#### CS6440

Deliverable #4: Final Project Presentation

December 4, 2016

#### **Team Phoenix FHIR**

Name	Primary Team Role	GT Username	Preferred Email			
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Our Final Proejct presentation can be viewed at the following link: <a href="https://youtu.be/xSWntV39ul4">https://youtu.be/xSWntV39ul4</a>

Please select 720p video quality on Youtube viewing options to assure highest quality playback of this final presentation video! (YouTube "Settings=>Quality")

A PDF of the power point is appended to this document.

A PDF of the Gantt chart is also appended to this document (and can be found in the last 2 pages of this overall document)

# CDC Population Health Informatics Framework: FHIR Identity Masking and Re-Linking Services

Team Phoenix FHIR
Final Project Presentation
December 4, 2016

Mentors:

John Loonsk, MD, FACMI Jason Bonander, MA

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### **Project Overview**

- The CDC's Center for Chronic Disease Prevention and Health Promotion is currently working on a Population Health Informatics Framework to identify and establish standard, interfaces, and the interactions needed to support population health management.
- The sharing of data for population health management purposes has a significant dependence on protecting the privacy of the patients included in the population data. All shared data must be deidentified; however, in some cases there will also be a subsequent need to reidentify data.
- Pseudonymization: each patient is given a unique identifier and the method for generating this identifier is maintained and protected separate from the healthcare data itself.

Project Objectives: Help develop RESTful FHIR services that protect patient identity and confidentiality through the support of dynamic identity masking, pseudonymization, and relinking.

#### Research

- Business cases
- HIPPA deindentification
- Lookup table vs. dynamic solution
- Encryption
- SMART on FHIR

#### Sources:

Lablans, Martine et al. "A RESTful interface to pseudonymization services in modern web applications." *BMC Medical Informatics and Decision Making* 15.2 (2015): http://www.biomedcentral.com/1472-6947/15/2.

Somolinos, Roberto, et al. "Service for the pseudonymization of electronic healthcare records based on ISO/EN 13606 for the secondary use of information." *IEEE journal of biomedical and health informatics* 19.6 (2015): 1937-1944.

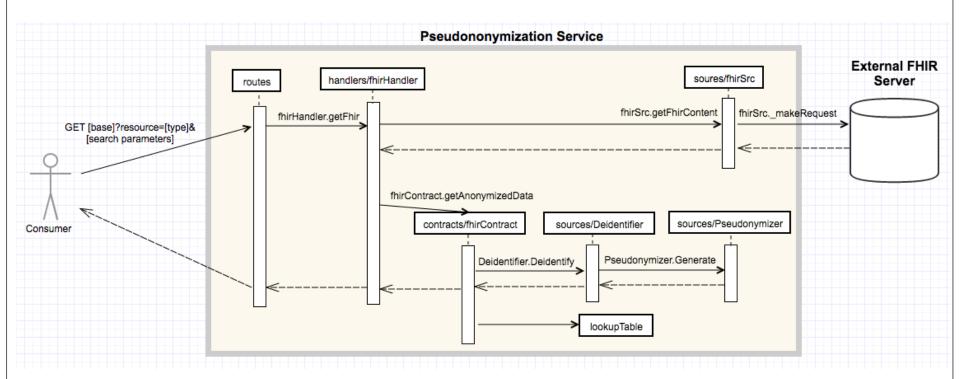
Kho, Abel N., et al. "Design and implementation of a privacy preserving electronic health record linkage tool in Chicago." *Journal of the American Medical Informatics Association* (2015): http://dx.doi.org/10.1093/jamia/ocv038.

Garfinkel, Simson L. "De-identification of personal information." *National Institute of Standards and Technology, Gaithersburg, MD, Tech. Rep. IR-8053* (2015): http://nvlpubs.nist.gov/nistpubs/ir/2015/NIST.IR.8053.pdf.

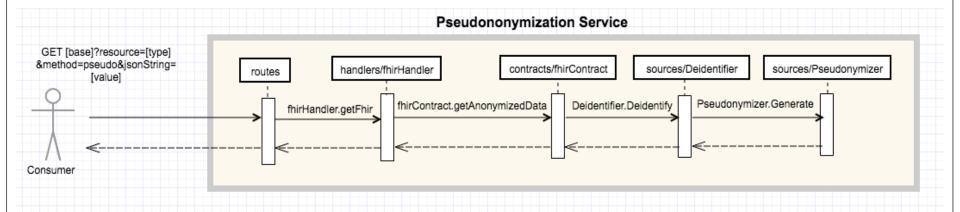
#### Solution

- Create node.js app that can be installed and connected to an HER/HIE.
- Utilize a Swagger interface to demonstrate the capabilities of the app.
- Use HMAC-SHA-1 encryption to generate a pseudonymous ID; store this in a lookup table with identifying information
- Support three use cases:
  - 1) Pseudonymize and return the results of a FHIR request GET [base]?resource=[type]&[search parameters]
  - 2) Pseudonymize and return data sent to the service GET [base]?resource=[type]&method=pseudo&jsonString=[value]
  - 3) Return identifying information for previously pseudonymized data GET [base]?resource=Patient&pseudoID=[value]

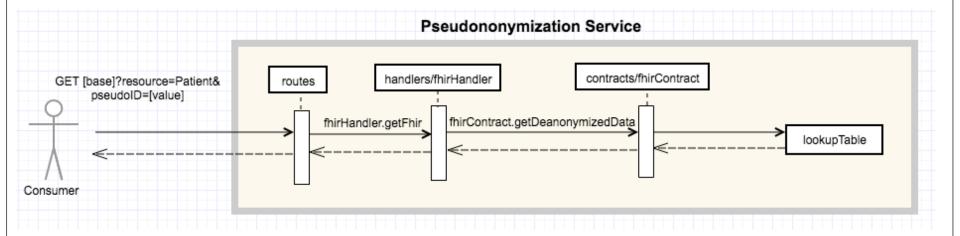
## Usage Case #1



## Usage Case #2

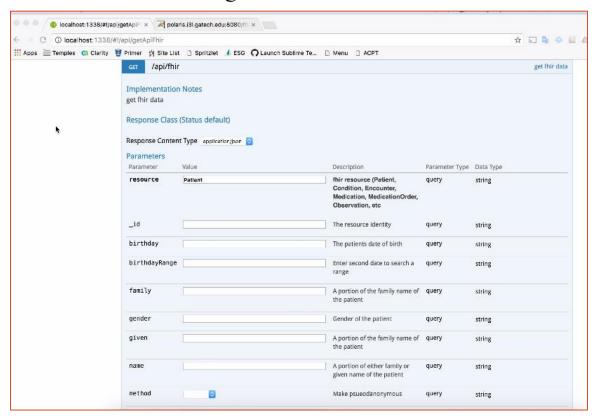


## Usage Case #3



# **Project Demonstration**

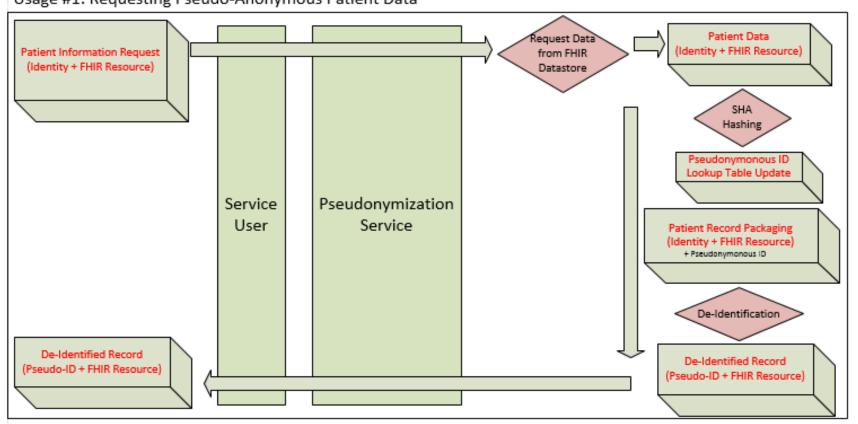
- We created a service that provides pseudo-anonymization related features;
- Our demo uses Swagger to demonstrate the functionality of this service.
- The following video demonstrates the usage of our server and shows the related content on the GT FHIR Data Server (GT FHIR Data server utilized for demonstration of Usage Case #1)



# Usage Case #1: Requesting Pseudo-Anonymous Patient Data

- This usage case involves an entity requesting a de-identified copy of a patient record (all identifying information removed).
- Our service strips out identifying information and inserts a unique hash. This data is then considered pseudo-anonymous and is returned to the requester

  Usage #1: Requesting Pseudo-Anonymous Patient Data



# Usage Case #2 Sending Arbitrary FHIR Data for Pseudo-Anonymization

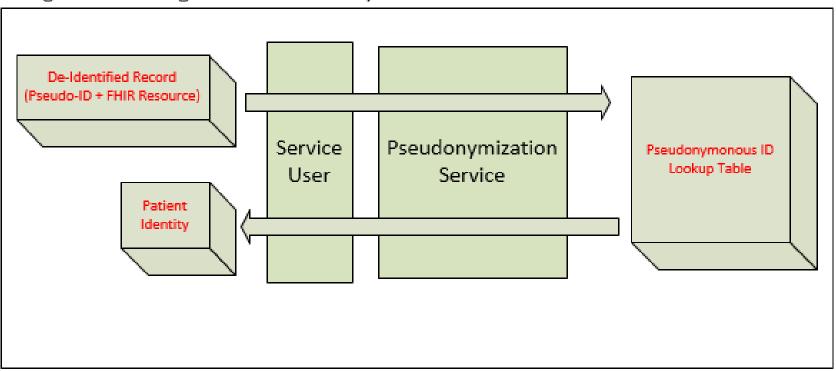
- This usage case involves an entity sending specific data for pseudoanonymization. This usage case does not require access to a FHIR Datastore
- Our service strips out identifying information and inserts a unique hash. This data is then considered pseudo-anonymous and is returned to the requester

Usage #2: Requesting Pseudo-Anonymization of Arbitrary FHIR Patient Data Arbitary FHIR Patient Data Hashing (Identity + FHIR Resource) Pseudonymonous ID Lookup Table Update Patient Record Packaging Service Pseudonymization (Identity + FHIR Resource) Service User + Pseudonymonous ID De-Identification De-Identified Record De-Identified Record (Pseudo-ID + FHIR Resource) (Pseudo-ID + FHIR Resource)

# Usage Case #3 Re-linking Pseudo-Anonymization Data with Real Patient ID

- This usage case involves an entity requesting a re-linking of pseudo-anonymous information with the Real Patient's ID
- Our service checks the unique hash stored in the pseudo-anonymous information and returns the linked Real Patient ID

Usage #3: Relinking based on Pseudonymous ID



### Remaining Elements / Further Developments

- We have implemented the key usage cases for this project and that there are no remaining elements within the scope of our project goals.
- For a production-level deployment, there are several other modules which will need to be developed to make this platform viable (These were considered outside the scope of our project)

Element	Description				
Authentication	Our server does not concern itself with authenticating valid users. Since the service maintains a secret lookup table, it is vitally important that Authentication / Access Control be implemented on a production deployment				
Batch Processing	Our server processes 1 record at a time. For a production deployment it is likely that a method of batch processing be implemented to speed up overall execution time on large data sets				
De-duplication of Records	Our server cannot create more uniqueness in records than already exists in those records. If the incoming records are non-obvious duplicates, then our server will treat them each as unique. It is suggested that a method of de-duplication can be added to this service to aid in identifying duplicate records				
De-Identification of Unstructured Data	Our server currently handles that which follow FHIR data structures. FHIR also has a facility for unstructured data. This data commonly holds identifying information and should be processed as well.				
Installer or Configuration File	Our server currently installs via command line, and defaults to the GT FHIR server. An installer or Configuration file can be created which allows further automation and configurability				

## **Project Gantt**

#### Please reference Project Presentation PDF for more readable Gantt Chart!

D Task Name	Duration	Start	Finish	Resource Names	Qtr 4, 2016 Qtr 1, 2017
1 Meet with Mentor	0 days	Thu 10/6/16	Thu 10/6/16	Aaron,Christy,George,Lucas	Sep Oct Nov Dec Jan Feb
2 Topic Presentation (Deliverable #1)	2 days	Thu 10/6/16	Fri 10/7/16	Aaron,Christy,George,Lucas	in I
3 Complete the PPT	0 days	Thu 10/6/16	Thu 10/6/16	Christy	♦ 10/6
4 Record the video	0 days	Thu 10/6/16	Thu 10/6/16	Lucas	♦ 10/6
5 Team review of the video	1 day	Fri 10/7/16	Fri 10/7/16	Aaron,Christy,George,Lucas	Aaron,Christy,George,Lucas
6 Submit the video for Assignment Topic Presentation	1 day	Fri 10/7/16	Fri 10/7/16	Lucas	Lucas
7 Weekly update #1 (entire team)	6 days	Sun 10/2/16	Fri 10/7/16	Aaron,Christy,George,Lucas	Aaron,Christy,George,Lucas
8 Weekly update #2 (entire team)	6 days	Mon 10/10/16	Sat 10/15/16	Aaron,Christy,George,Lucas	Aaron, Christy, George, Lucas
9 Technical Presentation (Deliverable #2)	11 days	Mon 10/10/16	Wed 10/19/16	Christy, George, Aaron, Lucas	
10 Complete the PPT	2 days	Fri 10/14/16	Sat 10/15/16	Christy, Lucas	Christy,Lucas
11 Record the video	2 days	Sat 10/15/16	Sun 10/16/16	George,Christy	■ George,Christy
12 Team review of the video	1 day	Mon 10/17/16	Mon 10/17/16	Aaron,Christy,George,Lucas	Aaron,Christy,George,Lucas
13 Submit the video for Assignment Topic Presentation	1 day	Tue 10/18/16	Tue 10/18/16	Lucas	Lucas
14 Discuss approaches with Mentor and read literature provide		Sat 10/8/16	Wed 10/19/16	Aaron Christy George Lucas	Aaron,Christy George,Lucas
weekly discussions	ided by Meritor for 14 days	3at 10/6/10	wed 10/19/10	Aaron, Christy, George, Lucas	Tanan, amany, according to
15 Research possible platforms and determine which path is b	best (Smart on 14 days	Wed 10/19/16	Sun 10/30/16	Aaron,Christy,George,Lucas	Aaron,Christy,George,Lucas
FHIR, PHP, Node.js)					
16 Weekly update #3 (entire team)	1 day	Sun 10/30/16	Sun 10/30/16	Aaron,Christy,George,Lucas	Aaron,Christy,George,Lucas
17 (Node.js selected) Implement a simple Node server	12 days	Mon 10/31/16	Thu 11/10/16	Aaron,George	Aaron George
18 Weekly update #4 (entire team)	1 day	Sun 11/6/16	Sun 11/6/16	Aaron, Christy, George, Lucas	Aaron, Christy, George, Lucas
19 Progress Report (Deliverable #3)	7 days	Mon 11/7/16	Sun 11/13/16	Aaron,Christy,George,Lucas	<b>→</b>
Complete the PPT	2 days	Tue 11/8/16	Wed 11/9/16	Christy, George, Lucas	<b>Ⅲ</b> Christy, George, Lucas
Record the video	2 days	Thu 11/10/16	Fri 11/11/16	Aaron	Aaron
Z2 Team review of the video	1 day	Sat 11/12/16	Sat 11/12/16	Aaron,Christy,George,Lucas	Aaron Christy, George, Lucas
23 Submit the video	1 day	Sun 11/13/16	Sun 11/13/16	Lucas	Lucas
24 Module Development: Hashing	13 days	Fri 11/11/16	Mon 11/21/16	George	- L
25 Document required inputs to module	13 uays	Fri 11/11/16		George	George
		Fri 11/11/16			George
				George	George
27 Create data structure to capture all generated hashes		Fri 11/11/16		George	George
28 Document output of module		Fri 11/11/16		George	George
Module Development: De-identification	13 days	Fri 11/11/16	Mon 11/21/16	Christy	_    •••
Document required inputs to module (JSON)				Christy	
31 Deploy JSON parsing module				Christy	
32 De-identify data based on HIPPA requirements				Christy	
33 Document output of module				Christy	
34 Module Development: Lookup Table & Re-Linking	13 days	Fri 11/11/16	Mon 11/21/16	Aaron	
35 Document required inputs to module				Aaron	
36 Define data structure for Lookup Table				Aaron	
Tark Name	Duration	Ctart	Cinich	Percurce Namer	
Task Name	Duration	Start	Finish	Resource Names	Qtr 4, 2016   Qtr 1, 2017     Sep
37 Define & implement API for adding entries to lookup ta	able	Start	Finish	Aaron	Qtr 4, 2016   Qtr 1, 2017
37 Define & implement API for adding entries to lookup ta 38 Define & implement API for looking up entries in looku	able	Start	Finish		Qcr 4, 2016   Qr 1, 2017   Sep   Qr 1, 2017   Fe   Sep   Qr 1, 2017   Fe
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### Plans for Deployment

Our project is a server/service which would exist in a larger FHIR based ecosystem. Many auxiliary components will need to be developed to make that overall ecosystem viable.

Our intended deployment is to serve as a element in the development of those auxiliary components. The most direct component which may be developed would be an application which makes use of our service.

Full source code, documentation, project details, and notes are captured on our team's Georgia Tech Github repository. This information is accessible for any entity which desires to further development of auxiliary components for the FHIR ecosystem.

Task Name			Duration	Start	Finish	Resource Names	Sep	Qtr 4, 2016 Oct Nov	Qtr 1, 2017 Dec Jan Fe
1 Meet with Mer	ntor		0 days	Thu 10/6/16	Thu 10/6/16	Aaron,Christy,George,Lucas	seb	◆ <b>10/6</b>	Dec Jan F
2 Topic Presenta	ition (Deliverable #1)		2 days	Thu 10/6/16	Fri 10/7/16	Aaron,Christy,George,Lucas		M)	
3 Complete th	e PPT		0 days	Thu 10/6/16	Thu 10/6/16	Christy		♦ 10/6	
4 Record the v	video		0 days	Thu 10/6/16	Thu 10/6/16	Lucas		<b>♦</b> 10/6	
Team review	v of the video		1 day	Fri 10/7/16	Fri 10/7/16	Aaron, Christy, George, Lucas		Aaron,Christy,Geor	ge,Lucas
Submit the v	video for Assignment Topic P	Presentation	1 day	Fri 10/7/16	Fri 10/7/16	Lucas		Lucas	
Weekly update	e #1 (entire team)		6 days	Sun 10/2/16	Fri 10/7/16	Aaron, Christy, George, Lucas		Aaron, Christy, Geo	rge,Lucas
Weekly update	e #2 (entire team)		6 days	Mon 10/10/16	Sat 10/15/16	Aaron, Christy, George, Lucas		Aaron,Christy,G	eorge, Lucas
Technical Pres	entation (Deliverable #2)		11 days	Mon 10/10/16	Wed 10/19/16	Christy, George, Aaron, Lucas			
0 Complete th	e PPT		2 days	Fri 10/14/16	Sat 10/15/16	Christy,Lucas		Christy, Lucas	
1 Record the v	video		2 days	Sat 10/15/16	Sun 10/16/16	George,Christy		<b>■</b> George,Christy	
2 Team review	v of the video		1 day	Mon 10/17/16	Mon 10/17/16	Aaron, Christy, George, Lucas		Aaron, Christy, 0	eorge, Lucas
3 Submit the v	video for Assignment Topic P	Presentation	1 day	Tue 10/18/16	Tue 10/18/16	Lucas		Lucas	
Discuss approa weekly discuss		literature provided by Mentor for	14 days	Sat 10/8/16	Wed 10/19/16	Aaron, Christy, George, Lucas		Aaron,Christy	
Research possi FHIR, PHP, Noc	•	e which path is best (Smart on	14 days	Wed 10/19/16	Sun 10/30/16	Aaron, Christy, George, Lucas			ty, George, Lucas
6 Weekly update	e #3 (entire team)		1 day	Sun 10/30/16	Sun 10/30/16	Aaron, Christy, George, Lucas			sty,George,Lucas
7 (Node.js select	ed) Implement a simple Nod	de server	12 days	Mon 10/31/16	Thu 11/10/16	Aaron,George		Aaron	
Weekly update	e #4 (entire team)		1 day	Sun 11/6/16	Sun 11/6/16	Aaron, Christy, George, Lucas		Aaron,C	hristy, George, Lucas
Progress Repo	rt (Deliverable #3)		7 days	Mon 11/7/16	Sun 11/13/16	Aaron, Christy, George, Lucas			
Complete th	e PPT		2 days	Tue 11/8/16	Wed 11/9/16	Christy, George, Lucas		Christy	George,Lucas
Record the v	video		2 days	Thu 11/10/16	Fri 11/11/16	Aaron		<b>Aaron</b>	
2 Team review	v of the video		1 day	Sat 11/12/16	Sat 11/12/16	Aaron, Christy, George, Lucas		Aaron	Christy, George, Lucas
Submit the v	video		1 day	Sun 11/13/16	Sun 11/13/16	Lucas		Lucas	
Module Develo	opment: Hashing		13 days	Fri 11/11/16	Mon 11/21/16	George			
5 Document re	equired inputs to module			Fri 11/11/16		George		_ Georg	
5 Implement S	SHA-512 using JAMIA paper s	structures		Fri 11/11/16		George		Georg	
7 Create data	structure to capture all gene	erated hashes		Fri 11/11/16		George		Georg	
B Document o	utput of module			Fri 11/11/16		George		Georg	e
9 Module Develo	opment: De-identification		13 days	Fri 11/11/16	Mon 11/21/16	Christy			
Document re	equired inputs to module (JS	SON)				Christy			
1 Deploy JSON	I parsing module					Christy			
2 De-identify of	data based on HIPPA require	ements				Christy			
3 Document o	utput of module					Christy			
4 Module Develo	lule Development: Lookup Table & Re-Linking		13 days	Fri 11/11/16	Mon 11/21/16	Aaron		<u> </u>	
5 Document re	Document required inputs to module					Aaron			
6 Define data	structure for Lookup Table					Aaron			
	Task	Project Sumn	nary	Manual Task		Start-only	Deadline	<b>.</b>	
oject: Simple Projec	t Plan Split	Inactive Task	•	Duration-only		Finish-only	Progress		1
ate: Sat 12/3/16	Milestone	◆ Inactive Miles	stone	Manual Summary	Rollup	External Tasks	Manual Progres	s	ı
	Summary	Inactive Sumi		Manual Summary	•	External Milestone			
	Sammary	- I Macroe Sum		- Manaa Samman	- '				

ID	Task Name	Duration	Start	Finish	Resource Names	Sep	Qtr 4, 2016 Oct	Nov	Qtr 1, 2017 Dec Jan Feb
37	Define & implement API for adding entries to lookup table				Aaron	seb	Oct —	INOV	Dec   Jan   Feb
38	Define & implement API for looking up entries in lookup table				Aaron				
39	Utilize Lookup Table to determine patient identity				Aaron				
40	Document output of module				Aaron				
41	Integrate all Modules and record demo usage	8 days	Tue 11/22/16	Mon 11/28/16	Aaron,George			П	
42	Test with valid and invalid data (QA)				Aaron,George				
43	Test with duplicate records (QA)				Aaron,George				
44	Record all usage cases for presentation				Aaron				
45	Weekly update #5 (entire team)	1 day	Sun 11/20/16	Sun 11/20/16	Aaron, Christy, George, Lucas			<b>■ A</b> a	ron, Christy, George, Lucas
46	Weekly update #6 (entire team)	1 day	Sun 11/27/16	Sun 11/27/16	Aaron, Christy, George, Lucas				Aaron, Christy, George, Lucas
47	Prepare Final Video Presentation (Deliverable #4)	8 days	Mon 11/28/16	Sun 12/4/16	Christy, Lucas, Aaron, George			<b>-</b>	1
48	Prepare initial PPT	5 days	Tue 11/29/16	Sat 12/3/16	Christy				Christy
49	Review and Fill in PPT gaps (if needed)	1 day	Sat 12/3/16	Sat 12/3/16	Aaron, Christy, George, Lucas				Aaron, Christy, George, Luca
50	Pre-record usage cases	1 day	Sat 12/3/16	Sat 12/3/16	Aaron				Aaron
51	Confirm content of pre-recorded usage cases	1 day	Sun 12/4/16	Sun 12/4/16	Lucas, Aaron				Lucas, Aaron
52	Update the Gantt for inclusion in video	1 day	Sun 12/4/16	Sun 12/4/16	Lucas				Lucas
53	Record final video presentation	1 day	Sun 12/4/16	Sun 12/4/16	Lucas				Lucas
54	Team review of the video	1 day	Sun 12/4/16	Sun 12/4/16	Aaron, Christy, George, Lucas				Aaron, Christy, George, Luca
55	Submit the video	1 day	Sun 12/4/16	Sun 12/4/16	Lucas				Lucas
56	Prepare Final Documentation & Package Project (Deliverable #5)	8 days	Mon 11/28/16	Sun 12/4/16	Aaron, Christy, George, Lucas				1
57	Create Data Elements to FHIR Resource Mapping Guide	2 days	Sat 12/3/16	Sun 12/4/16	Christy				Christy
58	Create UML Diagram describing each transaction	2 days	Sat 12/3/16	Sun 12/4/16	Christy				Christy
59	Summary document detailing the design decisions made	2 days	Sat 12/3/16	Sun 12/4/16	George,Lucas				George,Lucas
60	Update Software Architecture Design Document	2 days	Sat 12/3/16	Sun 12/4/16	George				George
61	Create Catalog.pdf (see Deliverable #5 requirements)	1 day	Sun 12/4/16	Sun 12/4/16	Lucas				Lucas
62	Create Special Instructions.pdf (see Deliverables #5 requirements)	1 day	Sun 12/4/16	Sun 12/4/16	Aaron,George				Aaron,George
63	Create Manual.pdf (see Delieverables #5 requirements)	1 day	Sun 12/4/16	Sun 12/4/16	Aaron,George				Aaron,George
64	Populate Research Directory with content uncovered during project	1 day	Sun 12/4/16	Sun 12/4/16	Lucas				Lucas
65	Populate Application Direction with application	1 day	Sun 12/4/16	Sun 12/4/16	George,Aaron				George,Aaron
66	Create Final Submission T-square pdf & submit to T-square	1 day	Sun 12/4/16	Sun 12/4/16	Lucas				Lucas
67	Wrap up project with live demo for Organization Mentor	1 day	Tue 12/6/16	Tue 12/6/16	Aaron,Christy,George,Lucas				Aaron, Christy, George, Luca

