



MASTER OF SCIENCE IN  
**CLINICAL INFORMATICS &  
PATIENT-CENTERED  
TECHNOLOGIES**

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SPRING 2022 NEWSLETTER

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## DIRECTORS' MESSAGE

**Donna Berry PhD, RN, AOCN, FAAN**  
Professor of Biobehavioral Health and  
Health Informatics

**Andrea Hartzler, PhD**  
Associate Professor, Biomedical  
Informatics and Medical Education.



As the 2021-2022 academic year is coming to a close, we celebrate many accomplishments in the program and are excited about the next steps. As the COVID 19 pandemic may be diminished, we know that many of you in direct care and roles supportive of direct care continue to be impacted. Please stay in touch with your instructors and advisors regarding your individual challenges.

This year we welcomed Mackenzie Klinker Hutchins as our CIPCT program specialist. I'm certain many of you have benefited from her support. Many thanks to Mackenzie!

Summer is always an exciting time as many of our students will be developing scholarly projects. Dr. Annie Chen is teaching the scholarly proposal development course in Summer 2022. Please speak with us if you have questions about projects.

We are also getting ready for our annual meeting and orientation on September 23rd and welcoming our 2022 cohort, which will likely be the largest ever. We look forward to seeing our second-year students in person or on Zoom.

## Congratulations to our 2021-2022 Graduating Class!

Lori Allshouse, Olawunmi Ayokunle, Jessica Bertram, Rica Lynn Bailey-Wysocki, Brittaney Belyeu, Rey Allan Bonus, Jessica Chang, Xuehong Fan, Tori Frisk, John Gladys, Katharine Hansen, Scott Hulse, Jeehoon Jang, Carla Jo Kimberlin, Megan Laine, Zachary Liao, Laura Sabin Lopez, Anna Lorenzetto, Tanya Louca, Madeline Lowry Woods, Esther Sung Eun Oh, Miriam Perez, Daniel Phan, Jake Portanova, Shayni Saftler, Alexander Stabile, Sarah Stewart, Michelle Stoffel, Allen Tang, Thanh Trinh, Joshua Nguyen Weiss, Tyler Wright, Fui Wei Yan, and Karen Yeager.



## STUDENT SPOTLIGHT

### Metasebia Afework and Laurel Buening – 2020 and 2021 Cohorts



Laurel and Metasebia were invited to assist the HIMSS 2022 weeklong conference in Orlando, FL, titled Re-Imagining Health. Since CIPCT is a predominantly virtual program, they had not previously met before the conference. They had the chance to work together as Program Assistants while networking with other informatics graduate students. Program assisting involves monitoring rooms to ensure each session proceeds without issue. They were part of the first P.A. cohort to utilize a new

system for scanning participant Q.R. codes for attendance. Laurel and Metasebia took advantage of after-hours HIMSS-sponsored events, such as the attendee-only Universal Studios night. The photo shows Laurel and Metasebia fresh off of the dinosaur-themed Velocicoaster. They both said they are eager to attend next year's conference and were so happy to have connected this year. Program Assisting at HIMSS requires an application process and is highly competitive. They are both grateful for this opportunity and consider it a rewarding experience overall.

### Megan Laine – 2019 Cohort

Master of Science Outstanding Student Award – University of Washington, School of Nursing

This year, Megan was recognized for her application of theory to practice, creativity, scholarship, professional potential, leadership and contributions to the community.

Congratulations, Megan!

### User Experience Research Internship

Megan completed a user experience research internship from May to July 2021 with the Health Intelligence group at Microsoft Research Cambridge. It was a memorable and great experience to live in England and learn alongside researchers from various backgrounds.



### Megan's Conference Participations / Submissions

Kearns W.R., Laine M., Oh E.\*, Thompson H.T., and Demiris G. (2021, Jun 10-13). Understanding Perspectives on Artificial Intelligence Technologies for Sleep Self-Management [Poster session]. Virtual SLEEP 2021. <https://www.sleepmeeting.org/>

Laine M., Oh E.\*, Kearns W.R., Thompson H.T., and Demiris G. (2021, May 18-20). User-Centered Design Recommendations for Sleep Technologies That Use Artificial Intelligence [Poster session]. AMIA 2021 Virtual Clinical Informatics Conference. <https://www.amia.org/cic2021>

*\*Esther Oh graduated from the CIPCT Program in Summer 2021*



## FACULTY SPOTLIGHT

**Annie T. Chen, MSIS, PhD** - Associate Professor,  
Biomedical Informatics and Medical Education.

### **What brought you to the University of Washington?**

I was impressed by the dedication of my home department, Biomedical Informatics and Medical Education, to pedagogy.

### **Please explain your research interests and why you are passionate about the topics.**

I have three main areas of research interest. First, I am interested in what people do to manage health long-term.

Over the course of a chronic condition, people can potentially learn a lot about their bodies, and come to see health and wellbeing differently. I am interested in the role that information plays in this development, and how we can design information services to fill their needs.

Second, an important thrust of my work is health-related uses of social technologies. For example, much of my work examines how people discuss health-related topics, particularly relating to mental health and substance use, on social media. This is part of a broader interest in the huge volume of data that is now being produced on social media and as a part of digital health interventions, including those delivered via mobile apps and online social networking platforms. In my research, our team works with stakeholders, including patients and providers, to analyze this data and incorporate it into subsequent iterations of digital health interventions.

Third, as we go through life, what we do carries with it our views and perspectives. I am interested in variations in research method and work practice within and across disciplines, which ultimately influence the conclusions that researchers make and what we do with these findings.

### **What do you wish others (colleagues, students) knew about what you do?**

Each person is embedded in a context, and understanding that context, where a person comes from and how they approach things, is critical to understanding how they will see health and wellbeing in the long term. However, life is rich and complex, and the signals that affect our health downstream may not be easily interpretable. My work leverages a variety of different methods to analyze quantitative and qualitative data in holistic and synthetic ways.

### **If you could share one piece of advice with students, what would it be?**

Take time out to listen to the signals that life, our world and surroundings afford us.

### **Finally, what would you be doing if you weren't doing this?**

It's hard to say. I believe that life takes you where it does, and our role is to figure out how to interpret this indication and interact with it synergistically.

## ALUMNI SPOTLIGHT

**Grace Sandoval, MS** – Director of Applications and Training,  
HealthPoint

*Graduated Winter 2021*

### **Why did you choose to attend the UW CIPCT Program?**

I wanted to deep dive in to health informatics as I had recently been promoted into management of our clinical information systems team. I met a nurse that had started the program and after learning about it, knew immediately it was what I needed to help me build the skills I sought.

### **What is one of your favorite memories, classes, professors, or activities as a UW CIPCT student?**

One of my favorite activities and memories as a student was the workgroup a few of us formed early on. We met at orientation and kept working together through the program. Each person brought unique skills and we all rotated through doing different roles and supporting each other's development. We had fun and did good work!

### **How has your education in the UW CIPCT Program influenced or helped you in your life and career?**

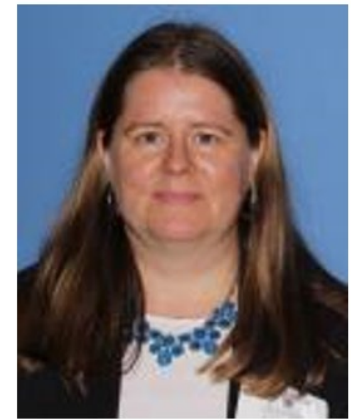
I came into the health informatics space by chasing opportunities that were presented in my organization. I didn't have any formal or academic foundation. This program helped me to understand where my organization and team are in the industry and gave me resources to visualize where we can go building for our future. Some of the most valuable content for me was learning about the regulatory programs, project management, and leadership.

### **What are one or two of your proudest professional or personal accomplishments after graduating from the UW CIPCT Program in which your education played a role?**

Two important accomplishments after I graduated were 1) Implementation of a new telehealth program and technology and 2) Leading the creation of a pharmacy informatics governance program--this included additional work creating a bridge across the chasm of misunderstandings and department misalignment.

### **What advice do you have for current students who want to make the most out of their experience in the UW CIPCT Program?**

Jump all in! Get involved with HIMMS and any other organization you can. Take advantage of all the amazing content at your fingertips with the library and professor experience. Make a plan for what YOU want to get out of it and go for it.



"Whatever you can do or dream you can, begin it. Boldness has genius, power and magic in it!"  
~ Johan Wolfgang von Goethe ~

## **SCHOLARLY PROJECTS: 2020-2021 ACADEMIC YEAR**

### **Lori Allshouse - A Scoping Review of Using the Various Suicide Screening Tools in the ED EHR**

With over 47,173 suicides in the United States in 2017 (an average of 130/day), and the numbers continuing to climb, with a 24% increase in the last ten years; more evidence-based suicide risk screenings are necessary at every patient intake area, including the emergency department (National Institute of Mental Health, 2017). The best way to prevent suicide is to conduct universal screening for suicide risk. The Columbia-Suicide Severity Rating Scale (C-SSRS) is an evidence-supported questionnaire used for suicide risk assessment (Columbia Lighthouse Project, The, 2019). The scale has been successfully implemented across many settings but there is a paucity of data of its utilization in the emergency department (E.D.) electronic medical records (E.H.R.). Having the screening data within the E.H.R. prevents suicides, allows for more resources to suicidal patients, increases follow-up psychiatric care, and allows access to screening data for the entire healthcare team.

The purpose of this scoping review was to provide an overview of the available research evidence on the use of the various suicide risk screening tools (i.e., Patient Health Questionnaire -2 or -9 [P.H.Q.], C-SSRS, ASQ, etc.) in ED EHR. This scoping review was conducted to answer the research question of whether the C-SSRS, or some other tool is commonly used in ED EHRs to screen for patients at risk of suicide. The search strategy included electronic databases, reference lists, and the gray literature. Papers published between 2012 and 2019, from which 298 articles were found. 277 articles were excluded for either language other than English, duplicate, no screening tool mentioned, not in the E.D., not suicide-specific, or were out of the date range. After removing 277 articles, 21 articles remained that identified the use of a suicide ideation screening tool in the ED EHR.

The final results showed the C-SSRS was used in 43.3% of the studies, while the ASQ (pediatrics) was used 6.7%, the PHQ-9 was used 6.7%, and the PHQ-2 was used 6.7% of the 21 research articles. The remaining tools made up 36.6% of the research articles. These results proved the C-SSRS was in much higher use than any other suicide risk screening tool in the E.D. In terms of evidence for including the suicide risk screening tools within the ED EHR, 66.7% mentioned the tool was documented within the ED HER.



## **Rica Lynn Bailey-Wysocki - Telehealth Impact on Chronic Pain Management: A Mixed-Methods Approach**

**Background:** Chronic Pain is a major health care problem in the United States affecting millions of individuals. It contributes significantly to rates of mortality, morbidity and disability in the U.S. Management of chronic pain traditionally has been designed for in-person interactions, however, COVID-19 has impacted how patients access and receive needed services. It has been found that hindrance of timely access to pain specialty care can contribute to suffering and increased healthcare utilization. Studies have shown that telehealth can be an effective approach for care management and coordination for multiple chronic conditions. However, the use of telehealth for chronic pain management has not been well studied. Given the current COVID-19 situation, there is a timely opportunity to explore the use of telehealth for effectively managing chronic pain.

**Methods:** The objective of this study was to evaluate the impact of telehealth services for chronic pain management, specifically at the Peninsula Pain Clinic. The purpose of this scholarly project is to describe the effectiveness of telehealth for managing chronic pain from the perspectives of the patients and to explore the benefits and barriers of employing this type of technology for managing patients with chronic pain. I applied a descriptive study design with a mixed-methods approach which utilized a semi-structured interview to gather patients' perspectives on the use of telehealth for chronic pain management. A content analysis was performed on the semi-structured data using a thematic analysis approach to find meaningful patterns in the data. Additionally, a structured survey via Google Forms was used to collect demographics data on the study participants to summarize the characteristics of the total sample population.

**Results:** 8 individuals interested and met inclusion criteria with a total of 6 who participated in the study. From the demographic survey results, five were female and one was male. The ages of the study participants included one (16.7%) in the 45-54 years old age group, three (50%) in the 55-64 years old age group and two (33.3%) participants in the 65-74 years old age group. Of the six participants, 5 lived in Kitsap County, WA and 1 lived in Clallam County, WA. 100% of study participants were white. Five study participants reported some college or associate's degree for education level with only one participant with a bachelor's degree education level. The study participants included two (33.3%) individuals with a married status, two (33.3%) individuals with a divorced status and two (33.3%) individuals with a widowed status. The employment status of the study participants included two (33.3%) individuals who were employed part-time (less than 35 hours), two (33.3%) individuals who were retired and two (33.3%) individuals who were unable to work due to their chronic pain. In addition, the study participants had private insurance (2), Medicare (2) and Medicaid (2) for health insurance coverage. The household income ranged from two (33.3%) individuals with incomes less than \$25,000 annually, one (16.7%) individual with \$25,000 to \$49,999 range, two (33.3%) individuals with \$50,000 to \$74,999 range and one (16.7%) individual with an income within the \$75,000-\$99,000 range. Moreover, four (66.7%) of the study participants reported living with chronic pain for six years or more, one individual with one to three years of chronic pain and one individual reporting four to six years of chronic pain. Lastly, the study participants revealed that a significant number of individuals participated in three or more telehealth visits during the COVID-19 closure with four (66.7%) out of the six participants in this category with the remaining two participants reporting at least two (33.3%) telehealth visits. Analysis of the semi-structured data resulted in 6 major themes: 1) Frustration With The Technology, 2) Travel time, 3) Transportation, 4) Continued Access During COVID, 5) Same Level Of Care, 6) Overall

## Experience/Satisfaction

**Conclusion:** Each study participant reported similar benefits with using telehealth for chronic pain management. The benefits of using this technology ranged from providing easier access to chronic care management, reducing travel time and costs, decreasing transportation accommodations for in-person visits and improving care delivery for individuals with mobility issues. The study participants reported limited experience with using this type of technology as the main barrier. Overall, the majority of study participants agreed they would continue to use telehealth for chronic pain care if the option was available. Ultimately, it would be important to consider older populations with limited experience using telehealth to ensure equitable access, as well as create an effective plan to mitigate the digital barriers that some may face with this type of technology for chronic health care management.

**Brittaney Belyeu - Artificial Intelligence and Adult Hypertension: A Scoping Review**

Globally, about a third of adults have high blood pressure. It is the leading risk factor in cardiovascular deaths and the disease has a large economic impact. Artificial intelligence (AI) has the potential to contribute toward prevention, earlier detection, and more targeted treatment of hypertension. This scoping review describes the English-language research literature covering 2010 to 2020 regarding AI use in hypertension. Of the 30 studies in this review, 77% focused on AI use in predicting or diagnosing hypertension. The remaining were studies involving surveillance or treatment. The majority (93.3%) of studies evaluated a machine-learning based model, with neural networks being most highly represented among machine learning techniques. There is momentum behind more work around artificial neural networks and deep learning in medicine. There is an opportunity for future research to focus more on treatment and management of hypertension, especially as personalized medicine takes a more prominent role in traditional healthcare. Future innovation should consider the potential for AI to exacerbate inequities in care. This study was limited in that it did not include non-English language studies.

## **Xuehong Fan - Utilizing an AI-enabled Conversational Agent**

**Background:** In 2020, approximately 53 million caregivers provide unpaid care to adults and children living with a chronic condition. There are significant physical and mental issues that exist amongst the caregivers of children with chronic conditions. Helping caregivers manage their psychological problems is imperative. Technology is an increasingly important part of our lives, and access to the internet and health-related information through portable devices greatly increased in the health seeking population, even for low-income communities. Being able to use artificial intelligence (AI) technology to provide caregivers with on-demand and self-management interventions are focused on by healthcare professionals and researchers. Based on the current healthcare technology background that has been revealed, a research team from the University of Washington developed the Caregiving of Caregivers Online (CocoBot). CocoBot is a tailored self-management program for family caregivers of children with chronic health conditions in underserved communities.

**Objectives:** The objective of this study is twofold: to evaluate the emotion states of the caregivers who are taking care of children with chronic conditions by observing the change in participants' emotion states before and after using CocoBot (Aim 1), and to improve the "Chabot's dialogue's quality and generated a more "human-like" conversation for the user-end (Aim 2).

**Methods:** We targeted the caregivers of children with chronic conditions and a quasi-experimental study method was used for this "Wizard of Oz" (WOZ) pilot testing. We used mixed methods data collection to collect quantitative and qualitative data in order to evaluate the participants' emotion states and improve the human-like quality of chatbot responses. The data collection was done through a one-on-one responsive WOZ testing and pre/post intervention quantitative survey. Differences between pre- and post- Positive and Negative Affect Schedule Measurement (PANAS-X) scores were compared using paired t-tests. Qualitative dialog review was performed during the study to improve the quality of chatbot.

**Results:** After about 6 weeks of pilot study with 40 participants in session 1. We used PANAS-selected scale to measure the participants' emotion states, which include both positive and negative affects Results shows that all the negative affects paired t tests p value less than 0.05, which indicated that interaction with CocoBot significantly reduced almost all the negative effects of interest for all the participants.

We collected dialogs and responses throughout the testing, with further analysis and by applying machine learning and natural language processing (NLP) methods. We were able to trained the prototype model to become more intelligent.

**Conclusion:** The high participation rate of session 2 and improved participants' overall negative affects revealed by the PANAS-selected survey indicate that CocoBot does indeed have a significant role in helping caregivers improve their physical and mental health. Throughout the dialog reviewing and modifying, team members applied machine learning and natural language processing (NLP) methods to the collected data and conducted a more human-like conversation. The study only measured the participants' emotion states over a short time span, this suggests that the long term influence of Cocobot still needs to be investigated.



### **Tori Frisk - eSAC Device Choice and Usability Interview and Observation**

The Electronic Self-Report Assessment and Care (eSAC) program is a patient recorded outcome tool created out of the need for better support and care of women with advanced ovarian cancer. These women have frequent clinic visits and need to stay in contact with providers about symptoms and care. Assessing the usability of eSAC enrollment and electronic device preferences to access the application can prompt changes to the application, enhance future users experience and improve satisfaction. Exploring why patients choose an electronic device is significant because when patients feel comfortable they are more likely to provide accurate, frequent, and consistent clinical data when filling out questionnaires. The purpose of this project was to observe participants during the access and registration of the eSAC system, observe the usability of the application, and the choice of electronic device to use. This study used a combined observation and semi-structured in-person interview with 18 women in a clinical setting. The most common electronic device of choice was a cellphone (iPhone or Android) to register for and utilize eSAC and there were multiple barriers as well as successes with the usability of the website. We also gained insight into password regulations and back-end I.T. issues. This evaluation has the potential to give usability insights that could enhance the eSAC technology for use on electronic devices, as well as new ideas for accessing the eSAC platform by smartphone app instead of web browser URL.

## Laura Sabin Lopez - The Electronic Health Record (E.H.R.) in Ambulatory Care: Inbox Simulation

**Purpose:** This project focused on educating students on EHR inbox prioritization, telephone triage, and team communication in a two-part simulation format. Students took a self-paced interactive virtual Inbox simulation (part 1) online and continued the course in a scheduled virtual class via the Zoom platform to complete (part 2) of the simulation content. Information was collected using an anonymous voluntary Google forms survey at the end of the course. The project was supported by the CARES Act supplemental funding for Nurse, Education, Practice, Quality, and Retention (NEPQR) awardees, enhanced telehealth training opportunities for Bachelor of Science in Nursing (BSN) students to Prevent, Prepare, and Respond to the COVID-19 crisis at the University of Washington School of Nursing (UW SON). The purpose of this simulation-based experience is for BSN students to practice prioritizing and responding to EHR inbox messages. Responding to messages and seeking provider input when appropriate is an important part of ambulatory care nursing that is likely unfamiliar to learners more accustomed to inpatient care. Additionally, the inbox is the hub of communication in ambulatory care facilities and little training has traditionally focused on inbox management for the care team. To prepare students for the challenges they will face during the COVID 19 crisis and beyond, a novel simulated virtual education for BSN students on the fundamentals of the Electronic Health Record (EHR) inbox management became critical in a time where access to clinical sites and their associated software systems became limited due to clinical site closures.

**Background/Significance:** This project evaluated how exposure to an E-Learning module and virtual simulation course on the Electronic Health Record (EHR) inbox management in the ambulatory care setting supports preparation to address the needs arising from COVID-19. This course was implemented in pre-licensure nursing curricula during a nursing clinical course in Fall 2020 quarter. Undergraduate nursing education has typically focused on inpatient nursing skills with a heavy emphasis on in-person clinical rotations in hospital and community health settings. The COVID-19 pandemic interrupted in-person educational opportunities and clinical experiences for nursing students at the University of Washington School of Nursing (UW SON) and required the school to create alternative methods of instruction. Additionally, clinical care has shifted from in-person to distance medicine-using new and existing technologies. Training for nursing students must be redirected to include the principles of nursing practice in a virtual environment.

**Sample:** The sample contained 83 BSN students enrolled in NCLIN 422 Fall quarter 2020. All 83 students received an anonymous survey which was available at the end of the virtual class simulation. Students were allowed time to complete the survey at the end of the simulation on a voluntary basis. The survey was also posted on Canvas Learning Management System.

**Inclusion Criteria:** Any UWSON BSN student enrolled in NCLIN 422 during Fall quarter 2020 that completes the module The EHR in Ambulatory Care inbox simulation will be eligible to take the voluntary survey.

**Exclusion Criteria:** Any UWSON BSN student that opted out of the survey will be excluded

**Sample Size:** With enrollment of 83 UWSON BSN students a goal was set of at least 20% of students to return the survey

**Gender, Race, and Ethnic Minority Composition:** Gender, race, and ethnicity was not collected in the selection of participants. It is expected that the volunteer sample will represent the UWSON BSN students enrolled in NCLIN 422 during Fall quarter 2020.

## **METHODS**

**Course content design and development:** The outline and purpose of this course was determined and partially written during the planning phase of the CARES Grant by Dr. Diana Taibi Buchanan, PhD, RN clinical faculty in preparation for clinical site closures and the need for virtual classrooms due to University closures in the context of COVID 19. An inbox simulation was planned as part of an ambulatory care clinical training rotation at the university. My original plan for the simulation was to utilize the simulated patient messages that Dr. Buchanan had already created and build them in the playground version of Epic systems software so that students could have access to the simulated Electronic Health Record (EHR) and learn how to prioritize messages within the EHR in a realistic fashion. I reached out to Epic Systems Software's user web training hub and explained that the nursing students would no longer have access to Epic at their clinical sites due to closures and asked if we could utilize their platforms for training purposes. This was Epic's response:

*Currently, we do not offer products or services directly to schools for training purposes. Instead, we encourage the community of healthcare organizations that use Epic to partner closely with their affiliated schools to offer experiences with the software to students. They often do this by extending copies of their training software to the schools, so that EHR use can be integrated into existing curriculum. These partnerships are possible for students of clinical practice, clinical informatics, and healthcare administration.*

I then went to University of Washington IT department and an Epic contact from UW school of medicine to request Epic playground or Epic sandbox access for myself and the students but ran into multiple barriers and time constraints.

Students require simulation hours and both synchronous and asynchronous content for their clinical simulation. Instead of using a prebuilt mock EHR I utilized the software program Articulate Storyline to create a module teaching the basics of documentation, telephone triage, and team communication in the Electronic Health Record as a basic foundation and prerequisite for the simulation. After creating the foundational learning content, I developed an interactive two-part simulation that is generalizable to many EHR's in terms of functionality, style, and interface.

## **Anna Lorenzetto - The Inpatient Nurse Experience with Secure Text Messaging: A Qualitative Study**

**Background:** Secure text messaging (S.T.M.) that is integrated into an electronic medical record has the potential to negatively impact wellbeing by contributing to cognitive overload. There is no knowledge of the impact of S.T.M. on the wellbeing of inpatient nurses, who send and receive the highest number of messages within the care team. This information is critical for healthcare organizations as they consider S.T.M. as part of their communication strategy.

**Methods:** The purpose of this study was to describe nurse's experiences with S.T.M. to determine what impact (positive or negative) it has had on nurse wellbeing and cognitive load. A cross-sectional, phenomenological study was designed to capture nurse's experiences through semistructured interviews. Transcription data was analyzed, and themes and subthemes were identified.

**Results:** 13 nurses responded, 11 consented and completed interviews. Demographic data, years as a nurse and areas of specialty varied. Analysis of the data resulted in mixed communication methods and S.T.M. feature preferences. Three negative impacts to wellbeing themes were identified: 1) inconsistent usage by all roles, 2) increased orders through S.T.M. and 3) workflow interruptions. Three positive impacts to wellbeing themes were identified: 1) ability to process and prioritize information, 2) less anxiety, and 3) efficiency gains. Nurses reported improved wellbeing overall. Three themes related to operational recommendations were identified: 1) keep innovating, 2) establish policy requirements of use, and 3) offer policy enforcement of no S.T.M. orders.

**Conclusion:** The introduction of S.T.M. as a new communication method has had a positive impact overall on nurse wellbeing and organizations should consider S.T.M. as part of their communication strategy. Additional studies that includes more reluctant users of S.T.M. would provide a more comprehensive view of the full impact of S.T.M. on wellbeing.



## **Tanya Louca - Advanced Stage Ovarian Cancer Patient-Reported Use of the Electronic Self-Report Assessment and Care Program**

**Background:** Approximately 20,000 women in the United States are diagnosed with ovarian cancer annually with greater than 70% diagnosed at an advanced stage III/ IV with a poor overall prognosis of a less than 50% 5-year survival rate. Due to late stage diagnosis and high incidence of recurrence, patients with ovarian cancer can experience extreme symptom severity when compared to other cancers. The high probability of poor outcomes makes quality of life management a priority with this diagnosis. The electronic Self-report Assessment and Care (eSAC) program is designed to address the frequency and severity of symptomatology and quality of life issues in ovarian cancer patients, as well as provide teaching on genetic testing. Examination of self-reported use of the eSAC will help further understanding of participant benefits and barriers to use.

**Methods:** The purpose of this project was to examine the patient-reported use of the electronic Self-report Assessment and Care (eSAC) program for women with advanced stage ovarian cancer. Approximately 9 weeks after enrollment, participants were contacted by email to participate in a qualitative semi-structured interview with open ended questions to obtain information about the unique usability experiences. Transcribed responses were analyzed using directed content analysis to identify themes.

**Results:** 59 participants were contacted by email and invited for a phone interview; 18 responded. Of the 18 participants interviewed, 16 reported that they were actively using the eSAC while 2 reported that they had set up an account but did not use the eSAC. Four major themes were identified: 1) Prompting of use, 2) Gather and exchange of information with clinician, 3) Self-Management, 4) Value. To evaluate participant response to email prompts active users were asked if they recalled the prompt five days prior to physician or NP appointment to which most did (n=15). To assess the use of the eSAC summary in a clinical setting, participants using the eSAC were asked if it was obvious that the clinician was using it. Most participants (n=11) responded that it was not obvious, yet when asked if the program improved communication with the provider, 11 participants answered 'yes.' To examine how participants were individually experiencing the eSAC they were asked if they were comfortable with their ability to use the eSAC of which all active users (n=16) replied that they were. When asked if they found the teaching tips relevant for their symptoms or issues a majority answered 'yes' (n=9). Finally, when asked if they found the app useful for symptoms and quality of life participants (n=9) stated that the eSAC was useful for them. Acceptability of the eSAC was gauged by asking active user participants if they would recommend the eSAC to other participants and all reported 'yes.'

**Conclusion:** The 9-week, eSAC post-enrollment interview data focused on the participant perspective and suggested the feasibility and acceptability from advanced stage ovarian cancer users. Participant reported use was individualized and demonstrated benefits such as improved symptom management and quality of life, improved patient-provider communication, and relevant teaching tips even when it did not result in direct communication with the provider.

## **Amanda Messinger - A Scoping Review of Using the Various Suicide Screening Tools in the ED EHR**

**Background:** Asthma is a common and expensive chronic illness that affects >25 million patients and 13.8 million children. Much of the accumulated cost and morbidity of asthma is due to asthma exacerbations. Machine learning (ML) techniques have been applied in many domains to help better understand and treat asthma and use of these tools in interpreting and applying insights from multiple digital data sources (Big Data, Electronic Medical Record (E.M.R.), social networks, adherence monitoring, home-telemonitoring) can improve asthma care and outcomes for both populations and individuals.

**Methods:** This scholarly project included 3 project phases; (1) review of clinical asthma, the impact of recurrent exacerbations and an overview of machine learning work in the field of asthma prediction which was published as a first author collaborative editorial in the Journal of Allergy and Clinical Immunology, (2) Targeted scoping review of pediatric asthma exacerbation prediction and creation of an annotated, comprehensive list of candidate pediatric features, (3) Subject matter expertise on pediatric asthma and assistance with feature analysis and selection for project using U.W. data for asthma outcome prediction.

**Results/Discussion:** Review of literature and abstraction of candidate features for ML based pediatric asthma exacerbation prediction was extensive. Specifically, ML based prediction of asthma exacerbations, in both children and adults, has yielded multiple models and algorithms, however significant gaps remain including assessing validity across diverse data sets, transitioning from retrospective data analysis to real time prospective prediction, and including enough comprehensive features to improve accuracy. Candidate features abstracted from the review included domains of labs/biomarkers, genetic markers, clinical symptoms, clinical history (including mental health), diagnoses, comorbidities, vital signs/lung function, medication prescription and adherence, social and economic factors and caregiver features. Feature analysis and classification is the process of translating features into machine readable attributes and requires complex comparisons and coding of data. This important process is time consuming and depends on methodical collaboration between computer scientists and clinicians/subject matter experts.

**Conclusion:** Machine learning has successfully been used to create models for acute asthma exacerbation prediction; however, most models have demonstrated insufficient performance metrics. To improve accuracy and enable translation of models into point of care tools requires inclusion of a robust array of features. It also demands innovative feature engineering to allow inclusion of clinical research insights into actionable predictions. Comparing these models, validating them across diverse settings, implementing and translating them into clinical tools, and integrating them into clinical workflows will require sustained collaboration between clinicians, data and computer scientists.

## **Natalia Mikhail - Caring for Caregivers Online (CocoBot): Study of User Experience for Caregiver Support**

**Background:** Support and empowerment of caregivers of children with chronic conditions cannot be underestimated. When a caregiver faces the challenges of caring for a child with a chronic condition in addition to fulfilling their other roles, it places an enormous strain on an individual and may undermine their physical and social functioning. At present there is a wide use of mobile technology, such as a smartphone with various applications accessible to the majority of the population, including low-income households. Utilization of technology in the healthcare sector is rapidly increasing with much promise vested in the development of healthcare-related mobile applications. While there may be many mobile health applications available on the market or undergoing development, there is a lack of successfully designed products to help caregivers of children with a chronic condition navigate their daily life and manage stress, anxiety and depression. One of such interventions is CocoBot, a mobile app that is undergoing its development with the aim of providing support for caregivers of children with a chronic condition.

**Objectives:** The aim of this scholarly project was to examine user perception of effectiveness of caregiver support through an online human-computer dialog system with natural language processing. The area of study explores users' insights of mHealth app's ability to provide support for caregiver symptom management in caregivers of children with a chronic condition while delivering a positive user experience. The research team attempted to find out whether an online human-computer dialog system can successfully interact with users in a human-like manner and deliver high-quality caregiver support services.

**Methods:** The study is a quasi-experimental approach using mixed method design to gather feedback from users of mHealth app prototype. Within the study, the user dialogue was managed through Wizard-Of-Oz (W.O.Z.) testing method that yielded qualitative data, while quantitative data was obtained through dissemination of Systematic Usability Scale (SUS) and Source Credibility Measures (S.C.M.) surveys. The survey recipients were caregivers of the pediatric patient population with chronic health conditions. Total of 40 individuals were recruited to participate in this study.

**Results:** Quantitative data obtained through SUS and S.C.M. indicated generally favorable user perception of CocoBot with the need to make some changes for enhancement of user experience. Qualitative data gathered from review of W.O.Z. dialogues revealed users' interaction patterns and enthusiasm to participate. User dialogues data indicated the need to offer more options for solutions in order to accommodate specific user circumstances and needs.

**Conclusion:** Similarly to previous usability studies of CocoBot, the quantitative data revealed only general user perceptions of the app, while the qualitative data added an additional layer of the information regarding the user experience. Based on the study results it is hard to point out the complete list of necessary required modifications for improvement of user experience. Additional studies are needed to diagnose particular system features that need to undergo improvement in order to attain better user outcomes for conversational agents in mHealth apps. Such studies could further investigate the areas outlined in SUS and S.C.M. surveys.

## **Esther Oh - Usability Testing of Consumer-Focused Artificial Intelligence Tools for Sleep Health**

**Problem:** More than 34% of adults in the United States reported sleeping less than 7 hours a night. Sleep disorders or lack of healthy sleep have been associated with increased risk of certain health conditions, decreased productivity, and increased risk of injury. There are many different technologies available to promote sleep health, but there is limited research on usability and consumer experience with these technologies that support sleep.

**Significance:** Evaluating the benefits and needs for improvement in different sleep technologies can help improve technologies and user experience to promote healthy sleep duration and quality.

**Purpose:** The purpose of this project is to assess the usability of different artificial intelligence (A.I.) sleep technologies used by consumers to aid in sleep. This study will answer the research questions: (1) what are user experiences with A.I. sleep technologies (2) and how can these technologies be improved?

**Study Design:** This qualitative study will apply usability testing and semi-structured interviews to describe adult user experiences with different A.I. sleep technologies and identify ways to improve the used technologies.

**Results:** Participants stated that consumer sleep technologies help provide an accurate picture of quantity and quality of sleep. Participants expressed room for improvement in use, accuracy, and design of the technologies. Five participants would continue using one or more of the sleep technologies.

**Conclusion:** C.S.T.s can be a valuable, affordable, and convenient starting place for people who have issues or concerns with sleep and want more information. They provide objective data that can be discussed with clinicians.



## **Jennifer Parkhurst - Analysis of Smart Home Technology and Home Modifications to Promote Aging in Place**

**Background:** Multiple factors influence an older adult's ability to safely age in place. However, there is a research gap between mapping known barriers to age with available interventions to facilitate older adults' ability to remain in their homes.

The purpose of this report is to provide an interpretive analysis of available patient-centered technology, smart home technology, and physical interventions that would promote active aging and affordable solutions to aging in place. The developer Squatch, L.L.C, a well-known builder in the Pacific Northwest, will utilize this analysis's outcomes to develop an affordable, modern active adult living community.

**Purpose (Specific Aims):** This project used Critical Interpretive Synthesis (C.I.S.) to answer the following:

1. Does current literature relate to contributing factors of aging to available interventions (e.g., smart home technology, home modifications) to facilitate aging in place in new home builds and existing homes?
2. The review results will provide home modifications, smart home technology for aging in place relating to physical home modifications, Ambient Assisted Living (A.A.L.), and commercial Smart Home technology.

**Methods:** This interpretive review follows the Critical Interpretive Synthesis (C.I.S.) by drawing on traditional qualitative research inquiries and systematic review methodology to synthesize qualitative and quantitative evidence forms. The search included medical, engineering, and nursing literature databases, including Cumulative Index to Nursing and Allied Health Literature (CINAHL) and PubMed.

**Results:** The review found evidence that physical home modifications and the use of commercial smart home technology provided more accessible interventions to promote aging in place versus the implementation of an Ambient Assisted Living (A.A.L.) technology. Also, evidence supports that while A.A.L. technology can further promote aging in place, much of the technology is not available for general use. However, some barriers impact the utilization of technology by older adults within their homes. These barriers include privacy, usability, negative attitudes, and beliefs towards using technology and access to technology.

**Conclusion:** This report aims to help Sasquatch, L.L.C identify interventions to known barriers to aging in place. The studies found that physical modifications and smart home technology influenced by the Internet of Things provide greater accessibility to aging at-home interventions. However, further research is needed to determine if and how the different home interventions (e.g., smart home technology, home modifications) correlate to specific known barriers to aging in place. Based on the existing published literature, there is a poor mapping between humans' diversity and their current or future disabilities with interventions necessary to safely age in place.

## **Daniel Phan – Consumer Health Dashboard Prototype User Testing in the Setting of Prostate Cancer Care**

**Problem:** In the United States, there is a significantly disproportionate overrepresentation of ethnic and racial minority groups afflicted with prostate cancer, particularly men of lower socioeconomic backgrounds, among which limited education and health literacy has been associated with poor engagement, disease management, and health outcomes. Health information tools that intend to enable patient-centered care are often developed with a level of content-richness and high-complexity design. However, those advanced features are often inadvertently unusable and inaccessible to individuals with limited health literacy. Prior research indicates that poor literacy skills are a significant contributing factor to the underutilization of preventive medical services, along with inadequate understanding of disease processes and effective self-management, leading to undesirable health outcomes.

**Significance:** Health technology tools that facilitate the management of chronic conditions through the self-tracking of symptomatic trends and patient-reported outcomes can enable improved consumer engagement and population health outcomes. However, existing barriers include literacy and comprehension issues, design and usability problems, practical utility and privacy concerns, and lack of device or internet access, particularly among lower socioeconomic groups. The reduction or elimination of these obstacles will serve to aid in increasing the efficiency of health service delivery, bolster the patient-provider relationship, enhance quality-of-life outcomes, and improve the individual patient experience.

**Objective:** The purpose of this study was to test the comprehension, usefulness, preferences, and usability of four patient-facing timeline prototypes among medically underserved prostate cancer survivors with limited health literacy, numeracy, and graph literacy. The following research question was addressed: which visualization format(s) offers the best comprehension, utility, preference, and usability among prostate cancer survivors with limited literacy: analog meter, qualitative timeline, comic strip, or emoji bar chart?

**Methods:** A convergent, mixed methods study design was utilized to evaluate the practical design of a series of graphical interface prototypes of fabricated longitudinal quality-of-life models in terms of usability, comprehension, usefulness, and preferences. Unique to the study was the co-development of health data visualization models in partnership with a prostate cancer survivor advisory group, representative of low literacy target users.

**Results:** The study involved 18 prostate cancer survivor participants with an average age of 69 years: 50% of which were African American; 50% reporting the highest education attainment level of high school or technical school graduate; 88.9% with low graph literacy; and 44.4% with a high likelihood of limited health literacy and numeracy. The emoji bar chart prototype scored highest among participants in the domains of comprehension, utility, and preferences; the analog meter format scored the highest in usability.

**Conclusions:** The results from this study suggest that the emoji bar chart format of timeline visualization may be suitable for healthcare providers, researchers, and organizations in developing communication tools for engaging with people with low health literacy, numeracy, and graph literacy.

## **Matthew Plourde - Readiness for Change Assessment for Implementation of PPID with Unit Lab Specimen Collection**

**Problem Statement:** Positive patient identification (PPID) – using digital technology to match patient identification to a lab specimen – has reduced lab specimen collection patient safety events (LC-PSEs). Assessing an organizations' readiness for change is an essential first step to implementing a system-wide change for nursing workflows that could reduce LC-PSEs and improve patient safety.

**Significance:** In 2018, an academic medical center reported 1,185 lab specimen patient safety events (i.e. wrong test, wrong person, wrong tube). In addition to patient safety risk and liability, the center's errors exceeded \$20,737 additional annual spending. These data echo the famous 1999 report, "To Err is Human: Building a Safer Health System" that identified needed improvements in accurate laboratory testing.

**Purpose:** The aim of this study was to assess the readiness for the change to using PPID workflows as a means to improve patient safety and reduce errors in inpatient settings at three hospitals owned by one health system.

**Methods:** A quantitative cross-sectional assessment study design was used to determine readiness for change across three hospitals moving to this new workflow. The assessment solicited areas of most vs least readiness using a validated organizational readiness for implementation change (ORIC) survey to quantify change phenomena. A five-minute video was created demonstrating the new inpatient lab specimen collection workflow and was embedded in the survey. The surveys were first conducted during change impact assessment (C.I.A.) sessions with a population of engaged stakeholders; participants were encouraged to scan a Q.R. code linking to the survey. Over a 3-month period, survey results were further solicited from clinicians through relevant local practice councils and nurse manager meetings. Further solicitation from bedside clinicians was achieved using a multifaceted approach of and distributed advertisements through email, strategically placed posters, and stickers on workstations on inpatient units.

**Results:** A total of 160 surveys were received with a participation rate of 2.95%. Overall, the ORIC assessment revealed relatively high readiness scores for both change commitment and change efficacy. System wide, change commitment scores were higher (mean 4.27; SD 0.839) than change efficacy scores (mean 3.91; SD 0.989). Scores showed no statistically significant differences between the two cohorts of clinicians (C.I.A. session vs bedside clinician), however readiness scores were significantly different between hospitals and between units within hospitals. Emergency room and I.C.U. scores at Harborview Medical Center readiness scores were the lowest with lower return rates, where Northwest Hospital scores were highest, but with low return rates.

**Conclusion:** With overall ORIC scores at a high levels, it is promising that implementation will go well. The survey showed that low participation rates or low scores in some clinical areas suggest challenging roll outs in these areas. These low participation rates are perhaps associated with the current challenging work environment related to the frequent change and the pandemic. Low scores are likely related to sociotechnical challenges and/or mismatched workflows which will need attention prior to or during roll out in specific clinical areas.

**Alexander Stabile - Usability Testing of a Mobile Health (mHealth) Application to Facilitate Self Medication Administration in Adults with Tuberculosis: A Mixed Methods Study**

**Background:** Treatment non-adherence is common with current tuberculosis (T.B.) treatment interventions. Current treatment interventions such as direct observational therapy (D.O.T.) have not had a significant enough impact to meet the World Health Organization End T.B. Strategy resulting in the need for research into new interventions.

**Purpose:** The purpose of this scholarly project is to evaluate the usability of a mHealth application designed to support individuals with active T.B. who are undergoing self-administered therapy. The specific aim of this study is to identify perceived barriers and facilitators to the usability of this mHealth application in order to improve the design and functionality of future iterations.

**Methods:** This iterative convergent mixed methods study consisted of two quantitative surveys, the mHealth Usability Questionnaire (MAUQ) and the HealthIT Usability Evaluation Scale (ITUES), and a qualitative talk-out-loud interview. Testing was conducted in three testing cohorts, with each cohort consisting of five to six interviews and between five and ten surveys for a total of 16 interviews and 26 surveys. Results were then analyzed and reported to the design team and software engineer. The app was then refined before beginning the next round of testing.

**Results:** All three testing cohorts rated the mHealth app as having high usability with a mean usability score of 5.96 out of seven on the MAUQ and 4.27 out of five on the ITUES. The iterative approach resulted in several refinements and additions being made to the mHealth application between testing cohorts in response to participant feedback. These refinements were well received during qualitative interviews but did not result in a statistically significant improvement in usability testing scores. Lastly, the MAUQ and ITUES were found to be highly correlated with one another ( $r = 0.82$ ) indicating that these two usability questionnaires can be used interchangeably.

**Conclusions:** Using an iterative convergent mixed methods design is an effective method for designing mHealth applications. Data collected from the two usability questionnaires when integrated with a thematic analysis of qualitative interviews identified key areas of the mHealth application that needed refinement including improving navigational components, ensuring consistent functionality, and providing more options for user control.

## **Michelle Stoffel - The Impact of Blood Ordering and Administration Redesign on Utilization**

**Objective:** To determine how a comprehensive electronic health record (EHR)-based blood ordering and administration redesign at Seattle Children's Hospital (SCH) impacted blood utilization by analyzing time series data.

**Methods:** Intervention: A blood ordering redesign project team formed of hematology, laboratory, and transfusion medicine leadership, a physician informatician, IT/EHR analysts, members of the SCH Clinical Effectiveness (CE) team, and an external consultant. The team used a Lean methodology approach and review of best practices from the literature and peers to comprehensively redesign the blood ordering and administration process.

The EHR-related changes were implemented between September 2014 and October 2016 and included creating a blood bank summary EHR view page, redesigning transfusion profiles, creating new ordering standards and integrated orders functionality, introducing evidence-based transfusion clinical decision support, creating nurse-driven blood product release and receipt views, and conducting initial and update rounds of training/job aid distribution.

**Analysis:** We analyzed crossmatch to transfusion ratio (C:T) and red blood cell (RBC) wastage data extracted from our laboratory information system (LIS) and electronic health record (EHR). We analyzed changepoints to examine whether there were statistically discernible breaks in each time series that were compatible with known interventions. Additionally, we performed causal impact analysis on RBC wastage time series data to estimate blood unit wastage savings, by comparing the actual time series to the projected baseline over the same time frame using a Bayesian dynamic linear model approach.

**Results:** Change point analysis estimated the decrease in C:T after the informatics interventions was 0.082, a relative decrease of 5.6% from the mean of C:T of 1.46 at the beginning of the informatics interventions. The decrease in RBC wastage after the informatics interventions was an estimated 10.9%, a relative decrease of 64.5% from the mean of 16.9% RBC wastage at the beginning of the informatics interventions. Causal impact analysis estimated an estimated savings of 3,492 units, and a relative RBC wastage decrease of 63% (95% CI: -71%, -56%).

**Conclusions:** Bayesian analysis of time series data can be a useful tool for evaluating the long-term impact of each stage of intervention in a longitudinal blood ordering redesign effort. Our data suggests that EHR redesign is an important part of an effective multimodal and multidisciplinary approach to improve blood utilization in the pediatric hospital setting.

### **Janna Lynn Templin - eSAC Device Choice and Usability Interview and Observation**

The Electronic Self-Report Assessment and Care Program (eSAC) is a Patient Recorded Outcome (PRO) tool created out of the need for better support and care of women with advanced ovarian cancer. These women have frequent clinic visits and need to stay in contact with their provider about symptoms and care. Assessing the usability of eSAC and which electronic device women use to access the application can enhance the users experience and improve satisfaction. Exploring why patients choose an electronic device is significant because when patients feel comfortable they are more likely to provide accurate, frequent, and consistent clinical data when filling out questionnaires. This idea is consistent with "Bring Your Own Device" or BYOD as a method for utilizing mHealth applications <sup>1</sup>. The purpose of this project was to observe participants during the access and registration of the eSAC system, the usability of the application, and the choice of electronic device to use. This study used a combined survey and semi-structured in-person interview with 18 women in a clinical setting. Most often the electronic device of choice was a cellphone (iphone or Android) to register for and utilize eSAC and there were common barriers as well as successes with the usability of the website. As a bonus, we gained insight into password regulations and back-end I.T. issues as well as the difficulties in recruitment. This research has the potential to give usability insights that could enhance the eSAC technology for use on electronic devices, as well as new ideas for accessing the eSAC platform by smartphone app instead of web browser URL.



**Ethan Tseng – A Retrospective Analysis of Patient Enrollment in the University of Washington  
Medicine COVID-19 Connect Program**

**Background:** COVID-19 Connect is a short message service (SMS) messaging home-based, multilingual symptom monitoring program for patients diagnosed with the novel coronavirus disease - COVID-19. This project reports on an analysis of the patient enrollment of those registered in this program between May and December 2020.

**Problem Statement:** COVID-19 is a global pandemic that has caused unprecedented suffering and mortality. To address the increased burden due to COVID-19, health systems are incorporating technology to improve resource allocation and utilization. Patient enrollment of an SMS program to monitor the symptoms of patients diagnosed with COVID-19 is uncertain.

**Significance Statement:** A significant proportion of patients diagnosed with COVID-19 can safely manage their symptoms conservatively at home. COVID-19 Connect was designed to identify patients at risk for developing preventable complications of COVID-19 and connect these patients with timely and appropriate medical evaluation prior to significant clinical deterioration. Understanding patient enrollment will help understand the usefulness of this program as a monitoring tool.

**Purpose:** The purpose of this study is to understand enrollment rates and characteristics of patients in the COVID-19 Connect by analyzing date of enrollment and date of unenrollment of patients from program logs.

**Study Design:** The study is a retrospective observational study of the logs collected by the COVID-19 Connect SMS program to understand daily patient enrollment and the average duration of patient enrollment in the 14-day program. Program logs were obtained from Amazon Pinpoint, a multichannel marketing communication service. These logs indicate the date of enrollment and date of unenrollment of patients and can be used to determine number of patients enrolled daily and enrollment duration.

**Results:** Between May 8, 2020, and December 1, 2020, 531 patients were enrolled in the COVID-19 Connect program. Patients whose primary languages were either English or Spanish were included in further analysis. English-speaking patients represented 78% of all enrollees (414/531) while Spanish-speaking patients represented 20% (104/531). Of the patients whose primary language was English, the mean enrollment duration was 11.7 days (SD=4.1). The median duration was 14 days (range=1-14). Of the patients whose primary language was Spanish, the mean enrollment duration was 11.9 days (SD=3.8). The median and mode duration was also 14 days (range=1-14). Of English and Spanish-speaking patients, 96% were enrolled in the program for at least one day and 65% of patients were enrolled for the entire 14-day duration of the program. The mean daily enrollment of all patients was 3.1 patients per day with a standard deviation of 3.1.

**Conclusion:** Because a majority of enrolled patients, both English- and Spanish-speaking, were enrolled for the entire 14-day duration of the program, text messaging appears to be a simple and widespread technology that can be leveraged to engage multilingual COVID-19 positive patients for symptom monitoring with the goal of reducing the burden on healthcare organizations due to the pandemic.

## **James Wilson - Electronic Medication Ordering and Pre-Procedure Patient Education for Bowel Prep Before Colonoscopy: An Exploratory Quality Improvement Project**

**Introduction:** Optimal bowel prep is the key component to helping ensure high quality and complete colonoscopy; however, nearly one in every four patients scheduled to undergo colonoscopy are unable to achieve optimal bowel prep outcomes.

**Objectives:** The primary objectives of this study were to: 1) Identify the current process for bowel prep electronic ordering by G.I. Division nursing, providers, and lead administrators at the VA Puget Sound Health Care System (VA PSHCS); 2) Identify the current process for bowel prep pre-education given by G.I. Division nursing to patients; 3) Conduct in-person interviews with the G.I. providers, nurses, and lead administrators to assess barriers and facilitators to current CPOE medication ordering processes and patient pre-procedure education; 4) Identify CPOE medication ordering completion rates by G.I. providers and create a report incorporating bar and pie charts to present the data to the agency; and 5) Develop recommendations for overcoming barriers and building upon facilitators in the electronic ordering system and patient pre-procedure education.

**Methods:** A mixed qualitative/quantitative analysis approach was used to explore the current state of bowel prep for colonoscopy CPOE and pre-education execution in the outpatient G.I. setting. A cross-sectional design applying semi-structured virtual audio and telephone interviews were conducted (and recorded) with G.I. registered and licensed practical nurses (schedulers), physician attendings, and medical support administrators.

in the outpatient G.I. Services setting at two V.A. sites in Seattle and Tacoma. Direct content analysis was applied to structure the gathered interview data into organized themes. Each interview's recorded audio and notes taken were reviewed to identify groupings of distinct barriers and facilitators. Barriers or facilitators were retained if deemed relevant and endorsed with relatable comments by subsequent participants. New barriers or facilitators introduced by a participant and not already identified in the existing questionnaire were queried with subsequent participants. All items not endorsed were removed from consideration. Ethical and non-research approval was obtained from VA Seattle Human Research Protection Program [#20200313] and Quality, Safety & Value Program [#20200312].

**Results:** Eleven total G.I. Division staff; most full-time (91%), were interviewed (seven G.I. nurses, two G.I. physicians, and two G.I. administrators). The group's mean age is 50.9 (deviation 12.4). Mean G.I. sub-specialty experience for participating females is just over 6-years and 24-years for males. Five priority and associated sub-themes along with their proposed facilitators were identified: CPOE design & functionality; pharmacy representation; orientation modeling; policies & protocols; and patient engagement. Over one-third (38%) of participating clinicians expressed frustration with the CPOE order interface. Over half (57%) of clinicians reported frustration by the order interface menu navigation and felt it was burdensome and overly complex. In addition, nearly half (43%) of the participating nurses reported feeling frustrated and/or confused when seeking prep order clarification, in addition to nearly half (43%) of nurses also not being afforded prep pre-education training at the time of new employee training orientation conducted by the G.I. Division. Lastly, only 28% of participating nurses were afforded formal preceptor/mentor assignment with a seasoned/experienced G.I. colleague nurse at orientation.

**Conclusion:** Priority barriers were noted in this project. To address these barriers and work towards the goal of improved bowel prep adherence there is a need for redesign to the CPOE template interface, bolstering of GI-substantiated prep pathways and protocols, and reevaluation for the current G.I. Division nursing orientation curriculum to incorporate CPOE order utilization, pre-education fundamentals, and expanded frontline clinical representative attendance. These requirements stand to best reach their full potential if enabled via greater shared discussions, transparent learning, and compliance flexibility among stakeholders including frontline care representatives sharing patient-facing engagement. Comparative studies of equal or larger outpatient settings are encouraged to help advance the operational needs for improved bowel prep adherence prior to colonoscopy.

## **Fui Wei Yan – Clinical Decision Support (CDS) Alert Appropriateness: A Review and Proposal for Improvement**

**Problem statement:** Many healthcare providers have adopted clinical decision supports (CDS) in their electronic health records (EHR) system to improve patient safety and meet meaningful use requirements within their organizations. Nonetheless, excessive and repeated alerts in the EHR have been shown to cause alert fatigue in healthcare professionals and resulted in inappropriate alert overrides.

**Significance statement:** Healthcare professionals who encounter high rates of medication alerts may exhibit alert fatigue and may override the guidance presented by the alert which can lead to patient safety events such as medication errors. Important and clinically relevant alerts designed specifically for drug-allergies, drug to drug interactions, and drug-disease warnings can prevent adverse drug events and harm. These alerts may potentially be overlooked and overridden which ultimately results in threats to patient safety.

**Purpose:** There are number of factors contribute to an excessive number of drug interaction alerts which associated with high overridden rate. One of them is flawed logic. For instance, some interaction checking systems will trigger an alert even though one of the offending medications is a topical agent with negligible systemic absorption. Apart from that, majority of drug interaction knowledge databases include minor interactions of low clinical relevance, and not differentiating it from the clinically significant ones failed to clearly convey the intended message and caused confusion for clinicians. Therefore, the purpose of this scholarly project is to review frequently overridden alerts based on data extracted from EHRs and propose improvement strategies to improve acceptance of alerts, reduce alert fatigue and improve patient safety.

**Study design:** The study was conducted by utilizing data captured in the EHR system to determine the types of alerts that were frequently overridden by physicians over a 3-month period. The top 5 alert type with the greatest average percentage of overridden per month were selected. Subsequently, the top 5 affected medication records or categories of each alert type were determined as the initial focus of alert refinement.

**Results:** The top 5 alert type with the greatest average percentage of overridden per month were found to be drug-study alerts, dose alerts, DDI alerts, duplicate medication order alerts and duplicate therapy alerts. Based on our findings, it was found that there are number of inaccurate and inappropriate alerts due to system limitations or local prescribing practice. Therefore, Improvement strategies such as removal of these inaccurate and inappropriate alerts in the EHRs, improvement in the CDS algorithm by customizing certain alerts based on patient's diagnosis, introduction of validation check to only trigger if there is no duplicate order for the same item can be applied to reduce the number of overridden per month.

**Conclusion:** In conclusion, it was estimated that a total of 9,100 (22.5%) of interruptive alerts can be removed per month if the proposed improvements are applied. This percentage could be higher in view of application of CDS refinements to other categories with the similar issues (e.g. validation check on the frequency and date range ordered, remove alert involving different dosage form, etc.). Based on a study conducted by Wan et. al. (2020), CDS with high volume of irrelevant alerts result in alert fatigue among clinicians which often results in relevant alerts being overridden unjustifiably, opening the door to medication errors. Therefore, removing insignificant alerts from the system will ultimately lead to a better CDS in the EHRs which would help to reduce alert fatigue and improve patient safety.

**THESIS STUDENTS: 2020-2021 ACADEMIC YEAR**

**Jayte Boehler - Towards Lean E.H.R. Usability Heuristics for Behavioral Health Providers**

This thesis research sought to determine whether Lean principles and practices make applicable heuristics for evaluating electronic health record (E.H.R.) usability for behavioral health providers. Over the past 10, years E.H.R.s have quickly become part of standard practice in health care yet there is serious concern regarding their direct impact on provider efficiency, job satisfaction and burnout. A review of the literature highlights a notable lack of content regarding the E.H.R. usability needs of behavioral health providers. I utilized contextual inquiry and qualitative analysis to identify the E.H.R. usability needs of behavioral health providers. Furthermore, my research followed a validated domain-specific usability heuristic development methodology to attempt to establish Lean heuristics. The results of this study formed a set of E.H.R. usability heuristics for behavioral health providers. Findings concluded that Lean principles and practices contributed significantly to specific and applicable rules in the resulting heuristics to improve E.H.R. usability.

## SCHOLARLY PROJECTS: 2021-2022 ACADEMIC YEAR

### **Olawunmi Ayokunle - MyChart Experience at U.W. Medicine: A qualitative analysis of patients' suggestions for improvement**

**Problem statement:** Epic MyChart is an electronic patient portal recently upgraded by U.W. Medicine as one of the digital tools to improve patients' access to their medical information. An upgrade of the patient portal was done by consolidating ten patient portals into one for ease of accessibility for patients to have one interface for their information. This necessitates a need to assess the ease of use and perception of the portal by patients after the upgrade.

**Significance statement:** Improved patient engagement with MyChart allows patients to take ownership of their health which may lead to better clinical outcomes.

**Purpose:** The aim of this study is to describe patient-reported perception and experiences with Epic MyChart after Epic go-live at U.W. Medicine.

**Study design:** An online survey was conducted at U.W. Medicine (U.W. Neighborhood Clinics, Harborview Medical Center, U.W. Medical Center – Montlake, U.W. Medical Center – Northwest, Valley Medical Center and Seattle Cancer Care Alliance) to determine perceptions of MyChart users, about their digital experience following a "go live" upgrade. Patients were asked questions about MyChart ease of use, the impact of MyChart on their care, overall satisfaction with MyChart, and open-ended suggestions for improving MyChart. I conducted a qualitative analysis of patients' open-ended comments on how MyChart can be improved.

**Results:** In this post go-live survey, the main functional code that was raised by most respondents was "general MyChart/app" (47.5%). The second most important functional code was "records" (15.8%) and the third most important functional code was communication (15.4%). Likewise, the main issue code that arose were "Design cluster-error" (19.7%). The next most important issue code was "robustness" (14.2%) and third was "Log on/Off, security" (14.1%). Based on these findings, I generated recommendations that prioritize how MyChart can be improved to better met patients' expectations.

**Conclusion:** Findings from this study reveal several issues MyChart users encounter in their utilization of MyChart. In order to improve patient usage of MyChart which may in turn improve patient experience, an overhaul of the UW EPIC MyChart would be necessary. Furthermore, there is a comment section in the analysis worksheet that highlights some pertinent comments and suggestions that should be followed up on.



## **Jessica Bertram - Provider Perceptions of Artificial Intelligence-Assisted Care Delivery: A Mixed Method Study**

**Problem statement:** We are in the middle of a mental health crisis. There is currently a shortage of mental health providers to meet the demand that will only increase and cause additional strain on an already fragile healthcare system. Digital health solutions have the potential to address the shortage of mental health providers as these tools can help increase accessibility and efficiency of mental health care. Engaging healthcare professionals in developing digital health tools is important.

**Significance Statement:** This study will add to our knowledge of provider perceptions of an artificial intelligence (AI) supported interface to improve their design, with the ultimate goal of developing a digital provider care platform that can increase provider volume, care efficiency, and reduce provider shortages.

**Purpose:** A team at the University of Washington developed a conversational chatbot (Caring for Caregivers Online - COCO) to support family caregivers. Given the technological limits of stand-alone AI “chatbots”, the team also designed a provider platform for healthcare providers to support caregivers’ needs through text-based therapy. The platform has AI-enabled features designed to improve care efficiency. The purpose of this study was to examine the perceptions (user acceptability and willingness to engage) of the COCO provider platform. We recruited two groups of providers, one with extensive mental health training (expert group), and one without extensive mental health training (non-expert group).

**Methods:** Using the technology acceptability model (TAM) as a conceptual framework, a mixed methods study design was used to measure provider perceptions, specifically acceptability and willingness to engage with the COCO provider platform. We also wanted to compare the perceptions between the two groups. The study was conducted in two phases. Phase 1: providers were recruited from University of Washington healthcare training programs as either expert (n=25) or non-expert (n=27) and a user acceptability survey was administered following a video on the COCO provider platform. The quantitative data were analyzed using descriptive and inferential statistics. For Phase 2: providers were recruited from the survey study in Phase 1 (N = 10). These participants interacted with the platform for about 20 minutes, after which semi structured interviews were conducted. Interviews were documented and analyzed using content analysis.

**Results:** The survey showed user acceptability among both the expert and non-expert groups (TAM 4.9 mean on Likert scale = slightly agree). The non-expert group showed significantly higher acceptability on all constructs. The mean acceptability scores out of 7 were: Perceived Use M = 5.47 (SD: 0.95); Perceived Ease of Use M = 5.75 (SD: 0.74); User Acceptability M = 5.09 (SD: 1.16) compared to the expert group (mean(s): Perceived Use M = 4.28 (SD: 1.26); Perceived Ease of Use M = 4.92 (SD: 0.92); User Acceptability M = 3.76 (SD: 1.62). The results of the survey study show that these constructs had a weak to strong correlation with each other. Results of the semi-structured interviews further amplified that both groups had positive perceptions of the provider platform but the non-expert group was more willing to engage with AI-enabled technology in their workflow than the expert group.

**Conclusion:** The results indicate that expert and non-expert providers have positive perceptions of an AI-assisted care delivery model. Further the results indicate that non-expert providers are more accepting and willing to engage than expert providers of an AI-augmented care model. Findings provide preliminary framework to further develop the platform. Further work is needed to explore the utility and efficacy of this care model.

## **Key Bonus - What Else? A Qualitative Content Analysis of Web-based Responses from Women with Advanced Ovarian Cancer**

**Problem:** Women with ovarian cancer on various treatments experience symptoms and psychosocial problems that may remain unidentified by their health care providers, resulting in low referrals to services, long-term challenges, or debility.

**Purpose:** The study aimed to generate categories from open-ended responses found in the 'Open Response' section of the electronic self-report assessment and care (eSAC) program by participants with advanced ovarian cancer.

**Methods:** The eSAC program is a novel, web-based patient-reported outcome (PRO) program aimed to reduce symptom distress and depressive symptoms, and improve communication between patients with cancer and their providers. Qualitative content analysis identified categories from de-identified data in eSAC's open-ended responses using a qualitative coding software (NVIVO).

**Results:** A total of 88 respondents entered 416 eSAC free-text responses from September 2020 to December 2021. Many of the respondents (72%) were over the age of sixty, identified as non-Hispanic white (82%), retired (52.3%), and most held a college education. Divided among 1,160 codes were five categories: (a) physical symptoms, (b) common discussion topics and questions, (c) emotional responses, (d) personal health practices, and (e) eSAC-related recommendations. Most frequently described symptoms were pain, gastrointestinal issues, and lack of energy. Trends in CA-125 values and COVID-19 vaccine effects were commonly addressed. Emotional responses shared included feeling restored, gratitude despite symptoms, hope, depression, anxiety and stress. Protective health behaviors that prevented and alleviated symptoms included personal relationships, exercise, nutrition, and mental health practices. eSAC-related comments included adding an option to update the previous entry, some wrote there were limited choices, and others clarified previous quantitative answers understood.

**Conclusion:** This study provided insights into the experiences of women with advanced ovarian cancer. Women with ovarian cancer, clinicians, and researchers can learn about the importance of prioritizing, early identification, management and referral of cancer physical symptoms and psychosocial issues. Additional education modules on CA-125 labs, COVID-19 vaccine, coping tools and emotional regulation techniques maybe worthwhile additions to the eSAC program.

## **Jessica Chang - Identifying the Needs of Asian Family Caregivers Utilizing an AI-enabled Conversational Agent**

**Problem statement:** There are nearly 53 million family caregivers of adults or children with health or functional needs in the United States. Asian Americans are the fastest growing racial and ethnic group with nearly 1 in 5 self-identifying as a family caregiver. There are several culturally-tailored interventions to support Asian family caregivers, but they are primarily in-person and lack the topic of self-care. Little is known about the self-care needs of Asian family caregivers. Therefore, in order to develop inclusive digital interventions, it is essential to better understand the needs of Asian family caregivers.

**Significance statement:** As the caregiving population becomes more diverse, capturing underrepresented voices in the design of emerging digital interventions is crucial. An understanding of the needs of ethnic minority caregivers are needed to develop inclusive technology solutions that aim to support caregivers within these communities in managing their own health.

**Purpose:** The purpose of this study is to describe and compare the common needs of Asian and non-Asian caregivers through data collected using a short message service (SMS)-based conversational agent. Common needs refers to daily needs of caregivers related to self-care and well-being.

**Study design:** This project is part of a larger ongoing study, Caring for Caregivers Online (COCO), conducted by researchers at the University of Washington (U.W.). For this study, we conducted analysis of data about the daily events and self-reported emotional statuses of caregivers collected through a SMS-based conversational agent over a 2-week timeframe. A codebook was developed utilizing directed content analysis to categorize different needs as guided by the Maslow's Hierarchy of Needs (i.e., physiological, safety, love and belonging, esteem, and self-actualization), followed by counting the frequencies of unique occurrences of Asian and non-Asian participant responses within each subcategory. Then the percentages were calculated and compared between Asians and non-Asian groups in each subcategory.

**Results:** There were a total of 122 participants in the study with 27 Asian participants and 95 non-Asian participants. We identified and described Asian and non-Asian family caregiver's similarities and differences in needs expressed through a conversational agent. While there were notable differences between the two groups in 14 of the 46 subcategories, similar results were found between both groups in a majority of the needs that they expressed. Asian caregivers more often discussed positive events of good sleep (physiological), the ability to take time for themselves (esteem) and work productivity (esteem).

**Conclusion:** This study provided insight regarding the common self-care and well-being needs of Asian and non-Asian family caregivers. The findings and the data collected from our study provides a stepping stone to address the lack of literature regarding the self-care needs of Asian caregivers, which is the first step towards developing inclusive digital solutions that aim to support the self-management of self-care for family caregivers. Asian and non-Asian groups differed in subcategories within the physiological, love and belonging, and esteem categories of Maslow's Hierarchy of Needs. While Asian caregivers more often discussed work productivity, non-Asian caregivers more often discussed experiences of being unproductive at work. This finding may suggest that Asian caregivers are of the working caregiver population who view

work as a positive aspect that allows them time away from caregiving demands, while others find it stressful to balance caregiving and work responsibilities. Additionally, we found that Asian family caregivers discussed positive experiences or met needs related to spending time with family less often than non-Asian caregivers. This may be attributed to Asian caregivers feeling that there is a lack of choice when taking on the caregiver role for their loved ones due to cultural factors, which can impact Asian caregivers' appraisals of spending time with family who may be the care recipient. Asian family caregivers may need support in normalizing the impacts of filial obligation and identifying sources of belongingness, whether that be family, friends, community groups, or even within the workplace. Finally, Asian caregivers reported less positive experiences of self-care. Asian family caregivers more often experience emotional difficulties rather than physical challenges related to caregiving, delaying their ability to identify and respond to the need for self-care. Overall, Asian and non-Asian caregivers expressed needs at similar rates in a majority of the subcategories. Despite the emotional and mental stress caregiving can cause, both Asian and non-Asian family caregivers rarely discussed needs related to mental health self-care. There is a need for inclusive digital interventions to provide resources for caregivers of ethnic minority groups that help to broaden the caregivers' understanding of the impacts of cultural values, such as familism and filial piety, on their health and well-being. This may help Asian family caregivers identify, recognize, and respond to their own self-care needs.

To our knowledge, this study is the first to utilize data collected through a SMS-based conversational agent to describe and compare the common needs expressed by Asian and non-Asian family caregivers. Asian family caregivers face cultural and systemic barriers to expressing and obtaining support for their needs. The volume and quality of data collected in this study may suggest that technology-enabled solutions may be able to bridge that gap for Asian family caregivers by providing a platform that is deemed private and trustworthy to more freely express their needs. Further work is needed to explore the data and obtain perspectives of Asian family caregivers in utilizing a conversational agent. Disaggregation of both the Asian and non-Asian subpopulations in future studies may reveal varying perspectives of overall needs and digital tools for support.

**John Gladys - Physician Adoption of Secure Communication Applications on Personally Owned Devices: A Systematic Review**

**Objective:** The goal of this systematic review is to review and summarize the current literature identifying the facilitators and barriers that affect adoption of secure communication text messaging applications on personally owned smart devices by providers.

**Design:** Systematic Review

**Setting:** PubMed and Web of Science databases were searched from January 2010 to present. The information was screened by the author and included if the article contained either facilitators or barriers of secure text messaging that affected adoption by providers on their owned personally owned smart devices.

**Results:** Article screening ultimately yielded 14 documents that were included in this systematic review. The corpus of material yielded the following categories that affected or contributed to adoption of secure text messaging on physicians personally owned smart devices. Security and privacy, institutional leadership, infrastructure and application reliability, and the ability to communicate with extended clinical staff were the key factors that impact whether a physician would install a secure messaging application on their own device and continue to use it long term.

**Conclusion:** The evidence suggests that secure communication applications have the potential to improve clinical communication and enhance patient care within the healthcare setting. The adoption of secure messaging can be facilitated by improved organizational governance focus including executive leadership involvement, success measurement and continued workflow and process improvements.

**Keywords:** Secure communication, cell phone, HIPAA, providers, mobile applications, text messaging

## **Katharine Hansen – Mobile Health App Dose and Outcomes: A Review of the Literature**

**Background:** With the widespread use of mobile devices and an increase in the availability of health information at your fingertips, more people desire increased autonomy in managing their own health. Mobile health (mHealth) apps have been shown to reduce adverse outcomes and drive down the cost of health care. Yet, the relationship between use or dose of the interventions and outcome is largely undocumented.

**Objective:** The objective of this study was to review the current literature for the discussion and/or documentation of the intended or discovered dose for interventions and resulting outcomes. This information serves to inform the health care community about how an mHealth application 'dose' is defined and highlights potential opportunities for improvement with the literature and/or research in the future.

**Methods:** A literature search was conducted in CINAHL and PubMed databases utilizing the same keywords, phrases and MeSH terms. Duplicates were removed and the literature was screened utilizing Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist which included the use of predetermined inclusion and exclusion criteria and the Prisma Guidelines flow diagram to document each step of the screening process. To be included, studies needed to be a mobile or web-based application intended for improving self-management for the user and include specific data on dose and outcomes. Findings are summarized qualitatively using narrative synthesis.

**Results:** Out of 954 potential studies from the search, 21 were found to discuss a dose and its relation to outcomes. The word 'dose' is not referenced consistently in the literature, but it was used at times. Other common words were use, usage, exposure, login, completed module(s) or completed lesson(s). A Dose-Response calculation was one of the more common ways in which the researchers attempted to establish a 'dose'.

**Conclusion:** As mHealth apps continue to be developed and released, highlighting and studying dose could be a key to understanding the noted dose-effect of the app itself, the impact of such a calculation and potentially set better expectations for overall use. The findings of this study contribute to the knowledge of how dose and outcomes are documented in current literature.



**Scott Hulse - Solutions in Health Analytics for Rural Equity Across the Northwest Dashboard**  
**Evaluation: Semi-structured Interviews and Thematic Analysis**

High quality public health requires interpreting and analyzing large volumes of complex data. Data visualization is one tool that offers tremendous potential benefit in processing and understanding so much highly complex data. The Solutions in Health Analytics for Rural Equity Across the Northwest (SHARE-NW) project developed a web-based resource to facilitate data-driven decision-making among rural public health practitioners. We sought to develop a framework for assessing how well the dashboard is achieving the SHARE-NW's goals and meeting the needs of public health practitioners. A review of the literature revealed that dashboards like SHARE-NW are best evaluated by metrics addressing perceived engagement of the end user. We developed a semi-structured interview based on evaluation frameworks described in the literature. Persons who had previously participated in SHARE-NW activities were invited to participate. A total of 9 individuals were interviewed. Three major themes emerged from thematic analysis of interview transcripts: the values of data aggregation, comparing across counties, and supporting the end user's work. SHARE-NW's consolidated and unified presentation of many disparate data provides tremendous value for public health practitioners. The dashboard may serve as a nidus and scaffolding for closed-loop communication and data-sharing from the national to the local level.

## **Jee Hoon Jang - Developing and Testing Heart Failure Resource Modules in a Digital Health Tool Caring of Caregivers Online (COCO)**

**Introduction:** More than 6 million adults in the United States have heart failure (HF) and require complex treatment plans. Caregivers of many individuals with HF manage the patient's health, including medication compliance, symptom recognition, and adhering to diet and exercise regimens with multiple challenges. Modern technologies such as mobile health technologies have the potential to provide this support in an accessible and on-demand manner. Caring of Caregivers Online (COCO) is a mobile application providing caregivers with interactive self-management skills. In addition to caregiver-related symptoms management, COCO has a resources section with disease-specific resources. In this study, we designed HF-related resource modules, implemented them to COCO, and conducted a round usability testing of COCO-Heart Failure (COCO-HF) modules.

**Methods:** A team of clinicians, designers, and software developers designed and developed a COCO-HF prototype. We recruited five people who are part of the COCO team to serve as expert testers to examine the usability heuristics of COCO-HF. The participants all have clinical backgrounds and did not directly participate in the design or development of COCO-HF. The participants, aged between 19 to 40 years old, tested the COCO-HF module prototype via a x hour video conferencing session. First participants completed pre-session survey that asked about ...[describe]. Then, the participants expressed their impressions, navigation, and comments in a standardized think-aloud procedure while navigating the mobile application . We also asked open-ended interview questions about their perceptions of the program, including x, y, and z. At the end of the session, they completed the System Usability Scale (SUS). For data analysis, summary statistics are described for each questionnaire from the pre-session survey and post-session SUS scores. Qualitative comments collected from the think-aloud recordings and open-ended interview questions was analyzed based on Nielsen's usability heuristics for user interface design.

**Results:** We categorized the participants' qualitative comments into five of the 10 Nielsen heuristics: user control and freedom, consistency of design, efficiency of use, minimalist design, and overall user experience. Specifically, four out of the five participants pointed out, changes to the functionality and aesthetics would improve the usability of the app (eg, indicator or button to show more content available when scrolling to the right, adding search functionality to easily locate specific information within the page). The participants recommended tailoring the tables and font size according to the average size of the smartphone screen. The average SUS the participants scored was 83.5 which is above the known average SUS score of 68 indicating the participants would recommend the tool to others for use .

**Conclusions:** Findings from this study indicate the COCO-HF module has great usability yet requires additional modifications and improvements in functionality as recommended by expert testers. We plan to conduct future rounds of usability testing with caregivers of individuals with HF, after updating COCO-HF for usability issues identified in this study, to examine the content and usability of the module. Those results will be synthesized with information gained from other formative work to determine the final app features and functionalities.

**Megan Laine – A Data-Driven Approach to Understand the Nature and Characteristics of Override Reasons and Comments as a Source of User Input to Troubleshoot and Improve Interruptive Alerts: A Case Study at UW Medicine**

Interruptive electronic health records (EHR) alerts are intended to improve patient safety and care, but clinicians often ignore them and experience alert fatigue. Clinical decision support (CDS) committees tasked with alert management have many metrics and data sources to consider when monitoring alert performance. User feedback is a valuable data source for identifying malfunctions but is challenging and time-consuming to obtain. Prior works suggest that monitoring free-text override comments can help detect alert malfunctions. However, prior works have not analyzed users' structured override reasons in conjunction with the comments. A paired analysis of reasons and comments may increase the amount of data and provide more actionable insights for CDS committees. In this case study of University of Washington Medicine's Epic BestPractice Advisories (BPAs) from the outpatient settings 1/1/2019 to 1/1/2021, I conducted a retrospective analysis of interruptive alert override data. My analysis of two BPAs included descriptive statistics and a three-part content analysis. The alerts had different burdens and rates of acceptance; override comment lengths were short. Seven unique categories emerged from the inductive content analysis of paired reasons and comments. The comments included misdirected communication and cranky comments. Two categories from the inductive content analysis closely matched some cranky words, illustrating how comment categories might relate with recurring problems as perceived by EHR users. Additionally, comments conveyed specific categories of information, suggesting that the paired analysis of reasons and comments shows promise by providing CDS committees with concrete detail that may help troubleshoot and improve alerts.

### **Zachary Liao - Automating Classification of Smartphone Photos of Home-Based Urine Assays for Monitoring Adherence to Tuberculosis Treatment**

**Background:** Digital adherence technologies hold promise for improving adherence to tuberculosis (TB) treatment while better respecting patient autonomy. An ongoing trial of the efficacy of a home-based urine test and a progressive web app in promoting TB treatment adherence is being conducted in Buenos Aires, Argentina. This project sought to develop a convolutional neural network (CNN)-based machine learning model that correctly classifies participant-submitted smartphone photos of isoniazid metabolite urine assays.

**Methods:** A dataset of 646 labeled photos of urine assays were used for the initial analysis. Following the initial analysis, two new datasets were created by segmenting the original images to isolate relevant parts of the urine assay. A machine learning model based on the VGG16 convolutional neural network was used to analyze the datasets and classify the urine test strip as positive, negative, or unclear.

**Results:** Model accuracy ranged from 52 percent for the original photos to 75 percent for segmented photos showing just the test strip. Tweaking the model to add additional layers and lengthen fine-tuning did not improve performance.

**Conclusions:** The accuracy achieved by this model is likely insufficient for automating urine test strip review. Future steps for improvement include reclassification of the dataset, fine-tuning a model to emphasize recall for non-positive results, and comparison of a CNN-based approach to other machine learning and/or digital colorimetry approaches.

### **Madeline Lowry Woods - Algorithmic Bias Against Protected Groups in Health Care: A Scoping Review**

**Background:** Bias against historically marginalized groups such as minority racial subgroups and those with lower socioeconomic status is a widespread and enduring problem in healthcare. Clinical prediction models are increasingly used to guide decision-making, but these can also be biased against marginalized groups, causing inaccurate predictions that may exacerbate health disparities. This type of algorithmic injustice is distinct from other types of statistical bias because of its disproportionate impact. The purpose of this scoping review is to summarize and characterize the breadth of knowledge on the topic of algorithmic injustice in health care, the sources of bias, any mitigation techniques, and expose controversies for further study.

**Methods:** A scoping review was conducted following PRISMA-Scr guidelines. A search was conducted in 5 databases covering different areas of knowledge to identify studies pertaining to the study topic. The included studies were selected after being compared by a single reviewer to a set of eligibility criteria, which included papers covering the topic of algorithmic bias in healthcare published since 2016. Data including study method, bias type, algorithm type, algorithm purpose, sources of bias identified, and bias mitigation methods identified, were extracted by the author to a spreadsheet and synthesized using descriptive statistics.

**Results:** The scoping review identified 3091 unique articles, of which 77 sources of evidence were included in the review. A broad range of medical specialties and different types of algorithms were represented.

Commonly identified sources of algorithmic injustice included poorly representative training data (n=19), failure to account for poor baseline health of a subgroup (n=5), issues with feature selection (n=5), and including race/ethnicity as a variable (n=5). Commonly identified methods of bias mitigation included using data with appropriate representation of diverse groups (n=10), removing race or other protected groups from the algorithm (n=8), identifying additional features to improve prediction for subgroups (n=11), and building entirely separate models to improve prediction for various subgroups (n=8). In contrast to the majority, three sources found that including protected groups as model features actually reduced the bias of the model, exposing a lack of consensus.

**Conclusions:** Algorithmic injustice in healthcare is a quickly growing research topic. Training data that fails to represent minority groups was the most identified source of algorithmic bias. The most identified bias mitigation techniques were using data which better represents minorities and including additional model features that improve prediction for subgroups. There is a lack of consensus regarding how protected group features, particularly race/ethnicity, should be handled throughout the model development lifecycle. There is a lack of consensus regarding how to balance model performance with model fairness from a bioethical standpoint. Further study is needed to identify best practices and inform regulation to mitigate harm.

## **Miriam Perez - Inpatient Fall Prevention from the Video Monitor Technician Perspective: A Qualitative Study**

**Background:** Falls in the hospital systems continue to occur despite the use of fall prevention tools which financially affect hospitals and causes a significant risk to patient safety. Fall interventions such as the AvaSys® telesitter device (ATD) are continuously introduced to help prevent falls. With the device being still relatively new to many institutions, the literature on challenges with utilizing ATD is limited. This gap in understanding the human component of AvaSys technology to help reduce falls and improve patient safety makes this area ripe for investigation. The purpose of this study was to understand how video monitor technicians (VMT) in a Seattle hospital system utilize the AvaSys telesitter device and investigate their perception of the device.

**Methods:** A one-time, anonymous, open-ended questionnaire was administered to VMTs. Each participant received an email through the central monitoring unit (CMU) general mailing list informing them of the study. A study information flyer was also posted in the CMU break room. The questionnaires were in the breakroom along with a cover sheet of the questionnaire containing the study information and waiver of documentation of consent. A drop box was provided in the breakroom to put their questionnaire in with sealed envelopes. Inductive content analysis was performed on the responses.

**Results:** A total of six participants of twenty-two VMTs that received the email completed the questionnaire. The inductive content analysis uncovered three main themes that reflected the VMT's experience from their perspective: 1) Using the telesitter device 2) Safety concerns I see and 3) How I feel about my role. *"Using the telesitter device"* described the VMT's perspective on the ATD. The subthemes of patient safety, challenging workload, adequate training, and importance of teamwork support this theme. The theme *"Safety concerns I see"* described the telesitters' viewpoint on the barriers they have experienced and witnessed from utilizing the ATD device for fall prevention. The subthemes under this theme were disconnect between the floor staff, isolation room and technical barriers, and increase patient load. Lastly, the theme *"How I feel about my role"* described the telesitters' view about their role. The subthemes under this were playing a vital role, feeling frustrated and wanting to be heard.

**Conclusion:** Overall, the VMTs perceived the device as a useful tool for fall prevention but stressed the importance of teamwork and the importance of staff following the institution protocol. Many expressed concerns about communication barriers with floor staff and how increasing their patient load can compromise patient safety. With the ATD recently introduced to healthcare systems, it is paramount to obtain feedback from the VMT and integrate that when establishing best practices for the healthcare systems. Healthcare workers are an essential component in the acute care setting. Therefore, understanding their experiences is critical to ensure appropriate standards and resources are in place to deliver safe, effective care to patients.



## **Jake Portanova - Psycholinguistic Indicators of Social Cognition in Schizophrenia**

**Problem statement:** Social cognitive impairments are associated with worse functional outcomes in people with schizophrenia.

**Significance statement:** Linguistic sources are increasingly employed in the analysis of people with schizophrenia and have been applied to study social cognition. Recent advances have focused on the automated assessment of symptoms and endophenotypes of the disorder. This use of automated computational linguistic methods and machine learning involves the use of descriptive linguistic variables acquired from dictionaries, word embeddings, and speech graphs to acquire measures of symptoms, cognition, and functioning. However, there is no synthesis of the linguistic indicators of social cognition in people with schizophrenia in a literature review.

**Purpose:** This paper aims to provide a scoping review of linguistic indicators of social cognitive ability in people with schizophrenia. In addition, it will cover background and history of social cognition in schizophrenia to provide context for the discussion of these methods.

**Study design:** The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines were followed to identify publications concerning schizophrenia, natural language processing, and linguistics from PubMed database. The search terms used were "linguistic", "social cognition", and "schizophrenia". These terms were chosen through a discussion with a prominent social cognition researcher. These terms were combined with the Boolean "and". They were screened for linguistic analysis on text and excluded articles that did not involve schizophrenia.

**Results:** I found ten articles that associated a social measure with a linguistic measure in the context of schizophrenia. These articles were published from 1975 on, but a clear increase is shown after 2008. The two venues of publication is schizophrenia-related journals (half of the articles) and linguistics journals (half of the articles). Social functioning in general, as measured in a variety of ways, is the outcome variable generally identified, with a variety of linguistic manifestations correlating with social functioning.

**Conclusion:** Automated linguistic methods on text-based sources in schizophrenia have been of interest to researchers since 2008, and the results of this scoping review illustrate this. The articles cover a wide variety of methods, experiments, and biomarkers. Computational linguistics for psychological measurement of social cognition in people with schizophrenia could improve outcomes of treatment by increasing the knowledge of the patient and provider of the efficacy of the treatment. As artificial intelligence, mobile technology, and social media use increase, employing natural language processing models for social cognitive assessment could play a complementary role to traditional psychiatry in the future of assessment in mental health.

## **Sarah Stewart - Using Electronic Health Record User Metrics to Improve User Satisfaction**

**Objective:** To develop a standard process utilizing Epic's Signal data to improve clinician satisfaction with the electronic health record (EHR) by focusing on the three pillars of EHR satisfaction: increasing shared EHR ownership, creating an EHR that meets unique user needs, and improving user mastery.

**Design:** After our hospital wide EHR transition to Epic, a group of physician informaticians were tasked with using Epic's Signal tool to improve clinician EHR satisfaction. Our team developed a standard process to analyze the Signal data on a division-basis, share this data with division leadership and their information technology liaisons, validate developed hypotheses with in-person observations, and then propose a division-specific EHR improvement strategy. We tested our standard process with a pilot group and shared our process and learnings with the physician informatician team to support expansion of this work to additional divisions.

**Results:** Through our standard process with the pilot division, we extracted 72 unique observations correlated with opportunities for improvement. We classified these into four actionable buckets: 1) "just-do-its," 2) small-scale projects, 3) large-scale projects, and 4) training issues. We were able to place tickets and solve the first bucket, "just-do-its," and ask the training team for assistance with the fourth bucket, training issues. We presented the remaining project ideas to the division in a pilot wrap-up meeting where they were able to prioritize these recommendations as a group. Since our work with the division, they have moved forward with many of our project recommendations, resulting in tangible EHR improvements for their division and others across the organization resulting in improved clinician EHR satisfaction.

**Conclusion:** We successfully developed a standard process for utilizing EHR user metric data gathered from Epic's Signal tool to drive an EHR improvement strategy grounded in data and user experience. We believe others at our institution and more broadly can learn from our approach and experience to develop similar strategies for utilizing this type of data to drive meaningful change.

## **Allen Tang - Patient-facing Modalities for Social Determinants of Health Data Collection: A Scoping Review on How Screening is Administered, SDoH Domains, and Data Types**

**Motivation:** There is scant research or collated evidence studying the different modes used to facilitate the screening and data collection of social determinants of health (SDoH). This scoping review explores current literature to describe the range, nature, and extent of current research activity and literature on patient-facing modalities used for collecting SDoH data. I define "modality" (i.e., or "mode" for short) as "a particular method or procedure" as it relates to screening and collecting data (e.g., in-person screening, telephone call, paper form).

**Methods:** Following the PRISMA-ScR guideline, I specifically investigate (a) current studies in the literature that have employed screening for SDoH, and (b) the prevalence of technology-assisted screening versus paper or verbal (i.e., in person) screening. I also explore (c) the data types and SDoH domains being collected (e.g., structured; housing), and (d) how the screening was administered (i.e., self-administered). All study designs including both qualitative and quantitative methods were considered. Inclusion criteria were defined as (a) primary studies written in English, (b) published between 2016-2021, (c) involved screening for SDoH (e.g., food insecurity, housing instability, etc.), (d) the modality used was patient-facing, and (e) the study reported on the tools or modes used to capture social health data. Articles were obtained from electronic databases PubMed, A.C.M. Digital Library, and Google Scholar. Data was extracted using the systematic review management software Covidence.

**Results:** From the analysis of fifty-seven studies included, the most common modality of screening were electronic or technology-assisted (33.3%), followed by paper (28.1%) and the combination of verbal and electronic (14.0%), or paper and electronic (12.3%) modalities. Verbal (8.8%), and a combination of paper and verbal (3.5%) modalities were the least common. Food insecurity (38.6%), housing instability (35.1%), and transportation problems (33.3%) were among the most targeted SDoH among the core domains. Utility help needs (28.1%) and interpersonal safety (21.1%) were the least screened for. Supplementary domains targeted the most often were community support (56.1%) and financial strain (45.6%). Other supplementary domains included education (43.9%), mental health (40.4%), and employment (33.3%). Least targeted supplementary domains included physical activity (14.0%), substance abuse (17.5%), and disabilities (5.3%). Structured data (61.4%) was most prevalent among studies collecting SDoH data, followed by those who collected both types (22.8%) of data (e.g., structured, unstructured). Unstructured data (8.8%) was the least common. Four studies (7.0%) could not describe the data type in sufficient detail. Self-administered screening (45.6%) was most common followed by provider-administered screening (36.8%). Few studies incorporated both provider and self-administered (15.8%) screening in their modalities. One study (1.8%) could not describe who administered screening in sufficient detail.

**Conclusion:** My findings indicate that self-administered, structured questionnaires are more common in studies screening for SDoH. Electronic modalities are most common, though paper or verbal modes are often incorporated alongside the electronic modality. Studies describing electronic screening modalities are more sufficient in detail than studies that only describe paper or verbal modalities. Core SDoH domains of high interest (e.g., food insecurity, housing instability, transportation problems) were captured more frequently using paper modalities. Supplemental SDoH (e.g., family and community support, financial strain, education) of high interest were captured frequently by both electronic and paper modalities.

## **Thanh Trinh - Breast Reconstruction in African American and White women: A Systematic Review**

**Abstract:** Breast cancer is the second most common cancer among women in the United States. Women may consider rebuilding their breast's appearance through breast reconstructive surgery; however, systematic differences in care for African American women present barriers to accessing breast reconstruction options. This systematic review aimed to explore insurance coverage for breast reconstruction surgery for African American and white women and its impact on their decision to undergo or forego. A table examining racial disparities between African American and white women is discussed and analyzed to understand outcomes during the decision-making process.

**Method:** This systematic review was conducted partially with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to assess the methodological quality of the study review (Page et al., 2020). The assessment employed a variety of scholarly reference databases, including PubMed, Embase, and CINAHL. Grey literature was explored through Google Scholar searches by reviewing the first three pages (10 articles per page) to capture potentially relevant studies.

**Results:** The systematic review included 24 articles of which 19 (79%) articles were cohort study, 1 (4.2%) mixed-method, 1 (4.2%) grounded theory, 1 (4.2%) cross-sectional study, 1 (4.2%) clinical trial, and 1 (4.2%) randomized controlled trial. Of the 24 articles, 9 (38%) articles provided complete statistical insurance data for evaluation; 16 (67%) articles did not provide insurance status; 22 (92%) articles provided no employment status; 5 (21%) articles discussed Medicaid coverage, and 4 (17%) articles discussed Medicare. All 24 (100%) articles reviewed African American and white women undergoing (yes) breast reconstruction, but only 8 (33%) articles discussed foregoing (no) breast reconstruction for review. All reported rates undergoing or foregoing breast reconstruction remained substantially different between African American and white women. The most frequently cited barriers to reconstruction were lack of health insurance, high-cost deductible health plan (HDHP), out-of-pocket expenses during the decision-making process. Medicaid Expansion provided more opportunities for African American women to undergo breast reconstruction.

**Conclusion:** The systematic review revealed that socioeconomic factors such as insurance coverage may play a role in determining breast reconstruction treatment options. Other unknown factors may also account for the difference. Persistent racial/ethnic disparity remains substantially different in African American and white women, and this study found that insurance coverage may be a small part of the decision-making process. The scope of this problem is significant, and future studies should continue to examine African American women's insurance status and socioeconomic factors as a whole. Decision aids may be solutions to reducing racial disparities in reconstruction. The development of such a decision aid must consider the perspective of users. The Human-Centered Design method is recommended.

## **Erin Von Gehr - Usability Testing of Patient Profiles in the Tuberculosis Treatment Support Tool (TB-TST) by Healthcare Professionals**

**Background:** Although tuberculosis (TB) infection is highly curable, global incidence of multidrug-resistant TB is increasing. The Tuberculosis Treatment Support Tool (TB-TST) web-based app has been used by healthcare professionals (HCPs) to monitor patients' TB medication adherence remotely, and a mobile version of the TB-TST is in development. The objective of this study was to refine the TB-TST mobile app prototype by conducting usability testing with HCPs, focusing on the patient profile tab.

**Methods:** We conducted a convergent mixed-method study over three iterative cycles with a convenient sample of sixteen HCPs. We interviewed and observed individual participants while they completed tasks on the TB-TST mobile app prototype during remote virtual usability testing sessions. Participants completed a questionnaire adapted from the mHealth App Usability Questionnaire (MAUQ) to quantify changes in usability between iterative cycles. We synthesized qualitative data from remote virtual usability sessions and the open-ended portion of the questionnaire to recommend changes to the prototype's patient profiles. Changes were made to the prototype after each cycle, and we evaluated the refined prototype in the next iterative cycle using the same process and different participants (six in the first cycle and five in the second and third cycles).

**Results:** The TB-TST mobile app prototype's mean usability score was 6.30 (SD = 0.49) out of 7 in the first cycle, 6.03 (SD = 0.56) in the second cycle, and 6.46 (SD = 0.37) in the third cycle. After the first cycle, dates in patients' daily reports were changed to display as "month/day", a broken link going to the wrong patient profile was fixed, home page icons became shortcut links to different sections of the patient profile, and a notification was added to confirm completion of test strip photo processing. After the second cycle we recommended adding customization options, an app tutorial and explanatory keys for reports and icons. These features were too complex to program for this prototype, so no changes were made. After the third cycle we recommended redesigning or removing the collapse/expansion option for patient profile sections, requiring patients to report side effects as "new" or "recurring", and adding an explanatory key for interpretation of test strip photos.

**Conclusions:** The increase in mean usability score of the TB-TST mobile app prototype from the first to third cycle suggested improvement of the prototype's usability over the course of this project. Two thirds of recommendations addressed navigation errors or display issues. One third of recommendations were made from participants' requests for clarification (explanatory keys and tutorials) and customization, but could not be programmed with the prototype's design platform. Development of a higher-fidelity prototype is indicated to incorporate complex features into the TB-TST mobile app and study its usability during TB medication adherence monitoring in clinical settings.

## **Joshua Weiss - Provider Usability Testing of the TB-TST: a TB Adherence Monitoring Mobile App**

**Background:** Tuberculosis (TB) is currently one of the leading causes of death worldwide. The ongoing COVID-19 pandemic has also exacerbated this problem by reducing the detection of this treatable chronic respiratory disease. The TB Treatment Support Tool was developed to assist clinicians with monitoring medication adherence of their patient cohort by providing a convenient method to review medication adherence trends through patient-submitted urine test strip photos and address patient-reported side-effects and other barriers through the app. This study focuses on development of the mobile version of the provider facing app.

**Purpose:** The purpose of this project was to identify potential barriers and refine the app for providers when navigating the mobile version of the app's home page, consisting of a list of patients who are at risk of poor adherence or experiencing an issue, such as a potential medication side effect, and require intervention. The overall goals of refining the home page were to display pertinent information at a glance without visually overwhelming the clinician and provide an intuitive means of navigating to other areas of the app.

**Methods:** Five to six participants were recruited primarily via word of mouth for each cycle, consisting of three cycles and sixteen participants in total. Feedback was obtained via talk-aloud interviews to collect qualitative data, and a modified 26-item mHealth app usability questionnaire (MAUQ) was administered to participants after each interview to obtain quantitative data. The main issues of each design iteration were identified and relayed to the rest of the team. The team's designer made changes to the layout of the high-fidelity wireframe of the app based on this feedback prior to initiating the next cycle.

**Results:** Feedback pertaining to the homepage typically fell under one of three categories: layout, navigation, or functionality. Some commonly observed behaviors amongst participants differed between each cycle, such as attempting to tap on icons under "items to review" in Cohort 1 and expressing uncertainty when asked to identify the patient with the current lowest adherence rate in Cohort 2. Certain items were removed or rearranged from patient cards on the homepage to present the information on each card more concisely. Priority flags were also replaced with percent medication adherence to reduce ambiguity. New features were also introduced to the app prototype to improve navigability and functionality, including a search bar, notification icon shortcuts, and a patient filtering system.

**Conclusions:** Participants' feedback from each cohort ultimately improved the overall layout and navigation of the app's home screen. Some of the more notable issues involved across iterations involved ensuring users understood the information presented to them. These issues were mostly resolved by the final iteration through layout changes, such as modifying the priority flags to instead display medication adherence percentages. Some changes that were identified in the final cohort but have yet to be implemented include a method of completing individual patient activities and implementation of an overview graph of adherence for the entire patient cohort over time.

## **Tyler Wright - Military Primary Care Program Director Perspectives on Formal Inclusion of OpenNote Training for Medical Residents**

**Problem Statement:** On April 5, 2021 the Office of the National Coordinator (ONC) mandated the 21st Century Cures Act which requires that healthcare entities provide access to healthcare information without delay or charge. It is well documented that OpenNotes, or online access to medical provider documentation for clinical encounters, bring benefits to patients that largely outweigh the risks. However, physicians, especially those in training, hold significant concerns about OpenNotes including workload addition, documentation discrepancies with patients, additional attending supervisory requirements, and omitting controversial clinical information.

**Significance statement:** To date, no known studies have been published outlining program directors' perspectives on adding OpenNotes education to the standard curriculum for medical residents. Research has shown that these concerns are significantly overestimated and additional training in OpenNotes during residency could alleviate these concerns, but this would require both the education and support of program directors. This study examines the both the perspectives of program directors in including OpenNotes training during residency and potential gaps in knowledge needed to implement such training.

**Purpose:** The purpose of this study is to utilize a cross-sectional survey to explore program directors' perspectives on developing and including OpenNotes educational curricula for medical residents as part of their residency training.

**Study design/Methods:** An online survey using the SurveyMonkey® tool was distributed via email to all of the military primary care residency program directors in family medicine, pediatrics, and internal medicine. Questions were written using a Likert scale and results were collected anonymously.

**Results:** The response rate was 24/37 (65%) of the current program directors. Two additional responses from previous program directors (within 5 years) were captured. 14/25 (56%) respondents were unfamiliar with ONC's Cures Act Final Rule mandating OpenNotes. 20/26 (77%) agreed that it is important to consider implications of OpenNotes. 21/26 (81%) agreed and 0/26 (0%) disagreed that it was important for residents to have formal OpenNotes training during residency. 22/26 (85%) disagreed that they had received sufficient personal training on OpenNotes. 17/26 (65%) disagreed that current faculty had the knowledge to educate residents on OpenNotes. 14/26 (54%) disagreed that their program had resources needed to provide OpenNotes education.

**Conclusion:** Military primary care program directors believe that OpenNotes are important and that formal education should be integrated into residency training. However, critical gaps in implementation have been identified. Faculty have not had sufficient OpenNotes training and programs lack needed resources to provide this education. Further research should address curricula development for both faculty and trainees. Barriers to resources should be explored.



## **Karen Yeager - Use of Machine Learning for Pediatric Sepsis: A Scoping Review**

**Introduction:** Pediatric sepsis in the United States is estimated to have an overall prevalence of 4.4%, with 176,000 hospitalizations annually and an 8.2% mortality rate (Paul et al., 2021). It is also one of the leading causes of childhood mortality worldwide, stressing the importance of early diagnosis and goal directed therapy (Dellinger et al, 2013). Machine learning (ML) is an emerging technology that holds the promise of superiority for applications such as early diagnosis and predictive risk stratification for a variety of conditions, including sepsis. This scoping review aims to identify the current landscape of literature regarding the application of ML methods for pediatric sepsis.

**Methods:** This scoping review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines – scoping review extension (PRISMA-ScR). We used PubMed, CINAHL, Web of Science, and Scopus, and two reviewers independently identified records and screened manuscripts. The search included English language, full-text original research articles published January 2010 onwards that utilized a ML or artificial intelligence (AI) for pediatric sepsis diagnosis, early detection, risk stratification, or mortality predication.

**Results:** Of the original 837 records originally screened from our search results, 210 records were eligible for full text review. Of these articles, a total of 35 were included in our final review. Most of the included studies were retrospective in nature (77%, n = 27), and developed models using datasets from a single institution or health care organization (66%, n = 23). The care setting for the majority of the studies evaluated was the PICU (46%, n = 16) or NICU (37%, n =13), with only 2 studies focusing on ED applications for ML for pediatric sepsis. The most prevalent outcome of interest was risk stratification (e.g. progression to severe sepsis, septic shock, vasoactive medication use), with 13 studies studying this as a primary outcome.

**Conclusions:** ML research is becoming more and more prevalent in pediatrics. Age-adjusted-normal for vital signs and physiologic differences make this population uniquely challenging for application of ML. While many studies show promise in this area, more multi-center, externally validated and prospective studies are required to provide higher quality evidence to assess suitability for clinical application. Additionally, more attention should to be paid to non-intensive care populations such as inpatient, ED and prehospital care settings.