
Section F, Other Direct Costs	0.00
1. Materials and Supplies	0.00
2. Publication Costs	0.00
3. Consultant Services	0.00
4. ADP/Computer Services	0.00
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	0.00
7. Alterations and Renovations	0.00
8. Other 1	
9. Other 2	
10. Other 3	
Section G, Direct Costs (A thru F)	890,812.00
Section H, Indirect Costs	436,496.00
Section I, Total Direct and Indirect Costs (G + H)	1,327,308.00
Section J, Fee	

PHS 398 Cover Page Supplement

OMB Number: 0925-0001

1. Project Director / Principal Investigator (PD/PI)

Prefix: Dr.
First Name*: Neal
Middle Name:
Last Name*: Patwari
Suffix:

2. Human Subjects

Clinical Trial? No Yes
Agency-Defined Phase III Clinical Trial?* No Yes

3. Permission Statement*

If this application does not result in an award, is the Government permitted to disclose the title of your proposed project, and the name, address, telephone number and e-mail address of the official signing for the applicant organization, to organizations that may be interested in contacting you for further information (e.g., possible collaborations, investment)?

Yes No

4. Program Income*

Is program income anticipated during the periods for which the grant support is requested? Yes No

If you checked "yes" above (indicating that program income is anticipated), then use the format below to reflect the amount and source(s). Otherwise, leave this section blank.

Budget Period* Anticipated Amount (\$)* Source(s)*

.....
.....
.....
.....
.....
.....
.....
.....

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5. Human Embryonic Stem Cells

Does the proposed project involve human embryonic stem cells?* No Yes

If the proposed project involves human embryonic stem cells, list below the registration number of the specific cell line(s) from the following list: http://grants.nih.gov/stem_cells/registry/current.htm. Or, if a specific stem cell line cannot be referenced at this time, please check the box indicating that one from the registry will be used:

Cell Line(s): Specific stem cell line cannot be referenced at this time. One from the registry will be used.

6. Inventions and Patents (For renewal applications only)

Inventions and Patents*: Yes No

If the answer is "Yes" then please answer the following:

Previously Reported*: Yes No

7. Change of Investigator / Change of Institution Questions

Change of principal investigator / program director

Name of former principal investigator / program director:

Prefix:

First Name*:

Middle Name:

Last Name*:

Suffix:

Change of Grantee Institution

Name of former institution*:

PHS 398 Research Plan

Please attach applicable sections of the research plan, below.

OMB Number: 0925-0001

1. Introduction to Application (for RESUBMISSION or REVISION only)	
2. Specific Aims	SpecificAimsProject11013416865.pdf
3. Research Strategy*	ResearchStrategyProject11013416866.pdf
4. Progress Report Publication List	
Human Subjects Sections	
5. Protection of Human Subjects	ProtectionsforHumanSubjects1013416633.pdf
6. Inclusion of Women and Minorities	WomenMinorities1013416817.pdf
7. Inclusion of Children	Children1013416818.pdf
Other Research Plan Sections	
8. Vertebrate Animals	
9. Select Agent Research	
10. Multiple PD/PI Leadership Plan	
11. Consortium/Contractual Arrangements	
12. Letters of Support	
13. Resource Sharing Plan(s)	
Appendix (if applicable)	
14. Appendix	

Project 1: Sensor Interface and Subject Interaction

Specific Aims

This proposal is to develop and evaluate a software information infrastructure for pediatric asthma research as part of the PRISMS project RFA-EB-15-003. The goal of this research is to enable and simplify new sensor and human subject's research that has the aim of collecting, analyzing, and compiling data from sensors in a subject's environment, displaying the data to the subject and allowing the user to interact with the data and their environment in some manner and at the same time provide mechanisms to allow integration of this data with other data sources necessary for clinical and translational research.

This project focuses on the sensor and user interfaces, and interaction with subjects. If successful, researchers can design a new studies, including what sensors will be used, what information they will collect, how the subject will interact with the data; the sensors and devices will be programmed, and study-specific software will be generated for use in such a study. The researchers will need little domain knowledge in the area of software development, sensor devices, wireless networking.

Specific aims for the Sensor and User Interface are:

1. *Develop a modular, secure, open standards platform for sensor data collection from a subject's home.* The platform must be simple to deploy and require no maintenance on the part of the subject, and must recover after outages (loss of power, internet) without human moderation. We will use test deployments and user studies to characterize a subject's acceptance of the sensor system. The system will use open standards for wireless interfaces and hardware sensor interfaces (e.g., lab of things).
2. *Develop a phone app designer,* a platform for designing a smartphone app that includes specifically the components required by a particular study, and provides exactly those interfaces to the user. The components are both for input (survey questions posed of the user) and visualization (providing information to the user). We will quantify user acceptance via surveys and phone app use data.
3. *Develop and test user interfaces and information visualization methods as a function of age.* We will investigate methods to provide information to a) children, b) young adults, and c) adults. For children, a phone may not be helpful, and instead, a separate wireless actuator can be used, e.g., a "toymail" like toy that reads instructions or information aloud to a child. For young adults, we can provide information on a phone but using alternative visualization methods. For adults, we can provide access to a broader variety of information displays.
4. *Deploy in subjects' homes to measure system performance.* This includes hardware and software performance (uptime, latency, accuracy of data time stamps); subject utilization (e.g., accessing app when notification set); and subject understanding of feedback (e.g., being able to answer questions about the data given various display / feedback mechanisms).

The Sensor Interface and Subject Interaction core personnel, Dr. Neal Patwari (ECE) and Dr. Miriah Meyer (CS) will lead the conduct of this research.

Research Strategy

Background and Significance

Fundamentally, the significance of this project is that it will enable development of a flexible, open source system for sensor deployments for human subjects experiments, designed for a variety of pediatric asthma research. We will design the system to have broad impact, capable of automatically configuring a wide range of asthma research experiments for use by experimenters and subjects with little to no subject knowledge of wireless embedded sensing networks. The project is to develop tools that automatically configure software, firmware, and networking protocols for a system of sensors that are to be deployed in a home, and with little human moderation, reliably send data from sensors to a database, and from the database and algorithms to a user interface such as an app on a smartphone.

This project is at the intersection of wireless networking, the “internet of things” (9), human computer interaction, data visualization, and cyber-physical systems. The subject is “in-the-loop”, that is, serving as both a sensor by answering questions posed by the experimenter (indirectly through an app), as well as an unpredictable actuator by controlling their environment. There is significant innovation in the automated interaction of a human with their sensor systems, with many potential benefits for human subjects research about the interaction between environment and pediatric health outcomes. The investigators for this project have expertise that spans these disciplines.

The primary problem with existing systems designed for the “internet-of-things” (IoT) is a lack of integration and modularity, which results in closed systems that cannot interact with each other (9, 10). Sensor, logistics, and actuator systems from one manufacturer tend not to work seamlessly with those from others; and the “internet-of-things” can be seen more of an “intranet” of vertically-stacked narrow solutions connected to the internet only through each vendors’ proprietary gateways. The result is minimal flexibility for a researcher designing an experiment with multiple modalities of sensors and interfaces. Further, data collection from sensors can be extremely challenging and require “hacking” an interface. In this project, we will expand upon existing open interface projects in the IoT space to further provide the sensor interfaces of interest to pediatric asthma researchers.

Innovation

We propose primarily the following innovations that will advance the capability of pediatric asthma researchers to conduct human subject experiments involving sensor data:

- We will develop new hardware, firmware, and software to seamlessly interface sensors of interest to asthma research to other information systems. These interfaces will follow open standards in the “lab of things” space.
- We will develop a tool to automate the generation of smart device (phone, tablet) apps that provide the researcher’s desired interaction between the subject and the collected data.
- We will investigate methods to provide information to a) children, b) young adults, and c) adults, not limited to smartphones, but also using audio feedback from “toys” for the youngest subjects, and other options for older subjects.

Research Team

This project will be led by Prof. Neal Patwari and Prof. Miriah Meyer, in conjunction with our center collaborators.

Preliminary Work

AirFeed System (Architecture)

A preliminary system has been developed for in-home air quality monitoring and user feedback at the SPAN lab (directed by Dr. Patwari) at the University of Utah. We call our present system the **AirFeed system** (6).

The AirFeed system is a modular architecture for collecting data from sensors deployed in a home, storage of the data in a database, and providing the data from a server to the web, to an analysis engine, and to a smart phone or tablet running our app. The system can be tailored to multiple sensors, and our prototype is tailored to monitor air quality. When the system detects poor air quality, it notifies the user and logs feedback messages, building a database of daily activities such as cooking, cleaning, and humidification. This available data raises the user's real-time awareness of indoor environmental conditions, providing an opportunity for users to take actions to improve them. We have prototyped the system from end to end, including three major components: Home, Air Server, and Smart Device.

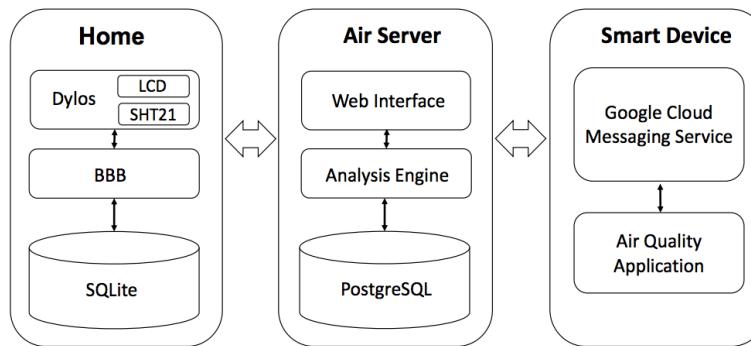


Figure 1. System Architecture

The Home system is a set of sensors connected to a WiFi-equipped Beaglebone Black (BBB). In our particular implementation, we are collecting air quality measurements (indoor particulate matter from 0.5 µm - 2.5 µm), temperature, and humidity sensor data. These measurements are stored in a local SQLite database and visually displayed on a LCD for better user interaction.

The Air Server is a storage point for air quality measurements taken from a network of Home systems. Home measurements are stored on a PostgreSQL database from which an Analysis Engine finds associations between activities near the Home and changes in the measurements. A Web Interface displays the processed data and allows access to the raw and processed measurements. The air server in turn sends air quality information to a user's smart device and can receive instructions from the user via the smart device (6).

The Smart Device is currently implemented for Android phones and tablets to obtain and provide feedback in real time between the user and air monitor based on changes in air quality.

Each component is discussed below as currently implemented.

Component: Home System (in-home sensors)

In our prototype, we have modified a DC1100 Pro Air Quality Monitor (1) (a laser particle counter that detects particles of size 0.5 - 2.5 µm) to include humidity and temperature and to be connected via WiFi as shown in Figure 2. The right side of Figure 2 shows the internal view of the additional hardware components we have added to the Dylos, which measure humidity and temperature using a SHT21 sensor and process and communicate data via a WiFi-enabled BeagleBone Black (BBB) (2), and an RGB-LCD for improved user interaction.

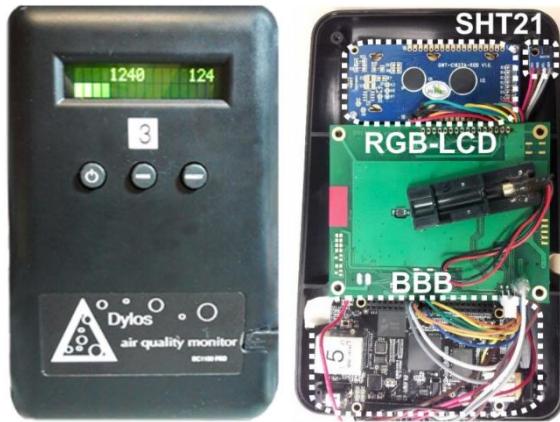


Figure 2. Modified Dylos DC1100 Pro

The BBB processes the sensor data, controls the LCD, and transmits via WiFi to the Air Server and Server-Side Air Quality Engine. For robustness, we use SQLite (3), a local transactional SQL database engine to mitigate variations in WiFi signals. The total hardware cost for our retrofitted air quality monitor is \$365 – which demonstrates that ubiquitous air quality sensing can be achieved at a reasonable cost. A network of DC1100s can be used in the same home.

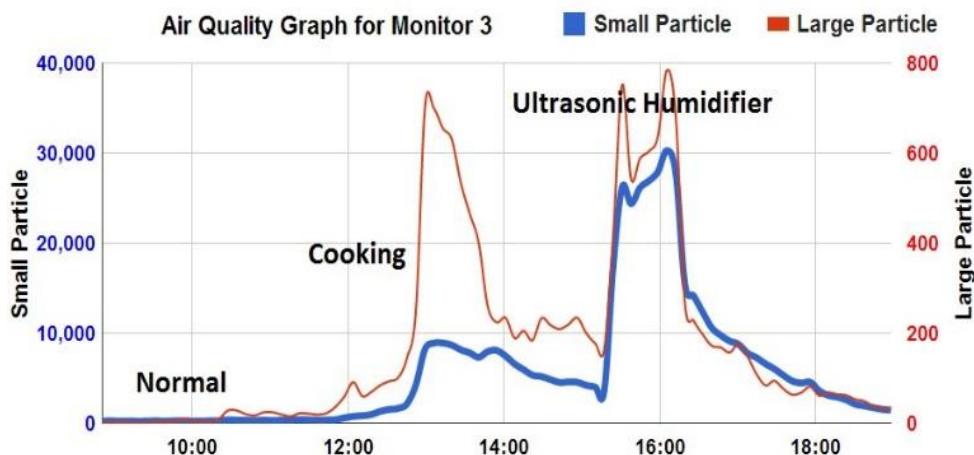


Figure 3. Air Quality Web Interface showing a graph of a single day during a home deployment

Component: Air Server System

The Air Server system contains a PostgreSQL database (4) to dump sensor measurements from many air quality monitors. The Air Server also contains a web interface to allow for easy user access to the data, and an analysis engine for analyzing data based on the amount of particulate matter, temperature, humidity, and time. This analysis engine can be configured to automatically classify user activity given a sequence of user-labeled samples.

The web Interface (Figure 3) shows a graph of a single day during a home deployment. The blue (thick) line represents the number of small particles and the red (thin) line represents the number of large particles. The data indicates two distinct human activities: cooking and the use of an ultrasonic humidifier. These spikes in air quality would prompt the user for feedback asking what types of activities are being performed. This allows the system to learn and recognize activity patterns. Notice how particles continue to stay relatively high compared to normal readings after the activities. By interacting with the user to explain and display the effects of particular actions, AirFeed can lead to changes in user behaviors that would improve air quality.

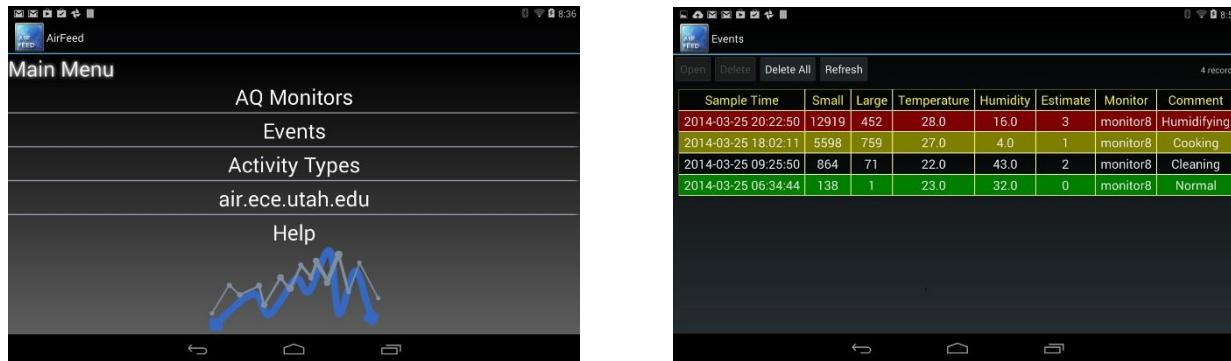


Figure 4. Smart Application Interface (left) showing notifications (right) to user

Component: Smart Device (Mobile app)

The Smart Device system is designed for Android phones and tablets to obtain and provide feedback between the user and Air Server based on changes in air quality. When significant changes in particulate matter, humidity, and temperature are detected, the air server sends a notification to the user android application through the Google Cloud Messaging (GCM) service (7) and asks the user what type of activities are being performed (e.g. cooking, cleaning, etc.). This feedback interface allows the system to learn behavioral patterns. Later, when air quality begins to deteriorate and it matches a known pattern, the app identifies what activity it believes is being performed.

Our system provides users with access to all past sensor data. Current conditions for both indoor and regional outdoor air quality, along with potential health risk assessments, are displayed on the monitor and Android application. The pattern information is plotted in graph form on the web interface allowing the user to understand the relationships between air quality and their daily activities (6).

Approach

We will take a problem-driven and user-centered approach to research and design. We rely on both a detailed understanding of the needs of, and a close collaboration with, domain experts to guide the design of algorithms, visual encodings, and interaction mechanisms. The domain experts for this project include children with asthma and their parents, as well as sensor developers, clinical care providers, and clinical and translational researchers. Our visualization systems build upon principles and methodologies from perception, design, and human-computer interaction, and combine novel mathematical models with algorithms from a range of fields such as computer graphics and computational geometry.

Our software and interfaces are open source and build upon popular standards, so that our work can take advantage of the state-of-the-art and provide others the opportunity to expand upon our results. We use tools that have large communities of support so that our contributions can be readily implemented well into the future.

1. Aim 1 – sensor data collection in the home

The PRISMS program will include studies that integrate data from multiple sensors. The platform will be simple to deploy and require no maintenance on the part of the subject, and must recover after outages (loss of power, internet) without human moderation.

We will engage the parents of children with asthma to design and validate our platform. We will use focus groups and individual interviews to determine requirements and needs. We will use test deployments and user studies to characterize a subject's acceptance of the sensor system, and to identify barriers and implementation issues.

2. Aim 2 – phone app designer

We will develop a platform for designing a smartphone app that includes specifically the components required by a particular study, and provides exactly those interfaces to the user (i.e., the parent or child). The components are both for input (survey questions posed of the user) and visualization (providing information to the user). We will quantify user acceptance via surveys and phone app use data. This aim interacts with project 3 aim 1, because clinical researchers, in designing a study, will configure the available components for their study. We will develop the software in accordance with the requirements that are identified in project 3.

3. Aim 3 – user interfaces and information visualization as function of age

Using principles and methodologies from perception, design, and human-computer interaction along with human growth and development, we will investigate methods to provide information to a) children, b) young adults, and c) adults. For children, a phone may not be helpful, and instead, a separate wireless actuator can be used, e.g., a “toymail” like toy that reads instructions or information aloud to a child (8). For young adults, we can provide information on a phone but using alternative visualization methods. For adults, we can provide access to a broader variety of information displays. We will engage clinical domain experts as well as parents and children in this design and development.

4. Aim 4- validate platform and evaluate performance

We will deploy a set of sensors in five volunteer homes to validate that the PRISMS data acquisition platform meets requirements and evaluate the performance. Evaluation will include hardware and software performance (uptime, latency, accuracy of data time stamps); subject utilization (e.g., accessing app when notification set); and subject understanding of feedback (e.g., being able to answer questions about the data given various display / feedback mechanisms).

Limitations and Strengths

The primary limitation to our project is that we are highly skilled at development but we are not health care clinicians or domain experts. To mitigate this we will collaborate with our colleagues in the PRISMS informatics center. We will leverage our clinical colleagues' expertise through requirements analysis and to guide our interactions with parents and children. This project is tightly integrated with the other projects in the informatics center; data will be exchanged bi-directionally with the core infrastructure.

Resource Sharing Plan: Individuals are required to comply with the Resource Sharing Plan as described in the Overall Component of this proposal.

Project Timeline

	Year 1 9/2015 - 9/2016 3 6 9 12	Year 2 9/2016 - 9/2017 15 18 21 24	Year 3 9/2017 - 9/2018 27 30 33 36	Year 4 9/2018 - 9/2019 39 42 45 48
Initial Requirements	X X X X			
identify/recruit participants				
Initial Requirements conduct focus groups and interviews	X X X	X		
Sensor data collection platform	X X X	X X X X	X X X X	
Phone app designer	X X X	X X X X	X X X X	
tailored user interfaces and information visualization methods		X X X	X X X X	X
evaluate project 1 system performance			X X X X	X
Overall Center Platform End-to-EndEvaluation. ALL 3 PROJECTS				X X X X X

Protections for Human Subjects

Approval of all protocols, forms, consents, and study modifications will be obtained from the University of Utah Institutional Review Boards.

Human Subjects Involvement and Characteristics: The subjects for this project include end user representative stakeholders in the design of user interfaces. Specifically, we will conduct focus groups of children with persistent asthma and their parents (most likely as parent/child dyads or triads) to develop requirements that will guide development of user interfaces.

Inclusion Criteria: Children/Parent Dyads: This will include children ages 5 to 18 years, with persistent asthma and/or parents of children with persistent asthma. Persistent asthma is defined as patients with a diagnosis of asthma and who have in the last 12 months: 1) one or more oral corticosteroid prescription(s) for an asthma attack or 2) one or more emergency department or hospital admissions for an asthma attack or 3) a clinical diagnosis of persistent or 4) not-well or poorly controlled asthma at the time of enrollment.

Exclusion criteria: patients with the following chronic or complex medical conditions will be excluded from the study since their co-morbid conditions may affect measured asthma outcomes. Patients with a history or increased risk of pulmonary disease (cystic fibrosis, lung dysplasia, broncho-pulmonary dysplasia, aspiration pneumonia, severe CP with aspiration risk, technology dependency (gastrostomy tube, tracheostomy), history of congenital heart disease requiring surgical correction or with complicating congestive heart failure requiring medical management, immunodeficiency (including patients on immunosuppressants), and malignancies. Also, patients who are uninsurable due to undocumented immigrant status will be excluded because their status regarding ability to pay for treatment may be an over-riding factor, confounding or obscuring effects of the intervention on "intent" to adhere to treatment.

Potential Risks to Human Subjects: We recognize that there are some potential patient risks related to the study. We will work closely with the Institutional Review Board at the University of Utah to ensure that procedures are in place to protect the rights and welfare of patients and parents. No adverse events that would harm study participants are anticipated. Participation in focus groups and interviews is voluntary and individuals can decide not to participate. The principal risks to participants of this research are loss of privacy and confidentiality, including potential subject identification, and potential breach of confidentiality through disclosure of protected health information. Installing rigorous security protections on data management, issuing regular reminders to project staff to change their passwords often, and adherence to HIPAA and IRB privacy and data security requirements will mitigate these risks.

Sources of Research Material: The data sources for this study will include recordings and notes from focus groups and usability testing as well as administrative data from sensors and example clinical data from longitudinal asthma symptom monitoring system. We will use patient identifiers (including patient's name, date of birth, address and gender) to link patients with sensors and clinical data to facilitate assessment of impact of environmental data on asthma outcomes.

Recruitment and Consent Procedures: Potential participants will be screen using inclusion and exclusion criteria at the time of an outpatient visit or hospital admission. Participants meeting criteria will be directly approached during hospital admissions for asthma care or invited to participate in the focus groups by the care coordinator through a phone call or letter. Parents who agree to participate will complete an informed consent document (for themselves) and **parental permission** (for their child). Children between 7 and 12 will provide **assent**.

Adequacy of Protection Against Risks: Approval of all protocols, forms, consents, and study modifications will be obtained from University of Utah IRB. The raw data from the focus groups will be stored on a secured network directory with authentication and authorization protections accessible only to the research team members requiring PHI access. All other research materials will be stored in a secure file cabinet in the PI's secured office at PCH. The key to linking data back to PHI will be secured on the PI's computer and will not be shared. All data analyses will be performed on data sets created without identifiers. Identifiers will be removed from study data files as early as possible in the data processing steps. All source/legacy data files will be

stored behind the University of Utah firewall. All investigators and project staff will sign confidentiality pledges annually and receive annual IRB and HIPAA privacy and data security compliance training

Potential Benefits: Participants will not benefit directly from participation in this study. This study will facilitate future research to enhance our understanding of the role of environmental exposures on asthma outcome. We anticipate that future interventions based on the new sensor monitoring system are expected to lead to improved overall asthma care, improved asthma control and possibly reduction of disparities among underserved children.

Importance of the knowledge to be gained: Therefore, our study will make significant contributions not only to the science about how to manage asthma and address asthma disparities but also to self-monitoring and self-management of other chronic diseases sensitive to environmental triggers, and to translation of effective interventions to patient populations with chronic disease. Results of our study will be of significance to health care organizations, researchers, parents, children with asthma care providers and policy makers nationwide.

Inclusion of Women and Minorities

We will use a convenience sample of representative end-user stakeholders. We will target professional participants based on their area of knowledge/expertise. We will recruit parents (and child) participants from patients or community members who are already known to the investigators. Parents may participate on their own or as part of a parent/child dyad or triad; it is likely that when we enroll children the child's mother (or female guardian) will enroll as part of the dyad or triad.

We will not exclude any stakeholder based on sex/gender, race, and ethnicity; to the extent possible we will recruit a broad and diverse a sample of stakeholders.

Planned Enrollment Report

Study Title: Project 1 Data Aquisition

Domestic/Foreign: Domestic

Comments: Professionals engaged in the design and evaluation are listed within project 3. For this project, we plan to include 6-8 children and their parents (1 or 2 parents per child, so up to 24 total people) to participate in focus groups and interviews for the design and validation. Given the local demographics we anticipate the enrollment as above. We will not exclude interested participants based on race or ethnicity so actual enrollment distribution may be different than below.

Racial Categories	Ethnic Categories				Total	
	Not Hispanic or Latino		Hispanic or Latino			
	Female	Male	Female	Male		
American Indian/Alaska Native	2	1	0	0	3	
Asian	1	1	0	0	2	
Native Hawaiian or Other Pacific Islander	0	0	0	0	0	
Black or African American	1	2	0	0	3	
White	5	5	3	3	16	
More than One Race	0	0	0	0	0	
Total	9	9	3	3	24	

Study 1 of 1

Inclusion of Children

We will recruit children ages 5-18, from patients or community members who are already known to the investigators. We will include children for the design and evaluation of components with which children will interact, such as for the design of age-appropriate interfaces. We expect this will be predominantly as a parent/child dyads or trios because we anticipate that in most cases, parents will supervise the child's use of sensors and software when they are deployed for a study. Project 1 will include children (and parents) in the design of sensor interfaces and for design of age-appropriate feedback. Children (and parents) will also be included in the end-to-end evaluation of the center infrastructure.

References

1. Dylos Corporation, *Learn more about the DC1100 Air Quality Monitor*, Online: <http://www.dylosproducts.com/learnabout.html> .
2. Adafruit, *Beaglebone Black Rev C*, Online: <https://www.adafruit.com/products/1876>.
3. SQLite, *About SQLite*, Online: <http://www.sqlite.org/about.html>.
4. PostgreSQL, *PostgreSQL: The world's most advanced open source database*, OnlineL <http://www.postgresql.org>.
5. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Outreach and Information Division, "AQI: air quality index: a guide to air quality and your health," Online: http://www.epa.gov/airnow/aqi_brochure_02_14.pdf, Feb. 2014.
6. K. T. Min, A. Forys, and T. Schmid, "Demo abstract: Airfeed: indoor real time interactive air quality monitoring system," in Proceedings of the 13th ACM/IEEE International Symposium on Information Processing in Sensor Networks. April 2014, pp. 325–326.
7. Google Android, *Google Cloud Messaging for Android*, <https://developer.android.com/google/gcm/index.html>
8. Toymail Inc., "Free voice messaging for kids!", Online: <http://www.toymail.co/>.
9. Fisher R, Ledwaba L, Hancke G, Kruger C. Open hardware: a role to play in wireless sensor networks? Sensors (Basel, Switzerland). 2015;15(3):6818-44.
10. Jimenez-Fernandez S, De Toledo P, Del Pozo F. Usability and interoperability in Wireless sensor networks for patient telemonitoring in chronic disease management. IEEE Trans Biomed Eng. 2013.

**APPLICATION FOR FEDERAL ASSISTANCE
SF 424 (R&R)**

5. APPLICANT INFORMATION

Organizational DUNS*: 009095365

Legal Name*: University of Utah
 Department:
 Division:
 Street1*: 75 South 2000 East
 Street2:
 City*: Salt Lake City
 County: Salt Lake
 State*: UT: Utah
 Province:
 Country*: USA: UNITED STATES
 ZIP / Postal Code*: 84112-8930

Person to be contacted on matters involving this application

Prefix:	First Name*:	Middle Name:	Last Name*:	Suffix:
	BRENDA		MALDONADO	

Position/Title: Sponsored Projects Officer
 Street1*: 75 South 2000 East
 Street2:
 City*: SALT LAKE CITY
 County: SALT LAKE
 State*: UT: Utah
 Province:
 Country*: USA: UNITED STATES
 ZIP / Postal Code*: 84112-8930

Phone Number*: 801-581-4798 Fax Number: 801-585-5749 Email: brenda.maldonado@osp.utah.edu

7. TYPE OF APPLICANT*

H: Public/State Controlled Institution of Higher Education

Other (Specify):

Small Business Organization Type Women Owned Socially and Economically Disadvantaged

11. DESCRIPTIVE TITLE OF APPLICANT'S PROJECT*

Prisms Informatics Platform - Federated Integration Architecture

12. PROPOSED PROJECT

Start Date*	Ending Date*
09/30/2015	09/29/2019

Project/Performance Site Location(s)

Project/Performance Site Primary Location

- I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name: University of Utah
Duns Number: 009095365
Street1*: 421 Wakara Way
Street2: Suite 140
City*: Salt Lake City
County: Salt Lake
State*: UT: Utah
Province:
Country*: USA: UNITED STATES
Zip / Postal Code*: 84108-3514

Project/Performance Site Congressional District*: UT-002

File Name

Additional Location(s)

RESEARCH & RELATED Other Project Information

1. Are Human Subjects Involved?* Yes No

1.a. If YES to Human Subjects

Is the Project Exempt from Federal regulations? Yes NoIf YES, check appropriate exemption number: 1 2 3 4 5 6If NO, is the IRB review Pending? Yes No

IRB Approval Date:

Human Subject Assurance Number 00003745

2. Are Vertebrate Animals Used?* Yes No

2.a. If YES to Vertebrate Animals

Is the IACUC review Pending? Yes No

IACUC Approval Date:

Animal Welfare Assurance Number

3. Is proprietary/privileged information included in the application?* Yes No**4.a. Does this project have an actual or potential impact - positive or negative - on the environment?*** Yes No

4.b. If yes, please explain:

4.c. If this project has an actual or potential impact on the environment, has an exemption been authorized or an environmental assessment (EA) or environmental impact statement (EIS) been performed?

4.d. If yes, please explain:

5. Is the research performance site designated, or eligible to be designated, as a historic place?* Yes No

5.a. If yes, please explain:

6. Does this project involve activities outside the United States or partnership with international collaborators?* Yes No

6.a. If yes, identify countries:

6.b. Optional Explanation:

Filename

7. Project Summary/Abstract* Abstract_Filler1013416978.pdf

8. Project Narrative***9. Bibliography & References Cited** ReferencesProject21013416868.pdf**10. Facilities & Other Resources****11. Equipment**

Please see the Abstract in the Overall component.

RESEARCH & RELATED Senior/Key Person Profile (Expanded)

PROFILE - Project Director/Principal Investigator				
Prefix:	First Name*: Ramkiran	Middle Name	Last Name*: Gouripeddi	Suffix:
Position/Title*:	Assistant Professor			
Organization Name*:	University of Utah			
Department:	BIOMEDICAL INFORMATICS			
Division:	SCHOOL OF MEDICINE			
Street1*:	421 Wakara Way			
Street2:	Suite 140			
City*:	Salt Lake City			
County:	Salt Lake			
State*:	UT: Utah			
Province:				
Country*:	USA: UNITED STATES			
Zip / Postal Code*:	84108-3514			
Phone Number*: 801-581-4080	Fax Number: 801-581-4297	E-Mail*: ram.gouripeddi@utah.edu		
Credential, e.g., agency login: RGOURIPEDDI				
Project Role*: Other (Specify)	Other Project Role Category: Project Lead			
Degree Type: MBBS	Degree Year: 2004			
Attach Biographical Sketch*:	File Name Gouripeddi1013416619.pdf			
Attach Current & Pending Support:				

PROFILE - Senior/Key Person					
Prefix: Dr.	First Name*: JULIO	Middle Name CESAR	Last Name*: FACELLI	Suffix:	
Position/Title*:	Professor				
Organization Name*:	University of Utah				
Department:	BIOMEDICAL INFORMATICS				
Division:	SCHOOL OF MEDICINE				
Street1*:	421 S. Wakara Way				
Street2:	Suite 140				
City*:	SALT LAKE CITY				
County:	SALT LAKE				
State*:	UT: Utah				
Province:					
Country*:	USA: UNITED STATES				
Zip / Postal Code*:	841083514				
Phone Number*:	801/585-3791	Fax Number:	801-581-4297	E-Mail*:	julio.facelli@utah.edu
Credential, e.g., agency login: JULIOFACELLI					
Project Role*:	Other (Specify) Other Project Role Category: Project Lead				
Degree Type:	PhD Degree Year: 1981				
	File Name				
Attach Biographical Sketch*:					
Attach Current & Pending Support:					

PROFILE - Senior/Key Person				
Prefix: Dr	First Name*: KERRY	Middle Name E.	Last Name*: KELLY	Suffix:
Position/Title*:	Research Associate			
Organization Name*:	University of Utah			
Department:	INST. CLEAN&SECURE ENERGY			
Division:	SR VP ACADEMIC AFFAIRS			
Street1*:	155 S 1452 E RM 380			
Street2:				
City*:	SALT LAKE CITY			
County:	SALT LAKE			
State*:	UT: Utah			
Province:				
Country*:	USA: UNITED STATES			
Zip / Postal Code*:	84112-5880			
Phone Number*:	801/587-7601	Fax Number:	E-Mail*:	kelly@eng.utah.edu
Credential, e.g., agency login: KERRYKELLY				
Project Role*:	Co-Investigator Other Project Role Category:			
Degree Type:	Degree Year:			
	File Name			
Attach Biographical Sketch*:	Kellyv21013343173.pdf			
Attach Current & Pending Support:				

PROFILE - Senior/Key Person				
Prefix:	First Name*: JOHN	Middle Name D	Last Name*: HOREL	Suffix:
Position/Title*:	Professor			
Organization Name*:	University of Utah			
Department:	ATMOSPHERIC SCIENCES			
Division:	COLL OF MINES & EARTH SCI			
Street1*:	135 S 1460 E RM 819			
Street2:				
City*:	SALT LAKE CITY			
County:	SALT LAKE			
State*:	UT: Utah			
Province:				
Country*:	USA: UNITED STATES			
Zip / Postal Code*:	84112-5880			
Phone Number*:	801/581-7091	Fax Number:	E-Mail*: john.horel@utah.edu	
Credential, e.g., agency login:				
Project Role*:	Co-Investigator	Other Project Role Category:		
Degree Type:	Degree Year:			
Attach Biographical Sketch*:	File Name SF424R_R_biosketch_Horel_NIH1013343174.pdf			
Attach Current & Pending Support:				

RESEARCH & RELATED BUDGET - SECTION A & B, BUDGET PERIOD 1

ORGANIZATIONAL DUNS*: 009095365

Budget Type*: ● Project ○ Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2015**End Date***: 09-29-2016**Budget Period:** 1

A. Senior/Key Person												
	Prefix First Name*	Middle Name	Last Name*	Suffix	Project Role*	Base	Calendar	Academic	Summer	Requested	Fringe	Funds Requested (\$)*
						Salary (\$)	Months	Months	Months	Salary (\$)*	Benefits (\$)*	
1.	Ramkiran		Gouripeddi		Project Lead	153,637.00	3.6			46,091.00	17,054.00	63,145.00
2.	JULIO	CESAR	FACELLI		Project Lead	183,300.00	1.2			18,330.00	6,782.00	25,112.00
3.	KERRY	E.	KELLY		Co-Investigator	105,000.00	1.8			15,750.00	5,828.00	21,578.00
4.	JOHN	D	HOREL		Co-Investigator	157,332.00	1.8			23,600.00	8,732.00	32,332.00

Total Funds Requested for all Senior Key Persons in the attached fileAdditional Senior Key Persons: File Name: Total Senior/Key Person **142,167.00**

B. Other Personnel

Number of Personnel*	Project Role*	Calendar Months	Academic Months	Summer Months	Requested Salary (\$)*	Fringe Benefits*	Funds Requested (\$)*
1	Post Doctoral Associates	12			70,000.00	36,400.00	106,400.00
1	Graduate Students	7.5			32,500.00	2,600.00	35,100.00
	Undergraduate Students						
	Secretarial/Clerical						
1	Technical Lead/Development Manger	1.2			9,613.00	4,999.00	14,612.00
1	Senior Software Engineer	2.4			20,384.00	10,600.00	30,984.00
1	Data Architect	1.2			10,278.00	5,344.00	15,622.00
5	Total Number Other Personnel					Total Other Personnel	202,718.00
						Total Salary, Wages and Fringe Benefits (A+B)	344,885.00

RESEARCH & RELATED Budget {A-B} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION C, D, & E, BUDGET PERIOD 1**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2015**End Date***: 09-29-2016**Budget Period:** 1

C. Equipment Description		Funds Requested (\$)*
List items and dollar amount for each item exceeding \$5,000		
Equipment Item		Funds Requested (\$)*
Total funds requested for all equipment listed in the attached file		Total Equipment
Additional Equipment:	File Name:	

D. Travel		Funds Requested (\$)*
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)		
2. Foreign Travel Costs		
		Total Travel Cost

E. Participant/Trainee Support Costs		Funds Requested (\$)*
1. Tuition/Fees/Health Insurance		
2. Stipends		
3. Travel		
4. Subsistence		
5. Other:		
Number of Participants/Trainees		Total Participant Trainee Support Costs
		0.00

RESEARCH & RELATED Budget {C-E} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTIONS F-K, BUDGET PERIOD 1**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2015**End Date***: 09-29-2016**Budget Period:** 1

F. Other Direct Costs	Funds Requested (\$)*
1. Materials and Supplies	
2. Publication Costs	
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8. Patient Care Cost	0.00
	Total Other Direct Costs
	0.00

G. Direct Costs	Funds Requested (\$)*
	Total Direct Costs (A thru F)
	344,885.00

H. Indirect Costs	Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)*
	1. MTDC_Research	49	344,885.00	168,994.00
	Total Indirect Costs			
	168,994.00			
Cognizant Federal Agency	DHHS, Wallace Chan, 415-437-7820			
(Agency Name, POC Name, and POC Phone Number)				

I. Total Direct and Indirect Costs	Funds Requested (\$)*
	Total Direct and Indirect Institutional Costs (G + H)
	513,879.00

J. Fee	Funds Requested (\$)*

K. Budget Justification*	File Name: Budget_Justification_Project_21013416819.pdf (Only attach one file.)
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RESEARCH & RELATED Budget {F-K} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION A & B, BUDGET PERIOD 2

ORGANIZATIONAL DUNS*: 009095365

Budget Type*: ● Project ○ Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2016**End Date***: 09-29-2017**Budget Period:** 2**A. Senior/Key Person**

	Prefix	First Name*	Middle Name	Last Name*	Suffix	Project Role*	Base	Calendar	Academic	Summer	Requested	Fringe	Funds Requested (\$)*
							Salary (\$)	Months	Months	Months	Salary (\$)*	Benefits (\$)*	
1.		Ramkiran		Gouripeddi		Project Lead	153,637.00	3.6			46,091.00	17,054.00	63,145.00
2.	JULIO	CESAR		FACELLI		Project Lead	183,300.00	1.2			18,330.00	6,782.00	25,112.00
3.	KERRY	E.		KELLY		Co-Investigator	105,000.00	1.8			15,750.00	5,828.00	21,578.00
4.	JOHN	D		HOREL		Co-Investigator	157,332.00	1.8			23,600.00	8,732.00	32,332.00

Total Funds Requested for all Senior Key Persons in the attached file

Additional Senior Key Persons:	File Name:	Total Senior/Key Person	142,167.00
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B. Other Personnel

Number of Personnel*	Project Role*	Calendar Months	Academic Months	Summer Months	Requested Salary (\$)*	Fringe Benefits*	Funds Requested (\$)*
1	Post Doctoral Associates	12			70,000.00	36,400.00	106,400.00
1	Graduate Students	7.5			32,500.00	2,600.00	35,100.00
	Undergraduate Students						
	Secretarial/Clerical						
1	Technical Lead/Development Manger	1.2			9,613.00	4,999.00	14,612.00
1	Senior Software Engineer	2.4			20,384.00	10,600.00	30,984.00
1	Data Architect	1.2			10,278.00	5,344.00	15,622.00
5	Total Number Other Personnel					Total Other Personnel	202,718.00
						Total Salary, Wages and Fringe Benefits (A+B)	344,885.00

RESEARCH & RELATED Budget {A-B} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION C, D, & E, BUDGET PERIOD 2**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2016**End Date***: 09-29-2017**Budget Period:** 2

C. Equipment Description	
List items and dollar amount for each item exceeding \$5,000	
Equipment Item	Funds Requested (\$)*
Total funds requested for all equipment listed in the attached file	Total Equipment
Additional Equipment: File Name:	

D. Travel		Funds Requested (\$)*
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)		0.00
2. Foreign Travel Costs		0.00
Total Travel Cost		0.00

E. Participant/Trainee Support Costs		Funds Requested (\$)*
1. Tuition/Fees/Health Insurance		0.00
2. Stipends		0.00
3. Travel		0.00
4. Subsistence		0.00
5. Other: None		0.00
Number of Participants/Trainees		Total Participant Trainee Support Costs
		0.00

RESEARCH & RELATED Budget {C-E} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTIONS F-K, BUDGET PERIOD 2**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2016**End Date***: 09-29-2017**Budget Period:** 2

F. Other Direct Costs	Funds Requested (\$)*
1. Materials and Supplies	
2. Publication Costs	
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8. Patient Care Cost	0.00
9. None	0.00
10. None	0.00
	Total Other Direct Costs
	0.00

G. Direct Costs	Funds Requested (\$)*
	Total Direct Costs (A thru F)
	344,885.00

H. Indirect Costs	Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)*
	1. MTDC_Research	49	344,885.00	168,994.00
	Total Indirect Costs			
	168,994.00			
Cognizant Federal Agency	DHHS, Wallace Chan, 415-437-7820			
(Agency Name, POC Name, and POC Phone Number)				

I. Total Direct and Indirect Costs	Funds Requested (\$)*
	Total Direct and Indirect Institutional Costs (G + H)
	513,879.00

J. Fee	Funds Requested (\$)*

K. Budget Justification*	File Name: Budget_Justification_Project_21013416819.pdf (Only attach one file.)
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RESEARCH & RELATED Budget {F-K} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION A & B, BUDGET PERIOD 3

ORGANIZATIONAL DUNS*: 009095365

Budget Type*: ● Project ○ Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2017**End Date***: 09-29-2018**Budget Period:** 3

A. Senior/Key Person												
	Prefix First Name*	Middle Name	Last Name*	Suffix	Project Role*	Base	Calendar	Academic	Summer	Requested	Fringe	Funds Requested (\$)*
						Salary (\$)	Months	Months	Months	Salary (\$)*	Benefits (\$)*	
1.	Ramkiran		Gouripeddi		Project Lead	153,637.00	3.6			46,091.00	17,054.00	63,145.00
2.	JULIO	CESAR	FACELLI		Project Lead	183,300.00	1.2			18,330.00	6,782.00	25,112.00
3.	KERRY	E.	KELLY		Co-Investigator	105,000.00	1.8			15,750.00	5,828.00	21,578.00
4.	JOHN	D	HOREL		Co-Investigator	157,332.00	1.8			23,600.00	8,732.00	32,332.00

Total Funds Requested for all Senior Key Persons in the attached fileAdditional Senior Key Persons: File Name: **Total Senior/Key Person** **142,167.00****B. Other Personnel**

Number of Personnel*	Project Role*	Calendar Months	Academic Months	Summer Months	Requested Salary (\$)*	Fringe Benefits*	Funds Requested (\$)*
1	Post Doctoral Associates	12			70,000.00	36,400.00	106,400.00
1	Graduate Students	7.5			32,500.00	2,600.00	35,100.00
	Undergraduate Students						
	Secretarial/Clerical						
1	Technical Lead/Development Manger	1.2			9,613.00	4,999.00	14,612.00
1	Senior Software Engineer	2.4			20,384.00	10,600.00	30,984.00
1	Data Architect	1.2			10,278.00	5,344.00	15,622.00
5	Total Number Other Personnel					Total Other Personnel	202,718.00
						Total Salary, Wages and Fringe Benefits (A+B)	344,885.00

RESEARCH & RELATED Budget {A-B} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION C, D, & E, BUDGET PERIOD 3**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2017**End Date***: 09-29-2018**Budget Period:** 3

C. Equipment Description		Funds Requested (\$)*
List items and dollar amount for each item exceeding \$5,000		
Equipment Item		Funds Requested (\$)*
Total funds requested for all equipment listed in the attached file		Total Equipment
Additional Equipment:	File Name:	

D. Travel		Funds Requested (\$)*
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)		
2. Foreign Travel Costs		
		Total Travel Cost

E. Participant/Trainee Support Costs		Funds Requested (\$)*
1. Tuition/Fees/Health Insurance		
2. Stipends		
3. Travel		
4. Subsistence		
5. Other:		
Number of Participants/Trainees	Total Participant Trainee Support Costs	0.00

RESEARCH & RELATED Budget {C-E} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTIONS F-K, BUDGET PERIOD 3**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date*:** 09-30-2017**End Date*:** 09-29-2018**Budget Period:** 3

F. Other Direct Costs	Funds Requested (\$)*
1. Materials and Supplies	
2. Publication Costs	
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8. Patient Care Cost	0.00
	Total Other Direct Costs
	0.00

G. Direct Costs	Funds Requested (\$)*
	Total Direct Costs (A thru F)
	344,885.00

H. Indirect Costs	Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)*
	1. MTDC_Research	49	344,885.00	168,994.00
	Cognizant Federal Agency			
	DHHS, Wallace Chan, 415-437-7820 (Agency Name, POC Name, and POC Phone Number)			

I. Total Direct and Indirect Costs	Funds Requested (\$)*
	Total Direct and Indirect Institutional Costs (G + H)
	513,879.00

J. Fee	Funds Requested (\$)*

K. Budget Justification*	File Name: Budget_Justification_Project_21013416819.pdf (Only attach one file.)
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RESEARCH & RELATED Budget {F-K} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION A & B, BUDGET PERIOD 4

ORGANIZATIONAL DUNS*: 009095365

Budget Type*: ● Project ○ Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2018**End Date***: 09-29-2019**Budget Period:** 4**A. Senior/Key Person**

	Prefix	First Name*	Middle Name	Last Name*	Suffix	Project Role*	Base	Calendar	Academic	Summer	Requested	Fringe	Funds Requested (\$)*
							Salary (\$)	Months	Months	Months	Salary (\$)*	Benefits (\$)*	
1.		Ramkiran		Gouripeddi		Project Lead	153,637.00	3.6			46,091.00	17,054.00	63,145.00
2.	JULIO	CESAR		FACELLI		Project Lead	183,300.00	1.2			18,330.00	6,782.00	25,112.00
3.	KERRY	E.		KELLY		Co-Investigator	105,000.00	1.8			15,750.00	5,828.00	21,578.00
4.	JOHN	D		HOREL		Co-Investigator	157,332.00	1.8			23,600.00	8,732.00	32,332.00

Total Funds Requested for all Senior Key Persons in the attached file

Additional Senior Key Persons:	File Name:	Total Senior/Key Person	142,167.00
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B. Other Personnel

Number of Personnel*	Project Role*	Calendar Months	Academic Months	Summer Months	Requested Salary (\$)*	Fringe Benefits*	Funds Requested (\$)*
1	Post Doctoral Associates	12			70,000.00	36,400.00	106,400.00
1	Graduate Students	7.5			32,500.00	2,600.00	35,100.00
	Undergraduate Students						
	Secretarial/Clerical						
1	Technical Lead/Development Manger	1.2			9,613.00	4,999.00	14,612.00
1	Senior Software Engineer	2.4			20,384.00	10,600.00	30,984.00
1	Data Architect	1.2			10,278.00	5,344.00	15,622.00
5	Total Number Other Personnel					Total Other Personnel	202,718.00
						Total Salary, Wages and Fringe Benefits (A+B)	344,885.00

RESEARCH & RELATED Budget {A-B} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION C, D, & E, BUDGET PERIOD 4**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2018**End Date***: 09-29-2019**Budget Period:** 4

C. Equipment Description		Funds Requested (\$)*
List items and dollar amount for each item exceeding \$5,000		
Equipment Item		Funds Requested (\$)*
Total funds requested for all equipment listed in the attached file		Total Equipment
Additional Equipment:	File Name:	

D. Travel		Funds Requested (\$)*
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)		
2. Foreign Travel Costs		
		Total Travel Cost

E. Participant/Trainee Support Costs		Funds Requested (\$)*
1. Tuition/Fees/Health Insurance		
2. Stipends		
3. Travel		
4. Subsistence		
5. Other:		
Number of Participants/Trainees		Total Participant Trainee Support Costs
		0.00

RESEARCH & RELATED Budget {C-E} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTIONS F-K, BUDGET PERIOD 4**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date*:** 09-30-2018**End Date*:** 09-29-2019**Budget Period:** 4

F. Other Direct Costs	Funds Requested (\$)*
1. Materials and Supplies	
2. Publication Costs	
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8. Patient Care Cost	0.00
	Total Other Direct Costs
	0.00

G. Direct Costs	Funds Requested (\$)*
	Total Direct Costs (A thru F)
	344,885.00

H. Indirect Costs	Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)*
	1. MTDC_Research	49	344,885.00	168,994.00
	Cognizant Federal Agency			
	DHHS, Wallace Chan, 415-437-7820 (Agency Name, POC Name, and POC Phone Number)			

I. Total Direct and Indirect Costs	Funds Requested (\$)*
	Total Direct and Indirect Institutional Costs (G + H)
	513,879.00

J. Fee	Funds Requested (\$)*

K. Budget Justification*	File Name: Budget_Justification_Project_21013416819.pdf (Only attach one file.)
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RESEARCH & RELATED Budget {F-K} (Funds Requested)

Budget Justification

All person month calculations based on a twelve month calendar year appointment, unless otherwise noted.

PROJECT 2:**A. Key Personnel**

Ramkiran Gouripeddi, MS, MBBS Project Lead [Effort: 30% FTE in years 1 through 4 (3.6 person months each year)] is an Assistant Professor of Biomedical Informatics at the University of Utah. He has expertise in clinical research informatics, machine learning, and Big Data analytics combined with experience with personalized medicine, data modeling, terminologies and ontologies. He played an instrumental role throughout the development of FURTheR and OpenFurther. Dr Gouripeddi will serve as Project Lead and in this capacity will oversee the successful accomplishment of all aims for project 2.

Julio Facelli, PhD Principal Investigator, Co-Project Lead [Effort for Project 2: 10% FTE in years 1 through 4 (0.6 person months each year)] is a Professor of Biomedical Informatics at the University of Utah and director of the BMI Core. He is the senior investigator and Co-Project Lead for this project and in this capacity will collaborate with and advise Dr. Gouripeddi in the development of the core infrastructure for the informatics platform.

B. Other Personnel

Kerry Kelly, PhD Content Expert [Effort: 15% FTE in years 1 through 4 (1.8 person months each year)] is an Assistant Professor in the Department of Chemistry at the University of Utah. She will serve as an environmental air quality content expert, helping to ensure that the infrastructure is generalizable to a large variety of environmental data.

John D Horel, PhD Content Expert. [Effort: 15% FTE in years 1 through 4 (1.8 person months each year)] is a Professor of Atmospheric Sciences who conducts research to improve data assimilation techniques over complex terrain and evaluate the cost effectiveness of surface observing networks. He will serve as a content expert regarding environmental sensor data and methods to incorporate geospatial links with sensor data.

Randy K Madsen Staff [Effort: 10% FTE in years 1 through 4 (1.2 person months each year)] is Senior Technical Lead for the Biomedical Informatics Core (BMIC) of the Center for Clinical and Translational Sciences (CCTS). He will oversee technical development of the core infrastructure.

TBN Staff [Effort: 20% FTE in years 1 through 4 (2.4 person months each year)] Senior Software Engineer will be assigned from the Biomedical Informatics Core (BMIC) of the Center for Clinical and Translational Sciences (CCTS). The senior software engineer will help to design and implement the core infrastructure and interfaces for project 3.

Peter Mo Staff [Effort: 10% FTE in years 1 through 4 (1.2 person months each year)] is a Data Architect for the Biomedical Informatics Core (BMIC) of the Center for Clinical and Translational Sciences (CCTS). He will help to design the data storage mechanisms for the core infrastructure.

TBN, Postdoctoral Student, a biomedical informatics post-doc student will be hired [Effort: 100% FTE in years 1 through 4 (12 person months each year)], to assist with the data modeling, software development and validation efforts for the core infrastructure.

Graduate Research Assistant, a biomedical informatics graduate students will be hired [Effort: 50% FTE for 9 months in years 1 through 4 (4.5 person months each year)and 100% for 3 months in years 1 through 4 (3 person months)], who will assist with the software development and validation efforts for the core infrastructure.

RESEARCH & RELATED BUDGET - Cumulative Budget

	Totals (\$)
Section A, Senior/Key Person	568,668.00
Section B, Other Personnel	810,872.00
Total Number Other Personnel	20
Total Salary, Wages and Fringe Benefits (A+B)	1,379,540.00
Section C, Equipment	
Section D, Travel	0.00
1. Domestic	0.00
2. Foreign	0.00
Section E, Participant/Trainee Support Costs	0.00
1. Tuition/Fees/Health Insurance	0.00
2. Stipends	0.00
3. Travel	0.00
4. Subsistence	0.00
5. Other	0.00
6. Number of Participants/Trainees	
Section F, Other Direct Costs	0.00
1. Materials and Supplies	0.00
2. Publication Costs	0.00
3. Consultant Services	0.00
4. ADP/Computer Services	0.00
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	0.00
7. Alterations and Renovations	0.00
8. Other 1	0.00
9. Other 2	0.00
10. Other 3	0.00
Section G, Direct Costs (A thru F)	1,379,540.00
Section H, Indirect Costs	675,976.00
Section I, Total Direct and Indirect Costs (G + H)	2,055,516.00
Section J, Fee	

PHS 398 Cover Page Supplement

OMB Number: 0925-0001

1. Project Director / Principal Investigator (PD/PI)

Prefix:

First Name*: Ramkiran

Middle Name:

Last Name*: Gouripeddi

Suffix:

2. Human Subjects

Clinical Trial? No YesAgency-Defined Phase III Clinical Trial?* No Yes

3. Permission Statement*

If this application does not result in an award, is the Government permitted to disclose the title of your proposed project, and the name, address, telephone number and e-mail address of the official signing for the applicant organization, to organizations that may be interested in contacting you for further information (e.g., possible collaborations, investment)?

 Yes No

4. Program Income*

Is program income anticipated during the periods for which the grant support is requested? Yes No

If you checked "yes" above (indicating that program income is anticipated), then use the format below to reflect the amount and source(s). Otherwise, leave this section blank.

Budget Period* Anticipated Amount (\$)* Source(s)*

.....
.....
.....
.....
.....
.....
.....
.....

PHS 398 Cover Page Supplement

5. Human Embryonic Stem Cells

Does the proposed project involve human embryonic stem cells?*

No Yes

If the proposed project involves human embryonic stem cells, list below the registration number of the specific cell line(s) from the following list: http://grants.nih.gov/stem_cells/registry/current.htm. Or, if a specific stem cell line cannot be referenced at this time, please check the box indicating that one from the registry will be used:

Cell Line(s): Specific stem cell line cannot be referenced at this time. One from the registry will be used.

6. Inventions and Patents (For renewal applications only)

Inventions and Patents*: Yes No

If the answer is "Yes" then please answer the following:

Previously Reported*: Yes No

7. Change of Investigator / Change of Institution Questions

Change of principal investigator / program director

Name of former principal investigator / program director:

Prefix:

First Name*:

Middle Name:

Last Name*:

Suffix:

Change of Grantee Institution

Name of former institution*:

PHS 398 Research Plan

Please attach applicable sections of the research plan, below.

OMB Number: 0925-0001

1. Introduction to Application (for RESUBMISSION or REVISION only)	
2. Specific Aims	SpecificAimsProject21013416869.pdf
3. Research Strategy*	ResearchStrategyProject21013416870.pdf
4. Progress Report Publication List	
Human Subjects Sections	
5. Protection of Human Subjects	ProtectionsforHumanSubjects1013416638.pdf
6. Inclusion of Women and Minorities	WomenMinorities1013416820.pdf
7. Inclusion of Children	Children1013416821.pdf
Other Research Plan Sections	
8. Vertebrate Animals	
9. Select Agent Research	
10. Multiple PD/PI Leadership Plan	
11. Consortium/Contractual Arrangements	
12. Letters of Support	
13. Resource Sharing Plan(s)	
Appendix (if applicable)	
14. Appendix	

Project 2: An Informatics Architecture for the Pediatric Asthma *Exposome*

Specific Aims

Understanding the effects of the modern environment on pediatric asthma requires generation of a complete picture of the environmental exposures and socio-economic factors. Such an *exposome* (1,2) would require integration of data from wearable and stationary sensors, environmental monitors, physiology, medication use and other clinical data. Also such an integration would need to have a high spatial-temporal resolution for correlating times and location of exposures to occurrences of conditions and their severities. This would require filling any gaps in the measured data with modeled data along with characterization of any uncertainties.

OpenFurther is an informatics platform that supports federation and integration of data from heterogeneous and disparate data sources (3-10). It supports clinical and translational research by bringing data directly to researchers without requiring the technical expertise to query large databases or knowledge about the data source in easy to use user interfaces. In addition to biomedical data, OpenFurther now prototypes air quality data integration (3) to support clinical and translational research.

Current methods of using and integrating sensor and environmental data with clinical and patient reported data are at best ad hoc and not generalizable. A major challenge in such an integration is the lack of harmonization of data measured from different sensor devices due to lack of common standards. Moreover, there are often difficulties in ascertaining different data sources for different research needs and therefore data from a single sensor device is usually used and is not supplemented with data environmental data to provide a complete picture of a child's exposure.

We propose the following specific aims to enhance the current OpenFurther informatics infrastructure to address the above limitations making it a central piece of the PRISMS informatics architecture for data integration:

Specific Aims:

1. Sensor Data Harmonization Framework: Augment OpenFurther with a logical data model to store and harmonize metadata from environmental mobile sensors.
2. Sensor - Environmental Mathematical Modeling: Incorporate into OpenFurther a state of the art mathematical modeling framework that uses sparse experimental data from mobile sensors and environmental monitoring providing a high resolution spatial-temporal grid of exposures along with associated uncertainties.
3. Data Integration and Storage: Add to OpenFurther the capabilities to federate, integrate and store environmental mobile sensor data with biomedical data as well as supplement with mathematically modeled data.

With these added capabilities, OpenFurther will support researchers by providing access to appropriate metadata annotated sensor and environmental data, supplemented with modeled data to provide a high resolution spatial-temporal grid of exposures, and finally integrated with clinical and patient reported data to generate a comprehensive pediatric asthma *exposome*.

Research Strategy

This project will provide the platform for integration of environmental, physiological, and behavior data from mobile sensors, and clinical data from electronic medical record systems. We will develop a logical model that is representative of mobile sensor data by assessing data needs and availability of different data types. We will then model mobile sensor data with environmental data to generate a high resolution spatial-temporal grid. Finally, we will integrate sensor data, environmental data and clinical data, store, and securely upload the data to the data coordination center. This project blends well with the other two projects by integrating data made available from Project 1 with environmental and clinical data to generate an asthma *exposome* and then provide the data to the clinical researcher for Project 3.

Background and Significance

Exposure Big Data Problem Area

Many studies show relationships between indoor and outdoor air pollution and pediatric asthma (11–25). Research in pediatric asthma calls for a better understanding of the complex interplay of various factors involved in the pathological mechanisms, and better management of children with asthma (26–28). Understanding the effects of the environment on pediatric asthma requires generation of a complete picture of exposures. Such an *exposome* (1, 2) would require integration of environmental, physiological, behavioral and clinical data from wearable and stationary sensors, environmental monitors, medication use and other clinical data.

Recent technological advances in wearable and non-wearable sensors, microelectronics, wireless networking, and mobile computing have been used in different clinical studies to understand the effects of air pollution on asthma (29–34). Most studies using sensor data are typically limited to using only a few sensors for the duration of the study. Exposure data from different sources are heterogeneous, having different contextual metadata and are modelled differently. Available sensors collect different data types including personal air quality, physiological and behavioral data, and each of these sensors use different data collection strategies, standards and sampling rates. In addition, while personal sensors could provide a high spatial-temporal resolution around the individual, it is quite possible that an individual isn't in proximity of the sensor at all times. Also, there is a limited understanding of lag times between exposures and the onset of asthma symptoms (17, 18, 23, 35, 36). This requires supplementing data from personal sensors with other environmental measurements to provide robust estimates of exposures.

Different pediatric research studies require different sets of input data variables, each at different semantic granularities and samplings rates. Further study analysis itself might require different data formats and models. Prospective clinical trials often record data about their cohort in spreadsheets or via REDCap (37). Research at its exploratory stage requires the data to be available in a web based query tool such as i2b2 (38). Retrospective analysis often requires large data sets in suitable models, for example Observational Medical Outcomes Partnership (OMOP) (39). In addition, clinical researchers have limited training in using environmental factors (40).

Critical Gaps Addressed

Our proposed project will empower pediatric researchers by reducing the complexities of working with multi-dimensional exposure Big Data and at the same time reducing semantic information loss associated with data transformations that might occur when integrating or converting to different formats. Our proposed projects will decrease the human and time requirements needed in using biomedical Big Data for pediatric asthma research. **The project is addressing fundamental areas in exposome Big Data research** (2, 41):

1. Accommodating and integrating heterogeneous mobile sensor data for generation of Big Data stores of interest to pediatric asthma research; along with developing methods and software tools that store contextual metadata for each type of sensor. We address this gap with Aim 1.
2. A framework along with methods and software tools to generating high spatial-temporal resolution air quality data to validate mathematically *modeled air quality data* with measured sensor data; along with its integration with sensor data and characterization of any *uncertainties* in the modeled data. We address these gaps with Aim 2.
3. A data *federating and integrating solution* that is scalable to heterogeneous air quality and clinical data sources (42) along with its storage, presentation to end user tools and secure uploading to the data coordinating center. We address this gap with Aim 3.

Innovation

Novel Software Methods and Tools Addressing the Challenging Problem

Our proposed project will include the development of a comprehensive logical data model to support the integration of various real life air quality sensors and physiological data among pediatric patients. It will also include a state-of-the-art computational framework that generates a high resolution spatial-temporal grid of air quality using experimental measurements from sensors, environmental monitors and mathematical models along with characterization of uncertainties associated with the models. Mathematical models and algorithms are specific for air quality variables and are dependent on the quality of data in a data source. In addition, different models work better in different topographies. Also there is limited evidence in selecting appropriate models for high spatial-temporal resolution in clinical research. To overcome the limitations of individual modeling approaches our proposed framework will allow selection of an appropriate modeling solution based on its relevance to air quality variable, quality of the input data and needs of the research domain to provide a modeled solution that has best performance and least uncertainty. To overcome difficulties of integrating different heterogeneous air quality data sources along with mathematically modeled and other biomedical data, our proposed software solution will have an interactive workflow that guides a researcher through this process. Our proposed workflow

solution will not only overcome the need to have multiple solutions and copies of data, but more importantly make the overall process of providing data less opaque and user-driven. In addition, integrated data can be presented to various analytical tools proposed in Project 3 and to the data coordinating center.

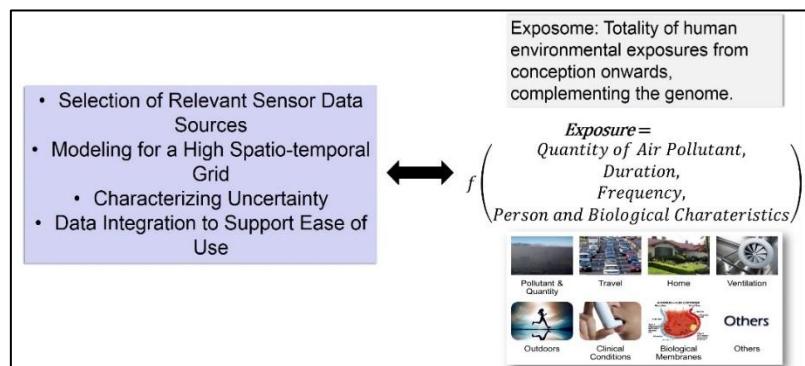


Figure 1: Data and integration for defining an air quality exposome.

Impact for Pediatric Asthma Research

Our proposed project will transform the way researchers can generate large scale datasets out of distributed air quality and biomedical data sources creating truly Big Data in aggregates as the process of harmonization of data models is alleviated. It will also make the federated/aggregated data more accessible to researchers by converting it to easily consumable formats and models without the requirement of understanding the data intricacies of the original source and presenting the same in understandable messages and workflows for Big Data analytics. Our proposed approach of integrating data from ubiquitous computing (43) and body sensor networks (44) with environmental monitor and biomedical data will provide holistic representations of the pediatric air quality *exposome* that could enable rigorous testing of many hypotheses about environmentally-related chronic illnesses such as asthma.

Approach

Our proposed project, first, consists of harmonization and integration of heterogeneous environmental sensor data by development of a comprehensive but extendable logical data model (Aim 1). Second, generation of a high resolution spatial-temporal grid by using mathematical models (Aim 2). Third, a user-driven workflow that orchestrates integration of various environmental, modeled and biomedical data that could be limited to specific cohorts for further analysis and/or to generate global data transformations of the integrated data for secure uploading to the data coordinating center (Aim 3).

Strategy/Architecture

OpenFurther (OF) (<http://openfurther.org/>)

We propose to develop a next generation data federation-integration platform by leveraging OF (4–10) and enhancing capabilities to define pediatric asthma *exposomes*. OF was developed by the Biomedical Informatics Core (BMIC), Center for Clinical and Translational Sciences, University of Utah. It has since been released as open-source. OF federates and integrates disparate and heterogeneous data sources; it supports cohort identification for prospective research and public health surveillance. It enables the development of a learning health system (45) by transforming data into interoperable forms that support discovery (46), providing

a digital infrastructure for conducting multi-organizational network research (47–49), and maintaining data quality (50) through rigorous processes.

OF provides semantic and syntactic interoperability as it translates health information on-the-fly and in real-time (dynamic federation) and does not require data source partners to extract data – facilitating integration by retaining data in their native format. At the same time it also has the ability to create a centralized database. Datasets can be created and exported in popular models such as Observational Medical Outcomes Partnership Common Data Model (OMOP-CDM) (39) for further analysis. It systematically supports federated and centralized data governance models. It also includes a framework to support granular security control to join targeted data across data sources.

OF utilizes components available from standards organizations and open source initiatives (Figure 2). **Query Tool**: Researchers can create a query to obtain cohort counts or export datasets for analysis. This is accomplished by using an ontology tree of concepts representing the domains in the data sources and a library of data sources to be queried. OF federated query engine (FQE) supports the use of an array of popular query tools (e.g. i2b2 web client [38]). **Metadata Repository (MDR)** (42): A repository of artifacts and knowledge about things that is standards-based and in-house developed. It stores metadata artifacts for each data source and the relationships between data models. These artifacts include, but are not limited to: (i) Logical models, local models, model mappings, (ii) Administrative information, (iii) Descriptive information, and (iv) XQuery (51) Translation Programs. **Terminology/Ontology Server (TS)** (52, 53): The TS stores local and standard terminologies as well as inter-terminology mappings, and provides terminology authoring and management tools. OF includes a layer of web-services that leverage the TS APIs. OF queries data sources by using metadata artifacts and terminology mappings stored in the MDR and TS to translate between different data models. It uses an XQuery approach to avoid writing specific translators for each data source/model (54). **Data Source Adapters (DSA)**: These facilitate interoperability across data sources. When a query is initiated the DSA tells the query engine whether a data source can respond to a particular query. **Federated Query Engine (FQE)** (42): The FQE (Figure 3) orchestrates queries between the query tool, MDR, TS and the data sources. It consists of two data stores: (i) FQE storage for the query details and its context in xml form and (ii) an interchangeable ephemeral in-memory or persisted result storage. **Administrative & Security Components (ACS)**: The security layer currently supports central authentication service (CAS) (55) against Lightweight Directory Access Protocol (LDAP) (56) and federated authentication using Security Assertion Markup Language (SAML) (57). OF embeds the regulations governing the conduct of research involving human subjects by integrating electronic institutional review board (IRB) systems (58, 59). **Virtual Identity Resolution on the GO (VIRGO)** (60, 61): VIRGO performs on the fly assembly of longitudinal health records containing personal health information (PHI) from distinct sources for use within the OF framework. **Quality and Analytics Framework (QAF)** (62): The QAF leverages the translational mechanism of OF to characterize data quality for helping users make informed decisions when selecting cohorts or generating datasets for research.

OF federates and integrates heterogeneous data types

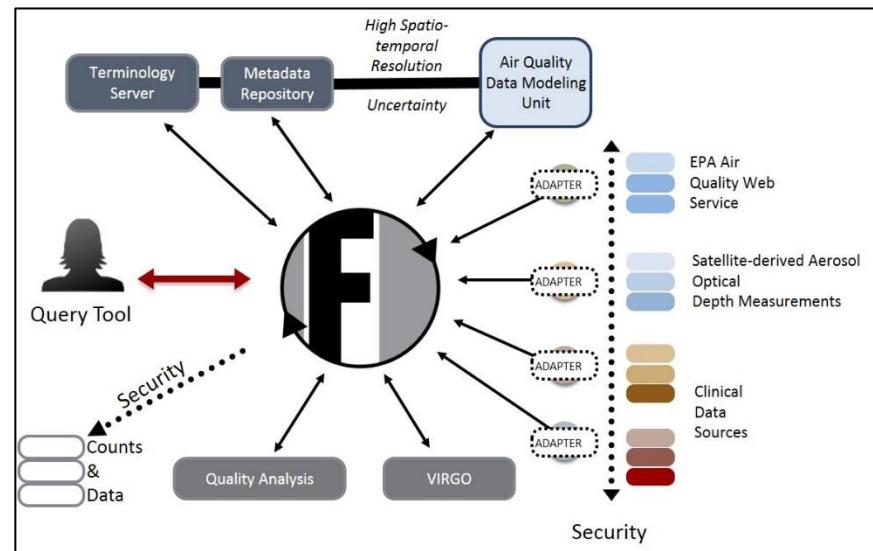


Figure 2: OpenFurther architecture for federating air quality and clinical data.

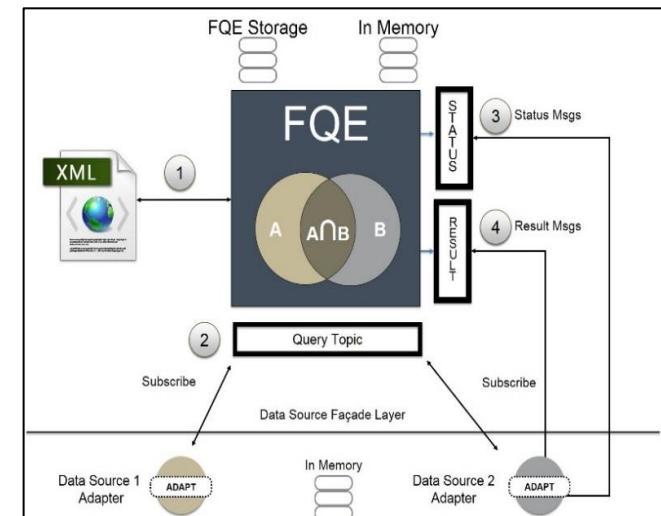


Figure 3: The FQE orchestrates queries by consuming XML query messages (1), generating Query Topics to data sources (2) that respond using status messages (3), and asynchronously executing queries at each data source (4).

including clinical, genotypic, phenotypic, public health, genealogical, environmental (e.g. air quality) (63, 64) and biospecimen (65, 66); and heterogeneous data sources including SQL, XML and web-services. OF has been implemented for the following use-cases: University of Utah: As FURTHeR (4, 5,10) for cohort Identification and providing datasets for analysis since August 2011 with over 500 users. FURTHeR federates data from the university, Intermountain Healthcare, Huntsman Cancer Institute and a prototype for air quality data (3); Pediatric Health Information System Plus (PHIS+) at the Children's Hospitals Association (CHA) (67–69) populating an aggregated database for comparative effectiveness research and consists of results for over 160 million laboratory tests, 2 million cultures and 4.5 million radiology studies representing 1.8 million pediatric patients; University of North Carolina: Cohort Identification (70); and Utah Department of Health (UDOH): Federating multiple disparate sources at UDOH for public health surveillance and health service research.

Team, Leadership and Work Environment

The proposed project's personnel are members of the Biomedical Informatics Core, Center for Clinical and Translation Sciences, University of Utah (BMIC). The BMIC provides informatics support for clinical and translation research at the university and partner institutions. OF was conceptualized and developed by the BMIC. We are also responsible for the deployment and operationalization of OF as FURTHeR at the University of Utah, for PHIS+ at CHA and the UDOH. The project team consists of personnel with diverse expertise including informatics faculty, senior software engineers, senior data architects and senior terminologist. The project is led by the leadership of the BMIC who are also faculty at the Department of Biomedical Informatics, University of Utah (BMI). Dr. Julio Facelli (Project PI) is the Director of BMIC and a Professor and Vice-Chair of the Dept. of BMI. Dr. Ramkiran Gouripeddi is the Senior Biomedical Informatics Scientist of BMIC and an Assistant Professor at BMI. Drs. Gouripeddi and Facelli will work with Dr. Kathy Sward (Project PI), and other key personnel of the administrative core: Drs. Collingwood, Kim, Patwari and Meyer on mobile sensor data details, Drs. Kelly and Horel on environmental data details, Drs. Nkoy, Stone and Cummins on the pediatric research requirements in the process of developing the informatics infrastructure. All computational infrastructure for the development and deployment are housed at the Center for High Performance Computing (CHPC) (71), University of Utah. This includes a HIPAA compliant space for storage of any PHI.

Preliminary Work

Details of OF architecture and development are described above. We demonstrated and released OF as open source at the American Medical Informatics Association Fall 2013 symposium (AMIA) (10). We prototyped the addition of heterogeneous air quality data from monitoring stations using data from the Utah Department of Air Quality (72) and the Environmental Protection Agency (73) that required cross-linking geospatial locations of patients and temporal occurrences of clinical events (3,74). In addition, we proposed an architecture for federated selection of mathematically modeled air quality data (Figure 2) (3).

We presented our work in integrating Salt Lake City, Utah air quality data with clinical data at Utah Big Data presentation (75) and were then invited by the Department of Technology Services, State of Utah to represent our work due to its relevance and importance to the Salt Lake Valley (76–80). In more recent work we explored other data sources, mathematical modeling, uncertainty and data integration required for generation of an air quality exposome (41, 81, 82), and validating mathematically modeled air quality data for biomedical research (83).

In other related work, both Drs. Gouripeddi and Facelli have extensive work in developing domain specific logical models for harmonizing data from heterogeneous data sources by involving various stakeholders and eventually using the integrated data for biomedical research (8, 9, 84, 85).

Methodology

Aim 1: Sensor Data Harmonization Framework: Augment OpenFurther with a logical data model to store and harmonize metadata from environmental mobile sensors.

Development: Federating or integrating increasingly large, complex and multi-dimensional sensor data requires a thorough human understanding of them. It often requires a team consisting of diverse expertise including domain experts, ontology and knowledge representation specialists, data architects, software engineers and informaticists, to fully understand the data, assemble metadata artifacts, and develop the software required for manipulative and transformative functions needed for federation/integration of data (4–10). Metadata is data about data including all physical data contained in software and other media, business and technical processes related to the data, and rules, constraints, structures and provenance of data (86). To begin the process of

augmenting OF's logical model to store and harmonize metadata from various environmental mobile sensors we will work with various domain experts in our team who are well-versed in sensor development and usage, and air quality experts (Drs. Kelly and Horel) to understand the data captured and metadata associated with various sensor. We will then work with pediatric asthma researchers (Drs. Nkoy and Stone) to elicit specific use-cases of the data. We will also perform extensive literature reviews on sensor and air quality data. Using the knowledge obtained we will develop a comprehensive logical model that is representative of mobile sensor data which we will then release for public review and critique. Based on the feedback, we will iteratively refine the model and incorporate it as metadata artifacts into OF's MDR(4) that will also be used to support Aim 3 of Project 3.

As a next step, we will onboard publically available sensors and sensors available with the University of Utah Air Quality Program as new data sources into OF's MDR (4–10). This step requires mapping the source's models and semantics to the central model developed in the previous step. We will then review these mappings with owners of different sensor. The central model will be refined based on. The work in both these steps will be based on previous methods and processes the investigators have used in developing logical models and mapping data sources to the developed central model (8, 9, 84, 85).

Evaluation, Potential Pitfalls, Alternative Approaches, and Future Directions: The developed logical model will be reviewed by domain experts for its comprehensiveness and accuracy and iteratively refined based on the feedback. We will follow an agile method in developing logical data model which will include support for extension and ease of updating the same within OF's MDR.

Aim 2: Sensor - Environmental Mathematical Modeling: Incorporate into OpenFurther a state of the art mathematical modeling framework that uses sparse experimental data from mobile sensors and environmental monitoring providing a high resolution spatial-temporal grid of exposures along with associated uncertainties.

Development: While personal sensors can provide high resolution estimates of air quality, it is likely that an individual isn't always with a sensor. Also, there is a limited understanding of lag times between exposures and the onset of asthma symptoms (17, 18, 23, 35, 36). This requires supplementing personal sensor data with other environmental measurements to provide estimates of exposures. In order to provide a high resolution spatial-temporal grid, we will incorporate into OF a service oriented architecture (SOA) based mathematical model unit as depicted in Figure 2. The Environmental Data Modeling Unit (EDMU) will consist of an extensible library of mathematic models. Examples of such models are explained in (83, 87–94) and will be supplemented by expert guidance and additional literature review. Recent modeling strategies combine monitoring data with study specific measurements (88). Each mathematical model will be characterized in terms of its input and output variables, applicability to different topographies and weather patterns and associated uncertainty. These characterized metadata will be stored within OF's MDR and will be used to provide decision support to end users, helping to select appropriate models and input variables for different intended research use-cases. These models will consume data from various mobile sensors as well as environmental monitors (72, 73), satellite based optical density readings (95–99), and other local measurements (100). The user will have the option to select mathematical models and input variables and set OF to orchestrate the generation of modeled data. OF (6, 7) being a SOA will call on the EDMU based on the users' selection and present the results of modeling for integration with other data selected by the user.

Evaluation, Benchmarks and Anticipated Results: Our anticipated

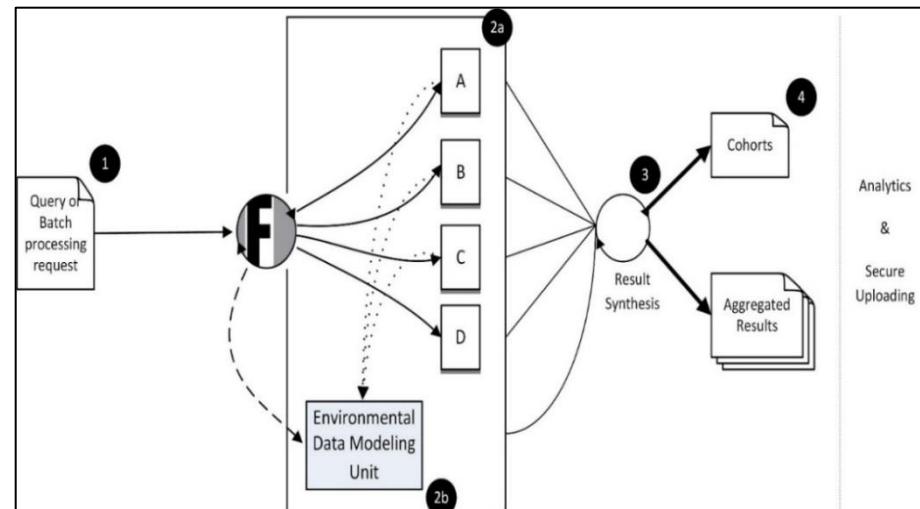


Figure 4: An end user can query for a cohort or complete datasets (1). Heterogeneous data sources (where A and B represent mobile sensor data sources, C represent environmental monitoring data sources and D represent biomedical data sources) (2a), and mathematical models data using EDMU (2b) would be selected. Mobile sensor data (A & B) would be harmonized to the central logical modeled stored in the MDR (Aim 1). Selection of mathematical models would be managed in the EDMU (Aim 2). OF would synthesize results and present them as cohorts and aggregated results (3, 4).

results for this aim are a SOA based EDMU that is orchestrated by OF. Each of the mathematical model will be evaluated and benchmarked using real world measurements (83).

Potential Pitfalls, Alternative Approaches, and Future Directions: Our approach of characterizing uncertainties associated with different mathematical models will reveal shortcomings in using any existing models. While environmental monitoring data do not reflect the true nature of indoor environment, they can be supplemented with other variables (e.g. HVAC, carpeting etc.) in mathematical models to provide better estimates. Future work may include refining the existing models and making the EDMU publicly available to other air quality researchers to submit their models to the library as well as characterize them for different topographies, weather patterns and research use-case. Also the EDMU will help to provide evidence in using mathematical models in biomedical research.

Aim 3: Data Integration and Storage: Add to OpenFurther the capabilities to federate, integrate and store environmental mobile sensor data with clinical data as well as supplement with mathematically modeled data.

Development: Integrating environmental and biomedical data needs to accommodate spatial-temporal variations of environmental data concentrations, locations of individuals, and timing of occurrence of conditions. In study specific measurements, an *a priori* linkage of individuals with personal sensors is usually the case, and global positioning systems within mobile sensors provide the individuals' spatial-temporal coordinates. When using data from environmental monitors and high resolution mathematical models, estimates need to be derived based on where a child spends their time (e.g. residence and school). Also, such an integration should support provisioning of data in different granularities as required by different research use-cases.

We plan to extend OF's AQ federation and integration capabilities by addition of new software artifacts to guide researchers with new user interface components and internal workflows to accomplish the above mentioned requirements. First (Figure 4), we will add software artifacts to leverage metadata of the mobile sensor logical model and mappings to individual sensors stored in the MDR (Aim 1) to federate and aggregate mobile sensor with other data. Second, we will add software to orchestrate the EDMU to select appropriate input variables, execute model development, present model results by extending OF's FQE to send and receive additional initiation, status and completion messages (Figure 3) (6, 7, 10). As a next step we will extend OF's result synthesis capabilities to include mobile sensor data along with environmental monitors, mathematically modelled and other biomedical data.

Synthesized results could then be stored on temporary basis or persisted depending on data governance requirements and research needs. These results could then be made available for further big data analytics (Project 3) and for secure upload to the data coordinating center.

Evaluation, Benchmarks and Anticipated Results: Our anticipated results for this aim are the ability to add mobile sensor data as a new data source and supplement it with environmental monitoring and mathematically modeled data along with its integration with biomedical data, and finally provisioning of such data to pediatric researchers. The platform will be tested at every stage of its development and also evaluated for its performance and usability.

Potential Pitfalls, Alternative Approaches, and Future

While there might be potential difficulties for clinical researchers to use mobile sensor, environmental monitor data and mathematical models, we intend to provide sufficient knowledge and documentation to the end user to simplify their use of the platform. An alternative approach would be to work in tandem with an environmental data expert to select appropriate data for individual research studies. Future directions would include releasing this informatics platform for environmental health research as an open-source product.

Tasks/Months	6	12	18	24	30	36	42	48
Aim 1								
Review mobile sensor data and metadata with domain experts		x						
Elicit research use-cases from clinical researchers		x						
Development of logical model for mobile sensor data	x							
Open to public review and iterative refinements		x						
Incorporation of logical model and mappings into MDR	x							
Dissemination & Release		x						
Aim 2								
Review & Benchmarking of Existing Mathematical Modeling Algorithms	x	x	x					
Development of EDMU & incorporation of algorithms	x	x	x					
Evaluation/Testing of EDMU	x	x						
Dissemination & Release								
Aim 3								
Addition of mobile sensor data federation into OF	x	x	x					
Addition of EDMU into OF	x	x	x					
Aggregation of results including environmental data	x	x						
Testing/Evaluation of OF	x	x						
Dissemination & Release							x	

Table 1: Aim-wise time-line of the proposed project.

Protections for Human Subjects

Approval of all protocols, forms, consents, and study modifications will be obtained from the University of Utah Institutional Review Boards.

Human Subjects Involvement and Characteristics: The subjects for this project include subject matter experts for content of the core architecture. Specifically, we will conduct unstructured and semi-structured interviews and evaluate pre-existing data sets.

Inclusion Criteria: subject matter experts: individuals involved in research or sensor development for children with asthma.

Exclusion criteria: none

Potential Risks to Human Subjects: We recognize that there are some potential patient risks related to the study. We will work closely with the Institutional Review Board at the University of Utah to ensure that procedures are in place to protect the rights and welfare of patients and parents. No adverse events that would harm study participants are anticipated. Participation is voluntary and individuals can decide not to participate. The principal risks to participants of this research are loss of privacy and confidentiality, including potential subject identification, and potential breach of confidentiality through disclosure of protected health information during the time we are evaluating pre-existing data sets. Installing rigorous security protections on data management, issuing regular reminders to project staff to change their passwords often, and adherence to HIPAA and IRB privacy and data security requirements will mitigate these risks.

Sources of Research Material: The data sources for this study will include notes from interviews as well as administrative data from sensors and example clinical data. We will use patient identifiers (including patient's name, date of birth, address and gender) to link patients with sensors and clinical data to facilitate assessment of impact of environmental data on asthma outcomes.

Recruitment and Consent Considerations: No prospective patient data will be collected for this project. Subject matter experts are predominantly co-investigators for this research study and other PRISMS program participants.

Adequacy of Protection Against Risks: Approval of all protocols, forms, consents, and study modifications will be obtained from University of Utah IRB. The raw data from the focus groups will be stored on a secured network directory with authentication and authorization protections accessible only to the research team members requiring PHI access. All other research materials will be stored in a secure file cabinet in the PI's secured office at PCH. The key to linking data back to PHI will be secured on the PI's computer and will not be shared. All data analyses will be performed on data sets created without identifiers. Identifiers will be removed from study data files as early as possible in the data processing steps. All source/legacy data files will be stored behind the University of Utah firewall. All investigators and project staff will sign confidentiality pledges annually and receive annual IRB and HIPAA privacy and data security compliance training.

Potential Benefits: Participants will not benefit directly from participation in this study. This study will facilitate future research to enhance our understanding of the role of environmental exposures on asthma outcome. We anticipate that future interventions based on the new sensor monitoring system are expected to lead to improved overall asthma care, improved asthma control and possibly reduction of disparities among underserved children.

Importance of the knowledge to be gained: Therefore, our study will make significant contributions not only to the science about how to manage asthma and address asthma disparities but also to self-monitoring and self-management of other chronic diseases sensitive to environmental triggers, and to translation of effective interventions to patient populations with chronic disease. Results of our study will be of significance to health care organizations, researchers, parents, children with asthma care providers and policy makers nationwide.

Inclusion of Women and Minorities

We will use a convenience sample of representative end-user stakeholders. We will target professional participants based on their area of knowledge/expertise. We will recruit parents (and child) participants from patients or community members who are already known to the investigators. Parents may participate on their own or as part of a parent/child dyad or triad; it is likely that when we enroll children the child's mother (or female guardian) will enroll as part of the dyad or triad.

We will not exclude any stakeholder based on sex/gender, race, and ethnicity; to the extent possible we will recruit a broad and diverse a sample of stakeholders.

Planned Enrollment Report

Study Title: Project 2 OpenFurther

Domestic/Foreign: Domestic

Comments: For this project, we plan to include 6 to 8 subject matter experts to participate in the project design and validation. Given the local demographics we anticipate the enrollment as above. We may use clinical or environmental data extracted from past studies to test the system but do not plan to collect any prospective patient (child or parent) information for this project.

Racial Categories	Ethnic Categories				Total	
	Not Hispanic or Latino		Hispanic or Latino			
	Female	Male	Female	Male		
American Indian/Alaska Native	0	0	0	0	0	
Asian	0	1	0	0	1	
Native Hawaiian or Other Pacific Islander	0	0	0	0	0	
Black or African American	0	1	0	0	1	
White	2	2	1	0	5	
More than One Race	0	0	0	0	0	
Total	2	4	1	0	7	

Study 1 of 1

Inclusion of Children

We will recruit children ages 5-18, from patients or community members who are already known to the investigators. We will include children for the design and evaluation of components with which children will interact, such as for the design of age-appropriate interfaces. We expect this will be predominantly as a parent/child dyads or trios because we anticipate that in most cases, parents will supervise the child's use of sensors and software when they are deployed for a study. Project 1 will include children (and parents) in the design of sensor interfaces and for design of age-appropriate feedback. Children (and parents) will also be included in the end-to-end evaluation of the center infrastructure.

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**APPLICATION FOR FEDERAL ASSISTANCE
SF 424 (R&R)**

5. APPLICANT INFORMATION

Organizational DUNS*: 009095365

Legal Name*: University of Utah
 Department:
 Division:
 Street1*: 75 South 2000 East
 Street2:
 City*: Salt Lake City
 County: Salt Lake
 State*: UT: Utah
 Province:
 Country*: USA: UNITED STATES
 ZIP / Postal Code*: 84112-8930

Person to be contacted on matters involving this application

Prefix:	First Name*:	Middle Name:	Last Name*:	Suffix:
	BRENDA		MALDONADO	

Position/Title: Sponsored Projects Officer
 Street1*: 75 South 2000 East, RM 211
 Street2:
 City*: SALT LAKE CITY
 County: SALT LAKE
 State*: UT: Utah
 Province:
 Country*: USA: UNITED STATES
 ZIP / Postal Code*: 84112-8930

Phone Number*: 801-581-4798 Fax Number: 801-585-5749 Email: brenda.maldonado@osp.utah.edu

7. TYPE OF APPLICANT* H: Public/State Controlled Institution of Higher Education

Other (Specify):

Small Business Organization Type Women Owned Socially and Economically Disadvantaged

11. DESCRIPTIVE TITLE OF APPLICANT'S PROJECT*

Prisms Informatics Platform - Federated Integration Architecture

12. PROPOSED PROJECT

Start Date*	Ending Date*
09/30/2015	09/29/2019

Project/Performance Site Location(s)

Project/Performance Site Primary Location

I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name: UNIVERSITY OF UTAH

Duns Number: 009095365

Street1*: 10 S 2000 E RM 4200

Street2:

City*: SALT LAKE CITY

County: SALT LAKE

State*: UT: Utah

Province:

Country*: USA: UNITED STATES

Zip / Postal Code*: 84112-5880

Project/Performance Site Congressional District*: UT-002

File Name

Additional Location(s)

RESEARCH & RELATED Other Project Information

1. Are Human Subjects Involved?* Yes No

1.a. If YES to Human Subjects

Is the Project Exempt from Federal regulations? Yes NoIf YES, check appropriate exemption number: 1 2 3 4 5 6If NO, is the IRB review Pending? Yes No

IRB Approval Date:

Human Subject Assurance Number 00003745

2. Are Vertebrate Animals Used?* Yes No

2.a. If YES to Vertebrate Animals

Is the IACUC review Pending? Yes No

IACUC Approval Date:

Animal Welfare Assurance Number

3. Is proprietary/privileged information included in the application?* Yes No**4.a. Does this project have an actual or potential impact - positive or negative - on the environment?*** Yes No

4.b. If yes, please explain:

4.c. If this project has an actual or potential impact on the environment, has an exemption been authorized or an Yes No environmental assessment (EA) or environmental impact statement (EIS) been performed?

4.d. If yes, please explain:

5. Is the research performance site designated, or eligible to be designated, as a historic place?* Yes No

5.a. If yes, please explain:

6. Does this project involve activities outside the United States or partnership with international collaborators?* Yes No

6.a. If yes, identify countries:

6.b. Optional Explanation:

Filename

7. Project Summary/Abstract* Abstract_Filler1013416979.pdf**8. Project Narrative*****9. Bibliography & References Cited** ReferencesProject31013416872.pdf**10. Facilities & Other Resources****11. Equipment**

Please see the Abstract in the Overall component.

RESEARCH & RELATED Senior/Key Person Profile (Expanded)

PROFILE - Project Director/Principal Investigator				
Prefix: Dr.	First Name*: KATHERINE	Middle Name A	Last Name*: SWARD	Suffix:
Position/Title*:	Assistant Professor			
Organization Name*:	University of Utah			
Department:	COLLEGE OF NURSING			
Division:	COLLEGE OF NURSING			
Street1*:	10 S 2000 E RM 4200			
Street2:				
City*:	SALT LAKE CITY			
County:	SALT LAKE			
State*:	UT: Utah			
Province:				
Country*:	USA: UNITED STATES			
Zip / Postal Code*:	84112-5880			
Phone Number*:	801/585-1481	Fax Number:	E-Mail*: kathy.sward@nurs.utah.edu	
Credential, e.g., agency login: KATHYSWARD				
Project Role*:	Other (Specify)	Other Project Role Category: Project Lead		
Degree Type:	Degree Year:			
File Name				
Attach Biographical Sketch*:				
Attach Current & Pending Support:				

PROFILE - Senior/Key Person			
Prefix: Dr.	First Name*: Flory	Middle Name L.	Last Name*: Nkoy
			Suffix: MD, MS
Position/Title*:	Associate Professor		
Organization Name*:	University of Utah		
Department:	PEDIATRIC INPATIENT MEDICINE		
Division:	SCHOOL OF MEDICINE		
Street1*:	100 North Mario Capecchi Drive		
Street2:			
City*:	Salt Lake City		
County:	Salt Lake		
State*:	UT: Utah		
Province:			
Country*:	USA: UNITED STATES		
Zip / Postal Code*:	84113-1103		
Phone Number*: 801-662-3645	Fax Number: 801-662-3664	E-Mail*: flory.nkoy@hsc.utah.edu	
Credential, e.g., agency login: FLORYNKOY			
Project Role*: Other (Specify)	Other Project Role Category: Project Lead		
Degree Type: MD	Degree Year: 1988		
Attach Biographical Sketch*:	File Name Nkoy_Biosketch_PRISMS_Informatics_Platform1013416404.pdf		
Attach Current & Pending Support:			

PROFILE - Senior/Key Person			
Prefix: Dr.	First Name*: MOLLIE	Middle Name REBECCA	Last Name*: CUMMINS
			Suffix:
Position/Title*:	Assistant Professor		
Organization Name*:	University of Utah		
Department:	COLLEGE OF NURSING		
Division:	COLLEGE OF NURSING		
Street1*:	10 S 2000 E RM 4200		
Street2:			
City*:	SALT LAKE CITY		
County:	SALT LAKE		
State*:	UT: Utah		
Province:			
Country*:	USA: UNITED STATES		
Zip / Postal Code*:	84112-5880		
Phone Number*: 801/585-9740	Fax Number:	E-Mail*: mollie.poynton@nurs.utah.edu	
Credential, e.g., agency login: MOLLIEPOYNTON			
Project Role*: Other (Specify)	Other Project Role Category: Project Lead		
Degree Type:	Degree Year:		
Attach Biographical Sketch*:	File Name CumminsBiosketch_SwardApplication_2015201013416405.pdf		
Attach Current & Pending Support:			

PROFILE - Senior/Key Person				
Prefix: Dr.	First Name*: BRYAN	Middle Name L	Last Name*: STONE	Suffix:
Position/Title*:	Associate Professor (Clinical)			
Organization Name*:	University of Utah			
Department:	PEDIATRIC INPATIENT MEDICINE			
Division:	SCHOOL OF MEDICINE			
Street1*:	295 CHIPETA WAY RM 2S010			
Street2:				
City*:	SALT LAKE CITY			
County:	SALT LAKE			
State*:	UT: Utah			
Province:				
Country*:	USA: UNITED STATES			
Zip / Postal Code*:	84108-5880			
Phone Number*:	801/588-3813	Fax Number:	E-Mail*: bryan.stone@hsc.utah.edu	
Credential, e.g., agency login:				
Project Role*:	Co-Investigator			
Degree Type:	Other Project Role Category:			
	Degree Year:			
	File Name			
Attach Biographical Sketch*:	STONE_bio_PRISMS1013416406.pdf			
Attach Current & Pending Support:				

PROFILE - Senior/Key Person				
Prefix: Dr.	First Name*: BOB	Middle Name GAR	Last Name*: WONG	Suffix:
Position/Title*:	Research Assistant Professor			
Organization Name*:	University of Utah			
Department:	COLLEGE OF NURSING			
Division:	COLLEGE OF NURSING			
Street1*:	10 S 2000 E RM 4200			
Street2:				
City*:	SALT LAKE CITY			
County:	SALT LAKE			
State*:	UT: Utah			
Province:				
Country*:	USA: UNITED STATES			
Zip / Postal Code*:	84112-5880			
Phone Number*:	801/587-9666	Fax Number:	E-Mail*: bob.wong@nurs.utah.edu	
Credential, e.g., agency login:				
Project Role*:	Co-Investigator			
Degree Type:	Other Project Role Category:			
	Degree Year:			
	File Name			
Attach Biographical Sketch*:	Wong_05_20151013416407.pdf			
Attach Current & Pending Support:				

PROFILE - Senior/Key Person				
Prefix: Dr.	First Name*: Erin	Middle Name L	Last Name*: Meyer	Suffix:
Position/Title*:	Reserach Associate			
Organization Name*:	University of Utah			
Department:				
Division:				
Street1*:	10 South 2000 East			
Street2:				
City*:	Salt Lake City			
County:	Salt Lake			
State*:	UT: Utah			
Province:				
Country*:	USA: UNITED STATES			
Zip / Postal Code*:	84112-5880			
Phone Number*: 801-587-8553	Fax Number:	E-Mail*: erin.meyer@nurs.utah.edu		
Credential, e.g., agency login: ERMEYER				
Project Role*: Co-Investigator	Other Project Role Category:			
Degree Type:	Degree Year:			
Attach Biographical Sketch*:	File Name Erin_Meyer_New_NIH_Biosketch_Sward_U541013416408.pdf			
Attach Current & Pending Support:				

RESEARCH & RELATED BUDGET - SECTION A & B, BUDGET PERIOD 1

ORGANIZATIONAL DUNS*: 009095365

Budget Type*: ● Project ○ Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2015**End Date***: 09-29-2016**Budget Period:** 1

A. Senior/Key Person												
	Prefix First Name*	Middle Name	Last Name*	Suffix	Project Role*	Base	Calendar	Academic	Summer	Requested	Fringe	Funds Requested (\$)*
						Salary (\$)	Months	Months	Months	Salary (\$)*	Benefits (\$)*	
1.	Dr. KATHERINE	A	SWARD		Project Lead	102,000.00	1.8			15,300.00	5,661.00	20,961.00
2.	Dr. Flory	L.	Nkoy		Project Lead	183,300.00	1.8			27,495.00	10,175.00	37,670.00
3.	Dr. MOLLIE	REBECCA	CUMMINS		Project Lead	102,000.00	3			25,500.00	9,435.00	34,935.00
4.	Dr. BRYAN	L	STONE		Co-Investigator	179,250.00	1.8			26,888.00	9,948.00	36,836.00
5.	Dr. BOB	GAR	WONG		Co-Investigator	96,593.00	3			24,148.00	8,935.00	33,083.00
6.	Dr. Erin	L	Meyer		Co-Investigator	67,800.00	3			16,950.00	8,814.00	25,764.00

Total Funds Requested for all Senior Key Persons in the attached file

Additional Senior Key Persons:	File Name:	Total Senior/Key Person	189,249.00
---------------------------------------	------------	--------------------------------	-------------------

B. Other Personnel									
Number of Personnel*	Project Role*	Calendar Months	Academic Months	Summer Months	Requested Salary (\$)*	Fringe Benefits*	Funds Requested (\$)*		
Post Doctoral Associates									
1	Graduate Students	7.5			32,500.00	2,600.00	35,100.00		
Undergraduate Students									
Secretarial/Clerical									
1	Total Number Other Personnel					Total Other Personnel	35,100.00		
					Total Salary, Wages and Fringe Benefits (A+B)		224,349.00		

RESEARCH & RELATED Budget {A-B} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION C, D, & E, BUDGET PERIOD 1**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2015**End Date***: 09-29-2016**Budget Period:** 1

C. Equipment Description	
List items and dollar amount for each item exceeding \$5,000	
Equipment Item	Funds Requested (\$)*
Total funds requested for all equipment listed in the attached file	Total Equipment
Additional Equipment: File Name:	

D. Travel		Funds Requested (\$)*
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)		0.00
2. Foreign Travel Costs		0.00
Total Travel Cost		0.00

E. Participant/Trainee Support Costs		Funds Requested (\$)*
1. Tuition/Fees/Health Insurance		0.00
2. Stipends		0.00
3. Travel		0.00
4. Subsistence		0.00
5. Other: None		0.00
Number of Participants/Trainees		Total Participant Trainee Support Costs
		0.00

RESEARCH & RELATED Budget {C-E} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTIONS F-K, BUDGET PERIOD 1**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2015**End Date***: 09-29-2016**Budget Period:** 1

F. Other Direct Costs	Funds Requested (\$)*
1. Materials and Supplies	
2. Publication Costs	
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8. Patient Care Cost	0.00
9. None	0.00
10. None	0.00
	Total Other Direct Costs
	0.00

G. Direct Costs	Funds Requested (\$)*
	Total Direct Costs (A thru F)
	224,349.00

H. Indirect Costs	Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)*
	1. MTDC_Research	49	224,349.00	109,931.00
	Total Indirect Costs			
	DHHS, Wallace Chan, 415-437-7820			
	(Agency Name, POC Name, and POC Phone Number)			

I. Total Direct and Indirect Costs	Funds Requested (\$)*
	Total Direct and Indirect Institutional Costs (G + H)
	334,280.00

J. Fee	Funds Requested (\$)*

K. Budget Justification*	File Name: Budget_Justification_Project_31013416822.pdf (Only attach one file.)
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RESEARCH & RELATED Budget {F-K} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION A & B, BUDGET PERIOD 2

ORGANIZATIONAL DUNS*: 009095365

Budget Type*: ● Project ○ Subaward/Consortium**Enter name of Organization:** University of Utah

Start Date*: 09-30-2016

End Date*: 09-29-2017

Budget Period: 2

A. Senior/Key Person												
Prefix	First Name*	Middle Name	Last Name*	Suffix	Project Role*	Base	Calendar	Academic	Summer	Requested	Fringe	Funds Requested (\$)*
						Salary (\$)	Months	Months	Months	Salary (\$)*	Benefits (\$)*	
1. Dr.	KATHERINE	A	SWARD		Project Lead	102,000.00	1.8			15,300.00	5,661.00	20,961.00
2.	Flory	L.	Nkoy		Project Lead	183,300.00	1.8			27,495.00	10,175.00	37,670.00
3.	MOLLIE	REBECCA	CUMMINS		Project Lead	102,000.00	3			25,500.00	9,435.00	34,935.00
4.	BRYAN	L	STONE		Co-Investigator	179,250.00	1.8			26,888.00	9,948.00	36,836.00
5. MR	BOB	GAR	WONG		Co-Investigator	96,593.00	3			24,148.00	8,935.00	33,083.00
6.	Erin	L	Meyer		Co-Investigator	67,800.00	3			16,950.00	8,814.00	25,764.00

Total Funds Requested for all Senior Key Persons in the attached file

Additional Senior Key Persons:	File Name:	Total Senior/Key Person	189,249.00
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B. Other Personnel									
Number of Personnel*	Project Role*	Calendar Months	Academic Months	Summer Months	Requested Salary (\$)*	Fringe Benefits*	Funds Requested (\$)*		
Post Doctoral Associates									
1	Graduate Students	7.5			32,500.00	2,600.00	35,100.00		
Undergraduate Students									
Secretarial/Clerical									
1	Total Number Other Personnel					Total Other Personnel	35,100.00		
					Total Salary, Wages and Fringe Benefits (A+B)		224,349.00		

RESEARCH & RELATED Budget {A-B} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION C, D, & E, BUDGET PERIOD 2**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2016**End Date***: 09-29-2017**Budget Period:** 2

C. Equipment Description	
List items and dollar amount for each item exceeding \$5,000	
Equipment Item	Funds Requested (\$)*
Total funds requested for all equipment listed in the attached file	Total Equipment
Additional Equipment: File Name:	

D. Travel		Funds Requested (\$)*
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)		0.00
2. Foreign Travel Costs		0.00
Total Travel Cost		0.00

E. Participant/Trainee Support Costs		Funds Requested (\$)*
1. Tuition/Fees/Health Insurance		0.00
2. Stipends		0.00
3. Travel		0.00
4. Subsistence		0.00
5. Other: None		0.00
Number of Participants/Trainees		Total Participant Trainee Support Costs
		0.00

RESEARCH & RELATED Budget {C-E} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTIONS F-K, BUDGET PERIOD 2**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2016**End Date***: 09-29-2017**Budget Period:** 2

F. Other Direct Costs	Funds Requested (\$)*
1. Materials and Supplies	
2. Publication Costs	
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8. Patient Care Cost	0.00
9. None	0.00
10. None	0.00
	Total Other Direct Costs
	0.00

G. Direct Costs	Funds Requested (\$)*
	Total Direct Costs (A thru F)
	224,349.00

H. Indirect Costs	Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)*
	1. MTDC_Research	49	224,349.00	109,931.00
	Total Indirect Costs			
	109,931.00			
Cognizant Federal Agency	DHHS, Wallace Chan, 415-437-7820			
(Agency Name, POC Name, and POC Phone Number)				

I. Total Direct and Indirect Costs	Funds Requested (\$)*
	Total Direct and Indirect Institutional Costs (G + H)
	334,280.00

J. Fee	Funds Requested (\$)*

K. Budget Justification*	File Name: Budget_Justification_Project_31013416822.pdf (Only attach one file.)
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RESEARCH & RELATED Budget {F-K} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION A & B, BUDGET PERIOD 3

ORGANIZATIONAL DUNS*: 009095365

Budget Type*: ● Project ○ Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2017**End Date***: 09-29-2018**Budget Period: 3****A. Senior/Key Person**

1.	Dr.	KATHERINE	A	SWARD	Project Lead	Base Salary (\$)	Calendar Months	Academic Months	Summer Months	Requested Salary (\$)*	Fringe Benefits (\$)*	Funds Requested (\$)*
							Name	Months	Months	Months		
1.	Dr.	Flory	L.	Nkoy	Project Lead	183,300.00	1.8				27,495.00	10,175.00
2.	Dr.	MOLLIE	REBECCA	CUMMINS	Project Lead	102,000.00	3				25,500.00	9,435.00
3.	Dr.	BRYAN	L	STONE	Co-Investigator	179,250.00	1.8				26,888.00	9,948.00
4.	MR	BOB	GAR	WONG	Co-Investigator	96,593.00	3				24,148.00	8,935.00
5.	Erin		L	Meyer	Co-Investigator	67,800.00	3				16,950.00	8,814.00
6.												25,764.00

Total Funds Requested for all Senior Key Persons in the attached file

Additional Senior Key Persons:	File Name:	Total Senior/Key Person	189,249.00
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B. Other Personnel

Number of Personnel*	Project Role*	Calendar Months	Academic Months	Summer Months	Requested Salary (\$)*	Fringe Benefits*	Funds Requested (\$)*
1	Post Doctoral Associates						
1	Graduate Students	7.5			32,500.00	2,600.00	35,100.00
	Undergraduate Students						
	Secretarial/Clerical						
1	Total Number Other Personnel					Total Other Personnel	35,100.00
						Total Salary, Wages and Fringe Benefits (A+B)	224,349.00

RESEARCH & RELATED Budget {A-B} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION C, D, & E, BUDGET PERIOD 3**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2017**End Date***: 09-29-2018**Budget Period:** 3

C. Equipment Description	
List items and dollar amount for each item exceeding \$5,000	
Equipment Item	Funds Requested (\$)*
Total funds requested for all equipment listed in the attached file	Total Equipment
Additional Equipment: File Name:	

D. Travel		Funds Requested (\$)*
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)		0.00
2. Foreign Travel Costs		0.00
Total Travel Cost		0.00

E. Participant/Trainee Support Costs		Funds Requested (\$)*
1. Tuition/Fees/Health Insurance		0.00
2. Stipends		0.00
3. Travel		0.00
4. Subsistence		0.00
5. Other: None		0.00
Number of Participants/Trainees		Total Participant Trainee Support Costs
		0.00

RESEARCH & RELATED Budget {C-E} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTIONS F-K, BUDGET PERIOD 3**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2017**End Date***: 09-29-2018**Budget Period:** 3

F. Other Direct Costs	Funds Requested (\$)*
1. Materials and Supplies	
2. Publication Costs	
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8. Patient Care Cost	0.00
9. None	0.00
10. None	0.00
	Total Other Direct Costs
	0.00

G. Direct Costs	Funds Requested (\$)*
	Total Direct Costs (A thru F)
	224,349.00

H. Indirect Costs	Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)*
	1. MTDC_Research	49	224,349.00	109,931.00
	Total Indirect Costs			
	DHHS, Wallace Chan, 415-437-7820			
	(Agency Name, POC Name, and POC Phone Number)			

I. Total Direct and Indirect Costs	Funds Requested (\$)*
	Total Direct and Indirect Institutional Costs (G + H)
	334,280.00

J. Fee	Funds Requested (\$)*

K. Budget Justification*	File Name: Budget_Justification_Project_31013416822.pdf (Only attach one file.)
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RESEARCH & RELATED Budget {F-K} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION A & B, BUDGET PERIOD 4

ORGANIZATIONAL DUNS*: 009095365

Budget Type*: ● Project ○ Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2018**End Date***: 09-29-2019**Budget Period:** 4

A. Senior/Key Person												
	Prefix First Name*	Middle Name	Last Name*	Suffix	Project Role*	Base	Calendar	Academic	Summer	Requested	Fringe	Funds Requested (\$)*
						Salary (\$)	Months	Months	Months	Salary (\$)*	Benefits (\$)*	
1.	Dr. KATHERINE	A	SWARD		Project Lead	102,000.00	1.8			15,300.00	5,661.00	20,961.00
2.	Dr. Flory	L.	Nkoy		Project Lead	183,300.00	1.8			27,495.00	10,175.00	37,670.00
3.	Dr. MOLLIE	REBECCA	CUMMINS		Project Lead	102,000.00	3			25,500.00	9,435.00	34,935.00
4.	Dr. BRYAN	L	STONE		Co-Investigator	179,250.00	1.8			26,888.00	9,948.00	36,836.00
5.	MR BOB	GAR	WONG		Co-Investigator	96,593.00	3			24,148.00	8,935.00	33,083.00
6.	Erin	L	Meyer		Co-Investigator	67,800.00	3			16,950.00	8,814.00	25,764.00

Total Funds Requested for all Senior Key Persons in the attached file

Additional Senior Key Persons:	File Name:	Total Senior/Key Person	189,249.00
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B. Other Personnel									
Number of Personnel*	Project Role*	Calendar Months	Academic Months	Summer Months	Requested Salary (\$)*	Fringe Benefits*	Funds Requested (\$)*		
Post Doctoral Associates									
1	Graduate Students	7.5			32,500.00	2,600.00	35,100.00		
Undergraduate Students									
Secretarial/Clerical									
1	Total Number Other Personnel					Total Other Personnel	35,100.00		
					Total Salary, Wages and Fringe Benefits (A+B)		224,349.00		

RESEARCH & RELATED Budget {A-B} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTION C, D, & E, BUDGET PERIOD 4**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date***: 09-30-2018**End Date***: 09-29-2019**Budget Period:** 4

C. Equipment Description	
List items and dollar amount for each item exceeding \$5,000	
Equipment Item	Funds Requested (\$)*
Total funds requested for all equipment listed in the attached file	Total Equipment
Additional Equipment: File Name:	

D. Travel		Funds Requested (\$)*
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)		0.00
2. Foreign Travel Costs		0.00
Total Travel Cost		0.00

E. Participant/Trainee Support Costs		Funds Requested (\$)*
1. Tuition/Fees/Health Insurance		0.00
2. Stipends		0.00
3. Travel		0.00
4. Subsistence		0.00
5. Other: None		0.00
Number of Participants/Trainees		Total Participant Trainee Support Costs
		0.00

RESEARCH & RELATED Budget {C-E} (Funds Requested)

RESEARCH & RELATED BUDGET - SECTIONS F-K, BUDGET PERIOD 4**ORGANIZATIONAL DUNS*:** 009095365**Budget Type*:** Project Subaward/Consortium**Enter name of Organization:** University of Utah**Start Date*:** 09-30-2018**End Date*:** 09-29-2019**Budget Period:** 4

F. Other Direct Costs	Funds Requested (\$)*
1. Materials and Supplies	
2. Publication Costs	
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8. Patient Care Cost	0.00
9. None	0.00
10. None	0.00
	Total Other Direct Costs
	0.00

G. Direct Costs	Funds Requested (\$)*
	Total Direct Costs (A thru F)
	224,349.00

H. Indirect Costs	Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)*
	1. MTDC_Research	49	224,349.00	109,931.00
	Total Indirect Costs			
	109,931.00			
Cognizant Federal Agency	DHHS, Wallace Chan, 415-437-7820			
(Agency Name, POC Name, and POC Phone Number)				

I. Total Direct and Indirect Costs	Funds Requested (\$)*
	Total Direct and Indirect Institutional Costs (G + H)
	334,280.00

J. Fee	Funds Requested (\$)*

K. Budget Justification*	File Name: Budget_Justification_Project_31013416822.pdf (Only attach one file.)
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RESEARCH & RELATED Budget {F-K} (Funds Requested)

Budget Justification

All person month calculations based on a twelve month calendar year appointment, unless otherwise noted.

PROJECT 3:**A. Key Personnel**

Katherine Sward, PhD, RN Principal Investigator, Project Lead [Effort for Project 3: 15% FTE in years 1 through 4 (3 person months each year)], will lead the requirements definition and development efforts for project 3 (researcher platform).

Mollie R. Cummins, PhD, RN, FAAN Co-Project Lead [Effort: 25% FTE in years 1 through 4 (3 person months each year)], will collaborate on requirements definition, will oversee user interface design for the researcher dashboards and reports, and will design user evaluation studies.

Flory Nkoy, MD, Co-Investigator, Co-Project Lead [Effort: 15% FTE in years 1 through 4 (1.8 person months each year)] is a Research Assistant Professor of Pediatrics & Biomedical Informatics at the University of Utah. As an expert who leads a team of pediatric asthma researchers, and in the electronic collection of patient self-assessment data, he will provide critical insights about the clinical researcher's needs and goals.

Bryan Stone, MD, Co-Investigator [Effort: 15% FTE in years 1 through 4 (1.8 person months each year)] is an Associate Professor of Pediatrics at the University of Utah. He will serve as an asthma care content expert.

Bob Wong, PhD, Co-Investigator [Effort: 25% FTE in years 1 through 4 (3 person months each year)], will serve as a content expert in the areas of data analysis and data visualization. He will also provide expertise to project 2 about the expectations and requirements of a data coordinating center.

Erin Meyer, PhD. Co-Investigator [Effort: 25% FTE in years 1 through 4 (3 person months each year)], will serve as a content expert regarding potential "basic science" (e.g., biomarker or similar) data that could be incorporated into epidemiological studies of pediatric asthma. In addition she will assist the administrative core with financial reports.

B. Other Personnel

Dr. Facelli and Dr. Gouripeddi (FTE listed in project 2) will be instrumental in development of the research analytics (aim 3), which will employ core features of the OpenFurther platform and the CHPC distributed computing architecture. They will also participate in the end-to-end evaluation.

Dr. Meyer and Dr. Patwari (FTE listed in project 1) will collaborate on aim 1. This project provides the requirements, and project 1 encompasses the software development, for configuring studies. They will also participate in the end-to-end evaluation.

Graduate Research Assistant, a biomedical informatics graduate student will be hired [Effort: 50% FTE for 9 months in years 1 through 4 (4.5 person months each year) and 100% for 3 months in years 1 through 4 (3 person months)], who will assist with the software development and validation efforts for the core infrastructure.

RESEARCH & RELATED BUDGET - Cumulative Budget

	Totals (\$)
Section A, Senior/Key Person	756,996.00
Section B, Other Personnel	140,400.00
Total Number Other Personnel	4
Total Salary, Wages and Fringe Benefits (A+B)	897,396.00
Section C, Equipment	
Section D, Travel	0.00
1. Domestic	0.00
2. Foreign	0.00
Section E, Participant/Trainee Support Costs	0.00
1. Tuition/Fees/Health Insurance	0.00
2. Stipends	0.00
3. Travel	0.00
4. Subsistence	0.00
5. Other	0.00
6. Number of Participants/Trainees	
Section F, Other Direct Costs	0.00
1. Materials and Supplies	0.00
2. Publication Costs	0.00
3. Consultant Services	0.00
4. ADP/Computer Services	0.00
5. Subawards/Consortium/Contractual Costs	0.00
6. Equipment or Facility Rental/User Fees	0.00
7. Alterations and Renovations	0.00
8. Other 1	0.00
9. Other 2	0.00
10. Other 3	0.00
Section G, Direct Costs (A thru F)	897,396.00
Section H, Indirect Costs	439,724.00
Section I, Total Direct and Indirect Costs (G + H)	1,337,120.00
Section J, Fee	

PHS 398 Cover Page Supplement

OMB Number: 0925-0001

1. Project Director / Principal Investigator (PD/PI)

Prefix: Dr.
First Name*: KATHERINE
Middle Name: A
Last Name*: SWARD
Suffix:

2. Human Subjects

Clinical Trial? No Yes
Agency-Defined Phase III Clinical Trial?* No Yes

3. Permission Statement*

If this application does not result in an award, is the Government permitted to disclose the title of your proposed project, and the name, address, telephone number and e-mail address of the official signing for the applicant organization, to organizations that may be interested in contacting you for further information (e.g., possible collaborations, investment)?

Yes No

4. Program Income*

Is program income anticipated during the periods for which the grant support is requested? Yes No

If you checked "yes" above (indicating that program income is anticipated), then use the format below to reflect the amount and source(s). Otherwise, leave this section blank.

Budget Period* Anticipated Amount (\$)* Source(s)*

.....
.....
.....
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.....
.....
.....
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5. Human Embryonic Stem Cells

Does the proposed project involve human embryonic stem cells?* No Yes

If the proposed project involves human embryonic stem cells, list below the registration number of the specific cell line(s) from the following list: http://grants.nih.gov/stem_cells/registry/current.htm. Or, if a specific stem cell line cannot be referenced at this time, please check the box indicating that one from the registry will be used:

Cell Line(s): Specific stem cell line cannot be referenced at this time. One from the registry will be used.

6. Inventions and Patents (For renewal applications only)

Inventions and Patents*: Yes No

If the answer is "Yes" then please answer the following:

Previously Reported*: Yes No

7. Change of Investigator / Change of Institution Questions

Change of principal investigator / program director

Name of former principal investigator / program director:

Prefix:

First Name*:

Middle Name:

Last Name*:

Suffix:

Change of Grantee Institution

Name of former institution*:

PHS 398 Research Plan

Please attach applicable sections of the research plan, below.

OMB Number: 0925-0001

1. Introduction to Application (for RESUBMISSION or REVISION only)	
2. Specific Aims	SpecificAimsProject31013416876.pdf
3. Research Strategy*	ResearchStrategyProject31013416877.pdf
4. Progress Report Publication List	
Human Subjects Sections	
5. Protection of Human Subjects	Protections_for_Human_Subjects1013416643.pdf
6. Inclusion of Women and Minorities	WomenMinorities1013416823.pdf
7. Inclusion of Children	Children1013416824.pdf
Other Research Plan Sections	
8. Vertebrate Animals	
9. Select Agent Research	
10. Multiple PD/PI Leadership Plan	
11. Consortium/Contractual Arrangements	
12. Letters of Support	
13. Resource Sharing Plan(s)	
Appendix (if applicable)	
14. Appendix	

Project 3: Lab/Researcher Platform

Specific Aims

There are multiple challenges to the use of sensors, mobile apps, and other technologies in research of environmental factors related to pediatric asthma and other illnesses. Software will be needed so that researchers can configure and control the system for a wide variety of experimental designs. This project (“project 3”) focuses on the **Lab/Research Platform** for the proposed PRISMS Informatics Federated Integration Architecture. The objective is to **develop, implement, and evaluate a replicable, scalable infrastructure** for designing and conducting epidemiological studies of asthma that integrate sensor data with clinical, outcomes, and other data sources using advance analytical techniques. The Lab/Research infrastructure will seamlessly integrate with the overall PRISMS Informatics Platform; employing the logical models in the Federation Integration Architecture (project 2) and communicating with the data acquisition pipeline (project 1).

We will employ a **user-centered design approach**, collaborating with pediatric asthma researchers and clinicians, and other relevant stakeholders. Researchers will need to learn about sensors in planning for a study, monitor data being accrued during the conduct of a study, and analyze study data. Researchers will need to be confident that the overall informatics platform is feasible and reliable to use for their research, while at the same time, and transparent to the users, we will provide the most advanced analytical techniques and infrastructure available from the Big Data community.

Specific Aims

1. **Identify requirements and develop a model process for designing and monitoring PRISMS studies.** We will identify the clinical researcher’s information needs related to study design and ongoing monitoring, and formally document and prioritize the functional and user interface requirements. We will design a replicable, scalable model process; building on the logical data model for clinically relevant exposome developed in project 2. This aim integrates with and informs project 1 aim 2, by defining the requirements and designing analytical solutions from the clinical researcher perspective.
2. **Develop and implement tools to support PRISMS research analytics.** We will design, develop, and implement clinically-relevant dashboards and reports for pediatric asthma research, whole at the same time provide appropriate mechanisms for direct data access for advanced analytical work. The advanced analysis and interpretation of integrated sensor data and clinical data will be facilitated by contemporary analytic methods and non-traditional tools and techniques including data visualization and Big Data analytic methods. We will develop a modular infrastructure using layers, which supports the use of these advanced analytic tools and methods.
3. **Develop a library of sensor metadata.** Sensor metadata is information about the sensor such as who developed, type of sensor, what it measures, as well as usage information such as battery life or how to configure the sensors is very difficult to obtain. Here we will develop an infrastructure that provides systematic access to this information.
4. **Conduct an end-to-end evaluation of the PRISMS Informatics Platform across the 3 projects.** We will conduct a small pilot studies focused on platform validation and usability. We will evaluate feasibility, functionality, and the perceived utility and usefulness of the platform as well as identifying barriers to implementation, training issues, and other problems.

This project will provide a step toward a flexible but replicable and scalable infrastructure for conducting multi-center epidemiological research as part of the PRISMS Program. It will result in freely available open-source tools that integrate into the overall center to support PRISMS research. It will produce documentation of researchers needs, requirements, and workflow; broadly informative for expansion of the PRISMS program to other chronic illnesses in pediatrics. It will produce tools and techniques that support the flexible design and conduct of future clinical trials in the PRISMS program.

Platform Development/Research Strategy

This project will provide the interface and infrastructure for clinical researchers. We will identify and document the information management needs surrounding clinical research for the PRISMS program. We will then design a process to address those needs, and develop infrastructure and usable user interfaces to support the clinical research process. The Lab/Researcher platform will have a high level of flexibility to allow researchers to design and monitor a variety of PRISMS Platform studies. This project is tightly integrated with the other 2 projects; the infrastructure will be based on logical models of the clinically relevant *exposome*, and will reside within the OpenFurther Federation Infrastructure (from project 2) and this project will link with the mobile app for project configuration (from project 1).

Background

Pediatric Asthma Research and the Need for Detailed High Quality Environmental Data

Asthma is the most common pediatric chronic illness in the US and associated with significant health care burden (1-3). Poor control is associated with multiple factors including environmental exposure. Current approaches do not adequately capture the complex relationships between environment, personal health and population level disparities (4), clinicians are not well trained in understanding how environmental factors influence chronic illness (5), and little is known about the mechanisms of such exposures. The *exposome* is an emerging concept representing the set of environmental factors to which a person is exposed, including the complex interplay between those factors (4, 6). The PRISMS program is designed to evaluate the portion of the *exposome* that is clinically relevant for pediatric asthma and other chronic childhood conditions, but the infrastructure developed here will be extensible to other conditions.

Sensors provide the opportunity to collect unprecedented detailed, high quality information about the environment, and to correlate behavioral and physiological data with environmental factors (8). These technologies will allow researchers to carefully assess risk factors for asthma development and better understand causative mechanisms for asthma exacerbations; and will improve the way we communicate this information in the healthcare system. This will allow parents, primary care providers, and asthma specialists to more effectively intervene in altering the course of asthma and further reduce asthma morbidity and mortality (9). **Configuring these clinical studies, however, is a complex endeavor well beyond the average clinical and translational researcher.** To accelerate this type of research there is the need to standardize data feeds from sensors (project1) aggregate sensor, clinical and geospatial, and other environmental data into a cohesive and accessible data source (project2) and finally to layer on top advance analytical tools easy to use by investigators (prtoject3).. In absence of this infrastructure build up, most likely a great deal of data will never be used to its potential and many question about *exposome* importance in asthma will remain unsolved. Specifically and related to project 3 the focus should be to provide the most advanced analytical capabilities without requiring advance training by the users, after all nobody gets trained to use Google, but behind the scenes users are taking advantage of some of the most powerful analytical techniques and IT infrastructure ever developed.

User-centered Design

To be meaningful, information must be useful (fill a need), credible (trusted), and findable (content needs to be easily located); and systems must be easy to use. User-centered design (UCD) is a philosophy about how to approach all phases of the system design and development lifecycle. The UCD process is based on deep understanding of who will be using the system; and their tasks, and environments. Users and the user experience drive iterative cycles of design, evaluation, and refinements. The UCD process involves multidisciplinary perspective rooted in cognitive and behavioral science. Many UCD methodologies are based on the international standard (ISO 9241-210:2010, Ergonomics of human-system interaction). (10) UCD approaches have been demonstrated to increase success of development projects, with increased user satisfaction and better support of workflow and task performance. UCD approaches help to identify challenges upfront so that a solution can be found early. Typical phases (10) are

1. **Identify the context of use:** Who will use the system, what are their tasks and information needs, and under what conditions will it be used. User research focuses on understanding user behaviors, needs, and motivations through interviews, observation techniques, task and workflow analysis, document analysis, and other methodologies.

2. Specify requirements. Business requirements (information needs) or user goals that must be met for the product to be successful
3. Design and create solutions. Solutions are designed in a progression of iterative stages, from rough designs (such as wireframe mockups) to partially functional and then complete functional solutions. Our software developers employ lightweight agile software development methodologies to create flexible and scalable solutions.
4. Evaluate design. This occurs throughout design and development, using informal evaluation, heuristics, and formal usability testing with actual users; with such evaluations given equal importance to traditional software development quality testing.

Big Data Analytics

The ability to harvest the wealth of information contained in sensor, environmental and clinical data will advance our understanding of pediatric health and disease. Understanding asthma and other conditions will require multi-scale approaches to modeling diverse types of high-dimensional interactions (11) that will require complex data analysis for validation. Given the complexity and heterogeneity of asthma, use of high-throughput technology and advanced analytic approaches would enable systems biology approaches to examining the myriad interdependencies between environmental, behavioral, physiologic, and clinical factors.

The huge, heterogeneous data sets that will be produced by the PRISMS program create what is essentially a biomedical Big Data scenario. “Big Data” are more than just large number of observations. Big Data are characterized by volume, velocity, and variety (12). Biomedical data are diverse and complex, with multiple phenotypic, exposure, behavioral, health, and other data types. The information is collected at high frequency, and is multi-dimensional (attached to various levels of temporal, geo-spatial, and identity information). Thus the program will benefit from using Big Data and “nontraditional” analytic techniques to facilitate discovery and interpretation of new knowledge. Healthcare has been slow to embrace Big Data techniques, but increasingly the value of these approaches is beginning to be recognized (13).

Big Data analytics employ a variety of tools and techniques to analyze heterogeneous data in search of insights, connections, and patterns, assisting researchers to construct knowledge in new ways (13). A variety of techniques can be used, from traditional statistical analyses, to data visualization, to advanced analytics such as predictive modeling, data mining, and text analytics.. However, traditional hardware and software configurations are not be able to handle the processing demands posed by Big Data at a reasonable cost. Newer technologies, built on an open source framework (e.g., Apache Hadoop, a framework written in Java for distributed processing of large data sets on computer clusters) support the processing of large and diverse data across clustered systems. We will leverage the expertise and facilities at the Center for High Performance Computing to design Big Data analytic approaches. To this end we propose the architecture in Figure 1 (see approach section) to implement the PRISMS Big Data strategy.

Significance

Investigators designing clinical studies of pediatric asthma will need to obtain information about available sensors. Investigators need to be able to program all aspects of their “experiments” including how and when samples are taken, and how data are processed; they will need to select sensors and configure them, define how data will be integrated, and may want to customize feedback and instructions for the parents or child. Investigators will need to monitor the study in process, and transmit data to the data coordinating center.

Currently there is no consensus about how sensor and mobile app data should be exchanged. This creates a vulnerability, leaving opportunity for miscommunication, inadequate communication, loss of information, and poor data quality. **This study will design a readily available and easily usable, standards based tool which would establish a replicable, scalable process for managing the design and conduct of future epidemiological studies of pediatric asthma and other conditions.**

Innovation

Project 3 innovation leverages the results from Project 1 (development of consistent data models for sensor information) and Project 2 (data integration from sensor, environmental geocoding and clinical data sources), that will make available for the first time in a scalable and consistent manner, a comprehensive data resource for studying the exposome effects on asthma treatment and management. The availability of such data

resources will make possible to combine for the first time two well established approaches in IT development, UCD and Big Data techniques to develop a scalable analytical environment that can accommodate users with increasing level of sophistication using dashboards, canned reports, SQL query capabilities and finally Big Data tools in the same environment and leveraging the newly integrated data source.

Preliminary Studies

Dr. Sward, Dr. Cummins, and Dr. Nkoy will conduct the user-centered design and requirements analyses. They each have expertise and experience with UCD approaches. Dr. Nkoy and colleagues conduct a program of research on improving the care for children with asthma, with observable improvements in care quality (20, 21). He was principal investigator for development and evaluation of an innovative application designed to engage children and their parents in weekly asthma self-monitoring and self-management. Dr Nkoy has experience with iterative usability testing cycles with children with asthma and their parents, to assess user performance and satisfaction with software applications (22) and with software validation (23). Dr. Sward has conducted multi-center pediatric network based clinical research (24, 25) and has engaged widely in data modeling, clinical terminologies, and standards for knowledge representation and in the development and evaluation of software to support interoperability (26-32). She is experienced with requirements analysis and user-centered design (pragmatically, through software development experience and academically, as she teaches these topics in the informatics program) and has conducted research evaluating clinician interactions with information systems (33-38). Dr. Cummins has engaged extensively in data modelling, clinical terminologies and standards in the domain of poison control (14-17). Her team designed a standards-based approach to support workflow-integrated, bidirectional health information exchange (16) that has been lauded as "elegant" (18). Dr. Cummins and her team utilized rapid prototyping and iterative usability testing to refine the design of a user interface in partnership with domain knowledge experts(19).

Dr. Facelli, as previous director of the Center for High Performance Computing and in some of his research projects has designed and deployed high end computational clusters, including big data clusters using Hadoop and Hive tools. We will dedicate 50% of the postdoctoral associate and one full time BMI student to build the Big Data infrastructure proposed here. In addition to Dr. Facelli's expertise we will tap into the great deal of expertise in large distributed system available at the Center for High Performance Computing system administrative staff (see letter of support from Dr. Cheatham).

Approach

Aim 1. Identify the clinical researcher's information needs related to study design and ongoing monitoring.
We will formally document and prioritize the initial functional and user interface requirements. Our approach is based on UCD and a Rapid Assessment Processes (39) that is essentially ethnographic in nature, drawing on our combined expertise in clinical research and clinical research informatics.

- Step 1. Identify context of use. We will interview key stakeholders, including clinical researchers who conduct asthma studies. We will identify the information needs related to study design and ongoing monitoring. We will conduct interviews, document reviews, and focused assessments with key stakeholders including clinical researchers who conduct studies of children with asthma, sensor designers, and other experts. We will also examine initial designs for environmental data collection that were created for the Utah vanguard site for the National Children's Study (40).
- Step 2. Specify requirements. We will document the information needs, and workflows, creating formal documentation of business requirements and user goals. We will prioritize those requirements and identify mandatory and optional elements. We will identify use cases and storyboards for major information flows.
- Step 3. Identify applicable standards, and any existing tools that might be useful in meeting the requirements. We will explore the emerging standards such as HL7 FHIR as well as standards such as the Observational Medical Outcomes Partnership (OMOP) [OMOP is a public-private partnership to inform the appropriate use of healthcare databases for studying the effects of medical products]. We will select the standard(s) that best fit the requirements and that fit with the overall architecture of the Prisms Informatics Federated Integration Architecture platform.

The data model for the clinically-relevant exposome within the OpenFurther infrastructure provides integration across the three center projects. We will analyze the requirements that represents environmental data that are seen by clinicians and researchers as important for PRISMS trials, develop relevant use cases, and evaluate the OpenFurther data model (41) from project 2 to ensure that the infrastructure will accommodate the requirements

Aim 2. Develop and implement informatics tools to support PRISMS study monitoring and analytics.

This activity has two components: the development of the basic architectural foundation depicted in Figure 1 and the layering on top of the architecture the services identified in Aim 1 as necessary to support clinical and translational research by expert clinicians.

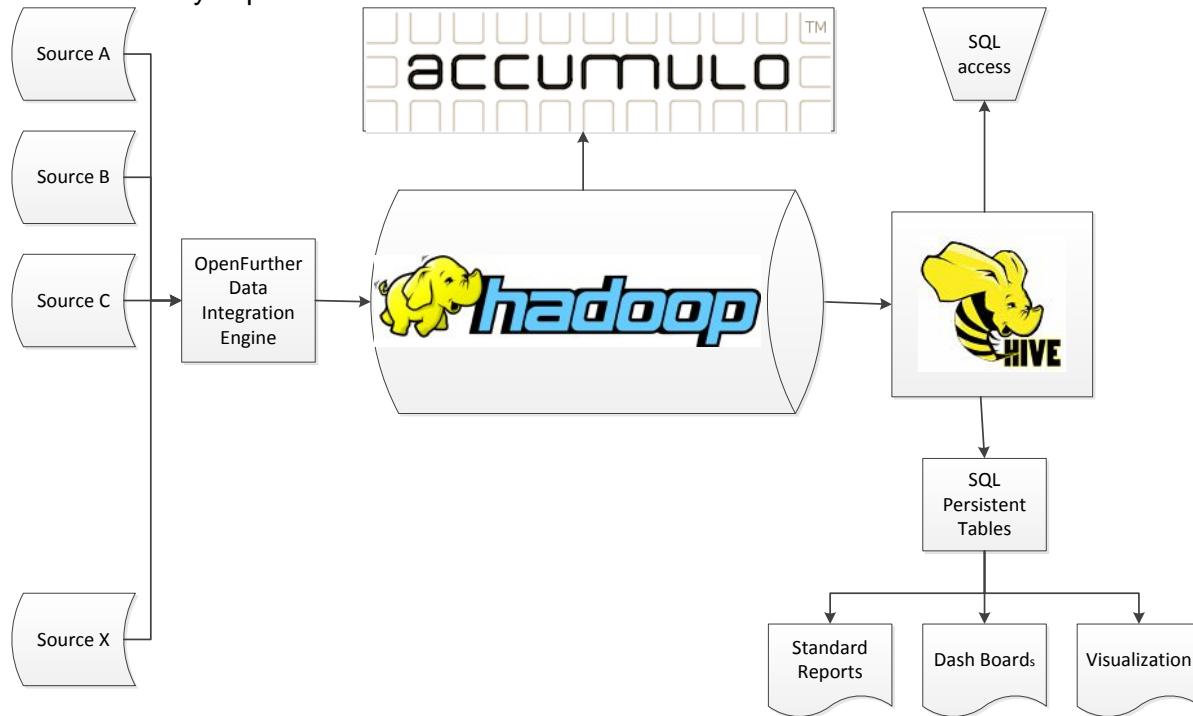


Figure 1. Overall architecture of the analytical environment that we will develop for the PRISMS Informatics Federated Integration Architecture Center.

As depicted in the figure the analytical component of the architecture will use the OpenFurther technology (OpenFurther Data Integration Engine) developed under Project 2 to aggregate data from multiple sources, including sensors, environmental, geographic, socio economical and clinical. These sources are indicated as Source A, B, C...X in the figure. The integrated data will be stored in a large Hadoop cluster (<https://hadoop.apache.org/>) available at the Center for High Performance Computing in either its protected environment or open environment depending of the protections required for the data. In order to accommodate different level of access complexity we will connect the Hadoop data base to two different interphases. A connection to Accumulo (<https://accumulo.apache.org/>), which is based on Google Big Table approach, will provide access to the most sophisticated users requiring ultimate granularity and access control at the cell level.

The second connection will provide access to the Hadoop database using the Hive (<https://hive.apache.org/>) technology that allows users or developers with expertise in SQL programming to use Hadoop databases mediated by Hive that emulates typical SQL database structures on top of a Hadoop data source. The Hive interphase will be used to meet the need of two different type of users, a direct SQL connection will be used to meet the need of intermediate users and developers that could use this interface to feed the Hadoop database into either tradition statistical, data mining and business intelligence applications that support direct SQL access and/or develop their own special purpose applications. Finally informed by the results of Aim 1 we will develop standard reports, dash boards and visualizations to meet most of the needs identified by our UCD approach.

All the developments described above will use an agile software development approach using standard open source technologies like Java and Python. Using the software development environment available at CHPC we will use industry standards for code revision control and daily regression testing to produce high quality software. Dr. Facelli has participated in many software development projects and he has the expertise necessary to manage this component of the project. Initial requirements of the PRISMS program include tools/techniques for study monitoring, such as a web-based dashboard and flexible reports; and tools for workflow integration, maintenance of sensor metadata, and evolution of the infrastructure. For the workflow integration and study design tools we will begin with wireframe mock-ups for each use case, followed by iterative development of increasingly functional prototypes.

Aim 3. Develop an easily queried library of sensor metadata.

In designing studies, clinicians will need to know what sensors are available through the PRISMS program (and elsewhere). They will need to know information such as what is monitored by the sensor, how it is worn (or where placed, if non-wearable), battery life, and similar “metadata” about the sensor. Sensor metadata is information about the sensor such as who developed, type of sensor, what it measures, as well as usage information such as battery life or how to configure the sensors.

We will determine what sensor information is relevant to clinicians, based on interviews with clinical researchers. We will develop a logical data model to represent this information. Using the logical data model we will implement a physical model that will be used to store this data within our core infrastructure using the DTS infrastructure, available from the OpenFurther (Project 2), to store information about artifacts defying the data and mappings in the system. We will design tools supporting selection of sensors for inclusion in studies, along with project 1 and provide access to this information using also the analytical infrastructure described in Aim 2.

Aim 4. End to end evaluation of the Informatics Center Platform.

In addition to formative validation of the tools and processes in aims 1-3, we will conduct an end-to-end validation of the entire center platform. We will evaluate feasibility, functionality, and the perceived utility and usefulness of the platform as well as identifying barriers to implementation, training issues, and other problems. We will examine the potential effects on research workflow. We anticipate three basic categories of evaluation:

1. Programming Quality Monitoring. We will conduct standard programming tests (unit, system, and integration testing) and document the results of all tests.
2. Usability Evaluation. We will conduct basic evaluation of processes with walkthroughs and simulated interactions; and will determine user perceptions by means of interviews and surveys. We will include heuristic evaluation by experts and validated usability evaluation instruments such as the System Usability Scale (SUS) or Computer System Usability Questionnaire (CSUQ) (45).
3. We will conduct a small scale, end-to-end evaluation of the Prisms Informatics Federated Integration Architecture platform, to demonstrate functionality, evaluate the feasibility of implementation, and identify barriers and challenges to scalability and generalizability.

We will ask two or three clinicians who conduct pediatric asthma research to design an example study, selecting and configuring sensors and mobile apps from the PRISMS platform. We will invite three parent volunteers (or parent-child dyads) to use the sensors and apps, reporting on any difficulties with set-up, use, or feedback from the sensors and apps. We will ask the clinical researchers to monitor the data during the study, evaluating all tools that were developed in aim 2. We will conduct formal usability evaluations, as in category #2.

Role/contributions of the project leader(s).

Dr Sward, Dr. Nkoy and Facelli (Big Data infrastructure) will oversee the overall project. Dr. Sward and Dr. Cummins will jointly oversee and conduct the requirements analysis (aim 1). Dr. Facelli will oversee aim 2. Drs. Nkoy and Sward will conduct aim 3. Dr Facelli, Dr. Sward, and the leads for all 3 projects will collaborate on the end to end evaluation of the overall platform under the lead of Dr. Nkoy who provides the clinical and translational research expertise to the team (aim 4).

High risk components and mitigation strategy

Representative Stakeholders: Obtaining a diverse group of representative stakeholders from multiple locations may be time and resource-prohibitive. Members of the investigative team and subject matter experts who are collaborators, collectively have the experience and background to serve as representative stakeholders for step 1. We can draw on their expertise initially, and then verify our findings with the larger PRISMS program participant groups.

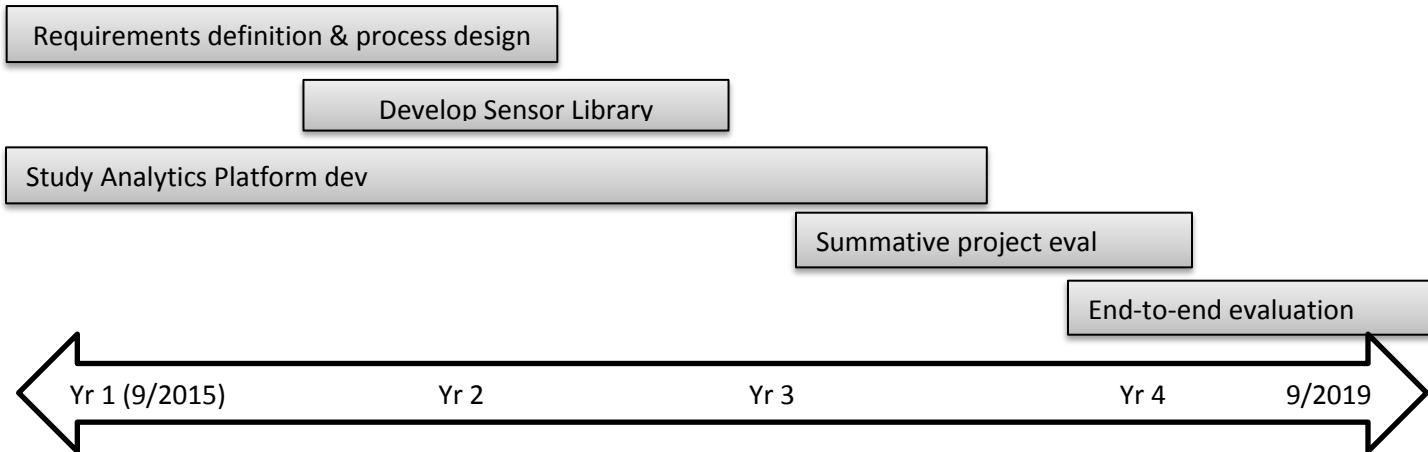
Competing priorities. While on the one hand, the overlap in these projects helps to facilitate the use of a common approach and architecture, the involvement of developers across projects risks affecting the timeline for this project. Three aspects mitigate that risk. (1) The projects are well integrated and the team is highly collaborative; (2) We have many graduate students who have high skills in software development, so student RAs will be highly productive; and (3) the University Health Sciences participates in an interdisciplinary program with the Entertainment, Arts, and Engineering; students in this “GApp lab” (<http://eae.utah.edu/the-gapp-lab/>) are easily accessible to faculty to help with software development projects. These readily-accessible resources can provide an alternative for design and development of the user interface.

Implementation challenges. Implementing new processes can be challenging, particularly for clinical researchers who have dual roles as clinical care providers. We have attempted to mitigate the risk of setbacks and challenges, and promote user acceptance, in several ways. First we are attending very closely to workflow, with detailed analysis of requirements, vision, and needs. Secondly, we are engaging clinical researchers in the design process, ensuring that their perspective and insight informs the design; and are designing with usability as a driving goal. Third, we use a lightweight agile approach to software development, with modular architecture that allows for multiple developers to work in synchrony.

Resource Sharing Plan: Individuals are required to comply with the Resource Sharing Plan as described in the Overall Component of this proposal.

Key milestones with timeline

We will conduct the project in overlapping phases. This project will occur simultaneously with the other center projects, and so the timelines may be re-adjusted to reflect interdependencies between the projects.



Milestones

Year 1 – initial requirements definition (interviews, evaluate NCS documents). Design of new processes/workflows

Latter part of year 1 and into year 2 – Design and Development of Sensor Library. Integration with projects 1 and 2.

Year 1-3. Iterative Researcher Platform Tool and Big Data infrastructure development and standard programming tests.

Year 3. Formal evaluation of the lab/research view

Year 4. End-to-end demonstration “pilot”.

Protections for Human Subjects

Approval of all protocols, forms, consents, and study modifications will be obtained from the University of Utah Institutional Review Boards.

Human Subjects Involvement and Characteristics: The subjects for this project include end user representative stakeholders in the design of user interfaces. Specifically, we will conduct focus groups of professionals (e.g., clinicians, researchers, and sensor developers) to develop requirements that will guide development of user interfaces.

We will conduct a small end-to-end evaluation of the entire platform to validate its functionality and usability, and to identify any potential deployment issues; this evaluation will include the professionals above and children with persistent asthma and/or their parents (most likely as parent/child dyads). For the end to end evaluation we will preferentially invite those participants who also participated in project 1, who may be interested in evaluating the overall platform.

Inclusion Criteria: Professionals: individuals involved in the care, research or sensor development for children with asthma. Children/Parent Dyads: This will include children ages 5 to 18 years, with persistent asthma and/or parents of children with persistent asthma. Persistent asthma is defined as patients with a diagnosis of asthma and who have in the last 12 months: 1) one or more oral corticosteroid prescription(s) for an asthma attack or 2) one or more emergency department or hospital admissions for an asthma attack or 3) a clinical diagnosis of persistent or 4) not-well or poorly controlled asthma at the time of enrollment.

Exclusion criteria: patients with the following chronic or complex medical conditions will be excluded from the study since their co-morbid conditions may affect measured asthma outcomes. Patients with a history or increased risk of pulmonary disease (cystic fibrosis, lung dysplasia, broncho-pulmonary dysplasia, aspiration pneumonia, severe CP with aspiration risk, technology dependency (gastrostomy tube, tracheostomy), history of congenital heart disease requiring surgical correction or with complicating congestive heart failure requiring medical management, immunodeficiency (including patients on immunosuppressants), and malignancies. Also, patients who are uninsurable due to undocumented immigrant status will be excluded because their status regarding ability to pay for treatment may be an over-riding factor, confounding or obscuring effects of the intervention on "intent" to adhere to treatment.

Potential Risks to Human Subjects: We recognize that there are some potential patient risks related to the study. We will work closely with the Institutional Review Board at the University of Utah to ensure that procedures are in place to protect the rights and welfare of patients and parents. No adverse events that would harm study participants are anticipated. Participation in focus groups is voluntary and individuals can decide not to participate. The principal risks to participants of this research are loss of privacy and confidentiality, including potential subject identification, and potential breach of confidentiality through disclosure of protected health information. Installing rigorous security protections on data management, issuing regular reminders to project staff to change their passwords often, and adherence to HIPAA and IRB privacy and data security requirements will mitigate these risks.

Sources of Research Material: The data sources for this study will include recordings and notes from focus groups and usability testing as well as administrative data from sensors and example clinical data from longitudinal asthma symptom monitoring system. We will use patient identifiers (including patient's name, date of birth, address and gender) to link patients with sensors and clinical data to facilitate assessment of impact of environmental data on asthma outcomes.

Recruitment and Consent Procedures: Potential participants will be screen using inclusion and exclusion criteria at the time of an outpatient visit or hospital admission. Participants meeting criteria will be directly approached during hospital admissions for asthma care or invited to participate in the focus groups by the care coordinator through a phone call or letter. Parents who agree to participate will complete an informed consent document (for themselves) and **parental permission** (for their child). Children between 7 and 12 will provide **assent**.

Adequacy of Protection Against Risks: Approval of all protocols, forms, consents, and study modifications will be obtained from University of Utah IRB. The raw data from the focus groups will be stored on a secured network directory with authentication and authorization protections accessible only to the research team members requiring PHI access. All other research materials will be stored in a secure file cabinet in the PI's secured office at PCH. The key to linking data back to PHI will be secured on the PI's computer and will not be shared. All data analyses will be performed on data sets created without identifiers. Identifiers will be removed from study data files as early as possible in the data processing steps. All source/legacy data files will be stored behind the University of Utah firewall. All investigators and project staff will sign confidentiality pledges annually and receive annual IRB and HIPAA privacy and data security compliance training.

Potential Benefits: Participants will not benefit directly from participation in this study. This study will facilitate future research to enhance our understanding of the role of environmental exposures on asthma outcome. We anticipate that future interventions based on the new sensor monitoring system are expected to lead to improved overall asthma care, improved asthma control and possibly reduction of disparities among underserved children.

Importance of the knowledge to be gained: Therefore, our study will make significant contributions not only to the science about how to manage asthma and address asthma disparities but also to self-monitoring and self-management of other chronic diseases sensitive to environmental triggers, and to translation of effective interventions to patient populations with chronic disease. Results of our study will be of significance to health care organizations, researchers, parents, children with asthma care providers and policy makers nationwide.

Inclusion of Women and Minorities

We will use a convenience sample of representative end-user stakeholders. We will target professional participants based on their area of knowledge/expertise. We will recruit parents (and child) participants from patients or community members who are already known to the investigators. Parents may participate on their own or as part of a parent/child dyad or triad; it is likely that when we enroll children the child's mother (or female guardian) will enroll as part of the dyad or triad.

We will not exclude any stakeholder based on sex/gender, race, and ethnicity; to the extent possible we will recruit a broad and diverse a sample of stakeholders.

Planned Enrollment Report

Study Title: Project 3 Lab View

Domestic/Foreign: Domestic

Comments: Traditional heuristics suggests that 6-8 participants should be sufficient for the interviews and focus groups for the user-centered design process but that more may be needed in some cases. We plan to include up to 10 professionals as participants. We will also invite 6 - 8 children with asthma, and parents to participate in the end-to-end testing of the entire platform.

Racial Categories	Ethnic Categories				Total	
	Not Hispanic or Latino		Hispanic or Latino			
	Female	Male	Female	Male		
American Indian/Alaska Native	2	1	0	0	3	
Asian	1	1	0	0	2	
Native Hawaiian or Other Pacific Islander	0	0	0	0	0	
Black or African American	2	3	0	0	5	
White	9	7	3	5	24	
More than One Race	0	0	0	0	0	
Total	14	12	3	5	34	

Study 1 of 1

Inclusion of Children

We will recruit children ages 5-18, from patients or community members who are already known to the investigators. We will include children for the design and evaluation of components with which children will interact, such as for the design of age-appropriate interfaces. We expect this will be predominantly as a parent/child dyads or trios because we anticipate that in most cases, parents will supervise the child's use of sensors and software when they are deployed for a study. Project 1 will include children (and parents) in the design of sensor interfaces and for design of age-appropriate feedback. Children (and parents) will also be included in the end-to-end evaluation of the center infrastructure.

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