ORIGINAL RESEARCH

Frequency and Predictors of Prescription-Related Issues after Hospital Discharge

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BACKGROUND: In the period immediately following hospital discharge, patients often experience difficulty with medication management. The problems related to patients' handling of discharge prescriptions are not well characterized.

METHODS: We conducted a large observational study of patients discharged from 170 community hospitals in 2005. By combining clinical, administrative, and call center data, we were able to examine independent predictors of prescription-related issues in the 48-72 hours after hospital discharge. Issues included: not picking up prescribed discharge medications, not knowing if these medications had been picked up, not taking discharge medications, and not understanding how to take the medications.

RESULTS: More than half (57.0%) of the 31,199 subjects in the study were women, and the mean age was 61.1 years. Overall, 7.2% of patients (n = 2253) reported prescription-related issues, most often not filling discharge prescriptions. In multivariable analyses, prescription-related issues were more common among adults age 35-49; women; patients with Medicare HMO coverage, Medicaid, or no insurance; adults with higher severity of illness ratings; and patients prescribed 6 or more medications or an inhaler. Predictors of fewer problems were being age 65 or older; having HMO or commercial insurance; being prescribed antibiotics, anticoagulants, or angiotensin II receptor blockers; and having a major diagnosis in the skin or musculoskeletal categories.

CONCLUSIONS: About 7% of patients reported prescription-related issues within a few days of hospital discharge. High-risk patients should be identified and offered additional assistance prior to discharge and receive a follow-up phone call to assess if discharge prescriptions have been filled. *Journal of Hospital Medicine* 2008;3:12–19. © 2008 Society of Hospital Medicine.

KEYWORDS: hospital discharge, medication use.

The period immediately following hospital discharge is a vulnerable time for patients, who must assume responsibilities for their own care as they return home.[1] The process of hospital discharge may be a rushed event, and patients often have difficulty understanding and following their postdischarge treatment plan.[2,3] Medication-related problems after hospital discharge, which include patients not filling or refilling prescriptions,[4–6] not understanding how to take medications,[2,3] showing discrepancies between what they are and what they should be taking,[7–9] and having adverse drug events,[10–12] are a major cause of morbidity and mortality.[13]

According to prior studies, elderly patients and patients taking more than 5 medications are more likely to experience problems with their medications.[5,14] Adverse drug events are more common with certain high-risk drugs, including cardiovascular agents,

anticoagulants, insulin, antibiotics, and steroids.[11,14,15] Beyond this, however, patient management of prescription medications after hospital discharge has not been well described. In particular, studies in the community setting and in the immediate postdischarge period are needed.

We conducted a large observational study of patients at 170 community hospitals in order to examine the frequency of prescription-related issues 48-72 hours after hospital discharge. These issues included problems with filling or taking medications prescribed at discharge. We hypothesized that age and number of medications would be independently associated with prescription-related problems. We also examined the effects of other factors, including insurance type, length of stay, severity of illness (SOI), clinical diagnosis, and use of certain high-risk drugs.

METHODS
Setting and Population
Information for the present analysis consisted of deidentified clinical, administrative, and survey data provided by a national hospitalist management group, IPC—The Hospitalist Company. At the time of the study, IPC employed more than 300 physicians working at 170 community hospitals in 18 regions across the United States. As part of their daily patient management, physicians entered clinical and administrative data into a proprietary Web-based program. At discharge, physicians completed discharge summaries in the same program. These summaries were faxed to the outpatient physicians scheduled to see the patients and were transmitted electronically to a call center. The call center attempted to contact all patients at home to assess their clinical status and satisfaction and to assist with any postdischarge needs. The call center staff made up to 2 attempts to reach each patient by telephone within 3 days of discharge. Patients who were reached were interviewed using a scripted survey. Any identified medical needs were addressed in a separate follow-up call by a nurse.

Patients were included in this analysis if they were at least 18 years old, were treated by an IPC hospitalist, had been discharged between January 1, 2005, and December 31, 2005, and were successfully surveyed by telephone 48-72 hours after hospital discharge. If patients had more than 1 discharge during the study period, only the first survey and its corresponding hospital stay were included.

The analytic plan was approved by the Emory University Institutional Review Board.

Data Collection
Hospitalists recorded the age, sex, and insurance coverage of each hospitalized patient and noted the discharge diagnoses and medications on the discharge summary. Primary diagnosis and length of stay were determined from hospitalist billing data, which were entered daily into the Web-based program. Each patient's severity of illness was classified as minor, moderate, major, or extreme using a commercially available program (3M Health Information Systems) that considered patient age, primary diagnosis, diagnosis-related group (DRG), and non–operating room procedures.

A common patient identifier code linked these data with patient-reported information obtained from the call center. Patients indicated whether they picked up their prescribed medications and if they had any trouble understanding how to take their medications. For the present analysis, patients were considered to have a prescription-related issue if they had problems filling or taking medications prescribed at discharge, a composite variable defined as including not picking up discharge medications, not knowing whether discharge medications had been picked up, not taking discharge medications, or not understanding how to take discharge medications.

Statistical Analysis
Initial analyses included construction of frequency tables to estimate the distribution of prescription-related issues across patient demographic characteristics, insurance type, clinical diagnosis, and number of medications, as well as among users of certain high-risk classes of medication. Some continuous variables, such as age and number of medications, were categorized (age into clinically relevant categories, number of medications into tertiles). Separate variables were created for clinical diagnoses by mapping DRGs to 26 major diagnostic categories (MDCs) so that comparisons could be made based on the frequency of prescription-related issues for those with a primary diagnosis pertaining to a particular organ system versus those with a primary diagnosis outside that organ system. The 10 most common MDCs were circulatory, digestive, respiratory, nervous, skin-subcutaneous-breast, kidney-urinary, musculoskeletal-connective, hepatobiliary-pancreas, endocrine-nutrition-

metabolic, and infectious. The categories of the severity of illness variable were reduced to 3 by combining "major" and "extreme" because there were so few in the extreme category.

Unadjusted odds ratios were calculated based on a logistic regression model relating any prescription-related issues to each possible covariate 1 at a time (ie, not adjusted for any of the other covariates). Adjusted odds ratios were obtained through stepwise building of a logistic regression model. Initially, all possible covariates were entered into the model, and the model was then reduced using Wald test results to assess the significance of dropped parameters. All analyses were conducted using SAS version 9.1 (Cary, NC) and a significance level of 0.05.

RESULTS

In 2005, there were 104,506 eligible adult hospital discharges, corresponding to 96,179 patients. Excluding discharged patients who could not be contacted by the call center or who refused to complete the survey (n = 67,084), multiple surveys of the same patient (n = 3156), and surveys with insufficient data to determine whether there were prescription-related issues (n = 3067) left 31,199 patients available for analysis (effective response rate 32.4%).

More than half the participants (57.0%) were women, and the mean age was 61.1 years (SD 17.8 years). The median number of discharge medications was 4 (range 1-28). The most frequently prescribed drugs were antibiotics and analgesics, followed by several cardiovascular drug classes (Table 1). About 60% of the primary diagnoses were of circulatory, digestive, and respiratory disorders (Table 1). Compared with nonparticipants, the study sample was more likely to be female, older, and covered by Medicare. Study patients also had greater comorbidity, as indicated by greater severity of illness rating and number of discharge medications.

Overall, 7.2% of patients (n = 2253) had prescription-related issues 48-72 hours after hospital discharge. This included not picking up prescribed discharge medications (n = 1797, or 79.8% of issues), not knowing if they were picked up (n = 55 or 2.4%), and admitting to not taking (n = 154, or 6.8%) or not understanding how to take (n = 247, or 11%) medications.

In unadjusted analyses, prescription-related issues were significantly associated with age, sex, insurance type, severity of illness rating, length of stay, number of discharge medications, certain medication types, and major diagnostic category (Table 2). Except for the youngest patients (age < 35 years), having prescription-related issues appeared to be inversely related to patient age. Adults 35-49 years old had the highest frequency of problems filling or taking medications (9.3%), whereas patients 80 years or older had the lowest frequency (5.6%). Analysis by insurance status showed that patients with Medicaid (12.6%) or self-pay/uninsured status (11.9%) had significantly higher rates of prescription issues and patients with non-Medicare HMO or commercial insurance had significantly lower rates (6.1% and 4.9%, respectively). Being prescribed at least 6 medications or taking ACE inhibitors, inhalers, oral hypoglycemics, or insulins was also associated with a higher frequency of prescription-related problems in unadjusted analyses. Patients prescribed antibiotics or anticoagulants were less likely to report problems in unadjusted analyses.

In multivariable models, age, sex, insurance type, severity of illness, number of medications, and certain medication types were independently associated with prescription-related issues after discharge (Table 3). Seniors reported significantly fewer problems than the youngest patients (65-79 years, OR 0.69; ≥ 80 years, OR 0.59). Those with Medicare HMOs, Medicaid, or no insurance had more difficulty obtaining and taking prescription medications (OR 1.29, 1.33, and 1.31, respectively), whereas patients with HMO or commercial insurance plans had less difficulty (OR 0.68 and 0.51, respectively). Prescription-related problems were also more common among women (OR 1.11), patients with higher severity of illness (moderate SOI, OR 1.12; major/extreme SOI, OR 1.23), and those with 6 or more discharge medications (OR 1.35). In adjusted analyses, inhalers were the only type of medication associated with a significantly higher frequency of problems (OR 1.14).

Analyses were repeated using only failure to pick up medications as the dependent variable, and results were similar (not shown).

DISCUSSION

In this large multicenter study, 7.2% of patients reported problems obtaining or taking prescribed medications in the 48-72 hours following hospital discharge. In about 80% of cases, the problem was failure to pick up discharge medications. Multiva-

TABLE 1
Patient Characteristics

Characteristic	Study sample (n = 31,199)	Excluded patients (n = 65,060)
Age (years), n (%)		
≤34	2712 (8.7%)	9064 (13.9%)
35-49	5645 (18.1%)	16,327 (25.1%)
50-64	8359 (26.8%)	17,583 (27.0%)
65-79	9192 (29.5%)	13,660 (21.0%)
≥80	5291 (17.0%)	8426 (13.0%)
Sex, n (% female)	17,450 (57.0%)	34,298 (52.7%)
Insurance type, n (%)		
Medicare	12,455 (39.9%)	21,255 (32.7%)
Medicare HMO	966 (3.1%)	1462 (2.2%)
HMO (non-Medicare)	11,076 (35.5%)	22,666 (34.8%)
Medicaid	1599 (5.1%)	4315 (6.6%)
Self-pay/uninsured	2151 (6.9%)	7717 (11.9%)
Commercial	2952 (9.5%)	7645 (11.8%)
Severity of illness, n (%)		
Minor	12,097 (39.1%)	27,958 (43.6%)
Moderate	14,800 (47.9%)	29,020 (45.1%)
Major/extreme	4020 (13.0%)	7353 (11.4%)
Length of stay (days), mean (SD)	3.9 (3.9)	3.6 (4.0)
Discharge medications, n (%)		
1-2	8100 (26.0%)	22,060 (33.9%)
3-5	13,299 (42.6%)	26,654 (41.0%)
≥6	9800 (31.4%)	16,346 (25.1%)
Medication class, n (%)		
Antibiotics	9927 (31.8%)	17,721 (27.2%)
Analgesics	9153 (29.3%)	18,660 (28.7%)
Beta-blockers	8398 (26.9%)	14,733 (22.6%)
Aspirin	7028 (22.5%)	13,040 (20.0%)
ACE inhibitors	6493 (20.8%)	11,640 (17.9%)
Lipid-lowering agents	5661 (18.1%)	9421 (14.5%)
Diuretics	5100 (16.3%)	8393 (12.9%)
Inhalers	4352 (13.9%)	7297 (11.2%)
Oral hypoglycemics	3705 (11.9%)	6819 (10.5%)
Steroids	3521 (11.3%)	6056 (9.3%)
Anticoagulants	3152 (10.1%)	4820 (7.4%)
Insulins	2236 (7.2%)	4589 (7.1%)
Angiotensin II receptor blockers	2034 (6.5%)	3285 (5.0%)
Major diagnostic category, n (%)		
Circulatory	7971 (25.7%)	16,963 (26.3%)
Digestive	4990 (16.1%)	10,211 (15.8%)
Respiratory	4955 (16.0%)	8482 (13.1%)
Nervous	2469 (8.0%)	5505 (8.5%)
Skin-subcutaneous-breast	1738 (5.6%)	3664 (5.7%)
Renal	1610 (5.2%)	3216 (5.0%)
Musculoskeletal-connective	1357 (4.4%)	2592 (4.0%)
Hepatobiliary-pancreas	1273 (4.1%)	2844 (4.4%)
Endocrine-nutrition-metabolic	1195 (3.9%)	2666 (4.1%)
Infectious	771 (2.5%)	1429 (2.2%)

Percentages are of totals for available data. Data were missing from some study patients for sex (n = 574), severity of illness (n = 282), and major diagnostic category (n = 183). Data were missing from nonstudy patients for sex (n = 1,289), severity of illness (n = 729), and major diagnostic category (n = 493).

TABLE 2

Frequency and Odds of Prescription-Related Issues after Hospital Discharge by Patient and Regimen Characteristics

Characteristic	Prescription-related issues, n (%)	Unadjusted OR (95% CI)	P value
Age			< .0001
≤34	195 (7.2%)	—	
35-49	523 (9.3%)	1.32 (1.11-1.56)	
50-64	646 (7.7%)	1.08 (0.92-1.28)	
65-79	592 (6.4%)	0.89 (0.75-1.05)	
≥80	297 (5.6%)	0.77 (0.64-0.93)	
Sex			.035
Male	906 (6.9%)—		
Female	1310 (7.5%)	1.10 (1.01-1.20)	
Insurance type		< .0001	
Medicare	891 (7.2%)	—	
Medicare HMO	86 (8.9%)	1.27 (1.01-1.60)	
HMO (non-Medicare)	674 (6.1%)	0.84 (0.76-0.93)	
Medicaid	201 (12.6%)	1.87 (1.59-2.20)	
Self-pay/uninsured	256 (11.9%)	1.75 (1.51-2.03)	
Commercial	145 (4.9%)	0.66 (0.55-0.79)	
Severity of illness			.0007
Minor	794 (6.6%)	—	
Moderate	1107 (7.5%)	1.15 (1.05-1.27)	
Major/extreme	328 (8.2%)	1.27 (1.11-1.45)	
Length of stay (days)	—	1.01 (1.00-1.02)	.014
Discharge medications			< .0001
1-2	526 (6.5%)	—	
3-5	928 (7.0%)	1.08 (0.97-1.21)	
≥6	799 (8.2%)	1.28 (1.14-1.43)	
Medication class			
Antibiotics	639 (6.4%)	0.84 (0.76-0.92)	.0003
Analgesics	656 (7.2%)	0.99 (0.90-1.09)	.8
Beta-blockers	608 (7.2%)	1.00 (0.91-1.11)	.9
Aspirin	539 (7.7%)	1.09 (0.98-1.20)	.1
ACE inhibitors	520 (8.0%)	1.15 (1.04-1.28)	.006
Lipid-lowering agents	438 (7.7%)	1.10 (0.98-1.22)	.1
Diuretics	370 (7.3%)	1.00 (0.90-1.13)	.9
Inhalers	373 (8.6%)	1.25 (1.11-1.40)	.0002
Oral hypoglycemics	295 (8.0%)	1.23 (0.99-1.28)	.06
Steroids	261 (7.4%)	1.03 (0.90-1.18)	.64
Anticoagulants	189 (6.0%)	0.80 (0.69-0.94)	.005
Insulins	210 (9.4%)	1.37 (1.18-1.59)	< .0001
Angiotensin II receptor blockers	126 (6.2%)	0.84 (0.70-1.01)	.06
Major diagnostic category			
Circulatory	619 (7.8%)	1.12 (1.01-1.23)	.025
Digestive	398 (8.0%)	1.14 (1.02-1.28)	.02
Respiratory	354 (7.1%)	0.99 (0.88-1.11)	.86
Nervous	188 (7.6%)	1.07 (0.91-1.25)	.41
Skin-subcutaneous-breast	71 (4.1%)	0.53 (0.42-0.68)	< .0001
Renal	98 (6.1%)	0.83 (0.67-1.02)	.075
Musculoskeletal-connective	74 (5.5%)	0.73 (0.58-0.93)	.01
Hepatobiliary-pancreas	105 (8.3%)	1.17 (0.95-1.43)	.14
Endocrine-nutrition-metabolic	93 (7.8%)	1.09 (0.88-1.35)	.43
Infectious	45 (5.8%)	0.79 (0.59-1.08)	.14

Data were missing from some patients for sex (n = 574), severity of illness (n = 282), and major diagnostic category (n = 183).

TABLE 3
Adjusted Odds of Prescription-Related Issues after Hospital Discharge by Patient and Regimen Characteristics, Reduced Model

Characteristic	Adjusted OR (95% CI)	P value
Age		< .0001
≤34	—	
35-49	1.27 (1.07-1.51)	
50-64	1.02 (0.86-1.21)	
65-79	0.69 (0.57-0.84)	
≥80	0.59 (0.48-0.73)	
Sex		.03
Male	—	
Female	1.11 (1.01-1.21)	
Insurance type		< .0001
Medicare	—	
Medicare HMO	1.29 (1.02-1.63)	
HMO (non-Medicare)	0.68 (0.60-0.76)	
Medicaid	1.33 (1.11-1.60)	
Self-pay/uninsured	1.31 (1.10-1.56)	
Commercial	0.51 (0.42-0.62)	
Severity of illness		.008
Minor	—	
Moderate	1.12 (1.02-1.24)	
Major/extreme	1.23 (1.07-1.42)	
Discharge medications		< .0001
1-2	—	
3-5	1.11 (0.99-1.24)	
≥6	1.35 (1.19-1.54)	
Medication class		
Antibiotic	0.78 (0.71-0.86)	< .0001
Inhalers	1.14 (1.01-1.29)	.04
Anticoagulants	0.81 (0.69-0.95)	.009
Angiotensin II receptor blockers	0.81 (0.67-0.98)	.03
Major diagnostic category		
Skin-subcutaneous-breast	0.52 (0.41-0.67)	< .0001
Musculoskeletal-connective	0.74 (0.58-0.94)	.01

n = 30,341. Patients with incomplete data were excluded from model.

riable analyses showed adults 35-49 years old; women; patients with Medicare HMO insurance, Medicaid, or no coverage (self-pay); adults with high severity of illness rating; and those prescribed more than 5 medications or an inhaler had significantly greater odds of prescription-related issues. Other factors were protective including age 65 or older; HMO or commercial insurance; prescription of antibiotics, anticoagulants, or angiotensin II receptor blockers; and major diagnosis in the skin or musculoskeletal category.

Among all the groups studied, patients with Medicaid or no insurance had the highest frequency of problems filling and taking discharge medications (12.6% and 11.9%, respectively). This was likely related to their having less prescription drug coverage or experiencing other financial con-

straints. In previous studies, patients have expressed concern over the rising cost of medications and have admitted to not filling prescriptions or stretching out the use of medications to make them last longer because of high out-of-pocket costs.[5,16] Prescriptions given at hospital discharge may pose a significant unexpected expense for patients who have a fixed monthly income, rely on samples from outpatient physicians for their medications, or need time to research cost-saving measures such as discount plans. Greater attention by physicians to knowing the cost of discharge medications, to prescribing only those drugs that are truly necessary, and to discussing cost-saving strategies with patients may help to minimize financial concerns and improve the ability of patients to fill discharge prescriptions.[17]

The finding that polypharmacy is associated with greater odds of prescription-related issues is consistent with research that found that other medication problems such as adverse drug events and nonadherence were more prevalent among patients prescribed more than 5 medications.[5,14] Polypharmacy may have contributed to prescription-related difficulties in this study by increasing medication costs or by increasing the chance that patients had a problem with at least 1 medication.

The higher frequency of prescription-related issues among patients prescribed inhalers indicates that this category of medication may be associated with lower fill rates or greater confusion after discharge. This would be concerning, given that repeat exacerbations of obstructive lung disease may lead to rehospitalization. Other medications, including anticoagulants and antibiotics, were associated with a lower frequency of problems. This may have been the result of better education at discharge about the importance of promptly filling prescriptions for these agents in order to avoid a lapse in therapy following acute treatment for thromboembolic disorders or acute infections. It is hoped that a similar educational effort about filling prescriptions for inhalers also would have occurred. These effects have not been noted in prior research and require further substantiation.[11,14] Also, the observed relationships may be related to the size of the data set and the number of variables considered, rather than to a true effect.

The main strength of this study was that the data from which conclusions were drawn came from a large and geographically diverse patient population. However, the study also had several

limitations. First, the response rate was relatively low, primarily because this study was a retrospective analysis performed using data collected for clinical and administrative reasons. Patient contact number was missing or incorrect in 16% of cases. Also, because of the narrow window of time during which the survey was administered, the call center, which was following up an average of 370 discharged patients per day, was only able to make 1 or 2 attempts to reach each patient. This contrasts with prospective research on postdischarge medication use such as the study by Forster and colleagues, in which the investigator made up to 20 attempts to reach patients at different times and on different days.[11] Despite these efforts, the follow-up rate was only 69%, underscoring the challenge of data collection in this setting.

The low response rate raises the possibility that the estimated prevalence of prescription-related issues may be inaccurate. Although highly unlikely, if all the nonresponders had problems with their prescriptions, the true event rate would be 69.9%. Conversely, if none of the nonresponders had problems, the true event rate would be 2.3%. Given the characteristics of responders and nonresponders, however, we expect that a higher survey completion rate would have yielded similar results. Nonresponders had certain characteristics that would be expected to be associated with a higher frequency of prescription-related issues (younger age, uninsured, covered by Medicaid), but these were balanced by others that would be expected to be associated with a lower frequency of problems (higher percentage of men, lower severity of illness, fewer medications).

Another study limitation concerns the self-reported nature of the composite outcome variable. After reviewing the structure of the call center data, we chose this composite measure because it conceptually represented difficulties in obtaining or taking prescribed discharge medications. When we analyzed results using only the most prevalent component of this composite variable, the results were similar. However, all these findings could have been influenced by social desirability bias. Patients may have underreported not filling their discharge prescriptions and also may not acknowledged difficulties in understanding how to take the medications. We would therefore expect the true prevalence of prescription-related concerns after hospital discharge to be higher than that found in this study.

These limitations notwithstanding, the findings from this large, multicenter study show that prescription-related issues are common after hospital discharge and, further, that they usually take the form of not filling discharge prescriptions. The highest-risk patients appear to be those without insurance and those covered by Medicaid or Medicare HMOs, as well as adults age 35-49, patients prescribed 6 or more medications, and patients with a higher severity of illness. When preparing patients to leave the hospital, physicians and other health care providers should strive to identify financial, behavioral, and other barriers to proper medication use so that appropriate assistance or counseling may be offered prior to discharge.[18,19] Close follow-up of patients by telephone may also be a helpful approach to promptly identifying prescription-related issues and other problems so that providers can intervene before more serious complications arise.

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