Grant Final Report

Grant ID: R18HS017817

Using HIT to Improve Transitions of Complex Elderly Patients from SNF to Home

Inclusive Project Dates: 09/30/08 – 9/29/12

Principal Investigator:
Terry S. Field, DSc

Team Members:
Sarah L. Cutrona, MD, MPH
Jennifer L. Donovan, PharmD
Lawrence Garber, MD
Jerry H. Gurwitz, MD
Leslie Harrold, MD
Abir O. Kanaan, PharmD
Peggy Preusse, RN
George Reed, PhD
Jennifer Tjia, MD, MSCE

Performing Organization:
University of Massachusetts Medical School

Federal Project Officer:
Rebecca Roper

Submitted to:
The Agency for Healthcare Research and Quality (AHRQ)
U.S. Department of Health and Human Services
540 Gaither Road
Rockville, MD 20850
www.ahrq.gov

Abstract

Purpose: The goals of this study were to evaluate, among a population of older adults, the impact of providing information through an HIT-based transitional care intervention on the rate of follow-up to an outpatient provider within 21 days of discharge from a skilled nursing facility, the prevalence of appropriate monitoring for high-risk medications after discharge, the incidence of adverse drug events (ADEs) through 45 days following discharge, and the rate of hospital readmission and emergency department (ED) visits within 30 days of discharge.

Scope: The growing trend for physicians and other healthcare providers to restrict their practices to single settings and not follow complex patients as they move between settings leaves older patients discharged from subacute care particularly vulnerable. This transition is uniquely challenging because of the complex healthcare needs of this population.

Methods: We conducted a pre/post analysis of an HIT-based transitional care intervention that included alerts about key therapeutic changes and monitoring recommendations in the setting of a large multispecialty group practice. We tested this intervention among adults, aged 65 and older, discharged from skilled nursing facilities to the ambulatory setting. The comparison group was individually matched on facility and patient age and sex.

Results: We did not find significant improvements in visits to the outpatient provider following discharge from a skilled nursing facility, laboratory monitoring in response to alerts, adverse drug event rates, or rehospitalization rates relating to the intervention. Emergency department visits were lower during the intervention period.

Key Words: ambulatory care; health information technology; HIT; medication safety; skilled nursing facilities

Final Report

Purpose

The incidence of drug-induced injury is high in the ambulatory geriatric population, especially for elders with complex healthcare needs during high risk transitions to the ambulatory setting. In a previous study funded by the National Institute on Aging and the Agency for Healthcare Research and Quality [AHRQ] (AG 15979), we determined that drug-related injuries occur at a rate of more than 50 per 1000-patient years in older adults in the ambulatory setting and that 28% are preventable.[1] Independent risk factors for adverse drug events among older adults in the ambulatory setting included advanced age, multiple comorbid conditions, and the use of medications requiring close monitoring.

The growing trend for physicians and other healthcare providers to restrict their practices to single settings and not follow complex patients as they move between settings leaves older patients discharged from subacute care particularly vulnerable. This transition is uniquely challenging because of the complex healthcare needs of this population, who often require coordinated care to manage complex medication regimens and fluctuating clinical status. To facilitate high-quality transitions from the subacute to the ambulatory setting and support interdisciplinary communication, we used the electronic medical record (EMR) to assure that physicians in the ambulatory setting receive key health information and alerts. This project focused on elderly patients, a population that has been identified by AHRQ as high priority.

In order to evaluate the impact of a HIT-based transitional care intervention, we performed a pre/post intervention analysis, tracking the experiences of patients discharged from skilled nursing facilities (SNFs) during a one year period with the transitional care intervention compared to matched patients discharged from SNFs during the previous 1.5 years without the intervention. We postulated that the efficient and coordinated delivery of actionable health information to outpatient primary care physicians via the use of HIT can improve medication safety for the growing elderly population.

The specific aims were to evaluate, among a population of older adults with multiple comorbid conditions, the impact of an HIT-based transitional care intervention upon discharge from subacute care in a skilled nursing facility to the ambulatory setting:

1. On the rate of follow-up to an outpatient physician within 21 days of discharge from subacute care;

2. On the rate of appropriate monitoring for selected high risk medications within 30 days of discharge from subacute care;

3. On the incidence of adverse drug events (ADEs) 45 days after discharge from subacute care; and

4. On the incidence of hospital readmission and emergency department (ED) visits within 30 days of discharge from subacute care.

The secondary aim for this study was to determine costs directly related to the development and installation of the HIT-based transitional care intervention.

The results from this study are intended to provide insights into the effective use of clinical alerts and coordinated delivery of actionable information to improve the quality of care delivered to complex elderly patients transitioning from subacute care to the ambulatory setting.

Scope

Background: Medication Utilization Patterns of Older Adults

Older adults are burdened by more chronic medical conditions and use substantially more medications compared to younger persons. Eighty-eight percent of people aged 65 years or older have one or more chronic illnesses, and one quarter of these have four or more conditions.[2] According to the most recent Slone Survey, nearly 60% of U.S. adults aged 65 or older in the ambulatory setting take at least 5 different medications per week, and over 15% take at least 10.[3] The use of multiple concurrent drug therapies is frequently necessary and appropriate in the care of elderly patients with multiple medical problems to optimize medical and functional status. However, suboptimal use of medications brings with it an increased risk for medication errors and adverse drug events.

Adverse drug events in the elderly are common in the ambulatory setting. Adverse drug events, especially those that may be preventable, are among the most serious concerns about medication use in older persons cared for in the ambulatory clinical setting.[1] A U.S. national surveillance study of emergency department visits for outpatient adverse drug events indicated that individuals aged 65 years or older were 2.4 times more likely than younger individuals to sustain adverse drug events, and nearly 7 times more likely to require hospitalization.[4] Some specific medication categories place patients at particularly high risk for adverse drug events, including: cardiovascular medications, diuretics, nonopioid analgesics, hypoglycemics, and anticoagulants.[1, 5] There is a dose-response relationship with comorbidity, number of medications and the incidence of preventable adverse drug events.[6] Twenty percent of preventable adverse drug events in the ambulatory setting among older adults relate to patient errors including administering the medication incorrectly, modifying the medication regimen, or not following clinical advice about medication use.[7]

Adverse drug events are particularly common after acute hospitalizations[8, 9] when multiple medication changes occur and may contribute to confusion regarding medication management among patients and physicians.[10] In one study that examined the influence of hospitalization on drug therapy in older patients, 40% of all admission medications were discontinued by discharge, and 45% of all discharge medications were newly started during the hospitalization.[11] It is estimated that 12% to 17% of general medicine patients experience adverse drug events after hospital discharge, more than half of them preventable.[8, 9] Although no studies have examined the occurrence of adverse drug events following discharge to the community from subacute clinical settings, similar concerns exist due to the growing national trend for physicians and other health care providers to restrict their practices to single settings (e.g., hospitals, subacute

facilities, or ambulatory clinics) and not to follow complex patients as they move between settings leading to increased fragmentation of care.[12]

Multiple factors contribute to problematic medication management following acute care or subacute care, including poor physician-patient communication and education regarding medication use,[13] poor therapeutic monitoring,[1, 14] and incomplete or inaccurate information transfer between clinicians.[15] During care transitions, patients receive medications from different prescribers who often lack access to patient's comprehensive medication lists.[16] In addition, lack of appropriate follow-up care exacerbates problems during this vulnerable period.

For many elderly patients, an illness leading to a hospitalization may result in worse physical, functional, and psychological impairments. According to the *Encyclopedia of Elder Care*, "subacute care (also referred to as post-acute or transitional care) is an episode of care that lasts weeks to months and which may follow an acute inpatient hospitalization when skilled services are required to treat active medical conditions, but at an intensity less than that of acute care and more than ambulatory care." Subacute care is often provided in skilled nursing facilities, where it includes the skilled care needed to transition individuals from the acute care setting back to the ambulatory setting. Patients receiving care in the subacute setting typically require between 3 and 8 hours of nursing care daily with active physician direction. Subacute care requires a treatment plan with specific goals attained through the provision of skilled nursing, rehabilitative, and medical services. It is not custodial care, designed to assist individuals with their activities of daily living.[17]

Subacute care is best viewed as care for patients who have diverse and complex needs, rather than care of a specific condition. In some cases under managed-care, which may have more flexible policies than Medicare, older patients with complex healthcare needs may be directed to subacute settings of care directly from the emergency department (ED) without a preceding acute hospitalization.

Successful transition to the ambulatory setting is the optimal goal of subacute care; however, re-hospitalization rates can be high.[18] Factors that may contribute to rehospitalization and presentation to the emergency department include inadequate communication of important information from the skilled nursing facility to primary care physicians and visiting nurses, and inadequate follow-up care post discharge.

Context, Setting, Participants

Overview. We conducted a pre-post intervention analysis of an HIT-based transitional care intervention that included alerts about key therapeutic changes and therapeutic monitoring recommendations in the setting of a large multispecialty group practice. We tested this intervention in adults, aged 65 and older, discharged from a SNF to the ambulatory setting.

Study site and setting. This study was conducted within the Fallon Clinic (now known as Reliant Medical Group), a medical group closely aligned with a non-profit, Central Massachusetts-based health plan (Fallon Community Health Plan). The medical group employs 330 outpatient clinicians, including 250 physicians at 23 ambulatory clinic sites covering 30 specialties. The group provides care to approximately 180,000 individuals. During the course of this study, the practice used the EpicCare Ambulatory EMR®, version Summer 2009 IU6. SNF care was delivered by geriatricians employed by the medical group.

Study Population. The study population was derived from Reliant Medical Group patients. The age and gender characteristics of the study population (n=25,942) were similar to those of the general population of the United States aged 65 or older (Table 1).

Table 1. Age and gender characteristics of study population vs. U.S. population aged 65 years and older

	Study Population (n=25,942)			United States (n=36,294,000)		
Age Group	Male	Female	Total	Male	Female	Total
65 – 74	18%	23%	41%	24%	29%	53%
75 – 84	18%	25%	43%	14%	21%	35%
85 +	5%	11%	16%	3%	9%	12%
Total	41%	59%	100%	41%	59%	100%

Inclusion and Exclusion Criteria. For inclusion in our study, patients needed to meet the following criteria: 1) be 65 years or older at the time of discharge; 2) be discharged from one of eight SNFs providing care for Reliant Medical Group's patients; 3) have no plans to enter a hospice facility upon discharge; and 4) be discharged back to the community (not to a skilled nursing facility or long-term care setting).

Methods

Intervention

The HIT-based intervention focused on key aspects of the transition of care from the SNF to the outpatient setting, with the provision of alerts and recommendations including: 1) alerts to the primary care provider about key therapeutic changes; 2) discharge follow-up appointment scheduling reminders to the staff; and 3) discharge medication monitoring alerts to the primary care provider.

While our original goal had been to develop a stand-alone workflow engine that used automated information from the EMR to generate an enhanced patient medication reconciliation list, this was not possible as the geriatricians working with the SNFs produced highly varied discharge summaries at varying lengths of time post-discharge which could not be aligned with the EMR used in the care of patients in the ambulatory setting. This undermined our ability to identify discharges and related medications automatically. The medical group is currently collaborating with the Massachusetts Department of Public Health in a project funded by ONC to automate the SNF discharge process in central Massachusetts, but this will not be in place until well after the completion of our project. We developed a work-around by establishing a collaborative link between a research nurse within the medical group and the social workers at the eight most commonly used SNFs. The social workers faxed discharge information, including the current list of medications, to the research nurse for each patient who had a Reliant Medical Group primary care physician. The research nurse cross-referenced this with the EMR and entered discharge information directly. This information she entered into the EMR triggered the automated system to send alerts to the primary care physician about new medications and

medication monitoring and also sent discharge follow-up appointment scheduling reminders to staff.

The system was designed to provide information to primary care physicians about new drugs added during the inpatient stay as well as warnings about drug-drug interactions, and recommendations of dose changes and laboratory monitoring related to high-risk medications. The team that selected the high-risk medications and developed monitoring guidelines consisted of a national advisory committee and local experts, including clinicians and pharmacists from the group practice.[19] Based on these guidelines, we constructed "blueprints" that contained the message content and criteria for triggering alerts and recommendations. Staff of the group practice medical informatics development team used the blueprints to guide the programming process.

Evaluation

We compared a series of measures related to the experiences of patients discharged from SNFs during the intervention period to patients during the 1.5 years pre-intervention.

Measures

1. The proportion who received a follow-up visit to an outpatient provider within 21 days of SNF discharge

2. The prevalence of appropriate monitoring for selected high-risk medications at 30 days from the time of SNF discharge

3. The incidence of adverse drug events (ADEs) through 45 days following discharge

4. The rate of hospital readmission and emergency department (ED) visits within 30 days of discharge

5. The costs directly related to the development and installation of the HIT-based transitional care intervention

Using information from claims data, we selected SNF discharges from the previous 1.5 years for which the patient's gender and SNF matched a SNF discharge from the intervention year. To validate that the comparison discharges actually referred to an overnight stay in a SNF with discharge to the patient's home and to ensure correct discharge dates, each potential match was reviewed by research nurses within the medical group by seeking evidence in the EMR that the patient was discharged to home from the relevant SNF within a month of the discharge date suggested in the claims data. Among the validated discharges matched to each intervention patient, we then selected the discharge with a patient closest in age.

Information about outcomes was drawn from several sources. Office visits to physicians within the medical group were extracted from the EMR as were current drugs and laboratory test orders. Re-hospitalizations, emergency department visits and office visits to providers outside the medical group were identified from claims data.

Adverse drug events were identified through medical record reviews performed by three trained clinical pharmacist investigators on the first 100 SNF discharges during the intervention year, and the matched 100 discharges from the pre-intervention period. Drug-related incidents occurring during the 45 day period following SNF discharge were considered relevant in the context of this study. Drug-related incidents occurring during the course of the SNF stay or the previous hospital stay were not considered relevant. All possible drug-related incidents were presented by a clinical pharmacist investigator to pairs of physician-reviewers. Physician-reviewers independently classified incidents using structured implicit review according to the following criteria: whether an adverse drug event was present, the severity of the event, whether the event was preventable, and the effects of the event on the patient. In determining whether an adverse drug event had occurred, the physician-reviewers considered the temporal relation between the drug exposure and the event, as well as whether the event reflected a known effect of the drug. When the physician-reviewers disagreed on the classification of an incident regarding the presence of an adverse drug event, its severity, or its preventability, they met and reached consensus; consensus was reached in all instances where there was initial disagreement.

To allow us to control for differences in patient circumstances between the intervention and pre-intervention periods, we extracted additional information from the EMR and claims data. Information about the reason for the SNF and previous hospital stays, whether the patient resided in an assisted living facility, and whether a caregiver was the primary contact with the medical group were extracted from manual reviews of the EMR. Automated data were drawn from the EMR and claims data to allow estimates of the Charlson comorbidity index and counts of current prescribed medications. For the sub-group of 100 intervention and 100 pre-intervention discharges reviewed for adverse drug events, we also manually extracted more detailed comorbidities including psychiatric diagnoses, traumatic events, and sensory impairments.

Estimation of Costs for Development of the Automated System

Throughout the development period, each participant completed and e-mailed weekly forms that fed the time spent on various aspects of the development process directly into a database. We used national estimates of hourly wages[20] for each participant's job title to summarize costs.

Limitations

Our study had several limitations. The time required to determine a work-around for the proposed fully automated system and establish and test it, left too short a time to conduct an adequately powered randomized trial. We replaced it with a pre/post analysis, using the pre-intervention period for comparison. This is a weaker study design with potential for confounding as an explanation for any differences found. We took a conservative approach by controlling confounding through matching as well as through the use of extensive data about comorbid conditions and medication and information on SNF and hospital stays and patients' living situations. An additional limitation is our choice to validate each potential pre-intervention SNF discharge based on evidence in the EMR. That evidence usually took the form of a SNF discharge report or a specific comment in a physician note. Thus, the validated discharges are likely to have received care very similar to that provided during the intervention period, undermining our ability to detect an impact of the intervention. Discharges without evidence in the EMR may have produced a less conservative comparison group.

Results

Principal Findings

During the one-year intervention period, 313 SNF discharges were faxed to the research nurse. For comparison, we identified 313 discharges from the previous 1.5 years matched on gender, age and SNF, with validation of the discharge in the EMR. Patients for the intervention and pre-intervention periods were similar (Table 2). Both groups were predominantly female, had multiple serious medical conditions and were taking a large number of prescribed medications, although patients during the intervention period had higher levels of comorbidity and were taking a greater number of prescribed medications. Their SNF stays were primarily due to a need for prolonged nursing care after hospitalizations, many of which followed an ED visit for trauma.

Table 2. Characteristics of discharges and patients during the intervention and pre-intervention periods

	Intervention period n=313 N(%)	Pre-intervention period n=313 N(%)	p-value
Age (mean, standard deviation)	82.4 (7.1)	81.8 (6.9)	0.6168
Gender % female	224 (71.6)	225(71.9)	0.9293
SNFs: SNF1	17 (5.43)	17 (5.43)	1.0000
SNF2	8 (2.56)	8 (2.56)	
SNF3	1 (0.32)	1 (0.32)	
SNF4	96 (30.67)	96 (30.67)	
SNF5	133 (42.59)	133 (42.59)	
SNF6	36 (11.50)	36 (11.50)	
SNF7	14 (4.47)	14 (4.47)	
SNF8	8 (2.56)	8 (2.56)	
Charlson Comorbidity Index 0-1	53 (16.93)	58 (18.53)	0.0265
2-3	132 (42.17)	148 (47.28)	
4-5	111 (35.46)	79 (25.24)	
6+	17 (5.43)	28 (8.95)	
Number of unique medications dispensed in previous 6 months: 0-5	57 (18.21)	89 (28.43)	0.0001
6-10	99 (31.63)	117 (37.38)	
11+	157 (50.16)	107 (34.19)	
Reside in assisted living facility %	30 (9.58)	22 (7.03)	0.1927
Caregiver mentioned in chart	178 (56.87)	242 (77.32)	<0.0001
SNF discharge report present in chart	311 (99.36)	285 (91.05)	<0.0001

Reason for SNF stay unknown	1 (0.32)	12 (1.28)	0.0020
rehab after ortho surgery	74 (23.64)	80 (25.56)	0.5777
rehab other	34 (10.86)	26 (8.31)	0.2774
needed continued in-patient care	236 (75.40)	219 (69.97)	0.1273
inadequate home situation	0 (0.0)	1 (0.32)	0.3169
Discharge summary from hospitalization prior to SNF stay in chart	245 (78.27)	261 (83.39)	0.1043
Primary reason for hospitalization prior to SNF stay Planned surgery	47 (15.02)	40 (12.78)	0.4186
From ED, cardiac	25 (7.99)	24 (7.67)	0.8817
From ED, respiratory	25 (7.99)	27 (8.63)	0.7721
From ED, GI	20 (6.39)	22 (7.03)	0.7493
From ED, infectious disease	3 (0.96)	7 (2.24)	0.2023
From ED, psychiatric	3 (0.96)	8 (2.56)	0.1283
From ED, trauma	58 (18.53)	63 (20.13)	0.6128
From ED, other	61 (19.43)	70 (22.36)	0.3765
Not from ED, other	3 (0.96)	8 (2.56)	0.1283

Outcomes

There were no differences between the two time periods for proportions with office visits within one week or three weeks or re-hospitalization within 30 days (Table 3). The proportion of patients with recommended lab tests ordered was substantially lower during the intervention period. Emergency department visits within 30 days were lower during the intervention period.

Table 3. Office visits, lab tests, hospitalizations, and emergency department visits during the intervention and pre-intervention periods

	Intervention period n=313	Pre-intervention period n=313	p-value	RR and 95% CI
Outpatient office visit within 1 week of SNF discharge Any office visit	86 (27%)	90 (29%)	0.7221	0.94 (0.66, 1.33)
Office visit with medical group MD	71 (23%)	70 (22%)	0.9238	1.02 (0.70, 1.48)
Office visit with primary care MD	34 (11%)	38 (12%)	0.6163	0.88 (0.54, 1.44)
Out-patient office visit within 3 weeks of SNF discharge Any office visit	226 (72%)	211 (67%)	0.1916	1.26 (0.89, 1.77)
Office visit with medical group MD	197 (63%)	192 (61%)	0.6803	1.07 (0.77, 1.48)
Office visit with primary care MD	113 (36%)	125 (40%)	0.3231	0.85 (0.62, 1.17)
# of patients with lab tests recommended by guidelines that had not been completed in the last 6 months	92 (29%)	65 (21%)		
Of lab tests recommended, # of patients with tests ordered within 30 days of discharge	5 (5%)	19 (29%)	<0.0001	0.19 (0.06, 0.49)
Hospitalization within 30 days of discharge from SNF	97 (30.99)	93 (29.71)	0.7281	1.06 (0.76, 1.49)
ED visit without hospital stay within 30 days of discharge from SNF	23 (7.35)	53 (16.93)	0.0002	0.39 (0.23, 0.65)

A sub-group of the first 100 discharges during the intervention period and their matches from the pre-intervention period were further analyzed, including chart abstraction of medical conditions (Table 4) and identification of adverse drug events (Table 5). There were few differences in the proportions of medical conditions among patients in the two periods, although the intervention period's patients had somewhat higher overall comorbidity scores, visual impairment, memory problems, and hip joint replacements. The proportion of patients with adverse drug events was identical during the two periods.

Table 4. Characteristics of the first 100 discharged patients during the intervention period and the matched discharges from the pre-intervention period

	Intervention period n=100 N(%)	Non-intervention period n=100 N(%)	p-value
Age mean (standard deviation)	82.7 (6.5)	82.2 (6.8)	0.6835
Gender % female	80 (80%)	80 (80%)	1.0000
Comorbidities abstracted from medical records for the Charlson Index			
myocardial infarction	20	27	0.2589
congestive heart failure	24	19	0.3489
peripheral vascular disease	12	8	0.3337
cerebrovascular disease	19	16	0.5766
dementia	18	13	0.2987
copd	22	24	0.7368

connective tissue disease	5	3	0.4705
ulcer disease	17	27	0.0878
mild liver disease	1	0	0.3161
moderate/severe liver disease	0	0	
diabetes mild/moderate	16	20	0.8307
diabetes with end organ damage	12	13	0.8307
hemiplegia	1	0	0.3137
moderate/severe renal disease	1	2	0.5667
any tumor	20	15	0.3521
leukemia	0	0	
lymphoma	2	2	1.0000
metastatic solid tumor	2	3	0.6588
AIDS	0	1	0.3161
Charlson comorbidity index 0	17 (17%)	14 (14%)	**0.6480**
1-2	40 (40%)	48 (48%)	
3-4	28 (28%)	27 (27%)	
5+	15 (15%)	11 (11%)	
Other comorbid conditions			
Bipolar disorder	1	0	0.3161
Major depressive disorder	24	31	0.2678
Other major psychiatric diagnosis	8	2	0.0516
Hip fracture	13	13	0.9559
Hip joint replacement	10	3	0.0407
History of frequent falls	22	19	0.5742
Serious fall requiring hospitalization	32	35	0.6531
Recent automobile accident	1	1	1.0
Substance abuse	10	6	0.2778
Visual impairment	17	29	0.0475
Hearing impairment	11	16	0.3005
Other issues			
History of compliance problems	6	5	0.7564
Memory problems	19	10	0.0661

Table 5. Adverse drug events during the intervention and pre-intervention periods.

Adverse drug events	Intervention period n=100 N(%)	Non-intervention period n=100 N(%)	Relative risk (95% confidence interval)
% with an ADE within 45 days of SNF discharge	30 (30.0)	30 (30.0)	1.0 (0.55, 1.83)
Controlling for age, sex, Charlson comorbidity index			1.0 (0.54, 1.89)
Number of ADEs within 45 days of SNF discharge	43	41	
% with a preventable ADE within 45 days of SNF discharge	13 (13%)	10 (10%)	1.3 (0.56, 3.1)
Number of preventable ADEs within 45 days of SNF discharge	13	10	

Development Costs

The development costs for establishing the automated system are reported in a manuscript that is currently in press.[21] The total cost is estimated at $76,314 with the major costs and time contributions from physicians. Ongoing costs for the SNF discharge alert system include the time of a research nurse, estimated at 5 hours per week at $32.29 per hour. The five-hour time was necessary to process an average of 6 SNF discharges per week. The low time required per week was a result of extensive effort spent developing close, collegial relationships with social workers at the SNFs to ensure on-going maintenance of the system from the SNF end.

Table 6. Overview of development costs

	Hourly wage ($)[20]	Hours*	Cost* ($)	% of Total cost
Activity Category				
Project management		22	1,983	3%
Preparing content		169	14,977	20%
Designing HIT application		62	5,543	7%
Preparing HIT application		268	10,304	13%
Developing blueprint		325	14,917	20%
Programming		273	17,406	23%
Testing		88	5,701	7%
Revising		76	3,253	4%
Maintaining		26	2,231	3%
				% of Total time
Personnel Category				
Internists, general	90.13	614	55,340	47%
Operations research analyst	33.93	370	12,561	28%
Research assistant†	19.23	202	3,885	16%
Registered nurse	32.29	58	1,873	4%
Computer software engineer, applications	42.30	40	1,692	3%
Database administrator	35.12	17	597	1%
Pharmacist	52.47	7	367	1%
Total		1,308	76,314	

* Hours and total costs are rounded

†Salary based on the category "miscellaneous health technologists and technicians"

Discussion

We conducted a pre/post analysis comparing outcomes pre and post a HIT-based transitional intervention for patients discharged from SNFs. We did not find significant improvements

during the intervention period, with the exception of a lower proportion of patients with an ED visit during the 30 days post discharge during the intervention period.

A number of factors may have contributed to the lack of an effect for the intervention. Despite an intense effort, we were unable to modify the workflow of the geriatricians to allow for a fully automated alert system and medication reconciliation. This limitation undermined our ability to perform a randomized trial and led to the provision of incomplete information regarding new medications to the outpatient provider. Importantly, we identified the pre-intervention discharges through claims data followed by validation in the EMR. Only about 1/3 of the potential SNF discharges could be validated in the EMR. This suggests that the comparison discharges selected may have been unusual in having more complete information flow from the SNF geriatrician and family members to the primary care physician. This potential bias would have undermined our ability to identify any improvements associated with the intervention. We will further analyze the apparent discharges appearing in the claims data to develop methods for identifying genuine SNF to home discharges without requiring EMR-based validation and assess outcomes in a broader group of pre-intervention patients. An additional issue is the short time period many of these patients spent at home after the SNF discharge; 63% of the re-hospitalizations occurred during the first week after the SNF discharge. Since the time required for transfer of information from the SNF to the research nurse required 3 to 5 days, there was little opportunity for the intervention to reduce re-hospitalization rates.

The study identified several additional important issues. It is clear that older adults discharged from SNFs to home form a highly vulnerable population. They have high rates of medical conditions, including traditionally considered comorbidities as well as serious depression and sensory impairments. Many of them were transferred to a SNF for continued in-patient care after a hospitalization triggered by an ED visit, frequently including trauma. Thirty percent were re-hospitalized within 30 days of the SNF discharge and 30% had an adverse drug event within 45 days.

For this vulnerable group, the lack of information in the EMR for 2/3 of the discharges identified in the claims data suggests the possibility of a serious lack of information flowing to primary care physicians. This is reinforced by the low rates of office visits to primary care physicians, even among this better documented group. Although there were high rates of office visits to other providers, the potential lack of continuity of care would be a source of further medical difficulties for this group of patients.

Conclusion

Our findings for the HIT-based transitional care intervention including alerts about therapeutic changes and monitoring recommendations suggest that the intervention was not effective in increasing the likelihood of a visit to an outpatient provider within 7 or 21 days following discharge from a SNF, increasing laboratory monitoring related to high-risk drugs, reducing adverse drug event rates, or reducing rehospitalization. It was associated with reduced rates of visits to emergency departments.

References

1. Gurwitz JH, Field TS, Harrold LR, et al. Incidence and preventability of adverse drug events among older persons in the ambulatory setting. *JAMA* 2003 Mar 5;289(9):1107-1116.

2. Bodenheimer T, Wagner EH, Grumbach K. Improving primary care for patients with chronic illness. *JAMA* 2002 Oct 9;288(14):1775-1779.

3. Patterns of Medication Use in the United States 2006: A report from the Slone Survey. February 8, 2008; http://www.bu.edu/slone/SloneSurvey/AnnualRpt/SloneSurveyWebReport2006.pdf

4. Budnitz DS, Pollock DA, Weidenbach KN, et al. National surveillance of emergency department visits for outpatient adverse drug events. *JAMA* 2006 Oct 18;296(15):1858-1866.

5. Budnitz DS, Shehab N, Kegler SR, et al. Medication use leading to emergency department visits for adverse drug events in older adults. *Ann Intern Med* 2007 Dec 4;147(11):755-765.

6. Field TS, Gurwitz JH, Harrold LR, et al. Risk factors for adverse drug events among older adults in the ambulatory setting. *J Am Geriatr Soc* 2004 Aug;52(8):1349-1354.

7. Field TS, Mazor KM, Briesacher B, et al. Adverse drug events resulting from patient errors in older adults. *J Am Geriatr Soc* 2007;55:271-276.

8. Forster AJ, Clark HD, Menard A, et al. Adverse events among medical patients after discharge from hospital. *CMAJ* 2004 Feb 3;170(3):345-349.

9. Forster AJ, Murff HJ, Peterson JF, et al. The incidence and severity of adverse events affecting patients after discharge from the hospital. *Ann Intern Med* 2003 Feb 4;138(3):161-167.

10. Beers MH, Sliwkowski J, Brooks J. Compliance with medication orders among the elderly after hospital discharge. *Hosp Formul* 1992 Jul;27(7):720-724.

11. Beers MH, Dang J, Hasegawa J, et al. Influence of hospitalization on drug therapy in the elderly. *J Am Geriatr Soc* 1989 Aug;37(8):679-683.

12. Coleman EA, Boult C. Improving the quality of transitional care for persons with complex care needs. *J Am Geriatr Soc* 2003 Apr;51(4):556-557.

13. Calkins DR, Davis RB, Reiley P, et al. Patient-physician communication at hospital discharge and patients' understanding of the post-discharge treatment plan. *Arch Intern Med* 1997 May 12;157(9):1026-1030.

14. Bates DW, Cullen DJ, Laird N, et al. Incidence of adverse drug events and potential adverse drug events. Implications for prevention. ADE Prevention Study Group. *JAMA* 1995 Jul 5;274(1):29-34.

15. van Walraven C, Seth R, Laupacis A. Dissemination of discharge summaries. Not reaching follow-up physicians. *Can Fam Physician* 2002 Apr;48:737-742.

16. Coleman EA. Falling through the cracks: challenges and opportunities for improving transitional care for persons with continuous complex care needs. *J Am Geriatr Soc* 2003 Apr;51(4):549-555.

17. Capezuti EA, Siegler EL, Mezey MD, eds. *The encyclopedia of elder care: the comprehensive resource on geriatric and social care.* (2nd Ed.). New York, NY: Springer Publishing Co.; 2007.

18. Coleman EA, Min SJ, Chomiak A, et al. Posthospital care transitions: patterns, complications, and risk identification. *Health Serv Res* 2004 Oct;39(5):1449-1465.

19. Tjia J, Field TS, Garber LD, et al. Development and pilot testing of guidelines to monitor high-risk medications in the ambulatory setting. *Am J Manag Care* 2010;16:489-496.

20. National Compensation Survey: *Occupational earnings in the United States*, 2009. Occupational earnings tables: United States, December 2008-January 2010. Washington, DC: U.S. Department of Labor. June 2010. http://www.bls.gov/ncs/ncswage2009.pdf. Accessed November 15, 2010.

21. Field TS, Garber L, Gagne SJ, et al. Technological resources and personnel costs required to implement an automated alert system for primary care physicians when patients transition from hospitals to home. *Inform Prim Care* in press.

List of Publications and Products

Journal publications

Tjia J, Field TS, Garber LD, et al. Development and pilot testing of guidelines to monitor high-risk medications in the ambulatory setting. *Am J Manag Care* 2010;16(7):489-496.

Objectives: To develop guidelines to monitor high-risk medications and to assess the prevalence of laboratory testing for these medications among a multispecialty group practice.

Study Design: Safety intervention trial.

Methods: We developed guidelines for the laboratory monitoring of high-risk medications as part of a patient safety intervention trial. An advisory committee of national experts and local leaders used a 2-round Internet-based Delphi process to select guideline medications based on the importance of monitoring for efficacy, safety, and drug–drug interactions. Test frequency recommendations were developed by academic pharmacists based on a literature review and local interdisciplinary consensus. To estimate the potential effect of the planned intervention, we determined the prevalence of high-risk drug dispensings and laboratory testing for guideline medications between January 1, 2008, and July 31, 2008.

Results: Consensus on medications to include in the guidelines was achieved in 2 rounds. Final guidelines included 35 drugs or drug classes and 61 laboratory tests. The prevalence of monitoring ranged from less than 50.0% to greater than 90.0%, with infrequently prescribed drugs having a lower prevalence of recommended testing ($P < .001$ for new dispensings and $P < .01$ for chronic dispensings, nonparametric test for trend). When more than 1 test was recommended for a selected medication, monitoring within a medication sometimes differed by greater than 50.0%.

Conclusions: Even among drugs for which there is general consensus that laboratory monitoring is important, the prevalence of monitoring is highly variable. Furthermore, infrequently prescribed medications are at higher risk for poor monitoring.

Field TS, Garber L, Gagne SJ, et al. Technological resources and personnel costs required to implement an automated alert system for primary care physicians when patients transition from hospitals to home. *Inform Prim Care* in press.

Background: With the adoption of electronic medical records by medical group practices, there are opportunities to improve the quality of care for patients discharged from hospitals. However, there is little guidance for medical groups outside of integrated hospital systems to automate the flow of patient information during transitions in care.

Objective: To describe the technological resources, expertise and time needed to develop an automated system providing information to primary care physicians when their patients transition from hospitals to home.

Development: Within a medical group practice, we developed an automated alert system that provides notification of discharges, reminders of the need for follow-up visits, drugs added during in-patient stays, and recommendations for laboratory monitoring of high risk drugs. We tracked components of the information system required and the time spent by team members. We used US national averages of hourly wages to estimate personnel costs.

Application: Critical components of the information system are notifications of hospital discharges through an admission, discharge and transfer registration (ADT) interface, linkage to the practice's scheduling system, access to information on pharmacy dispensing and lab tests, and an interface engine. Total personnel cost was $76,314. Nearly half (47%) was for 614 hours by physicians who developed content, provided overall project management, and reviewed alerts to ensure that only "actionable" alerts would be sent.

Conclusion: Implementing a system to provide information about patient transitions requires strong internal informatics expertise, cooperation between facilities and ambulatory providers, development of electronic linkages, and extensive commitment of physician time.

Conference presentations and abstracts

Tjia J, Field TS, Garber L, et al. Development and pilot testing of guidelines to monitor high-risk medications in the ambulatory setting and post-hospital discharge. AHRQ Annual Conference. 2009 Sep 13-16; Bethesda, MD.

Background/Purpose: Inadequate laboratory monitoring of high-risk medications contributes to many preventable adverse drug events. One barrier to appropriate monitoring is lack of standardized monitoring guidelines. This report describes the development of guidelines to monitor high risk medications in the ambulatory setting and post-hospital discharge. It also assesses the prevalence of appropriate testing for new and chronic medications based on these guidelines.

Methods: In a multispecialty group practice, we developed guidelines for laboratory monitoring of high-risk medications as part of a patient safety intervention trial to improve drug safety for ambulatory patients using the electronic medical record. We used a modified Delphi process to achieve consensus around selection of medications for monitoring and to determine monitoring frequency among a local and national interdisciplinary group of physicians, pharmacists, pharmacoepidemiologists, and patient safety experts. We then assessed the baseline prevalence of appropriate monitoring by ambulatory physicians for the period from January 1, 2008 to July 31, 2008 for both new and chronic users of high-risk medications.

Results: Consensus on guidelines was achieved in 2 rounds. Final guidelines included 38 drugs and drug classes and a total of 66 laboratory tests. Some medications required more than one laboratory test (e.g.. amiodarone monitoring included AST and TSH). The prevalence of appropriate monitoring ranged from less than 50% to over 90%, with infrequently prescribed drugs having a lower prevalence of appropriate testing. When

more than one test was indicated to monitor a medication, the prevalence of monitoring sometimes differed by as much as 50% among tests for the same drug.

Conclusions/Implications: Infrequently prescribed medications are at high risk for poor monitoring.

Tjia J, Field T, Garber L, et al. Development and pilot testing of guidelines to monitor high-risk medications in the ambulatory setting. 16th Annual HMO Research Network Conference; 2010 Mar 21-24; Austin, Texas.

Background: Inadequate laboratory monitoring of high-risk medications contributes to preventable adverse drug events. One barrier to appropriate monitoring is lack of standardized monitoring guidelines. The study aims were to develop guidelines to monitor high-risk medications and to assess the prevalence of laboratory testing for these medications in a multispecialty group practice.

Study Design/Methods: We developed guidelines for laboratory monitoring of high-risk medications as part of a patient safety intervention trial. An advisory committee of national experts and local leaders (clinicians, pharmacists, pharmacoepidemiologists, and patient safety experts) used a two-round, internet-based Delphi process to select guideline medications based on the importance of monitoring for efficacy, safety, and drug-drug interactions. Test frequency recommendations were developed by academic pharmacists based on literature review and local interdisciplinary consensus. To estimate the potential impact of the intervention, we determined the prevalence of high-risk drug dispensings and laboratory testing for guideline medications between January 1, 2008 and July 31, 2008.

Results: Consensus on medications to include in the guidelines was achieved in two rounds. Final guidelines included 35 drugs/drug classes and 61 laboratory tests. The prevalence of monitoring ranged from <50% to >90%, with infrequently prescribed drugs having a lower prevalence of recommended testing. When more than one test was recommended for a selected medication, monitoring within a medication sometimes differed by >50%.

Conclusions: Even among drugs where there is general consensus that laboratory monitoring is important, prevalence of monitoring is highly variable. Further, infrequently prescribed medications are at higher risk for poor monitoring.

Field T. Estimating the ROI for computerized clinical decision support systems: pieces of the puzzle. Track F: Economic Analysis of Health IT. AHRQ 2011 Annual Conference; 2011 Sep 18-21; Bethesda, MD.

Field TS, Garber L, Gagne SJ, et al. Technological resources and personnel costs required to implement an automated alert system for primary care physicians when patients transition from hospitals to home. University of Massachusetts Center for Clinical and Translational Science Annual Research Retreat. 2012 May 22; Shrewsbury, MA.

Background: With the adoption of electronic medical records by medical group practices, there are opportunities to improve the quality of care for patients discharged from

hospitals. However, there is little guidance for medical groups outside of integrated hospital systems to automate the flow of patient information during transitions in care.

Objective: To describe the technological resources, expertise and time needed to develop an automated system providing information to primary care physicians when their patients transition from hospitals to home.

Development: Within a medical group practice, we developed an automated alert system that provides notification of discharges, reminders of the need for follow-up visits, drugs added during in-patient stays, and recommendations for laboratory monitoring of high risk drugs. We tracked components of the information system required and the time spent by team members. We used US national averages of hourly wages to estimate personnel costs.

Application: Critical components of the information system are notifications of hospital discharges through an admission, discharge and transfer registration (ADT) interface, linkage to the practice's scheduling system, access to information on pharmacy dispensing and lab tests, and an interface engine. Total personnel cost was $76,314. Nearly half (47%) was for 614 hours by physicians who developed content, provided overall project management, and reviewed alerts to ensure that only "actionable" alerts would be sent.

Conclusion: Implementing a system to provide information about patient transitions requires strong internal informatics expertise, cooperation between facilities and ambulatory providers, development of electronic linkages, and extensive commitment of physician time.

Webinar Presentations

Gurwitz JH, Field TS. Potential of health it for prescribing and monitoring medication for older adults. National Web-Based Teleconference on Utilizing Health IT to Improve Medication Management for the Care of Elderly Patients. 2011 Aug 18. Agency for Healthcare Research and Quality. 2011 Nov. http://healthit.ahrq.gov/portal/server.pt/document/955352/accessible%2Baugust%2Bnational%2Bweb-based%2Bteleconference_pdf

Garber L. Achieving a higher level of patient safety with electronic health records and health information exchanges. National Patient Safety Foundation Webinar. 2010 Jul 28. National Patient Safety Foundation. 2010. http://www.npsf.org/wp-content/uploads/2011/10/PLS_1007_LG.pdf

Field TS. Transitions in care. Managing Patient Care Transitions: How Health IT Can Reduce Unnecessary Re-Hospitalization. A National Web Conference on Transitions in Care. 2010 Feb 24. AHRQ National Resource Center for Health Information Technology. 2011 Nov. http://healthit.ahrq.gov/portal/server.pt/gateway/PTARGS_0_3882_912257_0_0_18/2010-02-24%20Transitions%20In%20Care.pdf.