The Institute for the Design of Environments Aligned for Patient Safety (IDEA4PS)

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1. Structured Abstract.

Purpose: This study was designed to enable the integration of experts in systems engineering, design, human factors, organizational behavior, evaluation, and data analysis to explore the way that feedback of information is incorporated into the adaptation of work systems to enhance patient safety.

Scope: IDEA4PS assessed how all kinds of data collected at The Ohio State University Wexner Medical Center are leveraged to provide actionable information and how they are linked to patient outcomes.

Methods: Project 1 focused on telemetry alarms, seeking to improve what engineers call the signal-to-noise ratio, thereby allowing clinicians to focus on meaningful events over the din of background noise, leading to improvements in the safety and quality of patient care. The second project focused on hospital-acquired infections (HAIs). Despite the widespread use of electronic health records (EHRs), many hospitals continue to perform infection control surveillance retrospectively and often through manual review of records, which is both time consuming and labor intensive. We explored this problem and its potential solutions. Project 3 explored how the hospital-wide use of MyChart Bedside (MCB) – an inpatient EHR portal – impacted the provider work system and processes.

Results: IDEA4PS improved clinical practice by designing, testing, and exploring the type and kind of information flows resulting in adaptation of the health care work environment, as outlined below:

Project 1 improved the signal-to-noise ratio, thereby allowing clinicians to focus on meaningful events over the din of background noise, leading to improvements in the safety and quality of patient care. This was accomplished by changing hospital policies to reduce false alarms; redesigning audio tones for telemetry alarms; identifying needs of patients and families to improve satisfaction with alarms; and assisting with making changes to tones for a new mobile phone platform with a Secondary Alarm Notification System (SANS) and a new hospital.

Project 2 automated hospital-acquired infection (HAI) surveillance in order to provide results in near-real time to stakeholders as well as explore different visualizations for surveillance results. This was accomplished by creating a simple *Clostridioides difficile* (C. diff) algorithm that correctly identified all hospital-onset (HO) *Clostridioides difficile* infection (CDI) and by developing a demonstration C. diff interactive dashboard that used a map of the hospital as a form of visualization and building data infrastructure that takes into account space and time by leveraging geographic information systems (GIS) in order to better track infections within the hospital and that can be applied to other quality and safety outcomes that may benefit from localization within the hospital.

Project 3 explored how the hospital-wide use of MyChart Bedside (MCB), an inpatient patient portal, impacted the provider work system and processes. Interviews with hospital staff indicated frustrations around MCB because of the lack of time in their workflow to provision tablets to patients upon admission and the need to deal with technology issues and training. Interviews also identified that clinicians developed workarounds to circumvent the Secure Messaging function of MCB. A health system-level committee was convened to serve as a means of translating findings from Project 3 into operational improvements, which involved hiring technology navigators to assist with MCB provisioning and training of both patients and clinicians. Many providers discouraged use of secure messaging in the inpatient setting because of difficulty in accessing messages and/or their preference for face-to-face

communications. Log file analysis showed that patients use MCB to send secure messages to providers to make requests, ask questions, and express gratitude. Messages from patients generally involve topics about symptoms, treatment plans, and pain.

Conclusions: The patient safety learning laboratory, the Institute for the Design of Environments Aligned for Patient Safety, provided foundational infrastructure to connect stakeholders across The Ohio State University and Wexner Medical Center to conduct rigorous research in the context of practice. This focus allowed research to inform operations in a cycle of continuous improvement in which clinicians and researchers, inclusive of health services experts, analysts, and information technology staff, worked together and improved operational excellence and performance management processes for patient safety.

Key Words: Telemetry, Hospital-Acquired Infections, Patient Portals, Hospitalization, Medical Informatics, Technology Adoption, Organizational Change, Behavioral Intervention, Human Factors, Alarm Fatigue.

2. Purpose.

This study, "The Institute for the Design of Environments Aligned for Patient Safety (IDEA4PS)," was designed to identify and explore how feedback of information can be used to inform the development of robust practices that lead to improved patient safety. Our Institute sought to improve clinical practice by designing, testing, and exploring the type and kind of information flows that result in adaptation of the health care work environment.

3. Scope.

The Institute for the Development of Environments Aligned for Patient Safety (IDEA4PS) aimed to use systems approaches to bring together multidisciplinary teams to generate new ways of thinking with respect to the design of feedback to the environment of care in alignment with systems dynamics. Given that much of the progress in patient safety has been on egregious and amenable threats, the three projects conducted by our Institute provided an opportunity to be more proactive, to envision the quality and safety of care that patients and providers would like to have, and to test innovative designs that had the potential to alter the status quo and shape a safer future rather than simply add a new patient safety practice on top of the existing system.

Our projects were bound closely together by the costly harms associated with information problems. In Project 1, we focus on the information and signaling ecosystem that exists in the day-to-day environment of clinical care. In Project 2, we turned our attention to how retrospective data can be leveraged into prospective information about the spread of hospital-acquired infections. Finally, we investigated the challenge of integrating new sources of data, seeking to gain a more immediate and responsive understanding of the patient experience with an eye to leverage patient observation and engagement toward more rapidly identifying both exemplary practice and potential issues. The Ohio State University Wexner Medical Center offered an opportunity to evaluate these system interventions in a real-world clinical setting, with its full complement of facility design, equipment, people (patients, family members, and providers), new procedures and workflow, and organizational contextual features, as appropriate. By focusing on information as opposed to a specific patient safety challenge, we created generalizable experiential knowledge that is invaluable to improve both patient safety and the quality of care that health care organizations deliver.

4. Methods.

Project 1: Telemetry and Alarms: The first project focused on the manner in which information is provided to clinicians. The volume of information that clinicians receive and interpret is overwhelming. A number of studies have spoken to this problem, suggesting that current systems create a significant amount of noise through which clinicians must identify particular signals that indicate clinically significant events. Project 1 focused on the signal-to-noise problem experienced by clinicians, seeking to improve what engineers call the signal-to-noise ratio, thereby allowing clinicians to focus on meaningful events over the din of background noise, leading to an improvement in the safety and quality of patient care. Such an effort required significant engagement with stakeholders and an exploration of the state of the tools and technology deployed in situ, with the project team exploring the needs of clinicians within the context of the existing social-technical factors (e.g., facility design features, equipment and technology, work processes and flow, and organizational, cultural, and contextual characteristics) that shape the clinical experience. The Human Factors and Design Core provided the expertise to evaluate, experiment, and explore alternative attention-focusing designs. The Informatics and Analytics Core worked with the project team to channel the data into experimental experiential systems through rapid prototyping.

Project 2: HAI Surveillance: The second project focused specifically on hospital-acquired infections (HAIs). Despite the widespread use of EHRs, many hospitals continue to perform infection control surveillance retrospectively and often through manual review of records, which is both time consuming and labor intensive. Although the development of automated surveillance algorithms has been shown to be feasible and accurate, systems that use real-time data to recognize concerning trends do not exist. Surveillance data is most commonly displayed in tabular format or simple charts, which are not ideal representations of complex data, especially for potential outbreak detection. The result is a significant delay in the use of surveillance data to implement timely and effective interventions and reduce the likelihood of a hospital-acquired infection. We proposed to explore this problem and its potential solutions. The Informatics and Analytics Core worked with infection preventionists (IPs) and quality improvement (QI) personnel to develop real-time results to recognize concerning trends sooner in order to implement timely and effective interventions through the use of tools like digital hotspotting. The Human Factors and Design Core worked with the Informatics and Analytics Core to support the development of visualizations, coupled with automated algorithms, to identify and illustrate the potential visual-spatial distribution of HAIs within the hospital from clustering of patients based on clinical disease states and acuity as well as the compliance with nursing processes and potential transmission of infection. Automating manual processes and visualizing these data in a hospital-wide interactive surveillance map may allow for earlier recognition of potential adverse patient quality and safety trends.

Project 3: Inpatient Portals and Information Flows: Finally, Project 3 was developed to explore how the hospital-wide use of MyChart Bedside (MCB) – an inpatient EHR portal – is impacting provider work systems and processes. MCB is a tablet-based technology used by inpatients, and the secure messaging feature is the main element that could affect information flow to the care team. Information overload has been identified as a threat to patient safety, and the goal of the project was to identify workflow modifications and potential changes to the MCB technology that could moderate the flow of secure messages from patients into the work system. This project team worked closely with the Human Factors and Design Core during the Design and Development phases and called on the Informatics and Analytics Core during Problem Analysis and during the iterative Evaluation phase.

5. Results.

The interdisciplinary approach of the Institute for the Design of Environments Aligned for Patient Safety (IDEA4PS) explored how feedback of information could be used to inform the development of robust practices that lead to improved patient safety. Our Institute improved clinical practice by designing, testing, and exploring the type and kind of information flows resulting in adaptation of the health care work environment.

Project 1 focused on telemetry alarms, seeking to improve what engineers call the signal-to-noise ratio, thereby allowing clinicians to focus on meaningful events over the din of background noise, leading to an improvement in the safety and quality of patient care. The principal findings of Project 1 are presented and discussed here.

- Changed policy in five hospitals to reduce the alarm burden from both bedside monitors and the Secondary Alarm Notification System (SANS) delivered on nurses' phones. Policy changes included removing low-likelihood patient cohorts (Class III cardiac risk) from monitoring, lowering threshold defaults for pulse oximetry (SPO2 lo), and encouraging nurses to set patient-specific thresholds. Outcomes from intervention were lower ED boarding time, fewer alarms, fewer interruptions, shorter time when nurses were off the unit (monitored transport rate), and shorter nurse response times. A 15-59% reduction in response times for Code Blue was achieved. This was a clinically significant change in that Code Blue response times longer than 120 seconds changed from 63.5% (8256/12,999) to 19.9% (5544/27,822) in the cardiac hospital.
- Redesigned and replaced audio tones for cardiac and respiratory alarms delivered on SANS. Used human factors concepts of discriminability, masking, and usability (easy to learn, easy to localize); indicator encoding distinguishing human-initiated alarms (with digitized speech and earcons/auditory icons) from machine-initiated alarms; and orientation (beacon followed by repeated content sound) in tone design. Demonstrated improvements in laboratory study conducted on hospital unit to replicate authentic soundscape with hospital nurses in improved accuracy of detection and improved localization.
- Modified and standardized SANS escalation algorithms, including when and how long before escalation, delays before alarms sounded to reduce redundant alarms with bedside monitor, augmenting sounds with visually displayed information on phones without requiring logging in or navigation to information, and using visual displays instead of sounds for lower-priority alarms. Demonstrated 25% reduction in SANS alarms.
- Generated characteristics of ideal critical cardiac tones and patient-centered tones to support evaluations of anticipated transition to new SANS with different mobile device capabilities, sound options, and integration support with patient call system and electronic health record.
- Publicly sharable: We can share publicly one set of auditory alarm sounds that can be used in SANS systems. In addition, leveraged funding produced an alarm set that could potentially be shared upon request and that is compatible with the anticipated 2020 revision of the alarm standard, IEC/ISO 60601-1-8, with which the FDA requires compliance for bedside telemetry monitors. Both sets are accompanied by an ontology to support optional inclusion of individual tones rather than use of the full set. The ontology distinguishes origin of the alarm (clinician, patient, equipment), urgency (high, low), and clinical functions (e.g., respiratory system).

Project 2 focused on hospital-acquired infections (HAIs). Despite the widespread use of electronic health records (EHRs), many hospitals continue to perform infection control surveillance retrospectively and often through manual review of records, which is both time consuming and labor intensive. The results of surveillance are traditionally displayed to stakeholders in tables and charts

and are often weeks to months delayed. Project 2 studies focused on automating surveillance in order to provide results in near-real time to stakeholders as well as to explore different visualizations for surveillance results. The principal findings of Project 2 are presented and discussed here.

- Established demographic data on 2 years of adult inpatient admissions and discovered that there were over 65,000 patients in our initial cohort, with over 110,000 hospital encounters. Data from these encounters informed the basis of the retrospective database.
- Our simple *Clostridioides difficile* (C. diff) algorithm correctly identified all hospital-onset (HO) *Clostridioides difficile* infection (CDI) cases in 2015, with a PPV of 97.31%.
- Developed an initial version of a C. diff dashboard that uses a map of the hospital as a form of visualization. The user could change the time frame, select individual patients or groups of patients, and drill down to show where the patients moved within the medical center during their stay. It identifies the room where the patient was diagnosed with C. diff but also marks rooms that the patient was housed in while likely contaminating the environment.
- Performed user studies on the prototype dashboard with four subject matter experts. On the survey, all users "strongly agreed" that the dashboard would be a positive addition to Clinical Epidemiology and would allow them to present HAI information to others more effectively. All "agreed" or "strongly agreed" that they felt confident in manipulating the dashboard to demonstrate to others and that it was easy to learn and use. Respondents also suggested improvements to specific features, including improving the intuitiveness of changing the date ranges, adding isolation information, and showing present-on-admission CDI cases.
- Collaborated with colleagues in Geography to build data infrastructure that takes into account space and time by leveraging GIS. This allowed us to better track infections within the hospital and could be applied to other quality and safety outcomes that may benefit from localization within the hospital.
    a. Created a survey of hospital rooms to identify room-level factors that may be associated with patient safety outcomes. We piloted this survey on 597 distinct rooms over 6 months.
    b. Streamlined and improved the hospital room survey based on findings from this pilot and feedback from facilities personnel.
    c. Created a crosswalk that allowed us to connect room-level data from the EHR and room-level data from our room survey to the hospital geographic files in order to create a hospital GIS.
- We hypothesized that exposure to more intra-hospital environments may increase the risk for HO-CDI. We performed a matched case-control (3:1) study to determine whether number of in-hospital transfers increased the risk for acquiring HO-CDI. Between December 1, 2013, through January 1, 2016, there were 386 cases of HO-CDI. Results of a multivariate logistic regression model adjusting for age, the Charlson comorbidity index, and antibiotic use suggest a significant relationship between HO-CDI risk and the number of in-hospital transfers. Each additional transfer increases the odds of HO-CDI infection by approximately 7%.
- **Automated surveillance and novel visualization:** Created an interactive dashboard that allowed spatio-temporal visualization of cases.
- **Visualization of hotspots:** We created a social network analysis to analyze in-hospital networks of HO-CDI cases. We used a GIS visual representation of the network structure to highlight rooms most associated with these cases.
- **Pilot study investigating the role of intra-hospital transfers on HO-CDI:** For each additional transfer, the odds of HO-CDI increase by 7%.
- **Pilot study to analyze data within a hospital GIS.** Using a logistic regression model with hospital fixed effects modeled the risk of HO-CDI as a function of patient and hospital room characteristics:

a. **Patient characteristics**: Antibiotic use was associated with an increased risk, and the comorbidity score was associated with a slightly decreased risk.
b. **Room characteristics:** Furniture and flooring factors as well as antibiotics in the room prior were associated with increased risks; hygiene factors and a computer in the room were associated with decreased risks.

Project 3 explored how the hospital-wide use of MyChart Bedside (MCB), an inpatient EHR-based patient portal, is impacting the provider work system and processes. The principal findings of Project 3 are presented and discussed here.

- Interviews with hospital staff about secure messaging have consistently identified work-arounds that clinicians have developed to circumvent the Secure Messaging function. This was addressed at the hospital level through additional training but has not resulted in increased usage of the secure message function. There is considerable concern among clinical staff that secure messaging could create communications issues. A health system-level committee was convened to serve as a means of translating findings from Project 3 into operational improvements.
- Interviews with hospital staff have indicated frustrations around MCB because of the lack of time in their workflow to provision tablets to patients upon admission and the need to deal with technology issues and training.
- Many providers discourage use of secure messaging in the inpatient setting because of difficulty in accessing messages and/or their preference for face-to-face communications.
- Patients are using MCB to send secure messages to providers to make requests, ask questions, and express gratitude. Messages from patients generally involve topics about symptoms, treatment plans, and pain.
- Patients and physicians identified strategies at the patient, portal, physician, and health system levels that could help each group navigate the portal to communicate via secure messages more efficiently.
    a. Patient-focused training strategies included multimodal materials addressing how to navigate portal features and direction on when, what, and how to message.
    b. Changes to the format of the messaging feature and pop-ups with communication tips were also frequently mentioned.
    c. Physician and clinic-level strategies focused on how the clinic and health system management could enhance physician training on the patient-facing portal features and how to manage patient care within the portal.
- Patients and care team members identified inpatient portal functions that they perceived to positively impact health literacy. These functions included providing patients access to health information, care plans, and educational materials as well as enabling patient communication with their care team.
- In patients who were concerned that their medical information would be compromised if it was sent electronically between providers, the odds of withholding information from their provider was three times that of patients without concerns. Conversely, for patients who were confident about the privacy of their medical information, the odds of keeping information from their provider was approximately half of those who were not confident.
- Black patients were generally more likely to withhold information than White patients were. Patients who were older, married, employed, and in good mental health and who had health care coverage were less likely to keep information from their provider.
- The perspectives of patients and care team members around the use of the inpatient portal generally converged. Three features – 1) ordering meals, 2) looking up health information, and 3) viewing the care team – were most commonly used; the secure messaging feature was less commonly used and of some concern to care team members. The inpatient portal benefited

patients in four main ways: 1) promoted independence, 2) reduced anxiety, 3) informed families, and 4) increased empowerment.

- Inpatient portals are recognized as a tool that can enhance the delivery of patient-centered care. In addition to empowering patients by increasing their sense of control, inpatient portals can support family members and caregivers throughout the hospital stay. Given the consistency of perspectives about portal use across patients and care team members, our findings suggest that inpatient portals may facilitate shifts in organizational culture that increase the patient-centeredness of care and improve patient experience in the hospital context.

6. List of Publications.

Manuscripts Published or In Press:

1. **Rayo MF,** Mansfield J, Eiferman D, Mignery T, **White S, Moffatt-Bruce SD.** 2016. Implementing an institution-wide quality improvement policy to ensure appropriate use of continuous cardiac monitoring: a mixed-methods retrospective data analysis and direct observation study. *BMJ Qual Saf.* Oct;25(10):796-802. doi: 10.1136/bmjqs-2015-004137. Epub 2015 Nov 13. PubMed PMID: 26566801.

2. Ford EW, Silvera GA, Kazley AS, Diana ML, **Huerta TR.** 2016. Assessing the relationship between patient safety culture and EHR strategy. *Int J Health Care Qual Assur.* Jul 11;29(6):614-27.

3. **Rayo MF, Moffatt-Bruce SD.** 2016. Diagnosing and Treating "Alarm Fatigue": Pragmatic and Evidence-Based Approaches Needed. *Jt Comm J Qual Patient Saf.* Jul;42(7):291-2. PubMed PMID: 27301831.

4. Nguyen MC, **Rayo MF,** Eiferman DS, **Moffatt-Bruce SD.** 2016. Evidence-Based Cardiac Monitoring in Surgical Patients: Reducing Alarm Fatigue and Improving Resource Allocation. *Journal of the American College of Surgeons.* Oct 1;223(4):e168.

5. Fairbanks RJ, Bisantz A, Hettinger AZ, Ratwani R, **Patterson ES,** Roth E. 2016. Usability in Health IT: Beyond Compliance to Meaningful Design and Assessment. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting,* Vol. 60, No. 1, pp. 643-6. SAGE Publications.

6. **Moffatt-Bruce SD, Hefner JL,** Mekhjian H, McAlearney JS, Latimer T, Ellison C, **McAlearney AS.** 2017. What Is the Return on Investment for Implementation of a Crew Resource Management Program at an Academic Medical Center? *Am J Med Qual.* Jan/Feb;32(1):5-11. doi: 10.1177/1062860615608938. Epub 2016 Jul 9. PubMed PMID: 26419392.

7. **Hefner JL, Huerta TR, McAlearney AS,** Barash B, Latimer T, **Moffatt-Bruce SD.** 2017. Navigating a ship with a broken compass: evaluating standard algorithms to measure patient safety. *J Am Med Inform Assoc.* Mar 1;24(2):310-15. doi: 10.1093/jamia/ocw126. PubMed PMID: 27578751.

8. **Patterson ES,** Sillars DM, Staggers N, Chipps E, Rinehart-Thompson L, Moore V, Simmons D, **Moffatt-Bruce SD.** 2017. Safe Practice Recommendations for the Use of Copy-Forward

with Nursing Flow Sheets in Hospital Settings. *Jt Comm J Qual Patient Saf.* Aug;43(8):375-85. doi: 10.1016/j.jcjq.2017.02.009. Epub 2017 Jun 22. PubMed PMID: 28738982.

9. **Sieck CJ, Hefner JL,** Schnierle J, Florian H, Agarwal A, Rundell K, **McAlearney AS.** 2017. The Rules of Engagement: Perspectives on Secure Messaging From Experienced Ambulatory Patient Portal Users. *JMIR Med Inform.* Jul 4;5(3):e13. doi: 10.2196/medinform.7516. PubMed PMID: 28676467; PubMed Central PMCID: PMC5516097.

10. **Hefner JL,** Hilligoss B, Knupp A, Bournique J, Sullivan J, Adkins E, **Moffatt-Bruce SD.** 2017. Cultural Transformation After Implementation of Crew Resource Management: Is It Really Possible? *Am J Med Qual.* Jul/Aug;32(4):384-90. doi: 10.1177/1062860616655424. Epub 2016 Jul 15. PubMed PMID: 27422314.

11. **Yen PY, McAlearney AS, Sieck CJ, Hefner JL, Huerta TR.** 2017. Health Information Technology (HIT) Adaptation: Refocusing on the Journey to Successful HIT Implementation. *JMIR Med Inform.* Sep 7;5(3):e28. doi: 10.2196/medinform.7476. PubMed PMID: 28882812; PubMed Central PMCID: PMC5608986.

12. **Hefner JL, Sieck CJ, Walker DM, Huerta TR, McAlearney AS.** 2017. System-Wide Inpatient Portal Implementation: Survey of Health Care Team Perceptions. *JMIR Med Inform.* Sep 14;5(3):e31. doi: 10.2196/medinform.7707. PubMed PMID: 28912115; PubMed Central PMCID: PMC5620453.

13. **Walker DM, Sieck CJ, Menser T, Huerta TR, Scheck McAlearney A.** 2017. Information technology to support patient engagement: where do we stand and where can we go? *J Am Med Inform Assoc.* Nov 1;24(6):1088-94. doi: 10.1093/jamia/ocx043. PubMed PMID: 28460042.

14. **Patterson ES,** Anders S, **Moffatt-Bruce SD.** 2017. Clustering and Prioritizing Patient Safety Issues during EHR Implementation and Upgrades in Hospital Settings. *Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care.* Vol 6, Issue 1, pp. 125-31. SAGE Publications.

15. **Moffatt-Bruce SD, Huerta TR, Gaughan AA, McAlearney AS.** 2018. IDEA4PS: The Development of a Research-Oriented Learning Healthcare System. *Am J Med Qual.* Jan 1:1062860617751044. doi: 10.1177/1062860617751044. [Epub ahead of print] PMID:29310442

16. **Yen PY, Walker DM,** Smith JMG, Zhou MP, **Menser TL, McAlearney AS.** 2018. Usability evaluation of a commercial inpatient portal. *Int J Med Inform*. Feb;110:10-18. doi: 10.1016/j.ijmedinf.2017.11.007. Epub 2017 Nov 13. PubMed PMID: 29331248.

17. **Walker DM, Menser TL, Yen PY, McAlearney AS**. 2018. Optimizing the User Experience: Identifying Opportunities to Improve Use of an Inpatient Portal. *Appl Clin Inform.* Jan;9(1):105-13. doi: 10.1055/s-0037-1621732. Epub 2018 Feb 14. PubMed PMID: 29444536.

18. Schmidt CR, **Hefner J, McAlearney AS,** Graham L, Johnson K, **Moffatt-Bruce S, Huerta T,** Pawlik, TM, **White S.** 2018. Development and prospective validation of a model estimating

risk of readmission in cancer patients. *J Surg Oncol.* Feb 26. doi: 10.1002/jso.24968. [Epub ahead of print] PMID: 29484659

19. **Patterson ES**. 2018. Workarounds to Intended Use of Health Information Technology: A Narrative Review of the Human Factors Engineering Literature. *Hum Factors.* 60(3):281-92. PMID:29533682

20. **Patterson ES**, Dewart DM, Stevenson K, Mbodj A, Lustberg M, Hade EM, **Hebert C**. 2018. A Mixed Methods Approach to Tailoring Evidence-Based Guidance for Antibiotic Stewardship to One Medical System. (Published online April 23) *Proceedings of Human Factors and Ergonomics in Healthcare*, Boston, MA, Mar 26-28, 2018.

21. **Patterson ES**, Hritz C, Gebru L, Patel K, **Yamokoski T, Moffatt-Bruce S**. 2018. Use Preferences for Continuous Cardiac and Respiratory Monitoring Systems in Hospitals: A Survey of Patients and Family Caregivers. *Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care*, 2018 Jun, Vol. 7, No. 1, pp. 205-9. Sage India: New Delhi, India: SAGE Publications

22. **Rayo MF**, Pawar C, Sanders EB, Liston BW, **Patterson ES**. 2018. Participatory Bullseye Toolkit Interview: Identifying Physicians' Relative Prioritization of Decision Factors When Ordering Radiologic Imaging in a Hospital Setting. *Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care,* 2018 Jun, Vol. 7, No. 1, pp. 1-7. Sage India: New Delhi, India: SAGE Publications

23. **Horwood CR, Rayo MF**, **Fitzgerald M,** Balkin EA, **Moffatt-Bruce SD**. 2018. Gaps Between Alarm Capabilities and Decision-making Needs: An Observational Study of Detecting Patient Decompensation. *Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care,* 2018 Jun, Vol. 7, No. 1, pp. 112-16. Sage India: New Delhi, India: SAGE Publications*.*

24. **Patterson ES,** Dewart C, Stevenson K, Lustberg M, Hade E, Shah N, **Hebert C**. 2018. Using Cooperative Advocacy to Resolve Conflicts Between Functionally Distinct Groups: A Mixed Methods Approach to Tailoring Evidence-Based Guidance for Antibiotic Stewardship to One Medical System. *Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care*, 2018 June, Vol. 7, No. 1, pp. 224-31. Sage India: New Delhi, India: SAGE Publications.

25. Sarkhel R, Socha J, **Moffatt-Bruce S, Fernandez S,** Patel K, Nandi A, Mount-Campbell A, **Patterson ES**. 2018. How Nurses Identify Hospitalized Patients on Their Personal Notes: Findings From Analyzing "Brains" Headers With Multiple Raters. *Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care*, 2018 Jun, Vol. 7, No. 1, pp. 205-9. Sage India: New Delhi, India: SAGE Publications

26. **Patterson, ES.** 2018. Workarounds to Intended Use of Health Information Technology: A Narrative Review of the Human Factors Engineering Literature. *Hum Factors*. 60(3):281-92.

27. **Horwood, C. R., Moffatt-Bruce, S. D.**, **Fitzgerald, M., Rayo, M. F.** 2018. A qualitative analysis of clinical decompensation in the surgical patient: Perceptions of nurses and physicians. *Surgery*. doi: 10.1016/j.surg.2018.06.006

28. **McHaney-Lindstrom M, Hebert C, Flaherty J, Mangino JE, Moffatt-Bruce S, Dowling Root E**. 2019. Analysis of intra-hospital transfers and hospital-onset *Clostridium difficile* infection. *J Hosp Infect.* 102(2):168-9. doi: 10.1016/j.jhin.2018.08.016. PubMed PMID: 30172746. PMCID: PMC7321831

29. Duchemin, AM, Steinberg, B, **Moffatt-Bruce, S**, **Klatt, M.** 2018. Utilizing Mindfulness With Health-care Professionals to Improve Burnout, Self-compassion, and Patient Quality and Safety Measures: A Comparison of Cardiac Units. *Global Advances in Health and Medicine*. 7:139-40. (3397) doi: 10.1177/2164956118773837

30. **Edworthy J**, McNeer R, Bennett C, Dudaryk R, McDougall S, Schlesinger J, Bolton M, Edworthy, J, Vieira EO, Boyd A, Reid S, **Rayo MF**, Wright M, Osborn D. 2018. Getting Better Hospital Alarm Sounds into a Global Standard. *Ergonomics in Design*. 26(4):4-13. doi: 10.1177/1064804618763268

31. **Horwood CR, Moffatt-Bruce SD**, **Fitzgerald M, Rayo MF**. 2018. A Qualitative Analysis of Clinical Decompensation in the Surgical Patient: Perceptions of Nurses and Physicians. *Surgery* Dec;164(6):1311-15. doi: 10.1016/j.surg.2018.06.006. Epub 2018 Jul 27. PMID: 30061038.

32. **Hefner JL, Sieck CJ, McAlearney AS.** 2018. Training to Optimize Collaborative Use of an Inpatient Portal: A Case Report. *Applied Clinical Informatics.* Jul;9(3):558-64. doi: 10.1055/s-0038-1666993. Epub 2018 Jul 25. PMID: 30045386; PMCID: PMC6059853.

33. **Walker D, Hefner JL, Sieck CJ, Huerta T, McAlearney AS**. Framework for Evaluating and Implementing Inpatient Portals: A Multi-Stakeholder Perspective. *Journal of Medical Systems*. Jul 16;42(9):158. doi: 10.1007/s10916-018-1009-3. PubMed PMID: 30014267.

34. Knupp AM, **Patterson ES**, Ford JL, Zurmehly J, Patrick T. Associations Among Nurse Fatigue, Individual Nurse Factors, and Aspects of the Nursing Practice Environment. *J Nurs Adm*. 2018 Dec;48(12):642-8. doi: 10.1097/NNA.0000000000000693. PubMed PMID: 30431518.

35. **Fareed N, Walker D, Sieck CJ, Taylor R, Scarborough S, Huerta TR, McAlearney AS.** Inpatient portal clusters: identifying user groups based on portal features. *J Am Med Inform Assoc*. 2018 Nov 22. doi: 10.1093/jamia/ocy147. [Epub ahead of print] PubMed PMID: 30476122.

36. Sheffer J, Cvach M, **Edworthy JR, Patterson ES.** A Roundtable Discussion: Improving the 'Alarm Problem' Will Require Much More Than Just Reducing the Number of Alarms. *Biomed Instrum Technol.* 2018 Nov/Dec;52(6):454-61. doi:10.2345/0899-8205-52.6.454. PubMed PMID: 30479154.

37. **Sieck CJ, Hefner JL, McAlearney AS.** 2018. Improving the Patient Experience through Patient Portals: Insights from Experienced Portal Users. *Patient Experience Journal.* Vol. 5, Issue 3, Article 8. Available at: https://pxjournal.org/journal/vol5/iss3/8

38. Duchemin, AM, Steinberg, B , **Moffatt-Bruce, S, Klatt, M.** 2018.Utilizing Mindfulness With Health-care Professionals to Improve Burnout, Self-compassion, and Patient Quality and Safety Measures: A Comparison of Cardiac Units. *Global Advances in Health and Medicine*. 7:139-40. (3397) doi: 10.1177/2164956118773837.

39. **Mount-Campbell AF,** Evans KD, **Woods DD**, Chipps E, **Moffatt-Bruce SD, Patterson ES.** 2019. Value and usage of a workaround artifact: A cognitive work analysis of 'brains' use by hospital nurses. *Journal of Cognitive Engineering and Decision Making*. doi: 10.1177/1555343418825429

40. **McAlearney AS**, **Fareed N, Gaughan A, MacEwan S,** Volney J, **Sieck CJ.** 2019. Empowering Patients During Hospitalization: Perspectives on Inpatient Portal Use. *Applied Clinical Informatics.* 10:103-12.

41. **Sieck C, Walker DM,** Retchin S, **McAlearney AS.** 2019. Focusing on Capacity and Context: A New Approach to Understanding Patient Engagement. *NEJM Catalyst.* https://catalyst.nejm.org/patient-engagement-capacity-model/

42. **McAlearney AS, Sieck CJ, Gaughan A,** Fareed N, Volney J, **Huerta TR.** 2019. Patients' Perceptions of Portal Use Across Care Settings: Qualitative Study. *J Med Internet Res.* 21(6):e13126: 1-10. PMID: 31172960

43. **Huerta TR, Hefner JL, Sieck CJ,** Swoboda C, Taylor RD, **McAlearney AS**. 2019. Patient Engagement as Measured by Inpatient Portal Use. *J Med Internet Res.* Mar;21(3):e10957. PMCID: PMC6452277

44. **McAlearney AS,** Fareed N, **Gaughan A, Huerta TR.** 2019. Improving Acceptance of Inpatient Portals: Patients' and Care Team Members' Perspectives. *Telemedicine and E-Health*. May 13. doi: 10.1089/tmj.2019.0026. [Epub ahead of print] PMID: 31081723

45. **Patterson, ES, Hansen CJ**, Allen TT, Yang Q, **Moffatt-Bruce S**. 2019. Predicting mortality with applied machine learning: Can we get there? *Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care*, 2019 Sep, Vol. 8, No. 1, pp. 115-9. Sage CA: Los Angeles, CA: SAGE Publications.

46. **Melsop S, Rayo MF, Klatt M.** 2019. Working across Boundaries toward Patient Safety Using Design Thinking Methodologies for Transdisciplinary Team-of-Teams Collaboration*. The International Journal of Design Management and Professional Practice*. 13(3):1-12. doi: 10.18848/2325-162X/CGP

47. **Rayo MF, Patterson ES, Abdel-Rasoul M, Moffatt-Bruce SD.** 2019. Using timbre to improve performance of larger auditory alarm sets. *Ergonomics*. Dec;62(12):1617-29. doi: 10.1080/00140139.2019.1676473

48. **Yu SC, Lai, AM, Smyer J, Flaherty J, Mangino J, McAlearney AS, Yen PY, Moffatt-Bruce SD, Hebert CL.** 2019. Novel Visualization of Clostridium difficile Infections in Intensive Care Units. *Applied Clinical Informatics Open.* 03(02): e71-7. DOI: 10.1055/s-0039-1693651

49. **Walker DM, Hefner J, Huerta TR, McAlearney AS.** 2020. Exploring the Digital Divide: Age and Race Disparities in Use of an Inpatient Portal. *Telemedicine and E-Health.* May;26(5):603-13. doi:10.1089/tmj.2019.0065.

50. **Walker DM, Gaughan A,** Fareed N, **Moffatt-Bruce SD, McAlearney AS.** 2019. Facilitating Organizational Change to Accommodate an Inpatient Portal. *Applied Clinical Informatics.* Oct;10(5):898-908. doi: 10.1055/s-0039-1700867. Epub 2019 Nov 27.

51. **Hebert C, Root ED.** Repurposing Geographic Information Systems for Routine Hospital Infection Control. *Adv Health Care Manag.* 2019 Oct 24;18. doi: 10.1108/S1474-823120190000018003. PMID: 32077658.

52. **McHaney-Lindstrom M, Hebert C,** Miller H, **Moffatt-Bruce S, Root E.** 2019. Network analysis of intra-hospital transfers and hospital onset *Clostridium difficile* infection 2020 Mar; 37(1):26-34. *Health Info Libr J.* 10.1111/hir.12274. doi:10.1111/hir.12274 PMID: 31628725; PMCID: PMC7321830

53. **McAlearney AS, Walker DM, Gaughan AA, Moffatt-Bruce SD, Huerta TH.** 2020. Helping Patients Be Better Patients: Qualitative Study of Perceptions about Inpatient Portal Use. In press with: *Telemedicine and e-Health.* Jan 28. doi: 10.1089/tmj.2019.0198.

54. **Horwood CR, Moffatt-Bruce SD, Rayo MF.** 2019. Continuous Cardiac Monitoring Policy Implementation: Three-year Sustained Decrease of Hospital Resource Utilization. Oct 24;18. PMID: 32077648

55. **Vink S,** Fareed N, **MacEwan S, McAlearney AS**. 2019. An Exploration of the Association Between Inpatient Access to Tablets and Patient Satisfaction with Hospital Care. *Perspectives in Health Information Management.* 2019 Fall;16(Fall):1i. eCollection 2019 Fall.

56. Carter R, Rothwell C, **Sieck C, McAlearney AS.** 2019. Assessing Mental Models from Communications: Patient, Family, and Care Team Messaging within the Hospital. *Human Factors and Ergonomic Society Proceedings.* Nov 20;63(1).
doi: 10.1177/1071181319631440

57. **McAlearney AS, Gaughan A, MacEwan SR,** Fareed N, **Huerta TR.** Improving Acceptance of Inpatient Portals: Patients' and Care Team Members' Perspectives. *Telemedicine and e-Health*. 2020 Mar;26(3):310-26.

58. **McAlearney AS, Hefner J, MacEwan S, Gaughan A,** DePuccio D, **Walker DM,** Hogan CT, **Sieck CJ, Huerta TR.** 2020. Care Team Perspectives about an Inpatient Portal: Benefits and Challenges of Patients' Portal Use During Hospitalization. *Medical Care Research and Review*. doi: 10.1177/1077558720925296.

59. **Di Tosto G, McAlearney AS,** Fareed N, **Huerta TR.** 2020. Metrics for Outpatient Portal Use Based on Log File Analysis: Algorithm Development. *J Med Internet Res.* Jun 12;22(6):e16849. doi: 10.2196/16849. PMID: 32530435; PMCID: PMC7320309.

60. **Furniss S,** Rinehart-Thompson L, **MacEwan S,** Fareed N, Clutter J, **Huerta TR, Sieck CJ, McAlearney AS.** Characteristics of Patients Using a Patient Portal via Mobile Technology. *Perspectives in Health Information Management.* Winter 2020.

61. **Hefner JL, Sieck CJ, Walker DM.** Patient and physician perspectives on training to improve communication through secure messaging: Clarifying the rules of engagement. *Health Care Manage Rev.* 2020 May 5. doi: 10.1097/HMR.0000000000000279. [Epub ahead of print] PMID: 32379081.

62. **Patterson ES,** Papautsky EL, Krok-Schoen JL, Lee C, Park KU, White JR, **Moffatt-Bruce S,** Chirumamilla V, Lustberg M. Scheduling delayed treatment and surgeries post-pandemic: A stakeholder analysis. *Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care,* 2020 Sept 9(1):10-14. Los Angeles, CA: SAGE Publications.

63. Valvona SN, **Rayo MF, Abdel-Rasoul M,** Locke LJ, **Rizer MK, Moffatt-Bruce S, Patterson ES.** Comparative Effectiveness of Best Practice Alerts with Active and Passive Presentations: A Retrospective Study. *Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care,* 2020 Sept 9(1):105-9. Los Angeles, CA: SAGE Publications.

64. **Patterson ES**, McIntire A, Beecroft N, Happ MB, **Moffatt-Bruce SD**. Nursing Handovers in Critical Care: A Retrospective Analysis of Information Content and Function. *Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care,* 2019 Sep, Vol. 8, No. 1, pp. 4-8. Sage CA: Los Angeles, CA: SAGE Publications.

65. **MacEwan SR, Gaughan A, Hefner JL, McAlearney AS**. 2020. Identifying the Role of Inpatient Portals to Support Health Literacy: Perspectives from Patients and Care Team Members. *Patient Education and Counseling*. In press.

66. DePuccio M, **DiTosto G, Walker DM, McAlearney AS**. 2020. Patients' Perceptions about Medical Record Privacy and Security: Implications for Withholding of Information During the COVID-19 Pandemic. *Journal of General Internal Medicine*. In press.

Presentations:

1. **Moffatt-Bruce SD.** "Value-Based Care Transformation: What does it mean for Physicians?" Stanford Medicine Department of Medicine Clinical Excellence Retreat, Creating Pre-eminent Quality Care: Designing Our Future, Stanford, CA, Sept 25, 2015.

2. **Moffatt-Bruce SD.** "Healthcare Transformation: Engaging the Team." Second Annual IPE Symposium: Building Bridges to Interprofessional Health Care, College of Health Sciences and Professions, Heritage College of Osteopathic Medicine, Ohio University, Athens, Ohio, Oct 2, 2015.

3. **Moffatt-Bruce SD**, **Ward P.** "Engaging the Team to Improve Outcomes: Strategies from Within." AME Cincinnati 2015 Excellence Inside International Conference, Duke Energy Convention Center, Cincinnati, OH, Oct 22, 2015.

4. **Moffatt-Bruce SD**. "Healthcare Transformation: How do we engage and inform?" University of Pittsburgh Medical Center Grand Rounds, Pittsburgh, PA, Feb 17, 2016.

5. **Patterson ES.** "Addressing alarm overload with appropriate use of continuous cardiac monitoring." Health and Rehabilitation Sciences, The Ohio State University Wexner Medical Center, Columbus, OH, Feb 19, 2016.

6. Johnson K, **White S.** "Implementing Predictive Model for 30 Day Readmission." Ohio Health Information Management Association Annual Meeting, Columbus, OH, Mar 7, 2016.

7. **Moffatt-Bruce SD.** "Implementing and Evaluating Patient Reported Outcomes (PROs) & Aligning Cost and Quality." AAMC Research on Care Community (ROCC), Webinar, Columbus, OH, Mar 15, 2016.

8. **Moffatt-Bruce SD**. "Healthcare Transformation: How do we engage and inform?" University of Oxford Patient Safety Academy, Oxford, England, Mar 22, 2016.

9. **Klatt M.** "Mindfulness: Manage Stress and Improve Performance." Innovative Leaders Driving Thriving Organizations Webinar, May 3, 3016.
http://www.voiceamerica.com/promo/episode/91823

10. **Moffatt-Bruce SD.** "Simple Strategies for Safer Hospitals." Prime Institute of Public Health, Kuwait Teaching Hospital, Peshawar, Pakistan. Online Session, May 5, 2016.

11. **McAlearney AS, Huerta TR.** Invited Guests. Acute Care Patient Portals 2020 Workshop sponsored by the Moore Foundation Gordon and Betty Moore Foundation. Palo Alto, CA, Jun 6, 2016.

12. **Moffatt-Bruce SD, Huerta TR**. "From ideas to IDEA: The reality of research and the keys to making it work." St. Luke's University Health Network Research Day; Joint Nursing & Resident Scholarship Celebration, Bethlehem, PA, Jun 9, 2016.

13. **Sieck CJ,** Cross S, Parkison G, Parkinson C. "Improving the Patient Experience through Patient/Research Partnership." Institute for Patient and Family Centered Care Annual Conference, New York, NY, July 2016.

14. **Moffatt-Bruce SD.** "Engaging Healthcare Professionals in Operational Excellence." Association of Academic Health Centers, Senior Administrative, Fiscal Officers 2016 Annual Meeting, New York, NY, Jul 7, 2016.

15. **Moffatt-Bruce SD.** "Engaging Healthcare Professionals in Operational Excellence." Institute de Cardiologie, Cordoba, Argentina, Sept 20, 2016.

16. **Moffatt-Bruce SD**. Invited Lecture. "Healthcare Transformation: How do we engage and inform?" University of Pittsburgh Medical Center. Pittsburgh, PA, Sept 16, 2016.

17. **Rayo MR, Patterson ES.** "Usability in Health IT: Beyond Compliance to Meaningful Design and Assessment." Human Factors and Ergonomics Society (HFES) 2016 International Annual Meeting, Washington, DC, Sept 19, 2016.

18. **Rayo MR, Patterson ES.** "Promoting Patient Safety with Human Factors Methods: Practical Approaches to Current Medication Management Issues." Human Factors and Ergonomics Society (HFES) 2016 International Annual Meeting, Washington, DC, Sept 19, 2016.

19. **Nguyen M, Rayo M,** Eiferman D, **Moffatt-Bruce S.** "Evidence-based cardiac monitoring in surgical patients: Reducing alarm fatigue and improving resource allocation." American College of Surgeons Clinical Congress, Washington, DC, Oct 26, 2016.

20. **Klatt M.** "Mindfulness to Combat Stress." Society of Thoracic Surgeons, Houston, TX, Jan 21, 2017.

21. **Moffatt-Bruce SD.** "Improving Quality of Cardiothoracic Surgery on a National Scale: Moving from Data to Changes in Care." STS Annual Conference, Houston, TX, Jan 23, 2017.

22. **Patterson ES,** Anders S, **Moffatt-Bruce SD.** "Clustering and prioritizing patient safety issues during EHR implementation and upgrades in hospital settings." Human Factors in Healthcare International Symposium, New Orleans, LA. Mar 5, 2017. (*Jt Comm J Qual Patient Saf.* 2017 Aug;43(8):375-85. doi: 10.1016/j.jcjq.2017.02.009. Epub 2017 Jun 22)

23. **Moffatt-Bruce SD, Yamokowski T, Rayo MR.** "Clinical Alarms: How Do We Keep it Safe?" IDEA4PS Learning Laboratory Lecture, The Ohio State University Wexner Medical Center, Columbus, OH, Mar 16, 2016.

24. **Rayo MR.** "Alarms That Deserve Attention." Association for the Advancement of Medical Instrumentation (AAMI) Coalition Webinar, Mar 29, 2016.

25. **Patterson ES.** Panel Presenter. "How Nursing 'Brains' Annotations Support Verbal Handovers." Human Factors and Ergonomics Society Meeting, San Diego, CA, Apr 13, 2016.

26. **Patterson ES.** "Reducing Nurses' Information Foraging with 'At-A-Glance' Displays." The Ohio State University Healthcare Information and Management Systems Society webinar, May 31, 2016.

27. **Moffatt-Bruce SD.** "Public Reporting of Surgeon-Specific Data: Friend or Foe?" Western Thoracic Surgery Association (WTSA) 42nd Annual Meeting, Waikoloa, HI, Jun 24, 2016.

28. **Moffatt-Bruce SD**, **Hebert CL.** "Hotspotting: Keeping Patients Safe in Real Time." IDEA4PS Learning Laboratory Lecture; The Ohio State University Wexner Medical Center, Columbus, OH, Jun 29, 2016.

29. **Rayo MF**, Wears R, Fairbanks RJ, Perry S, Castro G. "Towards Proactive Safety Management: Adopting a Safety II Perspective." International Human Factors in Healthcare Symposium, New Orleans, LA. Mar 6, 2017.

30. **Moffatt-Bruce SD.** "Concentrating specialized surgical care-why (not) and how (not)?" Erasmus Master Class in Anesthesia and Perioperative Care, Rotterdam, Netherlands, Mar 31, 2017.

31. **Patterson ES.** Invited Presenter. "Supporting Nurses with Health Information Technology: Cognitive Functions of the Kardex and 'Brains' Artifacts." Advanced Interface Design Lab at the Department of Systems Design Engineering. Waterloo, Canada, Apr 10, 2017.

32. **Patterson ES.** "Increasing the Efficiency of Nursing Documentation While Avoiding Unsafe 'Copy Forward Workarounds.'" IDEA4PS Learning Laboratory Lecture; The Ohio State University Wexner Medical Center, Columbus, OH, Apr 26, 2017.

33. **McAlearney AS**. Invited lecture. "Lessons about Adoption of Healthcare Innovations." Redesigning Healthcare Organizations to Deploy New Knowledge from Data Science, Ann Arbor, MI, May 8, 2017.

34. **Moffatt-Bruce SD.** "Clinical Transformation: What does it mean for our patients?" Thomas Jefferson University Hospital, Philadelphia, PA, Jun 1, 2017.

35. **Walker DM, Hefner JL, Sieck CJ, Huerta TR, McAlearney AS**. "Framework for Evaluating Inpatient Portals: A Multi-Stakeholder Perspective." Academy of Management. Atlanta, GA, Aug 4, 2017.

36. **Moffatt-Bruce SD, Huerta TR, McAlearney AS.** "Patient Safety Learning Laboratory: Institute for the Design of Environments Aligned for Patient Safety (IDEA4PS)." Patient Safety Learning Labs In-Person Grantee Meeting, Rockville, MD, Sept 7, 2017.

37. **Moffatt-Bruce SD.** "Healthcare Transformation: How does it Impact Patient Safety?" Eastern Cardio-Thoracic Surgical Society Meeting, Amelia Island, FL, Oct 18-21, 2017.

38. **Moffatt-Bruce SD**, Lamendola J, **Rayo M.** "Alarms: An Institutional Update." Patient Safety IDEA4PS Learning Laboratory Lecture, The Ohio State University Wexner Medical Center, Columbus, OH, Oct 30, 2017.

39. **Yu S, Hebert C.** "Novel Visualization of *Clostridium difficile* Infections in Intensive Care Units." American Medical Informatics Association. Washington, DC, Nov 4, 2017.

40. **Furniss S,** Rinehart-Thompson L, **Sieck CJ, McAlearney AS, Huerta TR.** "Characteristics of Patients Using a Patient Portal via Mobile Technology." North American Primary Care Research Group. Montreal, Quebec, Nov 17, 2017.

41. **Sieck CJ, Hefner JL, Walker D, Huerta TR, McAlearney AS**. "The rules of engagement: perspectives on secure messaging from experienced ambulatory patient portal users." North American Primary Care Research Group. Montreal, Quebec, Nov 17, 2017.

42. **Klatt M.** "Mindfulness as a System Level Strategy: To Reduce Burnout and Promote Engagement." Clinical Leadership Development Institute, OSUMC, Columbus, OH. Nov 4, 2017.

43. **Klatt, M, Moffat-Bruce S.** "Building Resilience through Mindfulness: Can We Impact Patient Safety?" 2017 AAMC Integrating Quality and Safety Meeting, Chicago, IL.

44. **Klatt, M.** "Mindfulness to Combat Stress." Society of Thoracic Surgeons. Houston, TX, Jan 24, 2017.

45. Srinivasan R, Steinberg B, Duchemin A, **Klatt M.** Mindfulness and burnout prevention: The Impact Of A Mindfulness-Based Intervention On Burnout Factors In Healthcare Professionals. Association of Indian Physicians of Northern Ohio (AIPNO) Research Showcase, Cleveland, OH, 2017.

46. **Klatt M.** Plenary, Mindfulness and the Prevention of Burnout. 2017 Midwestern Fellows in Developmental-Behavioral Pediatrics. Nationwide Children's Hospital. Columbus, OH, 2017.

47. **Klatt M,** Steinberg B, **Moffat-Bruce S,** Duchemin AM. Transforming Patient Quality and Safety Measures through Mindfulness in Motion for Health Care Professionals (HCPs): A Comparison of Cardiac Units. International Conference to Promote Resilience, Empathy, and Well Being in the Health Professions: Centile 2017, Washington DC, 2017.

48. Steinberg B, Duchemin AM, **Klatt M.** Administrative Necessities for the Successful Implementation of Worksite Mindfulness Interventions in Academic Medical Centers." International Conference to Promote Resilience, Empathy, and Well Being in the Health Professions: Centile 2017, Washington DC, 2017.

49. **Klatt M.** Building a Culture of Wellness: An Interdisciplinary Panel Discussion With Q&A. OSUWMC, Columbus, OH, Mar 27, 2018.

50. **Klatt,M.** Presenter. Healthcare Transformation: Leadership and Resilience in an Era of Change. The Ohio State University Fisher College, Columbus, OH. 2018.

51. **Klatt M.** Presenter. MedEd First Friday – Wellness in Health Care Professionals, FAME, The Ohio State University College of Medicine, Columbus, OH, Feb 1, 2018.

52. **Klatt M.** Presenter. Wellness – Why Taking Care of Yourself should be Your #1 Priority, FAME Workshop. The Ohio State University College of Medicine. Columbus, OH. January 29, 2018.

53. **Rayo MF,** Pawar C, Sanders EB-N, Liston BW, **Patterson ES.** Deciding between diagnostic imaging alternatives: Participatory-toolkit cognitive task analysis for enhanced research and design insights. International Symposium on Human Factors and Ergonomics in Health Care, Boston, MA. Mar 26, 2018.

54. **Horwood CR, Rayo MF, Fitzgerald M,** Balkin EA, **Moffatt-Bruce SD**. Gaps Between Alarm Capabilities and Decision-making Needs: An Observational Study of Detecting Patient Decompensation. *Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care*. 2018 Jun, Vol. 7, No. 1, pp. 112-6. Sage India: New Delhi, India: SAGE Publications.

55. **Patterson ES**, Hritz C, Gebru L, **Patel K, Yamokoski T, Moffatt-Bruce SD**. Use Preferences for Continuous Cardiac and Respiratory Monitoring Systems in Hospitals: A Survey of Patients and Family Caregivers. *Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care.* 2018 Jun, Vol. 7, No. 1, pp. 123-8. Sage India: New Delhi, India: SAGE Publications.

56. **Sarkhel R, Socha J, Moffatt-Bruce SD, Fernandez S, Patel K, Nandi A,** Mount Campbell A, **Patterson ES.** How Nurses Identify Hospitalized Patients on Their Personal Notes: Findings From Analyzing "Brains" Headers With Multiple Raters. International Symposium on Human Factors and Ergonomics in Health Care, Boston, MA, Mar 26, 2018.

57. **Sieck C, McAlearney AS, Rizer, M**. Digital Inclusion, Health and Patient Engagement over the Lifecourse. Net Inclusion Annual Meeting, Cleveland, OH, Apr 18, 2018.

58. **Klatt MD**, Steinberg B, **Moffatt-Bruce S**, Duchemin, AM. Premier Poster Presentation. Utilizing Mindfulness with Health Care Professionals (HCPs) to Improve Burnout, Self-Compassion, and Patient Quality and Safety Measures: A Comparison of Cardiac Units. International Congress on Integrative Medicine and Health, Baltimore, MD, May 8, 2018.

59. **Huerta TR, Walker DM, McAlearney AS.** The Use, Usability, and Experience of Implementing a Systemwide Inpatient Portal. American Medical Informatics Association Annual Meeting, Phoenix, AZ, May 10, 2018.

60. **Sieck C, Hefner JL, Walker D, Huerta TR,** McAlearney AS. Development of a Taxonomy of Secure Messages Sent via an Inpatient Portal. American Medical Informatics Association Annual Meeting, Phoenix, AZ, May 10, 2018.

61. **Root E, McHaney-Lindstrom M, Hebert C.** Creating a Hospital GIS to Evaluate the Association of Room Characteristics with Risk of Hospital-Onset *Clostridium Difficile* Acquisition. AcademyHealth Annual Research Meeting, Seattle, WA, Jun 24, 2018.

62. **McAlearney AS, Sieck CJ, Gaughan AA,** Volney J, Fareed N. Patient Portal Use across the Continuum of Care. North American Primary Care Research Group, Chicago, IL, Nov 9, 2018.

63. **Sieck C**, Budzik K, Huber T, Volney J. Understanding Patient Engagement and Communication Across the Care Continuum. North American Primary Care Research Group, Chicago, IL, Nov 9, 2018.

64. **Hefner J, Sieck C,** Volney J. Developing Training on Patient Portal "Rules of Engagement" for Patients With Chronic Cardiopulmonary Conditions and Their Primary Care Providers. North American Primary Care Research Group, Chicago, IL, Nov 9, 2018.

65. Fareed N, **Huerta T, McAlearney AS.** Inpatient Portals: Identifying User Groups. Epic User Group Meeting, Verona, WI, Aug 28, 2018.

66. **McAlearney AS,** Fareed N. Implications of Secure Messaging for Patient Care. Epic UGM Conference, Verrona, WI, Aug 28, 2018.

67. **McAlearney AS.** Translating Research to Practice. 1st Lean Summit Salud – Creando Lideres Lean, Cordoba, Argentina, Oct 5, 2018.

68. **Moffatt-Bruce SD.** Leveraging the Learning Healthcare System. 1st Lean Summit Salud – Creando Lideres Lean, Cordoba, Argentina, Oct 5, 2018.

69. Fareed N, **Huerta T, McAlearney AS.** Inpatient Portals: Identifying User Groups. Academy Health Dissemination and Implementation Conference, Washington, DC, Dec 3, 2018.

70. **McAlearney AS, Sieck C, Gaughan A,** Fareed N, Volney, J, **Huerta T.** Patients' Perceptions of Portal Use Across the Continuum: Opportunities for Improved Convenience, Information Access, and Engagement. Academy Health Dissemination and Implementation Conference, Washington, DC, Dec 3, 2018.

71. **Rayo MF, Fitzgerald M,** Mansour L, **Patterson ES, Moffatt-Bruce SD.** The final mile – why aren't people implementing our sounds? Human Factors in Healthcare Symposium, Chicago, IL, Mar 24, 2019.

72. **Rayo MF,** Won J, Parker SH, Weinger M, Fairbanks RH. Building Human Factors Capabilities Within a Hospital System: Lessons Learned. Human Factors in Healthcare Symposium, Chicago, IL, Mar 24, 2019.

73. **Horwood CR, Fitzgerald M, Moffatt-Bruce SD, Rayo MF.** Methods for utilizing multidisciplinary team to create novel visual alarm designs that improve recognition of patient decompensation and alarm response. Human Factors in Healthcare Symposium, Chicago, IL, Mar 24, 2019.

74. **Fitzgerald M, Rayo MF, Abdel-Rasoul M, Moffatt-Bruce SD.** The Importance of Testing Sets of Clinical Alarm Sounds to Provide Real-World HFE Impact. Human Factors in Healthcare Symposium, Chicago, IL, Mar 24, 2019.

75. Reynolds ME, **Rayo MF, Fitzgerald M, Abdel-Rasoul M, Moffatt-Bruce SD.** Custom Alarm Design: You Don't Have to "Crank it up to 11." Human Factors in Healthcare Symposium, Chicago, IL, Mar 24, 2018.

76. **Patterson ES,** McIntire A, Beecroft N, Happ MB, **Moffatt-Bruce SD.** Nursing Handovers in Critical Care: A Retrospective Analysis of Information Content and Function. Human Factors in Healthcare Symposium, Chicago, IL, Mar 24, 2019.

77. **Patterson ES, Hritz C, Moffatt-Bruce SD.** Reducing alert fatigue for comfort care and palliative care hospital patients. *Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care*. 2019 Sep, Vol. 8, No. 1, pp. 1-3. Sage CA: Los Angeles, CA: SAGE Publications.

78. **Di Tosto G,** Fareed N, **Huerta TR McAlearney AS, Walker DM.** Outpatient Health Portal Usage: Analysis of Functions and Comprehensiveness of Engagement**.** American Medical Informatics Association Clinical Informatics Conference, Atlanta, GA, Apr 30, 2019.

79. **McAlearney AS, Walker DM,** Fareed N, **Huerta TR.** Translating Research into Practice: Evidence from a System-Wide Implementation of an Inpatient Portal. American Medical Informatics Association Clinical Informatics Conference, Atlanta, GA, Apr 30, 2019.

80. Rothwell CD, **Sieck CJ,** Fareed N, **McAlearney AS**. Challenges in Analyzing Inpatient Secure Message Logs. American Medical Informatics Association Clinical Informatics Conference, Atlanta, GA, Apr 30, 2019.

81. **Walker DM, Hefner J, Huerta TR, McAlearney AS.** Age and Race Disparities in Use of an Inpatient Portal: Exploring the Digital Divide." AcademyHealth Annual Research Meeting, Washington, DC, Jun 2, 2019.

82. **Hansen CJ,** Allen TT, Bitan Y, **Patterson ES**. Algorithmic Transparency for Predicting In-Hospital Mortality: A Targeted Literature Review. In Press, June 2019, Proceedings of the 14th International Naturalistic Decision Making Conference, San Francisco, CA.

83. **McAlearney AS, Gaughan AA, MacEwan S,** Fareed N, **Huerta TR.** Improving Acceptance of Inpatient Portals: Patients' and Care Team Members' Perspectives. Academy of Management, Boston, MA, Aug 13, 2019.

84. **McAlearney AS, Hefner J, Walker DM,** Hogan CT, Fareed N, **Gaughan A, MacEwan S, Sieck S, Huerta T.** Care Team Experience with Inpatient Portal Use During Patients' Hospitalization: Benefits and Challenges of Portal Use. Academy of Management Annual Conference, Boston, MA, Aug 13, 2019.

85. Carter R, Rothwell C, **Sieck C, McAlearney AS.** Assessing Mental Models from Communications: Patient, Family, and Care Team Messaging within the Hospital. Human Factors and Ergonomic Society Annual Conference, Seattle, WA, Oct 28, 2019.

86. **Patterson ES.** The Complexity of Comparatively Prioritizing Patients with Treatment Delays While Conserving Critical Resources and Protecting Staff During a Pandemic: A Stakeholder Analysis. 2020 International Symposium on Human Factors and Ergonomics in Healthcare (online due to 2020 Coronavirus pandemic)*,* May 19, 2020. Virtual Health Care Symposium.

87. **Moffatt-Bruce SD.** Prioritizing elective surgeries after the COVID-19 shutdown: A surgical, medical administrator, and medical educator' perspective. Human Factors in Healthcare Symposium, May 19, 2020. Virtual Health Care Symposium.

88. **Rayo MF, Fitzgerald M,** Gifford RC, Morey DA, Reynolds ME, D'Annolfo K, Jefferies CM. Extending system performance past the boundaries of predictive algorithms: evaluating graceful extensibility in human-machine teams. 2020 International Symposium on Human Factors and Ergonomics in Healthcare (online due to 2020 Coronavirus pandemic), May 20, 2020.

89. Reynolds ME, Morey DA, **Rayo MF**. Dispositioning machine answers: How data representation affects corroboration and reframing in human and machine teams. 2020 International

Symposium on Human Factors and Ergonomics in Healthcare (online due to 2020 Coronavirus pandemic), May 21, 2020.