# AHRQ-Funded Patient Safety Project Highlights

# Improving Healthcare Safety by Enhancing Medication Safety

## Overview

Medication safety refers to the practices and measures implemented to minimize the risk of medication errors and adverse drug events (ADEs) in various settings across the healthcare continuum. It is a critical process for protecting patients from harm and improving healthcare quality. Since 2000, AHRQ has supported 123 patient safety projects related to medication safety. This publication summarizes AHRQ's investments 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.

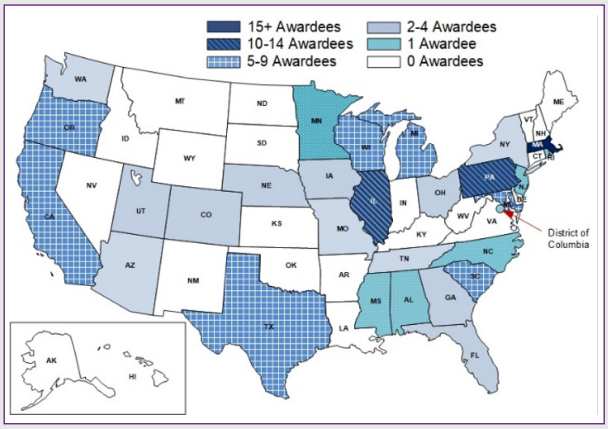
### Scope of AHRQ Investments

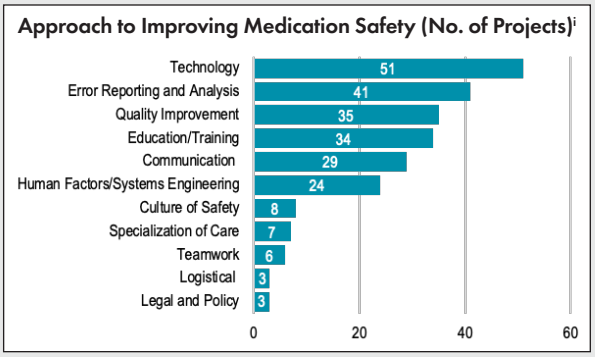
**123** projects

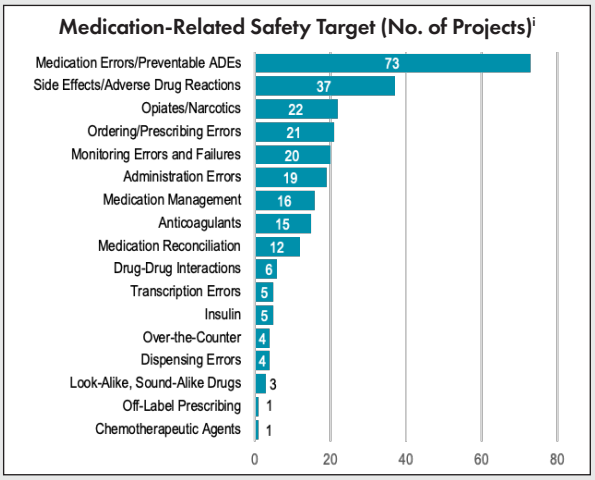
**920** publications*

**51,658** citations*

Geographical Distribution of Funding




*as of 11/6/2023

At least 920 publications, which have collectively been cited 51,658 times in other articles, have resulted from this research. Technology was the primary approach used for improving medication safety (n=51 projects, 41%). The primary medication-related safety target for 73 projects (59%) included work on understanding, identifying, and reducing medication errors and preventable ADEs, followed by side effects and adverse drug reactions (n=37, 30%), and harms associated with opiates and narcotics (n=22, 18%).

[i] The total number of projects is greater than 123 as some projects used more than one approach to improving safety or had more than one safety target.


AHRQ Agency for Healthcare Research and Quality

PATIENT SAFETY

## Examples of Project Findings

The projects included in this collection of work center around medication safety, which includes actions and errors that occur from the point of prescription to administration, as well as specific medications or delivery methods. These projects typically fall into one or more of the following categories:

- Epidemiology of medication errors in various settings and populations,
- High-risk medication errors and approaches to improve monitoring,
- Look-alike or sound-alike medications,
- Off-label prescriptions,
- Prescription and use of opioids,
- Medication reconciliation and management during transitions of care, and
- Use of technological advances to mitigate medication errors.

Examples of these projects and summaries of their results are described below and organized by research themes identified in this collection of work.

### Understanding and Addressing the Opioid Crisis

To improve the nation's response to the opioid epidemic, AHRQ funded several projects focused on understanding this crisis and providing solutions. For example:

- One project developed and successfully tested an intervention that increased HIV primary care providers' adherence to the Centers for Disease Control and Prevention Opioid Prescribing Guideline.
- Another project developed the Resources Encouraging Safe Prescription Opioid and Naloxone Dispensing (RESPOND) Toolkit to enhance community pharmacists' use of Prescription Drug Monitoring Program data to improve opioid safety.
- To provide a roadmap for improving care for patients with chronic pain using long-term opioid therapy, one project developed and evaluated an implementation toolkit for the Six Building Blocks: A Team-Based Approach to Improving Opioid Management in Primary Care.
- Another project successfully applied a systems-level approach to improve delivery of and access to pharmacy-based naloxone and concluded that pharmacies can be optimized for broader naloxone distribution with focused training and deliberate attention to stigma reduction.

### Improving Medication Safety Among Priority Populations

Several projects focused on improving medication safety among priority populations in various healthcare settings, most notably children and older adults. For example:

- One project successfully implemented a program that improved the quality of prescribing practices for older adults discharged from the emergency department in three health systems.
- Another project improved warfarin management among residents in 26 community nursing homes representative of nursing homes across the United States, using a standardized nurse-physician handoff communication tool.
- To reduce medication-associated acute kidney injury in nine pediatric hospitals, one project disseminated a successful screening and surveillance intervention and later aimed to disseminate it to 140 pediatric institutions in the Solutions for Patient Safety Network.

- Another project conducted a randomized controlled trial to better understand how older adults use risk information on over-the-counter (OTC) package labels to form their overall risk perceptions of using an OTC drug product and determine their sources of drug information.
- One project used learning networks supported by the Cincinnati Children's Hospital to develop and test efforts aimed at improving pediatric outcomes by optimizing the use of therapeutics. Subthemes included quality and patient safety, practice-based research and improvement networks, pharmacogenomics, and performance metrics.

### Improving Medication Safety During Transitions in Care

Several projects focused on improving medication safety transitions in care settings and during clinical handoffs between healthcare professionals. For example:

- One project successfully developed and tested a process for medication reconciliation at transitions and clinical handoffs (MATCH), using a multidisciplinary team that examined its internal processes, workflow, and staff responsibilities.
- A subsequent project was funded to develop the MATCH Toolkit to support broader implementation in other acute care settings. The toolkit incorporates the experiences and lessons learned by healthcare facilities that have implemented the MATCH strategies.
- Another project found that adoption of a multifaceted medication reconciliation quality improvement initiative using a mentored implementation model in inpatient hospital settings was associated with a reduction in potentially harmful medication discrepancies over time.
- A subsequent implementation study observed that hospital sites that implemented this quality improvement approach saw a steady decline in their medication discrepancy rate from approximately 2.85 discrepancies/patient to 0.98 discrepancy/patient.

### Applying Technological Approaches to Medication Safety

Many projects applied technological strategies for improving medication safety. For example:

- One project used barcode verification technology within an electronic medication-administration system to decrease overall rates of dispensing errors and potential ADEs and demonstrate a positive financial impact based on a cost-benefit analysis.
- Another project evaluated the impact of using a computerized provider order entry system to reduce the frequency of medication errors resulting from problems such as illegibility, use of inappropriate abbreviations, and missing information.
- One project found that Smart IV pumps administering high-alert medications with built-in dose limits benefited from prospective risk analysis and usability testing.
- Another project found that a multifaceted information technology intervention combining clinical information systems, clinician alerts, and a clinical decision support tool was associated with lower hospitalization rates and lower patient medication complexity risks.

## Impacts

AHRQ-funded medication safety projects have aimed to improve the quality of medication safety by better understanding and addressing related challenges such as medication error identification and management, availability of resources and training, and promotion of shared decision making. Collectively, the 123 AHRQ-funded projects have resulted in:

- New knowledge within the field of medication safety using qualitative and quantitative research methods, data analysis techniques, and risk models and assessments.
- Development, implementation, and evaluation of tools, toolkits, quality improvement measures, policies and guidelines, education and training programs, and technological interventions.
- Identification of research gaps and areas that may need further investigation within the field of medication safety.
- Synthesis and dissemination of research findings via conferences and publications.

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

- Surveillance and reporting of medication-related errors and adverse events (e.g., automated detection methods, reporting programs or systems).
- Physician adherence to clinical practice guidelines (e.g., for prescribing, dosing, monitoring).
- Patient adherence to prescribed medications (e.g., fewer missed doses, fewer side effects).
- Medication safety for various patient populations (e.g., older adults, children) and among a variety of high-risk medications (e.g., opioids, insulin, anticoagulants, and antipsychotics).
- Interprofessional collaboration and communication (e.g., between physicians, nurses, and pharmacists).
- Technological approaches and strategies to improving medication safety (e.g., barcode technologies, smart infusion pumps).

To learn more about each project included in the synthesis, refer to the Appendix that follows.

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# Appendix

## Medication Safety Project Summary

This appendix briefly describes AHRQ-funded projects related to medication safety. Projects are organized first by state, then by original date of funding. The grants listed below are linked to the NIH RePORTER, an electronic tool that allows users to search a repository of federally funded research projects and access publications resulting from such funding.

| Principal Investigator Organization City, State | Project Number [Type] Project Title Project Period Total Investment | Purpose, Key Findings/Impact, and Number of Publications |
|---|---|---|
| **ALABAMA** | | |
| Jacqueline Moss<br>**University of Alabama, Birmingham**<br>Birmingham, Alabama | U18 HS16660<br>[Grant]<br>**Clinical Decision Support Simulations for Medication Administration Safety**<br>2009-2011<br>$395,462<br>Final Report | **Purpose:** Develop a methodology and tools for the design of clinical decision support systems to decrease the incidence of medication administration errors.<br>**Key Findings/Impact:** Nurses' evaluation of the medication administration decision support tools as well as their actual performance revealed a tendency to underestimate their need for support. Their preferences were for decision support that was short, color coded, and easily accessed. Observations of medication administration showed that nurses exhibit a variety of work processes to prepare and administer medications to patients and access system decision support tools at a variety of points in this process.<br>This study was performed in one hospital and results may not generalize beyond this setting. However, this method used to design and test decision support could be transferred to other settings. System design should allow flexibility of multiple points and types of information delivery that can accommodate variations in workflow to minimize the tendency for system workarounds.<br>**Publications:** 2 |
| **ARIZONA** | | |
| Daniel Malone<br>**University of Arizona**<br>Tucson, Arizona | R13 HS21826<br>[Grant]<br>**Drug-Drug Interaction Clinical Decision Support Conference Series**<br>2012-2015<br>$287,596<br>Final Report | **Purpose:** Provide recommendations for evaluation of evidence for drug-drug interactions (DDIs), identify principles for including DDI alerts in clinical decision support (CDS), and establish preferred strategies for presenting DDI clinical decision support notifications.<br>**Key Findings/Impact:** Recommendations in the final report included consistent use of terminology, visual cues, minimal text, formatting, content, and reporting standards to facilitate usability. Experts recommended (1) a transparent, systematic, and evidence-driven process with graded recommendations by a consensus panel of experts and oversight by a national organization; (2) judicious classification of DDIs as contraindicated, and (3) more research to identify methods to safely reduce repetitive and less relevant alerts. The project deliverables (i.e., workgroup white papers, recommendations, webinars, meetings/conference proceedings) can provide meaningful improvement to DDI CDS and thereby reduce alert fatigue, improve workflow, reduce medication errors, and improve patient safety.<br>**Publications:** 7 |

| Principal Investigator Organization City, State | Project Number [Type] Project Title Project Period Total Investment | Purpose, Key Findings/Impact, and Number of Publications |
|---|---|---|
| Neena Abraham<br>**Mayo Clinic**<br>Phoenix, Arizona | R01 HS25402<br>[Grant]<br>**Gastrointestinal Safety of Antithrombotic Drug Regimens**<br>2017-2021<br>$1,410,985<br>Final Report | **Purpose:** Develop an algorithm to predict antithrombotic-related gastrointestinal bleeding (GIB) to inform the development of a clinical delivery platform.<br>**Key Findings/Impact:** Compared with the HAS-BLED bleeding risk score, Regularized Cox (RegCox) regression, random survival forest (RSF), and extreme gradient boosting (XGBoost) demonstrated similar performance in identifying high-risk gastrointestinal bleeding (GIB) patients. The most important variables in the RegCox model were prior GIB, atrial fibrillation, ischemic heart disease, and venous thromboembolism combined and use of gastroprotective agents.<br>Researchers concluded that the risk of antithrombotic-related GIB is significant in older patients. They constructed a model with improved sensitivity and specificity using machine learning methods and showed the choice of method was not critical to model performance. All models were superior to the HAS-BLED model and could serve as the basis for a clinical risk assessment tool.<br>**Publications:** 65 |
| **CALIFORNIA** | | |
| Timothy Dresselhaus<br>**Veterans Medical Research Foundation-San Diego**<br>San Diego, California | UC1 HS14283<br>[Grant]<br>**Real-Time Assessment of Risk Factors-Medication Errors**<br>2003-2005<br>$449,536<br>Final Report | **Purpose:** Demonstrate the feasibility of a novel handheld instrument for real-time assessment of risk factors and error reporting; Identify the types of medication errors that occur for different clinicians in different hospital settings and characterize the risks they pose to patient safety.<br>**Key Findings/Impact:** Researchers concluded the Dynamic Handheld Survey Tool is a feasible, efficient instrument for capturing complex information in real time in the clinical work context. The significance of this research is that understanding the factors in the clinical work environment that affect frontline clinicians will better inform the design of interventions to reduce errors. Generalizable findings will contribute to patient safety efforts nationwide. Importantly, these efforts provide insights into the usefulness of the novel patient safety methods embodied in this proposal, and these insights will assist in future research.<br>**Publications:** 6 |
| David Magid<br>**Kaiser Foundation Research Institute**<br>Oakland, California | UC1 HS14249<br>[Grant]<br>**Improving Drug Safety: Linking Lab and Pharmacy Data**<br>2003-2007<br>$930,778<br>Final Report | **Purpose:** Refine and implement a pharmacy alert system that uses linked data from the Pharmacy Information System and the Laboratory Information System to identify and warn pharmacists of possible errors.<br>**Key Findings/Impact:** This study addressed medication errors and provided a realistic estimate of intervention effects in other settings via multiple projects. The implications of these projects for Kaiser Permanente Colorado are improved patient safety and clinical outcomes and reduced costs due to fewer adverse medication-related events. The projects have improved communication and collaboration among pharmacists, physicians, laboratory personnel, call center staff, and patients. All the interventions have become part of routine clinical practice in Colorado.<br>**Publications:** 7 |

| Principal Investigator Organization City, State | Project Number [Type] Project Title Project Period Total Investment | Purpose, Key Findings/Impact, and Number of Publications |
|---|---|---|
| Grace Kuo<br>**University of California, San Diego**<br>San Diego, California | K08 HS14552<br>[Grant]<br>**Safe Use of Medications in Primary Care Practices**<br>2005-2010<br>$522,162 | **Purpose:** Identify exemplary methods and exemplars for medication reconciliation (e.g., capturing and resolving discrepancies between the medications actually being taken and those recorded in patients' medical records).<br>**Key Findings/Impact:** A final report was not available, but at least six publications were supported by this project. Three of them investigated functional health literacy and medication name recall or physician use of the electronic medical record (EMR) to print medication information. One described the results of a systematic review that confirmed the prevalence of medication discrepancy was high in ambulatory care and higher in primary care settings.<br>Effective strategies for medication reconciliation included the use of pharmacists, letters, a standardized practice approach, and partnership between providers and patients. Future studies were recommended to investigate potential cost-savings from medication features of the EMR.<br>Two publications described the production of a 10-step roadmap for conducting practice-based research network projects. Medication outcomes from the study included improved medication use, increased awareness of medication counseling, decreased medication errors, and identification of best practices for medication reconciliation.<br>**Publications:** 6 |
| Jinoos Yazdany<br>**University of California, San Francisco**<br>San Francisco, California | R01 HS24412<br>[Grant]<br>**ASPIRE: Advancing Safety Process Innovation in Rheumatology**<br>2015-2018<br>$1,444,344<br>Final Report | **Purpose:** Characterize ambulatory medication safety events related to high-risk immunosuppressive drugs and use these data to develop electronic quality measures (eMeasures) to monitor and improve care.<br>**Key Findings/Impact:** This project generated new epidemiologic evidence of patient safety risks and adverse events for drugs that are increasingly used by those with autoimmune diseases. Two eMeasures, related to screening for latent infections and hydroxychloroquine dosing, were developed and are now part of the Centers for Medicare & Medicaid Services Quality Payment Program. In addition, these patient safety eMeasures were successfully implemented nationally in RISE, a Qualified Clinical Data Registry used for federal reporting and practice improvement by U.S. rheumatologists.<br>**Publications:** 32 |
| Tina Hernandez-Boussard and Catherine Mills Curtin<br>**Stanford University**<br>Stanford, California | R01 HS27434<br>[Grant]<br>**Identifying Optimal Pain Management for Elders**<br>2021-2026<br>$393,732 | **Purpose:** Validate risk-stratification tools derived from real-world evidence to identify older patients at high risk for adverse pain outcomes after surgery, which can reduce prescribed opioids circulating in the community—a key to curbing the opioid epidemic.<br>**Key Findings/Impact:** This project is ongoing, and a final report is not available yet. In an early study, researchers conducted a systematic literature review to further identify quality measures in research publications after searching three databases: The National Quality Forum Quality (NQF) Positioning System, AHRQ Quality Indicators, and Centers for Medicare & Medicaid Services Measures Inventory Tool. Researchers identified 19 pain management quality measures from the quality measure databases, and NQF endorsed 5.<br>The NQF measures were not specific to postoperative pain management. Three of the non-endorsed measures were specific to postoperative pain. Researchers concluded there is a great need for more rigorous evidence and widely endorsed postoperative pain quality measures to guide best practices.<br>**Publications:** 3 |

| Principal Investigator Organization City, State | Project Number [Type] Project Title Project Period Total Investment | Purpose, Key Findings/Impact, and Number of Publications |
|---|---|---|
| Jinoos Yazdany<br>**University of California, San Francisco**<br>San Francisco, California | R01 HS28024<br>[Grant]<br>**Advancing Safety Process Innovation in Rheumatology (ASPIRE)**<br>2022-2027<br>$397,229 | **Purpose:** Develop and disseminate the first implementation toolkit to improve patient safety for high-risk immunosuppressive drugs.<br>**Key Findings/Impact:** This project is ongoing until April 30, 2027, and no final report is available yet. However, this grant has two published articles to date. One is a review of publications that assess opioid use in patients with inflammatory rheumatic disease. Researchers found high use of opioids in patients, although they found little evidence to support the efficacy of their use for pain control. In addition, evidence was found showing their use causes adverse events.<br>The other article describes a study that assesses factors among severe COVID-19 symptoms in patients with psoriasis, psoriatic arthritis, and axial spondylarthritis. Researchers found that older age, male sex, comorbidity burden, higher disease activity, and glucocorticoid use were associated with more severe symptoms.<br>**Publications:** 2 |
| **COLORADO** | | |
| Katherine Jones<br>**University of Colorado, Denver**<br>Denver, Colorado | U18 HS11093<br>[Grant]<br>**Improving Pain Management in Nursing Homes**<br>2000-2004<br>$1,583,029<br>Final Report | **Purpose:** Develop and test a multifaceted educational and behavioral intervention to improve nursing home (NH) pain management practices.<br>**Key Findings/Impact:** The intervention was partially successful in improving NH pain practices. Applied nursing knowledge improved, while attitudes remained unchanged in treatment homes. Residents experienced less constant pain but reported the same pain intensity. Prescribing practices improved over time, as did documentation of pain assessments. Staff and administrative turnover and leadership style influenced intervention implementation.<br>**Publications:** 10 |
| Wilson Pace<br>**University of Colorado, Denver**<br>Denver, Colorado | R18 HS17886<br>[Grant]<br>**Improving Medication Management in Ambulatory Care**<br>2008-2011<br>$891,952 | **Purpose:** Improve the safety culture of the ambulatory care clinics of University of Colorado Hospital using errors in medication management as the learning substrate.<br>**Key Findings/Impact:** A final report was not available, and publications could not be found.<br>**Publications:** 0 |

| Principal Investigator Organization City, State | Project Number [Type] Project Title Project Period Total Investment | Purpose, Key Findings/Impact, and Number of Publications |
|---|---|---|
| **DISTRICT OF COLUMBIA** | | |
| Julia Lear<br>**George Washington University**<br>Washington, DC | R13 HS14208<br>[Grant]<br>**Improving Quality in Medication Management in Schools**<br>2003-2005<br>$45,921<br>Final Report | **Purpose:** Examine the health safety and quality aspects of medication management for children in school settings.<br>**Key Findings/Impact:** Smaller workshop discussions examined the challenges to reducing risk in medication management in schools. Overall, this project had three important outcomes. First, the issues associated with medication management in schools were brought together, evaluated by a broad group of stakeholders and experts, discussed by a broader group of conferees, and refined into a document endorsed by the participants.<br>After the conference, the proceedings and the recommendations similarly were reviewed, edited, and endorsed by the 30 participants. The proceedings were published by the Center for Health and Health Care in Schools. By spring 2005, 2,500 copies had been mailed or distributed at conferences to key leaders in child health quality and in school health. In addition, the report was posted on the Center website where a larger number of unique visitors viewed the document.<br>Although not anticipated in the original grant application, concerns registered by conference participants on the specific issue of psychotropic drugs at school led the Center to prepare a fact sheet, "Psychotropic Drugs and Children: Use, Trends, and Implications for Schools." This publication has been well received by state policymakers and building-based school nurses. The Center has mailed out 4,400 copies of the fact sheet and 23,134 visitors have downloaded or viewed it from the Center website.<br>**Publications:** 2 |
| **FLORIDA** | | |
| Earlene Lipowski<br>**University of Florida**<br>Gainesville, Florida | R13 HS16844<br>[Grant]<br>**Embracing the PBRN Model To Improve the Medication Use Process**<br>2007<br>$47,200<br>Final Report | **Purpose:** Bring together faculty researchers and clinicians from multiple disciplines to consider practice-based research networks (PBRNs) in pharmacy settings as a way to improve medication use.<br>**Key Findings/Impact:** The first round of discussion groups identified actions needed to form a PBRN for improving medication use:<br>1. Establish relationships with key stakeholders to further PBRN development, which involves establishing relationships with key stakeholders and together creating a working definition of the desired PBRN.<br>2. Develop a rigorous and robust PBRN research program of study with the aim of improving patient care.<br>3. Empower and educate pharmacists for participation in practice-based research that would require forming a resource center for the PBRN, acquiring tools that facilitate collaboration, identifying and sharing best practices, and conducting the education and training needed to support research.<br>4. Engage patients in practice-based research by building personal relationships with them and removing barriers to their participation in research.<br>Within 6 months of the conference, PBRN development activity was reported by conference participants from University of Colorado, Iowa, Connecticut, Wisconsin, and Texas Tech. Two institutions already affiliated with the PBRN in upstate New York, University at Buffalo and Albany College of Pharmacy, continued their efforts. The Virginia Commonwealth Pharmacy Education and Research Network officially registered as a PBRN with AHRQ.<br>**Publications:** 10 |

| Principal Investigator Organization City, State | Project Number [Type] Project Title Project Period Total Investment | Purpose, Key Findings/Impact, and Number of Publications |
|---|---|---|
| Nisaratana Sangasubana<br>**Nova Southeastern University**<br>Fort Lauderdale, Florida | R03 HS16801<br>[Grant]<br>**The Elderly and Over-the-Counter (OTC) Labeling Information: A Randomized Controlled Experiment Test**<br>2007-2010<br>$61,135<br>Final Report | **Purpose:** Develop a questionnaire to test the effects of over the counter (OTC) medication risk labeling information on older consumers' overall risk perceptions of using OTCs and determine their likelihood of using different sources for additional information beyond the label.<br>**Key Findings/Impact:** Participants reacted favorably to the survey topic and design. However, the questionnaire needed to be redesigned because the subjects had difficulty with (1) imagining themselves in the scenarios, (2) recalling information, (3) distinguishing between different risk manipulations, and (4) understanding labeling terminology inconsistent with words used by healthcare professionals.<br>Researchers concluded it is critical to design questionnaires that address the needs of older subjects. The study design for questionnaire implementation should also be tailored to the needs of older subjects. Questionnaires should always be pretested in age-specific groups to evaluate subjects' understanding before actual field distribution.<br>**Publications:** 1 |
| Yu-Jung Wei<br>**University of Florida**<br>Gainesville, Florida | R03 HS27230<br>[Grant]<br>**Prescription Opioid Use Trajectories and Risk Factors Associated With Opioid-Related Hospitalizations in Older Adults**<br>2019-2021<br>$99,999<br>Final Report | **Purpose:** Assess high-risk prescription opioid use patterns and risk factors associated with opioid-related adverse events (ORAEs), including opioid misuse, opioid use disorder, and opioid overdose among older adults.<br>**Key Findings/Impact:** The risk of ORAEs increased with increasing prescribed opioid dose and was associated with receipt of duplicated opioids, chronic opioid use, and co-use of opioids with other central nervous system medications. Significant predisposing factors of ORAEs included mental health conditions, cardiovascular diseases, and kidney disease.<br>Significant prognostic factors associated with subsequent increased risk of ORAEs among older adults included newly diagnosed injury, respiratory infection, and infection due to nonsterile opioid injection after opioid initiation. Regular monitoring of these events after initiating prescription opioids may help identify older opioid users at risk for ORAEs.<br>**Publications:** 6 |
| **GEORGIA** | | |
| Mark Williams<br>**Emory University**<br>Atlanta, Georgia | U18 HS15882<br>[Grant]<br>**Hospital Patient Safe-D(ischarge): Discharge Bundle for Patients**<br>2005-2007<br>$466,664 | **Purpose:** Implement a "discharge bundle" of patient safety interventions advocated by the Joint Commission on Accreditation of Healthcare Organizations, the National Quality Forum, and AHRQ. Interventions included medication reconciliation, discharge education, and a postdischarge continuity check by a clinician.<br>**Key Findings/Impact:** A final report was not available. One publication is a commentary that describes several salient but dysfunctional moments in the discharge process and provides suggestions for improvement.<br>**Publications:** 1 |

| Principal Investigator Organization City, State | Project Number [Type] Project Title Project Period Total Investment | Purpose, Key Findings/Impact, and Number of Publications |
|---|---|---|
| Elizabeth Vaughan<br>**Emory University**<br>Atlanta, Georgia | R18 HS24499<br>[Grant]<br>**EQUIPPED (Enhancing Quality of Prescribing Practices for Older Adults Discharged From the Emergency Department)**<br>2016-2019<br>$1,527,584<br>Final Report | **Purpose:** Evaluate adaptation in non-Veterans Affairs health systems of the EQUIPPED program, an innovative quality improvement initiative developed within the Veterans Health Administration to reduce potentially inappropriate medication (PIM) prescribing to adults age 65 years and older discharged from the ED.<br>**Key Findings/Impact:** The EQUIPPED program was successfully implemented in three health systems (Grady Health System in Atlanta, GA; Mount Sinai Health System in New York, NY; and Duke Health System in Durham, NC). Assessment of the sequential approach yielded an implementation package that can be vetted, piloted, evaluated, and finalized for large-scale dissemination in community-based settings.<br>Evaluation of monthly PIM prescribing rates at each implementation site showed a sustained trend toward improved prescribing, approaching the monthly target of 5 percent PIMs or less. Evaluation of site and provider-level factors impacting EQUIPPED implementation was to be combined with a second AHRQ-funded spread/scale project.<br>**Publications:** 2 |
| **ILLINOIS** | | |
| Bruce Lambert<br>**University of Illinois at Chicago**<br>Chicago, Illinois | R01 HS11609<br>[Grant]<br>**Auditory Perception of Drug Names: Neighborhood Effects**<br>2003-2008<br>$1,700,525<br>Final Report | **Purpose:** Minimize the incidence of name confusion errors by developing an empirically validated, user-friendly software tool that healthcare providers and patients can use to screen proposed drug names against databases of existing drug names.<br>**Key Findings/Impact:** Overall, researchers found that high-quality drug name retrieval systems can be designed using techniques from computer science and computational linguistics. This project's experiments validated some of these measures against human performance in an auditory perception task. Findings suggest that no single ranking method will perform as well as a method that intelligently combines multiple ranking methods. Systems such as the one designed in this study are used by the Food and Drug Administration ( Phonetic and Orthographic Computer Analysis program) to analyze proposed new drug names. These systems need continual updating and refinement.<br>By the end of 2008, researchers had planned to release a test collection of drug names and relevance judgments that could be used to evaluate current and future retrieval systems. When evaluating new drugs for confusability, researchers believe the output of computerized drug name searches should be used as input to a panel of human experts.<br>**Publications:** 6 |
| Gary Noskin<br>**Northwestern University at Chicago**<br>Chicago, Illinois | U18 HS15886<br>[Grant]<br>**Medications at Transitions and Clinical Handoffs (MATCH)**<br>2005-2007<br>$575,480<br>Final Report | **Purpose:** Implement a process for medication reconciliation at Northwestern Memorial Hospital and evaluate the intervention's effectiveness.<br>**Key Findings/Impact:** Researchers found that medication discrepancies upon admission were common. Preliminary data suggest that patients on an increased number of medications are at risk for medication reconciliation failures. The presence of a medication list may help prevent discrepancies in patients' medication histories. Also, early identification and correction of medication reconciliation failures may mitigate or prevent patient harm. The results are consistent with the findings of other researchers and support the patient safety benefits of reconfirming medication histories and performing reconciliation.<br>**Publications:** 3 |

| Principal Investigator Organization City, State | Project Number [Type] Project Title Project Period Total Investment | Purpose, Key Findings/Impact, and Number of Publications |
|---|---|---|
| Bruce Lambert<br>**University of Illinois at Chicago**<br>Chicago, Illinois | U18 HS16973<br>[Grant]<br>**Tools for Optimizing Prescribing, Monitoring, and Education**<br>2007-2012<br>$3,937,671<br>Final Report | **Purpose:** Improve patient safety by developing and refining tools for safer medication use.<br>**Key Findings/Impact:** Researchers had varying levels of success and productivity across the five project areas. They were most successful and productive in the work on formulary decision making, drug utilization review, and lab-pharmacy linkages and less so in pharmacoeconomics and N-of-1 clinical trials.<br>**Publications:** 27 |
| **Northwestern Memorial Hospital**<br>Chicago, Illinois<br>**Island Peer Review Organization**<br>Lake Success, New York | HHSA290200900013C<br>[Contract]<br>**Medications at Transitions and Clinical Handoffs (MATCH) Toolkit for Medication Reconciliation**<br>2009-2013<br>NA | **Purpose:** Develop a toolkit based on the Medications at Transitions and Clinical Handoffs (MATCH) web site.<br>**Key Findings/Impact:** A final report was not available; however, the MATCH Toolkit for Medication Reconciliation is on the AHRQ website. The toolkit provides a step-by-step guide to improving the medication reconciliation process and is divided into seven components to assist with improvement:<br>• Building the Project Foundation: Gaining Leadership Support Within the Organization<br>• Building the Project Foundation: Project Teams and Scope<br>• Developing Change: Designing the Medication Reconciliation Process<br>• Developing and Pilot Testing Change: Implementing the Medication Reconciliation Process<br>• Education and Training<br>• Assessment and Process Evaluation<br>• High-Risk Situations for Medication Reconciliation<br>The appendix functions as a work plan for facilities to implement medication reconciliation according to the MATCH principles.<br>**Publications:** 1 |
| Bruce Lambert<br>**University of Illinois, Urbana-Champaign**<br>Urbana-Champaign, Illinois | U19 HS21093<br>[Grant]<br>**Tools for Optimizing Medication Safety (TOP-MEDS)**<br>2011-2017<br>$4,325,152<br>Final Report | **Purpose:** Develop and test tools in four areas: statistical methods for studies of drug safety and effectiveness, opioid prescribing for acute pain, prevention and detection of drug name confusion, and patient-centered drug information.<br>**Key Findings/Impact:** Researchers had varying success across the projects. They were most successful in their statistical methods and drug name confusion projects. They built and tested an opioid simulator and demonstrated its effects as a teaching tool. Similarly, data from the health literacy randomized trial was still being analyzed at the project's end, but preliminary results suggested a small or null patient benefit.<br>**Publications:** 23 |

| Principal Investigator Organization City, State | Project Number [Type] Project Title Project Period Total Investment | Purpose, Key Findings/Impact, and Number of Publications |
|---|---|---|
| Danielle McCarthy<br>**Northwestern University**<br>Chicago, Illinois | R18 HS23459<br>[Grant]<br>**EHR Based Medication Complete Communication Strategy To Promote Safe Opioid Use**<br>2014-2017<br>$1,466,127<br>Final Report | **Purpose:** Evaluate the effect of an Electronic Medication Complete Communication ($EMC^2$) Opioid Strategy on patients' safe use of and knowledge about opioids.<br>**Key Findings/Impact:** Researchers found that the intervention improved the safety of opioid dosing and increased patient knowledge. It also showed low cost with minimal workflow interruption; however, researchers could not show a significant impact of the intervention on patients' actual safe use of their medications. This lack of impact may have been partly due to the low frequency of "maximal dosing" of the medications at home or related to the fidelity with which the Take-Wait-Stop bottles were filled in the community pharmacies.<br>Researchers also found that the SMS text message portion of the intervention was possibly the most powerful for imparting knowledge. Patients who received the messages were more likely to plan to dispose of their pills. In addition, they had greater awareness of use precautions related to Tylenol and benzodiazepines.<br>**Publications:** 10 |
| Amisha Wallia<br>**Northwestern University**<br>Chicago, Illinois | R18 HS26143<br>[Grant]<br>**Implementation and Testing of a Diabetes Discharge Intervention To Improve Safety During Transitions of Care**<br>2019-2024<br>$1,495,907 | **Purpose:** Integrate and implement the Diabetes Discharge Toolkit to improve the quality and safety of the transition of type 2 diabetes mellitus (DM) care from hospital to home for patients newly prescribed insulin.<br>**Key Findings/Impact:** This project was ongoing until March 31, 2024, and no final report is available yet. However, publications produced thus far pertain to clinician perspectives on the needs of newly diagnosed DM patients, antidepressant medication use, and 3-year risk of progressing to DM and returning to normal glucose regulation based on lifestyle changes.<br>**Publications:** 3 |
| Jonah Stulberg<br>**Northwestern University**<br>Chicago, Illinois | R18 HS27331<br>[Grant]<br>**Preventing Opioid Misuse Through Safe Opioid Use Agreements Between Patients and Surgical Providers (PROMISE ME)**<br>2020-2024<br>$448,522 | **Purpose:** To test whether the use of contractual agreements between patients and surgical providers can improve safe opioid use to prevent misuse and opioid-related harm.<br>**Key Findings/Impact:** This project was ongoing until March 31, 2024, and no final report is available yet. However, publications produced thus far pertain to surgical pain management practices and the use of Video-Based Feedback for the Improvement of Surgical Technique.<br>**Publications:** 3 |

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|---|---|---|
| Howard Kim<br>**Northwestern University**<br>Chicago, Illinois | R01 HS27426<br>[Grant]<br>**A Cluster-Randomized Trial of the Northwestern Embedded Emergency Department Physical Therapy (NEED-PT) Protocol for Acute Low Back Pain**<br>2020-2025<br>$1,844,032 | **Purpose:** Offer ED patients with back pain ED-initiated physical therapy (ED-PT) to improve functioning and reduce the use of opioids and diagnostic imaging.<br>**Key Findings/Impact:** This project is ongoing, and no final report is available yet. However, in a study published in 2023, the researchers conducted focus group discussions and individual interviews among patients visiting an urban academic ED for acute low back pain. They recruited participants from an ongoing prospective study of 101 patients receiving either ED-initiated physical therapy or usual care. The researchers conducted four focus group discussions among 18 participants (median age 46.5 years, 66.7% women, 61.1% Black) and individual interviews with 27 participants (median age 45 years, 55.6% women, 44.4% White).<br>Five summary themes emerged: (1) participants decided to seek emergency care for low back pain due to severe pain, resulting disability, and fears about a catastrophic diagnosis; (2) participants had various goals from their ED visit but emphasized pain control; (3) participants were reluctant to use pain medications but acknowledged their benefit; (4) participants saw a number of benefits from direct access to a physical therapist in the ED; and (5) participation in physical therapy helped recovery, but pain was a barrier to performing exercises. These themes may be used to inform a more patient-centered emergency care experience and contextualize quantitative research findings on ED care for low back pain.<br>**Publications:** 6 |
| Carolyn Foster and Nicole Werner<br>**Lurie Children's Hospital of Chicago**<br>Chicago, Illinois | R18 HS29638<br>[Grant]<br>**The SafeCare@ Home4Kids Learning Lab: Designing Safer Healthcare at Home for Children**<br>2023-2027<br>$490,128 | **Purpose:** Bring together experts, including diverse families, for a long-term, equity-focused collaborative Patient Safety Learning Lab that codesigns ways to identify, communicate, and prevent safety events at home in children with complex medical conditions.<br>**Key Findings/Impact:** This project is ongoing until July 31, 2027, and no final report or publications are available yet.<br>**Publications:** 0 |
| **IOWA** | | |
| James Levett<br>**Kirkwood Community College**<br>Cedar Rapids, Iowa | U18 HS15830<br>[Grant]<br>**Improving Warfarin Management in Competitive Healthcare***<br>2005-2008<br>$607,031<br>Final Report | **Purpose:** Create a community model of care delivery and patient safety using ISO 9001 principles as a framework of cooperation at a community anticoagulation (CAT) clinic.<br>**Key Findings/Impact:** Eight ISO executive and four staff training sessions were held. The CAT clinic developed an electronic medical record/database, enrolled 250 patients, collected data on numerous metrics, and showed improved patient care. The percentage of International Normalized Ratios (INRs) in range improved from 49 to 65 percent. Nurse contacts with a physician decreased from a high of 20 percent to 1 percent; and percentage of INRs above 5 decreased from 3 to 1 percent.<br>The CAT clinic developed a "'compliance assessment'" tool measuring warfarin compliance. The clinic's compliance score increased from 97 to 99 percent. The CAT clinic tracks complications such as bleeding or clotting and whether these require emergency room treatment/hospital admission. Bleeding/clotting events requiring hospital admission remain below 0.02 percent of all patient visits. Cedar Rapids Healthcare Alliance (CRHA) was created to oversee the CAT clinic and other community projects. The CRHA became 501 I(3) certified in July 2007.<br>**Publications:** 4 |

| Principal Investigator Organization City, State | Project Number [Type] Project Title Project Period Total Investment | Purpose, Key Findings/Impact, and Number of Publications |
|---|---|---|
| Amany Farag<br>**University of Iowa**<br>Iowa City, Iowa | R18 HS29292<br>[Grant]<br>**Assuring Medication Safety in K-12 Schools: Implementing and Evaluating the Electronic School Medication Administration Record (E-SMAR) System**<br>2023-2026<br>$330,229 | **Purpose:** Implement eSMAR in a real-world setting (grade schools) and evaluate the usability and effectiveness of eSMAR on medication administration and documentation in schools.<br>**Key Findings/Impact:** This project is ongoing until March 31, 2026, and no final report or publications are available yet.<br>**Publications:** 0 |
| **MARYLAND** | | |
| Diane Cousins<br>**U.S. Pharmacopeia**<br>Rockville, Maryland | R13 HS16515<br>[Grant]<br>**Medication Error Reporting Systems: Challenges, Lessons, Future Direction**<br>2006-2007<br>$49,000<br>Final Report | **Purpose:** Explore how hospitals experienced in medication error reporting have used medication error reports to improve patient safety through a better understanding of how such reported information is used, which in turn encourages patient safety interventions at the health facility level.<br>**Key Findings/Impact:** This conference resulted in important information regarding how to enhance the value obtained from patient safety reporting systems. Most efforts focused on encouraging caregivers to submit reports, with less attention given to how best to analyze these data, how to prioritize improvement efforts based on the data, or how best to evaluate whether adverse event reporting systems are associated with improved patient safety. The conference participants also offered insights that will prove valuable in the creation of the proposed national patient safety database and for improving local reporting systems that will submit information to the national system.<br>Conclusions from discussions of the conference are directly applicable to AHRQ's mission to improve the quality and safety of healthcare for all Americans and are relevant to AHRQ's efforts to develop strategies for reducing errors and improving patient safety. Results from this conference should be especially useful as AHRQ administers the activities mandated by the Patient Safety and Quality Improvement Act of 2005, including the network of patient safety databases.<br>**Publications:** 0 |

| Principal Investigator Organization City, State | Project Number [Type] Project Title Project Period Total Investment | Purpose, Key Findings/Impact, and Number of Publications |
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| David Bundy<br>**Johns Hopkins University**<br>Baltimore, Maryland | R03 HS16774<br>[Grant]<br>**Pediatric Medication Safety**<br>2007-2009<br>$100,000<br>Final Report | **Purpose:** Identify medications and situational and patient characteristics associated with high-harm medication errors in selected pediatric conditions that pose a high healthcare burden and systematically explore the causes of these errors.<br>**Key Findings/Impact:** Researchers concluded that harmful pediatric medication errors were infrequently reported in the MEDMARX data. Nonetheless, the data generally supported the hypothesis that nonharmful medication errors would have characteristics similar to harmful errors. This finding suggests that, similar to the aviation industry's examination of "near-miss" events, the medical and pharmaceutical industries should consider studying nonharmful medication errors, of which many more are reported, to better understand and prevent harmful medication errors.<br>The researchers also found that the same types of system failures that plague inpatient medical settings (e.g., failure to discriminate between two look-alike/sound-alike medications) are present in outpatient settings. Remedying these system failures in outpatient settings is likely more complex than inpatient failures, since there is no single overlying structure across which to implement system changes as there might be within an inpatient setting.<br>**Publications**: 6 |
| Mae Thamer<br>**Medical Technology and Practice Patterns**<br>Bethesda, Maryland | R03 HS20572<br>[Grant]<br>**Do Safety Warnings Change Prescribing Among the U.S. Dialysis Population?**<br>2011-2013<br>$99,869<br>Final Report | **Purpose:** In March 2007, the Food and Drug Administration (FDA) issued a black box warning to use the lowest possible erythropoiesis-stimulating agent (ESA) doses for treatment of anemia associated with renal disease. The goal of this study was to determine if a change in ESA use was observed among U.S. dialysis patients after the warning.<br>**Key Findings/Impact:** Researchers concluded ESA therapy had been both profitable for providers and controversial regarding benefits for nearly two decades. The extent to which an FDA black box warning highlighting important safety concerns influenced use of ESA therapy among nephrologists and dialysis providers was unknown. This study found no evidence of changes in ESA prescribing for the overall dialysis population resulting from an FDA black box warning.<br>**Publications:** 2 |
| Stephen Berry<br>**Johns Hopkins University**<br>Baltimore, Maryland | R01 HS24079<br>[Grant]<br>**Hospital HIV/HCV Support Team To Improve Medication Safety and Engagement in Care**<br>2015-2021<br>$1,210,121<br>Final Report | **Purpose:** Assess whether an HIV/hepatitis C virus (HIV/HCV) Support Team (HST) could reduce inpatient medication errors and improve engagement in outpatient HIV care for people living with HIV (PLWH).<br>**Key Findings/Impact:** The results reflect a national shift to simpler, safer HIV regimens and indicate the HST was not effective at increasing postdischarge care engagement. The project results help show major changes in the field of HIV medicine. These include a dramatic shift toward single-tablet regimens with extremely low rates of side effects and drug interactions and a progressive (and highly desirable) shift toward more PLWH coming into care and achieving viral suppression on these regimens. Therefore, the project team discontinued plans for an online HST toolkit and for a cost-effectiveness analysis.<br>Despite the shifts in care, the study's electronic medical record (EMR) alert for PLWH was 100 percent sensitive (82%-100%) with a positive predictive value of 83 percent (81%-85%). The EMR alert that facilitated the interventional study was novel and successful, and researchers have submitted results of an analysis of its accuracy as well as a description of lessons learned in the process of creating it. The project team has also implemented and started to evaluate a similar alert for HCV.<br>**Publications:** 2 |

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|---|---|---|
| Angela Smith<br>**American Urological Association**<br>Linthicum, Maryland | R13 HS26679<br>[Grant]<br>**American Urological Association's Quality Improvement Summit: Opioid Stewardship in Urology**<br>2018-2019<br>$35,100<br>Final Report | **Purpose:** Convene a multidisciplinary panel of speakers to take part in a collaborative effort dedicated to reducing the impact of urologic surgery and subsequent pain management strategies on the current opioid epidemic.<br>**Key Findings/Impact:** Presentations facilitated information exchange between a broad range of clinicians and educated urology practitioners about the latest research and practices that can reduce opioid prescribing and effectively manage patient postoperative pain. This type of exchange gave attendees the knowledge needed to take first steps toward accelerating adoption of evidence-based practice.<br>In addition, the open format and multidisciplinary approach promoted partnerships that could facilitate physician-led opioid stewardship programs and research, thereby enhancing the quality and safety of medical care and improving the lives of patients, their families, and their communities.<br>**Publications:** 1 |
| Sadaf Kazi<br>**MedStar Health Research Institute**<br>Hyattsville, Maryland | R03 HS27510<br>[Grant]<br>**A Memory-Based Approach to Reducing Medication Errors**<br>2020-2023<br>$71,223<br>Final Report | **Purpose:** Use a cognitive psychology-based approach, with a focus on prospective memory (PM), to identify PM demands during medication administration.<br>**Key Findings/Impact:** Researchers found 2 percent of total warfarin orders placed had nonoptimal INR values with a gap of more than 24 hours from previous INR measure, indicating potential error. These potential errors were located on different units and facilities, demonstrating the need for systematic solutions and spreading best practices across the healthcare organization.<br>Researchers concluded that PM tasks could be anticipated during medication planning; however, several PM tasks also arise dynamically depending on changes to the patient's condition or because of changing nurse or unit workflow priorities. PM tasks that arise during planning are amenable to being encoded as reminders on the electronic health record and nursing paper tools ("nurse brains"). Still, there is a need to develop tools to improve support for PM tasks that arise dynamically.<br>The medication administration workflow in inpatient settings is complex and encompasses a variety of PM tasks. PM failure is likely to have adverse patient safety implications because of heightened risk of medication administration errors.<br>**Publications:** 0 |
| Brandyn Lau<br>**Johns Hopkins University**<br>Baltimore, Maryland | R18 HS27415<br>[Grant]<br>**Disseminating a Patient Centered Venous Thromboembolism Prevention Bundle**<br>2020-2025<br>$400,000 | **Purpose:** Empower patients to make informed decisions about their venous thromboembolism (VTE) preventive care, increase VTE prophylaxis medication adherence, and improve delivery of patient-centered, defect-free VTE prevention to hospitalized patients.<br>**Key Findings/Impact:** This project is ongoing, and no final report is available yet. However, one systematic review has been published reporting on evidence for ambulation as a prophylaxis for VTE in hospitals. Researchers concluded that ambulation should not be considered an adequate prophylaxis for VTE, nor an adequate reason to discontinue pharmacologic prophylaxis for VTE during a patient's hospital admission.<br>**Publications:** 2 |

| Principal Investigator Organization City, State | Project Number [Type] Project Title Project Period Total Investment | Purpose, Key Findings/Impact, and Number of Publications |
|---|---|---|
| Sadaf Kazi and Naveen Muthu<br>**MedStar Health Research Institute**<br>Hyattsville, Maryland | R18 HS29291<br>[Grant]<br>**A Systems Engineering Approach to Optimize Pediatric Medication Safety**<br>2023-2026<br>$500,000 | **Purpose:** Improve pediatric medication safety in the electronic health record through optimization, deployment, and testing of an assessment tool designed to identify pediatric weight-based dosing errors.<br>**Key Findings/Impact:** This project is ongoing until March 31, 2026, and no final report or publications are available yet.<br>**Publications:** 0 |
| **MASSACHUSETTS** | | |
| David Bates<br>**Brigham and Women's Hospital**<br>Boston, Massachusetts | U18 HS11169<br>[Grant]<br>**Improving Safety by Computerizing Outpatient Prescribing**<br>2000-2003<br>$1,700,187 | **Purpose:** Study the impact of electronic medical records and computerized prescribing in a diverse array of clinic settings associated with Partners HealthCare System and the Regenstrief Institute/Indiana University.<br>**Key Findings/Impact:** A final report was not available. However, resulting publications pertained to the steps involved in adverse drug event (ADE) monitoring development and rule validation at large outpatient practices in Boston and Indianapolis, as well as the cost efficiency of newly developed methods for identifying ADEs and medication errors. Publications also addressed development of a computerized ADE measurement process and computerized prescribing in the ambulatory setting.<br>**Publications:** 10 |
| David Bates<br>**Brigham and Women's Hospital**<br>Boston, Massachusetts | P01 HS11534<br>[Grant]<br>**Improving Medication Safety Across Clinical Settings**<br>2001-2007<br>$5,600,165<br>Final Report | **Purpose:** Broaden scientific knowledge about medication safety and create models of error reduction that may be generalized to other safety domains.<br>**Key Findings/Impact:** The final report summarizes results from six studies focusing on patient safety and medication errors in various healthcare settings. Study 1 evaluated a web-based reporting system, showing promise in improving incident reporting efficiency. Study 2 revealed that medication errors and adverse drug events (ADEs) are common in pediatric ambulatory care. Study 3 examined medication errors and ADEs in psychiatric inpatient settings, providing valuable information on prevention strategies. Study 4 investigated the use of smart pumps for intravenous infusions, leading to design improvements despite not reducing serious error rates. Study 5 highlighted the prevalence and preventability of warfarin-related adverse events in nursing homes. Lastly, Study 6 assessed safety culture in hospitals, identifying problematic areas and emphasizing the importance of hospital management support for safety. Together, these studies provide crucial insights into patient safety issues and potential improvement strategies across different healthcare environments.<br>**Publications:** 22 |

| Principal Investigator Organization City, State | Project Number [Type] Project Title Project Period Total Investment | Purpose, Key Findings/Impact, and Number of Publications |
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| Stephen Soumerai<br>**Harvard Pilgrim Health Care, Inc.**<br>Wellesley, Massachusetts | U18 HS12019<br>[Grant]<br>**Randomized Control Trial To Reduce Prescribing Errors in Hypertension**<br>2001-2005<br>$566,695<br>Final Report | **Purpose:** Compare two educational interventions, group versus individual academic detailing, to reduce prescribing errors in hypertension.<br>**Key Findings/Impact:** Researchers reported that in the first year following the intervention, the rates of diuretic or beta blocker use increased by 13.2 percent in the group detailing practices, 12.5 percent in the individual detailing practices, and 6.2 percent in the usual care practices. Compared with usual care practices, diuretic or beta blocker use was more likely in both group detailing practices and individual detailing practices. Neither intervention affected blood pressure control. Two years after this single-visit intervention, there was still a trend suggesting a persistent effect of individual, but not group, detailing, compared with usual care.<br>Researchers also found that both individual and group academic detailing can increase the use of guideline-based treatments for hypertension. Further study is needed to understand the economic ramifications of expanding this kind of intervention to improve the care of hypertension and other chronic diseases.<br>**Publications:** 4 |
| Tejal Gandhi<br>**Brigham and Women's Hospital (BWH)**<br>Boston, Massachusetts | R01 HS14053<br>[Grant]<br>**Using Barcode Technology To Improve Medication Safety**<br>2003-2006<br>$1,341,802<br>Final Report | **Purpose:** Conduct a randomized controlled trial to examine the impact of barcode/eMAR technology on medication transcribing and administration errors.<br>**Key Findings/Impact:** Researchers found evidence that barcode technology improves medication safety at the level of pharmacy dispensing. The overall rates of dispensing errors and potential adverse drug events substantially decreased after bar code technology was implemented. Baseline time-motion studies showed nurses spend about 25 percent of their time on medication administration and approximately 25 percent of their time on communication, emphasizing the importance of these two processes.<br>A pre-post time-motion workflow assessment revealed no statistically significant increase in the percentage of time spent on medication administration. Results of a nursing satisfaction survey showed meaningful and statistically significant improved satisfaction scores after the implementation of barcode technology. A cost-benefit analysis revealed that implementation of a hospital-based pharmacy barcode system for medications can result in a positive financial return on investment for the healthcare organization, as well as for society overall.<br>**Publications:** 9 |

| Principal Investigator Organization City, State | Project Number [Type] Project Title Project Period Total Investment | Purpose, Key Findings/Impact, and Number of Publications |
|---|---|---|
| Tejal Gandhi<br>**Brigham and Women's Hospital**<br>Boston, Massachusetts | R01 HS15226<br>[Grant]<br>**Improving Safety and Quality With Outpatient Order Entry**<br>2004-2008<br>$1,499,401<br>Final Report | **Purpose:** Study the impact of integrating ambulatory computerized physician order entry (ACPOE) with an advanced clinical decision support system (CDSS) on important safety and quality domains in the ambulatory setting using randomized controlled trials. Evaluate the impact on organizational efficiency and physician workflow and satisfaction, and perform a cost-benefit analysis.<br>**Key Findings/Impact:** For Aim 1, the authors implemented four enhanced actionable reminders targeting performance of annual mammography, one-time bone-density screening, and diabetic testing. They found that actionable reminders did not improve receipt of overdue tests, potentially due to limitations of workflow integration.<br>For Aim 2, the average adjusted overall time spent per scheduled patient increased but was not statistically significant. Surveys revealed that while many physicians agreed that the ACPOE improves the quality of patient care, a significant portion also found the system difficult to use and a hindrance to their personal efficiency.<br>Another survey found an increase in the percentage of clinicians agreeing that the electronic health record (EHR) improved quality of care, reduced medication-related errors, improved test result followup, and improved communication among clinicians. Over time, a decreasing percentage agreed that the EHR reduced the quality of patient interactions, resulted in longer patient visits, and increased time spent on medical documentation.<br>For Aim 3, results for the cost-benefit analysis required data and analysis from Aims 1 and 2 that were not available in the final report or literature.<br>**Publications:** 2 |
| Jerry Gurwitz<br>**University of Massachusetts Medical School, Worcester**<br>Worcester, Massachusetts | R01 HS16463<br>[Grant]<br>**Enhancing the Safety of Warfarin in the Nursing Home**<br>2006-2010<br>$899,931<br>Final Report | **Purpose:** Improve warfarin management among nursing home residents through the use of a standardized nurse-physician communication tool.<br>**Key Findings/Impact:** Researchers concluded the use of a communication protocol based on the SBAR handoff tool modestly improved the quality of warfarin management in nursing homes, as reflected by increased time in therapeutic range. This low-technology approach may also serve as a model for improving the safety of other medications associated with high rates of preventable adverse drug events and safety for vulnerable nursing home residents at special risk for medication-related problems.<br>The significance of this study is that it was set among 26 community-based nursing homes similar to nursing homes across the United States, making its results generalizable. Researchers also worked closely with the Clinician-Consumer Health Advisory Information Network (CHAIN) to disseminate the Warfarin Communication Toolkit. CHAIN is an online educational, informational, and resource dissemination program operated as a collaborative effort of the Centers for Education and Research on Therapeutics Educational Consortium.<br>**Publications:** 4 |

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|---|---|---|
| Terry Field<br>**University of Massachusetts Medical School**<br>Worcester, Massachusetts | P20 HS17109<br>[Grant]<br>**Proactive Risk Reduction in Medication Prescribing in the Ambulatory Setting**<br>2007-2008<br>$199,975<br>Final Report | **Purpose:** Use probabilistic risk assessment (PRA) to characterize systemic and behavioral elements that increase the risk of serious errors in prescribing and monitoring medications in the ambulatory care setting. Identify potentially high-yield and likely-to-be-successful interventions for lowering rates of preventable adverse drug events.<br>**Key Findings/Impact:** Several interventions were spontaneously undertaken in a bottom-up fashion as teams highlighted two areas of system failure—lack of up-to-date patient contact information and high rate of patient "no shows" for laboratory tests. A system for updating patient contact information was in full flow and consistently carried out by the end of the grant.<br>Researchers identified several themes that emerged for the PRA process: (1) lack of redundancy in the ambulatory care setting and the potential impact it may have on patient safety; (2) a need for better and more systematized communication within the clinic and between the clinic and patients; (3) ease of engaging clinicians in a probabilistic risk assessment endeavor; and (4) in an organization structured with open opportunities for bottom-up system changes, the possibility of staff participation in risk assessment activities leading directly to spontaneously generated system improvements.<br>**Publications:** 1 |
| Saul Weingart<br>**Dana-Farber Cancer Institute**<br>Boston, Massachusetts | P20 HS17123<br>[Grant]<br>**Oral Chemotherapy Safety in Ambulatory Oncology: A Proactive Risk Assessment**<br>2007-2009<br>$193,952<br>Final Report | **Purpose:** Assess the risks associated with the oral chemotherapy medication use process in adult and pediatric ambulatory oncology and develop improvement strategies.<br>**Key Findings/Impact:** Each stage of the medication use process poses risks to oral chemotherapy safety. Key vulnerabilities include patient education about drug handling and adverse effects; safe prescription writing; patient administration and adherence difficulties; and failure to monitor and manage toxicities.<br>This study also demonstrated the use of failure modes and effects analysis to analyze risks across drugs within a single cancer center. Although researchers found more similarities than differences in the failure modes, effects, and mitigation strategies, the differences were meaningful and could lead to targeted interventions for certain populations. Understanding the internal process involved in prescribing, dispensing, administering, and monitoring oral chemotherapy—as well as the interfaces between them—provided a new perspective on the process and made the vulnerabilities more transparent and actionable.<br>**Publications:** 3 |
| Sarah Shoemaker<br>**Abt Associates**<br>Cambridge, Massachusetts | 290-06-00011-5<br>[Contract]<br>**Assessing Organizational Responses to AHRQ's Health Literacy Pharmacy Tools**<br>2008-2011<br>$400,000 | **Purpose:** Understand the facilitators and barriers to the adoption and implementation of AHRQ's health literacy tools, particularly a tool to assess a pharmacy's health literacy practices.<br>**Key Findings/Impact:** Curricular modules about health literacy can be used or adapted for lectures, seminars, laboratory classes, and other courses deemed appropriate by faculty. The modules can also be used in pharmacy experiential education, including both Introductory Pharmacy Practice Experiences and Advanced Pharmacy Practice Experiences. Finally, the curricular modules offer valuable activities and content for Pharm.D. students and pharmacy residents' projects.<br>**Publications:** 3 |

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|---|---|---|
| Terry Field<br>**University of Massachusetts Medical School**<br>Worcester, Massachusetts | R18 HS17906<br>[Grant]<br>**Risk Informed Intervention To Improve Ambulatory Drug Monitoring and Safety**<br>2008-2012<br>$878,632<br>Final Report | **Purpose:** Improve patient safety by implementing interventions to improve the rate of ordering and completion of therapeutic laboratory monitoring of high-risk medications in the ambulatory setting.<br>**Key Findings/Impact:** Analyses of baseline ordering and completion of laboratory monitoring and interviews with patients about missed lab tests provided a basis for intervention design. However, the impacts of the interventions were small, and most were not statistically significant. Automated alerts generated to prescribers at the time of medication renewals did increase test ordering. Cost estimates for development of the interventions found extensive time required from a physician/informaticist.<br>**Publications:** 7 |
| Aaron Kesselheim<br>**Brigham and Women's Hospital**<br>Boston, Massachusetts | K08 HS18465<br>[Grant]<br>**Off-Label Prescribing: Comparative Evidence, Regulation, and Utilization**<br>2009-2011<br>$798,371<br>Final Report | **Purpose:** Study the characteristics of off-label drug use in three select classes: cancer drugs, neuropsychiatry drugs, and drugs for other rare diseases.<br>**Key Findings/Impact:** Researchers found varying effects of the interventions they studied on off-label drug use. For example, initiation of government investigations into illegal off-label marketing had little impact on off-label prescribing, while aspects of the drug/disease being studied, heightened consent requirements, and local restrictions on pharmaceutical/physician interactions had statistically significant effects.<br>Several resulting articles were published in premiere journals. Within the most cited, researchers found (1) there is no available evidence that brand-name antiepileptic drugs are more effective than generic in maintaining seizure control; (2) patients are more likely to suffer from serious adverse events compared with patients in studies of nonorphan products; and (3) the government should limit liability of designers and vendors who fear modifying alert systems that indicate potentially dangerous drug interactions.<br>The efforts of this project have contributed to an ongoing understanding of the proper role of off-label prescribing and promotion in the United States, for the benefit of physicians and patients.<br>**Publications:** 63 |
| Jeffrey Schnipper<br>**Brigham and Women's Hospital**<br>Boston Massachusetts | R18 HS23757<br>[Grant]<br>**Implementation of a Medication Reconciliation Toolkit To Improve Patient Safety**<br>2015-2018<br>$1,452,672<br>Final Report | **Purpose:** Determine the effects of mentored implementation of a refined medication reconciliation best practices toolkit on medication discrepancies across multiple hospitals.<br>**Key Findings/Impact:** During the intervention, sites saw a steady decline in their medication discrepancy rate from approximately 2.85 discrepancies/patient to 0.98 discrepancy/patient. In interrupted time-series analysis, the intervention was associated with a 5 percent relative decrease in discrepancies per month over baseline temporal trends.<br>The results showed that a multicenter medication reconciliation quality improvement initiative using mentored implementation of a refined best practices toolkit was associated with a significant reduction in unintentional medication discrepancies over time. Researchers recommended that future efforts focus on ensuring as many patients as possible receive effective interventions to minimize medication discrepancies.<br>**Publications:** 12 |

| Principal Investigator Organization City, State | Project Number [Type] Project Title Project Period Total Investment | Purpose, Key Findings/Impact, and Number of Publications |
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| Traci Green<br>**Boston Medical Center**<br>Boston, Massachusetts | R18 HS24021<br>[Grant]<br>**Advancing Patient Safety Implementation Through Pharmacy-Based Opioid Medication Use Research**<br>2015-2018<br>$1,326,127<br>Final Report | **Purpose:** Apply a systems-level approach to improve delivery of and access to pharmacy-based naloxone (PBN).<br>**Key Findings/Impact:** PBN access flourished during the study period. Focus groups helped finalize PBN materials and design approaches to reducing stigma in the pharmacy. Using academic detailing, pharmacies increased naloxone dispensing, and multiple detailing visits expanded access for places less ready to implement PBN. Store- and community-level factors independently associated with dispensing underscore how PBN complements community naloxone programs and extends naloxone availability to exurban areas.<br>The demonstration project's effects were bolstered by strong pharmacy leadership and corporate culture change, as well as shifts in the environment: new naloxone product availability, the Surgeon General's public advisory, and the prominence of illicitly manufactured fentanyl. To facilitate dissemination, the website prevent-protect.org houses all study materials.<br>**Publications:** 20 |
| Jerry Gurwitz<br>**University of Massachusetts Medical School**<br>Worcester, Massachusetts | R18 HS23774<br>[Grant]<br>**Improving Safety After Hospitalization in Older Persons on High-Risk Medications**<br>2015-2018<br>$1,352,940<br>Final Report | **Purpose:** Evaluate the effectiveness of a clinical trial focused on older patients who were recently discharged from a hospital with prescribed medications within one of three high-priority, high-risk drug classes (anticoagulants, diabetes agents, and opioids) to reduce the risk of clinically important medication errors.<br>**Key Findings/Impact:** Researchers developed a multifaceted intervention for older adults recently discharged from the hospital who were prescribed at discharge one or more of three high-priority, high-risk drug classes (anticoagulants, diabetes agents, and opioids). Clinical pharmacists thought the most critical components of the intervention were medication reconciliation and the ability to see firsthand all the patient's medications (prescription and over the counter). Medication discrepancies were the most common issues identified by the clinical pharmacists carrying out the intervention.<br>Researchers found that clinically important medication errors were common during the immediate posthospitalization period among study subjects. More than three-quarters of the events led to multiple symptomatic days, adding to the problems involved in recovering from hospitalization. However, the intervention did not lower the incidence rate of events. The frequency of such events and their impact on patients during a critical period suggests a need for further research and the development, testing, and adoption of more effective approaches to preventing these important events.<br>**Publications:** 2 |
| Yuri Quintana (Formerly, Charles Safran)<br>**Beth Israel Deaconess Medical Center**<br>Boston, Massachusetts | R18 HS24869<br>[Grant]<br>**Leveraging a Social Network of Elders and Families To Improve Medication Safety at Transitions of Care**<br>2016-2019<br>$1,491,436<br>Final Report | **Purpose:** Expand the functionality of the Information Sharing Across Generations (InfoSAGE) platform to include a mobile-first/point-of-care medication manager. The platform helps older people and their families keep an accurate medication list, coordinate the list with prescribing clinicians, track the impact of medications on symptoms, view medication precautions and drug-drug interactions, and become more engaged as partners in their care.<br>**Key Findings/Impact:** Researchers identified facilitators and barriers to the use of a shared online medication list and assessed the usability and e-health literacy needs for platform adoption and use. This research has shown that it is possible to recruit adults over 75 and their families to use online and mobile technologies for information sharing and care coordination.<br>**Publications:** 3 |

| Principal Investigator Organization City, State | Project Number [Type] Project Title Project Period Total Investment | Purpose, Key Findings/Impact, and Number of Publications |
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| Shoshana Herzig<br>**Beth Israel Deaconess Medical Center**<br>Boston, Massachusetts | R01 HS26215<br>[Grant]<br>**Characterizing Opioid-Related Adverse Events in Older Adults After Hospital Discharge**<br>2018-2024<br>$1,977,682 | **Purpose:** Determine the incidence and patient- and prescribing-related risk factors for postdischarge adverse events among older adults discharged on opioids.<br>**Key Findings/Impact:** This project was ongoing until June 30, 2024. Publications from this work describe the researchers' findings that potential opioid-related adverse drug events occurred within 30 days of hospital discharge in 7 percent of older adults. In addition, older adults filling an opioid prescription in the week after hospital discharge were at higher risk of death and other postdischarge adverse outcomes compared with those filling a nonsteroidal anti-inflammatory drug prescription only. Finally, among hospitalizations for some serious infections, those involving patients with opioid use disorder (OUD) were associated with longer length of stay, higher odds of discharge to post-acute care facilities or patient-directed discharge, and similar total hospital charges, despite lower daily charges. These findings highlight opportunities to improve care for patients with OUD hospitalized with serious infections and to reduce the growing associated costs.<br>**Publications:** 20 |
| **Abt Associates**<br>Cambridge, Massachusetts | HHSP233201300257P<br>[Contract]<br>**Evaluating and Implementing the Six Building Blocks Team Approach To Improve Opioid Management in Primary Care**<br>2018-2021<br>$1,039,225 | **Purpose:** Develop a Six Building Blocks (6BBs) How-To-Implement Guide for primary care practices to assist them in managing patients with chronic pain on long-term opioid therapy (LTOT) and evaluate use of the Guide and implementation of opioid management practices.<br>**Key Findings/Impact:** The 6BBs program is an evidence-based quality improvement roadmap that aids primary care teams in implementing effective, guideline-driven care for patients on LTOT by:<br>• Providing leadership support.<br>• Revising and aligning clinic policies, patient agreements, and workflows.<br>• Tracking and monitoring the population of patients using LTOT.<br>• Engaging in planned, patient-centered visits.<br>• Identifying resources for complex patients.<br>• Measuring success.<br>Overall, participating healthcare organizations found the Guide to be an acceptable, flexible, and useful tool to implement the 6BBs program.<br>**Publications:** 4 |
| Alok Kapoor<br>**University of Massachusetts Medical School**<br>Worcester, Massachusetts | R18 HS26859<br>[Grant]<br>**Leveraging Evidence-based practices for Ambulatory VTE Patients to be Safe with Direct Oral Anticoagulants: LEAVE Safe with DOACs**<br>2019-2023<br>$1,494,927 | **Purpose:** Operationalize items on the direct oral anticoagulants (DOACs) Checklist to create a comprehensive intervention delivered by clinical pharmacists and a pharmacy technician. The goal is to prevent DOAC-related clinically important medication errors. These include preventable adverse drug events (ADEs), ameliorable ADEs (i.e., ADEs in which the severity or duration could have been reduced), and potential ADEs (i.e., medication errors with the potential to cause harm).<br>**Key Findings/Impact:** No final report or publications are available yet.<br>**Publications:** 0 |

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| Anupam Jena<br>**Harvard Medical School**<br>Boston, Massachusetts | R01 HS26753<br>[Grant]<br>**Prescribing of Opioids at Hospital Discharge and Associated Adverse Patient Outcomes**<br>2019-2024<br>$1,948,891 | **Purpose:** Build a data infrastructure that allows up-to-date data access on opioid prescribing patterns, ensuring that the project's findings are relevant to current clinical practice and opioid policy.<br>**Key Findings/Impact:** This project was ongoing until July 31, 2024, and no final report is available yet. However, several articles funded by this work have been published. One found that one-click integration of a state's prescription drug monitoring program (PDMP) markedly increased the number of searches but was associated with modest decreases in opioids prescribed and patients receiving a prescription. Single-click electronic health record integration of the PDMP, if implemented broadly, may be a way for states to significantly increase PDMP use. Another study had results suggesting that differences in care provided in pediatric versus adult care settings may be important to understanding prescribers' roles in the opioid epidemic.<br>**Publications:** 9 |
| Katsiaryna Bykov<br>**Brigham and Women's Hospital**<br>Boston, Massachusetts | R01 HS27623<br>[Grant]<br>**Drug Interactions and Opioid-Related Emergency Room Visits and Hospitalizations Among Older Adults**<br>2020-2024<br>$1,599,996 | **Purpose:** Study whether interactions between medications prescribed for depression, hypertension, and acute coronary syndromes affect the rates of opioid-related emergency room visits and hospitalizations among older adults who use tramadol.<br>**Key Findings/Impact:** This project was ongoing until July 31, 2024, and no final report is available yet. However, one study conducted thus far compares opioid overdose rates in patients initiating oxycodone while taking selective serotonin reuptake inhibitors (SSRIs) that are potent inhibitors of the cytochrome-P450 2D6 enzyme (CYP2D6) with SSRIs that are not. Researchers found a small increased risk of opioid overdose in patients taking paroxetine or fluoxetine.<br>**Publications:** 2 |
| Kathleen Walsh<br>**Boston Children's Hospital**<br>Boston, Massachusetts | R18 HS27401<br>[Grant]<br>**Spread of Safety Interventions: Planning for Context**<br>2020-2024<br>$1,598,910 | **Purpose:** Reduce nephrotoxic medication-related acute kidney injury, assess acceptability of intervention, and test a scalable approach to overcome contextual and implementation barriers to spread patient safety interventions nationally and internationally more effectively and efficiently.<br>**Key Findings/Impact:** This project is ongoing, and no final report or publications are available yet.<br>**Publications:** 0 |

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| **MICHIGAN** | | |
| Christopher R. Friese<br>**University of Michigan**<br>Ann Arbor, Michigan | R01 HS24914<br>[Grant]<br>**Communication Processes, Technology, and Patient Safety in Ambulatory Oncology**<br>2016-2020<br>$1,430,301<br>Final Report | **Purpose:** Understand variation in clinician communication processes, technology use, and patient outcomes, and assess barriers and facilitators to safe chemotherapy delivery.<br>**Key Findings/Impact:** Higher satisfaction with technology and higher quality clinician communication were associated with increased patient safety actions (e.g., communication with other physicians, electronic health record capabilities, communication through technology) whereas increased reliance on all-digital records was associated with lower safety actions. Treatment delays were attributed to care plan discrepancies and missing orders, uncommunicated day-of-treatment order changes, orders not signed in advance by physicians, and laboratory testing processes. Patient toxicity rates varied across practices. Toxicity severity and service use incidence exceeded previously published trial data, particularly for pain, fatigue, and gastrointestinal issues.<br>Researchers noted that to their knowledge, this study is among the first multisite, mixed-methods studies to examine the impact of communication processes and communication technologies on patient safety actions in ambulatory oncology practices—care settings that deliver high-risk and high-cost cancer treatments. The collection, analysis, and integration of quantitative and qualitative data permitted rich exploration of key patient safety and quality issues in ambulatory oncology care.<br>**Publications:** 8 |
| Mark Becker and Laura Lee Bix<br>**Michigan State University**<br>East Lansing, Michigan | R01 HS25386<br>[Grant]<br>**Optimizing OTC Labels for Older Adults: Empirical Evaluation of Labels Designed To Provide Older Users the Information They Need To Minimize Adverse Drug Events**<br>2018-2024<br>$1,760,931 | **Purpose:** Apply empirical methods from basic research on attention and visual cognition (e.g., eye-tracking, change detection, and visual search tasks) to investigate how well different over-the-counter (OTC) label designs attract attention to critical information, promote decision making, and facilitate rapid, cross-product comparisons.<br>**Key Findings/Impact:** This project was ongoing until April 30, 2024. A preliminary study demonstrated medication label information with highlights was significantly more likely to be detected by older adults than information not highlighted. The study also found that placing information on the front of the package did not affect detection, accuracy, or time to find the information.<br>Another study involved a national survey of practicing pharmacists knowledgeable about OTC medication use by older adults. This cohort was asked to rank order the importance of Drug Facts Label (DFL) sections to reduce adverse drug events in older adults. There was high consensus that uses and purpose, active ingredient, warnings, and directions for use were the most important sections of the DFL. Within the warning section, two specific warnings, "Do not use" and "Ask a doctor or pharmacist," were deemed most important. Similarly, qualitative themes focused on seeking healthcare provider assistance or were specific to age-related precautions.<br>**Publications:** 3 |
| Geoffrey Barnes<br>**University of Michigan**<br>Ann Arbor, Michigan | R18 HS26874<br>[Grant]<br>**Improving Safe Use of Direct Oral Anticoagulants: A Population Health Approach**<br>2020-2024<br>$1,486,943 | **Purpose:** Evaluate the implementation of a population health approach to ensuring appropriate anticoagulant prescribing in a diverse collection of health systems.<br>**Key Findings/Impact:** This project was ongoing until March 31, 2024, and no final report is available yet. However, publications produced thus far pertain to the successful implementation of electronic health record tools, use of proton pump inhibitor therapy, evaluation of a nationwide implementation effort of the DOAC Dashboard in the Veterans Health Administration, and receipt of DOAC starter packs.<br>**Publications:** 8 |

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| Corey Lester<br>**University of Michigan**<br>Ann Arbor, Michigan | R18 HS28786<br>[Grant]<br>**Preventing Medication Errors Due to Unsafe Electronic Prescription Transactions With Just-in-Time Feedback**<br>2022-2026<br>$954,684 | **Purpose:** Test a tool that can actively monitor and communicate useful feedback to healthcare organizations about unsafe e-prescription transactions on the more than 2 billion new e-prescriptions transmitted each year in the United States.<br>**Key Findings/Impact:** This project is ongoing, and no final report or publications are available yet.<br>**Publications:** 0 |
| John Hoyle<br>**Western Michigan University School of Medicine**<br>Kalamazoo, Michigan | R18 HS29283<br>[Grant]<br>**Augmenting the On-scene Medic (ATOM): Development of a Head-Mounted Display Application To Reduce Prehospital Pediatric Medication Errors**<br>2023-2026<br>$500,000 | **Purpose:** Develop and test a highly dynamic cognitive aid application for use through a head-mounted display to dramatically decrease pediatric medication errors in emergency medical services.<br>**Key Findings/Impact:** This project is ongoing until March 31, 2026, and no final report or publications are available yet.<br>**Publications:** 0 |
| **MINNESOTA** | | |
| Joel Farley<br>**University of Minnesota**<br>Minneapolis, Minnesota | R18 HS27754<br>[Grant]<br>**Integrating Pharmacists Into an Automated Discharge Process To Promote Comprehensive Medication Management**<br>2021-2024<br>$1,417,221 | **Purpose:** Use an adapted Consolidated Framework for Implementation Research and the Reach, Effectiveness, Economics, Adoption, Implementation and Maintenance model to evaluate the implementation of pharmacist-led comprehensive medication management in transitions of care.<br>**Key Findings/Impact:** A final report and supporting literature for this project were not available.<br>**Publications:** 0 |

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| **MISSISSIPPI** | | |
| Andrew Brown<br>**University of Mississippi Medical Center**<br>Jackson, Mississippi | U18 HS11923<br>[Grant]<br>**Addressing Preventable Medication Use Variance in Mississippi**<br>2001-2005<br>$4,422,011<br>Final Report | **Purpose:** Establish a large-scale demonstration project to assess the effectiveness of Mississippi's methods of collecting and using information to reduce medical errors and their impact.<br>**Key Findings/Impact:** The project results were disseminated to different audiences via 7 refereed publications and 19 presentations at the state and national level. Specific projects were completed, including: (1) website development; (2) patient safety hotline; (3) Focus One focus groups; (4) medication error reporting system; (5) pharmacy survey; (6) ambulatory clinic patient survey; and (7) establishment of private industry partnerships (SoftMed and DecisionQ).<br>**Publications:** 8 |
| **MISSOURI** | | |
| Jill Scott-Cawiezell<br>**University of Missouri**<br>Columbia, Missouri | UC1 HS14281<br>[Grant]<br>**Technology To Improve Medication Safety in Nursing Homes**<br>2003-2007<br>$929,351<br>Final Report | **Purpose:** Evaluate the use of bedside technology (One Touch eMAR System) and the Quality Improvement Program for Missouri's Long-Term Care Facilities to improve medication safety practices within the nursing home setting as a companion study to a technology study funded by the Centers for Medicare & Medicaid Services.<br>**Key Findings/Impact:** Nearly 16,000 administered medications were observed over 2 years. Technology and related process improvements increased the efficiency of medication administration across all nursing homes. In addition, four of five nursing homes showed statistically significant improvement at some point during the study.<br>The pattern of improvement varied, suggesting many factors influenced the impact of technology and focused quality improvement activities on medication error. Organizational factors, such as nursing leadership and effective teamwork, appeared to be closely linked to the pattern of improvement. Nurse leaders were critical to improvement and varied in their skills, suggesting that nurse leader development is essential.<br>**Publications:** 11 |
| Thomas Bailey<br>**Washington University**<br>Saint Louis, Missouri | R18 HS17010<br>[Grant]<br>**Surveillance for Adverse Drug Events in Ambulatory Pediatrics**<br>2007-2011<br>$992,614<br>Final Report | **Purpose:** Evaluate automated detection methods for adverse drug events (ADEs) in pediatric patients with sickle cell anemia, cystic fibrosis, and cancer in the ambulatory setting.<br>**Key Findings/Impact:** Researchers found a high rate of ADEs in pediatric patients with sickle cell disease, cystic fibrosis, or cancer. In this study, these ADEs resulted in harm to patients and were associated with a high degree of causality with the associated drugs. Nearly 50 percent of these ADEs originated in the outpatient setting. The researchers also believed that automated detection of ADEs represented an efficient and feasible way to detect ADEs in high-risk pediatric populations in both the inpatient and outpatient settings that would otherwise go undetected in the absence of labor-intensive chart review.<br>**Publications:** 5 |

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| Grant Savage<br>**University of Missouri**<br>Columbia, Missouri | R03 HS16789<br>[Grant]<br>**Workarounds: Developing Definitions, Measurement Strategies, and Links to Medication Safety**<br>2007-2009<br>$100,000<br>Final Report | **Purpose:** Study the impact of employee-devised workarounds within intensive care units on medication errors.<br>**Key Findings/Impact:** Researchers concluded that analysis of work processes revealed common themes, such as the idiosyncratic nature of workarounds, common locations in the process where workarounds and rework occur, the number of barriers faced, and the downstream impact on work processes. Most important, the findings build on a growing body of literature that suggests that barriers in workflow and workarounds can lead to negative patient outcomes.<br>This study is among the first, to the researchers' knowledge, to document examples of rework in healthcare settings, such as where it occurs, why it occurs, and how it is associated with workarounds and patient safety concerns. The findings also reinforce the potential application of Lean manufacturing principles to healthcare work processes. If rework and workarounds are indeed the result of perceived barriers and inefficiencies, it suggests a need for continuous quality improvement initiatives that can address those inefficiencies, such as Lean practices. Involving staff in "leaning out" the process should also likely lead to positive outcomes.<br>**Publications:** 1 |
| **NEBRASKA** | | |
| Keith Mueller<br>**University of Nebraska Medical Center**<br>Omaha, Nebraska | U18 HS15822<br>[Grant]<br>**Implementing a Program of Patient Safety in Small Rural Hospitals**<br>2005-2007<br>$528,730<br>Final Report | **Purpose:** Implement the patient safety practices of voluntary medication error reporting and organizational learning to improve the safety of medication use in small rural hospitals.<br>**Key Findings/Impact:** The Hospital Survey on Patient Safety Culture was used to identify components of culture in need of improvement, raise awareness of safety culture, evaluate the effectiveness of patient safety interventions, and create benchmarks. Researchers found that a safe, informed culture requires a foundation of reporting, using standardized taxonomies and systematic analysis. They recommended that critical access hospitals (CAHs) collaborate with rural advocacy organizations to obtain the educational and technical resources needed to understand and execute the practices that support reporting, just, flexible, and learning cultures.<br>The significance of this research is that it can inform policymakers, network hospitals, quality improvement organizations, and other organizations that advocate for rural hospitals about resources and practices that 1,283 CAHs in the nation can use to improve medication safety and quality improvement efforts.<br>**Publications:** 5 |
| Karsten Bartels<br>**University of Nebraska Medical Center**<br>Omaha, Nebraska | R01 HS27795<br>[Grant]<br>**Efficiency And Quality in Post-Surgical Pain Therapy After Discharge – EQUIPPED**<br>2021-2026<br>$1,185,291 | **Purpose:** Demonstrate that the amounts of opioids prescribed and opioids taken after discharge following surgery can be reduced while ensuring effective treatment of pain.<br>**Key Findings/Impact:** This project is ongoing, and no final report is available yet. However, this project has published articles unrelated to its overall goal (e.g., the STRoke After Surgery (STRAS) screening tool, corticosteroid administration among COVID-19 patients, personal protective equipment shortages).<br>**Publications:** 13 |

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| **NEW JERSEY** | | |
| Stephen Crystal<br>**Rutgers University**<br>New Brunswick, New Jersey | R18 HS23464<br>[Grant]<br>**Improving Medication Safety in Nursing Home Dementia Care**<br>2014-2017<br>$1,291,034<br>Final Report | **Purpose:** Examine the effectiveness of national, state, and facility initiatives to reduce antipsychotic prescribing in nursing homes.<br>**Key Findings/Impact:** Antipsychotic prescribing declined nationally by 29 percent from 2011 to 2016. Reduction was particularly substantial for Black (from 21.0% to 13.4%) and Hispanic (from 25.9% to 17.2%) residents compared with non-Hispanic White residents (from 23.2% to 16.8%). Sedative/hypnotic prescribing decreased from 2011 to 2016 by an even greater amount, declining by nearly 43 percent.<br>In terms of implications for patient safety improvement initiatives in other clinical situations, particularly those related to safe medication use, results of this study suggest elements likely to lead to successful large-scale quality and patient safety initiatives. Broadly, they suggest that these elements include a balance between voluntary and mandatory features that require some level of provider engagement, integrating educational and regulatory components; strategies that achieve provider buy-in; use of public reporting as a motivator; and "normalization" of preferred provider behaviors as accepted best practices within the provider community.<br>**Publications:** 15 |
| **NEW YORK** | | |
| Rollin Fairbanks<br>**University of Rochester**<br>Rochester, New York | U18 HS15818<br>[Grant]<br>**The Emergency Department Pharmacist as a Safety Measure in Emergency Medicine**<br>2005-2008<br>$601,304<br>Final Report | **Purpose:** The purpose of this Partnerships in Implementing Patient Safety project was to optimize the role of emergency pharmacists (EPhs), assess acceptance, evaluate impact, and create a comprehensive toolkit for EDs creating new programs.<br>**Key Findings/Impact:** Researchers reported seven emerging themes identified for the optimization phase. During chart review, they examined 10,224 cases and found no difference in adverse drug events with an EPh in the ED, but a trend toward improvement was seen in certain quality measures. Nearly all (99%) responding staff felt the EPh improved quality of care. Eight percent of academic EDs surveyed reported EPh services were available 24 hours a day, but 70 percent reported no coverage. The EPh spent the highest percentage of time with communication events, roaming, and resuscitation efforts. Resources developed were available on a website that is no longer accessible.<br>**Publications:** 15 |
| Penny Feldman<br>**Visiting Nurse Service of New York**<br>New York, New York | R18 HS17837<br>[Grant]<br>**Improving Medication Management Practices and Care Transitions Through Technology**<br>2008-2012<br>$1,191,412<br>Final Report | **Purpose:** Conduct a randomized trial to examine the effectiveness of a multifaceted information technology (IT) intervention to improve management for patients at risk due to the complexity of their medication regimen.<br>**Key Findings/Impact:** No positive intervention impact was found. However, nurses' use of clinical decision support (CDS) (compared with non-use) within the intervention group was associated with more patients moving below the medication complexity risk threshold and lower patient hospitalization rates. CDS use was affected by both nurse and patient characteristics. Outcomes could be improved by increasing knowledge, comfort, and motivation to use IT of nurses paid on a per visit basis; improving continuity of care; and avoiding short lengths of stay.<br>This research has shown that polypharmacy and medication regimen complexity are associated with worse adherence and higher risk of adverse events. Reducing the frequency that a patient needs to remember to take a medication each day and simplifying administration instructions are strategies that can lower the risk.<br>**Publications:** 2 |

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| Jessica Robinson-Papp<br>**Icahn School of Medicine at Mount Sinai**<br>New York, New York | R18 HS25641<br>[Grant]<br>**Toward Safer Opioid Prescribing for Chronic Pain in High Risk Populations: Implementing the Centers for Disease Control (CDC) Guideline in the Primary Care HIV Clinic**<br>2017-2021<br>$1,483,542<br>Final Report | **Purpose:** Develop and pilot test an intervention to increase HIV primary care providers' (PCPs) adherence to the Centers for Disease Control Opioid Prescribing Guideline (CDCOPG).<br>**Key Findings/Impact:** PCPs randomized to the TOWard SafER Opioid Prescribing (TOWER) intervention were 48 percent more CDCOPG adherent. They showed significant improvement in use of nonpharmacologic treatments, functional treatment goals, opioid agreements, prescription drug monitoring programs, opioid benefit/harm assessment, and naloxone prescribing.<br>The main findings from the developmental stages of the work (Aim 1, Steps 1-4) were qualitative and were used to inform the development of the TOWER intervention. The TOWER pilot study demonstrated that a relatively simple and sustainable intervention (involving direct data collection from patients using a mobile health technology, a PCP decision support tool, and a PCP training) can assist HIV PCPs to deliver more guideline-adherent care to people with HIV and chronic pain-long-term opioid therapy. Moreover, doing so does not appear to compromise the patient-PCP relationship or lead to worsening of other patient-centered outcomes.<br>**Publications:** 5 |
| Ranjit Singh, Heui-Yen Chen, and David Jacobs<br>**State University of New York at Buffalo**<br>Amherst, New York | R18 HS29122<br>[Grant]<br>**Patient-Driven Medication Safety Learning Laboratory in Care Transitions**<br>2023-2027<br>$500,000 | **Purpose:** Develop a cross-system learning laboratory that brings together older adults, caregivers, researchers, and healthcare teams in innovative ways to protect them from medication harm.<br>**Key Findings/Impact:** This project is ongoing until June 30, 2027, and no final report or publications are available yet.<br>**Publications:** 0 |
| **NORTH CAROLINA** | | |
| Delesha Carpenter<br>**University of North Carolina**<br>Chapel Hill, North Carolina | R13 HS24471<br>[Grant]<br>**Addressing Methodological and Ethical Issues in Pediatric Medication Safety Research**<br>2015-2016<br>$33,151<br>Final Report | **Purpose:** Present a forum for discussing state-of-the-art methods and issues in pediatric medication safety research.<br>**Key Findings/Impact:** A final report was not available, but an executive summary of the conference described current challenges that clinicians and researchers encountered related to pediatric medication safety research and identified innovative and ethically sound methodologies to address these challenges to improve children's health. This article addresses five areas: (1) pediatric drug development and drug trials; (2) comparative effectiveness research in pediatric populations; (3) child and parent engagement on study teams; (4) ways to improve communication with children and parents; and (5) child-reported outcomes and adverse drug events.<br>**Publications:** 1 |

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| **OHIO** | | |
| Carole Lannon<br>**Cincinnati Children's Hospital Medical Center**<br>Cincinnati, Ohio | U19 HS21114<br>[Grant]<br>**Pursuing Perfection in Pediatric Therapeutics**<br>2007-2011 and 2011-2016<br>$4,235,825<br>Final Report | **Purpose:** The 2007–2017 Cincinnati Children's pediatric Center for Education and Research in Therapeutics (CERTs) Research Center (RC) aimed to improve outcomes for children by optimizing the use of therapeutics. Subthemes included quality and patient safety, practice-based research and improvement networks, pharmacogenomics, and performance metrics.<br>**Key Findings/Impact:** A final report for U18 HS16957 (2007-2011) showed the RC created a research core that supported clinicians and scientists in developing and testing innovative therapeutics and education projects. The RC also created new knowledge about how to use therapeutics effectively and how to translate that knowledge more rapidly into practice, resulting in safer and more effective clinical practice and improved patient outcomes. This project has implications for (1) emphasizing the importance of testing measures prior to adoption; and (2) understanding how quality measures developed for accountability can be used to support improvements in care that will lead to effective use of pediatric therapeutics.<br>In a final report for U19 HS21114 (2011-2017), researchers reported that CERTs supported multiple successful projects in several learning networks (LNs). The CERTs further developed the infrastructure to support LNs and worked with multiple partners capable of disseminating research and education programs to a large majority of the nation's pediatric practitioners and tertiary care settings. The LNs achieved improved pediatric health outcomes.<br>**Publications:** 48 |
| Stuart Goldstein<br>**Cincinnati Children's Hospital Medical Center**<br>Cincinnati, Ohio | R18 HS23763<br>[Grant]<br>**Reduction of Nephrotoxic Medication-Associated Acute Kidney Injury in Children**<br>2015-2018<br>$1,494,548<br>Final Report | **Purpose:** Reduce acute kidney injury caused by nephrotoxic medication (NTMx-AKI) in non-critically ill children across the collaborative.<br>**Key Findings/Impact:** Researchers found the intervention reduced nephrotoxic medication exposure and associated acute kidney exposure. Participating in a learning network that required all participants to implement Nephrotoxic Injury Negated by Just in time Action (NINJA), a daily monitoring tool, was associated with achieving targeted outcomes.<br>This project demonstrated successful dissemination and implementation of a program to decrease nephrotoxic medication-associated acute kidney injury in children at nine pediatric institutions. As a result of this work, nephrotoxic acute kidney injury has been selected as a hospital-acquired condition to be addressed by Solutions for Patient Safety. Researchers planned to disseminate NINJA to the 140 pediatric institutions in the Solutions for Patient Safety Network by 2020.<br>**Publications:** 12 |

| Principal Investigator Organization City, State | Project Number [Type] Project Title Project Period Total Investment | Purpose, Key Findings/Impact, and Number of Publications |
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| Lawrence Kleinman<br>**Case Western Reserve University**<br>Cleveland, Ohio | R01 HS24433<br>[Grant]<br>**Epidemiology, Exploration, and Evaluation: Addressing Potentially Dangerous Medications in Medicaid Children With a Mental Health Diagnosis**<br>2015-2018<br>$1,500,001<br>Final Report | **Purpose:** (1) Describe epidemiology of potentially dangerous (PD) behavioral and mental health medication (BMHRx) use in children; (2) analyze impact of specified policies on PD BMHRx practices; and (3) survey clinical practices regarding Med Rec practices.<br>**Key Findings/Impact:** Behavioral health diagnoses and BMHRx were associated with increased emergency department use and hospitalization, not explained fully by visits primarily for behavioral health diagnoses. Likely off-label use (LOLU) of BMHRx is common. It was seen in 36 percent of children in 2008 and decreased to 24 percent in 2014, when LOLU was most common in adults ages 18-20 (33%) and least common in children ages 6-11 years (20%).<br>Patient-centered-medical-home was not protective for drug-drug interactions or LOLU. Moving to a prescription carve-out was associated with reduction of PD BMHRx use. Despite nearly universal e-prescribing, Med Rec practices varied greatly and were not highly sophisticated.<br>**Publications:** 9 |
| Kathleen Walsh and Eric Kirkendall<br>**Cincinnati Children's Hospital Medical Center**<br>Cincinnati, Ohio | R18 HS26644<br>[Grant]<br>**Ambulatory Pediatric Safety Learning Lab**<br>2018-2023<br>$2,484,256 | **Purpose:** Redesign systems of care and coordination between the clinic and home to eliminate harm due to healthcare in these settings.<br>**Key Findings/Impact:** A final report is not available yet, but a few resulting publications pertained to top-priority research topics among pediatric clinicians, healthcare leaders, and families, as well as an oral presentation about the learning lab at the Human Factors and Ergonomics International Symposium in April 2021.<br>**Publications:** 3 |
| **OREGON** | | |
| **HMO Research Network**<br>[Unknown], Oregon | 290-00-0015-10<br>[Contract]<br>**Prevalence and Strategies for Appropriate Prescription Medication Dosing for Children**<br>2002-2003<br>$184,578 | **Purpose:** Assess the prevalence of inappropriate prescribing of medication in the ambulatory pediatric setting and the scope and breadth of current strategies to avoid inappropriate prescribing. Assess appropriate medication safety monitoring by recommended laboratory tests (e.g., liver function tests for carbamazepine).<br>**Key Findings/Impact:** A final report was not available, but an article supported by this project noted that potential medication dosing errors occurred frequently in outpatient pediatric care. Approximately 15 percent of children in the study population (N=1,933) were dispensed a medication with a potential dosing error. Eight percent were potential overdoses and 7 percent were potential underdoses.<br>For children less than 35 kg, only 67 percent were given medication within the recommended dosing range and more than 1 percent were give double the recommended maximum dose. Analgesics were most likely to be potentially overdosed (15%) while antiepileptics were potentially underdosed (20%). In addition, use of electronic prescription writers were not associated with fewer potential errors.<br>**Publications:** 2 |

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| Grant Higginson<br>**Oregon State Department of Human Services**<br>Salem, Oregon | UC1 HS14259<br>[Grant]<br>**Risk Models To Improve Long-Term Care Medication Safety**<br>2003-2004<br>$165,205<br>Final Report | **Purpose:** Determine if sociotechnical probabilistic risk assessment (ST-PRA) can create statewide risk models to identify combinations of medication delivery system and behavioral elements that produce wrong drug, wrong dose, wrong resident, and omission medication errors in nursing and community-based care facilities.<br>**Key Findings/Impact:** Researchers concluded that ST-PRA models offer four advantages over current risk management methodologies:<br>1. They provide a structure and process that allows gathering sometimes highly charged information about policy, procedure, and behavioral deviations not otherwise available.<br>2. They provide contextual maps of errors and behaviors leading to system failures so that policymakers, regulators, and managers can use ST-PRA to identify, prioritize, and prospectively model risk reduction interventions.<br>3. The models are dynamic; they are designed to evolve as fresh data from new studies, patient safety reporting systems, or facility incident reporting systems are used to refine probability estimates for different elements in the models.<br>4. Policymakers and regulators can appreciate the unanticipated consequences of particular enforcement actions (e.g., increased borrowing behavior to avoid citations for "drug not available," time pressures introduced by interpretations of the federal "2-hour rule" governing the time a drug is administered to a patient).<br>This research complements earlier studies of medication errors conducted by researchers over the last 20+ years.<br>**Publications:** 3 |
| Melinda Muller<br>**Emanuel Hospital and Health Center**<br>Portland, Oregon | U18 HS15904<br>[Grant]<br>**Medication Reconciliation: Bridging Communications/ Care**<br>2005-2007<br>$585,941<br>Final Report | **Purpose:** Develop and test an interdisciplinary medication reconciliation process to improve documentation and transfer of medication lists across the continuum of care.<br>**Key Findings/Impact:** This project created a standard process and location for the medication information accessible to everyone involved with patient care at all points of contact in the Legacy Health System. Researchers concluded that medication reconciliation requires input and cooperation from an interdisciplinary team to succeed.<br>To accomplish the process effectively, increased nursing and pharmacy resources are needed and physician buy-in is crucial. Involving the medical staff and senior leadership early in the process increases the chances of success. Current electronic medical records often require significant upgrades and modifications to successfully implement the process.<br>**Publications:** 3 |
| Mary Minniti<br>**Sacred Heart Medical Center**<br>Eugene, Oregon | P20 HS17143<br>[Grant]<br>**Medication Management at Home: Patient Identified Processes and Risk Assessment**<br>2007-2009<br>$199,977<br>Final Report | **Purpose:** Understand the patient experience and risks of managing medications at home.<br>**Key Findings/Impact:** Understanding the medication management process from the patient perspective yielded a rich picture of what behaviors and practices patients use everyday. A common framework and process maps provided a picture of steps that create a method to manage medications. This finding is significant because it promotes medication safety from the patient perspective. While they had a common framework—the high-level processes of getting, organizing, taking, and refilling medications for every patient interview—researchers learned their methods were diverse and very individual. A common theme was the use of visual cues for taking medications.<br>**Publications:** 1 |

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| Daniel Hartung<br>**Oregon State University**<br>Corvallis, Oregon | R18 HS24227<br>[Grant]<br>**Prescription Drug Monitoring Program (PDMP) Toolkit**<br>2015-2018<br>$1,486,713<br>Final Report | **Purpose:** Develop the Resources Encouraging Safe Prescription Opioid and Naloxone Dispensing (RESPOND) Toolkit to enhance community pharmacists' use of PDMP data to improve opioid safety.<br>**Key Findings/Impact:** The RESPOND Toolkit included a patient screening and communication algorithm, a provider communication checklist, and three online asynchronous educational modules. The final pilot demonstrated that the toolkit was effective at significantly improving perceived behavioral control and changing attitudes toward opioid use disorder, perceived barriers to address prescription opioid misuse, and PDMP attitudes. A moderate effect was observed for objective knowledge gains across the modules.<br>Researchers concluded that the toolkit was an effective and scalable training resource for community pharmacists, with the potential to promote behavioral shifts that support opioid safety for patients. Future work on the RESPOND Toolkit should focus on the measurement of objective behavior outcomes, including pharmacists' dispensing behaviors and the frequency and quality of pharmacist-patient engagement around opioid safety.<br>**Publications:** 9 |
| **PENNSYLVANIA** | | |
| Joel Portnoy<br>**Children's Hospital of Philadelphia**<br>Philadelphia, Pennsylvania | K08 HS11636<br>[Grant]<br>**The Effect of Medication Errors in the Pediatric ICU**<br>2001-2005<br>$520,776 | **Purpose:** Advance knowledge on the effect of medication errors on the morbidity, mortality, and costs of care of the population of patients in the pediatric intensive care unit.<br>**Key Findings/Impact:** A final report and supporting literature for this project were not available.<br>**Publications:** 0 |
| Brian Strom<br>**University of Pennsylvania**<br>Philadelphia, Pennsylvania | P01 HS11530<br>[Grant]<br>**Improving Patient Safety by Reducing Medication Errors**<br>2001-2007<br>$6,758,053<br>Final Report | **Purpose:** Improve patient safety by identifying the factors that predispose to medication errors and create a research base for the design of interventions to reduce the frequency of medication errors.<br>**Key Findings/Impact:** Researchers found that participants were 6 times more likely to take too few pills than to take extra pills. Adherence changed over time, initially worsening over the first 6 months of monitoring, followed by improvement beyond 6 months. Although clinicians were statistically better than chance at correctly labeling a participant's adherence, their estimates were often inaccurate.<br>Researchers also found that a widely used computerized physician order entry (CPOE) system contributed to 24 types of medication errors (e.g., pharmacy inventory displays mistaken for dosage guidelines). As CPOE systems are implemented, clinicians and hospitals must attend to errors they cause, in addition to errors they prevent. It is also critical to incorporate plans for continuous revisions and quality improvement. Researchers also concluded that improved patient education and delivery of medication organization systems are immediate opportunities to potentially reduce the risk of medication errors among older adults.<br>**Publications:** 19 |

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| Jane Barnsteiner<br>**University of Pennsylvania**<br>Philadelphia, Pennsylvania | R13 HS14836<br>[Grant]<br>**State of the Science on Safe Medication**<br>2004-2005<br>$50,000<br>Final Report | **Purpose:** Develop research priorities and clinical care and policy recommendations addressing the state of the science of safe medication administration.<br>**Key Findings/Impact:** Symposium participants identified specific barriers to safe medication administration in the areas of research, education, practice, policy, and administration. In addition to barriers, participants identified strategies to address them and priorities to research. Dissemination of the proceedings and recommendations were published in a supplement to the March 2005 *American Journal of Nursing* (AJN), the official journal of the American Nurses Association, and copublished in a supplement to the *Journal of Infusion Nursing*, the official publication of the Infusion Nurses Society.<br>The supplement was mailed to 90,000 AJN subscribers and all members of the Infusion Nurses Society. The supplement continues to be available at https://journals.lww.com/ajnonline/toc/2005/03001, a Lippincott Williams and Wilkins website that features AJN. The executive summary of the report was published within the March 2005 issue of AJN, which went to 344,000 registered nurse subscribers. Other dissemination included internet, mass media, professional publication, and presentations to regional and national audiences.<br>**Publications:** 9 |
| Carl Sirio<br>**University of Pittsburgh**<br>Pittsburgh, Pennsylvania | U18 HS15851<br>[Grant]<br>**Enhanced Patient Safety Intervention To Optimize Medication Education**<br>2005-2008<br>$598,565<br>Final Report | **Purpose:** Evaluate the hospital-wide implementation of a multi-modal patient medication education system hereafter referred to as EPITOME (i.e., Enhanced Patient Safety Intervention to Optimize Medication Education.)<br>**Key Findings/Impact:** Patients responded positively to the intervention with a greater awareness of their medication regimens and sense of satisfaction regarding the indications and side effects associated with their medications. Pharmacy and respiratory therapy consultations were the easiest to deploy. Significant work is required to sustain nursing engagement given workflow.<br>An important unanticipated benefit was identification of medication errors. Improving the intervention requires indepth workflow assessment and full administrative support. Researchers found that 30-day hospital readmission was affected, likely a result of inconsistent implementation.<br>**Publications:** 2 |
| Michael Cohen<br>**Institute for Safe Medication Practices**<br>Horsham, Pennsylvania | P20 HS17107<br>[Grant]<br>**Using Risk Models To Identify and Prioritize Outpatient 'High-Alert' Medications**<br>2007-2008<br>$199,050<br>Final Report | **Purpose:** Determine if sociotechnical probabilistic risk assessment (ST-PRA) can create detailed risk models that predict the incidence of preventable adverse drug events (PADEs) with high-alert medications dispensed in community pharmacies.<br>**Key Findings/Impact:** PADEs with the highest incidence include dispensing the wrong dose/strength of warfarin due to a data entry error; dispensing warfarin to the wrong patient; and dispensing an inappropriate fentanyl patch dose due to a prescribing error. PADEs with the lowest incidence include dispensing the wrong drug when filling a warfarin prescription. Increased patient counseling, conducting a second data entry verification process during product verification, bar-coding technology, and hard computer alerts that are not bypassed easily provided the largest quantifiable reductions in risk.<br>These findings quantify, for the first time, human error probabilities and at-risk behavior frequencies that combine and contribute to dispensing system failures and the overall incidence of PADEs with four high-alert medications. Researchers concluded that ST-PRA demonstrated important and largely correctable community pharmacy dispensing system vulnerabilities, identified by the people who work within those systems.<br>**Publications:** 1 |

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| Jeffrey Greenwald<br>**Society of Hospital Medicine**<br>Philadelphia, Pennsylvania | R13 HS17520<br>[Grant]<br>**Medication Reconciliation: A Team Approach**<br>2008-2009<br>$50,000<br>Final Report | **Purpose:** Identify key action items and stakeholder organization roles needed to address opportunities and challenges in medication reconciliation.<br>**Key Findings/Impact:** The principal findings from the conference were:<br>• A consensus among key stakeholders is essential in elucidating and addressing the opportunities and challenges in medication reconciliation.<br>• A standardized definition of "medication" and "reconciliation," with guiding principles and clearly defined processes, is a prerequisite to addressing specific medication reconciliation issues.<br>• Electronic health records (personal and provider based) must be standardized and implemented to transfer medication information effectively and efficiently across transitions of care.<br>• Developing a public health agenda around medication safety as the community-based concept of medication reconciliation is important for patient understanding and engagement in the medication reconciliation process.<br>• It is important to build on existing community-based initiatives and infrastructures in many national organizations to foster collaboration.<br>• Partnerships are an important implementation concept.<br>• Public health systems must partner with community-based organizations to encourage and promote the established standards for medication reconciliation.<br>**Publications:** 3 |
| Brian Strom<br>**University of Pennsylvania**<br>Philadelphia, Pennsylvania | R03 HS17358<br>[Grant]<br>**Clinical Importance of the Drug Interaction Between Statins and CYP3A Inhibitors**<br>2008-2011<br>$100,000<br>Final Report | **Purpose:** Compare the relative hazard of muscle toxicity, renal dysfunction, and hepatic dysfunction associated with the drug interaction between statins and concomitant medications that inhibit the cytochrome P450 3A4 (CYP3A4) isoenzyme.<br>**Key Findings/Impact:** Overall, this study found no difference in the relative hazard of muscle toxicity, renal dysfunction, or hepatic dysfunction for patients prescribed a statin-3A4 substrate versus a statin non-3A4 substrate with CYP3A4 inhibitor concomitancy. Additional research could further evaluate the nonsignificant yet increased muscle toxicity interaction ratio observed for highly potent statin dosages and within 6 months after statin initiation. However, the overall results show no evidence of increased hazard of statin-related adverse events based on statin metabolism.<br>**Publications:** 0 |
| Michael Cohen<br>**Institute for Safe Medication Practices**<br>Horsham, Pennsylvania | R18 HS17910<br>[Grant]<br>**Risk-Informed Interventions in Community Pharmacy: Implementation and Evaluation**<br>2008-2012<br>$708,616<br>Final Report | **Purpose:** Develop and test three risk-informed interventions in community pharmacies intended to identify, quantify, eliminate, reduce, or mitigate the risks associated with dispensing high-alert medications.<br>**Key Findings/Impact:** Researchers concluded for intervention 1 that mandatory scripted patient counseling was an effective and well-accepted model for patient education that should be considered in all community pharmacies. For intervention 2, a barcode verification system readiness assessment demonstrated the overall value of a readiness assessment. Results showed its ability to predict and thereby prevent technology problems when implementing the technology in community pharmacies. For intervention 3, High-Alert Medication Modeling and Error-Reduction Scorecards (HAMMERS™) was a robust tool that helped community pharmacies uncover important and largely correctable dispensing system vulnerabilities identified by people who work within those systems.<br>**Publications:** 1 |

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| Steven Handler<br>**University of Pittsburgh**<br>Pittsburgh, Pennsylvania | R01 HS18721<br>[Grant]<br>**Enhancing the Detection and Management of Adverse Drug Events in the Nursing Home**<br>2010-2014<br>$1,992,614<br>Final Report | **Purpose:** Improve patient safety with respect to medications in nursing homes.<br>**Key Findings/Impact:** A final report was not available, but this project resulted in 50 publications with more than 5,000 citations. A well-cited expert opinion article on polypharmacy in older adults presents information about the prevalence of polypharmacy and unnecessary medication use, negative consequences of polypharmacy, and interventions to improve polypharmacy. Researchers stated that polypharmacy is common in older adults and is highest in nursing homes. Another study looked at residents of 15 Veterans Affairs Community Living Centers age 65 and over with a diagnosis of dementia/cognitive impairment, history of falls/hip fractures, heart failure, history of peptic ulcer disease, or stage IV or V chronic kidney disease. Nearly 52 percent of the 696 residents were prescribed one or more medications that could exacerbate their conditions.<br>Another study found that automated health system-based communication and patient safety tools, including computerized discharge medication reconciliation, decreased hospital discharge medication errors in medically complex patients.<br>**Publications:** 50 |
| Vincent Lo Re<br>**University of Pennsylvania**<br>Philadelphia, Pennsylvania | R01 HS18372<br>[Grant]<br>**Clinical Prediction of Hepatotoxicity & Comparative Hepatic Safety of Medications**<br>2010-2015<br>$2,495,705<br>Final Report | **Purpose:** (1) Evaluate the incidence and outcomes of drug-induced acute liver failure (ALF) in an integrated healthcare system; (2) develop and validate a highly sensitive model to identify drug-induced liver injury patients at increased risk of ALF; and (3) compare the risk of severe acute liver injury and ALF associated with different medications to provide additional evidence on comparative hepatic safety.<br>**Key Findings/Impact:** Drug-induced ALF is uncommon, but over-the-counter products and dietary/herbal supplements are its most common causes. A new risk prediction model with platelet count and total bilirubin identified patients with drug-induced liver injury at increased risk of ALF with high sensitivity and reasonable specificity. Acute liver injury occurred rarely within the first year of modern antiretroviral initiation, but protease inhibitor use was associated with a higher risk of aminotransferase elevations among hepatitis-coinfected patients.<br>Researchers reported improved understanding of the incidence, etiology, and outcomes of ALF in a community-based population. These data highlight the rarity of this outcome and provide estimates of the true risk of ALF resulting from medications, herbals, and dietary supplements. Furthermore, such events are rarely due to prescription medications. These data suggest that closer attention to the hepatotoxicity of over-the-counter medications, particularly dietary and herbal supplements, is needed.<br>**Publications:** 21 |

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| Jeffrey Schnipper<br>**Society of Hospital Medicine**<br>Philadelphia, Pennsylvania | R18 HS19598<br>[Grant]<br>**Multi-Center Medication Reconciliation Quality Improvement Study – MARQUIS**<br>2010-2013<br>$1,480,620<br>Final Report | **Purpose:** The goals of MARQUIS were to operationalize best practices for inpatient medication reconciliation, test their effect on potentially harmful unintentional medication discrepancies, and understand barriers and facilitators of successful implementation.<br>**Key Findings/Impact:** Researchers concluded that adoption of a multifaceted quality improvement (QI) initiative for medication reconciliation using a mentored implementation model was associated with a reduction in potentially harmful medication discrepancies over time. They found that hiring additional pharmacy staff to assist with discharge reconciliation and patient counseling was the most effective component of a medication reconciliation QI program. They also identified several barriers to implementation.<br>Next steps included a larger round of mentored implementation, using an enhanced version of the toolkit, with rigorous recruitment of sites committed and able to improve their medication reconciliation process, and incorporating lessons learned regarding the most effective ways to implement this intervention and improve medication safety during transitions of care. A subsequent project to this one is included in this appendix (R18 HS23757).<br>**Publications:** 9 |
| Sandra Kane-Gill<br>**University of Pittsburgh**<br>Pittsburgh, Pennsylvania | R18 HS24208<br>[Grant]<br>**Transforming the Medication Regimen Review Process of High-Risk Drugs Using a Patient-Centered Telemedicine-Based Approach To Prevent Adverse Drug Events in the Nursing Home**<br>2015-2018<br>$1,496,302<br>Final Report | **Purpose:** Develop clinical decision support alerts to inform pharmacists of inappropriate prescribing and monitoring of high-risk drugs for the prevention of adverse drug events (ADEs).<br>**Key Findings/Impact:** Results led researchers to question the current model of practice for consultant pharmacists. The data provided evidence to support the use of telemedicine for patient-centered communication when performing medication reconciliation and regimen reviews at care transition on admission to the nursing home and during the resident's stay for residents receiving high-risk medications. The product of this research is a generalizable electronic health record-agnostic medication management model including decision support rules, as well as structured communication tools to optimally execute the consultant pharmacist's role in ADE prevention in the nursing home.<br>**Publications:** 4 |
| **RHODE ISLAND** | | |
| Kate Lapane<br>**Brown Medical School**<br>Providence, Rhode Island | R18 HS11835<br>[Grant]<br>**Pharmacist Technology for Nursing Home Resident Safety**<br>2001-2005<br>$1,049,839<br>Final Report | **Purpose:** Evaluate the effectiveness of the clinical software program Geriatric Risk Assessment Med Guide™ (GRAM™) in nursing facilities to improve medication safety.<br>**Key Findings/Impact:** Researchers concluded GRAM™ would not be used effectively unless completely integrated in the real-time operations of the long-term care pharmacy. Another option was to import the drug into the software without reentering detailed, complicated drug regimens**.** The rigorous validation protocol and enhancements to the algorithms underlying the software may have made the triggering much more selective.<br>The significance of this study is that GRAM™ was developed as a clinical decision-making tool for geriatric patients on medication therapy to treat chronic disease and conditions. It has applicability in all settings where older adults reside and widespread implementation of the tool is likely to occur in nursing facilities. Anyone can use the GRAM™ software, which is relatively inexpensive, but only health professionals with expertise in geriatric pharmacotherapy can use it as a clinical decision-making tool.<br>**Publications:** 6 |

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| **SOUTH CAROLINA** | | |
| William Basco<br>**Medical University of South Carolina**<br>Charleston, South Carolina | K08 HS15679<br>[Grant]<br>**Prescribing Errors in Ambulatory Pediatric Care**<br>2006-2010<br>$645,676<br>Final Report | **Purpose:** Evaluate the frequencies of prescribing errors in ambulatory pediatric care.<br>**Key Findings/Impact:** Out of 395 screening alerts, researchers identified 43 true errors. The implication of this research is that identifying either look-alike, sound-alike (LASA) substitution errors or dosing errors may be akin to "finding a needle in a haystack" and possibly not workable without automation. Use of health information technology, including automated screening of prescriptions for either LASA or dosing errors, would be a potential approach to decreasing the risk of pediatric medication errors.<br>In 2009, principal investigator William Basco secured an R03 grant (HS18841) to develop and evaluate a list of 200+ pediatric LASA pairs used in outpatient pediatric care and thought to be problematic for patients should a substitution occur at the time of drug dispensing.<br>**Publications:** 11 |
| Steven Ornstein<br>**Medical University of South Carolina**<br>Charleston, South Carolina | R18 HS17037<br>[Grant]<br>**Medication Safety in Primary Care Practice: Translating Research Into Practice (MS-TRIP)**<br>2007-2010<br>$1,183,549<br>Final Report | **Purpose:** Develop medication safety measures for primary care practice and assess the impact of a validated quality improvement (QI) intervention on performance on these measures among practices in an electronic health record (EHR)-based practice-based research network.<br>**Key Findings/Impact:** Medication safety measures the following categories were produced: avoiding potentially inappropriate therapy, inappropriate dosages, drug-drug interactions, and drug-disease interactions and monitoring or preventing adverse drug events.<br>Strategies adopted to improve medication safety included developing procedures to ensure accurate patient medication lists, increasing use of EHR decision support, adopting medication refill protocols, and using performance reports to identify patients with potential prescribing errors. During the intervention, practice performance improved significantly on avoidance of potentially inappropriate therapy, drug-disease interactions, and appropriate monitoring.<br>This project was the first of its kind in independent practices, which still constitute most primary care settings in the United States. The QI interventions incorporating audit and feedback and practice implementation and adaptation of safety strategies are relevant to the growing number of U.S. practices that will adopt EHRs in this era of physician incentives for meaningful use of EHRs.<br>**Publications:** 4 |
| Andrea Wessell<br>**Medical University of South Carolina**<br>Charleston, South Carolina | R18 HS19593<br>[Grant]<br>**Dissemination of the PPRNet Model for Improving Medication Safety**<br>2010-2012<br>$595,860<br>Final Report | **Purpose:** Decrease preventable prescribing and monitoring medication errors in primary care practices across the United States through dissemination of a quality improvement model focused on medication-safety (MS).<br>**Key Findings/Impact:** Only modest quantitative changes were observed, but lessons from this dissemination project on use of a broad MS indicator set and MS improvement strategies are relevant to the growing number of U.S. primary care practices that will adopt and "meaningfully" use electronic health records (EHRs).<br>MS indicators from this project have been supplemented with MS-related EHR Meaningful Use Clinical Quality Measures and added to PPRNet Reports. These reports are regularly disseminated to more than 150 member practices in 40 states.<br>The MS toolkit and findings from this project will continue to be integrated into PPRNet learning network activities as an AHRQ Center for Primary Care Practice-Based Research and Learning.<br>**Publications:** 3 |

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| Andrea Wessell<br>**Medical University of South Carolina**<br>Charleston, South Carolina | R18 HS23454<br>[Grant]<br>**Reducing ADEs From Anticoagulants, Diabetes Agents and Opioids in Primary Care**<br>2014-2017<br>$1,410,985<br>Final Report | **Purpose:** Develop adverse drug event (ADE) clinical quality measures (CQMs) for high-priority medications and test the impact of a community-engaged action research approach on practice performance on ADE CQMs.<br>**Key Findings/Impact:** The measure development process resulted in nine CQMs. Intervention practices improved on two anticoagulant CQMs compared with control practices; control group practices improved on Avoiding Potential Overtreatment of Diabetes and Proportion of Adult Patients With an Opioid Prescription. Control and intervention practices improved on Avoiding CNS Depressants in Patients on Long-Term Opioids. There was no difference in the adjusted change between groups in the three other CQMs.<br>Future work should focus on reducing variability across opioid CQMs and examine alternative roles for patient advisors in primary care. Selected ADE CQMs from this project were incorporated into the PPRNet 2017 Qualified Clinical Data Registry measure set recognized by the Centers for Medicare & Medicaid Services.<br>**Publications:** 0 |
| David Taber<br>**Medical University of South Carolina**<br>Charleston, South Carolina | R18 HS23754<br>[Grant]<br>**Improving Transplant Medication Safety Through a Pharmacist-Led, mHealth-Based Program**<br>2017-2021<br>$1,492,135<br>Final Report | **Purpose:** Examine the efficacy of improving medication safety through a pharmacist-led, mobile health–based intervention.<br>**Key Findings/Impact:** Researchers concluded that a pharmacist-led, mobile health–based intervention improved medication safety in kidney transplant recipients. During the 12-month study, the intervention produced a significant reduction in medication errors, lower rates of grade 3 or higher adverse events (AEs), and reduced hospitalization rates compared with controls. In terms of AEs, this study demonstrated a significant difference in severity, but was not powered, and did not demonstrate any difference in type of AEs between the treatment arms.<br>**Publications:** 14 |
| Ken Catchpole<br>**Medical University of South Carolina**<br>Charleston, South Carolina | R18 HS26625<br>[Grant]<br>**Identifying and Reducing Errors in Perioperative Anesthesia Medication Delivery**<br>2018-2023<br>$2,466,217 | **Purpose:** Engineer reductions in anesthesia medication errors in operating rooms that address three sources of failure: failures of execution, failures of intention, and complexities of the working environment.<br>**Key Findings/Impact:** This project was ongoing until November 30, 2023, and no final report is available yet. However, publications produced thus far pertain to anesthesia providers' decision making, the impact of flow disruptions during neonatal resuscitation, definitions of patient safety-related terminology in anesthesia, and a new professional model titled *the clinically-embedded human factors practitioner*.<br>**Publications:** 12 |

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| **TENNESSEE** | | |
| Jerry Shenep<br>**St. Jude Children's Research Hospital**<br>Memphis, Tennessee | UC1 HS14295<br>[Grant]<br>**Risk Analysis of Pediatric Chemotherapy Processes**<br>2003-2005<br>$200,000<br>Final Report | **Purpose:** Formally evaluate the risks associated with each step of a complex chemotherapy process for possible failure points before and after use of a commercially available integrated computerized provider order entry (CPOE) system at a leading children's cancer center.<br>**Key Findings/Impact:** Researchers examined a commercially available software system designed for CPOE, automated safety checks, pharmacy dispensing, and electronic documentation of medication administration in a pediatric oncology setting. They sought to determine if the system's available series of integrated applications were as safe as a long-established paper-based process with multiple redundant checks. Based on initial assessment of the individual components of the system, an integrated system, once available, appeared promising.<br>**Publications:** 1 |
| Kevin Johnson<br>**Vanderbilt University Medical Center**<br>Nashville, Tennessee | R03 HS16261<br>[Grant]<br>**Show Your Work: Do Prescription Annotations Impact Near-Miss Medication Errors?**<br>2006-2007<br>$100,000<br>Final Report | **Purpose:** Assess the impact of electronic prescription writing with Show Your Work on pharmacy callbacks to prescribers.<br>**Key Findings/Impact:** This study was the first of its kind to examine the incorporation of a prescription annotations tool in an e-prescribing system. Results suggested that a relatively low cost, easy-to-implement intervention could impact the pharmacist's perceived effectiveness and foster more effective partnering with prescribers.<br>**Publications:** 1 |
| **TEXAS** | | |
| Grace Kuo<br>**Baylor College of Medicine**<br>Houston, Texas | R03 HS14406<br>[Grant]<br>**The Effect of EMR on Medication Safety: A SPUR-Net Study**<br>2003-2005<br>$99,849<br>Final Report | **Purpose:** Provide an understanding of medication errors (MEs) in a diverse primary care population. Assess the effectiveness of an electronic medical record (EMR) with computerized provider order entry (CPOE) that had clinical decision support system (CDSS) features in decreasing MEs compared with paper medical records (PMRs).<br>**Key Findings/Impact:** Preliminary data analyses showed that EMRs helped prevent certain MEs (e.g., documentation or monitoring errors) while creating other types of MEs (e.g., prescribing errors due to missing information or errors in spelling). EMRs were associated with increased medication counseling in primary care clinics.<br>This study extended understanding of MEs in a diverse primary care population and highlighted the effects of CPOE with CDSS in increasing or reducing errors. These findings were used by clinicians and clinic administrators affiliated with the Southern Primary Care Urban Research Network (SPUR-Net) to design EMRs in clinics using PMRs that were starting to use EMRs. The findings also helped EMR clinics find ways to improve CPOE features to further decrease MEs.<br>**Publications:** 2 |

| Principal Investigator Organization City, State | Project Number [Type] Project Title Project Period Total Investment | Purpose, Key Findings/Impact, and Number of Publications |
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| Rajender Aparasu<br>**University of Houston**<br>Houston, Texas | R01 HS21264<br>[Grant]<br>**Anticholinergics and Cognitive Decline in the Elderly With Depression**<br>2012-2016<br>$872,568<br>Final Report | **Purpose:** Evaluate the central adverse effects profile of medications with significant anticholinergic activity in older residents with depression.<br>**Key Findings/Impact:** A final report was not available, but publications from this project shed light on the effects of anticholinergics. One found that clinically significant anticholinergic use was associated with significant risk of dementia compared with non-use. These findings remained consistent across levels of anticholinergic potency. Another found anticholinergic use to be associated with significant risk of death compared with non-use. Level-specific analysis indicated high mortality risk with only markedly anticholinergic (anticholinergic drug scale level 3) medication use.<br>**Publications:** 8 |
| Ayse Gurses (Formerly, Yan Xiao)<br>**Baylor Research Institute**<br>Dallas, Texas | R01 HS24436<br>[Grant]<br>**Patient-Centric Risk Model for Medication Safety During Care Transitions**<br>2015-2019<br>$1,396,509<br>Final Report | **Purpose:** Develop a patient-centric risk model of medication-related harms during transitions by (1) identifying hazards to medication safety using a patient work system framework; (2) developing a risk assessment tool; and (3) evaluating the risk assessment tool in a multisite prospective longitudinal study.<br>**Key Findings/Impact:** Top sources of hazards for medication-related harms identified by professionals were defects in patient education and inadequate homework system, challenging medications, cost, and information inaccuracies. Medications most frequently cited were anticoagulants, insulins, diuretics, opioids, and antiplatelets. Researchers concluded that risks to medication safety during transitions of care may be understood as a mismatch between medication management tasks and capabilities in an ambulatory environment.<br>The significance of this project is that a risk assessment tool was developed that may be implemented to reduce risks of patient harms due to medication use, misuse, or non-use. The project refined a framework for developing patient partnerships, which may be used for research and for practical solutions and technology development.<br>**Publications:** 5 |
| Hua Chen<br>**University of Houston**<br>Houston, Texas | R03 HS26790<br>[Grant]<br>**Risk of Acute Asthma Associated With the Pediatric Use of Opioids**<br>2019-2021<br>$100,000<br>Final Report | **Purpose:** Assess whether exposing children and adolescents to prescription opioid analgesics is associated with increased risk of asthma attacks.<br>**Key Findings/Impact:** The use of opioid analgesics was most common among children with outpatient procedures, dental procedures, traumatic injuries, or respiratory infections. Researchers concluded that opioid analgesics were commonly prescribed to children with asthma. The utilization rate was higher among non-Hispanic White children and children with prior asthma-related emergency department visits and short-acting beta agonist overuse.<br>Other than procedures and diagnoses associated with frequent opioid use, such as surgical and dental procedures, a considerable number of children with asthma also received opioids for relatively minor conditions, including respiratory infections, abdominal pain, and general infections. In addition, the findings indicated that asthma exacerbation was uncommon after the dispensing of either opioid or nonopioid analgesic medication in children with current asthma. There was no significant difference in the odds of asthma exacerbation following the dispensing of opioid versus nonopioid analgesics.<br>**Publications:** 3 |

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| Yan Xiao<br>**University of Texas**<br>Arlington, Texas | R18 HS27277<br>[Grant]<br>**PROMIS Learning Lab: Partnership in Resilience for Medication Safety**<br>2019-2024<br>$2,493,137 | **Purpose:** Improve the value of primary care services using work system design strategies, such as informational tools, task redesign, and space layout, to enable and build capacity.<br>**Key Findings/Impact:** This project is ongoing until September 30, 2024, and no final report is available yet. However, publications produced thus far pertain to past, current, and future work concerning human-centered design and research in deprescribing medications, as well as difficulties and obstacles faced by older adults during the COVID-19 pandemic.<br>**Publications:** 8 |
| **UTAH** | | |
| Ginette Pepper<br>**University of Utah, Salt Lake City**<br>Salt Lake City, Utah | R01 HS11966<br>[Grant]<br>**Nurses' Working Conditions: Effects on Medication Safety**<br>2001-2006<br>$1,008,919 | **Purpose:** Describe the relationships between working conditions that affect nurses and the safety and quality of care they provide, with a focus on medication safety. This study focused on organizational variables that could be affected administratively, rather than individual nurse characteristics.<br>**Key Findings/Impact:** A final report was not available for this project; however, a resulting review discussed potential theories or conceptual frameworks that combine clinical, organizational, financial, and outcome variables from the unique perspective of nursing. Theories not only suggest ideas for research, but also provide order and logic to an investigation and limit the number and type of variables to be considered to a reasonable few. Although relatively little health services research is done within nursing, there is a growing appreciation of the need for knowledge related to the use, costs, quality, delivery, organization, financing, and outcomes of healthcare and how nursing practice influences these variables.<br>Conceptual frameworks used by investigators in AHRQ-funded grants show that workforce-related health services research of nursing phenomena is based on a wide variety of conceptual models, many of the investigator's own inventions. Researchers believe that such conceptualizations will guide future researchers and add coherence to the body of health services research into nursing issues.<br>**Publications:** 1 |
| Jordan King<br>**University of Utah**<br>Salt Lake City, Utah | R18 HS26156<br>[Grant]<br>**Management of Direct Oral Anticoagulants To Lower Adverse Events in Atrial Fibrillation (MODL-AF)**<br>2018-2022<br>$1,378,518<br>Final Report | **Purpose:** Determine the comparative safety, effectiveness, and cost-effectiveness of different models of direct oral anticoagulants (DOACs).<br>**Key Findings/Impact:** Analysis included a robust comparison of baseline patient characteristics between DOACs and warfarin initiators in each Kaiser Permanente region. The study included 44,746 patients who met the inclusion criteria. Among all regions, DOAC-treated patients were modestly more likely to be younger, male, non-Hispanic White, former or never smokers, >60 kg in weight with hypertension.<br>Among DOAC initiators, researchers analyzed 1-year medication adherence (the proportion of days covered [PDC]—that is how many pills "covered" the observed followup period—and medication persistence [how long a patient took their initiated treatment]). There was no significant difference in the average PDC between the three DOAC care models. Between 65.5 percent and 72.4 percent of patients had a 1-year PDC ≥80 percent depending on the underlying assumptions and DOAC care model. No significant difference in medication persistence was found across the three DOAC care models.<br>**Publications:** 5 |

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| Daniel Witt<br>**University of Utah**<br>Salt Lake City, Utah | R18 HS27960<br>[Grant]<br>**Overcoming Barriers to Warfarin Patient Self-Management Implementation in the U.S. Healthcare System**<br>2021-2025<br>$1,347,674 | **Purpose:** Improve the safety of ambulatory warfarin therapy by increasing implementation of patient self-management.<br>**Key Findings/Impact:** This project was ongoing until April 30, 2025, and no final report is available yet. However, several articles have been published to date, one of which describes a single-center study that displayed the tremendous potential to improve patient safety and reduce bleeding harm. Based on recent guidelines limiting indications and duration of antiplatelet therapy (APT) added to anticoagulation, results showed that more than 95 percent of patients warranted reassessment of APT indication. Stable atherosclerotic cardiovascular disease and primary prevention were the prime targets for APT deprescribing.<br>**Publications:** 5 |
| **WASHINGTON** | | |
| Emily Devine<br>**University of Washington**<br>Seattle, Washington | K08 HS14739<br>[Grant]<br>**Evaluating e-Prescribing in a Community-Based, Integrated Health System**<br>2006-2011<br>$509,881<br>Final Report | **Purpose:** Provide protected time for the primary investigator to (1) obtain advanced training in health services research methods; and (2) use these newly acquired skills to design, conduct, analyze, and disseminate the findings of a sequence of research projects centered on evaluating the impact of the use of an electronic prescribing (or computerized provider order entry [CPOE]) system on outcomes.<br>**Key Findings/Impact:** This Mentored Clinical Scientist Training Award grant enabled the investigator to obtain skills in advanced health services research methods that she is now applying to launch her career at the intersection of comparative effectiveness research and clinical research informatics. For example, her work has led her to make the following conclusions: (1) a basic CPOE system in a community setting was associated with a significant reduction in medication errors of most types and severity levels; and (2) e-prescribing takes longer than handwriting and e-prescribing at the point of care takes longer than e-prescribing in offices/workstations.<br>**Publications:** 14 |
| Cindy Corbett<br>**Washington State University**<br>Pullman, Washington | R21 HS19552<br>[Grant]<br>**Transitional Care Medication Safety and Medical Liability: Closing the Chasm**<br>2010-2011<br>$298,810<br>Final Report | **Purpose:** Improve medication safety and quality of care during the hospital to community transition, thereby improving patient outcomes and reducing adverse events and costs, including medical liability.<br>**Key Findings/Impact:** Findings from aim 1 included:<br>• Discrepancies occur across all medicine classes and are surprisingly common in those considered at high risk of causing patient harm.<br>• The risk of harm from identified medication discrepancies is generally minimal but occasionally serious.<br>• Five types of medicines were found to pose a high risk for medical liability.<br>• Patient and system-level structure and process variables offer minimal to modest contributions to identifying the risk of medication discrepancies.<br>Findings from aim 2 included:<br>• Stakeholder groups could identify factors that impact antecedent, structure, process, and outcomes related to medication discrepancies during the transition from home to hospital and hospital to home. Different stakeholder groups often identify similar factors.<br>• Emerging themes were identified as contributing to medication discrepancies during hospital community care transitions.<br>• Strategies were identified by the Patient Safety Advisory Council for improving hospital community care transitions following the failure modes and effects analysis.<br>**Publications:** 4 |

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| Michael Parchman<br>**Kaiser Foundation Health Plan of Washington**<br>Seattle, Washington | R18 HS23750<br>[Grant]<br>**Team-Based Safe Opioid Prescribing**<br>2015-2018<br>$1,471,862<br>Final Report | **Purpose:** Improve safe prescribing of chronic opioid medication for patients with noncancer pain in rural primary care clinics across Washington and Idaho.<br>**Key Findings/Impact:** System redesign guided by the Six Building Blocks resulted in significant declines in the percentage of patients on high-dose opioids and the total number of patients receiving opioids in rural clinics compared with controls. Structural changes implemented as part of the intervention improved workplace organizational and emotional aspects for clinicians and staff. Increased confidence, comfort, collaboration, and teamwork improved clinician and staff practice environment perceptions and overall professional satisfaction.<br>With adequate implementation support, the Six Building Blocks program provides an incidence-based roadmap or guide for primary care clinics to provide guideline-concordant long-term prescribing of opioids for chronic pain in a manner that improves patient safety and the work life of primary care clinicians and staff.<br>**Publications:** 6 |
| **WISCONSIN** | | |
| Pascale Carayon<br>**University of Wisconsin**<br>Madison, Wisconsin | UC1 HS14253<br>[Grant]<br>**Medication Error Reduction, Technologies, and Human Factors**<br>2003-2006<br>$460,531<br>Final Report | **Purpose:** Examine the impact of the implementation of medication administration technology, namely Smart infusion pumps and barcode medication administration technology, using human factors techniques.<br>**Key Findings/Impact:** This project identified many medication-use practice issues, including unlabeled infusion bags from the operating room, missing medication orders for infusing medications, and protocols not being followed by the user. Researchers concluded that prospective risk analysis and usability testing greatly improved the implementation of the Smart infusion pump technology. Perceptions related to pump functioning, interface, improved patient safety, and ease of use predicted pump acceptance. Medication administration errors decreased and pump-related errors were few.<br>**Publications:** 20 |
| Korey Kennelty<br>**University of Wisconsin**<br>Madison, Wisconsin | R36 HS21984<br>[Grant]<br>**Medication List Consistency When Patients Transition From Hospital to Community**<br>2012-2013<br>$39,458<br>Final Report | **Purpose:** (1) Examine the agreement of medication lists for patients recently discharged from a hospital, focusing primarily on community pharmacy lists after the patient's first prescription fill. (2) Describe barriers and facilitators community pharmacists face when reconciling medications for recently discharged patients.<br>**Key Findings/Impact:** Researchers concluded that information should facilitate future research to better understand the mechanisms for medication discrepancies. In addition, specific facilitators and barriers community pharmacists perceive when reconciling medications for recently discharged patients suggest promising avenues for future research interventions to decrease medication discrepancies (e.g., publications, conference presentations).<br>A website, patient safety hotline, focus groups, and surveys offered participants additional portals for accessing information and updates pertaining to the project. Another mechanism for dissemination of project information and educational activities was Blackboard 5™, a comprehensive e-learning system that allows educators to enhance their learning product using the internet.<br>**Publications:** 4 |

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| Michelle Chui<br>**University of Wisconsin**<br>Madison, Wisconsin | R18 HS24490<br>[Grant]<br>**Improving Over-the-Counter Medication Safety for Older Adults**<br>2016-2020<br>$1,447,284<br>Final Report | **Purpose:** Examine the effectiveness of a structural pharmacy design change on over-the-counter (OTC) medication misuse in older adults, called the Senior Section™.<br>**Key Findings/Impact:** Researchers identified statistically significant reductions in drug/disease misuse and drug/label misuse subtypes, with reduced daily-dosage and single-dosage misuse. The Senior Section slightly reduced drug/drug misuse and improved the quality of pharmacist-older adult encounters. After implementation, pharmacy staff were more likely to initiate patient encounters, address more topics, provide details about OTC products, discuss appropriateness of OTC use, and discuss medication classes highlighted in the Senior Section.<br>Based on the proven effectiveness of the intervention and the minimal impact to pharmacist workload, the Senior Section can be scaled up to most community pharmacies in the United States. The Senior Section reduced the purchase of these products by 37 percent, which could potentially shield close to 6 million older adults from significant harms.<br>**Publications:** 16 |
| Michelle Chui<br>**University of Wisconsin**<br>Madison, Wisconsin | R18 HS27737<br>[Grant]<br>**Effectiveness and Sustainment of a Tailored Over-the-Counter Medication Safety Intervention in Community Pharmacies**<br>2020-2024<br>$1,467,146 | **Purpose:** Adapt, adopt, and provide long-term evaluation of a system redesign intervention (the Senior Section) to decrease over-the-counter (OTC) medication misuse for patients in 63 Advocate Aurora Health pharmacies.<br>**Key Findings/Impact:** This project is ongoing until September 29, 2024, and no final report is available yet. However, one publication described a protocol for a randomized control study that will test the Senior Section intervention, a previously designed intervention that addresses a gap in medication safety specifically related to older adults and use of OTC medications.<br>**Publications:** 1 |
| Ryan Coller<br>**University of Wisconsin**<br>Madison, Wisconsin | R18 HS28409<br>[Grant]<br>**Improving Medication Safety for Medically Complex Children With mHealth Across Caregiving Networks**<br>2022-2025<br>$999,999 | **Purpose:** Create a scalable mHealth intervention that improves medication safety for children with medical complexity across the caregiving network, which includes primary (physicians) and secondary (e.g., family, in-home care professionals, schools) caregivers.<br>**Key Findings/Impact:** This project is ongoing, and no final report or publications are available yet.<br>**Publications:** 0 |
| Michelle Chui<br>**University of Wisconsin**<br>Madison, Wisconsin | R18 HS29608<br>[Grant]<br>**Engineering Resilient Community Pharmacies (ENRICH)**<br>2023-2027<br>$499,979 | **Purpose:** Conceptualize, design, implement, and test a Medication Safety Map (MedSafeMap) for the community pharmacy setting to enhance pharmacists' and technicians' abilities to avoid, or to quickly identify and recover from, medication errors before patient safety is endangered. MedSafeMap is an innovative approach that pharmacists and pharmacy technicians will use to better navigate complex tasks in the pharmacy and to facilitate communication with both patients and clinicians, while safely providing medications to complex patients with chronic health conditions.<br>**Key Findings/Impact:** This project is ongoing until August 31, 2027, and no final report or publications are available yet.<br>**Publications:** 0 |

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