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Medication adherence, health-related quality of life, and hospital readmission outcomes of a diabetes transitional care intervention

Melissa Scollan-Koliopoulos*

Dr. Susan L. Davis R.N., & Richard J. Henley College of Nursing, Sacred Heart University, Fairfield, CT, USA

Abstract

***Background*:** The time between hospital discharge and follow-up medical care is a time that often leaves people with diabetes without the support necessary to ensure medication adherence and assistance with determining when emergency care may be appropriate. The I-Care-4-Health Transition intervention was developed to reduce hospital readmissions.

***Methods*:** A quasi-experimental intention-to-treat design was employed to evaluate a transitional care intervention in a Northeast Coast hospital in the United States of America, initiated during the initial hospital stay and continued for 6 months following hospitalization. The intervention adapted components of leading transitional care interventions. It was delivered to $n = 86$ people with diabetes by healthcare technicians serving in a navigational role with an advanced nurse practitioner-led team, which also included hospital nurses and physicians. Scripted talking points on red flag symptom instructions and medication adherence were delivered on scheduled telephone calls.

***Results*:** Significant improvements were noted in medication adherence ($t = 3.77$, $p < 0.001$) and health-related quality of life (HRQOL) ($t = 3.04$, $p = 0.003$), with medication adherence predicting HRQOL at program completion ($F = 8.37$, $p = 0.005$). Medication side effects accounted for 42% of the variance in HRQOL, and suboptimal adherence was associated with hospital admissions ($F = 4.5$, $p = 0.04$). The readmission rate was 22% for the sample.

***Conclusion*:** Team-based care can include technician-level navigators working under the supervision of advanced practice nurses to provide continuous, across-setting support through scheduled telephone calls, beginning during hospitalization and continuing after hospital discharge. The I-Care-4-Health Transitions project improved medication adherence and HRQOL in individuals with diabetes from low-income backgrounds and can ensure appropriate and timely emergency department use to prevent 30-day all-cause readmissions.

Keywords: *diabetes*; *readmissions*; *transitional care*; *medication adherence*; *health-related quality of life*

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Hospital readmissions for diabetes are a global concern for Europe, Australia, and the United States.[1] Hospital readmissions within 30 days are considered an indicator of incomplete or inefficient care, carrying a potential risk of adverse events.[2] Hospital readmission within 30 days for chronic illness in patients with very low incomes is 14% higher compared to those with higher incomes.[3,4] Hospital readmissions are often due to suboptimal self-management with medication adherence.[5] Suboptimal medication adherence is associated with a decline in health conditions and, ultimately, a reduction in health-related quality of life (HRQOL).[6] Individuals who self-report poor HRQOL are more likely to be readmitted to a hospital within 30–180 days.[5] Barriers to medication adherence are thought to be impacted by continuous support, effective communication, and efforts to build patient trust.[5] Continuity of care predicts self-care, which in turn predicts HRQOL.[7] This report describes the outcomes of an advanced practice nurse (APRN)-led transitional care project called the I-Care-4-Health Transition, which aimed to close the gaps in hospital readmissions through a team approach using a healthcare navigator who maintained continuous contact with patients following hospital discharge to deliver scripted talking points and provide resource linkage to improve self-care, specifically medication adherence, and enhance HRQOL, ultimately reducing hospital admissions for people with diabetes.

Background

Medication adherence is a global problem, even in high-income countries like the United States, where upward of 45% of patients with diabetes[8] report a lack of

adherence to their treatment regimens. Medication adherence in the context of diabetes care is shown to be independently associated with HRQOL when controlling for variables other than mobility, anxiety, and depression.[9] In older populations, medication adherence is positively associated with social functioning components of HRQOL.[10] Suboptimal self-management of chronic disease, especially medication adherence, is a leading cause of hospital readmissions.[11] Factors associated with medication nonadherence include polypharmacy, copays and costs, and medication adverse side effects.[12] Other factors include sex, age, physical inactivity, marital status, education level, caregiver involvement, alcohol consumption, and multiple comorbidities.[12] Many chronic conditions require multiple medications with heavy side effect profiles that can cause discomfort, coupled with high costs that can make initiation or perseverance challenging. When associated with complications, diabetes has high rates of readmission due to medication side effects and/or adverse effects, and/or medication reconciliation gaps resulting in low adherence rates.[13] Thirteen social determinants of health factors, including race, education, income, social isolation, social network, residential poverty, health professional shortage areas, rural areas, and state public health infrastructure, are associated with hospital readmissions.[14] Approximately 27% of 30-day readmissions are thought to be preventable by addressing social determinants of health issues, such as psychosocial issues, food insecurity, housing, and transportation issues, which increase the risk of hospitalization by 16%.[15]

Interventions utilizing Health Care Technicians (HCTs) and community health workers show potential for reducing 30-day all-cause readmissions by 50% compared to control groups receiving routine care.[15] Those receiving routine interactions with HCTs who try to ensure attendance at post-hospital clinic visits experience a 32% reduction in readmissions.[15] Factors beyond social determinants of health issues include inadequate post-discharge care, a major contributor to readmissions, such as insufficient, delayed, or absent follow-up care, medication management issues, inadequate communication regarding care coordination, and a lack of patient education.[16] When HCTs maintain contact with patients recently discharged from the hospital for 30 days via telephone, text, or in-person visits, readmissions are reduced by addressing psychosocial and clinical care needs.[15] Hospital readmissions are considered detrimental to patient welfare, creating emotional stress and are associated with an increase in physical complications, as well as a strain on the healthcare system.[16] Patients themselves often perceive their hospital readmissions could be preventable with home healthcare and improved discharge timing.[17] Hospital-initiated transitional programs that bridge the gap between pre-hospital discharge and post-hospital discharge support are shown to reduce readmissions.[18]

Based on the preceding literature review, we tested the hypothesis that a nurse practitioner-led team, including a healthcare technician, could positively impact health outcomes in a very low-income hospitalized population by improving medication adherence and HRQOL, thereby preventing hospital readmissions.

Methods

The purpose of this quasi-experimental intention-to-treat study was to test the hypothesis that providing an HCT in a navigator role from the community, supervised by an APRN, would improve medication adherence and HRQOL and prevent hospital readmissions in those with diabetes. This study underwent expedited review by the institutional review board at the participating facility prior to participant recruitment. Participants over the age of 18 years old who were hospitalized and had diabetes and did not have a current primary care provider were recruited upon admission to the hospital. Participants were excluded if they did not speak English or Spanish, were under 18 years of age, or were admitted from a long-term care facility or would be returning to one. The purpose of this quasi-experimental intention-to-treat study was to test the hypothesis that providing an HCT in a navigator role from the community, supervised by an APRN, would improve medication adherence and HRQOL and prevent hospital readmissions in those with diabetes. A patient finding model was employed, whereby the physician overseeing the medical residents would bring the HCT on daily rounds. The APRN and HCT would then round to consult with discharge planners and emergency department (ED) staff to recruit patients. The HCT visited patients daily during their hospital stay, was present at their medical appointments after discharge, and made regularly scheduled telephone calls for 6 months. The HCT was tasked with using talking points about medication adherence and red flag symptom awareness, adapted from a hybrid of leading transitional care models (ie. Naylor,[19] Coleman,[20] and Project RED[21]), which were implemented to create a process that focuses on interprofessional collaboration, patient engagement, medication reconciliation, identifying red flag symptoms requiring intervention, treatment adherence, symptom management, enhancing health literacy, and expediting access to primary or specialist care. Four levels of provider collaboration were employed (physician, APRN, nurses/social workers, and HCT/certified home health aide).

The HCT in the navigator role in this project was a certified home health aide. The HCT would visit the patient during their inpatient stay within the first 1–2 days of admission and make daily bedside visits, establishing a relationship with the patient before discharge. The HCT used talking points and the acronym PIFO (pick with cost in mind, include all supplies, fax orders, order the same as

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pre-admission if possible) used by the entire healthcare team involved with this project as an easy-to-remember mnemonic to identify barriers to medication adherence and would bring identified barriers to the attention of the medical and nursing staff in real-time (see Table 1).

Following discharge, the HCT would contact the patient at 24, 48, and 72 h, and then at 1 week, followed by 2 weeks, and again at 1 month, 3 months, and 6 months. Participants were asked to try to contact the technician before going to the emergency room unless they had red flag symptoms. This allowed for expedited ambulatory care visits or for the APRN to reconcile medication adherence barriers. If the patient arrived in the ED, the staff would notify the project team, and the HCT would visit with the patient at their earliest availability to maintain the continuity of the established relationship. Participants were provided with a direct cell phone number for the HCT. The HCT also reviewed medication adherence strategies using scripted talking points and referred to the APRN if concerns arose or action was needed to assist with medication reconciliation. The HCT would also ensure an appointment was made for a primary care follow-up visit and would be visibly present in the clinic on the days the patients attended their primary care appointments in the hospital's academic clinics.

Measures

Participants were administered several paper-and-pencil surveys at the bedside and completed follow-up surveys during their primary care follow-up appointments or by telephone.

SF-8 HRQOL

The SF-8[22] has been demonstrated to be a valid and reliable measure of HRQOL in individuals from low-income backgrounds.[23] The Cronbach's alpha for the physical subscale is 0.73, and the mental component subscale is 0.74, with a test-retest reliability at 0.59–0.70. The Likert scale is coded 1–5, and a mean of 50 (SD 10) is the average score in the USA.[23]

In this study, high scores indicated poor quality of life.

The Care Transitions Measure (CTM)-3

CTM-3 for satisfaction with transitions[20] is a short form adapted from an original 15-item scale to assess patient satisfaction with care transitions.[20] The Cronbach's alpha is 0.85–0.90 with high internal consistency reliability. It is a Likert scale ranging from 1 to 4.

Morisky Medication Adherence Measure

The Morisky medication adherence 8-item tool[24] has an internal consistency reliability of Cronbach's alpha = 0.83 with a 93% sensitivity and 53% specificity with a test-retest reliability of 0.80–0.81. The scale ranges from low to high adherence using 3 points after answering 'yes' or 'no' to ever forgetting one's medication (total score can be 4 for high adherence and 0 for none).

Table 1. Medication adherence talking points used at the bedside and on phone calls post-hospitalization

Before you go home: ***Ask your doctor to PIFO:***

*To **pick** a medicine on the pharmacy discount plan (i.e. Good Rx or Single care, etc.)

*To **include** prescriptions for all supplies, such as insulin syringes.

*To **fax** your prescriptions to your pharmacy.

*To **order** the same medicine you used at home prior to admission.

Be sure to:

*Go to the pharmacy before you go home or ask for delivery.

*Start taking the medication the first night home.

*Take the medication the exact way the doctor tells you.

*Don't try to spare pills

Example: Avoid taking half the dose will not fix your problem – you may get the same side effects with less medication benefit.

Statistical analysis

Power was estimated a priori using G-Power[25] for multiple regression analyses. The sample size of 100 was estimated as the minimum required to achieve a 20% response rate and provide 80% power at an alpha level of 0.05 to detect changes using psychological survey methodology. The data were analyzed using SPSS version 29.0.[26] Regression analysis was used to identify root cause predictors of readmission, and *t*-tests were conducted from baseline to project end to evaluate medication adherence and HRQOL. Missing data were handled with list-wise deletion. Mean scores were calculated, and the difference between means was estimated using *T*-tests. Analysis of variance was used to detect differences in means for demographic variables related to social determinants of health, ED visits, and readmission data. Regression analyses were conducted to better understand the differences at baseline, at baseline hospital admission, and 30 days post-hospital discharge by regressing study-end perceptions of disease threat/severity, medication adherence, and HRQOL scores. ED visits and reasons were obtained by self-report during the regularly scheduled calls.

Results

Sample

The sample consisted of n = 86 participants, recruited from a target of 100 eligible volunteers at a Northeastern urban academic medical center. Most of the participants were uninsured and required assistance with obtaining charity care funding for service reimbursement.

The entire sample represented individuals at the 100% poverty level, below the age of 65, with multiple comorbidities besides diabetes. Table 2 depicts the sample demographic characteristics and immigration status.

Education level was significantly associated with readmission (p = 0.04). Tables 3 and 4 depict the reasons for telephone calls to the HCT to seek emergency room care. The calls resulted in preventing an ED visit through intervention in collaboration with the supervising APRN. Education level was associated with the number of calls to the HCT (F = 2.2, p = 0.03). Additionally, an ED visit (F = 4.5, p = 0.04) for symptom-based calls was associated with a higher likelihood of readmission.

Table 2. Demographic characteristics

	Percentage
Age	
19–30	17
31–64	78
65–83	4
Gender	
Male	53
Female	44
Ethnicity	
Hispanic	56
Non-Hispanic	42
Race	
Black	65
White	3
Mixed race	26
Asian	1
Immigration	
US born	63
Not US-born	37
Puerto Rico	16
Portugal	10
Peru	6
Haiti	9
Ecuador	6
Giana	6
Mexico	9
Ivory Coast	3
Santo Domingo	6
Dominica	3
Salvador	3
Uruguay	3
Costa Rica	3
Guatemala	3
Cuba	3
Nigeria	3
Jamaica	3
Immigration year	
<1980	22
1981–1990	26
1991–2011	52

Table 5 depicts APRN or Physician Care Linkage and Rehospitalizations. Primary care physician (PCP) visits were arranged at discharge, with 66% occurring within 1 week and 78% within 1 month. ED visits occurred at an overall rate of 15% within 30 days, with 8% occurring within 1 week of discharge. Interestingly, PCP or Specialist visits or time to appointment following discharge were not associated with ED visits or readmissions.

Results

From baseline to project end, there was a significant change in medication adherence and HRQOL. For medication adherence, the baseline pre-test (M = 1.0, SD = 1.1) and the post-test at project end were (M = 0.33, SD = 0.64) significantly different

Table 3. Outreach following hospital discharge

HCT telephone reach	Percentage						
Day	1	2	3	14	30	90	120
Patient reached	70	47	63	53	42	08	
Assistance physician appointment		16	29	29	29	8	
Medication questions	100	11	9	7	8	12	25
Need an assistive device		5	2	1	2		
Red flag symptoms		8	7	7	46		25
Blood sugar control issues		6	16	11	4	3	
Charity care paperwork		6	2	5	2	8	
Nutrition education		3					
Need health information			1	4	3		
Pain symptoms				1			

HCT, Health Care Technicians.

Table 4. Qualitative reasons: emergency department visit prevention with transitional care phone calls

No PCP yet.
Medication Issues
Refills due to inadequate dispense amount
No syringes or pen needles
Insulin vial broke
Medication cannot afford medication
Medication can't be obtained at local pharmacy
Pre-hospital regimens not re-ordered
Confusion (uncertainty of dosing/timing/purpose)
Dose adjustment
Hypoglycemia
INR and warfarin issues

INR, International Normalized Ratio

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Table 5. APRN or physician care linkage and rehospitalizations

Advanced practice nurse interaction	
Medication reconciliation	100%
Link to outpatient physician care, emergency department, or hospitalization	
Emergency department visit for sample 36%	
Readmission rate for sample – hospitalization one 22%; hospitalization two 9%	
Within 10 days	
Primary care	71%
Specialist care	66%
Emergency department	7%
First hospital readmission	86%
Second hospital readmission	1%
Within 11–20 days	
Primary care	18%
Specialist care	9%
Emergency department	4%
First hospital readmission	3%
Second hospital readmission	1%
Within 21–30 days	
Primary care	9%
Specialist care	6%
Emergency department	1%
First hospital readmission	1%
Second hospital readmission	1%
Within 31–60 days	
Primary care	10%
Specialist care	12%
Emergency department	10%
First hospital readmission.	4%
Second hospital readmission	2%
Emergency department visit >60 days	11%
Re-hospitalized over 60–168 days	4%
Re-hospitalized a second time	2%

APRN, advanced practice nurse.

(t = 3.77(48), p = <0.001, d = 1.24). For HRQOL, the baseline pre-test (M = 24.48, SD = 8.4) and the post-test at project end were (M = 20.9, SD = 8.1) significantly different (t = 3.043(61), p = 0.0033). At baseline, medication adherence did not significantly influence HRQOL (F = 2.56 (1), p = 0.11). However, at the project end, medication adherence significantly explained the variance in HRQOL (F = 8.37(1), p = 0.005), with medication adherence explaining of the variance in HRQOL 34%.

At hospital discharge, patients endorsed their perception of their knowledge of red flag symptoms (80%) and reasons for medication (82%), with some who could name all reasons for the medication (76%) or no reasons (7%), could name each common side effect for all medications prescribed (50%), and some knew of no side effects (7%). Approximately 3% of patients were anticipated to be non-adherent because they would not be able to afford medication.

Calls about symptoms to the HCT were associated with an improvement in quality of life (F = 2.4, p = 0.03). Medication side effects accounted for 42% of the variance in quality of life (F = 5.8, p = 0.005). Suboptimal medication adherence due to side effects (β = -0.42, p = 0.002) following hospital discharge was associated with a higher likelihood of readmission. Education level was associated with the number of calls made by the navigator (F = 2.2; p = 0.03). The readmission rate was 22%, with a leading cause being medication discontinuation due to side effects (F = 4.5, p = 0.04) and/or beliefs that the treatment was ineffective (F = 5.9, p = 0.02). Approximately 42% of the variance in quality of life was explained (F = 5.8, p = 0.005), with medication side effect symptoms contributing uniquely to the prediction model (β = -0.42, p = 0.002).

Those with less medication adherence had poorer quality of life. On average, participants had more medication prescriptions at discharge than at admission, given no prior PCP relationship. When it came to the timeline of identifying medication side effects that led to ED visits, 50% occurred within 10 days, 60% within 30 days, and 25% within 60 days. This suggests that most medication-related issues leading to an ED visit can be addressed with continuous support within 30 days following hospitalization.

Baseline HRQOL uniquely explained variance in quality of life at the end of the project (β = 0.39, p = 0.002), indicating that those who initially functioned worse showed improvement by the end of the intervention. For those with a poor quality of life in terms of physical and mental functioning, more calls were made to the HCT. This indicates that seeking and receiving help is beneficial to those with poor physical and mental health. The topic of call for red flag symptoms, rather than the number of calls, was significantly associated with readmission (F = 11.5, p = 0.001) and ED visit (F = 4.5, p = 0.04).

Baseline HRQOL uniquely explained variance in ED visits (β = -0.33, p = 0.005). ED visits were significantly associated with readmission within 30 days (F = 5.2, p = 0.02). The sooner someone visited the ED, the more likely they were to be readmitted (F = 4.7, p = 0.03). The time interval from hospital discharge to ED visits for red flag symptoms significantly explained 26% of the variance in 30-day readmissions (p = 0.05). For example, the initial 6 months resulted in a mean of 8.5 days until the first readmission, with 10% of the sample readmitted. In contrast, the last 6 months had a mean of 29.8 days until readmission, with 8% of the sample readmitted.

Project evaluation results using the CTM-3 revealed that participants (67%) reported that their healthcare needs were fully considered, had improved understanding of patient responsibility (72%), and improved understanding of medication purpose (73%).

Discussion

Consistent with the study by Shnipper et al., the Transitions Project reduced readmissions using technician-level support across various settings (hospital, home, and clinics).[27] The project was effective in reducing hospital readmissions by helping individuals identify and differentiate red flag symptoms that warrant ED assistance, as well as by improving medication adherence and medication reconciliation through the use of talking points and continuous contact from the initial admission days to 1-month post-hospital discharge. Consistent with Chantzaras and Yfantopoulos, we found that HRQOL was associated with readmissions.[9] The use of the HCT to establish a relationship prior to discharge was a meaningful source of social and informational support during the vulnerable transitional care period following hospital discharge – providing continuous cross-setting support from HCTs and a collaborative team approach to reducing ED usage and readmissions.

Seven key elements are necessary for ensuring safe transitional care, including medication management, transition planning, patient/family engagement and education, communication during transfers, follow-up care, healthcare provider engagement, and shared accountability across providers and organizations.[28] Medication reconciliation is considered a key factor in preventing 30-day readmissions. Examples of medication reconciliation behaviors that benefit people with low incomes and underinsured include returning patients to pre-hospital regimens, when possible, to avoid wasting previously filled prescriptions, and consideration of prescription cost as a barrier to adherence. Consistent with Shah et al., future studies can incorporate medication possession ratios as well as the proportion of days covered using pill counts or diaries.[29] Our findings are consistent with Becker et al., communication interventions are effective in reducing hospital readmissions.[30]

Clinical practice recommendations

Nursing involvement in transitional care is essential to improving health outcomes for people with diabetes. Transitional care between hospital and ambulatory care appointments is a vulnerable time where self-care is essential, yet often unsupported. HCTs with APRN oversight, including certified home health aides, can use talking points about appointments and medication adherence in diabetes care. Hospitalization may be viewed as a catchment for opportunities for behavioral interventions for those with diabetes. Using an easy-to-understand mnemonic like PIFO can help patients and providers communicate in a way that does not undermine respect for the prescriber, allowing for patient self-agency and advocacy through interdisciplinary collaboration.

Conclusion

APRN-supervised HCTs working as part of an interdisciplinary healthcare team across settings (hospital, telehealth, and ambulatory care clinic) can serve in a health coaching role by delivering tailored talking points, impacting 30-day transitional care between hospital discharge and primary care provider access in a meaningful way that prevents readmission by improving medication adherence and HRQOL in a very low-income, racial, and ethnic minority population. In this project, individuals who had suboptimal medication adherence had a reduced HRQOL and were more likely than others to be readmitted to the hospital. The I Care-4-Health Transitions Project resulted in a significant reduction in all-cause readmissions and improved medication adherence among a low-income population.

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Declaration

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***Melissa Scollan-Koliopoulos**
Dr. Susan L. Davis R.N., & Richard J. Henley College of Nursing
Sacred Heart University, Fairfield CT, USA
Email: scollan-koliopoulosm@sacredheart.edu