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Lessons from a patient partnership intervention to prevent adverse drug events

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Abstract

Background. Patient safety 'best practices' that call for patient participation to prevent adverse drug events have not been rigorously evaluated.

Objective. To consider lessons learned from a patient partnership intervention to prevent adverse drug events among medical in-patients.

Design. Prospective randomized, controlled pilot trial.

Setting. Boston teaching hospital.

Patients. Two hundred and nine adult in-patients on a general medicine unit.

Intervention. Intervention patients (n = 107) received drug safety information and their medication list; controls (n = 102) received drug safety information only.

Measurements. Adverse drug events and close-call drug errors were identified using chart review and incident reports from nurses, pharmacists, and physicians. Patients and clinicians were surveyed about the intervention.

Results. In 1053 patient-days at risk, 11 patients experienced 12 adverse drug events and 16 patients experienced 18 close calls. There was a non-significant difference between intervention patients and controls in survey responses and in the adverse drug event rate (8.4% versus 2.9%, $P = 0.12$) and close-call rate (7.5% versus 9.8%, $P = 0.57$). Eleven percent of patients were aware of drug-related mistakes during the hospitalization. Among nurse respondents, 29% indicated that at least one medication error was prevented when a patient or family member identified a problem.

Conclusion. Partnering with in-patients to prevent adverse drug events is a promising strategy but requires further study to document its efficacy.

Keywords: adverse drug event, medical error, patient participation

Several patient safety 'best practices' call for clinicians to enlist patients as partners to prevent adverse events [1–3]. Patient partnership practices include the distribution of patient education materials and policies that require clinicians to engage patients and families in making treatment decisions.

These recommendations rest on several observations: patients and families can identify deficiencies in health care, patient adherence is essential for successful delivery of outpatient care, and patients may have personal health information that is inaccessible to clinicians in different practice settings [4–7]. Although patient partnership initiatives may improve clinical outcomes among patients with asthma and diabetes, the use of patient partnership to prevent medical error has not been evaluated [8–15].

Accordingly, we developed a pilot study to examine the feasibility of a larger, definitive, randomized, controlled trial of the impact of a patient partnership intervention on medication safety. We sought to assess whether patients would be willing to participate, whether such an intervention might improve patient safety, and to estimate the magnitude of the impact of the intervention, if any.

We hypothesized that providing medical in-patients with personalized drug information would reduce the number and

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severity of adverse drug events (defined as injuries due to drugs) and potential adverse drug events (defined as 'close-call' errors with the potential for drug-related injury). In theory, providing drug information would permit patients or their surrogates to prevent prescribing errors by identifying potential allergies and confirming the patient's current drug list. Providing patients with the medication list would permit patients to prevent drug dispensing and administration errors by verifying their own identity, confirming the name of the medication, and insuring correct dosing, drug form, route, and administration time. We also hypothesized that the drug safety intervention would improve patients' experience of care and that clinicians would find the intervention unobtrusive.

Methods

Study site

The study site was a 40-bed general medicine unit in a Boston teaching hospital. The unit used paper medication order forms that were faxed to the pharmacy and entered into the hospital's electronic pharmacy information system. The pharmacy system checked allergies, interactions, and dose ranges. An electronic profile was generated for each patient, listing the current active medications with their doses and frequency. This medication list could be printed from computer workstations throughout the hospital. However, a physician computer order-entry system was not operational at the time of this study.

Enrollment of study subjects

Adult in-patients admitted to the study unit from 15 December 2001, through 31 March 2002 were eligible for enrollment. A physician investigator (M.T.) approached each patient on the first weekday morning following his or her admission. She described the study, requested informed consent from the patient or patient's proxy, and abstracted demographic and administrative data from the electronic registration system, and medical history information (including drug allergies and medical comorbidities) from the medical record. Spanish and Russian interpreters were available as needed for the two largest groups of non-English speaking patients; informed consent documents and other written materials were provided in English, Spanish, or Russian translation. Patients with multiple hospitalizations were enrolled at most once.

Of the 402 medical in-patients admitted to the study unit, 209 were enrolled (107 intervention patients and 102 controls). Of 193 non-enrolled patients, the most common reasons for non-enrollment were inability to obtain consent (n = 70), declined without explanation (63), and discharge or transfer (45). Of the 70 cases where consent could not be obtained, 23 patients were confused, 19 were not in their rooms, nine were too ill to participate, eight were in respiratory isolation, six patients were undecided, and five were unable to see or hear. Enrolled patients were younger than non-enrolled patients (mean age 60 versus 70 years, $P < 0.001$) and had fewer medical comorbidities (2.7 versus 3.2, $P = 0.02$). Compared with non-enrollees, fewer enrollees had Medicare and more had managed care insurance (43% versus 57% and 35% versus 17%, respectively, $P < 0.001$).

Study protocol

Patients who consented to participate were assigned by random number to an intervention or control group. All patients received a one-page consumer education guide to medication safety (Appendix) [2,16]. Patients in the intervention group also received a copy of their current medication list printed from the electronic pharmacy profile, along with a glossary that explained common medical terms (e.g. BID = twice a day, PO = by mouth). Patients in the intervention group received an updated medication list every 3 days during the hospitalization. We chose not to provide daily updates in order to encourage patients to monitor actively changes in their medication regimen.

Patient and clinician surveys

At discharge, we surveyed patients about medication errors and injuries, adequacy of drug information, and quality of care during the hospitalization. If the patient did not complete the written questionnaire at discharge, we followed up with a mailed questionnaire and telephone call. Response rates were similar for intervention patients (82%) and controls (83%).

At the conclusion of the study, we surveyed nurses who worked on the study unit with an anonymous written questionnaire about the impact of the intervention on their workload, their relationship with patients, and medication safety. Seventeen of 23 (74%) nurses completed surveys.

Incident identification

We used four complementary strategies to identify adverse drug events (injuries due to drugs) and close-call drug errors. Firstly, we obtained a list of incidents filed with the hospital's Department of Healthcare Quality electronic incident reporting system during the study period. Secondly, we collected a list of 'interventions' recorded by staff pharmacists who worked on the study unit. An intervention occurred when the pharmacist contacted the prescriber regarding a possible problem with an order. Thirdly, a medical house officer (J.E.) elicited confidential reports of adverse drug events and medication errors using brief interviews with house officers on the study unit and during morning sign-in rounds [17,18]. Finally, a research pharmacist reviewed the medical records of all patients enrolled in the study to identify candidate adverse drug events and close calls, using coding forms adapted from Bates [20, 21] and a chart review method described by Rozich [19] that searches for triggers that suggested the presence of an adverse drug event.

Unit pharmacists, the house officer interviewer, and chart reviewer were blinded to patient assignment.

Case review and classification

Two board-certified internists (A.N.S., D.Z.S., or M.D.A.), blinded to assignment, scored each incident independently in

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order to assess the presence of adverse drug events and close calls. Events were classified by severity and preventability. For close calls, reviewers determined whether the incident had been detected and prevented ('intercepted') before the medication was administered. In contrast, non-intercepted close calls occurred when medications were administered but there was no injury. Incidents that occurred in the emergency department and prior to admission (n = 3) were excluded. Disagreement among reviewers was resolved by discussion; a third internist was consulted if a consensus could not be reached.

Inter-rater agreement was excellent for coding of adverse drug events/close calls (kappa = 0.94) and preventability (weighted kappa = 0.88). Agreement was satisfactory for judgments of severity (weighted kappa = 0.66), a finding consistent with other medical error studies and related to the difficulty of calibrating judgments about the extent of injury [22].

Data analysis

We compared characteristics of patients in the intervention and control groups using Fisher's exact test for nominal and Wilcoxon rank-sum test for continuous variables. We also used the exact test to compare the proportion of patients in each group who experienced adverse drug events and close calls, selecting the single most severe event for the three patients who each experienced two events. We used the rank-sum test to compare groups by ordinal variables including preventability and severity of adverse drug events and close calls, intercepted close calls, and patients' survey responses, again using at most one event per patient. To analyze the impact of the intervention on adverse drug event and close-call rates, we created a Poisson regression model with number of events per person as the dependent variable and assignment (intervention or control) as the independent variable. Although a definitive study would seek to measure a change in the combined end-point of serious preventable adverse drug events and serious non-intercepted close calls, this pilot study was powered (80%) only to detect a 71% reduction in total adverse drug events and close calls (assuming a baseline combined adverse drug event and close-call rate of 14%, one-tailed test (Poisson distribution), alpha = 0.05). We used Stata, Version 6.0 (StataCorp, Austin, TX, USA) for statistical analyses.

Human subjects

The study was approved in advance by the hospital institutional review board. Because of the possibility of eliciting sensitive information about clinician errors, we obtained in advance written informed consent from nurses, pharmacists, and house officers assigned to the study unit. We also obtained consent from patients, as described above. The project was carried out under the auspices of the Medicine Department Quality Improvement Committee to insure peer review protection.

Results

Patient characteristics

Table 1 shows the characteristics of patients in the intervention and control groups. There was no apparent difference in demographic profile (age, sex, race/ethnicity, need for an interpreter); insurance type; number of prescribed drugs, drug allergies, and comorbidities; number of days from admission to enrollment; and length of stay.

Of the 209 patients enrolled in the study during 1053 patient-days at risk, 11 patients (5.3%) experienced 12 adverse drug events and 16 patients (7.7%) experienced 18 close calls (Table 2). Three serious adverse drug events included a patient who had worsening renal failure due to in-hospital use of diuretics and an angiotensin receptor antagonist in the setting of congestive heart failure; a patient on a patient-controlled morphine pump developed hypoxia and decreased responsiveness until treated with naloxone; another patient experienced acute renal failure due to elevated serum levels of an antibiotic that clinicians failed to dose-adjust. Two life-threatening adverse drug events included a patient with known ceftriaxone allergy who was re-challenged and developed angioedema; and a debilitated patient who received an overdose of lorazepam and developed respiratory distress. The latter three events were judged preventable, but only the ceftriaxone allergy was possibly preventable by the patient's actions. The intervention was ineffective in this case, as that patient was assigned to the intervention group.

Three close-call events were judged serious (none were intercepted), including a patient with elevated International Normalized Ratio of 7 and possible gastrointestinal bleed who was started on a non-steroidal anti-inflammatory drug for migraine headache; a patient with diabetes mellitus and renal insufficiency (serum creatinine >1.6 mg/dl) was treated inappropriately with metformin 1500 mg/day; and a patient was prescribed a potentially hepatotoxic dose of acetaminophen when written for maximal doses of both acetaminophen and acetaminophen with codeine. None of these events was preventable by the patient's use of a current medication list.

There was no significant difference between intervention and control groups in the severity, preventability, or proportion of adverse drug events, or in the severity, percent intercepted, or proportion of close calls.

The adverse drug event rate was calculated as the total number of events per group, including multiple events per person. The adverse drug event rate in the intervention group (8.4%) exceeded the rate among controls (2.9%), while the close-call rate was lower in the intervention group (7.5%) than among controls (9.8%). Neither comparison yielded a statistically significant difference (P = 0.12 and 0.57, respectively, using the Poisson model). The lack of intervention effect may have been related, in part, to the finding that half of adverse drug events (6/12) and three-quarters of close calls (14/18) occurred after admission but before enrollment in the study the next morning. There was no significant difference in the rates of post-enrollment adverse drug events and close calls between intervention patients and controls (P = 0.45 and 0.98, respectively).

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Table 1 Characteristics of intervention and control groups

	Intervention, $n = 107$	Control, $n = 102$	P-value[1]
Mean age (range), SD	57.9 (19.8–100.3) 18.8	61.8 (20.5–100.7) 20.1	0.16
Male patients, *n* (%)	45 (42.1)	32 (31.4)	0.12
Patients requiring interpreter, *n* (%)	9 (8.4)	4 (3.9)	0.25
Race, *n* (%)			0.98
White	79 (73.8)	78 (76.5)	
African American	11 (10.3)	10 (9.8)	
Hispanic	5 (4.7)	4 (3.9)	
Other	12 (11.2)	10 (9.8)	
Insurance type, *n* (%)			0.23
Indemnity	6 (5.6)	4 (3.9)	
Medicare	42 (39.3)	48 (47.1)	
Managed care	36 (33.6)	38 (37.3)	
Medicaid	4 (3.7)	0 (0.0)	
Free care/self pay	2 (1.9)	4 (3.9)	
Medicare managed care	7 (6.5)	3 (2.9)	
Medicaid managed care	8 (7.5)	5 (4.9)	
Other	2 (1.9)	0 (0.0)	
Mean no. of medications (range), SD	10.6 (0–33) 6.3	10.0 (0–27) 5.5	0.69
Mean no. of drug allergies (range), SD	1.2 (0–7) 1.8	1.2 (0–7) 1.6	0.72
Mean no. of comorbidities (range), SD	2.6 (0–11) 1.9	2.8 (0–8) 2.0	0.47
Mean no. of days from admission to enrollment (range), SD	1.9 (0–20) 2.5	1.4 (0–11) 1.2	0.08
Mean LOS (range), SD	5.7 (2–31) 4.4	5.1 (2–30) 4.0	0.19

[1]Wilcoxon rank-sum test for continuous variables and Fisher's exact test for categorical variables.

Patient survey

We surveyed patients in order to understand their experience. Of 173 (83% of 209 possible) respondents, 11% were aware of 'mistakes' related to their medications during the hospitalization (Table 3). Nine percent confirmed 'serious problems or bad reactions' to their medications. Twenty-six percent rated 'medication safety' better (4% worse) than at other local hospitals; in comparison, 52% of respondents rated 'quality of care' better (4% worse) than at other hospitals. A majority (79%) of patients said that a hospital staff member explained adequately the purposes of their medications, but only 49% said that they received an explanation of medication side effects that they might experience after discharge. There were no statistically significant differences in response between intervention and control groups.

In open-ended written responses, patients offered a variety of observations about medication safety. Several complained about the timeliness of in-patient medication administration (e.g. 'My medications were never on time' and 'Persistently late with pain medications on the afternoon shift'). Other patients identified problems with diabetes care (e.g. 'They sent me home with a blood sugar of 446' and 'They forgot to give me insulin for high blood sugar'). Another patient described an intercepted close-call error:

> One morning a nurse came in and got my morning pills in my hand to take. As she left, she asked how the walker was working. When I told her that it belonged to my neighbor, she was horrified and asked if I had taken my pills. She was relieved that I had not.

Nurse survey

We surveyed nurses on the study unit in order to understand how the intervention affected front-line clinicians (Table 4). Of 17 respondents, 11 (59%) were 'aware' or 'somewhat aware' of the intervention. Four (24%) said that patients and families asked more questions than usual about their medications. One nurse (6%) said that medication questions affected her workload; no one indicated that patients' questions affected their relationship with patients. Five respondents (29%) said that at least one medication error was prevented because a patient or a family member identified a drug-related problem.

Discussion

We conducted a pilot study to assess the feasibility of an intervention to prevent drug ordering and administration errors by providing in-patients with medication information.

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Table 2 Adverse drug events and close calls between intervention and control groups

	Intervention (n = 107), n (%)	Control (n = 102), n (%)	P-value[1]
Adverse drug events			
Severity level			0.09
Life-threatening	2 (1.9)	0 (0.0)	
Serious	3 (2.8)	0 (0.0)	
Significant	3 (2.8)	3 (2.9)	
Little or none	0 (0.0)	0 (0.0)	
Preventability			0.38
Definitely preventable	0 (0.0)	0 (0.0)	
Probably preventable	3 (2.8)	0 (0.0)	
Probably not preventable	4 (3.7)	2 (2.0)	
Definitely not preventable	1 (0.9)	1 (1.0)	
Serious and preventable	3 (2.8)	0 (0.0)	0.25
Total adverse drug events	8 (7.5)	3 (2.9)	0.22
Close calls			
Severity level			0.07
Life-threatening	0 (0.0)	0 (0.0)	
Serious	0 (0.0)	3 (2.9)	
Significant	5 (4.7)	7 (6.9)	
Little or none	1 (0.9)	0 (0.0)	
Intercepted versus non-			0.06
Non-intercepted	4 (3.7)	10 (9.8)	
Intercepted	2 (1.9)	0 (0.0)	
Serious and non-intercepted	0 (0.0)	3 (2.9)	0.11
Total close calls	6 (5.6)	10 (9.8)	0.30
Total adverse drug events + close calls	14 (13.1)	13 (12.7)	1.00
Combined end-point[2]	3 (2.8)	3 (2.9)	1.00

[1]Wilcoxon rank-sum test for ordinal variables and Fisher's exact test for categorical variables (i.e. serious and preventable, serious and non-intercepted, and combined end-point).
[2]Combined end-point = serious and preventable adverse drug events + serious and non-intercepted close calls.

Although one-quarter of nurses reported that medication errors were prevented because a patient or family member identified drug-related problems, there was no significant difference in the rates of adverse drug events, close calls, and self-reported experience of care between intervention patients and controls. These results provide little support for 'best practice' recommendations regarding patient participation to prevent medical errors, but the study was not powered sufficiently to demonstrate the ineffectiveness of such recommendations [1–3]. However, we showed that patients were willing to participate, that nurses found the intervention unobtrusive, and that patients and clinicians believe that patient participation in care can prevent errors.

In addition to our small sample size, several limitations of this pilot study may explain a negative result, and be relevant to the design of future studies. Firstly, the treatment effect may have been diluted by providing drug safety information to both intervention and control groups. Although we hypothesized that personalized medication lists would influence the behavior of intervention patients, it is possible that general drug safety information provided to both groups had the larger impact. Also, clinicians cared for both intervention patients and controls, so the presence of study materials at the bedside and changes in intervention patients' behavior may have elicited a common clinician response. Since front-line clinicians were not blinded to patient assignment, the treatment effect would be blunted if the study increased the general attentiveness and responsiveness of clinicians to medication problems reported by all patients on the unit, or if it altered clinicians' documentation and incident reporting. Randomization by nurse or unit might have mitigated this problem.

Secondly, many patients with an acute illness, cognitive impairment, and few available family and friends were unable to enroll in the study. These patients may be particularly susceptible to adverse drug events. We suspect that some patients who enrolled were unable to use the medication list effectively to prevent errors for these same reasons. Furthermore, we did not pre-test the intervention materials to assess their readability, nor did we assess patients' medical literacy. Careful selection of the study population for their ability to participate and pre-testing of intervention materials is recommended.

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Table 3 Patient survey

	Intervention (n = 88), n (%)	Control (n = 85), n (%)	P-value[1]
1. Were you aware of any mistakes related to your medications?			1.00
Yes	10 (11.4)	9 (10.6)	
No	71 (80.7)	67 (78.8)	
Don't know	7 (8.0)	9 (10.6)	
2. Did you have any serious problems or bad reactions to your medications?			0.19
Yes	11 (12.5)	5 (5.9)	
No	75 (85.2)	77 (90.6)	
Don't know	2 (2.3)	3 (3.5)	
3. How would you rate 'medication safety' at your hospital compared with other local hospitals?			0.95
Better	23 (26.1)	22 (25.9)	
About the same	31 (35.2)	27 (32.1)	
Worse	4 (4.5)	3 (3.6)	
Don't know	30 (34.1)	32 (38.1)	
4. How would you rate the quality of care at your hospital compared with other local hospitals?			0.19
Better	49 (56.3)	40 (47.1)	
About the same	15 (17.2)	23 (27.1)	
Worse	4 (4.6)	2 (2.4)	
Don't know	19 (21.8)	20 (23.5)	
5. Did someone on the hospital staff tell you about medication side effects to watch for in the hospital or when you went home?			0.55
Yes	41 (47.7)	43 (51.2)	
No	35 (40.7)	37 (44.0)	
Don't know	10 (11.6)	4 (4.8)	
6. Did someone on the hospital staff explain the purpose of the medications you were to take in the hospital or at home in a way you could understand?			0.12
Yes	73 (83.0)	63 (75.0)	
No	12 (13.6)	20 (23.8)	
Don't know	3 (3.4)	1 (1.2)	

[1]Fisher's exact test.

Thirdly, the intervention may have been too weak. Providing an updated medication list daily may have strengthened the intervention by reminding the patient about the list and by removing the onus from the patient for tracking daily changes. Providing photographs of pills, information about drug-specific side effects, or telephone access to a hospital pharmacist might prove more useful to patients than a medication list alone.

Fourthly, our strategy for identifying adverse events may have been inadequate to identify drug administration errors. These errors are common among in-patients, but potentially difficult to detect. If few drug administration errors were intercepted by other clinicians, then there may be little documentation to help investigators ascertain these events. In fact, if our patient partnership intervention affected administration errors related to wrong drug, dose, patient, and administration time, this may explain why nurses viewed the intervention favorably despite a null result.

Although our study does not provide evidence for the efficacy of providing drug safety information and a medication list to medical in-patients, we believe that this remains a promising strategy for reducing medical errors. Our study offers insights into the design of interventions that might, more effectively enlist patient participation in patient safety improvement. Many patients have a limited capacity to partner with clinicians to reduce medical errors. Indeed, half of the in-patients on the study unit were unable or unwilling to enroll due to the acuity or severity of illness, cognitive impairment, and abbreviated length of stay. Interventions that rely on patient and family participation may be more effective in

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Table 4 Nurse survey (n = 17/23)

	n	%
1. Were you aware that some patients on your unit received medication safety information and copies of their medication sheet?		
Yes	8	47.1
Somewhat	2	11.8
No	7	41.2
2. Approximately how many medication errors were prevented because a patient of yours or a family member identified a problem related to their medications?		
None	6	35.3
1–5	5	29.4
Don't know	6	35.3
3. Did you perceive that patients and their families asked more questions than usual about their medications?		
More	4	23.5
No change	13	76.5
Fewer	0	0.0
4. How did patients' questions about their medications affect your workload?		
Increased	1	5.9
No change	16	94.1
Decreased	0	0.0
5. How did patients' questions about their medications affect your relationship with your patients?		
Improved	0	0.0
No change	17	100.0
Detracted	0	0.0
6. How would you rate 'medication safety' at your hospital compared with other local hospitals?		
Better	6	35.3
About the same	5	29.4
Worse	0	0.0
Don't know	6	35.3
7. Do you think that giving patients medication safety information and copies of their medication lists affects patient safety?		
Safer	8	47.1
No change	4	23.5
Less safe	0	0.0
Don't know	5	29.4

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populations with few comorbid illnesses (e.g. labor and delivery, elective surgery), with reliable family involvement (e.g. pediatrics), and with satisfactory functional status (e.g. ambulatory care). Participation rates may increase if the intervention itself is easily understood and acted upon. For example, our intervention might have been more successful if we had pretested patients' understanding of the material and provided patients with information about drug-related side effects and administration times.

In addition, we should design interventions to target vulnerabilities in the health care delivery system. Since medication errors occur throughout the hospitalization, medication safety interventions should be initiated early in the admission. For example, using patient advocates in the emergency department and implementing policies that require reconciliation of home and in-patient medications may ensure appropriate dosing, timing, and recognition of allergies [19].

As we design new and improved patient partnership interventions for patient safety, we must identify activities to which patients are well suited [23]. Consumer surveys provide compelling evidence of patients' ability to identify deficiencies in the quality of in-patient care [5, 6]. In primary care practices, patients reported at least six times as many adverse drug events as identified on chart review [24, 25]. Similarly, 9% of

medicine in-patients in our study identified serious problems or reactions due to medications. A promising area of research is to determine whether hospitalized patients' real-time incident reports identify significant preventable and ameliorable adverse drug events.

In conclusion, partnering with in-patients to prevent adverse drug events is an attractive and feasible strategy, but requires further study to document its efficacy.

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Appendix

Preventing medication errors in the hospital: What can YOU do?

Medication errors are common, even in the best hospitals. Studies show that up to 7% of patients are injured because of accidents with prescribed drugs.

The doctors, nurses, and pharmacists who take care of you will do everything they can to keep you safe during your hospital stay. But they need your help. You and your family can prevent medication errors:

- Tell your doctors about **all the drugs that you take at home** including prescription medicines and over-the-counter drugs, herbs, and vitamins.
- Tell your doctors about any past **allergies or reactions** to medications.
- **Keep a list** of all the medicines that you receive in the hospital. Include the dose and time you take each one. Some medications are taken on a regular schedule. Others are used 'as needed' (for pain or nausea, for example).
- If you don't **know the reason** you are taking a particular medication, ask someone to explain it to you.
- Ask your doctor to tell you about **possible side effects** of new medications so that you can recognize problems right away.
- **When you take a medication** (by mouth, injection, or intravenous), **ask your nurse what it is and what it is for.** This is a way to prevent accidental mix-ups and mistakes.
- Ask your doctor or nurse to tell you **how to get help** if you have a bad reaction to a medication.
- When you are **discharged from the hospital**, make sure that you receive a list of your medications. The list should include the dose and time to take each drug. You should also receive new prescriptions if needed, and information about what to do if you have problems at home.

Medication safety is everyone's top job. Together, we can reduce medication errors and create a safer health care system.

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