

CATVAX

Request for Project Funding and Permission to Publish Request for

Proposal to Project Vendors

Prepared for:

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**1. Project Abstract Summary**

CatVax is our proposed immunization automation application. Its main goal is to achieve automated entry of immunization record data and validation of patient information through character recognition technology and a real-time interface with a robust database and end-user web access for ease of use to manage and store immunization records and to notify patients of immunization requirements and Center for Disease Control releases directly to end-users mobile devices. CatVax will save a significant amount of time for both end-users and health center staff. Saving staff time will translate to a significant cost savings. CatVax aims to serve as a new best practice in public health when manual human validation is not feasible given staffing levels and costs of validation-processes. Our innovation simplifies and removes the burden of paper records with the intention of dramatically improving immunization information systems participation.

CatVax aims to improve clinical practices by providing automated assessment of recommended vaccinations, reducing visits in health centers for vaccination recommendations and minimizing the burden for a patient to receive consultations. This service will offer increased accessibility for both the end-user and the administrator who is interested in evaluating coverage and making evidence-based decisions. This service will also allow smart-alerts to notify existing participants of CatVax about recent virus outbreaks based on their GPS location and their location on file, ultimately working towards reducing the rate of vaccine preventable disease.

Based on recommendations from the California Department of Public Health the UC system intends to require vaccinations for measles, mumps, rubella, chicken pox, meningococcus, tetanus and whooping cough, under a plan set to take effect in 2017. Our proposal plans to implement alpha and beta testing in the UC campus communities to greatly reduce the burden of documentation validation.

The project team is excited to tackle a project with significant technical innovations to improve the delivery and standards in the public health domain. This project represents the opportunity for the UC system to innovate and lead the way in public health. After the UC system develops, implements and pilots the application our goal is to extend it to the national level so that we may reduce disparities in vaccination coverage rates and vaccine-preventable disease.

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**a. Background**

Over 20% of U.S. children by the age of two typically have seen more than one healthcare provider, resulting in scattered paper medical records across multiple providers and immunization registries. Despite an increasing effort to drive immunization records to more robust computerized systems, the upload and validation of data remains a very manual process that requires visual inspection and physical entering of data from patients and health care providers. Because of the manual process, operation and management is a costly and complex endeavor requiring specialized management, technical and epidemiologic skills.

By automating and improving the data entry process:

1. Reduced operating costs with less training and staff time required for manual data entry.
2. Improved data quality with validation of records.
3. Improved data tracking and sharing ability across registries, geographies, and providers, ultimately leading to more strategic evidence-based decisions about directing resources to parties who have the most need.
4. Increased participation of children, adolescents, and adults who have immunization records in fully, operational, population-based IIS.
5. Automated recommendations and regular alerts for suggested immunization services.

**b. Approach**

**i. Purpose**

CatVax primary goal is to eliminate manual data entry and achieve automated entry of immunization record data and validation of patient information through character recognition technology and a real-time interface with a robust database and secure web access for ease of use to manage and store immunization records. Our proposed mobile application will have several advantages: improved IIS administration and geopolitical analysis, increased data for coverage analysis, improved end-user accessibility and a simplification of entry and validation. CatVax intends to reduce cost and complexity while increasing IIS participation rates and data quality so that coverage analysis can be performed and we may reduce vaccine-preventable disease.

**ii. Outcomes**

CatVax intends to achieve the following outcomes:

1. Modern mobile application that can provide conditional checks for parsed and entered vaccination information.

2. Character recognition

- Electronically extract and parse information from immunization record.   
- Novel methods to read a mixed format record handwritten and machined-type data.s

3. Secure end-to-end data transfer

- HIPAA-compliant mobile framework and secure data transfers between client/hosts and other parties such as CAIR (California Immunization Registry)

**iii. Strategies & Activities**

Develop and disseminate methodologies for key IIS assessment activities

**1. Proposed/Collaborators**

**a.) University of California Student Health Centers**

**b.) California Department of Public Health**

**c.)**

The CatVax team will collaborate with CDC to improve technical assisstance, program guidance, and program evaluation efforts.

**b. With organizations external to CDC:**

The University of California campuses (UC Berkeley, UC Davis, UC Irvine, UC Los Angeles, UC Merced, UC Riverside, UC San Diego, UC San Francisco, UC Santa Barbara, UC Santa Cruz, UC San Francisco, UC Office of the President) will collaborate to implement alpha and beta testing within the student health adult patient populations.

Pharmacy collaborators need to be identified

Can we work with Merced County public health (racial and ethnic minority and uninsured)

UC Merced Professor Ming-Hsuan Yang, will serve as a subject matter expert for Computer Vision aspects of the project.

UC Merced Director Stergios Roussos, will serve as a subject matter expert for Community Development and Public Health.   
  
Steve Nickell, the Acting Chief Registry and Assessment Section of the immunization branch in the California Department of Public Health will serve as a collaborator to facilitate data transfer between CatVax and the California Immunization Registry (CAIR). The CatVax team and CAIR will also explore potential novel immunization record design.

The Department of Public Health in Merced will focus on disparities within Merced County and explore ways to improve immunization care. They will collaborate in developing strategic ways to improve awareness and perform outreach through forums.

**2. Target Populations**

Phase one of the pilot program will begin at UC Merced student health center focused on adult populations. Phase two of the pilot program will include all UC campuses student health centers focused on adult populations.

**Approach Summary Table**

|  |  |  |  |
| --- | --- | --- | --- |
| Strategies and Activities | Short-term Outcomes | Intermediate Outcomes | Long-term Outcomes |
| 1. Develop and disseminate methodologies for key IIS assessment activities:  a. Develop methodologies for IIS data quality evaluation  b. Support the development of methodologies for use of IIS in population-based coverage assessments | Implementation of community-developed techniques for evaluation of IIS data quality by IIS  Increased understanding of the methodological and practical framework necessary for performing population-based immunization coverage assessment using IIS | Broad and uniform adoption by IIS of data quality evaluation using community-developed processes  Increased use of IIS for population-based coverage assessment following systematically-derived methods. | Increased overall immunization coverage  Increased operational and technical capacity of IIS |
| 2. Develop and deliver training and education products to IIS professionals in the planning, implementation, and ongoing management of IIS | Increased skills and knowledge among awardee IIS staff needed for successful IIS management and operations | Improved management and performance of IIS | Increased efficiency in immunization and VFC program management |
| 3. Develop and provide an infrastructure for ongoing IIS peer-to-peer support and specialized assistance |  |  |  |
| 4. Support the development of consensus-based IIS operational guidelines to address specific operational and technical issues critical to successful IIS program management |  |  |  |
| 5. Create and disseminate guidance for leveraging IIS data and functions in Immunization and Vaccines for Children (VFC) Program operations | Increased integration of IIS data and capabilities in Immunization and VFC Program management and operations | Increased reliance on IIS data for VFC and Immunization Program management |  |
| 6. Develop a standardized automated application that will record and validate patient immunization information | Increased understanding of process and data quality of current data entry methods |  |  |
| 7. Develop a standardized automated application that will record and validate patient immunization information | Increased understanding of process and data quality of current data entry methods |  | Increased operational and technical capacity of IIS  Efficient application capable of processing records with measurable accuracy  Reduced burden on end-user and organization to process immunization |

**4. Evaluation and Performance Measurement Plan**

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| --- | --- | --- | --- |
| Performance Measurement | Responsible Party and Evaluation Activity/Type | Actions to Continuously Improve Quality Based on Performance Measures | Addressed Evaluation Questions |
| Data Quality. Overall accuracy and precision based on evaluation of “test” set: true positives, true negatives, false positives and false negatives. | Computer Vision Advisor, PhD, graduate student researchers. | Increase accuracy by improving model or implementing other models. | What is the accuracy of reading handwritten data? |
| Data Quality. Overall accuracy and precision based on evaluation of “test” set: true positives, true negatives, false positives and false negatives. | Computer Vision Advisor, PhD, graduate student researchers. | Increase accuracy by improving model or implementing other models. | What is the accuracy of reading machine-typed data? |
| Overall vaccination coverage rate at each campus. | Entire team. | Increase coverage rate through the use of the application. | What is the vaccination coverage rate at each campus? |
| Overall vaccination coverage rate at all of the geopolitical areas we serve. | Entire team. | Increase coverage rate through the use of our application. | What is the vaccination coverage rate at a national level and within the geopolitical areas we are serving? |
| Overall vaccination coverage rate for VFC. | Entire team. | Increase coverage rate for existing programs by providing integration with current programs. | What is the vaccination coverage rate for VFC? |

**5. Organizational Capacity of Awardees to Execute the Approach**

The University of California system has250,000 enrolled students. The UC system is currently improving best practices by requiring incoming students to be screened for tuberculosis and vaccinated for measles, mumps, rubella, chicken pox, meningococcus, tetanus and whooping cough, under a plan set to take effect in 2017.

Our team brings together many senior medical and technical advisors to consult and aid in the process of building our program.

Michael Sanfilippo and Dr. Brandon Boggs bring technical medical vision and hands-on experience in their respective areas. Michael Sanfilippo will serve as the principal design and technical architect for CatVax. Dr. Brandon Boggs will serve as a principal design and medical architect for CatVax.

Dr. Brandon Boggs graduated from Merced High School and went on to college and received his Bachelor of Science degree in Zoology from Brigham Young University in 1996. He then received his Medical Degree from The Chicago Medical School in 2000. He completed his residency training at the University of Nevada School of Medicine, Reno in 2003. He subsequently became board certified in Family Medicine in 2003. He became a Fellow of the American Academy of Family Physicians in 2012. He has practiced as an emergency room physician, hospitalist and intensive care unit physician and private practice physician beginning in 2002. He also served as Medical Director of the Emergency Department and Chief of Emergency Medicine at a local hospital for over 7 years. He has also served as an outreach clinical preceptor for UC Davis and in other teaching settings. He is certified in Advanced Cardiac Life Support and Pediatric Advanced Life Support. He joined the University of California, Merced in 2012 as the Medical Director for Student Health Services. He subsequently was asked to be the Executive Director of Health and Counseling Services at the University in January of 2014.

Michael Sanfilippo has a BS in computer science & engineering from UC Merced, and is pursuing an advanced degree in electrical engineering & computer science where he focuses on computer vision and machine learning. He works as the Health Systems Engineer at the student health center and has hands-on experience with EMR system development. He has served as an advisor for a mobile health application for the CITRIS mobile app challenge. He is the CEO of Sophus, LLC that serves as the technical contractor for a First5 grant to aid children who may be at risk for intellectual and learning problems (ID-LDs). He has received the University of California Star award for his contribution to advance the use of technology to assist students with their health and wellness. He has received the Blum Center Scholarship to support his research in 2014 and 2015. He has received the Chancellor's innovation award for the proposal of CatVax.

Ming-Hsuan Yang is an associate professor in Electrical Engineering and Computer Science at University of California, Merced. He received the PhD degree in computer science from the University of Illinois at Urbana-Champaign in 2000. He studied computer science and power mechanical engineering at the National Tsing-Hua University, Taiwan; computer science and brain theory at the University of Southern California; and artificial intelligence and operations research at the University of Texas at Austin. He was a senior research scientist at the Honda Research Institute (formerly Honda Fundamental Research Labs) working on vision problems related to humanoid robots. In 1999, he received the Ray Ozzie fellowship for his research work. His research interests include computer vision, pattern recognition, artificial intelligence, robotics, and machine learning. Yang received the Google Faculty Award in 2009, and the Distinguished Early Career Research Award from the UC Merced Senate in 2011. Yang is a recipient of the Faculty Early Career Development (CAREER) award from the National Science Foundation in 2012. In 2015, Yang receives the Distinguished Research Award from UC Merced Senate. He is a senior member of the IEEE and the ACM.

Steve Roussos, Ph.D.,MPH leads operational and administrative functions for the UC Merced Blum Center. Roussos has more than 15 years of academic and community leadership in public health and community development. He holds a doctorate in child psychology and human development, and a master's in public health. His current work aims to understand and improve how organizations and community partnerships influence population-level outcomes, especially those outcomes disproportionately affecting vulnerable and underrepresented communities.

**6. Work Plan**

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| Milestone | Activity & Responsible Party | Start Date & End Date | Evaluation Measures |
| Inform providers about adult immunization recommendations, coverage rates, and the Standards. | Develop standards and implementation strategy.  (Community Development Committee)  Implementation to support evaluation of IIS data. (Technical Team) | Start: Q1 (Community Development Committee)  Start: Q2 (Technical Team) | Documentation. |
| Assess barriers to implementing the Standards | Needs assessment of barriers. (Community Development Committee) | Start: Q1 (Community Development Committee) | Needs assessment documentation. |
| Identify strategies to implement potential approaches such as expanding effective reminder/recall or standing orders, or other Evidence Based methods as described in the Community Guide to Prevention | Development and implementation of CatVax. | Ongoing.  (Technical Team and Community Development Committee) | Documentation based on development and implementation decisions/policies. |
| Developed methods to track progress for implementation of these strategies for each group | Project management through basecamp (Community Development Committee)  Project management, documentation, and issue tracking through Github (Technical Team) | Ongoing. | Documentation of project progress. |
| Identified potential methods to better utilize 317 funds for vaccinations for uninsured adults. | Identify potential methods based off of CatVax data (Community Development Committee) | Q4 (Community Development Committee) | Potential methods to utilize 317 funds. |
| CatVax - pharamacy usage and ability to routinely assess adult patient vaccination needs | Facilitate pharmacy usage of CatVax (technical team)  Develop automated process for assessing patient vaccination needs.  (technical team & community development committee) | Start: Q1 End: Q4 | Ability to allow pharmacies to use CatVax. |
| Work with CAIR to allow CatVax data transfer and computability. | Technical team and California Immunization Registry. | Starts: Q2  Ends: Q3 | Ability to provide secure transfer to CAIR from CatVax |
| Create CatVax module to allow entry of doses into registry | Technical team and community development team. | Starts: Q2 | Module that interfaces with registry and allows dosage information |
| Measure doses entered by pharmacists | Pharmacy team and technical team. | Starts: Q1  Ends: Q4 | Number of doses |
| Increase adult vaccinations in community | Entire Team | Starts: Q1  Ends: Q4 | Measure vaccinations through CatVax and compare with other EMRs and existing community systems |
| Develop and implement CatVax at pilot sites to test the implementation of these methodologies, provide support and evaluation of the pilot implementation, and use the results to improve the process or methodologies | Start with UC Merced, then deploy to all UC campuses.  Create strategy and plan for Merced County.  (Merced County Department of Public Health and technical team) | Starts: Q1  Ends: Q4 | Metrics to be determined. |
| Support implementation of methodologies for population-based coverage assessments using CatVax | Work to generalize framework, where some information may not be given and will need to be solicited.  (Technical Team and Immunization Compliance Developer) | Starts: Q3  Ends: Q4 | Number of communities we can reach, population in each community, percentage of coverage reached in the community. |
| Enter adult vaccinations via CatVax, providing adult vaccines by vaccine type | Technical Team and Community Development Team. | Starts: Q1  Ends: Q2 |  |
| Implement reminder and recall system in CatVax | Technical Team  Create tracking system for vaccinations that allows for notifications when vaccinations are recommended and a recall system to allow batch recall administration. | Starts: Q1  Ends: Q2 | Web application with administration to perform recalls. |
| Engage with community annually to assist with implementation standards | Technical Team and Immunization Compliance Policy Developer. | Starts: Q4  Ends: Q4 | Annual community conference. |
| Support the exchange and adoption of technical and operational practices, lessons learned, and other information related to the successful IIS management and operations among the IIS community. | Immunization Compliance Policy Developer and Technical Team. | Ongoing. | Documented work in box.com and github. |
| Make CatVax assessment a routine part of adult HCP practice. | Entire Team.  Develop and implement CatVax to be used within the UC system as a routine application that provides recommendations. | Starts: Q1  Ends: Q4 | Implementation within UC system. |
| CatVax improved delivery of immunization services | Entire Team. | Starts: Q1  Ends: Q4 | Comparison of immunization process with and without CatVax with estimated costs. |
| CatVax will increase adult vaccinations that are documented in vaccine registries through CAIR integration. | Technical Team will facilitate integration.   Community Development Team will work on driving patients to the application. | Starts: Q1  Ends: Q4 | Increase in number of adults who have the immunization records in CAIR. |
| A greater degree of collaboration among multiple healthcare providers is achieved, especially through the use of IIS. | The Community Development Team will create strategies to collaborate and push out standards within the UC system. | Starts: Q1  Ends: Q4 | Project management tracking of healthcare providers. |
| A greater degree of Section 317 funds are used to assist in providing ACIP recommended vaccines for uninsured adults and racial/ethnic disparity is reduced. ￼￼ | The Immunization Compliance Policy Developer and Community Development Advisor will create a strategy on how to target uninsured adults and racial/ethnic populations. | Starts: Q1  Ends: Q4 | Proposal to develop specified populations. |
| Support development of IIS operational and technical best practices and disseminate in the IIS community. | Immunization Compliance Policy Developer and Technical Team.  Develop secure innovative automation framework to process paper records. | Starts: Q1  Ends: Q4 | Document best practices and implementation.  Documentation on HIPPA/FERPA security of mobile framework. |
| Facilitate access to training data set that includes scanned documents of immunization records and labels for dates and vaccination name. | Community Development committee will be responsible for facilitating access and may solicit the help of PNC subcontractor. | Starts: Q1  Ends: Q1 | Labeled data set to train computer vision system. |
| Develop recognition of machine-typed data. | Computer Vision Advisor, PhD, graduate student researchers. | Starts: Q1  Ends: Q4 | Accuracy rate for recognition. |
| Develop recognition of handwritten data. | Computer Vision Advisor, PhD, graduate student researchers. | Starts: Q1  Ends: Q4 | Accuracy rate for recognition. |
| Develop compliance checks for application as specified by requirements. | Compliance Policy Developer and Technical Team. | Starts: Q1 Ends: Q2 | Validation testing of secure processing images taken from mobile device. |
| Develop ability to text alerts based on recent CDC virus outbreaks. | Compliance Policy Developer and Technical Team. | Starts: Q3  Ends: Q4 | Validation testing of feature. |
| Develop secure cross-platform mobile application with web interface for data analysis. | Technical Team. | Starts: Q1  Ends: Q4 | Validated application for uploading immunization records. |
| Method for securely interfacing with EMR systems and other IIS systems. | Technical Team. | Starts: Q1  Ends: Q4 | Secure transfer of data. |

**7. Budget Narrative**

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| Salary/Wages Including Benefits (40%) | Year 1 |
| Michael Sanfilippo (PI) | $14,000 |
| Brandon Boggs (Co-PI) | $14,000 |
| Steve Roussos  (Community Development Advisor) | $14,000 |
| Ming-Hsuan Yang (Computer Vision Advisor) | $14,000 |
| 8x Medical Director Consultants for Community Development Committee | $56,000 |
| 2x Graduate Student Researchers (year-round)  Includes (additional benefits, costs per student): Tuition $15,102, $486 Student Services Fee, $1173 Health Insurance Fee | $120,000 |
| 1x Subcontracted PhD | $150,000 |
| 1x Subcontracted Software Engineer | $100,000 |
| 1x Subcontracted Application Developer/Programmer | $100,000 |
| 1x Subcontracted Immunization Compliance Policy Developer and Data Analyst | $100,000 |
| 1x Subcontracted Software Tester | $80,000 |
| PNC Subcontractor | $50,000 |
| Personnel Total: | $812,000 |

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| --- | --- |
| Equipment/Travel | Year 1 |
| Travel & Electronic Equipment for: PI, Co-PI, and Graduate Student Researchers | $40,000 |
| Servers (Amazon Web Services) | $25,000 |
| Security, Software Licenses | $20,000 |

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| --- | --- |
| Indirect Costs | Year 1 |
| 55% of “On-Campus” Personnel Wages based on F&A Rate Agreement | $202,000 |

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| --- | --- | --- | --- |
| Total Funds Requested |  |  | Program Total |
|  |  |  | $1,099,000 |