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Perceived discharge quality and associations with hospital readmissions and emergency department use: a prospective cohort study

Tefani Perera,[1] Eshleen Grewal,[2] William A Ghali,[3,4] Karen L Tang [2,4,5]

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[1]Department of Clinical Neurosciences, University of Calgary, Calgary, Alberta, Canada
[2]Department of Medicine, University of Calgary, Calgary, Alberta, Canada
[3]Office of the Vice President (Research), University of Calgary, Calgary, Alberta, Canada
[4]O' Brien Institute for Public Health, University of Calgary, Calgary, Alberta, Canada
[5]Department of Community Health Sciences, University of Calgary, Calgary, Alberta, Canada

Correspondence to
Dr Karen L Tang;
klktang@ucalgary.ca

ABSTRACT

Background At hospital discharge, care is handed over from providers to patients. Discharge encounters must prepare patients to self-manage their health, but have been found to be suboptimal. Our study objectives were to describe and determine the correlates of perceived discharge quality and to explore the association between perceived discharge quality and postdischarge outcomes.

Methods We conducted a prospective cohort study in medical inpatients admitted to a tertiary care hospital in Calgary, Canada. Perceived discharge quality was measured by the Care Transitions Measure (CTM). Linkage to administrative databases provided data for the composite outcome—90-day hospital readmission or emergency department visit. Logistic regression modelling was used to determine the association between global CTM scores, and the individual CTM components, and the composite outcome.

Results A total of 316 patients were included in the analysis. The median CTM score was 80.0 (IQR 66.6–100.0). The distribution of CTM scores were significantly different based on comorbidity burden, with the median and maximum CTM scores being lower and the IQR being narrower, for those with six or more comorbidities compared with those with fewer comorbidities. CTM scores were not associated with the composite outcome, though a single CTM item—not understanding warning signs and symptoms—was (adjusted OR 3.46 (95% CI 1.02 to 11.73)).

Conclusion Perceived quality of discharge varies based on patient burden of comorbidities. While global perceived discharge quality was not associated with postdischarge outcomes, lack of patient understanding of warning symptoms was. Discharging healthcare teams should pay special attention to these priority patient groups and specific discharge process components.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The transition period after hospital discharge is a high-risk time for patients. Discharge communications, particularly relating to patient education, tend to be suboptimal.

WHAT THIS STUDY ADDS

⇒ Global scores of perceived discharge quality are not associated with increased odds of hospital readmission and emergency department (ED) visits within 90 days of discharge. However, patients who reported not understanding the warning signs to watch for had an increased odds of ED visits or hospital readmissions post discharge. The information conveyed at the discharge encounter is therefore important for patient safety and well-being.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The discharge encounter should focus on ensuring that patients recognise warning signs and symptoms that they need to monitor, as this was reported to be a gap in current discharge communications that may lead to increased risk of adverse events. Greater attention also needs to be paid to patients with greater medical complexity and comorbidity burden, as these in particular report experiencing lower quality of discharges.

INTRODUCTION

Discharge from hospital to home represents an important part of the patient care journey, where responsibility for health maintenance shifts from the inpatient care providers to patients, families and their community-based care providers. This transition period signifies a particularly vulnerable time for adverse medical events.[1] Unplanned hospital readmissions are both common and costly to the healthcare system, with up to one-third of medical patients being readmitted to hospital within 3 months of discharge.[2 3] Given the high frequency, burden on patients and high cost, hospital readmission is considered a poor patient outcome and is the focus of interventions aimed to improve quality of care,[4 5] including the processes involved in discharging a patient from hospital.[1 6–8]

Discharge processes are intended to prepare patients and their caregivers to self-manage their conditions at home.[9] The essential elements include: communication (and/or coordination) among healthcare providers about the discharge plan, preparation of the patient and their family for hospital

discharge, development of a follow-up plan, medication reconciliation and education of the patient and their family to facilitate self-management.[1 10 11] Collaboration across disciplines, organisations and sectors (eg, health and social care agencies) is typically required.[12 13] Due to the many moving parts, the discharge process is complex and multifaceted. This is the case especially for medical patients who tend to have significant informational and coordination needs given their older age, high number of comorbid conditions (many of which tend to be chronic), involvement of multiple inpatient and outpatient care providers and significant medication burden.[14–16]

Though patients are handed over a significant responsibility to manage and coordinate health services and care after discharge, they often feel ill-prepared to do so due to common gaps in the discharge process.[17–19] These include lack of medication reconciliation, delayed or inaccurate information transfer and absence of outpatient follow-up planned before discharge.[17] While these gaps represent suboptimal care, it is unclear how frequently they occur, and to what extent they lead to objective postdischarge adverse outcomes such as readmissions and emergency department (ED) visits. We conducted a prospective cohort study with three objectives: (1) to report perceived quality of hospital discharge of patients being discharged from a medical unit; (2) to determine clinical and sociodemographic correlates of patient perceived ratings of discharge quality; (3) to explore whether the risk of readmissions or ED visits within 90 days of discharge is associated with either global perceived discharge quality or quality of the individual discharge components.

METHODS

Study population

Study participants were patients admitted to the internal medicine service at the Foothills Medical Centre in Calgary, Alberta, between December 2014 and October 2015. To be included in the study, patients required a unique healthcare number for data linkage and their discharge destination was mandatorily home or an independent living facility. Those discharged to long-term care or an assisted living facility, and those transferred to another service, hospital or a rehabilitation facility was excluded.

Data collection

Sociodemographic variables

A variety of different sociodemographic and health-related variables was collected via a questionnaire administered by a research assistant during the index hospitalisation. These variables included age, sex, socioeconomic variables (household income, educational attainment, employment status), ethnicity and health literacy. Health literacy was assessed using the validated Single Item Literacy Screener.[20] Clinical variables, including length of stay, need for intensive care and comorbidities, were obtained through linkage to an administrative database (Discharge Abstract Database) for the index hospitalisation. Elixhauser comorbidities were identified using established International Classification of Diseases 10th Revision (ICD-10) coding algorithms.[21 22]

Exposure variables

The Care Transitions Measure (CTM) is a validated 15-item questionnaire developed by Coleman *et al*, that measures the patient-perceived quality of care transitions,[23] particularly within four domains: (1) information transfer; (2) patient and caregiver preparation; (3) support for self-management; and (4) empowerment to assert preferences.[23] A truncated form of the original questionnaire, CTM-3, has also been validated and has been shown to explain the majority of the variance seen in the full 15-item CTM.[24] The CTM-3 includes three items from the full questionnaire: (1) hospital staff taking patient and family preferences into account, (2) the patient's understanding of their responsibilities in managing health and (3) the patient's understanding of the purposes of their medications.[24] In our cohort study, the 15-item CTM questionnaire was administered on the day of discharge prior to the patient leaving the hospital when possible. Otherwise, data were collected via telephone interview within 1 week of discharge. CTM-3 and CTM-15 scores were linearly transformed, out of 100.[25 26] Each individual questionnaire item was considered as a dichotomised exposure variable (disagree/strongly disagree vs agree/strongly agree/not applicable).

Outcome variables

The primary composite outcome was readmission or ED visit within 90 days of discharge from the index hospitalisation. The choice of 90 days as a follow-up interval was selected based on prior studies showing association between CTM-3 scores with postdischarge outcomes including (readmission, death and ED visits) at 90 days but not 30 days.[27 28] Study data were obtained through deterministic data linkage to administrative databases (Discharge Abstract Database for readmissions and National Ambulatory Care Reporting System for ED visits).

Data analysis

Frequencies and proportions were reported for categorical sociodemographic variables, and means and medians were reported for continuous variables. Boxplots were created for CTM-15 scores, stratified by age, sex, comorbidities, hospital length of stay and health literacy. Distributions of CTM-15 scores across patients within each of the five afore-mentioned strata were compared using the Kruskal-Wallis test. Distributions of CTM-15 scores were considered to be significantly different if p values were ≤0.05.

Recognising the importance of not only global perceived discharge quality but also individual discharge components, we conducted logistic regression analyses to

Table 1 Sociodemographic and clinical variables for the study population and their associations with the composite outcome

	Cohort characteristics	Association with composite outcome in crude models	
	Frequency (%); N=316	OR (95% CI)	P value
Age			
Mean (SD)	56.5 (18.5) years	1.00 (0.98 to 1.01)	0.508
Male	162 (51.3)	1.39 (0.88 to 2.18)	0.153
Ethnicity			
Caucasian	207 (65.5)	Reference	
Aboriginal	26 (8.2)	1.54 (0.68 to 3.49)	0.303
South Asian	17 (5.4)	0.72 (0.26 to 2.02)	0.531
Other	54 (17.1)	1.42 (0.78 to 2.59)	0.254
No response	12 (3.8)		
Education			
Less than high school	58 (18.4)	Reference	
High school graduate	78 (24.7)	1.07 (0.54 to 2.12)	0.846
Apprenticeship or trades	28 (8.9)	0.84 (0.34 to 2.07)	0.700
Some postsecondary	83 (26.3)	0.54 (0.27 to 1.07)	0.079
Postsecondary graduate	59 (18.7)	0.66 (0.32 to 1.38)	0.271
No response	10 (3.2)		
Employment			
Currently working	86 (27.2)	Reference	
Unemployed	28 (8.9)	0.82 (0.33 to 1.96)	0.640
Retired	126 (39.9)	1.18 (0.67 to 2.06)	0.564
Other	66 (20.9)	1.75 (0.91 to 3.34)	0.091
No response	10 (3.2)		
Household income			
<CAD$25 000	69 (21.8)	Reference	
CAD$25 000-CAD$49 999	46 (14.6)	1.16 (0.54 to 2.48)	0.708
CAD$50 000–CAD$74 999	36 (11.4)	0.90 (0.40 to 2.05)	0.810
CAD$75 000-CAD$99 000	28 (8.9)	1.27 (0.52 to 3.06)	0.599
CAD$100 000 or greater	41 (13.0)	0.63 (0.24 to 1.61)	0.337
No response	96 (30.4)		
Marital status			
Married/common law	164 (51.9)	Reference	
Widowed	28 (8.9)	1.04 (0.46 to 2.33)	0.930
Divorced/separated	40 (12.7)	1.25 (0.62 to 2.51)	0.528
Single, never married	75 (23.7)	1.46 (0.84 to 2.54)	0.180
No response	9 (2.9)		
Number of Elixhauser comorbidities			
0	52 (16.5)	Reference	
1–2	136 (43.0)	2.26 (1.11 to 4.62)	0.025
3–4	98 (31.0)	3.00 (1.43 to 6.32)	0.004
5 or greater	30 (9.5)	6.00 (2.24 to 16.07)	<0.001
Comorbidities			
Hypertension	120 (38.0)	1.29 (0.81 to 2.04)	0.281
Diabetes mellitus	94 (29.8)	1.22 (0.75 to 1.98)	0.419
Congestive heart failure	41 (13.0)	2.07 (1.05 to 4.05)	0.036

Continued

Table 1 Continued

	Cohort characteristics	Association with composite outcome in crude models	
	Frequency (%); N=316	OR (95% CI)	P value
Alcohol use disorder	47 (14.9)	1.68 (0.90 to 3.13)	0.105
Chronic pulmonary disease	34 (10.8)	1.20 (0.58 to 2.47)	0.619
Metastatic cancer	10 (3.2)	0.65 (0.34 to 1.25)	0.199
Number of preadmission medications			
0	26 (8.2)	Reference	
1–5	134 (42.4)	0.89 (0.38 to 2.09)	0.793
6–10	85 (26.9)	1.36 (0.56 to 3.32)	0.495
Greater than 10	31 (9.81)	2.16 (0.75 to 6.24)	0.155
Missing	40 (12.7)		
Length of stay			
Mean (SD)	8.3 (8.3) days	1.04 (1.00 to 1.07)	0.033

assess the associations between each individual component (ie, question) on the CTM-15 and the composite outcome.

In the adjusted models, we controlled for age, sex, Elixhauser comorbidities, hospital length of stay, household income, health literacy and marital status. All models excluded patients without an event, who died within 90 days. Statistical analyses were performed using Stata V.14 (StataCorp, 2015).

Patient and public involvement

Neither patients nor the public were involved in the design, conduct or reporting of this study.

RESULTS

A total of 470 patients were recruited. Of these, 64 were excluded (16 were not internal medicine patients, 19 were not discharged home or to an independent living facility, 2 died in hospital, 14 withdrew consent, 13 were not residents of Alberta and therefore had no unique provincial health number). Of the 406 patients remaining, 316 completed the CTM and were therefore included in the analysis.

Patient sociodemographic and clinical characteristics

The mean age of the sample population was 56.6 (SD 18.5) years (table 1).

Over half (51.3%) were male and 18.4% had less than a high school education. The majority were either actively employed (27.2%) or retired (39.9%), with 8.9% of the sample being unemployed. Based on the Single Item Literacy Screener, 13.0% of the sample had low health literacy. The mean number of Elixhauser comorbidities was 2.21 (SD 1.61); 42.4% and 26.9% were taking 1–5 and 6–10 medications, respectively, prior to the index hospitalisation. Only 8.2% were not taking any medications prior to admission. During the index hospitalisation, 7.3% had a stay in the intensive care unit. The mean length of stay in hospital was 8.3 (SD 8.3) days. Associations between these patient characteristics and the composite outcome are also reported in table 1.

CTM response characteristics

The mean score for CTM-3 was 81.5, (SD 18.5), with a median of 77.8 (IQR 66.0–100.0). The mean score for CTM-15 was 79.7 (SD 17.7), with a median of 80.0 (IQR 66.6–100.0). Four patients responded 'strongly disagree' to every question, and therefore had CTM-3 and CTM-15 scores of 0. In general, the majority of patients indicated that they agreed or strongly agreed to each of the 15 items in the CTM asking about patient understanding and engagement in the discharge process (table 2). In our study sample, 18.0% and 38.1% had maximum scores on the CTM-15 and CTM-3, respectively.

The items with the highest proportion of patients noting inadequacies of the discharge process were items 6 ('I clearly understood the warning signs and symptoms I should watch for to monitor my health condition'), 7 ('I had a readable and easily understood written plan that described how all of my health care needs were going to be met') and 15 ('I clearly understood the possible side effects of each of my medications'), with 6.0%, 8.5% and 10.7% strongly disagreeing or disagreeing with these respective statements. The proportion of patients strongly disagreeing or disagreeing to the other 12 statements on the CTM ranged between 2.3% and 5.4% (table 2).

Correlates of CTM scores

Stratified median CTM-15 scores for patients were calculated based on age (age<25 years—median 86.7 (IQR 66.7–796.7); age 85 years or older—median 68.9 (IQR 64.1–68.9)), health literacy (low health literacy—median 68.9 (IQR 66.7–90.5); high health literacy—median 80.5 (IQR 66.7–96.1)), sex (female—median 78.6 (IQR 66.7–97.8); male—median 80.0 (IQR 66.7–95.6) and length of stay (<7 days—median 80.0 (IQR 66.7–95.6); >30 days—median 66.7 (IQR 57.8–100.0). However, statistical testing showed no significant difference in the

Table 2 Response characteristics to individual items of the Care Transitions Measure

		Strongly disagree n (%)	Disagree n (%)	Agree n (%)	Strongly agree n (%)	Not applicable n (%)
1	Before I left the hospital, the staff and I agreed about clear health goals for me and how these would be reached.	8 (2.5)	5 (1.6)	151 (47.8)	148 (46.8)	4 (1.3)
2	The hospital staff took my preferences and those of my family or caregiver into account in deciding what my health care needs would be when I left the hospital.	8 (2.5)	8 (2.5)	143 (45.3)	135 (42.7)	22 (7.0)
3	The hospital staff took my preferences and those of my family or caregiver into account in deciding where my health care needs would be met when I left the hospital.	8 (2.5)	9 (2.9)	148 (46.8)	130 (41.1)	21 (6.7)
4	When I left the hospital, I had all the information I needed to be able to take care of myself.	7 (2.2)	9 (2.9)	136 (43.0)	157 (49.7)	7 (2.2)
5	When I left the hospital, I clearly understood how to manage my health.	5 (1.6)	7 (2.2)	154 (48.7)	142 (44.9)	8 (2.5)
6	When I left the hospital, I clearly understood the warning signs and symptoms I should watch for to monitor my health condition.	5 (1.6)	14 (4.4)	140 (44.3)	143 (45.3)	14 (4.4)
7	When I left the hospital, I had a readable and easily understood written plan that described how all of my health care needs were going to be met.	8 (2.5)	19 (6.0)	144 (45.6)	123 (38.9)	22 (7.0)
8	When I left the hospital, I had a good understanding of my health condition and what makes it better or worse.	6 (1.9)	11 (3.5)	154 (48.7)	139 (44.0)	6 (1.9)
9	When I left the hospital, I had a good understanding of the things I was responsible for in managing my health.	4 (1.3)	3 (1.0)	149 (47.2)	154 (48.7)	6 (1.9)
10	When I left the hospital, I was confident that I knew what to do to manage my health.	4 (1.3)	6 (1.9)	156 (49.4)	138 (43.7)	12 (3.8)
11	When I left the hospital, I was confident I could actually do the things I needed to do to take care of my health.	5 (1.6)	4 (1.3)	156 (49.4)	139 (44.0)	12 (3.8)
12	When I left the hospital, I had a readable and easily understood written list of the appointments or tests I needed to complete within the next several weeks.	5 (1.6)	7 (2.2)	141 (44.6)	142 (44.9)	21 (6.7)
13	When I left the hospital, I clearly understood the purpose for taking each of my medications.	5 (1.6)	3 (1.0)	131 (41.5)	166 (52.5)	11 (3.5)
14	When I left the hospital, I clearly understood how to take each of my medications, including how much I should take and when.	6 (1.9)	6 (1.9)	129 (40.8)	164 (51.9)	11 (3.5)
15	When I left the hospital, I clearly understood the possible side effects of each of my medications.	7 (2.2)	27 (8.5)	149 (47.2)	115 (36.4)	18 (5.7)

distributions of CTM scores based on these four variables (figure 1). Distributions of CTM-15 scores, however, did significantly differ based on number of comorbidities. CTM-15 scores for those with six or more comorbidities had a lower maximum score (93.3), a lower median and a narrower interquartile (median 66.7 (IQR, 65.6–73.3)) compared with those with fewer comorbidities (maximum score of 100, median score 83.9 (IQR 66.7–97.6) for those with 0–2 comorbidities).

Readmissions and ED visits

Of the 316 patients, a total of 139 (44.0%) experienced the composite outcome of hospital readmission or ED visit at 90 days post discharge from the index hospitalisation; 86 (27.2%) patients were readmitted within 90 days, while 81 (25.6%) experienced an ED visit (leading to hospital readmission) in the same time frame. A total of 14 patients died within 90 days after discharge, 11 of which had a preceding hospital readmission or ED visit. There were no significant differences in median CTM scores for patients experiencing the composite outcome and those who did not (figure 2). The median CTM-15 Score for patients who had either a hospital readmission or ED visit within 90 days of discharge was 80.0 (IQR 66.7–97.4), compared with a median of 80.0 (IQR 66.7–95.6) for those who had neither.

We conducted logistic regression modelling the odds of hospital readmission or ED visit within 90 days of discharge, for the individual CTM-15 items (table 3).

While ORs were greater than 3 in adjusted analyses for two CTM items (item 6—'When I left the hospital, I clearly understood the warning signs and symptoms I should watch for to monitor my health condition'—and item 14—'When I left the hospital, I clearly understood how to take each of my medications, including how much I should take and when'), associations were statistically significant only for item 6 (adjusted OR 3.46 (95% CI 1.02 to 11.73)).

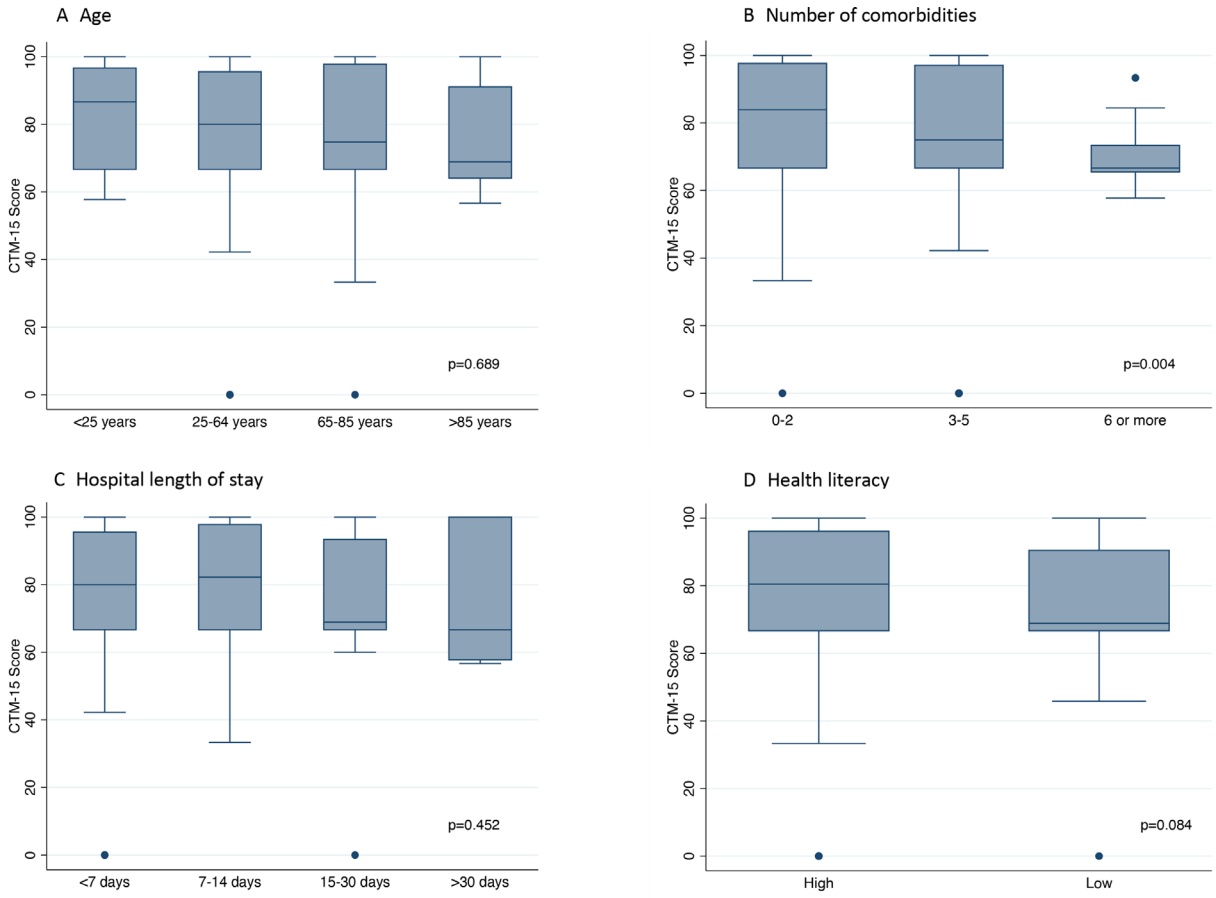

Figure 1 Boxplots of the 15-item Care Transitions Measure (CTM-15) scores, stratified by (A) age; (B) number of comorbidities; (C) hospital length of stay; and (D) health literacy.

DISCUSSION

Readmissions and subsequent ED visits after discharge are common among the general medical population. Despite this, patients reported high perceived quality of the discharge process of their index hospitalisation. Patient characteristics may be associated with perceived discharge quality, with distributions of CTM-15 scores being significantly different based on burden of comorbidities. While we did not find that global CTM scores were associated with hospital readmissions or ED visits within 90 days of discharge, individual components of the discharge process may be. Of the 15 CTM items, we found that one (not knowing the warning signs/symptoms to monitor post discharge) was significantly associated with over a threefold increase in the odds of this composite outcome in adjusted analyses.

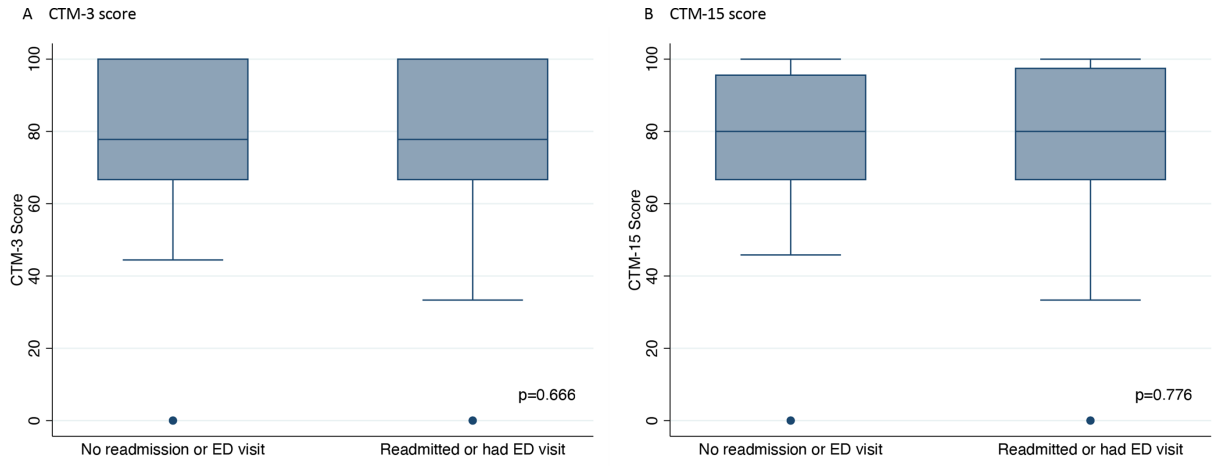

Figure 2 Boxplots of the (A) 3-item Care Transitions Measure (CTM-3) scores and (B) 15-item Care Transitions Measure (CTM-15) scores; for those with and without a hospital readmission or emergency department (ED) visit within 90 days of discharge.

Table 3 Logistic regression modelling odds of the composite and individual outcomes (ED visit and hospital readmission) at 90 days

	Crude models		Adjusted models*
	OR (95% CI)	P value	OR (95% CI)
Q1: Unclear health goals	2.10 (0.67 to 6.57)	0.202	2.24 (0.61 to 8.30)
Q2: Preferences not met: what health needs are	1.02 (0.37 to 2.82)	0.970	0.87 (0.30 to 2.52)
Q3: Preferences not met: where health needs are met	1.79 (0.66 to 4.84)	0.251	1.73 (0.61 to 4.92)
Q4: Not having all information to manage	1.26 (0.46 to 3.44)	0.657	1.35 (0.46 to 4.01)
Q5: Not understanding how to manage	1.24 (0.39 to 3.95)	0.711	1.55 (0.44 to 5.50)
Q6: Not understanding warning signs	2.93 (1.08 to 7.94)	0.034	3.46 (1.02 to 11.73)
Q7: Not having understandable written plan	0.64 (0.28 to 1.50)	0.307	0.63 (0.24 to 1.63)
Q8: Not understanding health condition	1.68 (0.61 to 4.64)	0.314	1.35 (0.44 to 4.18)
Q9: Not understanding responsibilities	3.24 (0.62 to 16.99)	0.164	2.56 (0.43 to 15.32)
Q10: Not confident in knowing what to do	1.26 (0.36 to 4.46)	0.716	1.24 (0.33 to 4.67)
Q11: Not confident in doing these things	1.59 (0.42 to 6.04)	0.496	1.42 (0.35 to 5.78)
Q12: Not having a list of appointments and tests	0.70 (0.20 to 2.46)	0.581	0.67 (0.17 to 2.57)
Q13: Not understanding purpose of medications	2.14 (0.50 to 9.14)	0.302	2.67 (0.48 to 14.89)
Q14: Not understanding how to take medications	1.83 (0.57 to 5.91)	0.310	3.20 (0.58 to 17.58)
Q15: Not understanding medication side effects	1.07 (0.51 to 2.20)	0.865	1.19 (0.49 to 2.87)

*Adjusted for age, sex, number of Elixhauser comorbidities, hospital length of stay, household income, health literacy, marital status.
ED, emergency department; Q, question number on the 15-item Care Transitions Measure.

The CTM scores reported by the sample population (CTM-15 median 80.0 (IQR 66.6–100.0)) were high relative to the published literature, where median CTM-15 scores tend to range between 63.7 and 81.8, with between 1% and 10% of patients in these studies reporting the maximum score.[23 24 29–32] In contrast, 18.0% of patients in our sample had maximum scores on the CTM-15. While the high CTM scores in this study may be attributable to true strengths in our institution's discharge processes, where we have daily multidisciplinary rounds and a discharge coordinator for support,[33] it is also possible that these scores may not accurately reflect adequacy of care processes or patient understanding of their medical conditions. In our study, over 10% of patients being discharged reported that they did not agree that they understood the warning signs to monitor or the side effects of their medications, or that they had an understandable written plan, despite discharge teaching having been completed merely hours (and sometimes minutes) before the questionnaire was administered in the vast majority of cases. Similarly, Horwitz *et al* found that despite high CTM scores (mean 77.2 (SD 18.3)), there were clear gaps in care, with over 2/3 of patients being discharged without documented follow-up, and over 1/3 of discharge instructions not including important information about dietary restrictions.[10] Others have also demonstrated patient knowledge gaps at the time of discharge. Markaryus and Friedman found that only 28% of their study participants were able to list their medications, and only 14% were able to state common medication side effects.[34] The need to provide patient information that is clear and understandable to patients at the time of discharge cannot be overstated. Multiple systematic reviews have shown that discharge interventions that empower patients to self-care are effective in reducing hospital readmissions.[6 8] Despite this evidence, discharge communications and patient education continue to be suboptimal,[35 36] often being rushed, lacking standardisation and not being given sufficient priority in the context of competing care demands.[18] The focus of the discharge process also currently tends to be on the completion of a discharge summary rather than on conveying information to patients,[36] even though prior literature suggests that discharge documentation is not associated with improved outcomes.[7] If we hope to improve patient satisfaction and postdischarge outcomes, there needs to be a greater focus on the face-to-face discharge encounter, particularly with regard to educating patients about warning signs and symptoms to monitor post discharge, the absence of which we found was associated with hospital readmission and ED visits.

We make a unique contribution to the discharge literature through our exploration of the correlates of CTM scores, thereby allowing us to identify certain patient groups who may be at risk for poor quality discharge care. Our study serves an exploratory purpose, to generate hypotheses for further testing on larger datasets. For example, median CTM scores for patients in the oldest age group were lower than the median scores for the younger age groups. While these differences were not statistically significant in our study, the lack of significance may be the result of our study being underpowered to detect these differences. It is nonetheless plausible that

the experience of the discharge process may differ based on patient age. Bobay *et al* noted that older patients tend to receive less information at discharge, potentially due to providers assuming that these patients have some level of baseline knowledge of chronic conditions, or due to the prevalence of cognitive issues in this population, resulting in higher demands on the time of healthcare providers to relay discharge information in a way that is understandable to the patient.[37] Other at-risk patient groups include those with a greater burden of comorbidities and longer lengths of stay in hospital. These groups may report lower perceived discharge quality, as the presence of chronic conditions has been shown to be associated with increased difficulty in understanding health information and in engaging with healthcare providers.[38] Furthermore, these patient groups are also likely represent those with increased medical complexity and therefore high discharge complexity, which has been demonstrated to increase the risk of errors in adherence to medications and comprehension of medication side effects,[39] particularly among those with low health literacy.[39 40] Perceived discharge quality may therefore depend on patient characteristics, and future studies should focus on identifying and quantifying these differences, so that specific patient subgroups who require special attention in discharge education and communications can be better supported in a targeted manner.

Our study has some limitations, the first of which is the relatively small sample size. This study is a subanalysis of a larger prospective cohort study examining the effect of social vulnerabilities on hospital readmissions and ED visits. Only those who completed the CTM were included in this analysis. As a result, our analyses assessing associations between CTM responses and scores and the composite outcome are underpowered (ie, vulnerable to type II error) and are therefore primarily hypothesis generating, as previously mentioned. With our available sample size, we have 80% power to detect a difference in CTM scores of 12, at an alpha of 0.05, assuming a mean CTM score of 80 and a common SD of 17. A related issue is that we do present multiple statistical comparisons for which statistical correction of p value thresholds could be considered. In the context of an exploratory study like this one, such statistical correction is less relevant and perhaps may even be somewhat distracting from the objective of generating hypotheses relating to potential determinants of discharge quality and postdischarge outcomes. A second limitation is inherent to the CTM itself, where ceiling effects and acquiescence bias (where respondents tend to agree, or respond positively, to statements of opinion regardless of content) have been described.[29] We also note that a high proportion of patients in this study agreed or strongly or strongly agreed to the individual items of the CTM, which may have resulted in misclassification bias. Because the misclassification is non-differential in nature, this biases toward the null, indicating that we may have underestimated the strengths of association. Finally, this was a single-centre study, which may limit its generalisability. However, it is one of the largest hospitals in Canada, providing care to more than two million people from Calgary, southern Alberta, southeastern British Columbia and southern Saskatchewan. In contrast to these limitations, an important strength of our study is the collection of data on perceived discharge quality on the day of discharge whenever possible, with only a small minority of patients completing the survey within 7 days. This differs from other studies that also use the CTM, where data are collected weeks after discharge,[27 31 41–43] which may result in response bias, particularly if completed after a hospital readmission or ED visit.

CONCLUSION

Overall, medical patients perceive their hospital discharge process to be of high quality. We have identified that perceived discharge quality varies based on patient characteristics—specifically burden of comorbidities. Patients with greater medical complexity and comorbidities may require dedicated time and attention to ensure understanding of discharge information. Furthermore, while global CTM scores were not associated with postdischarge outcomes, a single CTM item (not understanding warning symptoms and signs) was. Provision of this specific information is critical as a part of the discharge encounter, given its potential to affect postdischarge outcomes.

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Patient consent for publication Not applicable.

Ethics approval This study involves human participants. Ethics approval was obtained from the Conjoint Health Research Ethics Board at the University of Calgary (REB 14-0696). Participants gave informed consent to participate in the study before taking part.

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ORCID iD
Karen L Tang http://orcid.org/0000-0001-9008-2289

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