

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: Yalini Senathirajah

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

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
Harvard University, Cambridge, MA, US	AB	06/1979	Biology
Ontario Veterinary College, Guelph, Ontario, CA	N/A	9/1981 – 9/1983	Veterinary Medicine
Columbia University, New York City, NY, US	Doctorate (PhD)	10/2010	Biomedical Informatics

A. Personal Statement

My doctoral training and subsequent Agency for Healthcare Research and Quality (AHRQ)-funded research centered on a novel paradigm to improve the design of electronic health records (EHR) in ways that increase their fit to task, give clinicians greater control, and address the variability and complexity of healthcare information needs using new technical approaches. This new paradigm entails a different interaction method and software development approach which allows clinician users to assemble and share whatever they need on screen using drag and drop methods, instead of being limited to information layouts set by programmers. I built and tested a unique example experimental system. Findings shed light on how clinicians assemble information mentally and on screen, revealing their thinking and information needs in real-time while engaged in clinical cognition processes. Findings from my previous work have implications for cognitive load, safety, efficiency, and improved interaction design to better support clinical tasks (see below). Another area of study this work relates to is how EHR design affects diagnostic reasoning and overall cognitive processes. I am thus expert on clinical data and in the 'putting knowledge into the system' end of Learning Health Systems. I have conducted prior studies including the mixed method techniques to study clinician cognition, workflow, and interaction with EHRs. I lead the large 2000-record chart review for the national RECOVER project studying Post-Acute Sequelae of Covid (PASC, 'long Covid') and am thus familiar with methods of computable phenotyping and chart review.

I have extensive knowledge and 18 years of experience with web technologies and interaction design from work as webmaster of a large academic medical center and other research institutes, creating applications for research and patient care. As Principal Investigator (PI) of two AHRQ R01s, I am also experienced in managing AHRQ grants. I am thus expert in the technologies of EHRs and the web, and the development issues involved in conceiving and implementing new tools into the EHR.

I have not created research projects under another name.

Relevant grants:***Evaluating and Enhancing Health Information Technology for COVID-19 Response Workflow in a Specialized COVID-19 Hospital in a Medically Underserved Community***

Funder: AHRQ (R01) PI: Kaufman, D, Senathirajah, Y. (1/1/21-12/31/22)

This research project will study how a lower-resourced safety-net hospital, University Hospital of Brooklyn, responds to a pandemic, specifically COVID-19, under conditions of great stress and strain and with much uncertainty. In the short term, the project will investigate how information needs are met and how decisions are made and communicated to other individuals internally and externally to the institution (Aims 1 and 2), and the results of this investigation will be used to develop a range of information technology solutions, such as dashboard displays, visualizations, and data extraction tools (Aim 3), so that the institution can better address

gaps in information needs and workflow. In the long term, this work has the potential to impact public health by illuminating the needs of lower resource hospitals during pandemic situations and introducing novel approaches to improve decision-making and response and therefore enhance patient quality of care, safety, and well-being.

Researching Covid to Enhance Recovery (RECOVER) Initiative

This is a large national project including several regional health system networks pooling data and resources to understand Post-Acute Sequelae of Covid ('long Covid') via creation and validation of computable phenotypes. *Funder: NIH 1 OT2 HL161847-01 - NIH subcomponent 2022-2023 PI: Rainu Kaushal 30% salary.*

Finding the Safer Way: Novel Interaction Design for Health IT Safety

Funder: AHRQ (R01) PI: Senathirajah, Y Years: 7/2015-4/2021

This project extends our previous work using the MedWISE paradigm and tools to examine specific interaction design and cognition aspects of health IT safety with the goal of producing better design patterns which can be adopted by vendors. Experiments examine clinical reasoning when the end-user clinician has great control of the EHR. It employs newer methods such as pupillary dilation eyetracking. Further experiments test the approach involving online sharing of user-created tools, interruptions in high-stress simulations, and related safety concerns.

Relevant Publications

- **Characterizing and Visualizing Display and Task Fragmentation in the Electronic Health Record: Mixed Methods Design.** Senathirajah Y, Kaufman DR, Cato KD, Borycki EM, Fawcett JA, Kushniruk AW. *JMIR Hum Factors*. 2020 Oct 21;7(4):e18484. doi: 10.2196/18484. PMID: 33084580
- **Safer Design - Composable EHRs and Mechanisms for Safety.** Senathirajah Y. *Stud Health Technol Inform*. 2015;218:86-92. PMID: 26262532
- Senathirajah Y, Kaufman, D, Bakken S. **The clinician in the driver's seat: part 1 & 2 - a user-composable electronic health record platform.** *Journal of Biomedical Informatics*, Nov/Dec 2014 doi:10.1016/j.jbi.2014.09.002. PMID: PMC6027643 and PMID: PMC5926811
- Cheng L, Senathirajah Y. **Using Clinical Data Visualizations in Electronic Health Record User Interfaces to Enhance Medical Student Diagnostic Reasoning: Randomized Experiment.** *JMIR Hum Factors* 2023;10:e38941) doi: 10.2196/38941

B. Positions, Scientific Appointments, and Honors

Positions and Employment

2017 – Present	Associate Professor, University of Pittsburgh School of Medicine, Pittsburgh, PA
2017 – Present	Visiting Associate Investigator, Northwell Health/Hofstra Medical School, East Garden City, NY
2017	Associate Investigator, Northwell Health/Hofstra Medical School, East Garden City, NY
2011 – 2017	Assistant Professor, Department of Medical Informatics, State University of New York – Downstate Medical Center, Brooklyn, NY
2010 – 2011	Instructor/Researcher, Department of Biomedical Informatics, Columbia University, NY
2006 – 2010	National Library of Medicine Pre-Doctoral Fellow, Department of Biomedical Informatics, Columbia University, New York, NY
2004 – 2005	Programmer/Researcher, Harlem Health Promotion Center, Columbia University, New York, NY
2003 – 2004	Webmaster, Columbia School of Journalism, New York, NY
1998 – 2003	Webmaster, Health Sciences Campus, Columbia Medical Center, New York, NY

Recent Honors

Society to Improve Diagnosis in Medicine – Best Abstract Finalist 2018. Top 6 of 185.

Finalist, 'Ideas that Work' Innovation Competition of the American Medical Informatics Association, 2014.

Best Paper Award, Context-Sensitive Health Informatics International Meeting (MedInfo), 2013: *Essential Questions: Accuracy, Errors and User Perceptions in a user-composable EHR.*

Ariadne Award (winning team at Brigham/MIT medical hackathon – Twiage ‘app’ for emergency information transmission from ambulances to emergency departments)

Best Poster Award, National Library of Medicine Informatics Trainee Conference, 2009: Development and Evaluation of a web 2.0-based EHR

Best Talk Award, Robert Wood Johnson Public Health Informatics Fellows Meeting, 2009: *Rapid reconfiguration of a web 2.0-based EHR to meet an emerging need (H1N1).*

Finalist, Diana Forsythe Award for Best Qualitative Methods Paper in 2006: American Medical Informatics Association (AMIA) 2006: *Health Information Seeking and Technology Use in Harlem – A Pilot Study Using Community-Based Participatory Research*

Additional Training/Licensures

National Institutes of Health – Mobile Health Training, 2012

National Institutes of Health – Causal Discovery Training, 2016

National Institute for Nursing Research – Health analytics training 2017

National Institutes of Health – Brain Imaging Training, 2018

C. Contributions to Science

Contribution 1

My earlier contributions involved ‘consumer/public health informatics’, i.e. how technology might play a role in fostering healthy behaviors, helping people find and understand health information, and addressing the needs of minority and underserved populations. As webmaster of the Columbia Health Sciences campus, I was often involved in creating websites or other tools to communicate with special populations, such as those with HIV and depression, psychiatric syndromes, or clinical trials patients. My work at Harlem Health Promotion Center involved planning and implementing a health portal for Harlem residents and using technology to help understand youth with HIV. Similar work included studies with community physicians in underserved communities, using online tools to teach them about sensitive screening for colorectal and prostate cancers. I am currently involved in research using tablets and mobile phones to streamline clinic workflow with underserved patients and who might be non-native English speakers, collecting data from patients (including use of audio to accommodate those with limited literacy or English proficiency), and providing decision and workflow support to the healthcare provider (based on collected data and EHR data). Other work includes use of patient- and clinician-facing tablet tools to improve health behaviors and streamline diagnosis of sleep disorders among those of African descent in NYC.

Papers generated from this work include:

- Robbins R, Senathirajah Y, Williams NJ, Hutchinson C, Rapoport DM, Allegrante JP, Cohall A, Rogers A, Ogedegbe O, Jean-Louis G. **Developing a tailored website for promoting awareness about obstructive sleep apnea (OSA) among blacks in community-based settings.** *Health Commun.* 2019 May;34(5):567- 575. doi: 10.1080/10410236.2018.1423865. Epub 2018 Jan 17.PMCID: PMC6420401
- Cohall AT, Dini S, Senathirajah Y, Nye A, Neu N, Powell D, Powell B, Hyden C. **Feasibility of using computer-assisted interviewing to enhance HIV test counseling in community settings.** *Public Health Rep.* 2008 Nov-Dec;123 Suppl 3:70-7. PMID: 19166091 PMCID: PMC2567006
- Sheinfeld Gorin S, Franco R, Hajiani F, Senathirajah Y. **Systematic development and usability testing of a physician-based prostate cancer education program in an African American community.** *AMIA Annu Symp Proc.* 2007 Oct 11:1112. PMID: 18694209
- Cohall AT, Senathirajah Y, Dini S, Nye A, Powell D, Powell B **An online audio computer-assisted self-interview for pre-screening prior to rapid HIV testing in a vulnerable population..** *AMIA Annu Symp Proc.* 2007 Oct 11:915. PMID: 18694015

Contribution 2

My most significant contribution is addressing problems with the design of EHRs and other health information technology (HIT) software. Because healthcare presents extremely complex, dynamic, rapidly changing, collaborative and high-stakes work, creating HIT systems which truly meet the needs of clinicians has been very problematic. This has been compounded by a commercial system in which vendors can charge exorbitant amounts; making change and innovation difficult. My analysis was that there is too much of a gap between

programmers and clinicians, and thus software does not truly reflect their ways of thinking, needs, contexts, nor the need for rapid change with new public health emergencies (such as the Ebola situation) or new treatment development. Consequently, I proposed and built an example platform which reflects a new paradigm. It allows nonprogrammer clinicians to create and share their own software tools and interfaces, thus systems can develop which truly reflect their needs and ways of thinking. We implemented this as a working prototype at a large academic medical center. User testing revealed HCI and cognition advantages, ability to change the system rapidly for an emergent condition (H1N1), fit to task, user-created patterns useful for care, and several other advantages. Building the system established the technical feasibility of this approach, and the ability to create it within an existing legacy system. Key findings are below.

Cognitive and usability studies showed that users can use such systems for appraising real patient cases (and a majority prefer it). Clinician users made use of the new flexibility to solve existing perceived problems in the EHR, create interfaces and tools geared to their medical concepts and needs, and expressed great enthusiasm for the overall approach, believing it saved time, could facilitate colleague communication, and has the capability for solving context-specific problems of workflow and treatment. Objective measures revealed a sharp reduction (from 70% to 15%, $p < .0001$) in the repetitious navigation seen with the conventional system, as expected. Analysis of distinctive spatial patterns of user creations showed users used the new functionality to aid their cognitive processes via various intelligent uses of space found in other work domains. Users perceived that the approach saved time (both at the time of use and in future, due to the sharing and social networking features). Comparison with log file analyses of the conventional system show a 2- to 7-fold theoretical time savings if all users caring for the same patient were to create and share interfaces. A study of comparative diagnostic accuracy and errors found no significant difference between use of the MedWISER and conventional systems. Users perceived many other advantages, e.g., the composed tools serving as checklists. Users stated that the ability to gather and view information together (the most liked feature), and to externalize information assisted their cognitive process. During the H1N1 epidemic, we demonstrated creation of new decision support tools in hours rather than the usual weeks for EHR development. Papers include:

- Cheng L, [Senathirajah Y](#). **Testing Medical Student Diagnostic Reasoning Using Clinical Data Visualizations**. *Stud Health Technol Inform*. 2022 May 25;294:819-820. doi: 10.3233/SHTI220596. PMID: 35612216.
- [Senathirajah Y](#), Kaufman DR, Cato KD, Borycki EM, Fawcett JA, Kushniruk AW. **Characterizing and Visualizing Display and Task Fragmentation in the Electronic Health Record: Mixed Methods Design**. *JMIR Hum Factors*. 2020 Oct 21;7(4):e18484. doi: 10.2196/18484. PMID: 33084580; PMCID: PMC7641790.
Borycki E, Dexheimer JW, Hullin Lucay Cossio C, Gong Y, Jensen S, Kaipio J, Kennebeck S, Kirkendall E, Kushniruk AW, Kuziemsy C, Marcilly R, Röhrig R, Saranto K, [Senathirajah Y](#), Weber J, Takeda H. **Methods for Addressing Technology-induced Errors: The Current State**. *Yearb Med Inform*. 2016 Nov 10;(1):30-40. doi: 10.15265/IY-2016-029. PMID: 27830228; PMCID: PMC5171580.
- Kushniruk A, [Senathirajah Y](#), Borycki E. **Effective Usability Engineering in Healthcare: A Vision of Usable and Safer Healthcare IT**. *Stud Health Technol Inform*. 2017;245:1066-1069. PMID: 29295265.
- [Senathirajah Y](#), Kaufman, D, Bakken S. **The clinician in the driver's seat: part 1 & 2 - a user-composable electronic health record platform**. *Journal of Biomedical Informatics*, Nov/Dec 2014 doi:10.1016/j.jbi.2014.09.002. PMCID: PMC6027643 and PMCID: PMC5926811
- [Senathirajah, Y.](#), Kaufman, D., Bakken, S. **Essential questions: accuracy, errors, and user perceptions in a modular, user-composable electronic health record**. (MedInfo 2013 CSHI preconference Best Paper award).

Contribution 3

Other contributions I have made concern data analytics with respect to various clinical informatics problems. In connection with the new paradigm posed in contribution 2, I carried out analysis of log files of clinicians' use of the EHR, establishing that clustering using data mining methods is feasible as a way to find patterns of use which can be used to automate EHR design for different conditions.

- [Senathirajah, Y](#), Bakken S. **Visual Clustering Analysis of CIS Logfiles to Inform Creation of a User-configurable Web 2.0 CIS Interface**. *Methods of Information in Medicine*, 2011;50(4):337-48. PMCID: PMC5926809

Contribution 4

Another study which received wide press concerned analysis of log file data from 1.7 million patient records from the New York City Department of Health immunization registry to determine whether EHR modules which automate immunization record submission improve efficiency and quality. Our findings were that the automation improved accuracy, reduced submission time and validated the use of this type of technology for public health. Although I am listed as senior author, I did the majority of the design and analysis work.

- J. Merrill, A. Phillips, J. Keeling, R. Kaushal, Y. Senathirajah. ***Effects of automated immunization registry reporting via an electronic health record deployed in community practice settings.*** *Applied Clinical Informatics* 2013 (4)2 p267-275. PMID: PMC3716417

Link to NLM Publications:

<https://www.ncbi.nlm.nih.gov/myncbi/browse/collection/47986698/?sort=date&direction=descending>