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Linking Technology to Address the Social and Medical Determinants of Health for Safe Medicines Use

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Objectives: Both social and medical factors can negatively affect health outcomes, especially in vulnerable populations. To address these 2 types of factors in a postdischarge population, 2 nonprofit organizations collaborated to combine their novel decision support programs and address the question: Could combined programs have greater potential for improved health outcomes?

Methods: HomeMeds, a social health program in which trained social services staff make home visits to vulnerable clients, was combined with MedSafety Scan, a medical health, clinical decision support tool. Data captured in the home visits were entered into the HomeMeds and MedSafety Scan programs to detect those patients at the greatest risk of adverse health outcomes because of medications.

Results: Patients (n = 108; mean age, 77 years; multiple comorbidities and LACE+ (length of stay, acuity, comorbidities, emergency department visits [hospital index]; score >29) received a postdischarge home visit by trained social services staff. The number of drugs reported as being taken was 10.4 ± 5.1 (range, 1–26), which was less than prescribed at discharge in 62% of patients (range, 1–8). Both programs detected a serious risk of medication-induced harm, mostly from different causes such as drug-drug interactions or for use not recommended in the elderly.

Conclusions: Combined analysis of data from 2 novel decision support programs yielded complementary findings that together address both medical and social determinants of health. These have the potential to reduce medication-induced harm, costly rehospitalization, and/or emergency department visits and support the further evaluation of this combined approach in other vulnerable populations such as the seriously mentally ill, frail, those confined to home, opioid dependent, or otherwise impaired.

Key Words: home, health, medication errors, drug safety, social determinants, clinical decision support

In the 1990s, reports of medication-induced deaths[1] were the focus of several books[2,3] and white papers including 2 series of publications from the Institute of Medicine, "To Err Is Human"[4] and the "Quality Chasm Series."[5,6] After a series of hearings, in 1997 Congress authorized the federal Agency for Healthcare Research and Quality to fund a network of centers[7] that grew to include 14 Centers for Education and Research on Therapeutics (CERTs). The CERTs independently conducted research and education programs to reduce the growing number of patients being harmed by medications and their misuse.[8] One of these centers, now the nonprofit Arizona CERT (AZCERT), focused on prevention of drug-drug interactions, especially those that can precipitate arrhythmias and sudden death.[9] In 2017, with funding from the Food and Drug Administration's Safe Use of Medicines program, AZCERT developed a clinical decision support technology to identify hospitalized patients who are at a high risk of harm from their medications.[9,10] In 2020, in response to a growing concern for the safety of drugs being used to treat COVID-19, AZCERT released this decision support technology as an open-access Web-based program, MedSafety Scan (MSS).[11,12]

In 1998, separately from AZCERT's work, the nonprofit Partners in Care Foundation (Partners) developed a home-based medication safety program, HomeMeds, that focuses on the social determinants of health and the improved use of medications in the home.[13] In addition to addressing social factors, this program captures a complete record of the medications actually being taken by patients. HomeMeds communicates the information gathered in the home visit to social service agencies that can respond to the patients' needs, and it reports potential medication problems to clinical pharmacists who can contact prescribers and reconcile potential problem medications.[13,14] In 2004, the Agency for Healthcare Research and Quality selected the HomeMeds program for its Health Care Innovations Exchange and rated the quality of evidence for its impact on health outcomes as "strong."[15] A randomized clinical trial of 259 Medicare patients demonstrated the ability of the HomeMeds program to improve medication use and dramatically reduce therapeutic duplication.[16] A recent retrospective cohort study using propensity score matching found that the HomeMeds program of community-based health coaches and collaborating clinical pharmacists was associated with a 50% lower rate of hospital readmissions within 30 days of discharge.[13]

The purpose of this study was to compare the findings and recommendations of HomeMeds and MSS for a randomly selected sample of high-risk patients enrolled in the HomeMeds program and evaluated after hospital discharge. The question posed in this quality improvement project is: Will the combined application of

these 2 analyses (HomeMeds and MSS) identify more opportunities to improve patient well-being and health outcomes more than either program alone?

METHODS

For this study, patients who were discharged from a network of 4 hospitals in southern California were referred to the Partners' HomeMeds program when they met any of the following criteria: a LACE+ (length of stay, acuity, comorbidities, emergency department visits [hospital index]) score >29,[17] recent (within 3 months) hospitalization for acute myocardial infarction, coronary artery bypass graft, heart failure, pneumonia, sepsis, total hip/knee replacement, cognitive challenge, or elderly living alone. The HomeMeds program includes a home visit made by a Partners' health coach, who is, by training, either a community health worker or social worker with additional training to apply observational skills that are critical to the HomeMeds process. Home visits were scheduled to occur within 72 hours after discharge from hospital or postacute skilled nursing facility (or as agreed upon by the patient) using the evidence-based Care Transitions Intervention (Coaching Model).[18] Data were analyzed for consecutive patients who enrolled in the HomeMeds program over a 60-day period.

HomeMeds is an evidence-based, in-home, medication review and multilevel intervention program that includes a computerized risk assessment and advisory process and, when deemed necessary, referral to a clinical pharmacist for review and recommendations to address potential therapeutic problems.[14] HomeMeds may include psychosocial, functional needs, and home safety assessments. The program is performed by highly trained health coaches who are competent in cultural and linguistic diversity, adept at patient engagement and knowledgeable about community social resources. Not requiring licensure, this workforce is an alternative with unique value in the rapidly changing health and social environments. The coaches' evaluations are carried out in the home and include creation of an individualized plan of care, patient education, and social services. HomeMeds may also include home safety evaluation, home modifications for fall prevention, screening for propensity to suicide, nutrition, and dietary deficits. The program can refer patients to evidence-based health self-management programs available in community settings and online. When the HomeMeds computerized analysis detects medication risk signals, a summary report is sent to a consulting clinical pharmacist for analysis and possibly recommendations for risk mitigation.

In this study, 4 bilingual (Spanish/English) health coaches from Partners made the home visits and captured data for subsequent computer entry and analysis. All had at least a bachelor's degree and a minimum of 2-week specific training by Partners in how to conduct the visits, how to execute the HomeMeds questionnaire, what environmental cues to observe, how to enter data into the HomeMeds software, Health Insurance Portability and Accountability Act compliance, and how to communicate with consulting pharmacists using an encrypted secure e-mail system.

MedSafety Scan,[11,12] developed by the nonprofit AZCERT, is a decision support platform to assist prescribers and health care providers in medication risk management.[19] It includes risk factor analysis for cardiac safety and drug-drug interaction detection to identify patients at the greatest risk of adverse drug events.[11] MedSafety Scan captures medical history information to identify patients with a high risk profile and then generates a report that includes notifications when medications and/or combinations of medicines have the potential to cause adverse events including a prolonged QT interval on the electrocardiogram (ECG), torsades de pointes arrhythmia, and/or sudden cardiac death.[20] MedSafety Scan also reports serious potential drug-drug interactions focusing on those recommended by the Center for Medicare & Medicaid Services as quality of care metrics[21,22] and serious interactions listed in the official drug label. Potential drug-drug interactions are classified by severity (scale 1–10) with a severity ≥7 considered "major"; that is, the interaction could result in death, permanent injury, hospitalization, impairment, or disability.

RESULTS

Data from 108 consecutive posthospitalization, home visits performed by Partners' health coaches (December 16, 2019, to February 15, 2020) were analyzed. The demographics of the patients referred for HomeMeds visits and selected for this analysis are summarized in Table 1. The patients ranged in age from 32 to 101 years, with a mean age of 77 years, and 91 were 65 years or older. Fifty-nine were female, and 49 were male. Sixty-four were Hispanic, 16 were Asian, and 28 were White. All patients had at least one chronic illness diagnosed: hypertension (65%), diabetes (36%, with 17% requiring insulin), atrial fibrillation (18%), hypothyroidism (13%), prior myocardial infarction (12%), congestive heart failure (7%), renal failure on dialysis (7%), or hepatic failure (3%). The number of medications prescribed per patient at the time of hospital discharge ranged from 6 to 24 (mean, 11.7 ± 5.1). At the time of the home visit, the patients reported taking an average of 10.4 ± 5.1 medications. For 4 patients, the course of medicines such as antibiotics that had been prescribed at discharge had been completed and discontinued or were no longer taken. Sixty-two percent of patients were taking from 1 to 11 fewer medicines than had been prescribed at discharge. Eight percent were taking from 2 to 7 more medications than at the time of discharge.

The findings and recommendations from the HomeMeds and MSS analyses are summarized separately in Tables 2 and 3, respectively. Review of the 108 HomeMeds reports found 24 (22%) patients had experienced recent, unreported falls. The following new symptoms were reported as having developed since hospital discharge: dizziness or vertigo, 37 (34%); dizziness on standing, 11 (10%); confusion, 27 (25%); and uncontrolled pain, 37 (34%). In 78% of HomeMeds visits, computer analysis identified the following medication concerns that prompted referral to a consulting pharmacist for evaluation: drug-induced bleeding risk, 25 (23%); improper adherence to prescribing instructions, 4 (4%); Beer's criterion[23] met for inappropriate drug for the elderly, 22 (20%); duplicate therapies, 12 (11%); and potentially serious drug-drug interactions, 25 (23%). After review of HomeMeds alerts, the consulting pharmacists recommended medical reconsideration of 1 to

TABLE 1. Patient Demographics (n = 108)

Age, mean (range), y	77 (32–101)
Sex, female/male	59/49
Diagnoses, n (%)	
Hypertension	70 (65)
Diabetes (all)	39 (36)
Congestive heart failure	35 (32)
Diabetes taking insulin	18 (17)
Atrial fibrillation	19 (18)
Hypothyroidism	14 (13)
Prior myocardial infarction	13 (12)
Renal failure	8 (7)
Liver cirrhosis	3 (3)
Medicines/person at discharge, mean ± SD	11.7 ± 5.1
Medicines/person at home visit, mean ± SD	10.4 ± 5.1

TABLE 2. Summary of HomeMeds Visit Reports

	n (%)
Recent falls reported	24 (22)
New symptoms reported since hospital discharge	
Dizziness/Vertigo	37 (34)
Dizziness on standing	11 (10)
Confusion	27 (25)
Uncontrolled pain	37 (34)
Medication risk detected	
Bleeding risk	25 (23)
Improper medicine adherence	4 (4)
Beers criterion risk for elderly	22 (20)
Duplicate therapies	12 (11)
Potential serious DDI*	25 (23)
Referral to consulting pharmacist	84 (78)
Pharmacists' recommendations	
Medical reevaluation of Rx	75 (69)
Patient education on topic	59 (55)
Psychotropic and confusion	11 (10)
Opioid use reevaluation	20 (19)

DDI, drug-drug interaction.

3 prescriptions each for 75 patients. They recommended patient education on 1 to 3 specific topics each for 59 patients. Psychotropic medications were identified as a potential cause of confusion for 11 patients, and reconsideration of opioid therapy was recommended for 20 patients.

MedSafety Scan analysis of the data collected during the home visits is summarized in Table 3. Three patients (3%) were taking 2 drugs contraindicated in the drugs' labels. Therapeutic duplications were detected in the medications being taken by 15 patients (14%). Twenty-two (20%) patients had a QT risk score ≥9, which generated warnings for a risk of excessive QT prolongation, torsades de pointes, and cardiac arrhythmias. One of these had a QT risk score of 16, the threshold for a warning of very high risk of arrhythmia. Figure 1 shows the MSS report listing the elements of the QT risk score for this patient. Three patients (3%) had a QT risk score from 12 to 15 resulting in a warning of high risk, and

TABLE 3. Summary of MSS Reports (n = 108)

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Contraindicated drug combinations, n (%)	3 (3)
Therapeutic duplications	15 (14)
Increased risk of cardiac arrhythmia (torsades de pointes), n (%)	
Very high risk (QT score ≥16)	1 (1)
High risk (QT score 12–15)	3 (3)
Moderate (QT score 9–11)	18 (17)
Recommendations for action to reduce the risk of arrhythmia, n (%)	
Change to alternative drug	8 (7)
Obtain ECG to check QTc	15 (14)
Check serum electrolytes	8 (7)
DDIs detected per patient, mean ± SD	
All serious DDIs/patient	6.2 ± 5.6
Major DDIs/patient (severity ≥7)	4.2 ± 3.9

DDIs = drug-drug interactions.
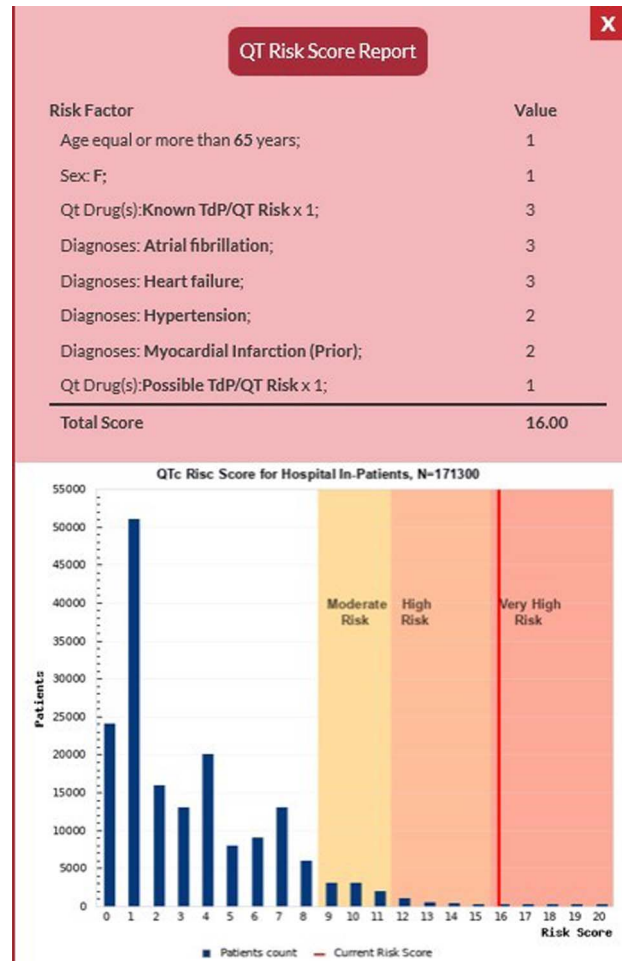
FIGURE 1. QT risk score report for patient with a very high risk of QT prolongation.

18 (17%) had a score from 9 to 12 resulting in a warning of moderate risk of arrhythmia. For these patients, MSS recommended monitoring the ECG and QT in 15 patients (15%), checking the serum electrolytes for 8 (7%), and considering an alternative drug for 8 (7%). MedSafety Scan also identified an average of 6.2 ± 5.6 potential drug interactions per patient for 88 patients, and of these, 4.2 ± 3.9 combinations per patient were considered major.

DISCUSSION

In this mostly elderly, high-risk population of patients recently discharged from hospital or rehabilitation, home visits made by trained health coaches identified serious medical conditions such as falls, dizziness, presyncope, uncontrolled pain, and confusion that had not been previously reported to the patients' health care providers. HomeMeds computerized analysis identified serious medication risk that was referred to consulting pharmacists who made recommendations for reevaluation or change in therapy for 69% of patients. By combining the HomeMeds program with MSS analysis of the drugs lists, 22 additional patients were identified who were at a high risk of harm from medications that are inappropriate for the elderly or specifically dangerous because of the patients' clinical diagnoses and overall risk profile.

Substantial differences were found between the lists of drugs in the hospital discharge orders and the medications that the patients

reported taking. The MSS and HM analyses of the lists of medications that were being taking by the patient, supplemented by information directly reported by patients in their home environment, were incorporated in the evaluations made by consulting pharmacists and more fully informed their discussions and recommendations to the patients' primary care providers.

The results of this quality improvement project confirm many prior reports of the value of community-based models that utilize trained social workers[24] who visit the home and serve as advocates, communicators, and linkages for those patients who, for one reason or another, cannot access the level of health care they need. In addition, this study demonstrates the important potential value of decision support programs that help analyze data from a home visit and coordinate the response of health care providers. The scope of work for these programs includes gathering data and making connections, referrals, and linkages that address both the medical and the social determinants of health. In addition to the assessment of conventional medical needs such as helping capture the results from patient-monitored glucose or blood pressure, they can assess the person's need for food, their inability to travel to doctors' offices or rehab services, their need for smoking cessation programs, opioid remediation, and risk assessment for suicidality, falling, or threats of violence in the home, and so on.

The health coaches who perform home visits have specific training to recognize those patients who need either health maintenance or health care interventions and must know how to connect that person with the appropriate social or health care programs. As with any health worker, they must be carefully screened and they must be trained in a new curriculum that should require for entry only a high school or bachelor's level of education, taking far less time and expense than the usual training of nurses or pharmacists. The training should include the use of checklists, preprogrammed electronic devices, and decision support tools such as HomeMeds and MSS to capture and manage the complex data that must be conveyed to health care providers. As in this project, the coaches can collect accurate medication lists and forward their computer-generated reports to pharmacists and physicians who, here-to-fore, had to perform medication reconciliation based on incomplete office records or administrative data that is out of date and incomplete.

We acknowledge some weaknesses in this quality improvement study. For this analysis, we lack outcome data on readmissions, emergency department visits, or records of actions taken by care providers after consultant pharmacists received the HM and MSS reports. However, previous randomized trials have demonstrated the value of surveillance of postdischarge medication lists[25] and the proven ability of HomeMeds to improve medication use and reduce rehospitalizations.[13,16] We believe the results of this study build on earlier results and support the potential value of further evaluation of the impact of these decision support programs on quality metrics for improved health outcomes.

CONCLUSIONS

A community-based staff trained to make home visits and equipped with culturally sensitive skills and science-based decision support tools can uncover significant and otherwise undetected medical and social needs in a vulnerable population of patients recently discharged from the hospital or rehabilitation care. The feasibility, and cost of training and operation of this combined approach deserve further evaluation in additional studies that focus on vulnerable populations. Because of the education level and focused but limited training required for health coaches, compared with nurses or pharmacists, recruitment and ramp-up should be fast and the relatively modest expense should be more than balanced by the savings incurred from reduced redundancy in health services and timely targeting of medical care and social services to those with the greatest need. Health policymakers should consider these factors and the added value of integrating software programs that, when linked, can fill gaps in both the social and medical determinants of health. To expand accessibility and utility of their software, Partners and AZCERT are partnering to offer technologies that combine the features of HomeMeds and MSS and are interoperable with most medical record systems.

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