AHRQ-Funded Patient Safety Project Highlights

Improving Healthcare Safety by Supporting Healthcare Workforce, Working Conditions, and Other Environmental Factors

Overview

Healthcare professionals are highly educated and committed to delivering the best care possible, yet they often face challenges from complex systems and environments that can impact patient safety. Improving workflow, ergonomics, resources, and device design can create more supportive work environments that enhance provider well-being and reduce the risk of medical errors, ultimately leading to better patient outcomes. From 2000 through 2024, AHRQ supported 69 patient safety projects related to healthcare workforce, working conditions, and other environmental factors. This publication summarizes AHRQ's investments in this pathway toward safer care, including examples of project findings and products, collective outputs, and impacts of this work. Details about each AHRQ-supported project are available in the Appendix.

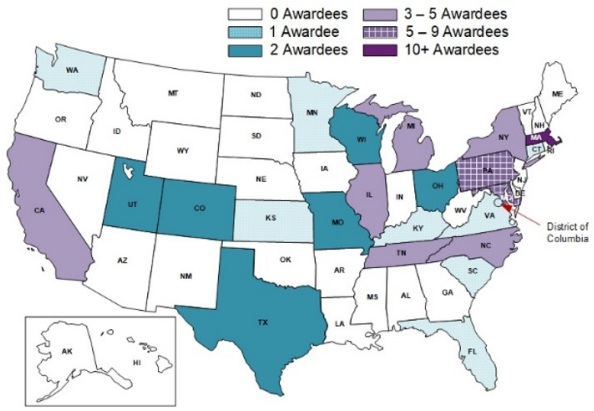
Scope of AHRQ Investments

69 projects*

449 publications*

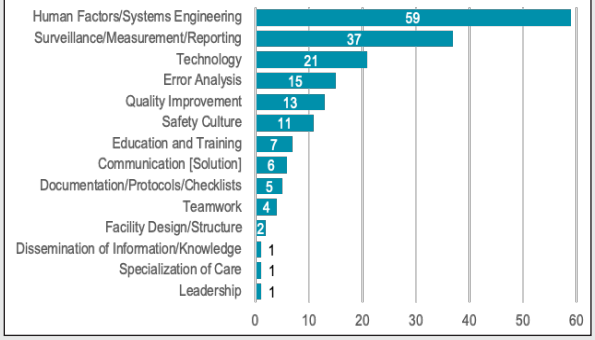
46,309 citations*

Geographical Distribution of Funding

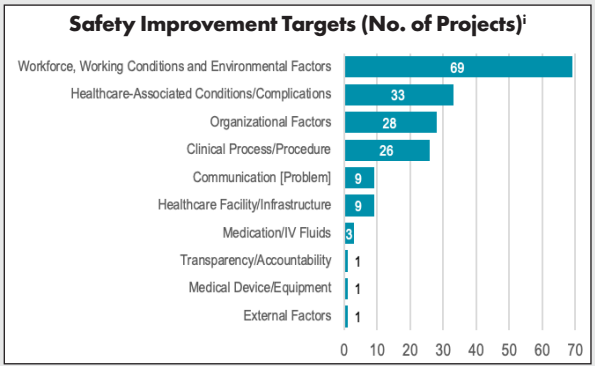


*as of January 20, 2025

Approaches to Improving Safety (No. of Projects)[i]



Safety Improvement Targets (No. of Projects)[i]



[i] The total number of projects is greater than 69, as some projects used more than one approach to improving safety and/or had more than one safety target.

Agency for Healthcare Research and Quality
PATIENT SAFETY

As of January 2025, AHRQ funded 69 workforce and environmental factors projects, resulting in 449 publications that have been collectively cited in other studies 46,309 times. Institutions in Massachusetts (n=14, 20%) were awarded the most projects, followed by Pennsylvania (n=9, 13%) and Maryland (n=7, 10%). Among the 69 projects, the most common primary approach category used to improve workforce and environmental factors was human factors and systems engineering (n=59, 86%), followed by surveillance, measurement, and/or reporting (n=37, 54%). The top two patient safety areas targeted for improvement in these projects were workforce, working conditions, and other environmental factors (n=69, 100%) and healthcare-associated conditions/complications (n=33, 48%).

Examples of Project Findings

Most projects included in this collection of work explore the workforce, working conditions and other environmental factors that contribute to errors. These projects typically focus on interactions between people, technology, and work environments that negatively impact patient safety. The most common topics are provider fatigue and sleep deprivation, workplace and personal stress, workload and staffing, and the impact of different management styles and organizational cultures. Examples of these projects and summaries of their results are described below and organized by research themes identified in this collection of work.

Measuring Workforce Stress and Fatigue

AHRQ funded several projects that focused on the measurement of stress, fatigue, and sleep deprivation among healthcare workers. For example:

- One project was first to document that most hospital nurses rarely leave work immediately after their 12-hour shifts, which is associated with reduced sleep, difficulty staying awake at work, and more errors.
- Another project found that patient safety risks resulting from nurses' cognitive effectiveness increases from "low" to "elevated" risk after 8 hours of work and increases further from "elevated" to "high" risk after 10 hours of work.
- One project developed a mathematical "risk index" for healthcare provider work schedules and used the Institute of Medicine's recommendations to design safer scheduling alternatives.
- Another project examined middle cerebral artery blood flow velocity profiles to differentiate between novices and experts on performance of a laparoscopic training task.

Managing Provider Workload and Staffing

Some of the projects in this collection of work investigated the effects of provider workload and staffing on the quality of patient care. For example:

- One project found that California legislation mandating minimum nurse-to-patient ratios in hospitals was significantly associated with lower surgical mortality and failure to rescue rates.
- Another project assessed remote cardiac telemetry technicians and nurses and found that increasing patient load adversely impacted detection of patient events (e.g., ventricular fibrillation).
- One project explored the feasibility and benefits of using queueing models to inform nurse staffing and found that 6 to 9 nurses are needed, depending on the time of day and the day of the week, to meet specified targets for reducing care delays.
- Another project found that extended-duration work shifts for resident physicians significantly impair their performance and patient safety, contributing to research on ideal duty hour limits.

Improving Workforce Well-being and Safety Culture

Examples of projects using cultural approaches to improve workforce well-being and the quality of patient care across healthcare settings include:

- An evaluation of emergency department (ED) operational and quality management characteristics to identify and implement generalizable process improvements to enhance quality and safety in EDs
- Identification of strategies to reduce moral distress and increase ethical confidence and well-being among nurses to improve the safety cultures in which they work
- Using safety culture approaches to identify factors influencing the timeliness and effectiveness of ED care and implement interventions to improve ED care quality
- Using organizational culture and care coordination to examine the effect of changes in nurse working environments on patient outcomes and nurse retention

Impacts

AHRQ-funded workforce and environmental factors projects have aimed to create more supportive work environments that enhance provider well-being, reduce medical errors, and improve patient outcomes. Collectively, the 69 AHRQ-funded projects have resulted in:

- New knowledge about how workforce and environmental factors contribute to patient safety using qualitative and quantitative research methods, and modeling techniques
- The development, implementation, and/or evaluation of tools, toolkits, quality improvement measures, policies/guidelines, education and training programs, and other interventions to enhance patient safety
- Identification of research gaps and areas for continued investigation in the field of workforce and environmental factors
- The synthesis and dissemination of research findings via publications and conferences

The developed resources and project results of this body of AHRQ-funded work have helped:

- Improve a wide range of issues faced by health professionals (e.g., fatigue, sleep deprivation, workplace/personal stress, capacity, workload).
- Create more supportive work environments (e.g., improved scheduling patterns, safety cultures, ergonomic workspace configurations).
- Advance relevant technological innovations (e.g., electronic prescribing, monitoring, screening, decision support, simulation software).
- Improve provider outcomes (e.g., job satisfaction, skills development, cognitive workload).
- Improve patient outcomes (e.g., postoperative health and survival, perceived quality of care).

To learn more about each of the projects included in this synthesis, view the companion Appendix that follows.

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Appendix

Healthcare Workforce, Working Conditions, and Other Environmental Factors Project Summary

This appendix briefly describes AHRQ-funded projects related to healthcare workforce, working conditions, and other environmental factors. Projects are organized alphabetically by state, then by original date of funding. Each description includes key findings and/or results as reported in available final reports and/or companion publications, and in some cases is taken verbatim from the source (e.g., journal abstracts, journal articles). To learn more about a grant listed below, go to NIH RePORTER, and enter the grant's project number (e.g., R18HS012345).

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
CALIFORNIA		
Timothy Dresselhaus **Veterans Medical Research Foundation** San Diego, California	UC1 HS014283 [Grant] **Real-Time Assessment of Risk Factors-Medication Errors** 2003–2005 $449,536 Final Report	**Purpose:** Use rigorous assessment tools to examine the risk factors for potential adverse drug events in the inpatient medical settings of four teaching hospitals, specifically examining the relationship between medication errors and extrinsic (clinical environment) and intrinsic (clinician) factors among practicing physicians and nurses. **Key Findings/Impacts:** According to the final report, medication events were associated with 36.1% higher perceived workload ($p<.05$), 38.6% higher inpatient caseloads ($p<.01$), and 55.9% higher emotional stress scores ($p<.01$). There was a trend for reported events to also be associated with less sleep ($p=.10$). **Publications:** 6
Amy Kaji **Los Angeles Biomedical Research Institute at Harbor-UCLA Medical Center (LA BIOMED)** Los Angeles, California	F32 HS013985 [Grant] **Hospital Disaster Plans: Structure, Training, and Function** 2004 $57,954	**Purpose:** Demonstrate associations among structural characteristics of disaster plans, implementation methods, and the effectiveness of the disaster response. **Key Findings/Impacts:** A final report was not available; however, a publication resulting from this grant found that three evaluation methods used to measure each of six hospitals' level of disaster preparedness demonstrated qualitatively different results. Investigators concluded that the difference in scores among the hospitals could mean there is no single method that adequately characterizes overall hospital preparedness. Two additional publications addressed disaster education for medical students. These publications resulted in the development of a comprehensive 2-week medical student disaster elective, based upon an introductory disaster seminar, which was rated highly by student participants. **Publications:** 6

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
Rita Secola **University of California, Los Angeles** Los Angeles, California	R36 HS019103 [Grant] **Central Venous Catheter (CVC)-Related Bloodstream Infections in Pediatric Cancer** 2010–2011 $39,170 Final Report	**Purpose:** Conduct an experimental study that implements a team of specialty nurses, rather than the assigned bedside nurses, to provide evidence-based CVC care to pediatric oncology patients and determine its effectiveness in reducing these types of infections in pediatric cancer patients with a CVC. **Key Findings/Impacts:** Investigators concluded in their final report that preliminary results demonstrated the feasibility of implementing a CVC registered nurse (RN) team for CVC blood draw procedures in pediatric oncology patients. The results of this pilot study from both units suggest in part that essential CVC blood stream infection (BSI) prevention interventions should include targeted CVC nursing education, ongoing and active staff nurse participation in CVC BSI prevention research, and implementation of a CVC care bundle checklist. Furthermore, a larger cohort in a multisite study will be required in the future to determine the effectiveness of a CVC RN team intervention in reducing BSIs and to determine if risk factors are significantly associated with the development of CVC-related BSIs in pediatric oncology patients. **Publications:** 3
Audrey Lyndon **University of California San Francisco** San Francisco, California	R01 HS025715 [Grant] **Looking at Birth Outcomes and Their Relationship to Registered Nurse Staffing** 2017–2020 $1,125,210	**Purpose:** Determine (1) relationships among nurse staffing, missed nursing care during labor and birth, and patient outcomes; and (2) whether variations in nurse staffing and missed nursing care may contribute to health disparities in maternal and infant outcomes. **Key Findings/Impacts:** According to the final report, a study involving 3,676 nurses from 273 hospitals across 34 states examined the relationship between nurse staffing, missed care, and perinatal quality measures. The research found that hospital characteristics influenced nurse-reported staffing, and adequate staffing was positively associated with exclusive breast milk feeding rates. The study highlighted that system-driven missed nursing care can contribute to preventable maternal morbidity and mortality. Findings from this research informed the 2022 Association of Women's Health, Obstetric, and Neonatal Nurses (AWHONN) Standards for Professional Registered Nurse Staffing for Perinatal Units, which maintained the nurse-to-patient ratios recommended in 2010. The study emphasizes the importance of adequate resources and staffing in providing essential care during childbirth, a critical period affecting maternal, infant, and family health. **Publications:** 8
COLORADO		
Marion Sills **University of Colorado, Denver** Denver Colorado	R03 HS016418 [Grant] **Emergency Department Overcrowding and Quality of Acute Asthma Care for Children** 2007–2010 $99,968 Final Report	**Purpose:** Examine the association between emergency department (ED) overcrowding and quality of care in a pediatric population, using asthma as the disease model. **Key Findings/Impacts:** Investigators stated in the final report that this was the first study to explore the link between crowding measures and the quality of emergency care for children. Their analysis comparing crowding measures showed that the most influential factors affecting quality were hospital-wide metrics (total ED patient-care hours) and incoming patient volume—not measures of provider throughput. This demonstrates that ED crowding arises from multiple systemic issues that cannot be resolved simply by expecting providers to work more efficiently. Their analysis of crowding and three dimensions of quality of ED care for children with acute asthma found that both timeliness and effectiveness of care were inversely associated with crowding, and that equity of care was not associated with crowding. **Publications:** 12

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
Mustafa Ozkaynak **University of Colorado Denver** Denver, Colorado	R18 HS030071 [Grant] **Implementing Decision Support for Long-Term Care** 2024–2027 $449,999	**Purpose:** Enhance the quality and safety of care for people living with dementia in long-term care (LTC) facilities by implementing and evaluating decision-support technologies tailored to specific LTC contexts and workflows. **Key Findings/Impacts:** This project is ongoing until Aug. 31, 2027, and the final report and/or publications are not yet available. **Publications:** 0
CONNECTICUT		
Leigh Evans **Yale University** New Haven, Connecticut	R01 HS028340 [Grant] **Improving Patient and Clinician Safety During COVID-19 Through a Rapidly Adaptive Simulation Intervention** 2020–2022 $999,988 Final Report	**Purpose:** Develop and test the COVID-19 Responsive Intervention: Systems Improvement Simulations (CRI:SIS), a simulation-based training and quality improvement intervention to minimize physician stress and improve system responsiveness. **Key Findings/Impacts:** According to the final report, researchers demonstrated the effectiveness of a rapidly adaptive simulation intervention (CRI:SIS) in improving emergency clinician preparedness and reducing stress during the COVID-19 pandemic. Through qualitative interviews with 27 frontline workers, the research team identified key stressors affecting healthcare providers, including external factors beyond the hospital environment and disruptions to resident education and social support systems. The randomized controlled trial involving 81 physicians revealed that participants who received the simulation-based preparedness intervention experienced significantly reduced physiological stress, as measured by heart rate variability, during clinical shifts compared with the control group. The team also successfully implemented a simulation-based process improvement strategy that helped clarify new clinical workflows, identify logistical challenges, and improve perceptions of a new emergency care space. Additionally, the researchers developed Heart Rate Variability Experimental Sensor Toolkit (HRVEST), an innovative algorithm for processing large volumes of wearable biometric data, which may facilitate future real-time stress monitoring and intervention for clinicians. **Publications:** 13
DISTRICT OF COLUMBIA		
Melissa McCarthy **The George Washington University** Washington, DC	K01 HS017957 [Grant] **The Quality of Emergency Care and Relationship to Patient-Reported Outcomes** 2009–2014 $755,636	**Purpose:** Assess the quality of ED care by identifying factors that influence patient safety, timeliness, effectiveness, and efficiency of ED care; and implement and evaluate promising interventions to improve the quality of ED care. **Key Findings/Impacts:** A final report was not available; however, several articles funded by this project yielded significant findings. One publication revealed that patient satisfaction with overall care was influenced by waiting room time and the clinicians who treated them, rather than service completion time estimates provided at triage. Another study found that diagnostic testing at triage substantially reduced ED treatment time for common complaints. Research also highlighted the challenges of measuring ED crowding due to its variability, suggesting that ED census at arrival could be a useful metric. Lastly, a study examining service completion times across academic EDs found significant variations and proposed quantile regression as an effective method for estimating service completion experiences. These findings collectively emphasize the importance of accurately modeling ED service times to identify barriers to patient flow and improve care timeliness. **Publications:** 10

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
FLORIDA		
Gabriel Picone **University of Southern Florida** Tampa, Florida	R03 HS013386 [Grant] **Hospital Volume and Quality of Care** 2003–2005 $100,000 Final Report	**Purpose:** (1) Obtain unbiased estimates of the effect of hospital volume on health outcomes, and (2) analyze potential explanations for this causal relationship. **Key Findings/Impacts:** Investigators state in the final report that hospital volume is positively correlated with all their measures of quality of care for urban patients. The effect of hospital volume decreases substantially once controlled for hospital characteristics, such as the number of beds and binary variables for cardiac surgery, teaching status, and ownership status. Controlling for endogenous selective referrals does not affect hospital volume. For rural patients, they found a much weaker relation between volume and outcomes. **Publications:** 4
ILLINOIS		
Rahul Khare **Northwestern University** Chicago, Illinois	K08 HS019005 [Grant] **Improving Emergency Department Quality and Safety by Enhancing Operations and Quality Management** 2010–2015 $708,579 Final Report	**Purpose:** Evaluate specific ED operational and quality management characteristics and identify and implement generalizable process improvements to enhance quality and safety in EDs. **Key Findings/Impacts:** The final report indicated that hospitals in the top two quartiles for time-to-percutaneous coronary intervention (PCI) quality measures had significantly lower acute myocardial infarction mortality rates compared to lower-performing hospitals. A risk assessment at two hospitals identified 51 failure points in the door-to-balloon process, with 58% of high-risk failures occurring between ECG and catheterization laboratory activation. The study revealed potential areas for improvement to reduce door-to-balloon time from 90 to 60 minutes. Notably, median door-to-balloon times were significantly shorter during regular working hours (55 minutes) compared to off-hours (77 minutes), highlighting the need for consistent performance across all time periods. **Publications:** 6
Janet Stifter **University of Illinois Chicago** Chicago, Illinois	R36 HS023072 [Grant] **Using an Electronic Health Record to Examine Nurse Continuity and Pressure Ulcers** 2014–2015 $40,192 Final Report	**Purpose:** Examine the influence of nurse continuity on the prevention of hospital-acquired pressure ulcers (HAPUs). **Key Findings/Impacts:** In the final report, investigators reported poor nurse continuity (unit mean continuity index=.21-.42 [1.0=optimal continuity]) on all nine study units. Nutrition, mobility, perfusion, hydration, and skin problems on admission, as well as patient age, were associated with HAPU development ($p<.001$). Controlling for patient characteristics, nurse continuity and the interactions between nurse continuity and other nurse-staffing variables were not significantly associated with HAPU development. Investigators concluded they demonstrated a high level of variation in the degree of continuity between patient episodes in the Hands-on Automated Nursing Data System (HANDS) data, showing that it offers rich potential for future study of nurse continuity and its effect on patient outcomes. **Publications:** 6

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
KANSAS		
Shin Hye Park **University of Kansas Medical Center** Kansas City, Kansas	R01 HS026134 [Grant] **Effects of Patient Turnover on Nursing Care and Patient Outcomes in Acute Care Hospital Settings** 2019–2023 $604,862 Final Report	**Purpose:** Determine the effects of patient turnover on nursing care and patient outcomes in acute care. **Key Findings/Impacts:** The final report revealed significant variations in patient turnover based on hospital and unit characteristics, with hospital size, safety-net status, and unit type having the most substantial impact. Investigators performed data analyses using national samples, including 1,940 hospitals used for hospital-level analyses and 694 units in 107 hospitals used for unit-level analyses. Units with high patient turnover exhibited poorer work conditions and more nurses reporting extra work hours. Interestingly, higher patient turnover rates in hospitals were associated with better patient and nurse outcomes, as well as improved practice environments. The study found that hospitals and units with high patient turnover required more registered nurses (RNs), and higher RN staffing correlated with improved job satisfaction and perceived quality of care. These findings are crucial as nurses play a vital role in providing safe and high-quality care, even in high-turnover environments. While concerns about the negative effects of high patient turnover exist, this area has been understudied in hospital inpatient settings. As the first known study of its kind, this research provides valuable insights into patient turnover in hospital inpatient settings, helping to identify gaps in nursing care delivery, practice environment, and resource allocation. The findings underscore the importance of RNs in high-turnover environments and their role in improving patient satisfaction, job satisfaction, and overall quality of care. **Publications:** 0
KENTUCKY		
Wei Li **University of Kentucky** Lexington, Kentucky	R03 HS024633 [Grant] **Systematic Evaluation of Operating Room Scheduling Across the Perioperative Process** 2016–2018 $99,999 Final Report	**Purpose:** Examine the root causes of stagnant patient and information flows for surgery services in three hospitals at University of Kentucky (UK) HealthCare, and the performance inconsistencies in the peri-op process. Solutions to OR management generated by this project are efficient at the unit level and effective at the hospital level, which is critical to improve the efficiency of surgery service. **Key Findings/Impacts:** According to the final report, researchers found that tradeoff balancing (e.g., OR utilization, patient flow time) is essential for OR scheduling across the three-stage perioperative process. The research findings of this project can be used for operations management to allocate resources into each stage across the serial process, and to set up performance goals and specification limits in different time phases. Three factors affect tradeoff balancing for systematic evaluation in OR scheduling. The first one is different capacities of internal processes, such as surgeons' skills, nurses' experience, and the number of available resources. The second one is different properties of external demands, such as the number of cases, types of surgeries, the emergency levels of cases, and case cancellations or no-shows. And the third one is OR managers' preference variations in balancing tradeoffs. Taking all three of these factors into operations management, the investigators stated that modeling a steady state of tradeoff balancing will be their next research topic. **Publications:** 9

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
MARYLAND		
CMS Baltimore, Maryland	04-489MO-04 [Contract] **Collaborative Evaluation of Paid Home Feeding Assistants in State Programs** 2004 $158,000	**Purpose:** Evaluate the federal paid feeding assistants (PFA) regulation that allows nursing homes to hire single task workers to provide feeding assistance to nursing home residents. The PFA regulation was designed to increase the number of staff available to aid with eating and improve nutritional care process quality. **Key Findings/Impacts:** While six states and DC hadn't implemented the fFederal PFA rule, most stakeholders strongly supported it. PFA programs often exceed federal requirements, with PFAs spending more time assisting residents than certified nursing assistants (CNAs). Both PFAs and CNAs performed similarly, though both occasionally neglected offering alternatives when residents ate less than half their meal. The report suggests that further CMS and AHRQ-backed research could provide valuable insights on the impact of mealtime assistance on residents' oral intake and guide PFA program implementation in facilities. **Publications:** 0
CMS Baltimore, Maryland	05-489MO-04 [Contract] **Evaluation of Paid Nursing Home Feeding Assistants in State Programs** 2005 $142,000	**Purpose:** Evaluate the federal PFA regulation that allows nursing homes to hire single task workers to provide feeding assistance to nursing home residents. The PFA regulation was designed to increase the number of staff available to aid with eating and improve nutritional care process quality. **Key Findings/Impacts:** See key findings/impacts for 04-489MO-04 above. **Publications:** 0
CMS Baltimore, Maryland	06-489MO-04 [Contract] **Evaluation of Paid Nursing Home Feeding Assistants in State Programs** 2006 $158,000	**Purpose:** Evaluate the federal PFA regulation that allows nursing homes to hire single task workers to provide feeding assistance to nursing home residents. The PFA regulation was designed to increase the number of staff available to aid with eating and improve nutritional care process quality. **Key Findings/Impacts:** See key findings/impacts for 04-489MO-04 above. **Publications:** 0
CMS Baltimore, Maryland	07-489MO-04 [Contract] **Evaluation of Paid Nursing Home Feeding Assistants in State Programs** 2007 $35,000	**Purpose:** Evaluate the federal PFA regulation that allows nursing homes to hire single task workers to provide feeding assistance to nursing home residents. The PFA regulation was designed to increase the number of staff available to aid with eating and improve nutritional care process quality. **Key Findings/Impacts:** See key findings/impacts for 04-489MO-04 above. **Publications:** 0

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
Raj Ratwani **Medstar Health Research Institute** Hyattsville, Maryland	R03 HS022362 [Grant] **Developing and Training Interruption Management Strategies for Emergency Physicians** 2013–2014 $99,868 Final Report	**Purpose:** Develop a set of cognitive strategies for emergency physicians by developing new simulation-based training modules to mitigate the disruptiveness of interruptions in the ED. **Key Findings/Impacts:** According to the final report, physicians were interrupted 12.7 times per hour and the most frequent source of interruptions was nurses and other attending physicians or residents. The most common physician tasks interrupted were computer-based tasks. Physicians rarely used strategies to delay or reject interruptions; these strategies were documented as being used less than 3% of the time. A newly developed interruption decision framework is presented that looks at the priority of the primary task and the interrupting task to guide how physicians might respond to interruptions. Specific cognitive strategies for handling interruptions were also developed. The significance of this research is that it demonstrates a high rate of interruptions to emergency physician workflow, primarily driven by nurses and other physicians and residents. Interruptions have been associated with increased rates of error and given that many of the interruptions occurred while the physician was working at the computer—which is the primary method for ordering medications, labs, and diagnostic tests—there is risk for error on these critical tasks. **Publications:** 4
Kathryn Kellogg **MedStar Health Research Institute** Hyattsville, Maryland	R03 HS024801 [Grant] **Identifying Stress-Associated Factors to Develop Advanced Emergency Medicine Simulation** 2016–2018 $99,727 Final Report	**Purpose:** Improve medical simulation, and later develop and test stress-management techniques that, if implemented, have the potential to improve physicians' decision making, team communications, and technical skills, and thereby improve patient care and patient outcomes. **Key Findings/Impacts:** This research project yielded significant findings in two key areas. For Aim 1, the study validated a new ECG sensor for heart rate monitoring, showing a strong correlation ($r=0.94$, $p<0.001$) with pulse oximeter readings and a low standard error of estimate (3.4 bpm). Observations of 24 physicians revealed that residents generally had higher average heart rates than attending physicians across various tasks. For Aim 2, the study surveyed 16 emergency physicians to identify major stressors in their work environment. Key findings included overwhelming workload, multitasking, and high patient volume as the most reported stressors. Attending physicians and residents differed in their perceptions of stress sources, with attendings focusing more on interruptions and teaching, while residents emphasized workload and critical decision making. The study also found that physicians experienced an average of 10–22 interruptions per hour, which most found stressful. Notably, 69% of participants reported no formal training in managing interruptions or multitasking. These findings highlight the need for targeted interventions to address workplace stressors and improve stress management strategies for emergency physicians, potentially enhancing both physician well-being and patient care quality. **Publications:** 2

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
Kristen Miller **Medstar Health Research Institute** Hyattsville, Maryland	R18 HS027280 [Grant] **Re-engineering for Accurate, Timely, and Communicated Diagnosis of Cardiovascular Disease in Women (DREAM Lab)** 2019–2024 $2,499,460	**Purpose:** Apply a mixed-methods systems engineering approach to understand the complex interplay of factors contributing to cardiovascular disease (CVD) diagnostic error in women in the ambulatory care setting, and codesign and evaluate adaptive solutions. **Key Findings/Impacts:** According to the final report, investigators systematically addressed the critical issue of cardiovascular disease misdiagnosis in women—a population nearly twice as likely to receive incorrect heart attack diagnoses compared to men. Using a systems engineering approach across multiple workstreams, researchers identified key diagnostic breakdowns through EHR analysis, patient safety reports, and stakeholder interviews. The team found that communication barriers, clinician biases, and inadequate decision support tools contributed significantly to diagnostic errors. Notable outcomes included development of patient-facing educational materials, machine learning models for diagnostic error surveillance, and identification of gaps in clinical decision support tools that rarely incorporated sex-specific variables. The research highlighted that "patients are concerned about possibilities; providers are concerned with probabilities," revealing fundamental communication disconnects that informed intervention design, resulting in multiple peer-reviewed publications and advancing diagnostic safety specifically for women with cardiovascular disease. **Publications:** 3
MASSACHUSETTS		
Charles Czeisler **Brigham and Women's Hospital** Boston, Massachusetts	R01 HS012032 [Grant] **Effects of Extended Work Hours on Intensive Care Unit (ICU) Patient Safety** 2001–2004 $1,618,514 Final Report	**Purpose:** To evaluate the efficacy of providing 10 hours of protected time for sleep in improving patient safety and reducing serious adverse events by alleviating alertness and performance deficits in interns associated with recurrent 30- to 38-hour on-call shifts. **Key Findings/Impacts:** The final report revealed that interns on traditional schedules worked 19 hours more per week, slept 5.8 hours less, and experienced twice as many attentional failures during night shifts compared with those on alternative schedules. They also made 36% more serious medical errors, including 21% more medication errors, and more than five times as many diagnostic errors. Overall, ICUs experienced 22% more serious medical errors under traditional schedules. This study provided the first objectively validated data on work hours, sleep, and attentional failures in medical trainees, highlighting the negative impacts of extended work shifts. The researchers suggested that these findings may apply to other healthcare professionals and recommended further studies to evaluate the effects of current working practices and interventions designed to reduce working hours on physician well-being and patient safety. (Note: The research in this project is related to later work led by Christopher Landrigan [U18 HS015906]). **Publications:** 20

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
David Studdert **Harvard University School of Public Health** Boston, Massachusetts	U18 HS011886 [Grant] **MALPRACtice Insurers' Medical Error Prevention Study** 2001–2005 $3,789,897 Final Report	**Purpose:** (1) Harness the potential of malpractice insurance programs to operate as a nationwide error-reporting system; (2) identify the most frequent factors contributing to errors found in a focused review of malpractice claims files; (3) test case-control analysis as a method of quantifying the role of various contributing factors to the occurrence of specific errors; (4) assess how the patterns of errors and contributing factors detected through claims file analysis compare to those identified in other reporting systems; and (5) use claims data to facilitate design and implementation of a series of targeted patient safety interventions. **Key Findings/Impacts:** According to the final report, researchers reviewed 1,452 closed malpractice claims from five liability insurers (83% closed between 1995–2004, with an average of 5 years between injury occurrence and claim closure). The analysis revealed that 97% (n=1,415) of claims involved medical injury, with 63% (n=889) of those injuries judged to be due to errors. Injuries were typically severe, with 80% causing significant disability (39%), major disability (15%), or death (26%). The project successfully addressed aims 1 and 2 through comprehensive analysis of contributing factors to errors, finding that cognitive factors were present in approximately 90% of errors but typically acted in concert with system factors; patient-related factors contributed to about one-third of errors; and most errors resulted from multiple factors. The study completed multiple analyses including (1) descriptive studies of each clinical area, (2) focused analyses of recognized patient safety problems (with published findings on retained foreign bodies and wrong-site surgery), and (3) medico-legal analyses of claims without evidence of error. Case-control studies (aim 3) were initiated but incomplete at the time of reporting. The project proposed potential interventions for specific breakdown points in care processes (partially addressing aim 5), but implementation was not documented. The report did not include comparative analysis with other reporting systems (aim 4). **Publications:** 12
Joel Weissman **Massachusetts General Hospital** Boston, Massachusetts	R01 HS012035 [Grant] **The Relation of Hospital Workload to Patient Safety** 2001–2005 $1,305,725 Final Report	**Purpose:** (1) Determine the extent to which hospital workload pressures affect the rate at which adverse events (AEs) occur among hospitalized patients, and (2) develop a computerized tool using the electronic medical record (EMR) to monitor AEs. **Key Findings/Impacts:** According to the final report, investigators were disappointed with the accuracy of their computerized tool to monitor AEs. The overall sensitivity of the system was 24.6%, while the overall specificity was 89.47%. Adverse drug events (ADEs) also appeared to be a difficult area for the administrative screening criteria used. In this study, ADEs were more common (7.5%) in the patients whose screens were negative for AE than they were for whose screens were positive (4.5%). A combination of the two approaches (screening based on administrative data and natural language analysis of discharge reports), possibly augmented by other data from the EMR, may prove more accurate than any single source of data. The final report does not include findings related to the first aim regarding how hospital workload pressures affect the rate of adverse events among hospitalized patients. **Publications:** 3

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
Carol Ellenbecker **University of Massachusetts, Boston** Boston, Massachusetts	R01 HS013477 [Grant] **Job Retention Among Home Healthcare Nurses** 2003–2007 $847,248 Final Report	**Purpose:** Examine the relationship between job satisfaction and individual nurse characteristics to intent to stay and job retention in home healthcare nurses. **Key Findings/Impacts:** Investigators in the final report reported (1) a negative effect of job stress and work demands on job satisfaction, (2) a significant positive relationship between job satisfaction and nurses' intention to stay at the job, (3) a significant positive relationship between job satisfaction and nurse retention, (4) evidence of nursing shortages, and (5) a positive relationship between shared decision making and job satisfaction. **Publications:** 7
Joel Weissman **Massachusetts General Hospital** Boston, Massachusetts	R03 HS014073 [Grant] **Weekend Effect and the July Phenomenon in Patient Safety** 2003–2005 $99,939 Final Report	**Purpose:** Examine (1) whether AEs or complications in hospitals occur more often on weekends and holidays, and (2) whether there is a July phenomenon of heightened risk of complications corresponding to the arrival of new house officers in teaching hospitals. **Key Findings/Impacts:** The final report revealed that certain medical complications—including postoperative bleeding, newborn trauma, and some birth-related injuries—occurred more frequently on weekends. However, anesthesia-related complications were less common on weekends. Vascular surgery patients experienced more complications on weekends. The study also found variations in patient safety incidents between teaching and non-teaching hospitals, as well as fluctuations by month. While evidence suggests a "weekend effect" in hospitals, researchers recommend further investigation into factors like staffing levels and organizational structure to fully understand these differences. **Publications:** 1
Amresh Hanchate **Boston Medical Center** Boston, Massachusetts	R03 HS015617 [Grant] **Refinements Evaluating Minimum Surgery Volume Standards** 2005–2007 $96,270 Final Report	**Purpose:** Reevaluate an influential study on surgical mortality using an improved statistical model to determine if surgeon volume truly has a greater protective effect than hospital volume for coronary artery bypass graft (CABG) and other high-risk surgeries. **Key Findings/Impacts:** According to the final report, investigators used fixed-effects (FE) regression to show that lowest volume tertile hospitals have 1.4 and lowest volume tertile surgeons have 1.6 additional operative deaths (for every 100 coronary artery bypass graft surgeries) compared to highest volume tertile counterparts. The corresponding random effects (RE) estimates are 0.5 and 1.4, respectively. The substantially higher FE hospital volume effect compared with RE indicates that low-volume providers have unobserved factors that partly offset their higher mortality rates. These factors appear to include treating patients with less complicated profiles, which masks some of the quality-related mortality differences in traditional analyses. **Publications:** 2

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
Christopher Landrigan **Brigham and Women's Hospital** Boston, Massachusetts	U18 HS015906 [Grant] **Implementing Reduced Work Hours for All ICU House Staff** 2005–2009 $599,750 Final Report	**Purpose:** Study the effectiveness of implementing evidence-based reductions in resident physician work hours and disseminate information on best practices in work-hour redesign. **Key Findings/Impacts:** According to the final report, 61 residents and senior physicians consented to participate in the study pre-intervention (Apr–June 2006); 60 residents, physicians, and physician extenders participated post-intervention (Apr–June 2009). Data on medical errors were collected for 3 months pre-intervention and 3 months post-intervention. Although analyses were ongoing when the final report was released, in data from publications associated with this grant investigators found that extended-duration work shifts significantly increase fatigue and impair performance and safety. The work of this lab, with support from this grant and others, contributed to an extensive portfolio of research that helped to identify ideal duty hour limits that reduce medical errors. Investigators also developed a Web-based toolkit as a product of this project, which was comprised of resources to help hospitals and program directors design new schedules intended to reduce provider sleep deprivation. (Note: This project appears to build off the earlier work of R01 HS012032 [2001–2004], led by Charles Czeisler. **Publications:** 9
Elizabeth Martinez **Massachusetts General Hospital** Boston, Massachusetts	K08 HS013904 [Grant] **Organization of Care and Outcomes in Cardiac Surgery** 2006–2011 $536,422 Final Report	**Purpose:** Identify the characteristics of the postoperative care of cardiac surgical procedures that impact outcomes by identifying variation in the organization of the postoperative ICU care of cardiac surgery patients and identifying those characteristics that correlate with outcomes in cardiac surgery. **Key Findings/Impacts:** According to the final report, investigators studied cardiovascular surgical intensive care units (CVICUs) across the United States and found significant variations in staffing patterns, particularly in daytime intensivist coverage, multidisciplinary team involvement, and nighttime staffing. While nurse staffing remained relatively consistent, these other differences could potentially impact patient outcomes. The researchers emphasized the need for further investigation into the relationship between CVICU staffing patterns and patient results, as similar associations have been observed in general ICU populations. They also recommended additional research to determine optimal CVICU staffing arrangements and to identify potential hazards in cardiac surgical ICU care. **Publications:** 10

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
Meghan Dierks **Beth Israel Deaconess Medical Center** Boston, Massachusetts	R18 HS017907 [Grant] **Optimizing Safety in Ambulatory Procedural Care: Risk Informed Interventions** 2008–2011 $461,185	**Purpose:** Develop and implement a highly reliable screening tool to assess the need for anesthesia involvement in procedural sedation. **Key Findings/Impacts:** A final report was not available; however, a 2010 progress report revealed that investigators had identified a number of scheduling processes, capacity utilization, screenings to identify risk, actual resource allocation, and provider behaviors that increase risk during procedural sedation in ambulatory care settings. Additionally, they had made significant progress toward the creation and validation of tools and planned to subsequently use them across a range of clinical settings. Investigators noted that as hospitals face increasing financial constraints, the pressure to favor productivity and throughput over safety is likely to become even greater. With their tools, the goal is to assist institutions in balancing throughput, case complexity, and safety. **Publications:** 0
Christopher Landrigan **Brigham and Women's Hospital** Boston, Massachusetts	R03 HS017357 [Grant] **Developing a Risk Index of Healthcare Provider Alertness to Improve Safety** 2009–2011 $99,997 Final Report	**Purpose:** Develop a scientifically based mathematical "risk index" to study healthcare workers' schedules. This index would allow healthcare managers to quantify the risk associated with current work schedules and design safer alternatives. **Key Findings/Impacts:** Investigators in the final report identified periods of poor performance based on schedules. Simulations found that new schedules designed according to the Institute of Medicine's (now National Academy of Medicine) recommendations will result in better performance compared to traditional schedules. This project led to practical and theoretical extensions of the university's scheduling research program. Its existing simulation software was improved to make simulation and evaluation of schedules easier. A new software infrastructure for automating analysis of schedules is proposed. The project facilitated the adoption of newly proposed schedules and a request to provide training on the effects of poor sleep for physicians in training. **Publications:** 2
Andrew Elbardissi **Brigham and Women's Hospital** Boston, Massachusetts	F32 HS019190 [Grant] **A Prospective Human Factors Approach to Improve Patient Safety in Cardiac Surgery** 2010–2012 $135,516	**Purpose:** Compare the intraoperative phase of cardiac surgical care between patients who experience major complications to patients of similar risk profile who do not experience negative outcomes. **Key Findings/Impacts:** A final report was not available; however, publications from this grant offer valuable insights. One study recommends interventions to mitigate work system failures' impact on surgical performance, using a human factors model to highlight various systems factors, including the OR environment, teamwork and communication, technology and equipment, tasks and workload factors, and organizational variables. Another study reveals that the combined experience of attending cardiac surgeons and cardiothoracic fellows significantly affects operative efficiency in CABG procedures, more so than individual surgeon experience. Lastly, research indicates that over the past decade, CABG patient profiles have changed, with improved medical therapy and widespread use of the left internal thoracic artery leading to substantially better outcomes and reduced postoperative mortality and morbidity. **Publications:** 3

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
Linda Isbell **University of Massachusetts Amherst** Amherst, Massachusetts	R01 HS025752 [Grant] **Emotional Influences on Diagnostic Error in Emergency Medicine: An Experimental Approach to Understand Diagnostic Failure and Facilitate Improvement for Patients With and Without Mental Illness** 2017–2023 $1,716,480 Final Report	**Purpose:** (1) Identify specific ways in which the emotional factors of patients and/or providers may contribute to errors in diagnosis in the practice of emergency medicine (EM); and (2) develop and test cognitive interventions that may reduce these errors. **Key Findings/Impacts:** According to the final report, this project investigated how emotions impact clinical reasoning and patient safety in emergency medicine, particularly while treating patients who have mental illness. Through interviews, mixed-methods research, and experiments with emergency physicians and nurses, researchers developed models showing how emotions triggered by patient, hospital, and system factors influence clinical judgments. The study found that patients displaying irritable behaviors consistently elicited negative emotions in providers, decreased their engagement, and led to more unfavorable patient assessments—including judgments that patients were poor historians, exaggerating pain, and less likely to adhere to treatment. Nurses were less likely to recommend necessary diagnostic tests for patients with mental illness. The research showed that while healthcare providers believe they regulate their emotions effectively, this assessment is often inaccurate, as 75% of participants reported that emotions influenced their clinical judgment in at least one patient encounter. These findings provide a foundation for developing interventions to address provider's emotional influences on clinical decision making and improve patient safety, especially for stigmatized populations. **Publications:** 10
James Benneyan **Northeastern University** Boston, Massachusetts	R01 HS030271 [Grant] **Understanding and Addressing Community Health Center Burden, Resiliency, and Burnout: Systems Engineering Analyses and Approaches** 2024–2029 $399,999	**Purpose:** Apply systems science and engineering approaches to understand and mitigate healthcare worker burnout by optimizing workflows, improving system resiliency, and enhancing care quality and safety, particularly in under-resourced community health settings. **Key Findings/Impacts:** This project is ongoing until July 31, 2029, and afinal report or related publications are not yet available. **Publications:** 0
Gordon Schiff **Brigham and Women's Hospital** Boston, Massachusetts	R01 HS030232 [Grant] **Time for Better Diagnosis: Measuring Outcomes, Stress and Time proposal (MOST)** 2024–2028 $500,000	**Purpose:** Analyze and improve the impact of time constraints on diagnostic quality by leveraging emergency medical record (EMR) technologies and artificial intelligence (AI) for better patient-clinician communication and clinician stress management in primary care settings. **Key Findings/Impacts:** This project is ongoing until July 31, 2028, and a final report or related publications are not yet available. **Publications:** 0

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
MICHIGAN		
Carolyn Sampselle **University of Michigan, Ann Arbor** Ann Arbor, Michigan	R13 HS016436 [Grant] **Health Care Policy and Practice: Promoting Environments for Quality Care** 2006–2008 $39,980 Final Report	**Purpose:** Organize a 1-day leadership conference to address the critical role played by nurses in assuring patient safety and the importance of work environment characteristics to protect patient safety. **Key Findings/Impacts:** The May 2006 conference titled, "Have Patient Safety & the Workforce Shortage Created the Perfect Storm?" addressed the tension between patient safety needs and workforce shortages in nursing. Drawing 162 attendees from across the nation, including healthcare researchers, administrators, faculty, and students, the conference featured presentations from thought leaders in the field. The proceedings culminated in the publication of a special supplement to Nursing Research (January/February 2008) containing articles that analyzed implications of the IOM Committee recommendations on the nursing work environment and patient safety, identified strategic implementation approaches, and advanced a research agenda within the context of nursing workforce challenges. **Publications:** 4
Prashant Mahajan **University of Michigan** Ann Arbor, Michigan	R18 HS026622 [Grant] **Improving Diagnosis in Emergency and Acute Care: A Learning Laboratory (IDEA-LL)** 2018–2024 $2,490,136	**Purpose:** Use multidisciplinary approaches to design, implement, and evaluate interventions to improve diagnostic safety. **Key Findings/Impacts:** According to the final report, the IDEA-LL project identified specific diagnostic safety vulnerabilities through multiple methodologies including video ethnography that revealed previously hidden cognitive processes of physicians, qualitative interviews that categorized five key vulnerability areas (team dynamics, information gathering, ED processes, patient education, and EHR use), and machine learning analysis that discovered patient, provider, and system-level risk factors in the diagnostic process. These findings directly informed the development of concrete interventions: a provider dashboard for diagnostic decision support, a patient-centered communication tool, and an ED decision support system that uses EHR data to predict diagnostic error risk in real time. The project produced several publications, established seven cross-institutional research partnerships, and created a foundation for testing these interventions in both academic and community emergency departments to measurably reduce diagnostic errors. **Publications:** 10
Elizabeth Marie Viglianti **University of Michigan** Ann Arbor, Michigan	R01 HS030246 [Grant] **ARISING: Addressing Institutional Sexual Harassment to Improve Physician Well-Being** 2024–2028 $500,000	**Purpose:** Develop and validate a best practices framework to prevent and mitigate sexual harassment in medical institutions, enhancing physician well-being and reducing workforce attrition. **Key Findings/Impacts:** This project is ongoing until July 31, 2028, and a final report or related publications are not yet available. **Publications:** 0

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
MINNESOTA		
Daniel Buysse **American Academy of Sleep Medicine** Rochester, Minnesota	R13 HS010963 [Grant] **Sleep and Fatigue in Medical Education** 2001–2002 $49,810	**Purpose:** Bring together world renowned sleep researchers, physician-educators, educational leaders, and policymakers in medical education concerned with the effects of sleep loss and fatigue on patient safety and the delivery of medical care in the medical education setting. **Key Findings/Impacts:** According to the final report, the conference brought together stakeholders concerned with the impact of sleep loss and fatigue on patient safety and medical education. Participants explored how sleep deprivation affects performance, evaluated fatigue countermeasures, and discussed applying lessons from other industries to medicine. They identified knowledge gaps crucial for establishing effective policies on sleep, fatigue, and medical training. The conference reviewed existing data on the effects of sleep deprivation in resident physicians' learning and patient care environments, highlighted areas needing further research, and maintained a focus on enhancing patient care quality while preserving the integrity of graduate medical education. **Publications:** 0
Marcelline Harris **Mayo Clinic** Rochester, Minnesota	R01 HS015508 [Grant] **Analyzing Nurses' Impact on Outcomes Using Detailed Data** 2006–2010 $883,444 Final Report	**Purpose:** (1) Address limitations to, and gaps in, the existing literature pertaining to nurse staffing and outcomes sensitive to nurse staffing; and (2) inform an empirically based business case for nurse staffing and quality. **Key Findings/Impacts:** A study of nearly 200,000 hospital admissions and 177,000 nursing shifts across 43 units found that understaffing of registered nurses (RNs) and high patient turnover were associated with increased mortality rates. Using Cox proportional hazards model, researchers discovered that for every shift where RN staffing was 8 or more hours below the target, the hazard ratio for mortality increased by 1.02 (95% CI: 1.01–1.03, P<0.001). Similarly, high patient turnover shifts had a hazard ratio of 1.04 (95% CI: 1.02–1.06, P<0.001). These findings emphasize the importance of adequate nursing staff to meet patient care needs. **Publications:** 1
MISSOURI		
Douglas Wakefield **University of Missouri–Columbia** Columbia, Missouri	R03 HS017554 [Grant] **Verbal Order Policies, Perceptions, and Occurrences** 2009–2010 $99,364 Final Report	**Purpose:** Improve understanding of the nature and scope of verbal and telephone order standards of practice, effectiveness of these standards in improving patient care, and estimates of the utilization of verbal and telephone orders in acute care hospitals. **Key Findings/Impacts:** In the final report, investigators stated that analysis of the verbal and telephone order (VO) policy documents revealed a range of different types of health professionals authorized to give VOs, and a much wider range of health professionals authorized to receive a verbal order. Nearly all verbal order policies indicated requirements for documenting who gave, who received, and time and date of VO. While almost 100% of the policies identified specific time frames in which the VO must be countersigned, many hospitals had different time frames listed in their VO-related policy documents. Few VO policies excluded specific types of VOs, such as for chemotherapy. The surveys found that almost none of the study hospitals reported conducting any systematic monitoring of VOs, with the exception of tracking VOs that had not been countersigned within the approved time frame. **Publications:** 2

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
Naresh Khatri **University of Missouri–Columbia** Columbia, Missouri	R03 HS017549 [Grant] **HR and IT Capabilities and Complementarities in Healthcare** 2011–2012 $94,490	**Purpose:** Examine how healthcare organizations can enhance their clinical outcomes via managing human resources (HR) and information technology (IT) more effectively. **Key Findings/Impacts:** A final report was not available; however, an article produced by this project found that the quality of patient care was significantly higher in hospitals deploying homegrown health IT (HIT) systems compared to those using outsourced HIT systems. The professional competence and compelling vision of the chief information officer (CIO) was identified as a major driver of hospitals' IT capabilities, particularly in developing professionalism of IT staff. Furthermore, this professionalism of IT staff positively influenced the quality of patient care through proactive employee behavior. The investigators concluded that homegrown HIT systems achieves better quality of patient care than an outsourced ones, and that developing strong internal IT capabilities, particularly through CIO leadership and professional IT staff, is critical for effective HIT implementation that improves clinical outcomes. **Publications:** 2
NEW MEXICO		
Les Becker **Pacific Institute for Research and Evaluation** Albuquerque, New Mexico	R03 HS011750 [Grant] **Impacts of Alcohol/ Fatigue on Paramedic Skills** 2001–2004 $99,842 Final Report	**Purpose:** Validate a methodology for assessing whether routine levels of fatigue and alcohol hangover among certified practicing emergency medical technicians (EMT-Ps) impair judgment and/or performance, and to provide pilot information about specific areas of performance deficit that may place patients at risk. **Key Findings/Impacts:** According to the final report, the pilot study successfully established that an instrumented manikin simulator system could effectively detect deficits in paramedic performance. After initial software challenges, researchers implemented a responsive logging system, allowing for real-time coding of subjects' actions and minimizing measurement error through rapid, accurate documentation of provider interventions. Preliminary data from the first three subjects demonstrated that the simulator's difficulty levels were sufficient to potentially detect performance variations. The study provided a foundation for more extensive research, with ongoing subject enrollment expected to yield adequate data to assess the impacts of fatigue and alcohol hangover on paramedic performance and to develop evidence-based recommendations regarding hours of service and pre-duty alcohol consumption policies. **Publications:** 6

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
NEW YORK		
Nina Bickell **Mount Sinai School of Medicine** New York, New York	R03 HS013464 [Grant] **ED Staffing and Patient Outcomes** 2002–2004 $99,813 Final Report	**Purpose:** Assess the relationship of emergency department (ED) physician and nurse staffing on time to treatment and patients' health outcomes for three delay-sensitive conditions: appendicitis, ectopic pregnancy, and intestinal obstruction. **Key Findings/Impacts:** According to the final report, investigators examined the relationship between ED staffing levels and timely care for 237 appendicitis patients at an urban tertiary hospital. Key findings showed that the speed of initial examination was primarily influenced by patient factors—younger age and arrival by ambulance—rather than staffing levels. For ED length of stay, however, higher physician staffing levels were significantly associated with shorter stays, along with a correct first diagnostic impression of appendicitis. Undergoing computerized tomography scanning was associated with longer ED stays. Surprisingly, neither patient census in the ED nor nurse/support personnel staffing affected length of stay, potentially because nursing staff numbers were flexible and could be increased during busy periods, while physician staffing remained fixed. The researchers found no association between ED staffing levels and appendiceal perforation rates. They concluded that ensuring adequate physician staffing is critical for timely treatment of time-sensitive conditions and maximizing patient safety. **Publications:** 1
Patricia Stone **Columbia University in the City of New York** New York, New York	R21 HS017423 [Grant] **Exploratory Study Using Queueing Theory to Improve Nurse Staffing Effectiveness** 2007–2009 $470,658 Final Report	**Purpose:** Explore the feasibility and benefit of using queueing models to inform nurse staffing. **Key Findings/Impacts:** In the final report, investigators reported 45 nurses (83% response rate) agreed that 35 interventions were time sensitive. The most useful electronic time-stamped data were admit/transfer/discharge and call light data. Volume and variability of demands, estimates of nursing times, and call light delays were used to parameterize a queueing model to inform nurse staffing. The model estimates that six to nine nurses are needed, depending on the time of day and the day of the week, to meet specified target delays. These levels are higher than the average levels currently used. Queueing models are promising; continued development of electronic data sources is needed to support operational planning. **Publications:** 5
Dennis Lee Fowler **Columbia University in the City of New York** New York, New York	R03 HS021549 [Grant] **Determining a Learning Curve for Complex Laparoscopic Gastrointestinal Surgery** 2012–2014 $98,869 Final Report	**Purpose:** Validate the Global Operative Assessment of Laparoscopic Skills (GOALS) as an assessment tool and define the learning curve for complex laparoscopic gastrointestinal surgery. **Key Findings/Impacts:** The final report indicated that 402 performance assessments were analyzed for 148 surgical fellows, showing significant improvements in various skills throughout the fellowship year. Gastric bypass and bariatric procedures saw improvements across all domains, while colectomies showed improvements in overall performance, bimanual dexterity, and efficiency. The assessment tool demonstrated construct validity by documenting gradual improvement from moderate skill levels at the beginning to superior technical skills by year end. This progression aligns with expectations for fellows who have completed a 5-year surgery residency. Future research with more assessments could better define learning curves for specific operations. **Publications:** 1

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
NORTH CAROLINA		
Noa Segall **Duke University** Durham, North Carolina	R03 HS021332 [Grant] **Workload Effects on Response Time to Life-Threatening Arrhythmias** 2012–2014 $99,989 Final Report	**Purpose:** Determine the impact of increasing the number of patients monitored on response time to simulated cardiac arrest. Remotely monitored patients may be at risk for a delayed response to critical arrhythmias if the telemetry watchers who monitor them are subject to an excessive patient load. There are no guidelines or studies regarding the appropriate number of patients that a single watcher may safely and effectively monitor. **Key Findings/Impacts:** The final report indicates that participants found the simulation to accurately represent a telemetry technician's work. While no significant difference in response times to life-threatening arrhythmias was found among different patient loads, this may be due to insufficient statistical power. However, response time variability and failure rates increased significantly with higher patient loads. Secondary measures showed decreased task performance and event detection as patient load increased, although the self-paced rhythm interpretation task remained unaffected. These findings suggest that increased patient loads can negatively impact a telemetry technician's performance in certain areas. **Publications:** 1
Lukasz Mazur **The University of North Carolina at Chapel Hill** Chapel Hill, North Carolina	R18 HS025597 [Grant] **Simulation-Based Research to Enhance Performance of Radiation Therapist** 2018–2021 $714,513	**Purpose:** Develop and assess the impact of a generalized simulation-based training and neurofeedback intervention on radiation therapists' mental workload, situation awareness, and performance. **Key Findings/Impacts:** According to the final report, a simulation-based training intervention was associated with significant improvements in performance ($p<0.01$) but had no significant impact on mental workload or subjective/objective quantifications of situational awareness. Following the neurofeedback protocol, participants showed a decrease in subjective cognitive workload and a decrease in response time during a performance task, as well as a decrease in desynchrony of the alpha electroencephalogram (EEG) band. Additionally, novel microstate analysis for neurofeedback showed a significant decrease in global field power (GFP) following neurofeedback. GFP quantifies the amount of activity across all electrodes in an EEG recording at each time point. These results suggest that the radiation therapists successfully learned the protocol and decreased their perceived cognitive workload following neurofeedback intervention. **Publications:** *7*

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Prithima Mosaly **The University of North Carolina at Chapel Hill** Chapel Hill, North Carolina	R03 HS025258 [Grant] **To Quantify the Impact of the Existing vs. Enhanced Work Configuration of Radiation Therapy Technicians on Workload, Situation Awareness, and Performance During Pretreatment QA Tasks** 2018–2020 $97,573 Final Report	**Purpose:** Assess the impact of modifications to workflows, workspace design, and environment factors on radiation therapy technicians (RTTs), workload (WL), situational awareness (SA), and performance during pre-treatment quality assurance (QA) tasks in a simulated environment. **Key Findings/Impacts:** According to the final report, researchers compared different workplace configurations and workflows for radiation therapy technicians (RTTs). The current setup with two RTTs showed increased mental workload but improved situational awareness and timeout performance. Conversely, the three-RTT workflow resulted in poor performance and higher physical stress despite lower mental workload. An enhanced configuration reduced physical stressors and improved timeout compliance. This pioneering study in radiation therapy ergonomics suggests that ergonomically designed workspaces and optimized workflows can reduce physical stress and enhance RTTs' performance, particularly in timeout compliance. **Publications:** 3
Alison Stuebe **The University of North Carolina at Chapel Hill** Chapel Hill, North Carolina	R18 HS027260 [Grant] **Re-engineering Postnatal Unit Care and the Transition Home to Reduce Perinatal Morbidity and Mortality** 2019–2024 $2,498,938	**Purpose:** Define postnatal unit problems and create an innovative, individualized delivery system for more effective mother–infant management during postnatal hospitalization and the discharge transition to home. **Key Findings/Impacts:** According to the final report, the Postnatal Patient Safety Learning Lab (PSLL) identified significant barriers to safe postnatal care, particularly affecting Black, Spanish-speaking, and low-income birthing parents, including inadequate staffing, language barriers, misaligned workflows, and insufficient patient education. The project implemented multiple interventions that yielded measurable improvements: monthly clinical simulations and checklists improved response times to obstetric emergencies; health information materials provided to over 500 patients resulted in 95% reporting better understanding of postpartum warning signs; emergency department visits and readmissions decreased by 20% within 90 days postpartum; redesigned hypoglycemia protocols reduced treatment delays and errors; multilingual educational text messages for hypertension management reached over 200 patients, improving blood pressure monitoring adherence; interpreter service utilization increased by 25% through workflow improvements; and automatic meal tray delivery enhanced nutritional access for postpartum patients, particularly those with limited English proficiency. **Publications:** 28
OHIO		
Kimberly Johnson **University of Cincinnati** Cincinnati, Ohio	R03 HS025844 [Grant] **Development of an Education Intervention for Triage Interruption Management** 2018–2021 $98,505 Final Report	**Purpose:** Develop an educational intervention to teach triage nurses successful strategies to manage interruptions in the emergency department. **Key Findings/Impacts:** According to the final report, the Delphi group identified eight strategies to mitigate the impact of interruptions and the best teaching modalities for each strategy. For the pilot study, all nurses in both the control and experimental group scored well on managing interruptions in triage. There was not a significant difference between the two groups. Through datamining, researchers found that experience is more impactful on triage quality than training. Less time spent on interruptions was related to higher scored triage interviews. **Publications:** 1

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
Sara Bayramzadeh **Kent State University** Kent, Ohio	R18 HS027261 [Grant] **Towards a Model of Safety and Care for Trauma Room Design** 2019–2024 $2,445,076	**Purpose:** Use the Systems Engineering Initiative for Patient Safety (SEIPS) model to investigate obstacles to improved patient safety outcomes in trauma rooms. **Key Findings/Impacts:** According to the final report, this project developed evidence-based design guidelines for trauma rooms to improve patient safety and care efficiency. Through systematic literature reviews, focus groups with 69 healthcare professionals, video observations of actual trauma cases, and scenario-based simulations in physical mockups and augmented reality environments, the study identified critical environmental factors affecting trauma care. Key findings revealed that room layout, equipment integration, communication systems, and sensory factors (noise, lighting, temperature) significantly impact workflow and patient outcomes. The research resulted in innovative design strategies including modular layouts, color-coded zones, decentralized storage, anteroom buffers, integrated displays, and enhanced sensory controls. Additionally, the team developed a privacy-preserving video surveillance system for real-time monitoring that achieved high detection accuracy while protecting patient and staff identities. These evidence-based recommendations offer actionable guidance for architects and healthcare planners to create safer, more efficient trauma environments. **Publications:** 6
		PENNSYLVANIA
Ann Rogers **University of Pennsylvania** Philadelphia, Pennsylvania	R01 HS011963 [Grant] **Staff Nurse Fatigue and Patient Safety** 2001–2005 $1,636,380 Final Report	**Purpose:** Evaluate the relationship of staff nurse fatigue to patient safety. **Key Findings/Impacts:** The final report revealed that nurses routinely worked 50–55 minutes overtime per shift, with shifts exceeding 12.5 consecutive hours, overtime work, and workweeks over 40 hours significantly increasing error risks. Short sleep durations were also linked to higher error rates and alertness difficulties. One-third of participants reported making errors, with only 58% of the errors involving medication administration. This study was the first to document the prevalence of 12-hour shifts among hospital staff nurses and the associated risks of extended work hours and inadequate sleep. The findings emphasized that working longer than 12 consecutive hours or with insufficient sleep jeopardizes patient safety, nurses' health, and public safety when drowsy driving occurs. Researchers urged nurses, managers, administrators, and policymakers to collaborate in changing the culture that promotes long work hours without adequate rest. **Publications:** 9

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
Brian Strom **University of Pennsylvania** Philadelphia, Pennsylvania	P01 HS011530 [Grant] **Improving Patient Safety by Reducing Medication Errors** 2001–2007 $6,758,053 Final Report	**Purpose:** Create the Center of Excellence for Patient Safety Research and Practice to expand the patient safety knowledge base through multidisciplinary research and education programs designed to identify and implement systems approaches to reducing error in the use of medications. **Key Findings/Impacts:** Investigators found two distinct sources of stress and error—hospital workplace stressors and personal/psychological characteristics. Although some findings were still undergoing analysis, the study revealed promising connections among psychological characteristics, stressors, and medication errors. A followup study on a newly installed computerized provider order entry (CPOE) system found that staff overall preferred the newer system. It remedied some of its predecessor's error risks, but several remained, and new ones were introduced. Technological solutions to medication errors are still emerging and are mitigated by hospitals' organizational/workflow realities. Investigators noted that proactive and responsive evaluations of CPOE systems remained critical. **Publications:** 17
Ann Kutney Lee **University of Pennsylvania** Philadelphia, Pennsylvania	K08 HS018534 [Grant] **Changes in Hospital Care Organization and Outcomes** 2008–2012 $395,048 Final Report	**Purpose:** Examine the effect of changes over time in nurse staffing, nurse education, nurse practice environments, and patient characteristics within hospitals on medical-surgical patient outcomes and on nurse outcomes related to nurse retention. **Key Findings/Impacts:** The final report provided strong evidence supporting the importance of nursing in hospitals. A longitudinal study showed that increasing the proportion of baccalaureate-prepared nurses was associated with reduced 30-day surgical mortality and failure to rescue rates. Improvements in nurse practice environments and staffing were linked to better job outcomes and retention. Hospitals with supportive work environments, strong nurse–physician relationships, and increased nurse participation in hospital affairs experienced decreased rates of job dissatisfaction, intentions to leave, and burnout. The study also noted a significant increase in comorbid chronic conditions among hospitalized patients between 1999 and 2006, which negatively impacted all patients. Future research should focus on understanding these relationships and optimizing care delivery for improved patient outcomes. **Publications:** 9
Matthew McHugh **University of Pennsylvania** Philadelphia, Pennsylvania	K08 HS017551 [Grant] **Nurse Staffing Policy, Hospital Occupancy, Market Structure, and Patient Outcomes** 2008–2011 $371,311 Final Report	**Purpose:** Determine the impact of California legislation (and similar laws being considered in more than 25 other States) mandating minimum nurse-to-patient ratios in hospitals. **Key Findings/Impacts:** The final report indicated that California's nursing staff mandate led to significant increases in staffing levels compared to hospitals without such requirements. The policy resulted in approximately an additional half-hour of nursing care per adjusted patient day. Contrary to concerns, the mandate did not negatively impact skill mix; instead, it improved, keeping pace with national trends. Safety net hospitals, particularly those previously understaffed, benefited most from the mandate. Preliminary comparisons with Pennsylvania, which lacks such a mandate, suggested that California's staffing improvements were associated with lower surgical mortality rates and fewer deaths following complications. Initial results indicated that reducing the patient-to-nurse ratio by 1 in California hospitals was linked to approximately 5 fewer surgical deaths and 24 fewer deaths following complications per 10,000 surgical patients. **Publications:** 9

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
Scott Halpern **University of Pennsylvania** Philadelphia, Pennsylvania	K08 HS018406 [Grant] **Measuring and Mitigating Patient Safety Threats Due to Strains on ICU Capacity** 2009–2014 $762,910 Final Report	**Purpose:** Produce (1) a valid measurement to inform current triage and staffing decisions and (2) a conceptual framework that non-ICU investigators may use to evaluate threats posed by capacity strain within other clinical entities. **Key Findings/Impacts:** The final report validated three measures of ICU capacity strain: census, proportion of new admissions, and average patient acuity. Higher strain levels during the first 3 days of ICU stay were associated with slightly increased mortality and significantly decreased use of appropriate venous thromboembolism prophylaxis. Strain on discharge day correlated with shorter ICU stays and slightly increased readmission risk but did not affect hospital length of stay or mortality. The studies demonstrated that these measures of ICU capacity strain influence patient flow, care processes, and outcomes. ICUs with open physician staffing models appeared more adaptable to capacity strains than those with closed models. The research also revealed that ICU discharge circumstances vary daily, affecting patient flow without impacting short-term outcomes, suggesting that patients' needs for ICU-level care are regularly reassessed. **Publications:** 37
Aleksandra Sarcevic **Drexel University** Philadelphia, Pennsylvania	R03 HS026057 [Grant] **Analysis of Factors Associated With Clinical Checklist Compliance** 2018–2020 $99,392 Final Report	**Purpose:** Identify context attributes associated with non-compliant use of a checklist that is administered concurrently with dynamic clinical activities during trauma resuscitation. **Key Findings/Impacts:** The final report identified four key contexts affecting digital checklist usage in resuscitation: team leader experience, team leader's arrival to the resuscitation room after the patient, patients with penetrating injuries, and patients with external injuries. Three non-compliant behaviors were observed: false checks (16% of all checks), inaccurate checks (5%), and failed checks (49% of unchecked items). Researchers concluded that new checklist designs should consider task attributes and contexts, particularly supporting group tasks, long-duration tasks, repetitive tasks, multistep tasks, and rarely performed tasks. Additionally, future designs should accommodate retrospective checking behaviors to improve overall compliance and effectiveness in resuscitation scenarios. **Publications:** 4
John Harris **Magee-Womens Research Institute and Foundation** Pittsburgh, Pennsylvania	R01 HS026943 [Grant] **Developing and Testing an Evidence-Based Toolkit for Nursing Home Care of Residents With Obesity** 2019–2025 $1,996,115	**Purpose:** Evaluate the strategies nursing homes (NHs) use to prevent adverse safety events affecting residents with obesity and develop an evidence-based toolkit to help NHs adapt to the increasing care challenges for residents with obesity. **Key Findings/Impacts:** Thus far, the project has produced several publications. Through interviews with medical providers, one publication identified three key themes: the complex medical needs of obese residents, difficulties in providing adequate daily care, and obstacles to facilitating weight loss and healthier lifestyles. While the current findings are limited by sample size, they provide valuable insights into the unique challenges faced by healthcare providers in managing obesity in nursing home settings. Future research will aim to incorporate perspectives from additional stakeholder groups to further validate and expand upon these initial observations. **Publications:** 9

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
Karen B. Blanchette **University of Pennsylvania** Philadelphia, Pennsylvania	R01 HS028978 [Grant] **Learning from Hospital Preparedness during COVID: Chronically Under-Resourced Nurses and Patient Safety** 2022–2025 $399,292	**Purpose:** Evaluate how hospital nurses weathered the COVID-19 public health emergency, whether and to what extent hospital nurse resources (staffing, work environment, Magnet designation) buffered nurses from poor outcomes (such as burnout) during the pandemic and facilitated recovery 3 years after the onset of the COVID emergency, and the extent to which patient outcomes, safety, quality, and value of care indicators paralleled changes in nurse outcomes and hospital nurse resources over the study period **Key Findings/Impacts:** This project ended August 31, 2025; however, resulting publications examining nurse work environments during COVID-19 revealed that, contrary to popular belief, nurses did not leave hospitals en masse during the pandemic's first 18 months. However, pre-pandemic nurse staffing levels and work quality strongly predicted patient outcomes during the crisis. Medicare patients from socially vulnerable communities and Medicaid patients in New York and Illinois showed significantly higher survival rates when treated in hospitals with adequate nursing resources, with researchers estimating hundreds of preventable deaths occurred where these resources were lacking. Emergency departments with "mixed" work environments experienced longer patient stays and higher walkout rates, with "poor" environments particularly affecting behavioral health patients. These findings collectively demonstrate that investing in nurse work environments is fundamental to healthcare quality, patient safety, and system resilience during public health emergencies. **Publications:** *7*
Connie M. Ulrich **University of Pennsylvania** Philadelphia, Pennsylvania	R01 HS028427 [Grant] **Modeling How Moral Distress and Ethical Confidence Impact Nurses' Emotional and Physical Health and Safety Culture** 2022–2027 $399,902	**Purpose:** Inform development of behavioral interventions, structural/operational workplace changes, and message campaigns that reduce moral distress in existing and future cohorts of nurses and improve the safety culture in which they work. **Key Findings/Impacts:** This project is ongoing until February 28, 2027, but six publications have already been produced. Researchers developed and tested a measurement tool for parent-perceived miscommunication in the Pediatric Intensive Care Unit (PICU). An evaluation of institutional ethics committees (IECs) in children's hospitals found inconsistent adherence to operational recommendations, suggesting the need to identify barriers and enablers to policy implementation. The project also established methods to quantify moral distress among healthcare providers and examined its various origins. A related commentary highlighted how the COVID-19 pandemic exposed and intensified systemic healthcare issues including understaffing and resource shortages, demonstrating how these structural problems contribute to moral distress among clinicians. This work provides tools and insights to improve communication, ethical decision making, and provider well-being in pediatric healthcare. **Publications:** 6

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
SOUTH CAROLINA		
Ken Catchpole **Medical University of South Carolina** Charleston, South Carolina	R01 HS026491 [Grant] **Human Factors and Systems Integration in High Technology Surgery (HF-SIgHTS)** 2018–2024 $1,957,531 Final Report	**Purpose:** Evaluate multiple interventions to address the specific challenges in robotic-assisted surgery (RAS), studying whether and how interventions work and can be spread. **Key Findings/Impacts:** According to the final report, researchers examined 292 robotic surgeries across four sites, documenting 30,751 flow disruptions. They identified that robot docking, room size, workload, robot design, and patient BMI significantly affected surgical safety and efficiency. Computational analysis revealed two accident mechanisms: "snowball cascades" of related disruptions and unrelated events reflecting deeper system issues. To address these challenges, researchers developed the "Robot Olympics"—escape room-style games focusing on safety, troubleshooting, workspace management, and instrument handling. Post-intervention analysis showed a reduction in flow disruptions from 24.7 to 22.1 per hour. The project produced an implementation guide for gamified surgical training and several peer-reviewed publications, demonstrating that human factors engineering provides a valuable framework for safely integrating new surgical technologies. **Publications:** 22
TENNESSEE		
Matthew Weinger **Vanderbilt University** Nashville, Tennessee	R01 HS011375 [Grant] **Unexpected Clinical Events: Impact on Patient Safety** 2001–2005 $263,001 Final Report	**Purpose:** (1) Elucidate the factors that contribute to the occurrence and management of non-routine clinical events during actual anesthesia care, and (2) delineate the role of non-routine events (NREs) in the occurrence of adverse patient outcomes. **Key Findings/Impacts:** The final report analyzed 404 elective surgical cases, finding that 34% (139/404) contained at least one non-routine event (NRE), with 23% of those cases having multiple NREs. In total, 187 NREs were observed. Of these NREs, 78% affected patients (representing 36% of all cases), and 19% resulted in patient injury (representing 9% of all cases). Airway management NREs were the most common. Provider experience and reported sleep quality were significant predictors of NREs. A retrospective sample of 412 cases showed similar results. Researchers emphasized the need to redesign systems for better detection and recovery from potential injury-causing events. They suggested further research to determine if NREs are associated with higher patient injury rates, potentially making them a valuable endpoint for evaluating safety interventions due to their prevalence. **Publications:** 13

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
Matthew Weinger **Vanderbilt University Medical Center** Nashville, Tennessee	R18 HS026616 [Grant] **Cancer Patient Safety Learning Laboratory (CaPSLL): Preventing Clinical Deterioration in Outpatients** 2019–2023 $2,499,922 Final Report	**Purpose:** Improve providers' detection and response to prevent unexpected clinical deterioration for cancer patients. **Key Findings/Impacts:** According to the final report, the prototype surveillance-and-response system successfully predicted cancer patients' 7-day risk of unplanned treatment events using patient-reported outcomes and clinical data, though smartphone geolocation data was insufficient due to various issues. The system effectively communicated risk information to clinicians through dashboard prototypes designed for EHR integration. As one of few such systems in development, it provides initial evidence for monitoring cancer outpatients' health and predicting clinical deterioration risks. While the necessary technologies are becoming more accessible, further work is needed to improve patient engagement, trust in wearables and apps, and integration of at-home reporting. Enhancing patient onboarding, simplifying device management, and automating data processing will support the seamless integration of these technologies into modern ambulatory cancer care. **Publications:** 5
Daniel J. France **Vanderbilt University** Nashville, Tennessee	R01 HS028430 [Grant] **Realtime Measurement of Situational Workload in NICU Nurses to Improve Workload Management and Patient Safety** 2022–2026 $799,026	**Purpose:** Improve neonatal patient safety by changing the way nursing workload in the neonatal intensive care unit (NICU) is measured and used for workload management, organizational learning, and improvement. **Key Findings/Impacts:** This project is ongoing until February 28, 2026, and a final report is not available, but a resulting article provides insights into nurses' experiences and self-initiated strategies for handling unanticipated workload challenges, which can inform the development of real-time workload measurement tools and interventions proposed in the grant. By examining the practical challenges and adaptive strategies of NICU nurses, it offers valuable perspectives that can enhance the grant's approach to workload management and patient safety. **Publications:** 1
TEXAS		
Jason Etchegaray **The University of Texas Health Science Center at Houston** Houston, Texas	K02 HS017145 [Grant] **Linking Characteristics of High-Performing Hospitals with Patient Safety** 2007–2011 $320,592 Final Report	**Purpose:** Review the literature focused on high-performance work systems (HPWS) practices (e.g., training, rewards), develop and validate a survey to measure HPWS practices, and explore measurement and content issues in the safety culture area. **Key Findings/Impacts:** In the final report, investigators stated that surveys to predict healthcare outcomes traditionally focused on safety and teamwork culture, but other organizational factors merit attention, such as HPWS practices. Given general interest from researchers in examining more contextual factors, they recommended that HPWS practices and new types of culture (e.g., error disclosure culture) should be examined to see what role they play in predicting outcomes. They concluded that HPWS and error disclosure culture add substantial value when predicting outcomes and should therefore be examined by researchers in future studies trying to predict safety and quality outcomes. **Publications:** 17

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
Martina Klein **Texas Tech University** Lubbock, Texas	R03 HS025548 [Grant] **Validity Assessment of a Real-Time Indicator of Attentional Load and Task-Induced Fatigue in the MIS Environment** 2017–2019 $103,397 Final Report	**Purpose:** Assess whether blood flow velocity (BFV) of the middle cerebral arteries (MCAs) can serve as a real-time indicator of attentional load, attentional resource depletion, and task-deterioration in the laparoscopic environment, also known as a minimally invasive surgery (MIS) environment. As experts are expected to experience lower attentional load, the present study also investigated whether MCA BFV can differentiate between novice and expert laparoscopists. **Key Findings/Impacts:** The final report revealed that MCA BFV profiles could effectively differentiate between novice and expert laparoscopists in a single-task environment. However, the method lacked sensitivity in distinguishing various camera-induced attentional load levels. Preliminary evidence suggested that MCA BFV declines coincided with vigilance decrements, indicating potential attentional resource depletion during laparoscopic tasks. While these findings support the potential use of MCA BFV as a real-time indicator of vigilance performance in laparoscopic training, further research is needed to clarify these initial results and determine the method's sensitivity to different factors affecting task difficulty and attentional load in the laparoscopic environment. **Publications:** 2
UTAH		
Ginette Pepper **The University of Utah** Salt Lake City, Utah	R01 HS011966 [Grant] **Nurses' Working Conditions: Effects on Medication Safety** 2001–2006 $1,115,432	**Purpose:** Describe the relationship between working conditions that affect nurses and the safety and quality of care they provide, with a focus on medication safety. This study emphasized organizational variables that can be affected administratively, rather than individual nurse characteristics. **Key Findings/Impacts:** A final report was not available; however, a review produced by the project highlighted the importance of theories in guiding health services research related to nursing. While nursing-focused health services research is relatively limited, there is growing recognition of the need to understand how nursing practice influences various aspects of health care, including use, costs, quality, delivery, organization, financing, and outcomes. The review noted that researchers use a diverse range of conceptual models, often of their own creation, when conducting workforce-related health services research in nursing. The authors suggested that this diversity may eventually lead to the emergence of new theories or frameworks that uniquely combine clinical, organizational, financial, and outcome variables from a nursing perspective, providing guidance for future researchers and enhancing coherence in nursing-related health services research. **Publications:** 1

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
Barbara Wilson **The University of Utah** Salt Lake City, Utah	R03 HS024607 [Grant] **Labor and Delivery Nurse Staffing: A Patient Safety Intervention** 2016–2018 $100,000 Final Report	**Purpose:** Test a validated labor and delivery (L&D) staffing model to determine if it can predict nurse-sensitive perinatal outcomes as in other areas of care, thus leading to future studies that can examine whether manipulating staffing levels can mitigate adverse obstetrical outcomes. **Key Findings/Impacts:** According to the final report, researchers reported that while a simple linear regression of the likelihood of a C-section on nursing hours per delivery indicated no statistically distinguishable effect, their 'optimal staffing' model indicated that intrapartum nurse staffing influences unanticipated cesarean births in low-risk women. The optimal staffing models did not appear to influence NICU admissions. However, there were significant differences between hospitals. In all specifications, there were controls for weeks' gestation, race, sex of the child, and mother's age. **Publications:** 1
VIRGINIA		
Marianne Baernholdt **Virginia Commonwealth University** Richmond, Virginia	R01 HS023147 [Grant] **Care Interventions and Quality of Care in Rural and Urban Nursing Units** 2014–2018 $941,576 Final Report	**Purpose:** Identify risks and prevent patient injury associated with delivery of health care, including examining effective ways to make systems changes and creating an environment within healthcare settings that prevents adverse patient safety events. **Key Findings/Impacts:** According to the final report, a study comparing pressure ulcer rates (PUR) and fall rates (FR) in rural and urban nursing units found no significant differences between them. However, rural units had about 30% lower hospital-acquired PUR despite similar patient risk levels. The percentage of patients assessed for fall risk and patients deemed at risk for falls were higher in rural units, but actual FR were comparable. Rural nurses reported lower job satisfaction and practice environment scores, but also lower intent-to-leave scores. While rural units had higher overall nursing care hours, they had a lower proportion of RN hours (versus LPN and unlicensed assistive personnel) and fewer BSN-educated RNs compared to urban units. This indicates rural units relied more heavily on non-RN staff and RNs with associate degrees or diplomas to deliver patient care. Researchers recommend considering contextual factors, patient characteristics, and preventive interventions in future studies and healthcare policies to avoid unintended consequences based on location. **Publications:** 3

Principal Investigator Organization City, State	Project Number [Type] Project Title Project Period Total Investment to Date	Purpose, Key Findings/Impact, and Number of Publications
WASHINGTON		
Lois James **Washington State University** Pullman, Washington	R01 HS025965 [Grant] **The Impact of Shift-Accumulated Fatigue on Patient Care and Risk of Post-Shift Driving Collisions Among 12-Hour Day- and Night-Shift Nurses** 2018–2021 $1,043,953 Final Report	**Purpose:** Determine the impact of shift-accumulated fatigue on the spectrum of daily activities that nurses engage in, from patient care to post-shift drive home. **Key Findings/Impacts:** According to the final report, a study on nurse sleep patterns and their effects on performance revealed that nurses experienced significant sleep restriction and increased sleepiness after three consecutive shifts. However, they generally maintained patient care competence and driving safety in simulated environments. Night-shift nurses showed impaired patient care skills, particularly in communication, and demonstrated greater driving safety risks compared with day-shift nurses. The study found that cognitive effectiveness declined to "elevated risk" levels after 8 hours and "high risk" levels after 10 hours, especially during second and third consecutive shifts. Night-shift nurses were at high risk 2 hours before shift end, while day-shift nurses remained at low risk. Based on these findings, researchers recommended hospitals consider limiting shifts to 8 hours, be cautious with night shift scheduling, and assess nurses' capacity for additional hours before assigning overtime. The study employed physiological measurements and bio-mathematical modeling to identify sleep characteristics and estimate cognitive decline, offering insights for policy decisions regarding shift duration, timing, and overtime allocation. While extended shifts may benefit patient continuity of care, concerns were raised about increased stress, fatigue, and burnout potentially compromising patient safety. **Publications:** 6
WISCONSIN		
Mark Linzer **University of Wisconsin–Madison** Madison, Wisconsin	R01 HS011955 [Grant] **MEMO 2: Improving Work Conditions and Quality in Ambulatory Care** 2001–2005 $1,475,349 Final Report	**Purpose:** Determine the effect of the healthcare work environment on the quality of care and the role of physicians as mediators of this effect. **Key Findings/Impacts:** Investigators in the final report conclude that early results from Minimizing Error, Maximizing Outcome (MEMO) clearly establish the primacy of the work environment in affecting physicians' abilities to carry out their roles as patient care providers. The impact of the stress, burnout, and lack of trust reported by many medical doctors, and of the chaotic environment seen in many offices, was quantified in the final (patient) phase of MEMO. **Publications:** 14
Jonathan Temte **University of Wisconsin–Madison** Madison, Wisconsin	R03 HS016026 [Grant] **Problem Density, Mental Workload, and Medical Error in Primary Care Practice** 2006–2008 $99,998 Final Report	**Purpose:** Evaluate relationships among number of problems per encounter, clinician workload, and medical error. **Key Findings/Impacts:** In the final report, investigators reported that they attempted to dissect components of primary care complexity in a causal chain from a human factors engineering perspective. The number of problems in a visit affects the clinician's workload. Workload may contribute to errors. Further study of this is warranted to better define relationships and identify interventions that can reduce workload and medical error. **Publications:** 3

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