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HOSPITAL MANAGEMENT OF DIABETES (A WALLIA AND JJ SELEY, SECTION EDITORS)

Strategies to Prevent Readmission in High-Risk Patients with Diabetes: the Importance of an Interdisciplinary Approach

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Abstract

Purpose of Review Patients with diabetes are known to have higher 30-day readmission rates compared to the general inpatient population. A number of strategies have been shown to be effective in lowering readmission rates.

Recent Findings A review of the current literature revealed several strategies that have been associated with a decreased risk of readmission in high-risk patients with diabetes. These strategies include inpatient diabetes survival skills education and medication reconciliation prior to discharge to send the patient home with the "right" medications. Other key strategies include scheduling a follow-up phone call soon after discharge and an office visit to adjust the diabetes regimen. The authors identified the most successful strategies to reduce readmissions as well as some institutional barriers to following a transitional care program.

Summary Recent studies have identified risk factors in the diabetes population that are associated with an increased risk of readmission as well as interventions to lower this risk. A standardized transitional care program that focuses on providing interventions while reducing barriers to implementation can contribute to a decreased risk of readmission.

Keywords Readmission · Discharge · Inpatient diabetes · Inpatient hyperglycemia · Transitional care

Introduction

Studies have shown that a substantial portion of diabetes readmissions are preventable through effective inpatient diabetes education, discharge planning, and close patient follow-up to make adjustments in the diabetes regimen post discharge. The transition from hospital to home is a critical time to evaluate the preadmission diabetes regimen and consider the current and past regimen to formulate a safe and effective home regimen that the patient and care partner(s) can support [1]. In order to decrease length of stay and readmission rates and improve patient satisfaction, the American Diabetes Association Standards of Medical Care (2018) recommends creating a structured yet individualized discharge plan for each diabetes patient [2].

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Significance of the Problem

Given the significant impact on cost and quality, hospital readmission rates are increasingly used as an indicator of health care quality and a potential source of regulatory penalties for hospitals [3]. Since October of 2012, the Center for Medicare and Medicaid Services (CMS) implemented a hospital readmissions reduction program that decreases reimbursement to hospitals with high rates of early readmission (within 30 days of discharge) [4]. Despite this incentive to improve quality of care and decrease 30-day readmissions, there has not been substantial research devoted to identifying strategies that address this goal. The studies that have been performed have examined the impact of transitional care interventions. In 1999, Naylor et al. conducted a randomized control trial of more than 350 patients to examine the effectiveness of an advanced practice nurse-centered discharge planning intervention for high-risk seniors transitioning from hospital to home. Comprehensive discharge planning began in the hospital and continued for the next 4 weeks at home. Patients in the intervention group had lower rates of readmission (37.1 vs. 20.3%; $p < 0.001$. In addition, length of stay was decreased (1.53 vs. 4.09 days; $p < 0.001$ [5]. Another study evaluated the impact of a care transition intervention (CTI) in patients with complex medical conditions and did find lower rates of readmission. The intervention included tools to promote communication across settings following discharge, encouragement of patients to take a more "active" role in their care, and guidance from a nurse "transition" coach. The patients who received the intervention had lower readmission rates at 30 days (8.3 vs. 11.9, $p = 0.048$) and 90 days (16.7 vs. 22.5, $p = 0.04$) [6]. An additional study examined the impact of a CTI on readmission rates in specific cardiac and respiratory patients. This CTI consisted of a coach completing a hospital visit, a home visit, and two follow-up phone calls within 30 days following discharge. Part of the coaching included helping the patients identify worsening of their condition as well as how to communicate more effectively with their healthcare providers. Those patients who received coaching had significantly fewer 30-day readmission rates (20 vs. 12.8%; odds ratio, 0.61; 95% confidence interval, 0.42–0.88) [7].

The overall rates of early readmission among the diabetes population are significantly higher than those among the general population (14.4–22.7 vs. 8.5–13.5%) [8–14]. One study with more than 35,000 patients with diabetes found the readmission rate to be 24.3 versus 17.7% in patients without diabetes. The most common cause for readmission in that study was infection [15]. One third of patients with diabetes who have had two or more hospitalizations make up more than half of the total cost of all diabetes hospitalizations [9]. The direct medical costs for diabetes inpatient admissions are estimated at more than $75 billion [16]. There have been reports that appropriate attention has not been devoted towards reducing diabetes readmission rates because of the low frequency of diabetes actually being listed as a primary diagnosis in hospital discharges [17], which underestimates the overall magnitude of diabetes and its macrovascular and microvascular sequela spanning all organ systems. With a 20% readmission rate, the estimated cost of early readmissions attributed to patients with diabetes was $25 billion in 2012 [12, 18]. With the ever-increasing rates of diabetes among the general population and the higher proportion of hospitalized patients with diabetes, it behooves us to investigate various causes of readmission and seek solutions to mitigate them.

Several studies have investigated risk factors for 30-day readmission in the diabetes population. Among these studies, common factors associated with readmission rates include male gender, hospital length of stay, prior hospitalizations, comorbidity burden, income level, education level, being discharged with home health care, and not having an outpatient follow-up within 30 days of discharge [16, 18–21, 22•, 23–27]. In addition, considerable effort has been placed on predicting patients at highest-risk for early readmission. The Diabetes Early Readmission Risk Index (DERRI) is a multivariable logistic regression model that predicts 30-day readmission risk among hospitalized patients with diabetes based on a large retrospective study [23–25, 28•].

These studies of risk factors highlight that diabetes readmission is a multifaceted problem that is dependent upon both socio-demographic and health system factors. Of the trials performed in the diabetes population to reduce readmission rates, there have been conflicting data. In a small study in which a diabetes nurse educator performed daily diabetes education rounds and an endocrinologist provided glycemic management consults, the 30-day readmission rates decreased from 32 to 15% [29]. In a large-scale retrospective cohort study with patients with diabetes having a baseline A1c > 9%, inpatient diabetes education by a diabetes educator significantly decreased 30-day readmission rates (11 vs. 16%, $p = 0.0001$) [22•]. A randomized controlled trial in a single United Kingdom (U.K.) university hospital found that the addition of a diabetes nurse specialist to the standard inpatient diabetes care significantly decreased the hospital length of stay from 11.0 to 8.0 days ($p < 0.01$), but did not significantly decrease readmission rates at 1 year [30]. The impact of inpatient diabetes management and education along with a discharge transition program has been evaluated retrospectively, resulting in lower early-readmission rates as well as improved A1c results 1 year post discharge [31, 32•].

From Research to Practice

After a thorough review of the CTI literature, we conducted a retrospective chart review of all patients admitted to the medical service at our institution with an A1c > 9% over a 6-month

period in 2015. We found that 64% of inpatients were readmitted within 90 days and postulated that a lack of a standardized transitional care program was a contributing factor. In an effort to prevent readmissions in our high-risk patients with diabetes, we incorporated what we learned from the literature into a plan and implemented a comprehensive, evidence-based systematic approach to transitional care for our diabetes population.

Methods

In creating our comprehensive transitional care program, we designed a multi-pronged approach to offer several strategies at various stages of the hospitalization. The setting was an 862-bed tertiary care academic hospital in an urban setting in the Northeast. The program was implemented on two medicine units with a high volume of patients with diabetes admitted for a variety of diagnoses. These two specific units were also chosen because they had their own unit-based care coordinators.

Our first stage involved meeting with the care coordinators and reviewing our established inclusion criteria to identify high-risk patients with diabetes. Criteria included an A1c > 9%, patients that were new to any insulin, or those intensified to a basal/bolus regimen (e.g., calculating bolus insulin based on blood glucose (BG) for the first time). Patients with a known history of diabetes who may have received previous diabetes education were educated according to their current diabetes status and discharge plan. Our institution provides prescribers with a transition algorithm to determine a safe and effective discharge regimen that is part of the *New York-Presbyterian/Weill Cornell campus adult inpatient glycemic management guidelines* (see Table 1). This algorithm was adapted from a prospective multicenter study that examined the efficacy and safety of a discharge algorithm based on a preadmission A1c. This algorithm was divided into three groups: A1c < 7%—discharged on prior home regimen; A1c between 7 and 9%—discharged on prior home regimen plus 50% hospital glargine dose; and A1c > 9%—discharged on oral diabetes regimen plus glargine at 80% inpatient dose. At 12 weeks post discharge, the A1c decreased from 8.7 to 7.3% ($p < 0.001$) [33].

The care coordinators were then instructed to refer these patients to the study team. When the research coordinator received notification from the care coordinator that a high-risk patient was identified, she instructed the diabetes educator and the care team to review the recent BGs and insulin usage and determine a safe and effective diabetes discharge regimen based on the discharge transition algorithm. The team then launched a sequence of interventions all aimed at decreasing risk of readmission in this high-risk population. The NYP/Weill Cornell campus transitional care comprehensive program consisted of the following steps outlined below:

A. *Medication reconciliation with insurance reimbursement and "med-to-bed" delivery of prescriptions*

Performing medication reconciliation prior to discharge is a key strategy to decrease the risk of medication errors soon after discharge. In a prospective observational study of patients with diabetes, medication reconciliation revealed that one third of patients had medication errors. [34]. The polypharmacy associated with diabetes management was considered to be an important risk factor in medication errors [35]. In a review of over 82,000 new prescriptions from community based practices, only 72% of the prescriptions were actually filled, 31% of which were prescribed for diabetes management [36].

For our TCI, the care coordinator or social worker faxed the home diabetes prescriptions to a pre-arranged "med-to-bed" local pharmacy providing timely one-time bedside delivery to patients. Patients were encouraged to participate in this benefit to streamline their care transition, but could opt out if they chose to use their usual pharmacy. The purpose of providing the prescription ahead of discharge was to identify and reconcile any insurance reimbursement benefit for each patient. If it was determined that the prescribed regimen was not covered or had a higher co-pay, the patient was counseled and appropriate modifications were made based on

Table 1 Transition guide from inpatient to outpatient regimen (algorithm was created using data from Umpierrez et al. [33])

Transition guide from patients from inpatient to outpatient regimen		
A1c < 7%	A1c 7–9%	A1c > 7%
Return to same home regimen unless contraindicated	Restart home regimen if not contraindicated, keep basal at 50–75% of inpatient dose	Best option: basal insulin at 75–100% of current dose and bolus insulin with meals at fixed or calculated dose Other options: • Basal plus: basal insulin + bolus insulin at largest meal • Pre-mixed insulin once daily + repaglinide with meals • Basal insulin once daily and GLP-1 injectable daily or weekly to cover prandial needs

Basal insulin: U100 and U300 glargine, U100 detemir, and U100 and U200 degludec; bolus insulin: aspart, lispro, and glulisine; pre-mixed insulin analogs: 70/30, 75/25, and 50/50

reimbursement and patient ability to pay. This served to ensure that patients left the hospital with their next dose whenever possible in an effort to prevent gaps in treatment from delays in obtaining diabetes medications and supplies.

B. *Diabetes self-management assessment*

Assessment of diabetes self-management skills and provision of diabetes education have been shown to significantly decrease 30-day readmission rates [31, 32•]. Since diabetes is rarely the primary diagnosis for admission, formal diabetes education may not be prioritized and is often overlooked. Clinicians should consider that uncontrolled diabetes may have played a substantial role in the primary reason for hospitalization [22•].

For our TCI, the team-based care coordinator contacted the primary RN or diabetes nurse practitioner who would then assess the individual patient's ability to perform the recommended diabetes self-care management skills prior to discharge. Knowledge was also assessed to determine patients' understanding of the fine points of the regimen such as the timing of blood glucose measurements and insulin dosing prior to meals and treatment and prevention of hypoglycemia.

C. *Scheduling timely follow-up phone call and office visits*

Follow-up phone calls within 72 h was chosen as an intervention because they have been shown to reduce readmissions in high-risk individuals. In a prospective randomized control study of almost 4000 patients, the 60-day readmission rate was reduced from 9.6 to 7.4% ($p = 0.01$) [37]. In a retrospective observational study of billing data, readmission rates decreased from 8.6 to 5.8% ($p < 0.01$) in over 5000 patients [38]. Randomized trials have shown that having a follow-up visit within 1 week of discharge has been associated with fewer readmissions. In a study with patients with diabetes seen within 5 days of discharge, 42.9 vs. 12.5% were readmitted within 90 days [39].

In our TCI, a follow-up appointment was made prior to discharge within 7 days with a nurse practitioner (NP) in a primary care faculty practice with experience managing patients with diabetes or an endocrinologist (MD) or NP in the endocrinology faculty practice at Weill Cornell. The purpose of this follow-up visit was threefold. It was an opportunity to (1) review the patient's performance of diabetes self-care behaviors following discharge, (2) review the details of the meal plan and blood glucose (BG) logs, and (3) make timely adjustments in the insulin regimen as needed. Whether the patient was referred to the primary care or endocrinology practice was determined by patient preference and insurance coverage. Once the follow-up appointment was scheduled, a 3-day post-discharge follow-up phone call was scheduled with the same provider as the scheduled 7-day visit. The phone call was to ensure there was no difficulty in obtaining the correct diabetes prescriptions and that the prescribed regimen was being followed correctly. The call also served as a reminder of the time, location, and importance of the 7-day follow-up appointment.

Our goal was to test the feasibility of implementing this comprehensive series of strategies aimed at improving the transition from inpatient to outpatient in high-risk patients with diabetes. After the intervention, the number of emergency department visits and readmissions over the 30-day post-discharge period was evaluated.

Results

Over the time period from May 2014 to December 2015, 36 patients were enrolled in this prospective cohort study. The study was approved by the Institutional Review Board and all subjects signed an informed consent. The following series of key strategies known to reduce readmission rates was implemented.

1. Provide individualized diabetes self-management education prior to discharge.
2. Obtain discharge prescriptions in advance for reconciliation of insurance coverage and cost.
3. Deliver "med-to-bed" prescriptions to bedside prior to discharge whenever possible.
4. Schedule a 3-day follow-up phone call with outpatient study provider.
5. Schedule a follow-up visit within 7 days of discharge with same outpatient study provider.

During the initial phase, we encountered an unforeseen resistance by the care teams when asked to order an A1c test. Our research coordinator identified 80 potential high-risk patients (defined as having two or more BGs > 180 mg/dL in 24 h). She then requested an A1c via text page to the care team. It took up to 3 days with multiple requests to have the A1c ordered. By the end of the 6-month study period, only 48 of the 80 patients (60%) had an A1c ordered. The remaining 32 patients (40%) did not have an A1c done prior to discharge. When the research coordinator queried residents about their reluctance to order an A1c, she learned the barrier to completing the task was twofold: many felt they needed approval from their attending to order an A1c and they did not assign this task as a high priority. Because of the difficulty in recruiting patients based on hard-to-obtain A1c results, the inclusion criteria were expanded to include two BGs > 180 mg/dL in 24 h.

Thirty-six patients were enrolled from June 2014 to December 2015. The number of patients who received any of the study interventions is described below.

Our first intervention was diabetes self-management education (DSME). Twenty-eight of the 36 patients (77.8%) enrolled in the study received DSME prior to discharge. Of note,

there is one diabetes nurse practitioner at our site. Bedside nurses are expected to provide routine diabetes education. The diabetes nurse practitioner provides nursing units with diabetes education resources such as a comprehensive self-care guide (available in three languages), saline insulin pen training kits, and blood glucose meters to take home. The nurses are advised to consult the diabetes nurse practitioner for complex cases, subject to availability. Half of the study patients were seen by the diabetes nurse practitioner in addition to the bedside nurses providing ongoing education.

The second and third interventions targeted obtaining discharge prescriptions in advance for reconciliation of insurance coverage and med-to-bed delivery to the bedside. This provided an opportunity for the pharmacy to make the prescribers aware of alternative products that were covered at a lower cost and to obtain new prescriptions if needed. In addition, the med-to-bed pharmacy was instructed to confirm that there were prescriptions for syringes and pen needles for all patients discharged home on insulin. Despite the research coordinator's best efforts, only 14 of the 36 patients (38.9%) received medication reconciled and delivered to the bedside. The barriers to the successful completion of this strategy were multi-factorial. There was an unexpected delay in obtaining prescriptions from the resident to send to the med-to-bed pharmacy. When the prescribers were asked the reason for the delay, the uncertainty about which medications and the home dose was cited. Another major finding was the prevalence of incorrect prescriptions. Figure 1 highlights the types of errors found. One barrier in particular was the absence of prescriptions for needles in the majority of patients that had prescriptions for insulin (79.2% of the 95.9% who had prescriptions for insulin). In addition, only 25% of patients received prescriptions for supplies to monitor their blood glucose at home.

The fourth intervention, an agreed upon and scheduled 3-day follow-up phone call with an outpatient study provider had an extremely low completion rate—only 9 of the 36 study patients (25%) answered the phone call. The study provider made at least three attempts to reach the patient. When some of the patients were readmitted, the research coordinator asked the reason for not answering the call. The most frequent answer was that the caller ID identified the caller as the hospital and they thought it was the billing office. After this discovery, the research coordinator started blinding her phone number and noted an increase in phone calls being answered.

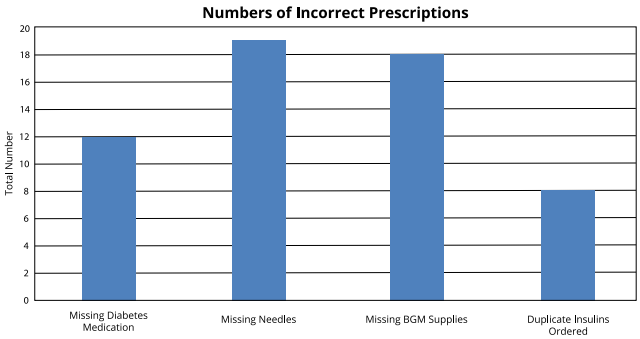

Fig. 1 Number of incorrect prescriptions

The last intervention was the scheduled 7-day visit. Only five patients (13.9%) attended the follow-up visit. The main reasons given by patients were the need to return to work or to resume care responsibilities for another family member.

The 30-day readmission rate for our study group was 50%. Of the 18 patients who were readmitted, 12 of them had received diabetes education (66.7%). Of the 18 patients who were *not readmitted*, 16 of them had received diabetes education (88.9%).

Conclusions and Future Directions

Our study highlights the challenges of implementing a comprehensive transitional care program in high-risk patients with diabetes. It involved an interdisciplinary team using multiple strategies at various times during the hospital stay and immediately post discharge.

The first barrier we encountered was resistance from the care team to place an order for an A1c. This delayed the identification of these high-risk patients. In the inpatient setting rife with competing priorities, auto-selecting of an A1c in the electronic health record if one had not been performed in the past 2 months is a possible solution.

Diabetes education prior to discharge has been associated with a lower risk of readmission in this and other studies [31, 32•]. Requesting a diabetes nurse practitioner consult on all high-risk patients with diabetes to perform expert diabetes education is not a sustainable solution in most inpatient settings. It is recommended that some nurses are designated to receive additional training to become diabetes champions to serve as the point person on every medicine unit and beyond [40]. These diabetes nurse champions can ensure that all necessary resources are made available to high-risk patients including additional time to practice survival skills during the hospital stay. In addition, referrals should be made for individualized follow-up care for additional diabetes education, reviewing blood glucose monitoring results and making diabetes medication adjustments.

Insurance reconciliation and "med-to-bed" delivery of home medication were both key steps in ensuring that patients had their discharge medications in hand and were ready to take their next dose. The correct prescriptions for blood glucose monitoring supplies as well as insulin vials, pens, pen needles, and syringes were also critical to give the patient the best chance of following the prescribed diabetes regimen. In our study, although the pharmacy was informed of this need, they were often unsuccessful in providing all of the necessary

supplies. After the results of our study were discussed with a new pharmacy, appropriate steps were taken to place reminders in the pharmacy to link the prescription for insulin to the pen needles/syringes to avoid overlooking this critical step.

The majority of our patients did not benefit from receiving the extra support of a follow-up call and outpatient visit despite the fact that both these interventions were set up prior to discharge and the patients agreed to the date and time of the visit as well as the provider chosen. The use of virtual follow-up visits such as mobile health technology may be a solution to overcome the barriers seen. Projects such as Project ECHO (Extension for Community Healthcare Outcomes) are an example of a successful telemedicine model for health care delivery. It has been found to improve the confidence of both primary care providers and community health workers in managing complex patients with diabetes in areas that are underserved. [41]. Post-discharge mobile health platforms are currently available or in development that are designed to improve patient outcomes and prevent readmission (https://www.fitangohealth.com). The "Diabetes to Go" survival skills education pilot study employed a knowledge pre- and post-test and subsequent diabetes education videos and print materials to prepare patients for discharge. Improvement was shown in both diabetes knowledge and medication adherence for a 3-month period post discharge [42].

Managing diabetes at home is not an easy task. It requires the patient to make numerous critical decisions and perform multiple tasks throughout the day. Since type 2 diabetes is a chronic and progressive illness, the diabetes regimen is naturally changing over time. The need to make adjustments is pronounced immediately after an acute illness and requires special attention. One thing that is certain based on the studies highlighted in this paper is that discharge planning interventions should begin during hospitalization to properly prepare the patient for discharge but need to continue post discharge in order to prevent readmissions.

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Compliance with Ethical Standards

Conflict of Interest Naina Sinha Gregory, Jane J. Seley, Savira Kochhar Dargar, Naveen Galla, Linda M. Gerber, and Jennifer I. Lee declare that they have no relevant conflict of interest pertinent to this study.

Human and Animal Rights and Informed Consent This study involved human subjects. The study received approval from the Weill Cornell Medicine Institutional Review Board. All subjects provided informed consent and ethical standards were followed.

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