Engaging hospital patients in the medication reconciliation process using tablet computers

Jennifer E. Prey,1 Fernanda Polubriaginof,1 Lisa V. Grossman,1,2 Ruth Masterson Creber,3 Demetra Tsapepas,4,5 Rimma Perotte,1,4 Min Qian,6 Susan Restaino,4,7 Suzanne Bakken,1,3 George Hripcsak,1,4 Leigh Efird,4 Joseph Underwood,4,7 and David K. Vawdrey1,4

1Department of Biomedical Informatics, Columbia University, New York, New York, USA, 2Columbia University College of Physicians and Surgeons, New York, New York, USA, 3School of Nursing, Columbia University, New York, New York, USA, 4Value Institute at NewYork-Presbyterian Hospital, New York, New York, USA, 5Department of Surgery, Columbia University, New York, New York, USA, 6Department of Biostatistics, Columbia University, New York, New York, USA, and 7Department of Medicine, Columbia University, New York, New York, USA

Corresponding Author: Jennifer E. Prey, Department of Biomedical Informatics, Columbia University, 622 W. 168th St. PH-20, New York, NY 10032, USA (jep2175@columbia.edu)

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ABSTRACT

Objective: Unintentional medication discrepancies contribute to preventable adverse drug events in patients. Patient engagement in medication safety beyond verbal participation in medication reconciliation is limited. We conducted a pilot study to determine whether patients’ use of an electronic home medication review tool could improve medication safety during hospitalization.

Materials and Methods: Patients were randomized to use a tool before or after hospital admission medication reconciliation to review and modify their home medication list. We assessed the quantity, potential severity, and potential harm of patients’ and clinicians’ medication changes. We also surveyed clinicians to assess the tool’s usefulness.

Results: Of 76 patients approached, 65 (86%) participated. Forty-eight (74%) made changes to their home medication list before: 29 (81%), after: 19 (66%), p = .170. Before group participants identified 57 changes that clinicians subsequently missed on admission medication reconciliation. Thirty-nine (74%) had a significant or greater potential severity, and 19 (36%) had a greater than 50-50 chance of harm. After group patients identified 68 additional changes to their reconciled medication lists. Fifty-one (75%) had a significant or greater potential severity, and 33 (49%) had a greater than 50-50 chance of harm. Clinicians reported believing that the tool would save time, and patients would supply useful information.

Discussion: The results demonstrate a high willingness of patients to engage in medication reconciliation, and show that patients were able to identify important medication discrepancies and often changes that clinicians missed.

Conclusion: Engaging patients in admission medication reconciliation using an electronic home medication review tool may improve medication safety during hospitalization.

Key words: patient engagement, medication reconciliation, medication safety, patient-centered care, information technology
BACKGROUND AND SIGNIFICANCE

Unintentional medication discrepancies, defined as differences in documented medication regimens across different care sites, contribute substantially to adverse drug events (ADEs) in hospitalized patients.1–4 The most common cause of preventable ADEs is unintentional discrepancies in the admission medication list.1,5,6 Studies demonstrate that 48% to 87% of emergency department (ED) patients’ medication lists contain one or more discrepancies,7,8 and 22% to 54% still contain discrepancies on hospital admission.1,6,9 To avoid unintentional discrepancies and prevent ADEs, the Joint Commission has designated medication reconciliation at admission, transfer, and discharge, a National Patient Safety Goal since 2005.10 Medication reconciliation is the process of systematically reviewing a patient’s complete medication regimen to ensure its accuracy.11

Medication reconciliation is challenging to implement successfully in general practice.12 The reconciliation process is complex and error prone, particularly if patients’ medication histories are unavailable, located in different systems, or contradictory.13 While the process to take a standardized medication history has been established,14 studies suggest that a thorough approach to medication reconciliation is time consuming, and may take an hour or more per patient.15 The process relies heavily on verbally confirming the medication list with the patient, and 40% to 60% of in-hospital medication errors result from poor communication during reconciliation.7,16,17

In the ambulatory care setting, the positive impact of medication management interventions through online patient portals is well documented.18–31 Previous studies have provided patients with their medication lists,18–29 empowered patients to communicate medication-related information to their providers,18–28 and allowed patients to refill prescriptions online.19,30 Such interventions have reduced medication discrepancies19,27,28 prevented ADEs,22,26,28,29 and improved medication safety.19,22,26–29

Despite the success of patient engagement in medication safety in the ambulatory setting, patient engagement beyond verbal participation in medication reconciliation remains limited in the acute care setting. Interventions to improve medication reconciliation in the hospital generally focus on providers’ practices, rather than patients.32–34 Interventions that do facilitate accurate collection of medication data from patients generally focus on the home setting.12,33,35–38

OBJECTIVE

In this work, we conducted a pilot study to investigate whether an electronic home medication review tool can engage patients in the medication reconciliation process and allow them to contribute information to their home medication lists upon hospital admission. Patients with varied health and technology literacies reviewed their home medication lists either before or after the admitting team completed medication reconciliation. We evaluated the quantity, potential severity, and potential harm of the changes that patients suggested, in comparison with their clinicians’ changes. Using surveys, we assessed the tool’s potential usefulness to the admitting clinicians.

MATERIALS AND METHODS

Study design

We recruited patients from the ED of a large urban academic medical center. First, we identified and consented patients designated for hospital admission who had not yet completed admission medication reconciliation. Participants completed a baseline patient survey to assess their demographic characteristics, technology literacy, health literacy, patient activation level, and illness severity. Then, we randomly assigned participants to use the electronic home medication review tool before or after their admitting team completed the admitting medication reconciliation. Afterwards, we accessed participants’ medical records to determine what changes the admitting team made to their home medication lists. Clinicians who cared for before group participants completed a survey about the intervention’s usefulness. The medical center’s Institutional Review Board approved the study.

Intervention

To access the internally developed home medication review tool and complete their medication reconciliation process, participants used an Apple iPad (Wi-Fi 16GB, Apple Inc., Cupertino, California) provided by the research coordinator. The tool displayed their home medication list, including the medication name, dose, route, and frequency (Figure 1a), automatically populated from the medical center’s live electronic health record (EHR) (Allscripts Sunrise Clinical Manager). The EHR system is unified across the hospital system, allowing for inpatient and ED visits to access the same medication lists. Participants selected Yes, No, or Not Sure as to whether they were currently taking each medication listed. In a free-text box, participants could record any medications missing from their lists. The system interface was designed simply, with patients of all health literacy levels in mind. The design implemented was the same used in an application developed for a randomized clinical trial that focused on patient engagement, which was successfully used by patients of all literacy levels.39 Additionally, the research coordinators were available throughout the process to answer any questions.

Recruitment

Inclusion and Exclusion Criteria: We included English-speaking adult patients aged 18 years or older. We excluded patients with a history of cognitive impairment and acutely ill patients unable to participate in the study.

Recruitment Protocol: The research coordinator recruited participants from new arrivals to the ED that occurred between 9 am and 6 pm. Participants agreed to use the home medication tool and granted permission to access to their medical records. After providing written informed consent, participants completed the baseline patient survey. Then, the coordinator used stratified randomization to assign participants to the before or after group (Figure 1b). We used 3 strata based on participants’ home medication list: 1) no medications listed, 2) 1 to 5 medications listed, and 3) 6 or more medications listed. The coordinator conducted a brief training session to familiarize the participant with the tool. We encouraged participants to seek assistance from family, friends, or outside healthcare providers, available in person or by phone, to provide accurate information. Participants were compensated $10 for their time, typically around 15 minutes, received upon study completion.

Before group participants used the tool while in the ED. They reviewed their home medication list from previous ambulatory, emergency, or inpatient visits as documented in the medical record. After they used the tool, the coordinator provided them with a brightly colored printout detailing their responses. The coordinator encouraged participants to share the printout with their admitting team to aid medication reconciliation.
After group participants used the tool one day after hospital admission. They reviewed the home medication list their admitting team created during medication reconciliation and documented in the medical record.

Clinician Recruitment: The coordinator contacted attending physicians, fellows, residents, and physician assistants (PAs) who had cared for before group study participants and asked them to complete the clinician survey.

Data collection
The medication review tool stored all patient-provided and system usage data on a secure research server. The coordinator administered the patient survey via a secure online survey tool (Qualtrics LLC, Provo, Utah). Clinicians completed their survey online through the same survey tool. We accessed participant’s medical records from the clinical data warehouse at our institution. The coordinator followed specific protocols to ensure consistency in data collection.

Measurements
Patient Survey: We collected information about demographics, socioeconomic status, and technology literacy using our previously described patient survey.39 We used Chew and colleagues’ 3-item questionnaire to screen participants for inadequate health literacy.40 We used the 13-item Patient Activation Measure (PAM) to assess patient activation,41–47 a tool we have previously validated in the acute care setting.48 Patient activation refers to patients’ knowledge, skills, and confidence in managing their health and healthcare. The PAM categorizes patients into 1 of 4 activation levels: 1) disengaged and overwhelmed, 2) becoming aware, but still struggling, 3) taking action, 4) maintaining behaviors and pushing further. We assessed illness severity using the Emergency Severity Index (ESI), ranging from level 1 (most urgent) to level 5 (least urgent).49

Patient Medication Changes: We classified patients’ changes to their home medication lists as additions, deletions, and modifications. We assessed the potential harm and potential severity of each change if it had gone unreported.5 The potential harm scale uses 6 levels, from “little to no confidence” to “virtually certain confidence.” The potential severity scale uses 4 levels, “insignificant,” “significant,” “serious,” and “life-threatening.” We used patients’ medical record information to determine which changes went uncorrected, or unaddressed by the admitting team.

Clinician Survey: The survey asked clinicians whether they received the brightly colored printout from patients, and clinicians answered 3 questions about the intervention’s potential usefulness. The 3 questions included 1) Do you think the tool will be useful? 2) Do you think the changes patients report through the tool will be accurate? 3) Do you think the tool will save you time? Clinicians who reported not receiving the printout were asked to report their beliefs on the potential usefulness, accuracy, and impact on time to
complete admitting medication reconciliation if they had been provided with a patient-generated review first. In addition, the survey asked clinicians to report their role type (attending, fellow, resident, PA) and time in the role (<1 year, 1-2 years, ≥2 years).

**Clinician Medication Changes:** We used participants’ medical record information to assess the admitting team’s changes to participants’ home medication lists on admission. As with patient changes, we classified clinician changes as additions, deletions, and modifications, and assessed the potential harm and potential severity of each change.

**System Usage Log:** To determine how long participants needed to complete their home medication reviews, we recorded each user action in a detailed system usage log.

**Data analysis**
We analyzed all data using Stata SE version 14.0 and R version 3.3.3.56,57 We conducted descriptive analyses of patient and clinician survey results. We compared patients’ baseline characteristics between groups using 2-sample t tests for continuous variables and Pearson’s chi-squared or Fisher’s exact tests for categorical variables.

We conducted descriptive analyses of patient and clinician medication changes, including frequency, type, and average number of changes. To evaluate the impact of the use of the tool on the medication reconciliation process at different points in time during the patients’ hospitalization, we assessed differences between the before and after groups using 2-sample z tests for proportions, Wilcoxon rank-sum analyses, and Pearson’s chi-squared or Fisher’s exact tests. To determine the correlation between baseline characteristics and total number of patient medication changes, we used linear regression and Spearman rank correlation for ordinal characteristics and pairwise correlation analysis for continuous variables. Within the before group, we evaluated differences between patient and clinician medication changes using McNemar’s test for paired proportions, Wilcoxon signed-rank analyses, and Pearson’s chi-squared or Fisher’s exact tests. Within the after group, we did not compare patient and clinician medication changes because the patients and clinicians modified different home medication lists. Specifically, patients in the after group modified the list that the admitting team had already modified.

Two pharmacists independently coded each patient and clinician medication change to assign potential harm and potential severity.58 We conducted 1 round of inter-rater agreement using a weighted Cohen’s Kappa. For patient medication changes, agreement was 90.0% (κ = 0.694) for potential harm and 90.1% (κ = 0.643) for potential severity. For clinician medication changes, agreement was 91.7% (κ = 0.715) for potential harm and 90.9% (κ = 0.647) for potential severity. We resolved discrepancies in assignment using averaging.

**RESULTS**

**Study population**
Of the 76 patients approached, 65 consented to and completed the study, while 11 (15%) declined to participate. The before group contained 36 participants, and the after group contained 29. Table 1 describes participants’ baseline characteristics. On average, study participants were 49 years old (range: 20-88). Participants were 38% Black and 42% Latino, and 14% preferred Spanish. Overall, 79% of participants reported access to the Internet, and 57% reported access to a desktop, laptop, or tablet.

**Patient medication changes**
Overall, 48 (74%) participants suggested changes to their medication lists using the electronic tool, with an average of 2.57 suggested changes per patient (range 0-13; Table 2). Participants spent a median of 1.7 minutes (IQR 0.8-4.4), or on average 3 minutes, completing their home medication reviews using the tool. Three participants (5%) reported being Not Sure about 1 or more medications displayed on their lists. No significant differences existed between the before and after groups.

In the before group, 57 (58%) patient medication changes went unreconciled, or unaddressed by the admitting team. Thirty-nine (74%) unreconciled changes had a level 2 (significant) or higher potential severity, and 24 (45%) had a level 4 (greater than 50-50 chance) or higher potential harm (Table 3; Figures 2a and b). In the after group, patients made 68 additional changes to their already-reconciled medication lists. Fifty-one (75%) unreconciled changes had a level 2 (significant) or higher potential severity, and 33 (49%) had a level 4 (greater than 50-50 chance) or higher potential harm.

Both patients and clinicians made changes with a broad range of potential severities and potential harms. No significant differences existed in the distributions of potential severity (p = .662) or potential harm (p = .576) of patients’ versus clinicians’ changes. Patients and clinicians identified similar numbers of changes with a potential harm level of 4 to 6, but patients tended to identify more changes with a potential harm level of 1 to 3 than clinicians, although nonsignificant (p = .126).

The total number of patient medication changes was positively correlated with age (r = 0.30, p < .001), number of home medications (r = 0.32, p < .001), and previous tablet use (r = 0.366, p = .010). This suggests that older patients with more medications and tablet users make more medication changes. Patient activation and health literacy level were not associated with the number of patient medication changes.

In the before group, only 1 clinician viewed the patient’s suggested changes prior to admission medication reconciliation (see Clinician Survey section), and clinicians made changes to the same home medication lists as patients. Therefore, we compared patients’ and clinicians’ changes in the before group (Table 4). Significantly more patients than clinicians made one or more changes to the medication list (p = .021). Twenty-nine (81%) patients changed their lists, whereas clinicians changed only 20 (56%) patients’ lists.

**Clinician medication changes**
On average, clinicians made 2.11 changes to patients’ home medication lists on admission (range 0-15; Table 2). No significant differences existed between groups. In the before group, clinicians made 42 (42%) of the changes that patients suggested. Clinicians made an average of 1.06 changes that patients did not suggest.

**Clinician survey**
Of the 34 clinicians contacted, 20 (59%) completed the survey. Only 1 clinician reported receiving the brightly colored printout prior to admission medication reconciliation. Among respondents, 14 (70%) described the intervention as very or extremely potentially useful, 14 (70%) thought patients’ information would be moderately, very, or extremely accurate, and 16 (80%) agreed the invention would save them time (Figure 2c). No significant differences existed based on role type or experience.
This study used an electronic home medication review tool to pilot engaging patients in the hospital admission medication reconciliation process in a high-volume urban ED. There was a high willingness of patients to participate in medication reconciliation, and participation was completed in a short amount of time. While the time commitment required was brief, we found participants could identify multiple medication discrepancies, many with a greater than 50-50 chance of harm, and were often discrepancies that clinicians did not make during their reconciliation. Clinicians reported a
### Table 2. Patient and clinician medication changes

| Variable | Overall (n = 65) | Before (n = 36) | After (n = 29) | p-value |
|----------|------------------|-----------------|----------------|---------|
| **Patient medication changes** | | | | |
| Number of patients who made changes | 48 (73.8%) | 29 (80.6%) | 19 (65.5%) | .170 |
| Average number of changes per patient | 2.57 (2.88) | 2.75 (2.73) | 2.34 (3.10) | .310 |
| Additions | 1.14 (2.39) | 1.36 (2.52) | 0.86 (2.23) | .536 |
| Deletions | 1.09 (1.43) | 1.14 (1.42) | 0.97 (1.48) | .466 |
| Modifications | 0.37 (1.04) | 0.25 (0.87) | 0.52 (1.21) | .385 |
| Unreconciled | – | 1.58 (2.49) | – | |
| Total number of changes made | 169 | 101 | 68 | .975 |
| Additions | 74 (44.3%) | 49 (49.5%) | 25 (36.8%) | |
| Deletions | 71 (42.5%) | 43 (43.4%) | 28 (41.2%) | |
| Modifications | 24 (14.4%) | 9 (9.1%) | 15 (22.1%) | |
| Number of patients who received changes | 36 (55.4%) | 20 (55.6%) | 16 (55.2%) | |
| Average number of changes per patient | 2.09 (2.95) | 2.28 (2.70) | 1.90 (3.27) | .529 |
| Additions | 0.87 (2.12) | 1.06 (2.33) | 0.69 (1.85) | .624 |
| Deletions | 1.11 (1.74) | 1.11 (1.56) | 1.10 (1.97) | .710 |
| Modifications | 0.11 (0.31) | 0.11 (0.32) | 0.10 (0.31) | .562 |
| Total number of changes received | 137 | 82 | 55 | |
| Additions | 58 (42.3%) | 38 (46.3%) | 20 (36.4%) | |
| Deletions | 72 (52.6%) | 40 (48.8%) | 32 (58.2%) | |
| Modifications | 7 (5.1%) | 4 (4.9%) | 3 (5.5%) | |

### Table 3. Potential severity and potential harm

| Variable | Overall (n = 65) | Unreconciled (n = 36) | Before (n = 36) | After (n = 29) | p-value |
|----------|------------------|-----------------------|-----------------|----------------|---------|
| **Patient medication changes** | | | | | |
| Average potential severity | 1.16 (0.77) | 1.01 (0.73) | 1.09 (0.69) | 1.26 (0.86) | .308 |
| Potential severity | | | | | |
| Level 0 (insignificant) | 36 (22.2%) | 14 (26.4%) | 20 (21.1%) | 16 (23.9%) | .172 |
| Level 1 (significant) | 91 (56.2%) | 31 (58.5%) | 59 (62.1%) | 32 (47.8%) | .060 |
| Level 2 (serious) | 28 (17.3%) | 7 (13.2%) | 14 (14.7%) | 14 (20.9%) | .710 |
| Level 3 (life-threatening) | 7 (4.3%) | 1 (1.9%) | 2 (2.1%) | 5 (7.5%) | .562 |
| Average potential harm | 3.44 (1.44) | 3.09 (1.47) | 3.38 (1.37) | 3.53 (1.54) | .558 |
| Potential harm | | | | | |
| Level 1 (little or no confidence) | 26 (16.0%) | 13 (24.5%) | 16 (16.8%) | 10 (14.9%) | .100 |
| Level 2 (slight to modest confidence) | 25 (15.4%) | 9 (17.0%) | 14 (14.7%) | 11 (16.4%) | |
| Level 3 (< 30–50 but close call) | 27 (16.7%) | 7 (13.2%) | 14 (14.7%) | 13 (19.4%) | |
| Level 4 (> 30–50 but close call) | 54 (33.3%) | 19 (35.8%) | 39 (41.1%) | 15 (22.4%) | |
| Level 5 (strong confidence) | 20 (12.3%) | 2 (3.8%) | 8 (8.4%) | 12 (17.9%) | |
| Level 6 (virtually certain confidence) | 10 (6.2%) | 3 (5.7%) | 4 (4.2%) | 6 (9.0%) | |
| **Clinician medication changes** | | | | | |
| Average potential severity | 1.12 (0.69) | – | 1.10 (0.62) | 1.15 (0.78) | .905 |
| Potential severity | | | | | |
| Level 0 (insignificant) | 28 (20.7%) | – | 15 (18.5%) | 13 (24.1%) | .060 |
| Level 1 (significant) | 84 (62.2%) | – | 57 (70.4%) | 27 (50.0%) | |
| Level 2 (serious) | 20 (14.8%) | – | 8 (9.9%) | 12 (22.2%) | |
| Level 3 (life-threatening) | 3 (2.2%) | – | 1 (1.2%) | 2 (3.7%) | |
| Average potential harm | 3.64 (1.31) | – | 3.62 (1.22) | 3.69 (1.44) | .497 |
| Potential harm | | | | | |
| Level 1 (little or no confidence) | 17 (12.6%) | – | 9 (11.1%) | 8 (14.8%) | .147 |
| Level 2 (slight to modest confidence) | 15 (11.1%) | – | 8 (9.9%) | 7 (13.0%) | |
| Level 3 (< 30–50 but close call) | 14 (10.4%) | – | 11 (13.6%) | 3 (5.6%) | |
| Level 4 (> 30–50 but close call) | 66 (48.9%) | – | 44 (54.3%) | 22 (40.7%) | |
| Level 5 (strong confidence) | 18 (13.3%) | – | 7 (8.6%) | 11 (20.4%) | |
| Level 6 (virtually certain confidence) | 5 (3.7%) | – | 2 (2.5%) | 3 (5.6%) | |

Averages reported as mean (SD), categorical variables reported as n (%). Percentages adjusted to account for missing data.
belief that the intervention would save them time, and that patients would report useful information. These data suggest that obtaining patient-reported medication information electronically may facilitate the medication reconciliation process and potentially improve patient safety during hospitalization, and is acceptable to both patients and clinicians.

Integrating patient-reported information into the clinical workflow remains challenging. In our study, only provider reported receiving the brightly colored printout containing patient-reported medication changes. Patients may have felt uncomfortable giving providers the printout, forgotten about it, or not known to whom it should be given. Even if providers had received the printout, it is not
clear whether they would use the information it contained. Staroselsky and colleagues found that emailing physicians about patient-reported medication discrepancies had no effect. Future work should design and evaluate strategies to better incorporate patient-reported medication information into the clinical workflow, potentially through integration with the electronic medical record, so that providers may easily utilize it.

Successful medication reconciliation interventions often employ pharmacists. A 2016 systematic review found that pharmacist-led reconciliation processes prevented discrepancies and potential ADEs at hospital admission. However, pharmacists’ time is a limited and costly resource. Patient-centered medication reconciliation interventions, such as the intervention used in our study, may supplement pharmacist-led or physician-led interventions to save time and achieve better outcomes. The National Academy of Medicine (formerly the Institute of Medicine) promotes patient-centered interventions as central to learning health systems, or systems that generate the best evidence for patients’ and providers’ collaborative choices. Although some studies have already integrated pharmacist-led and patient-centered interventions opportunity remains to investigate the impact of these multi-level, combined interventions on patient safety.

Work involving the engagement of patients is often viewed hesitantly, as providers often believe that patients do not always know enough to contribute to their clinical care. Only 2 (10%) providers thought that patients’ information would be very or extremely accurate. Providers’ belief that patients cannot accurately report their medications contrasted sharply with their patients’ actions, as the majority of participants’ suggested changes to their medication lists were often changes evaluated to be potentially severe and causing potential harm, and only 3 participants (5%) reported feeling “unsure” about 1 or more medications on their lists. Previous research at Geisinger Health System found that most patients (89%) who submitted feedback through their portals requested changes to their medication lists. These data suggest that patients possess the knowledge and desire to participate in medication reconciliation, and will take an active role given the opportunity. Future work should explore additional opportunities to engage patients with their medication lists in the acute care setting in general, and analyze the accuracy of patient-reported medication discrepancies and the source of providers’ concerns about accuracy.

In our study, pharmacists found that patients identified numerous medication discrepancies with potential for serious harm. This result is consistent with Schnipper and colleagues’ finding that patient portal use significantly decreased medication discrepancies with potential for serious harm. Heyworth and colleagues piloted the “Secure Messaging for Medication Reconciliation Tool” (SMMRT) with 60 patients after hospital discharge. The patients identified 23 potential ADEs, with 13 classified as serious. Tools within patient portals, such as SMMRT and our review tool, stand to improve medication safety during transitions of care. Our study focused on the outpatient-to-inpatient transition, which the Joint Commission recognizes as a critical time to complete accurate medication reconciliation.

Interestingly, patients’ participation before or after the admitting team completed medication reconciliation did not significantly impact the number of patient medication changes. Furthermore, patients made changes to their medication lists that the admitting team did not, and vice versa. As this comparison was performed using information from different time points during the patients’ hospitalization, we expected the number of medication changes to be smaller in the after group, since the clinical team had completed the medication reconciliation. One potential reason for these unexpected results may be the admitting team’s focus on medications related to the admitting diagnosis. For example, a hospital team admitting a heart failure patient might not modify that patient’s documented psychiatric medications. Future work should explore why patients and providers make different changes to the lists. Additional data to collect include the classification of patient medication changes as related or unrelated to the admitting diagnosis, medication categories, and

### Table 4. Comparison of before group patient and clinician medication changes

| Variable | Patient changes (before group) | Clinician changes (before group) | p-value |
|----------|--------------------------------|---------------------------------|---------|
| Number of patients who made or received changes | 29 (80.6%) | 20 (55.6%) | .021* |
| Average number per patient | 2.75 (2.73) | 2.28 (2.70) | .140 |
| Additions | 1.36 (2.52) | 1.06 (2.33) | .546 |
| Deletions | 1.14 (1.42) | 1.11 (1.36) | .539 |
| Modifications | 0.25 (0.87) | 0.11 (0.32) | .245 |
| Average potential severity | 1.09 (0.69) | 1.10 (0.62) | .570 |
| Potential severity | | | |
| Level 0 (insignificant) | 20 (21.1%) | 15 (18.5%) | .662 |
| Level 1 (significant) | 59 (62.1%) | 57 (70.4%) | |
| Level 2 (serious) | 14 (14.7%) | 8 (9.9%) | |
| Level 3 (life-threatening) | 2 (2.1%) | 1 (1.2%) | |
| Average potential harm | 3.38 (1.37) | 3.62 (1.22) | .902 |
| Potential harm | | | |
| Level 1 (little or no confidence) | 16 (16.8%) | 9 (11.1%) | .576 |
| Level 2 (slight to modest confidence) | 14 (14.7%) | 8 (9.9%) | .576 |
| Level 3 (< 50–50 but close call) | 14 (14.7%) | 11 (13.6%) | |
| Level 4 (> 50–50 but close call) | 39 (41.1%) | 44 (54.3%) | |
| Level 5 (strong confidence) | 8 (8.4%) | 7 (8.6%) | |
| Level 6 (virtually certain confidence) | 4 (4.2%) | 2 (2.5%) | |

Number of patients reported as n (%); averages reported as mean (SD), categorical variables reported as n (%).
Percentages adjusted to account for missing data.
* p-value significant at the .05 level.
types (eg, blood pressure-related, diabetes management, etc.) and sub-stratification of changes by prescription, over-the-counter medications, or herbal products.

As noted, the moderate association between previous tablet use and number of changes highlights the critical importance of designing robust yet simple systems to engage populations with low technology literacy. Poor usability is patients’ top complaint about portals, and better attention to system design may prevent discrepancies in engagement between populations with low and high technology literacy.

Limitations
This study assessed patients’ willingness to engage with medication reconciliation, the potential impact on medication safety, and the intervention’s potential usefulness to providers. We did not demonstrate the intervention’s efficacy or compare users to a control group of nonusers. We also did not have a gold standard medication list to compare patient and provider changes against. Additionally, patients in the after group may have been influenced by the changes that their admitting team made to their medication lists. Future work should determine the efficacy of patient-centered medication reconciliation interventions prior to hospital admission, as well as analyze the accuracy of patient-provided changes. Our study excluded patients with acute illness and cognitive impairment, despite evidence that these patient populations experience more ADEs. Future work should explore strategies to engage these patient populations, such as contacting healthcare proxies.

We conducted our study at a large academic medical center with an advanced informatics infrastructure, which may limit its generalizability. Our intervention relied on data from an EHR system, and as has been studied, EHRs can have the unintended consequence of introducing new errors, which can then influence the data available. Additionally, we sourced the home medication list solely from our institution’s EHR. Interfaces with outside sources, such as outpatient visits and insurance claims databases, may provide a more comprehensive list for both patients and clinicians to review.

Our sample included only 65 patients, which potentially limited our power to detect differences between groups. The modest difference in the level of education between the 2 groups could have impacted how they used the tool. We did not collect patient measures such as comprehensive medication knowledge or confidence with patient-provider communication, which could have provided additional insight. Our Kappa metrics for agreement on potential severity and harm lay between 0.6 and 0.7. Standardized measures for usefulness and acceptability in the clinician survey may also have provided additional insight.

CONCLUSION
This study engaged hospital patients in admission medication reconciliation using an electronic home medication review tool. Participants identified potentially serious and harmful changes that clinicians missed on admission medication reconciliation, suggesting that patient engagement in medication reconciliation may improve medication safety. Future work should explore additional opportunities to engage patients with medication safety in the acute care setting, including combined patient-centered and pharmacist-led interventions.

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CONTRIBUTORS
All authors contributed extensively to the work presented in this manuscript, including the generation of content for and the revision of the manuscript. J.E.P., F.P., and D.K.V. conceptualized and designed the study. J.E.P. and F.P. performed recruitment. J.E.P., F.P., and L.V.G. performed data analysis. J.E.P. wrote the original manuscript, and L.V.G contributed to significant revisions and additions for the final draft. All authors provided expertise and feedback.

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