



Nurses and Medication Management

Four research projects on nursing's role in reducing medication errors

SUMMARY

Medication errors in hospitals are common. A 2006 Institute of Medicine [report](#) estimated that a patient on average is subjected to at least one medication error per day.

Program staff at the Robert Wood Johnson Foundation (RWJF) wanted to generate research that would help improve nurses' ability to prevent harm from hospital medication errors—not just nurses' errors but those made throughout the medication process.

During 2007–2010 RWJF supported four research projects that examined nursing's role in—and contribution to—medication management in hospital and transitional care settings.

The grantee organizations were:

- Rutgers University College of Nursing, Newark, N.J.
- University of Wisconsin–Madison College of Engineering, Madison, Wis.
- Johns Hopkins Hospital, Baltimore
- Washington State University College of Nursing, Spokane, Wash.

The four project teams worked independently, researching different aspects of the medication process and reporting separately on their efforts and findings. The teams were multidisciplinary, with a nurse either as director or co-investigator.

While the projects were not collaborative, RWJF sought to facilitate information-sharing among the teams by supporting a medication management meeting and webinar series in collaboration with the Gordon and Betty Moore Foundation of Palo Alto, Calif.

Key Findings

Rutgers College of Nursing project:

- Hospital medical-surgical nurses engage in six “patient-focused” medication safety practices to prevent errors from reaching patients, according to analysis of interviews with 50 New Jersey hospital nurses.

University of Wisconsin–Madison College of Engineering project:

- An assessment of nursing medication management practices at two Wisconsin hospitals identified 21 major medication management “failure modes” (the ways that the medication management process can break down) and 71 contributing factors.

Johns Hopkins Hospital project:

- A nurse-pharmacist intervention to improve medication reconciliation management—a process to prevent harmful drug events—found that 226 of 563 participating hospital patients (40%) experienced a medication discrepancy on admission or discharge. Of those 226 patients, 162 (72%) had a discrepancy rated potentially harmful.

Washington State University College of Nursing project:

- Home care patients participating in an intervention to improve medication reconciliation had significantly fewer emergency department visits during the first 30 days after hospitalization compared to control group patients. However, there was no statistically significant difference in the groups’ 30-day rehospitalization rates.

Funding

RWJF supported each of the four projects with a grant of approximately \$300,000 over two years. Two of the grants were awarded through the *Interdisciplinary Nursing Quality Research Initiative (INQRI)*, an RWJF national program that supports research examining the relationship between nursing and the quality of patient care.

The INQRI program office at the University of Pennsylvania provided guidance and logistical support for the medication management meeting and webinars. Additionally, some members of the medication management project teams participated in INQRI-sponsored events.

CONTEXT

Medication errors in hospitals are common. A 2006 Institute of Medicine report¹ on the problem estimates that a patient on average is subjected to at least one medication error per day. Only a small portion of these mistakes result in patient harm—less than 1 percent according to research cited by the Veterans Health Administration. But serious injuries, including fatalities, do occur.

For example, the Institute of Medicine report cites the case of Betsy Lehman, a breast cancer patient who died in 1994 after receiving an overdose of a toxic chemotherapy agent at the Dana-Faber Cancer Institute in Boston—the result of a physician’s erroneous prescription.

How often do hospital medication errors have consequences? Different researchers have come up with different estimates. One confounding factor is that many medication-related injuries—termed *adverse drug events*—are not the result of error.

For example, an allergic reaction to a drug by a patient with no such history is an adverse drug event but not an outcome that could be foreseen and prevented—and, thus, not an error. Estimates of how many adverse drug events are preventable vary widely—from 15 percent to 50 percent in the studies reviewed by the Institute of Medicine committee that produced the 2006 report.

As a rough yardstick, the report cites two studies conducted in the 1990s that taken together indicate about 400,000 preventable adverse drug events occur in hospitals nationwide each year. Including long-term and ambulatory care, the nation experiences at least 1.5 million preventable events annually, the report estimates.

In addition to harming patients, medication mistakes increase health care costs. Based on a 1997 study, the Institute of Medicine report estimates that preventable hospital medication injuries add \$3.5 billion (in 2006 dollars) annually to inpatient hospital costs.

Mistakes can and do occur throughout the medication process, from drug procurement to patient monitoring. However, two steps—prescribing and administering—account for the majority of errors.

RWJF’s Interest in This Area

The mission of RWJF is to improve the health and health care of all Americans. The Foundation views nurses—who make up more than half the health care workforce—as

¹ *Preventing Medication Errors: Quality Chasm Series*, Committee on Identifying and Preventing Medication Errors. Aspden P, Wolcott J, Bootman JL and Cronenwett LR (eds). Washington: Institute of Medicine. Available [online](#).

central to that endeavor and has invested more than \$150 million in programs to strengthen the nursing profession.²

In the wake of the Institute of Medicine report, RWJF program staff was interested in generating research that would help improve nurses' ability to prevent harm from hospital medication errors—not just nurses' errors but those made throughout the medication process.

Responsibility for administering medications in hospitals falls principally on nurses, making them well-positioned to catch mistakes of whatever origin before they reach the patient—a function that nurses do in fact perform. Research shows that nurses are responsible for the vast majority of medication error interceptions.

RWJF staff wanted to explore and strengthen this important nurses' function.

THE PROJECT

During 2007–2010, RWJF supported four research projects that examined nursing's role in—and contribution to—medication management in hospital and transitional care settings.

The grantee organizations—each of which received approximately \$300,000 over two years³—were:

- Rutgers University College of Nursing, Newark, N.J.
- University of Wisconsin–Madison College of Engineering, Madison, Wis.
- Johns Hopkins Hospital, Baltimore
- Washington State University College of Nursing, Spokane, Wash.

The four project teams worked independently, researching different aspects of the medication process and reporting separately on their efforts and findings. (There was no synthesis of the individual project results into an overall set of findings, conclusions or recommendations.)

The project teams were multidisciplinary, involving nurses, pharmacists, physicians and academics in other field, including, in one instance, engineers. All of the teams had a nurse as either director or co-investigator.

² Recent programs include *Robert Wood Johnson Executive Nurse Fellows Program*, *Robert Wood Johnson Foundation Initiative on the Future of Nursing*, *Robert Wood Johnson Foundation New Careers in Nursing*, *Robert Wood Johnson Foundation Nurse Faculty Scholars*, *Wisdom at Work: Retaining Experienced Nurses* and INQRI.

³ See [Appendix 1](#) for details of each grant.

An Information-Sharing Component

While the projects were not collaborative, RWJF sought to facilitate information-sharing among the research teams by convening a kick-off meeting and a concluding series of webinars on medication management. The webinars included presentations by three of the four project directors.

“We wanted to create a body of evidence related to this topic. We also wanted to have something of a learning community established, which is why we had the meeting early on in the grant cycle,” says RWJF Senior Program Officer Lori A. Melichar, PhD, MA.

The Gordon and Betty Moore Foundation of Palo Alto, Calif., which at the time was supporting medication-related projects in California, collaborated with RWJF on the meeting and webinars.⁴ Grantees of both foundations participated in these events, but the two sets of projects were themselves unconnected.

See [Appendix 2](#) for the meeting agenda and list of webinar speakers with online links to many of the presentations. (The links remained active and the presentations accessible as of September 2011, when this report was prepared.) See [Appendix 3](#) for a description of the two projects funded by the Moore foundation.

PROJECT OBJECTIVES, METHODOLOGIES, FINDINGS AND LESSONS LEARNED

The following is a project-by-project summary of objectives, methodologies, key findings and lessons learned reported by the teams to RWJF or in journal articles or book chapters. There was no synthesis of the individual project results into one summary set of findings, conclusions or recommendations.

Rutgers College of Nursing

The Rutgers team sought to identify key care processes that facilitate nurses’ interception of medication errors on hospital medical-surgical units and, conversely, processes that serve as barriers to interception.

The team, which included the disciplines of nursing, pharmacy, sociology and biostatistics, also set out to determine:

- The relative effect of nurse staffing levels, medication safety technologies and other factors on the frequency of medication error interception

⁴ The two philanthropies jointly funded Constella Group LLC of Durham, N.C., to organize the meeting and webinars. For its share, RWJF paid Constella \$65,740 under a contract (ID# 61149). See [Appendix 1](#) for contract details. Constella was subsequently acquired by SRA International Inc. based in Fairfax, Va.

- The impact of non-intercepted medication errors on length of patient stay and total hospital costs

Fourteen New Jersey hospitals collaborated on the study, providing access to their nursing and pharmacy staffs and various administrative data. The 14 were among some 25 hospitals invited to participate as a representative sample of all New Jersey hospitals in size, geographic location and other factors.⁵

The research team:

- Interviewed 50 registered nurses (RNs) on medical-surgical units in 10 of the collaborating hospitals⁶ about the processes the nurses used to prevent and intercept medication errors, and the facilitators and barriers to those processes.
- Analyzed transcripts of the recorded interviews to identify the nurses' key medication safety processes and, based on that data, developed a survey questionnaire, "Nursing Medication Safety Process Scale."
- Administered the written survey instrument to 725 RNs on 83 medical-surgical units across the 14 hospitals. The 725 constituted a response rate of 95.9 percent of the nurses working the shift sampled at each unit—in most instances the 7 a.m.–7 p.m. shift.⁷
- Conducted a separate survey of 83 pharmacists at the same hospitals—one pharmacist for each medical-surgical unit surveyed—about the extent of the institution's use of medication safety technology, particularly computerized provider order entry (CPOE).⁸
- Collected unit-level administrative data from the hospitals for the period January–August 2008, including RN hours per patient day and the number of reported medication errors. Two of the hospitals also provided patient discharge data on patients who experienced a medication error during 2005–2006.

⁵ Initially about 20 hospitals agreed to participate, but for a variety of reasons, including difficulty collecting administrative data at several sites, the project findings were based on activities at 14, according to the project director. All of the hospitals were assured they would not be identified.

⁶ For the project's qualitative component, the project director selected a subgroup of hospitals that she considered to be representative in size and geography.

⁷ The project director administered the survey over a period of days, personally handing out the questionnaire to nurses in the participating hospitals. Originally, she said, she planned to survey all nurses over a 24-hour period but concluded that was not practical or affordable. Also, the significant response rate among the daytime nurses provided a representative sample, she said.

⁸ CPOE technology allows the provider to order medications and other patient treatment electronically instead of on a paper chart, eliminating the danger of mistakes and confusion stemming from unclear handwriting.

Findings

- **Analysis of the 50 nurse interviews indicated that hospital medical-surgical nurses engage in six medication safety practices to prevent errors from reaching patients.** In an article accepted for publication by *Qualitative Health Research*,⁹ team members identified the six “patient-focused” practices as:
 - Educating patients
 - Taking everything into consideration (meaning paying attention to all factors relevant to the patient—such as age, weight and diagnosis—and not focusing just on the medication itself)
 - Advocating for patients with the pharmacy
 - Coordinating care with physicians
 - Conducting independent medication reconciliation
 - Verifying with colleagues (meaning developing positive relationships with peers and double checking with them on medication issues)
- **In addition to the six patient-focused practices, the qualitative interview data identified four “environmental-focused” practices by nurses to deal with workplace challenges to medication safety.** The article listed the four as:
 - Coping with interruptions and distractions
 - Interpreting physician orders
 - Documenting near misses (potentially harmful errors that are caught before they reach the patient)
 - Encouraging open communication between disciplines

Summing up the importance of the project’s interview-based findings, Linda Flynn, PhD, RN, project director and article co-author,¹⁰ said in an interview for this report:

“There are medication safety processes that registered nurses employ to keep their patients safe—not only to keep themselves from committing a medication error, which is where the focus has usually been.... We have at least begun the attempt to describe what those processes are.”

⁹ Dickson GL and Flynn L. “Nurses’ Clinical Reasoning: Processes and Practices of Medication Safety.” *Qualitative Health Research*, 22(1): 3–16, 2012. Abstract available [online](#).

¹⁰ Flynn is associate dean for graduate education and professor at Rutgers College of Nursing.

In a September 2009 report to RWJF, the research team reported these additional findings based on analysis of the nurse/pharmacist survey responses and hospital data:

- **Higher levels of nursing medication safety processes were associated with fewer medication errors.** Predictors of higher level nursing medication safety processes included a supportive nursing practice environment¹¹ and a higher number of RN hours per patient day.

“These findings indicate that nursing medication safety practices make a difference in patient care, and that nurses are more likely to engage in these practices when they are in a supportive organization,” Flynn said.

- **Implementation of a CPOE system as a safety technology was significantly associated with fewer medication errors.**
- **Costs of hospital stays were, on average, \$6,973 higher for patients who experienced a medication error.**

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Survey or Poll Results Reports

“Nursing Medication Safety Process Scale,” Rutgers College of Nursing, fielded 2008.

Lessons Learned

1. **When contemplating research involving hospitals, develop a collaborative working relationship with the hospitals’ personnel *before* designing the study and seeking funding.**

The Rutgers team viewed the participating hospitals as research partners, and their representatives helped design the study, including determining the research questions and data collection methods. The result was that the hospitals’ administrators and staffs were exceptionally supportive of the project—and a primary factor in its completion.

¹¹ Criteria of a supportive nursing environment include such factors as providing adequate resources, having competent front-line managers and ensuring a positive physician-nurse relationship, according to Flynn.

“Collaboration with your participating organizations doesn’t start after the grant is funded. It starts when you start to have an idea—when you’re thinking about going for a grant.” (Project Director/Flynn)

Afterward

A 2010 Institute of Medicine report on the future of the nursing profession¹² cited some of the project’s findings among the body of evidence linking nursing care to patient safety. The report, which RWJF funded, called for increasing nursing’s contribution to—and leadership role in—the health care delivery system.

The manuscript will appear as the lead article in the January 2012 issue of *Qualitative Health Research*. A manuscript presenting the quantitative findings of the study is in review at a well-known research journal. A third manuscript presenting the cost analysis is in preparation and a fourth paper describing the challenges of a multi-site study was published in the American Association of Critical-Care Nurses’ *Advanced Critical Care* in 2009.

Meanwhile, Rutgers College of Nursing received a new RWJF grant¹³ to support a follow-up project focused on enhancing the leadership and team-building skills of nurse managers in New Jersey hospitals.

The project team—led by Flynn and Joel Cantor, ScD—designed and implemented a nurse manager development program and studied its impact by tracking medication errors and patient falls in the units managed by the program participants. The work was ongoing when this report was prepared.

University of Wisconsin–Madison College of Engineering

A multidisciplinary team that included engineers, nurses and physicians explored how nurses contribute to the quality of medication management and how health information technologies impact that contribution.

The project built on two studies of medication management information technologies initiated earlier by team members with funding from the federal Agency for Healthcare Research and Quality.

The project director was Pascale Carayon, PhD, Procter & Gamble Bascom Professor in Total Quality in the College of Engineering and director of its Center for Quality and

¹² *The Future of Nursing: Leading Change, Advancing Health*, Committee of the Robert Wood Johnson Foundation Initiative on the Future of Nursing, at the Institute of Medicine. National Academies Press. Available [online](#).

¹³ The two-year, \$299,987 grant (ID# 68224) was awarded in September 2010 through the *Interdisciplinary Nursing Quality Research Initiative* (INQRI), an RWJF national program. More information is available [online](#).

Productivity Improvement—an interdisciplinary organization that applies human factors and systems engineering principles to improve products and processes, in particular in the areas of health care quality and patient safety.

The study focused on two intensive care units (ICUs) in separate Wisconsin hospitals: an adult ICU that was implementing CPOE technology and a pediatric ICU initiating a bar code medication administration system.¹⁴

The team:

- Spent a total of 168 hours observing activities at the two hospitals and conducted two sets of one-hour interviews with unit nurses. The resulting information allowed the team to determine the tasks and related cognitive activities performed by nurses when managing medications.
- Used the observation and interview data to prepare for a *proactive risk assessment* of nursing medication management. A proactive risk assessment seeks to determine how a process can fail and how people involved in the process can contribute to or recover from a failure. In this instance, the team:

- Developed a document listing the ways that the medication management process can break down at each step. After incorporating feedback from nurse interviews, the team presented the list of breakdowns—termed failure modes—to two focus groups of RNs.
- Participants were asked to identify additional failure modes and then to rank the full list by frequency and impact. The nurses were also asked to identify factors that contribute to each failure mode and to explain how they themselves recover from them. Example:

A failure mode: The electronic health record system is difficult to navigate and not user-friendly.

A possible contributing factor: The system is continuously being upgraded, making it hard for the nurse to become familiar with how to operate it.

One recovery process: Ask co-workers for help.

- Used data from the focus groups, observations, and interviews to create a tool for surveying nurses on how frequently they perform specified medication management activities and how important each activity is to patient well-being.

The survey tool, which the team distributed to 280 unit nurses, included questions on both general medication management activities and activities specifically related to health information technologies.

¹⁴ A bar code system uses scanning technology to track medications and ensure a correct patient match.

Challenges

The team initially planned to study the two ICUs before and after implementation of their new health information technologies. However, the team did not complete collection of the “before” data on the pediatric unit by the time the unit began using its new bar code system. This development—which the team attributed to a time lag between the study’s proposal and funding—restricted the before-after portion of the study.

Findings

In a report to RWJF and a webinar presentation, the team included the following among the project’s key results:

- **The team’s assessment of nursing medication management practices identified 21 major medication management *failure modes* and a total of 71 contributing factors.** The team identified 47 different *recovery processes* in which nurses engage to overcome breakdowns in the medication management process.
 - Medication management health information technologies are able to support some nursing activities, but problems with the technologies “can delay care or result in some care not happening.”
 - Problems with medication management technologies require nurses to implement recovery strategies to allow care to continue.
- **Nursing medication management is composed of a highly complex set of cognitive activities.** While medication management is typically thought of as a set of discrete tasks (assessing the patient, retrieving medication, etc.), nurses support those tasks with continual cognitive activities, such as adapting to unplanned events, recovering from problems, and planning and forecasting.
- **Based on survey data, the team identified the most common nursing contributions to medication management quality.** With respect to health information technologies, the five most common are:
 - Maneuvering around objects in the patient’s room because the tethered bar code scanner cannot reach the patient’s wristband.
 - Working around the electronic health record system.
 - Compensating for incorrect/incomplete/missing information in electronic medication administration records.
 - Working around the electronic medication administration record system.
 - Troubleshooting the electronic health record system.

Without regard to information technology, the most common nursing contributions to medication management quality include:

- Adapting workflow to the urgency of the patient care situation.
- Using discretion when administering medications ordered to be given *as needed* (instead of on a fixed schedule).
- Gathering information from assessment of the patient to help make medication management decisions.

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Survey or Poll Results Report

“Measuring Nursing Contributions to Medication Management Quality,” University of Wisconsin-Madison College of Engineering, fielded in 2009.

Lessons Learned

- 1. Before gathering data for a field study, make sure the study subjects understand the goals, methods, timing, risks and benefits of the research.**

By waging an information campaign among the study subjects (as opposed to simply getting their signatures on a consent form), researchers demonstrate their commitment to ensuring the subjects understand what the project is all about.

It also provides an opportunity to identify influential and supportive individuals among the subjects who can serve as “champions” of the project. (Final Grantee Report to RWJF)

2. **Spend time preparing for a *proactive risk assessment*.** The hours invested in observing and interviewing the ICU nurses permitted the team to “speak the local language” and ask questions grounded in the “reality of the unit” as opposed to made-up scenarios. (Final Grantee Report to RWJF)

Afterward

Team members published articles and books chapters on aspects of the project, including the process of involving nurses in a proactive risk assessment.

Johns Hopkins Hospital

Medication reconciliation—a process to prevent harmful drug events—can be a difficult and time-consuming task for busy, front-line hospital caregivers. Researchers at Johns Hopkins evaluated the effectiveness of using a special nurse-pharmacist team to improve medication reconciliation management at admission and discharge.

The research objectives were twofold:

- To determine if the intervention team would be successful in identifying unintended discrepancies between the medications that patients took at home and the medications ordered for them while under hospital care.
- To conduct a cost-benefit analysis of the intervention, comparing the additional expense of the intervention team against the benefit of averted harmful medication error.

The intervention team consisted of two clinical nurses recruited to work full-time on medication reconciliation during the project plus a clinical pharmacist whom the nurses consulted for guidance.

From March 2008 through April 2009, the team conducted medication reconciliation on 563 Johns Hopkins medicine patients enrolled in the study. Almost all of the patients were emergency admissions, many with chronic conditions.

The project had these main elements:

- One of the two nurses interviewed each study patient 24 to 48 hours after admission to compile a list of medications (prescription and over-the-counter) that the patient took at home.

Many patients were unable to provide a full accounting, and in those instances the nurses contacted family members, primary care providers, community pharmacists and other information sources to complete the list.

- The nurses compared the patient’s home medication list with the medications ordered for the patient at the hospital, looking for discrepancies in the hospital-ordered drugs, dosage and frequency.
- When a discrepancy was identified, the nurse evaluated whether it was intended or unintended based on the patient’s overall treatment plan. If uncertain, the nurse consulted the team pharmacist—to find out, for example, if a particular hospital-ordered drug was an appropriate substitute for one on the home list.
- The nurses presented discrepancies thought to be unintended to the hospital prescribing physician for a final determination. If, based on the team’s information, the prescriber changed the medication order, the discrepancy was confirmed as unintended.

If the order was not changed, the discrepancy was considered intended. “If they (the prescribers) said, ‘We already knew all that information, and we decided to order this anyway,’ then we didn’t count it,” explains Linda L. Costa, PhD, RN, the project director.¹⁵

- At discharge, the team followed a similar procedure, comparing the patient’s home list and active hospital medications with the discharge medication list and instructions. (When an unintended discrepancy was confirmed after the patient had left the hospital, the patient was contacted at home and given a corrected medication plan.)
- Two physicians and two pharmacists not part of the intervention reviewed all confirmed unintended discrepancies and graded them for the potential to cause harm on a three-point scale (unlikely to cause harm, potential to cause moderate harm, and potential to cause serious harm).

Findings

In a report to RWJF and webinar presentation,¹⁶ the researchers reported the following:

- **Of the 563 patients in the nurse-pharmacist intervention study, 226 (40%) were found to have experienced an *unintended* medication discrepancy on admission or discharge. Of those 226 patients, 162 (72%) had a discrepancy rated potentially harmful.**

¹⁵ Costa is nurse researcher at Johns Hopkins Hospital and assistant professor at Johns Hopkins University School of Nursing.

¹⁶ A journal article on the project and its findings was undergoing peer review in November 2011, at the time this report was prepared.

- The number of medications taken by a patient was significantly associated with the number of discrepancies. The number of medications per patient ranged from one to 31; the average was 7.76.
- The potential for harm was greater among discrepancies identified at discharge than admission, according to Costa. The reason, said Costa in an interview for this report, is that a discrepancy is more likely to be detected before it causes injury if the patient is under hospital observation.
- **The estimated savings attributed to the intervention exceeded its cost. To break even, the intervention had to prevent one adverse drug event in every 290 patient encounters. In actuality, it prevented 81 adverse drug events for every 290 patient encounters (or 28 per 100 encounters).** The research team based that favorable cost-benefit finding on two estimates:
 - The cost of the intervention—consisting of the wages and benefits paid to the nurse-pharmacist team—came to \$32 per patient.
 - The benefit was \$9,300 for each adverse drug event prevented, using a 1997 adverse event cost estimate adjusted for inflation.

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Costa LL and Poe SS. “Challenges in Posthospital Care: Nurses as Coaches for Medication Management.” *Journal of Nursing Care Quality*, 26(3): 243–251, July-September 2011. Abstract available [online](#).

Lessons Learned

1. **When collaborating with other disciplines on a research project, allow extra time for the design process.** Nurses, physicians and pharmacists bring their own unique and valuable perspectives to a project. But getting consensus among them on how to proceed and what tools to use is apt to take more time than if just one discipline were involved. (Project Director/Costa)
2. **Brief key audiences on the results of a research project while it’s underway. Don’t wait until all the data are in.** Many researchers want to share their findings only when the work is completed, but delaying dissemination of the results is apt to delay their potential impact.

The Johns Hopkins researchers kept some internal audiences informed as the project progressed—but not the organization’s top leadership. Briefing key decision-makers

on the emerging evidence of a beneficial medication reconciliation model might have helped spur replication. (Project Director/Costa)

Afterward

The Johns Hopkins researchers led by Costa initiated two new medication reconciliation research projects that built on the results of the nurse-pharmacist intervention:

First Project: Pilot Study of Transitional Care Intervention

“The real question became: What is the patient doing at home,” says Costa. To find out, she and her colleagues conducted a small pilot study of two nurse-conducted interventions aimed at helping patients manage their medication regimens after leaving the hospital:

- Forty-eight hours after discharge, an intervention nurse interviewed the patient by telephone about his or her medications.
- Within 14 days of discharge, the nurse made a home visit to observe the patient’s actual medication use and any symptoms related to illness.

The study, which was supported with leftover RWJF grant funds and internal resources, enrolled 32 hospital patients, but post-discharge contact with a number of patients proved difficult. The following were among the findings reported by Costa and a colleague in the *Journal of Nursing Care Quality*:¹⁷

- Through the post-discharge telephone interviews and home visits, nurses found 67 percent of the study participants had medication discrepancies.
- In 10 of 16 home visits (62.5%), the nurses found discrepancies that had not been detected in the phone interview.
- Of 36 discrepancies identified in the home visits, 25 were at the patient level, with drug omission the most common. System-level discrepancies—including incomplete, inaccurate, or illegible discharge instructions—accounted for the remaining 11 discrepancies.
- Conclusion: “Preliminary evidence supports that a hospital-based nurse-led post-discharge intervention can detect medication discrepancies in inner city populations.”

Second Project: Randomized Study of Transitional Medication Management

In March 2011, Costa and her research team initiated a randomized two-arm study of post-discharge nurse-led assistance in medication management.

¹⁷ Costa LL and Poe SS, “Challenge in Posthospital Care: Nurses as Coaches for Medication Management.” *Journal of Nursing Care Quality*, 26(3): 243–251, 2011. Abstract available [online](#).

- One of the study arms received the same post-discharge intervention provided in the pilot study.
- The other received additional nurse coaching aimed at identifying and implementing dietary, exercise and other behaviors to help patients better manage their health.

The researchers planned to compare the two groups according to medication adherence and hospital readmission. The study, which was supported by the Johns Hopkins University School of Nursing, was ongoing at the time this report was prepared.

Washington State University College of Nursing

Researchers mounted and evaluated an intervention to more effectively identify and resolve medication discrepancies among patients transitioning from hospital to home care. The initiative differed from the Johns Hopkins project in that it focused on medication reconciliation of patients after hospitalization.

“The transition from hospital to home is an exceptionally risky time for medication errors,” particularly for older adults with complex health problems, the team wrote in *Geriatric Nursing*.¹⁸ While a medication discrepancy does not necessarily constitute an error, studies show that the one can lead to the other, the team said.

The team, led by Cynthia Corbett, PhD, RN, and Stephen M. Setter, PharmD, DVM,¹⁹ defined medication discrepancy as any difference between a patient’s hospital discharge medication list and the medications that the patient was actually taking at home.

The project had these key ingredients:

- The team enrolled 259 Spokane-area patients and randomized them into intervention and control groups of about 130 each. The patients were age 50 or older, had chronic health issues and were referred for home care services following inpatient treatment at one of two collaborating hospitals. (The hospitals and the home care agency were part of the same health system.)
- Patients in the intervention group were assigned to one of two home care nurses trained to apply the study protocol for identifying and resolving medication discrepancies. The intervention nurses:
 - Interviewed each patient at home to learn what medications he or she was taking. If necessary, the nurses contacted the patient’s druggist or other supplemental sources.

¹⁸ Corbett CF et al. “Nurse Identified Hospital to Home Medication Discrepancies: Implication for Improving Transitional Care.” *Geriatric Nursing*, 31(3): 188–196, 2010. Abstract available [online](#).

¹⁹ Corbett is a professor in the university’s College of Nursing; Setter an associate professor in the College of Pharmacy.

- Compared the patient’s home medication list to the medications ordered for the patient at discharge from the hospital, and documented any discrepancies on an electronic tool.
- Worked with physicians and other providers to resolve the discrepancies.

The “crux of the intervention,” says Corbett, was a nurse who “really focused on identifying medication discrepancies... and continually followed up” to resolve them.

- Control group patients were assigned to one of the agency’s regular nurses and received usual care. While medication reconciliation is a standard home care practice, it can be time-consuming, and discrepancies sometimes get “lost” in the process, says Corbett.
- A pharmacist²⁰ made home visits to the patients in both groups to independently identify medication discrepancies—but not resolve them. Thirty days after each patient’s admission to home care, the pharmacist reviewed the patient’s electronic medical record for evidence that identified medication discrepancies had been resolved.
- To evaluate the impact of the nurse-led medication reconciliation intervention, the research team tracked the number of emergency department visits and inpatient re-admissions experienced by study patients in the two groups during the 30 days following hospitalization.²¹

Challenges

Initially one of the aims of the project was to design and implement an electronic system that would integrate and automatically compare the patient’s hospital discharge medication list with the list of medications that the nurse found the patient was actually taking.

However, after the project got underway, the team dropped that aspect of the project—including development of related software—in response to concerns that home care agency nurses raised.

They contended such a system would increase the number of steps involved in reconciliation, and that it would be more efficient to get the hospital discharge medication list by email and make the comparison themselves.

In response, the team dropped the planned automated system and adopted the process advocated by the nurses.

²⁰ More than one pharmacist participated over the course of the September 2008–August 2010 study period, but only one was involved at any one time.

²¹ Nearly all hospitals in the region used the same centralized electronic record system, enabling comprehensive tracking of the patients’ subsequent acute care encounters, the team said.

Findings

In a report to RWJF,²² the research team stated the following:

- **Intervention home care patients had significantly fewer emergency department visits during the first 30 days post-hospitalization compared to control group patients. However, there was no statistically significant difference in the groups' 30-day rehospitalization rates.**

Elaborating in an interview, Corbett said that while the difference was not statistically significant, the rehospitalization rate for the intervention group was lower than for the control group. Also, she stated that when emergency department use and rehospitalization were analyzed together as “acute care utilization,” the intervention group rate was lower by a statistically significant amount.

Based on these results, she said the intervention appears to have made a difference—an outcome she attributes to consistent follow-through by the intervention nurses to resolve discrepancies.

“The importance of making sure there is follow-through...is, I think, the most important finding,” she said.

- **However, quantitatively the intervention nurses did not identify or resolve more medication discrepancies than were resolved in the control group by the regular home care nurses.**

Given this result—which Corbett says surprised the research team—how can the difference in 30-day acute care utilization be attributed to the intervention?

The researchers concluded that the intervention nurses must have done something different from the control group nurses that the study did not measure, Corbett said. One possibility is that the intervention nurses may have done more to educate their patients in medication use and adherence, she said.

- **Pharmacists identified twice as many medication discrepancies as did the nurses—a mean of six discrepancies per patient compared to a mean of nearly three for nurses.** Corbett said the research team had anticipated that pharmacists would catch more discrepancies given their education and knowledge of drug interactions.
- **More than 90 percent of the study patients—including those in both groups—had at least one medication discrepancy.** Discrepancies were found among virtually all classes of medications, including those classified as high risk, such as anti-diabetic (insulin), anti-coagulants and narcotics.

²² An article reporting on the project and findings was in preparation as of fall 2011, according to Corbett. In May 2010, Corbett and colleagues reported partial, preliminary results in the journal *Geriatric Nursing*. The article (“Nurse Identified Hospital to Home Medication Discrepancies: Implication for Improving Transitional Care”) was based on a subsample of the intervention group. Abstract available [online](#).

Bibliography

Journal Articles

Corbett CF, Setter SM, Daratha KB, Neumiller JJ and Wood LD. “Nurse Identified Hospital to Home Medication Discrepancies: Implication for Improving Transitional Care.” *Geriatric Nursing*, 31(3): 188–196, May 2010. Abstract available [online](#).

Setter SM, Corbett CF, Neumiller JJ. “Transitional Care: Exploring the Homecare Nurse’s Role in Medication Management.” *Home Healthcare Nurse*. In press.

Toolkit, Toolbox or Primer

Medication Discrepancies, a three-minute DVD on factors contributing to medication discrepancies, the potential negative outcomes and related topics. Spokane, WA: Washington State University College of Nursing, August 2010. Available [online](#).

Lessons Learned

1. Engage collaborating organizations to the greatest extent possible at the planning stage of a project. That is likely to save time in the long run.

During the planning process, the Washington State University team met several times with members of the home health care agency’s management and information technology (IT) staff.

The plan was to develop software that would automatically identify discrepancies between the patient’s actual and hospital-ordered medications. After the project was funded, the discussions got down to operational details. Only then did it become clear that the agency’s nursing staff viewed the proposed IT approach as a hindrance, not a solution.

The team agreed to drop the automated system, and the project proceeded successfully without it. But “if we could have figured that out ahead of time, it would have saved us time,” said Project Director Corbett.

2. Don’t underestimate the time that will be needed to recruit patients for a study.

Recruiting participants for this study was more difficult than expected. Initially the age criterion was 65 and over, but the cutoff had to be lowered to 50 to get enough patients.

In the future, Corbett said she will estimate what would seem to be a realistic time period for recruitment and then increase that figure by 25–30 percent.

3. Give significant forethought to the composition of the research team. The correct mix of disciplines is critical when implementing a study that may impact practice across a range of providers. One highly successful aspect of this project was the multidisciplinary composition of the team that oversaw the work. (Project Director/Corbett)

Afterward

In 2010 the Washington State University team received a \$262,399 award from the federal Agency for Healthcare Research and Quality to expand on the RWJF-funded research. Specifically, the new project is examining the potential for the discrepancies identified in the RWJF study to contribute to patient harm and medical liability.

The work—ongoing as of fall 2011—included:

- A rating by pharmacists of the discrepancies identified in the RWJF study for their potential to cause patient harm
- A review by nurse lawyers of the medical and legal literature to identify the medications most likely to cause permanent harm and lead to medical liability law suits
- A series of focus groups with patients, providers, lawyers and others to get their perspectives on medication discrepancies and how to deal with them

Additionally, the team successfully applied in 2011 to the National Institute of Diabetes and Digestive and Kidney Diseases for funding to implement a medication discrepancy intervention similar to the one tested in the RWJF-funded study. The main difference is this project will focus exclusively on kidney disease patients.

Prepared by: Michael H. Brown

Reviewed by: Kelsey Menahan and Molly McKaughan

Program Officer: Lori A. Melichar

Grant ID # 59188, 61148, 61149, 62596, 63961

Program area: Quality/Equality and Human Capital

APPENDIX 1

Grant Details

RWJF awarded the four medication management research grants through two different mechanisms. The first two were ad hoc grants (grants that are unconnected to RWJF's national programs) awarded simultaneously as the Foundation's Medication Management Initiative.

The second two grants were awarded later as part of the *Interdisciplinary Nursing Quality Research Initiative* (INQRI), an RWJF national program based at the University of Pennsylvania.

During the years 2006–2010 INQRI oversaw the competitive selection of 40 projects that examined how nursing practices impact the safety and quality of patient care. The projects included these two on medication management. See the [INQRI website](#) for more about the program.

Following are the titles, amounts and other details of the four project grants and one contract detailed in this report.

Rutgers, The State University of New Jersey, College of Nursing (Newark, N.J.)

Multifaceted approach to reducing medication errors

ID# 59188 (June 2007–May 2009): \$298,724

Project Director

Linda Ruth Flynn, PhD, RN

(973) 353-5060

lflynn@rutgers.edu

University of Wisconsin-Madison College of Engineering (Madison, Wis.)

Capturing nurses' role in medication management and use of technologies using new measures of quality and cost

ID# 61148 (June 2007–December 2009): \$299,726

Project Director

Pascale Carayon, PhD

(608) 265-0503

carayon@engr.wisc.edu

Johns Hopkins Hospital (Baltimore, Md.)

Economically supporting direct care providers in medication reconciliation to ensure safe transition to and from hospital and community

ID# 62596 (September 2007–August 2009): \$289,194

Project Director

Linda L. Costa, PhD, RN

(410) 614-2805

lcosta5@jhmi.edu

Washington State University College of Nursing (Spokane, Wash.)

Empowering home care nurses to resolve medication discrepancies

ID# 63961 (September 2008–September 2010): \$288,763

Project Director

Cynthia F. Corbett, PhD, RN

(509) 324-7404

corbett@wsu.edu

Contract

Constella Group LLC (Durham, N.C.)²³

Administrative support for the medication management project

ID# 61149 (May 2007–July 2010): \$65,740

Project Director

Meghan Boteler

(301) 360-2150 (Ext 2046)

[Meghan Boteler@sra.com](mailto:Meghan.Boteler@sra.com)

²³ The firm has since been acquired by SRA International Inc. in Fairfax, Va. and no longer operates under the Constella name.

APPENDIX 2

Grantee-Stakeholder Meeting Agenda and Webinar Speakers List

Meeting: "Improving Practice through Methodology, Measurement and Technology," November 27-28, 2007, Princeton, N.J.

Keynote Address

Linda Cronenwett, PhD, RN

Dean, School of Nursing
University of North Carolina, Chapel Hill
Co-Chair, Institute of Medicine Committee on
Identifying and Preventing Medication Errors

INQRI Program Co-Director
University of Pennsylvania

Facilitator: Josef Reum, PhD

Associate Dean for Finance and
Administration, School of Public Health and
Health Services
George Washington University

Session I: Why Here and Why Now?

Lori A. Melichar, PhD, MA

Senior Program Officer
RWJF

Helen Kim, MBA

Chief Program Officer
Gordon and Betty Moore Foundation

Mary D. Naylor, PhD, RN

INQRI Program Director
University of Pennsylvania

Mark V. Pauly, PhD

Luncheon Remarks

John Lumpkin, MD, MPH

RWJF Senior Vice President, Director Health
Care Group

Afternoon Small Group Sessions

What Can I Learn From What You've Done?
How Can This Initiative Support a Culture of
Safety?

Webinars: Medication Management Webinar Series²⁴

Examining the Impact of Nursing Structures and Processes on Medication Errors

Speaker: Linda Flynn, University of Maryland

October 7, 2009

[PowerPoint Presentation](#)

[Webinar Recording](#)

Empowering Front-Line Nurses: A Structured Intervention Enables Nurses to Improve Medication Accuracy

Speaker: Julie Kliger, Integrated Nurse Leadership Program Center for the Health
Professions, University of California, San Francisco

November 12, 2009

[PowerPoint Presentation](#)

²⁴ Some links are inaccessible and are not included with the presentation.

Nursing, Technologies and Medication Management: New Multidimensional Measures of Cost and Quality

Speakers: Pascale Carayon, Bentzi Karsh and Joy Rivera, University of Wisconsin-Madison

December 11, 2009

[PowerPoint Presentation](#)

Nursing-Pharmacy Collaboration on Medication Reconciliation: A Novel Approach to Information Management

Speaker: Linda Costa, Johns Hopkins Hospital

Date: January 19, 2010

[PowerPoint Presentation](#)

[Webinar Recording](#)

Creating a Culture of Patient Safety, Together

Speaker: Sorrel King, The Josie King Foundation

Date: February 24, 2010

[PowerPoint Presentation](#)

An Update From the Institute for Safe Medication Practices (ISMP)

Speaker: Mike Cohen and Susan Paparella, ISMP

Date: March 18, 2010

[PowerPoint Presentation](#)

[Webinar Recording](#)

Beacon, The Bay Area Patient Safety Collaborative

Speaker: Bruce Spurlock, Convergence Health

Date: April 14, 2010

[PowerPoint Presentation](#)

[Webinar Recording](#)

Triad for Optimal Patient Safety

Speaker: Mary Blegen, University of California, San Francisco

Date: May 6, 2010

[PowerPoint Presentation](#)

[Webinar Recording](#)

A Vision for Transformative Change

Speakers: Horst and Luisa Ferrero, the Sebastian Ferrero Foundation

Date: June 16, 2010

[PowerPoint Presentation](#)

APPENDIX 3

Medication Management Projects Funded by the Gordon and Betty Moore Foundation

Grantee: University of California, San Francisco, School of Nursing

Project: Developing a model patient safety collaborative triad

Grant: \$1.9 million for 24 months, approved May 2005

Grantee: University of California, San Francisco, Center for the Health Professions

Project: Nursing Leadership Institute

Grant: \$5.7 million for 38 months, approved July 2004

See the [More Foundation's website](#) for further information about these and other supported projects.