THE RELATIONSHIP BETWEEN PATIENT ACTIVATION AND SURGICAL OUTCOMES: A PILOT STUDY

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ABSTRACT

Background:

Patient activation is a behavioral concept, defined as a patient's knowledge, skills, beliefs and confidence to manage their own health care. In patients with chronic medical conditions, there is a strong association between higher levels of activation and improved healthcare outcomes, higher patient satisfaction, lower rates of health care system utilization and lower costs. However, there is very little evidence investigating the role of patient activation in surgical patients. The purpose of this study was to estimate the extent to which low preoperative activation predicts emergency department (ED) visits, complications, adherence with perioperative care processes and satisfaction after colorectal surgery.

Methods:

A secondary analysis of data obtained from a randomized trial performed in 2017 at the McGill University Health Center assessing the impact of a mobile health application on adherence with care processes (clinicaltrials.gov identifier NCT03277053) was performed. Participants were adult patients with colonic or rectal diseases who underwent colorectal surgery. The main exposure was patient activation, measured using the Patient Activation Measure (PAM) survey at baseline and before hospital discharge, and classified as high or low. The main outcome was ED visits within 30 days of surgery after hospital discharge. Secondary outcomes were complications, patient satisfaction and adherence to a postoperative colorectal surgery care pathway. Distribution of characteristics was compared between patients with high and low activation using Chi-square or Fisher's exact test and t-test or ANOVA for categorical and continuous variables, respectively. A univariate logistic regression was performed to determine predictors of return to the ED and complications. A multivariate logistic regression including complications, age, gender, comorbidity index and diagnosis was used to estimate the effect of low preoperative activation on return to the ED.

Results:

A total of 97 patients were included in the study cohort, of which 14% (n=14) had a low baseline level of activation and 86% had high levels of activation. Patient characteristics were similar between the two activation groups. Highly activated patients had higher adherence to postoperative care processes on postoperative day 1 (66% vs 47%, p=0.004), and felt more informed (p=0.000) and more motivated(p=0.004) about their care on the Satisfaction questionnaire. More patients with high activation were discharged within 3 days of surgery compared to low activation patients (37% vs 7%, p=0.021). There was no difference in the percentage of patients with at least one ED visit between the two activation groups (21% in high vs 20% in low group, p=0.548). At hospital discharge, a higher number of patients had low levels of activation compared to preop (30% vs 14% p=0.009). On the univariate logistic regression, the presence of postoperative complications (OR 16.06, 95%CI 3.45-74.72) was the only independent predictors of ED visits. On the multivariate regression, the presence of complications was the only independent predictor of ED visits (OR 19.41, 95%CI 3.84-98.14).

Conclusion:

This pilot study suggests that levels of activation do not predict of emergency department utilization after discharge in patients undergoing colorectal surgery. However, highly activated patients have a higher adherence to care pathways, tend to be discharged sooner after surgery, and feel more informed and motivated with their care. Furthermore, patient activation levels were decreased in the immediate postoperative period. Further studies in a larger cohort of surgical patients is warranted.

RÉSUMÉ

Introduction:

L'activation des patients est un concept comportemental défini par les connaissance, les compétences, les croyances et la confiance que les patients ont à gérer leurs propres soins de santé. Chez les patients souffrant de maladies chroniques, une forte association a été démontrée entre des hauts niveaux d'engagements et de meilleurs résultats postopératoires, une plus grande satisfaction des patients, une diminution du taux d'utilisation du système de santé et de plus faibles coûts. Cependant, il n'existe presqu'aucune donnée sur le rôle de l'activation des patients en chirurgie. L'objectif de cette étude était d'estimer à quelle mesure un bas niveau d'activation préopératoire prédit le nombre de visites aux urgences, les complications, l'adhérence aux programme de soin peropératoire et la satisfaction avec les soins après une chirurgie colorectale.

Méthodes :

Une étude secondaire a été réalisé en utilisant des données obtenues d'un essai clinique randomisé complété au Centre Universitaire de Santé McGill qui avait pour but d'évaluer l'impact d'une application mobile sur l'adhérence aux processus de soins (numéro identifiant sur clinicaltrials.gov : NCT03277053). Tous les participants étaient des patients adultes atteints de maladies du colon ou du rectum ayant subi une chirurgie colorectale. L'activation du patient a été mesurée en utilisant la mesure d'activation du patient (PAM) en préopératoire ainsi qu'en postopératoire et a été classé en tant que niveau élevé (niveaux 3 et 4) et niveau faible (1 et 2). L'issue principale analysée étaient les visites à l'urgence après dans les 30 jours suivant la chirurgie. Les issues secondaires étaient la présence de complications postopératoires, l'adhérence aux programme de soins postopératoires et la satisfaction des patients. La distribution des caractéristiques personnels et chirurgicaux des patients a été comparée entre les patients à taux d'activation élevé et faible en utilisant un test Chi-square ou la méthode exacte de Fisher pour les variables catégoriques, et le test t ou ANOVA pour les variables continues. Une régression logistique à variable unique a été effectuée pour déterminer les facteurs prédictifs du retour à l'urgence et des complications. Une régression logistique multivariée ajustée pour l'âge, le sexe, l'indice de comorbidité, le

diagnostic et les complications a été utilisée afin d'estimer l'effet d'une basse activation préopératoire des patients sur le retour à l'urgence.

Résultats :

Un total de 97 patients ont été inclus dans la cohorte étudiée, desquels 14% (n=14) avaient un bas niveau d'activation et 86% avaient des taux élevés. Les caractéristiques des patients étaient similaires entre les deux groupes d'activation. Les patients avec un haut niveau d'activation avaient un plus haut taux d'adhérence postopératoire le jour après la chirurgie (66% vs 47%, p = 0,004) et se sentaient plus informés (p=0.000) de leur soins et plus motivés (p=0.004) à participer. Un plus grand de patients avec une activation élevées un reçu leur congé de l'hôpital dans les 3 jours suivant la chirurgie par rapport aux patients avec un faible activation (37% vs 7%, p = 0,021). Il n'y avait aucune différence entre le pourcentage de patients ayant au moins une visite à l'urgence entre les deux groupes d'activations (21% dans le groupe élevé vs 20% dans le groupe bas, p=0.548). Un plus grand nombre de patients présentaient un faible niveau d'activation sur le questionnaire post-opératoire que sur celui complété en préopératoire (30% vs 14%, p=0,009). La régression logistique à variable unique a démontré que la présence de complications postopératoires (OR 16,06, IC à 95%: 3,45 à 74,72) était le seul facteur prédictif indépendant des visites à l'urgence. La régression multivariée a aussi démontré que la présence de complications était le seul facteur prédictif indépendant des visites à l'urgence (OR 19,41, IC à 95% de 3,84 à 98,14).

Conclusion :

Cette étude pilote suggère que les niveaux d'activation ne permettent pas de prédire l'utilisation des services d'urgence chez les patients subissant une chirurgie colorectale. Cependant, les patients hautement activés ont une plus grande adhérence aux programmes de soins, ont tendance à quitter l'hôpital plus rapidement après la chirurgie et se sentent plus informés et motivés. De plus, le niveau d'activation des patients a diminué dans la période postopératoire immédiate. D'autres études dans une plus grande cohorte de patients chirurgicaux sont justifiées.

STATEMENT OF SUPPORT

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I would also like to recognize the McGill General Surgery Division for supporting my interests in academic surgery and providing me with the necessary support and time off clinical duties to enroll in a Master's of Epidemiology and complete this thesis project.

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Lastly, I am thankful for the never-ending support of my family, my sister, my fiancé and my friends without whom I could not have completed this work.

DEDICATION

I would like to dedicate this thesis to my mother and my father for teaching me from a very young age that with dedication, perseverance and strong work ethics, I could achieve every goal I set for myself.

THESIS FORMAT

This is a manuscript-based thesis in compliance with the guidelines and specifications detailed by the Faculty of Graduate and Postdoctoral studies at McGill University. The thesis begins with an introductory chapter detailing relevant background information and an extensive review of the literature. Chapter 2 is a manuscript by the Master's candidate (Dr. Teodora Dumitra) and co-authors formatted for submissions to Surgery. Chapter 3 contains a more detailed discussion of the methodology. Chapter 4 presents the conclusion of the thesis as well as details on future research avenues based on the data presented in this thesis.

CONTRIBUTION OF AUTHORS

Dr. Teodora Dumitra (Thesis Candidate): In collaboration with my thesis supervisor Dr Liane S. Feldman and co-supervisor Dr. Nancy E. Mayo, I developed the research question and the study design. I was responsible for the data analysis, the interpretation of the data, the literature review and the writing of this thesis document.

Dr. Liane S. Feldman (Supervisor): Dr. Feldman was instrumental in the development of the research question and conception of the study design. She provided clinical insight into the study design, methodology and interpretation of data. Dr Feldman reviewed and edited the manuscript and this thesis document.

Dr. Nancy E. Mayo (Co-Supervisor): Dr. Mayo provided insight into the development of the research question, the study design, methodology and interpretation of the statistical analysis. Dr. Mayo reviewed and edited the manuscript and this thesis document.

Pepa Kaneva (co-author of manuscript): Mrs. Kaneva provided help in the conception of the study design and collected the data of the cohort used in this study.

Juan Mata (co-author of manuscript): Dr. Mata was the co-investigator of the randomized clinical trial that was the source of the data used in this study.

Julio F. Fiore Jr (co-author of manuscript): Dr. Fiore provided insight on the methodology and interpretation of the results.

LIST OF ABBREVIATIONS

CCI: Comprehensive Complication Index

ECRI: Emergency Care Research Institute

ED: Emergency Department

EMR: Electronic medical record

ERAS: Enhanced Recovery After Surgery

ERP: Enhanced Recovery Program

LOS: Length of stay

MUHC: McGill University Health Center

OR: Odds ratio

PAM: Patient Activation Measure

POD: Postoperative day

RCT: Randomized clinical trial

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CHAPTER 1 – LITERATURE REVIEW

1.2. Quality of Surgical Care

With the number of surgical procedures performed in Canada nearly doubling in the last decade, reaching almost 400,000 in 2018 (1), healthcare quality measurement and improvement have become a focus of healthcare systems and policy makers. The theory behind healthcare quality improvement was first brought forward by the Donabedian framework, a triad of structure, process and outcome (2). "Structure" was defined as the settings, qualifications of providers, and administrative systems through which care takes place; "process" is the components of the care delivered; and "outcome" is defined as recovery, restoration of function and survival (3). Several Systems have been developed to measure quality and outcomes in surgery, including the National Surgical Quality Improvement Program, the Surgical Care Improvement Program and the World Health Organization Surgical Safety Checklist. These systems have led to a significant reduction in surgical complications and mortality by more than 30% (4). However, little evidence exists on the role of patients in perioperative care and quality measurement. This is inconsistent with the current movement toward a more patient-centered care in other medical fields.

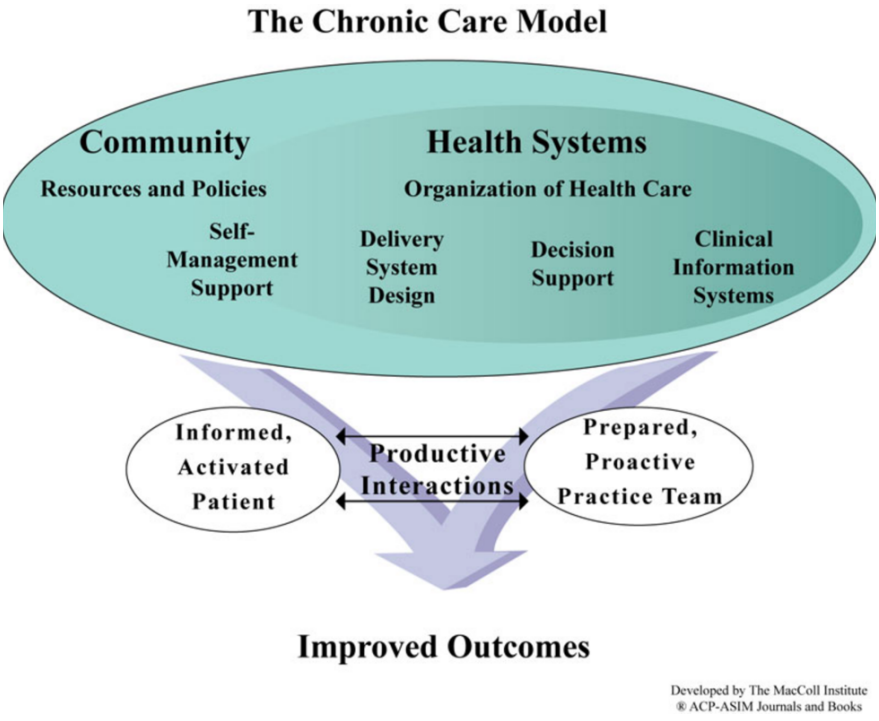
1.1. The Patient Centered Care Movement

A patient-centered approach has become fundamental to ensure appropriate and high quality patient care and to optimize outcomes (5). The Institute of Medicine 2014 Summit agreed on the following definition: "Self-management support is defined as the systematic provision of education and supportive interventions by health care staff to

increase patients' skills and confidence in managing their health problems, including regular assessment of progress and problems, goal setting, and problem-solving support." (6). The involvement of patients in their care and participatory decision making between patients, their families and clinicians are now recognized as a critical component to determine what support patients need to manage their care (7).

Most of the evidence around the engaged patient has been developed from the study of patients with chronic illnesses. The Chronic Care Model developed in 1998 called for a change in the health care system to emphasize interactions of clinicians with more informed and active patients (8). Wagner et al. identified "patient activation" as a critical element in health care prevention and effective self-management support as essential to minimize the emotional impact of disease.

Figure 1. The Chronic Care Model (8)



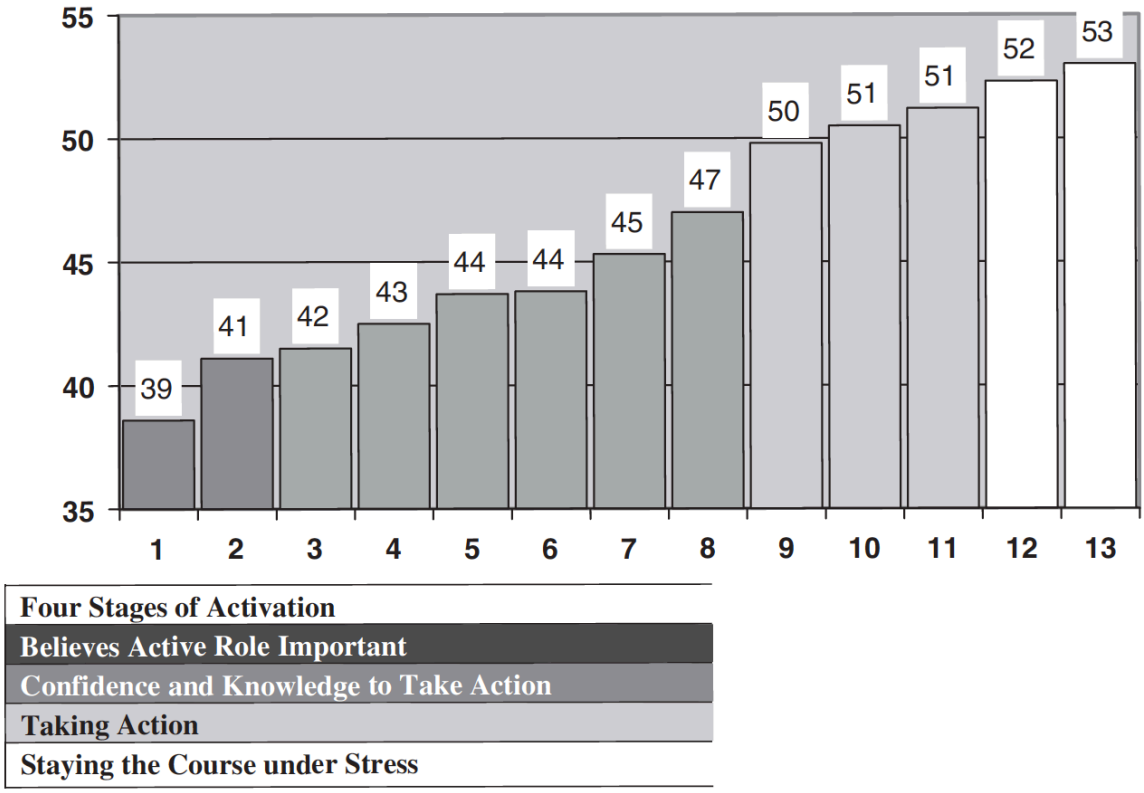
The goal of a patient-centered approach is for the patient to become a member of the care team. This model requires the patient to have the knowledge, the skills and the motivation to participate. The term "patient activation" is now widely used to define this behavioural concept. Patient activation encompasses multiple core components of patient involvement, including self-efficacy in self-managing behaviour and readiness to change health-related behaviours (9). The Emergency Care Research Institute (ECRI) has identified patient engagement and literacy one of the top ten Patient Safety Concerns for Healthcare Organizations in 2018 (10). This list is based on over 2 million patient safety organization reports and identifies the challenges with the highest frequency and severity. Furthermore, the Affordable Care Act has made patient engagement a central component of health policies and created Accountable Care Organizations to prompt patient activation and engagement (11). Thus it is necessary to adequately measure a patient's ability to engage in self-care behaviours and what are the determinants of their behaviours.

1.2 Patient activation measure (PAM® Survey)

As attributed to Lord Kelvin: "To measure is to know. If you cannot measure it, you cannot improve it". Establishing an appropriate measurement is a necessary first step in effectively improving care. In 2004, Hibbard et al. developed the Patient Activation Measure (PAM), a valid and reliable measure of patient activation (9). The original 22-item questionnaire was based on 6 domains that can improve health outcomes: self-management of symptoms and problems, engaging in activities that maintain function and reduce health declines, involvement in treatment and diagnostic choices, collaboration with providers, selection of providers based on quality and navigation of the health care system (9).

Activation is comprised of the knowledge, skills, belief and confidence for managing health and health care. These elements have a hierarchical order, making the PAM survey developmental in nature. The individual items form a unidimensional, probabilistic Guttman-like scale. Individuals are stratified in one of four stages based on their overall score. In the first stage, patients do not understand that playing an active role in their own health care is important; they are passive recipients of care. Patients in the second stage lack the knowledge to understand their health and treatment regimens. In the third stage, patients do understand the facts, such as when to seek help and what the nature and causes of their health conditions are. They are beginning to take action but lack the confidence to do so. In the fourth and final stage, patients have adopted new behaviours but they might not be able to maintain them under stressful circumstances (Figure 2).

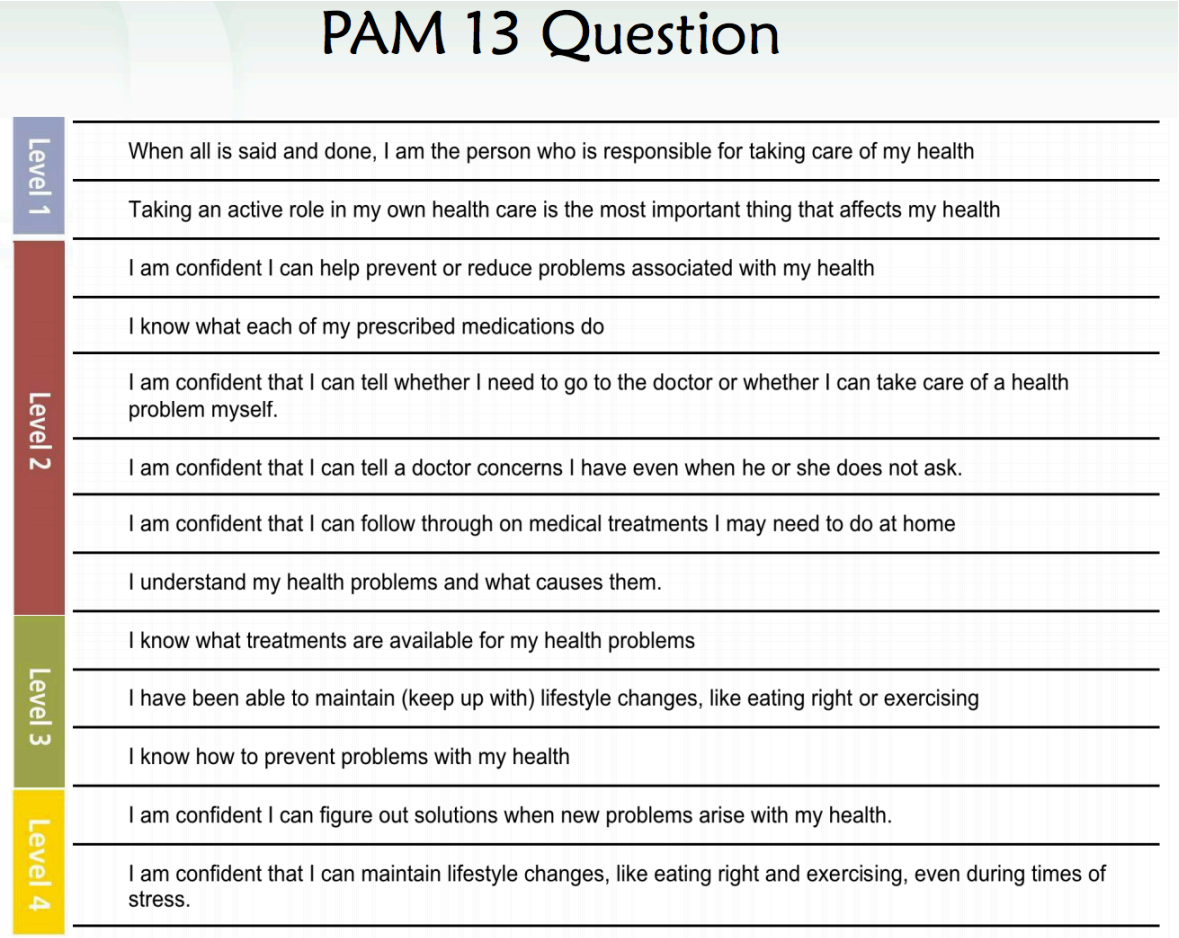
Figure 2. Adapted from Hibbard et al. (12) Thriteen-Item Patient Activation Measure with Item Calibrations and the Four Stages Identified



Key: Item calibrations are the calibrated scale value of the item. This represents how much activation is required to endorse the item.

Also designed as a method to hold the health care system and providers accountable for supporting and increasing patient activation, the questionnaire was redesigned into a 13-item questionnaire with similar psychometric properties that is now widely used (12). The development of this shorter measure was consistent with the requirements established by the Institute of medicine (6) and designed to be less costly and less burdensome. In the last decade, the PAM survey has been highly validated in multiple languages and cultures, and it is now being used in 16 countries around the world.

Figure 3. The 13-item Patient Activation Measure survey (12)



1.3 Why measure Patient Activation?

Since its inception, multiple studies have established an association between higher levels of activations and better outcomes. A cross-sectional study of over 25,000 patients concluded that patients with higher levels of activation were more likely to utilize screening preventive measures, less likely to engage in unhealthy behaviours such as smoking or being overweight, and were less likley to be hospitalized or use the emergency department (ED) (13). A systematic review by Kinney et al. (14) of ten publications strongly confirmed these results, with chronically ill patients in stages 1 and 2 having higher healthcare utilization,

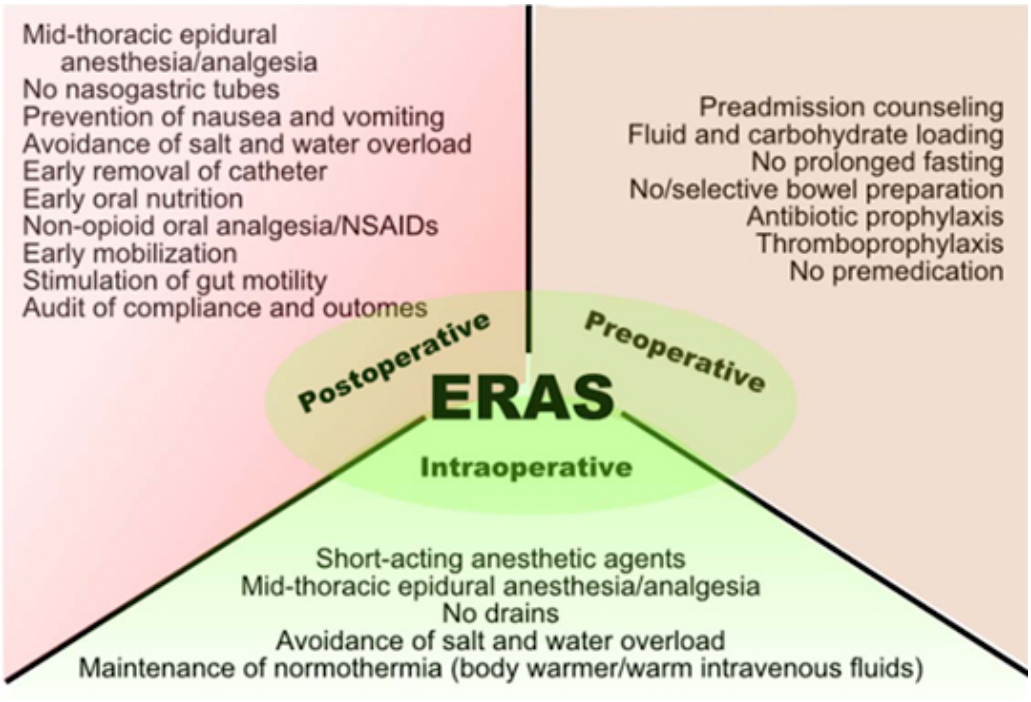
including readmissions and ED visits. Patient empowerment has been identified as an approach that promotes patient's well-being in decision making and self-management behaviours. A randomized clinical trial (RCT) of patients (n=50) with end stage renal disease demonstrated that a program using empowerment strategies significantly improves empowerment, self-care self-efficacy as well as depression (15). Empowerment and self-efficacy are central to a highly activated patient. Most importantly, activation being developmental in nature suggests different strategies can be tailored to each stage in order to improve it. Multiple interventional studies have identified patient activation as being a modifiable factor (7, 16, 17). In several studies of patients with chronic illnesses such as diabetes, hypertension and heart failure, a tailored approach to increasing patient activation led to improvements in self-management bahaviours (n=479) (17), decreased ER visits and readmissions (n=6,828) (18), and decreased health care costs (n=25,047) (13). Patients with lower levels of activation may lack the necessary knowledge and skills to manage a health care problem at home or do not believe they can resolve a problem wihtout their health care professional. This may lead to increasing visits to the ED for some health care problems that are considered avoidable with the appropriate prior guidance. Interestingly, even patients within level 4 can improve their activation in terms of health behaviors (n=320) (19). Thus, being able to measure activation and subsequently tailoring patient education can siginificantly impact individual care and the health care system overall.

1.4 Enhanced Recovery Programs in Colorectal Surgery

Major abdominal surgery causes a significant metabolic stress that requires a prolonged period of recovery. The concept of Enhanced Recovery After Surgery (ERAS) was

first developed by Kehlet and promoted by the ERAS society with the goal to optimize the quality of surgical care (20). The main purpose of Enhanced Recovery programs (ERP) is to more rapidly return patients to baseline (21). ERPs involve the reorganization of perioperative care from a clinican-centered to a patient centered model, implementing a standardized evidence-based care pathway to guide care throughout the perioperative period (22) (Figure 4). In metanalyses of randomized trials ERPs decrease complications, length of stay (LOS) and costs (18,19). However, the institution of ERPs has not decreased the number of visits to the Emergency Department or readmissions after hospital discharge, which are considered important quality metrics (23).

Figure 4. Components of an Enhanced Recovery Program (Adapted from the ERAS© Society Website).



1.5 Patient Activation in Surgery

Chronic conditions involve complex treatment regimens, careful monitoring, the adoption of lifestyle changes and decision-making in regards to seeking professional medical care (18). Patients who undergo surgery may not only have chronic conditions but also experience significant physical and emotional stress due to the procedure (24). It is now well recognized that patient engagement and participation in their own care is crucial when implementing ERPs and discharge programs. Guidelines strongly recommend patient education as a cornerstone of ERPs (20, 25) however the level of evidence is low (26). It is presumed that engaged patients would be more adherent to care processes, and adherence is strongly associated with outcomes (n=347) (27). However, very few studies have assessed the impact of patient activation in patients hospitalized secondary to an operation, most of which were done in patients undergoing orthopedic surgery (28-30). In one study (n=174), higher preoperative patient activation was associated with better pain control, improved mental health and greater satisfaction after total joint arthroplasty (28). Higher PAM scores have also been correlated with improved participation and adherence to a physical therapy program after lumbar spine surgery (n=283) (29).

To our knowledge, no studies have assessed patient activation in patients undergoing general surgery or colorectal surgery. However, the implications of quantifying the effect of patient activation on surgical outcomes and health system utilization are potentially significant. One important driver of health system utilization is unscheduled emergency department visits. Return to the ED after colorectal surgery occurs in 10 to 15 % of patients. In Canada, surgical patients account for a fifth of all post-discharge ED returns which generate over $6 million in costs per year (31). Risk factors for postoperative ED visits

include age, gender, Charlson comorbidity index score, an ED visit in the last 6 months and rural residence (31). ED visits that do not result in readmission are considered a potential target for quality improvement, as more effective and efficient care may have been available through self-management, contact with a health care provider or clinic visit (32). These are factors that may be related to patient activation and therefore may be modifiable.

CHAPTER 2 – OBJECTIVES AND HYPOTHESIS

3.1 Main objectives

The main objective of this study is to estimate the effect of preoperative patient activation on healthcare system utilization after hospital discharge following colorectal surgery, measured as return to the emergency department and readmission within 30 days. We hypothesize that patients with lower levels of engagement, as estimated by the patient activation measure (PAM) score, will have a higher rates of emergency department visits after discharge, compared to patients with higher levels of activation.

3.2 Secondary objectives

A secondary objective is to estimate the effect of preoperative patient activation on adherence to prescribed in-hospital perioperative care processes after elective colorectal surgery, on complications within 30 days after surgery, on length of hospital stay and on patient satisfaction with care processes. We hypothesize that patients with higher levels of engagement will have greater adherence to postoperative care processes, lower complication rates, shorter lengths of stay and higher satisfaction compared to patients with lower levels of engagement.

CHAPTER 3 – MANUSCRIPT (formatted for submission to Annals of Surgery)

THE RELATIONSHIP BETWEEN PATIENT ACTIVATION AND SURGICAL OUTCOMES: A PILOT STUDY

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INTRODUCTION

There are over 300,000 colorectal operations performed each year in the United States, accounting for over $6 billion in health care costs (33). The introduction of standardized perioperative Enhanced Recovery pathways (ERP) has significantly decreased complications, reduced hospital length of stay and decreased overall costs after colorectal surgery, when compared to traditional care (23, 34). However, the implementation of ERPs has not impacted emergency department visits or readmissions after discharge. A recent study of almost 3,000 Canadian colorectal surgery patients enrolled in an ERP reported that 11.6% of patients returned to the ED, surgical site infections and wound complications being the two principal reasons (35).

In Canada, surgical patients overall account for 20% of all emergency department (ED) returns after discharge and 24% of readmissions (31). Hospital utilization within 30 days of discharge is costly, after colorectal surgery, with unplanned ED visits averaging at 904$ per visit and each hospital day of readmission costing 2696$ on average (36). . For this reason, hospital utilization is often used as a surrogate to assess the quality of intra-hospital care and outcomes. Strategies to improve the quality of surgery and resource utilization traditionally focus on clinician behaviour and on the organization of the health care system but successful care transition is also contingent upon a patient's ability to manage their discharge care plan once they have returned home. Male gender, advanced age, complex medication regiments, depression and low health literacy are risk factors for early unplanned hospital reutilization in patients with chronic illnesses (37). Patient engagement and literacy are considered to be in the top ten Patient Safety Concerns for Healthcare Organizations in 2018 (10).

Patient activation is a behavioural concept that encompasses the core components of patient engagement, including self-efficacy in self-managing behaviour and readiness to change health-related behaviours (9). Patient activation requires patients to have knowledge, skills, confidence and motivation to participate. In patients with chronic medical conditions, evidence supports an association between higher levels of activation and improved healthcare outcomes, higher patient satisfaction and lower costs. Highly activated patients are more likely to utilize screening preventive measures, they are less likely to engage in unhealthy behaviours and less likely to be hospitalized (13, 38, 39). Most importantly, patient activation may be modifiable through coaching, education and peer support (40, 41). Studies have shown that a tailored patient approach to increase patient activation leads to improved self-management behaviours (17), a 22% decrease in ED visits, a 33% decrease in readmissions (18), along with a decrease in health care costs (19). This is of particular interest in Canada, and specifically the province of Quebec, where access to outpatient clinics and family doctors has become more difficult and patients often use the ED as a first access point to healthcare (32).

However, there is a lack of evidence on the role of patient activation in surgical patients, and no studies in patients undergoing colorectal surgery. The primary objective of this study was to estimate the extent preoperative patient activation impacts emergency department use after hospital discharge in adults undergoing colorectal surgery. The secondary objective was to estimate the extent to which other outcomes of adherence to an ERP, postoperative complications, length of stay and satisfaction with care after colorectal surgery and postoperative complications are affected by preoperative levels of activation.

METHODS

Participants and Setting

A secondary analysis of data from 97 adult patients enrolled in a recent randomized controlled trial (clinicaltrials.gov NCT03277053) was performed. The trial included patients undergoing scheduled colorectal surgery at the Montreal General Hospital, a university-affiliated tertiary care centre, in 2017. This trial investigated the impact of a mobile device application to improve adherence to an enhanced recovery program after colorectal surgery compared to standard patient education. Adult patients (>18 years old) undergoing surgery for colonic or rectal diseases were included. Patients with medical conditions that precluded them from following the pathway or using a tablet computer (i.e. cognitive, neurological, or musculoskeletal diseases) were excluded. Patients unable to understand or read English or French were also excluded. This cohort study was in accordance with approval obtained from the Institutional Review Board of the McGill University Health Centre. All patients received perioperative care according to an established ERP (42), including a preoperative education session with a trained nurse and an illustrated booklet including recovery goals for each postoperative day (43).

Measures

Patient and Surgical Characteristics

Demographic data, including age, gender and comorbidities, were collected. The average individual income was determined based on the postal code using the 2016 Census Profile on Statistics Canada (44). This, along with owning a smartphone or a computer were used as a surrogate of socioeconomic status. Comorbidity level was classified using the

Charlson Comorbidity Index (45, 46). Underlying diagnosis was categorized as malignant or benign, including inflammatory bowel disease, diverticular disease or other. Surgical procedure, new stoma creation, procedure duration (minutes) and surgical approach (laparoscopic, open or converted from laparoscopy to open approach) were recorded.

Patient Activation

The Patient Activation Measure Questionnaire (PAM® Survey) was supplied by ©Insignia Health, 2016, on a research license. The survey includes 13 items evaluating knowledge, skills, beliefs and confidence , each scored as Strongly agree, Agree, Disagree, Strongly Disagree or Not applicable (appendix 1). An overall score of 0 to 100 is calculated based on a hierarchical item calibration using the licensed PAM® Survey Calculator (47). Patient activation has a hierarchical structure and the overall PAM score stratifies patients into four stages, or levels of activation: scores ≤ 47 for level 1, scores ≥47.1 and ≤ 55.1 for level 2, scores ≥55.2 and ≤ 72.4, for level 3, and scores ≥72.5 for level 4. At the lowest stage, level 1, patients are passive recipients of care, and at the final stage, level 4, patients have adopted new behaviours but might not be able to maintain them under stress. The questionnaire was administered in French or English, based on patient preference. The questionnaire was administered at the preoperative visit (baseline level), postoperatively prior to hospital discharge and four weeks after surgery . Consistent with other studies, patients were further categorized into a low level of activation (levels 1 and 2) and high levels of activation (levels 3 and 4) (37).

Outcomes

Primary outcome

The primary outcome was the percentage of patients with one or more unplanned emergency department (ED) visits within 30 days of surgery. These were recorded from the electronic medical record (EMR) and confirmed with the patient at the four-week postoperative follow-up, either in person or by phone. Readmissions were not analyzed as an independent outcome since all readmissions were via the emergency department. The reasons for ED visits were also recorded from the medical record (appendix 2).

Secondary Outcomes

Adherence to a bundle of 5 postoperative care elements on postoperative day (POD) 0, 1 and 2 were collected. These included early mobilization, gum chewing, consumption of oral fluids, breathing exercises (spirometry) and consumption of a nutritional drink. Achieving adherence to each element is described in appendix 3. Adherence for each postoperative day was calculated as the number of completed elements divided by five. Overall adherence was calculated as the percent adherence to the five elements on postoperative days 0,1 and 2.

Postoperative complications were recorded up to 30 days using predefined criteria (27). Complications were graded using the Comprehensive Complication Index (CCI), a validated measure summarizing the complete spectrum of complications and their severity in a single score ranging from 0 to 100 (48). Evidence suggests the CCI is more sensitive in assessing morbidity compared to the classic Dindo-Clavien classification (49).

Length of stay (LOS) was defined as the number of nights spent in the hospital from the day of the surgery to the day of discharge. LOS was dichotomized as less than 3 days and 3 days or more, as the target day of discharge for the ERP was 3 days.

Patient satisfaction with the ERP was measured at hospital discharge using 4 items derived from the Consumer Assessment of Healthcare Providers and Systems Surgical Care Survey (S-CHAPS) (50), with responses ranked on scale from Strongly Disagree to Agree (see questionnaire in appendix 4) .

Statistical Analysis

Descriptive statistics using means and 95% confidence intervals (CI) were used to characterize the patient population. For each patient, median and interquartile range (IQR) PAM scores were compared at baseline, prior to hospital discharge and 30 days after surgery. Demographics, patient characteristics, adherence to ERP elements and postoperative outcomes were compared between patients with high versus low preoperative levels of activation. Comparisons were done using Chi-square test or Fisher's exact test for categorical variables, and t-test or ANOVA for continuous variables. Mann-Whitney test was used to compare median scores for each item assessing satisfaction with care.

The impact of patient activation, patient characteristics, postoperative outcomes and adherence to perioperative care elements on the occurrence of unplanned ED visits within 30 days of surgery was assessed using a logistic regression (occurrence of at least one ED visit). Based on the results of the univariate analysis and existing data, a multivariate logistic regression was performed to determine independent predictors of unplanned ED visits. The following independent variables were included: baseline level of activation (low versus

high), age (using 65 years as a cut-off based on this cohort mean), gender (male versus female), age-adjusted Charlson Comorbidity index, and diagnosis of malignancy (known to be related with higher healthcare utilization than benign colorectal diseases (51, 52)). No interaction term was used in the multivariate regression. Occurrence of complications within 30 days of surgery was also included in the multivariate analysis as it was the only predictor of ED visits in the univariate analysis. A second multivariate analysis was performed using the pre-discharge level of activation as it differed from the baseline level of activation. Statistical analysis was performed using STATA version 13.1 software (StataCorp, CollegeStation, TX, USA).

RESULTS

In the original trial, there were 135 patients assessed for eligibility, of whom 100 were randomized and 97 were analyzed (53) (Table 1). The mean age was 60 years (95% CI 57-63) and males represented 55% of the cohort. The majority of patients underwent surgery for a malignancy (55%) using a laparoscopic approach (78%). The mean preoperative PAM score was 66 (95% CI 64 to 69), with 14% of patients having a low level of activation (2% level 1 and 12% level 2) (Table 2).

Of the 97 patients assessed preoperatively, 3 declined to complete a post-surgical PAM survey prior to discharge and 1 patient was missed, resulting in 93 secondary PAM surveys. Patient activation at baseline and 30 days after surgery had a similar distribution (Figure 1). However, prior to discharge, patient activation score had a wider distribution and there was a higher proportion of low levels of activation (30% low at pre-discharge vs 14% low at baseline, p=0.001).

Enhanced Recovery Program (ERP) Adherence and Postoperative Outcomes

Adherence to the bundle of care pathway processes was 50% on POD 0, 64% on POD 1 and 33% on POD 2 (Table 3). Postoperative complications occurred in 45% of patients, with 19% of patients developing infections and 16% developing primary ileus (Table 4). The median length of stay was 4 days (IQR 2 to 5 days), with 33% of patients discharged prior to POD3. Nineteen patients (20%) had at least one unplanned emergency department visit after discharge (see reasons in appendix 2), all at the Montreal General Hospital. Of these, 5 patients (5%) were readmitted to the ward of which four patients required a reoperation. Of the 19 patients with visits to the ER, 74% (n=14) could have potentially been avoided.

Comparison of patients with high and low activation

At baseline, 14 patients had lower levels of activation (levels 1 and 2) and 83 patients had higher levels (levels 3 and 4). The mean baseline PAM score was 50.7 (95%CI 49.7-51.8) in the lower level group compared to 69.0 (95%CI 66.8-71.1) in the higher level group (p=0.000). Patient and operative characteristics were otherwise similar between the two groups (Table 5). While overall adherence to postoperative care processes was similar between the two groups, patients with high levels of activation had higher adherence to the care process bundle on POD 1 compared to patients with low levels of activation (66% vs 47%, p=0.004). A higher proportion of highly activated patients had early discharge (LOS < 3 days) compared to poorly activated patients (37% vs 7%, p=0.031). There was no difference in the incidence of postoperative complications. Return to the ED after discharge was similar between the high and low activation groups (20% vs 21%). On the Satisfaction questionnaire, patients who were highly activated felt more informed (IQR [4-5] vs 3-4,

p=0.000) and more motivated to participate in their care (IQR [4-5] vs [3-4], p=0.042) than patients with low activation (Table 6).

Predicting return to the Emergency Department after Discharge

On the univariate logistic regression, the presence of any postoperative complication (OR 16.06, 95%CI [3.45-74.72]) and higher CCI score (OR 1.05, 95%CI [1.02-1.09]) were predictors of ED visits after discharge. A low baseline of activation did not significantly increase the odds of ER visits (OR 1.14, 95CI [0.28-4.6]), nor did a low pre-discharge level of activation (OR 2.2, 95%CI [0.76-6.36]) (Table 7).

Multivariate regression was used to adjust for known predictors of ED visits post discharge, including age, male gender, malignancy and Charlson comorbidity index. After adjusting for these variables, the only independent predictor of ED visits was the presence of complications (OR 18.50, 95%CI [3.63-94.19]). A low preoperative level of activation was not an independent predictor of unplanned emergency department visits (Table 8).

DISCUSSION

The findings from this pilot study suggest that the baseline level of activation of patients does not predict unplanned emergency department visits after hospital discharge in patients undergoing colorectal surgery. However, patients having higher activation scores had higher adherence to the care pathway after surgery and were more likely to be discharged early. Highly activated patients also felt more informed about the tasks to undertake and more motivated to undertake the tasks of the ERP. Interestingly, activation score was affected by the surgical intervention and hospitalization, with more patients being less activated in their care. This returned to baseline by one month after surgery.

To our knowledge, this is the first study of patient activation in patients undergoing abdominal surgery. There is a large body of research on the role of patient activation in patients with chronic illnesses, such as diabetes or hypertension. Higher PAM scores have also been correlated with improved participation and adherence to physical therapy programs after lumbar spine surgery (29). Patient activation is now recognized as a determinant of length of stay, outcomes, healthcare system utilization and health care costs. A recent study by Mitchell et al. (37) demonstrated that level 1 patients (passive recipients) have a 75% higher incidence rate of hospital utilization 30 days after discharge (ED visits and readmissions) compared to level 4 chronic patients. Our study did not confirm this association in patients undergoing colorectal surgery. However, the cohort only included 14% patients with low activation of which a single patient was level 1. This proportion is much lower than the 10-15% of level 1 patients noted in previous studies in medical patients (13, 16, 37, 54). This discrepancy may be secondary to the fact that this cohort of patients was extracted from an RCT. Moreover, unlike medical studies, planned surgeries are not performed on the sickest patients and the latter are usually optimized prior to surgery. The small sample may explain the inability to demonstrate an association in colorectal patients.

Short-term unplanned return visits to the emergency department are increasingly used as a performance, metric by hospitals and policy makers, particularly if readmission is required (55). After colorectal surgery, the cost of an unplanned ED visit averages 904$ and the cost of each hospital day of readmission is 2696$ (36). Not only are these visits costly, but they also cause significant distress for the patient (56). Quality improvement efforts focus on so-called “preventable” ED visits (32), a term that may be difficult to define. In the present study, a total of 19 patients (20% of the cohort) visited the emergency department

after discharge, with only 5 readmitted to hospital. The results of our study confirm other studies reporting postoperative complications as the only predictor of ED visits, with an odds ratio of 16.05 (95%CI 3.45-74.72) in the univariate regression analysis. However, the majority of patients presented with problems related to wound issues, mild abdominal pain and constipation, which might have been possible to address in other settings. The ability to understand their own postoperative care and to obtain an outpatient postoperative appointment were identified as the most common barriers to preventing a readmissions in a recent study of colorectal patients (57). It is not known whether patients in the current study attempted to receive care through other outpatient settings such as the surgeon's clinic, a CLSC, or their family doctor, rather than present to the emergency room. This may reflect a lack of access to outpatient clinics and family doctors in Quebec.

While there was no difference in ED visits post-discharge, there were other differences identified in the low and high activation groups. Mean adherence to the care pathway elements on POD 1 was higher in highly activated patients compared to low activation patients (66% vs 47% respectively). Highly activated patients were also more likely to be discharged prior to postoperative day 3 compared to patients with low activation (37% vs 7%, respectively, $p<0.005$). This may be directly correlated with adherence to postoperative ERP elements and completion of daily milestones on POD 1, which would result in an earlier hospital discharge (27). If activation is modifiable, this suggests a potential avenue to improve ERP success rates and improve outcomes. Engaging patients in ERPs is not a "one-size-fits-all" approach and personalized adaptations of these pathways based on activation level may need to be considered to guarantee the highest success.

The data presented in this study is in agreement with the principle that patient activation is independent of demographics or socioeconomic status. As Dr Hibbard, the developer of the PAM stated: "Contrary to what some may assume, patients who demonstrate a lower level of activation do not fall into any specific racial, economic, or educational demographic." (58). Age, gender and estimated average income and possession of a computer or smartphone were similar between patients with high and low activation. However, postal codes were used as a surrogate for income and no data on education was available in this study. Health literacy and knowledge of diseases are directly related to patient activation as they are components of the first stage of activation. In this study, highly activated patients felt significantly more informed than patients with low activation (median 5 vs 3 on 5, respectively). This generates the question: Why do they feel more informed? Patients with higher activation may be more engaged in their own care, resulting in information-seeking and knowledge-seeking behaviours. They may also be better able to incorporate the patient education materials provided as part of preoperative care, including written and spoken information. There is a known association between limited health literacy and a higher number of preventable ED visits (59). Patients at risk of inadequate self-management due to inadequate knowledge or information may benefit from targeted and tailored interventions (60), whether it be through peer support (61) or healthcare workers. Although previous studies have demonstrated patient activation to be a predictor of self-confidence in managing a treatment (62), we did not find an association between patient activation and a higher level of confidence in their care. However, our study showed that motivation to participate in care was higher in patients with higher activation, which is directly associated with items of stage 2 in the PAM survey.

The present study confirms that patient activation levels may fluctuate with time and with events. The percentage of patients with low activation levels doubled from 14% at baseline to 30% at prior to hospital discharge. PAM scores also had a higher variability at this latter time in perioperative period. This suggests that undergoing surgery, a potentially life-altering experience, can significantly impact a patient's healthcare attitudes and behaviours. Although patient activation has been shown to vary with time and to be modifiable (63), these were studied in the context of a program implementation. In the context of a surgical population, patients are experiencing the acute impact of the major procedure, often in the context of chronic illnesses. The study sample was too small to enable further evaluation of the reasons for the changes in activations score at discharge, and these returned to baseline by the 30 day assessment.

Strengths and Limitations

A strength of this study is the use of data collected from an RCT with no losses to followup. However, this study also has several limitations. Selection bias is a concern in this study since the entire cohort was enrolled in a randomized clinical trial and patients with language barriers, cognitive, musculoskeletal or cognitive disorders were excluded. There may be a higher level of motivation in patient's participating in an RCT which may explain the relatively low proportion of patients with low activation at 14% compared to 30% in the literature (38). As a secondary analysis, certain variables of interest were not directly measured. There is a potential for misclassification of individual average income as it was determined using postal codes and census data rather than asking the patient directly. However, it is unlikely that this misclassification introduced a systematic error as it would

have occurred in patients of all activation levels and was not relevant in the main outcome analysis. Education data was also not available in this cohort which would have more accurately assessed the literacy level of patients. We lacked information on patient-reported outcomes including pain, functional status and health-related quality of life. The patient satisfaction questionnaire used was a briefer adaptation of the S-CAHPS questionnaire which may not capture all aspects of patient satisfaction. The size of the cohort (n=97) and particularly the small number of patients with low activation brings its own limitations, including a decrease in the power of the study as well as a decreased power of statistical analysis. The lack of statistical significance in the logistic regression may be due to the small sample size rather than the absence of an association.

CONCLUSION

In this pilot study, we are assessing for the first time the impact of patient activation on unplanned hospital utilization following discharge after colorectal surgery. This study does not seem to suggest that low activation predicts visits to the ED after discharge in these patients. However, this study highlights the variability of patient activation prior and after a major surgical procedure. Consistent with literature in chronic medical conditions, it also suggests an association between activation levels and a patient's knowledge and motivation about their care, which may play an important role in the context of adherence to an enhanced recovery program. Further studies are required to effectively assess the role of patient activation in a larger population of surgical patients undergoing a wider range of procedures.

Table 1. Characteristics of patients included in the study.

Data presented as n(%) unless specified

Variables	Total (n=97)
Age, mean (95% CI)	60.1 (57 – 63)
Gender, male	54 (56)
Average estimated income per year*	
<30,000$	26 (27)
30,000-39,999$	37 (39)
40,000-49,999$	23 (24)
≥50,000$	10 (10)
Owns Smartphone or Computer	80 (82)
Charlson Comorbidity Index, mean (95% CI)	3.43 (2.9 – 3.9)
Diagnosis:	
Malignancy	53 (55)
Inflammatory bowel disease	19 (20)
Diverticular disease	9 (9)
Other	16 (16)
Surgical approach, laparoscopic	75 (78)
Procedure performed:	
Right hemicolectomy	25 (26)
Low anterior resection	19 (20)
Sigmoid resection	16 (16)
Left hemicolectomy	8 (8)
Ileocecal resection	14 (14)
Abdominoperineal resection	5 (5)
Proctocolectomy	3 (3)
Total / subtotal colectomy	6 (6)
Other	1 (1)
Creation of a new stoma	12 (12)
OR duration in minutes, mean (95%CI)	217 (201 to 233)

* Based on postal codes using the 2016 Census Profile on Statistics Canada (44)

Table 2. Patient activation level of patients included in the study.

Data presented as n(%) unless specified otherwise

Variables	Preoperative (n=97)	Pre-discharge (n=93)	30 days postoperative (n=94)
PAM[a] score, mean (95% CI)	66 (64 - 69)	67 (63-71)	68 (65-71)
Activation Level:			
Level 1	2 (2)	9 (10)	4 (4)
Level 2	12 (12)	19 (20)	12 (13)
Level 3	49 (50)	22 (24)	44 (47)
Level 4	34 (35)	43 (46)	34 (36)

[a]PAM: Patient Activation Measure

Figure 1: Median (IQR) of patient activation measure scores at 3 time intervals

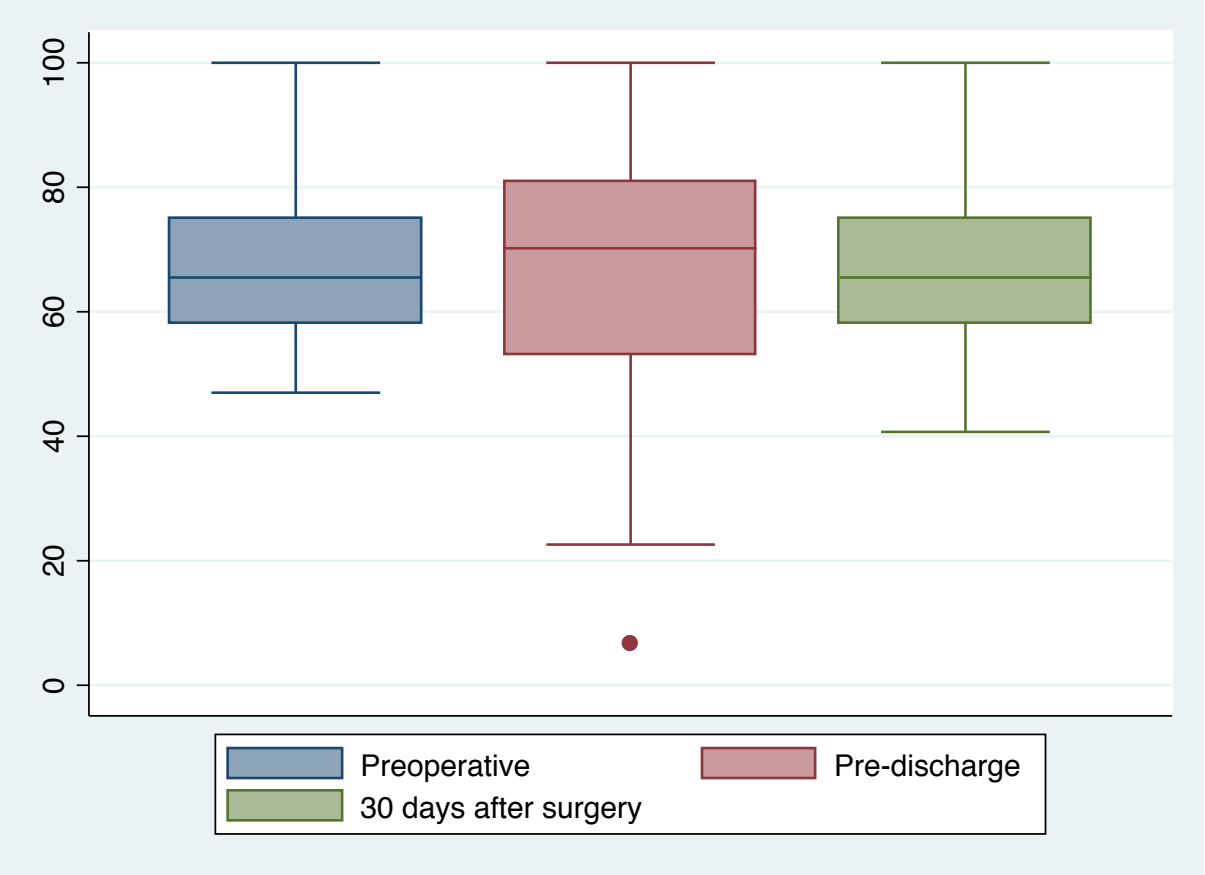

Table 3. Adherence to Enhanced Recovery Program care processes of all patients included in the study. Data presented as n(%) unless otherwise specified

Variables	Total (n=97)
POD 0 adherence, mean (95%CI)	50 (44-56)
Mobilization	34 (35)
Chewing gum	36 (37)
Oral fluids 400mL	72 (74)
Spirometry	64 (66)
Protein drink 1 can	36 (37)
POD 1 adherence, mean (95%CI)	64 (58-69)
Mobilization	44 (45)
Chewing gum	60 (62)
Oral fluids 400mL	76 (78)
Spirometry	85 (88)
Protein drink 1 can	43 (44)
POD 2 adherence, mean (95%CI)	33 (27-40)
Mobilization	23 (24)
Chewing gum	30 (31)
Oral fluids 400mL	45 (46)
Spirometry	57 (59)
Protein drink 1 can	6 (6)
Overall ERP[a] adherence (POD 0 - 2), mean (95% CI)	49 (45-53)

POD 0: day of the surgery. *POD 1*: first day after surgery. *POD 2*: second day after surgery
[a]ERP: Enhanced Recovery Program.

Table 4. Postoperative outcomes of all patients included in the study.

Data presented as n(%) unless otherwise specified

Variables	Total (n=97)
LOS[a], median (IQR)	4 (2 – 5)
LOS < 3 days	32 (33)
30-day postoperative complications	44 (45)
Type of postoperative complication:	
Cardiovascular	2 (5)
Respiratory	3 (7)
Infectious	8 (19)
Bowel perforation	3 (3)
Wound dehiscence	1 (1)
Bleeding	11 (11)
Primary Ileus	16 (16)
Other	12 (27)
30-day comprehensive complication index, mean (95%CI)	12 (8 – 15)
30-day emergency department visits	19 (20)
30-day hospital readmissions	5 (5)

[a]LOS length of stay

Table 5. Patient characteristics and postoperative outcomes for high and low pre-operative levels of activation. Data presented as n(%) unless otherwise specified

Variables	Low level (n=14)	High level (n=83)	p-value
Age, mean (95% CI)	65 (58-73)	59 (56-63)	0.905
Gender, male	7 (50)	47 (56)	0.429
Owns Smartphone or Computer	10 (71)	70 (84)	0.207
Average estimated income per year			
<30,000$	6 (43)	20 (24)	0.613
30,000-39,999$	4 (29)	33 (40)	
40,000-49,999$	3 (21)	20 (24)	
≥50,000$	1 (7)	9 (11)	
Charlson comorbidity index, mean (95% CI)	3.5 (2.27-4.73)	3.42 (2.87-3.97)	0.543
Baseline PAM score, mean (95%CI)	50.7 (49.7-51.7)	69.0 (66.8-71.1)	**0.000***
Diagnosis:			
Malignancy	9 (64)	44 (53)	0.652
Inflammatory bowel disease	2 (14)	17 (20)	
Diverticular disease	2 (14)	7 (8)	
Other	1 (7)	15 (18)	
Surgical approach, laparoscopic	12 (86)	63 (77)	0.872
Procedure performed:			
Right hemicolectomy	6 (43)	19 (23)	0.835
Low anterior resection	3 (21)	16 (19)	
Sigmoid resection	1 (7)	15 (18)	
Left hemicolectomy	1 (7)	7 (8)	
Ileocecal resection	1 (7)	13 (16)	
Abdominoperineal resection	1 (7)	4 (5)	
Proctocolectomy	0	3 (4)	
Total / subtotal colectomy	1 (7)	5 (6)	
Other	0	1 (1)	
New stoma creation	2 (14)	10 (12)	0.547
Procedure duration in minutes, mean (95%CI)	218 (166-269)	218 (201-234)	0.498
Overall ERP[a] adherence, mean (95%CI)	45 (37-53)	49 (45-53)	0.210
POD 0 adherence	56 (42-69)	49 (42-55)	0.791
POD 1 adherence	47 (34-60)	66 (61-72)	**0.004***
POD 2 adherence	33 (18-48)	33 (25-41)	0.483
LOS[b], mean (95% CI)	4.3 (3.3 – 5.3)	5.7 (3.4 – 7.9)	0.310
LOS[b] < 3 days	1 (7)	31 (37)	**0.031***
30-day postoperative complications (any)	6 (43)	38 (46)	0.537
30-day CCI[c], mean (95%CI)	10 (2-18)	12 (8-16)	0.322
30-day ED[d] visits (any)	3 (21)	16 (20)	0.548
30-day hospital readmission	1 (7)	4 (5)	0.549

[a]ERP: Enhanced recovery program. POD 0: day of the surgery. POD 1: first day after surgery. POD 2: second day after surgery. [b]LOS: Length of stay. [c]CCI: comprehensive complication index. [d]ED: Emergency Department. * p-value<0.05 considered statistically significant

Table 6. Patient satisfaction scores on the Satisfaction Questionnaire by preoperative levels of activation. Data presented as median (IQR).

Variables	Low level (n=14)	High level (n=83)	p-value
I felt well informed	3 (3-4)	5 (4-5)	**0.000***
I felt well confident	4 (4-4)	5 (4-5)	0.063
I felt well motivated	4 (3-4)	4 (4-5)	**0.042***
I felt satisfied with my recovery	4 (4-4)	4 (3-5)	0.506

* p-value<0.05 considered statistically significant

Table 7. Univariate logistic regression of 30-day Emergency Department visits

Predictors	OR	95% CI	p-value
Age >65 years old vs <65 years old	1.23	0.45-3.36	0.685
Male vs Female	0.89	0.32-2.46	0.828
Average income per year			
<30,000$	1.64	0.16-16.73	0.678
30,000-39,999$	3.33	0.37-29.77	0.281
40,000-49,999$	1.89	0.18-19.48	0.591
≥50,000$	Referent	Referent	Referent
Owns Smartphone or Computer vs none	1.17	0.30-4.55	0.824
Charlson Comorbidity Index			
0	Referent	Referent	Referent
1	0.92	0.12-6.83	0.932
2	1.38	0.22-8.67	0.735
>2	0.79	0.19-3.32	0.748
Diagnosis, malignancy vs benign	0.53	0.19-1.47	0.225
Laparoscopic approach vs Open approach	0.74	0.25 – 2.16	0.578
Procedure performed	1.07	0.88-1.29	0.517
Creation of new stoma	1.44	0.35-5.92	0.615
Procedure duration	1.00	1.00-1.01	0.138
RCT[a] Intervention vs Control group	1.06	0.39-2.88	0.916
Preoperative Activation Level			
Level 1	4.67	0.25-85.55	0.299
Level 2	0.93	0.16-5.40	0.939
Level 3	1.20	0.39-3.68	0.754
Level 4	Referent	Referent	Referent
Low preoperative level of activation vs High	1.14	0.28-4.6	0.851
Low pre-discharge level of activation vs high	2.2	0.76-6.36	0.145
LOS[b] <3 vs ≥3 days	1.24	0.43-3.52	0.691
Overall ERP[c] adherence <50%	1.96	0.67-5.67	0.217
30-day postoperative complications vs none	**16.06**	**3.45-74.72**	**0.000 ***
30-day comprehensive complication index	**1.05**	**1.02-1.09**	**0.001 ***

[a]RCT:Randomized clinical trial. [b]LOS: length of stay. [c]ERP: Enhanced Recovery Program.

* 95%CI that exclude 1.0 are considered statistically significant

Table 8. Multiple logistic regression of Emergency Department visits

Predictor	Odds ratio	95% CI	p-value
Low preoperative level of activation vs high	1.53	0.29 – 8.01	0.611
Age >65 years old	1.61	0.32 – 8.01	0.558
Male vs Female	0.78	0.23 – 2.82	0.620
Charlson Comorbidity index			
0	Referent	Referent	Referent
1	1.57	0.16 – 15.32	0.701
2	3.33	0.30 – 37.08	0.328
>2	0.85	0.09 – 8.05	0.887
Diagnosis, malignancy vs benign	0.97	0.56 – 1.69	0.914
30-day complications vs none	**18.50**	**3.63 – 94.19**	**0.000***

CHAPTER 4 – DISCUSSION OF METHODOLOGY

4.1. Data Extraction

Patient characteristics were collected at the time of enrolment in the randomized clinical trial, based on the information from the patient and review of the medical record. Details of the surgical procedure were collected in the immediate postoperative period and adherence to care pathway elements was recorded on every postoperative day. Postoperative complications within 30 days of the surgery, as well as the occurrence of ED visits and readmissions were collected from the medical record. These were confirmed with the patient at their clinic or phone follow-up four weeks after surgery. All data was entered and stored in a password-protected system of electronic data capture (REDCap; Research Electronic Data Capture) and was subsequently transferred to the statistical program for analysis. Patients were only identifiable using a unique, deindividualized record number. The principal author of this thesis confirmed the occurrence of ED visits and readmission as well as the reason for those visits through medical record review.

4.2. Demographic Data

Data on patient socioeconomic status, income and education level was not collected during the completion of the RCT. Average individual income was estimated based on patient's postal code using Statistics Canada Census Data (44), a method commonly used in Canadian health services research (64). Although it has been shown to have high specificity (92%) in Metropolitan areas, it may lead to misclassification of socioeconomic status of patients (64) and confounding which may be a source of ecological fallacy.

4.3. Data on Technology Use

The format and delivery of educational material can significantly affect patient's ability to learn as well as to act upon that knowledge. As previously discussed, the first stage of patient activation requires the acquisition of knowledge about their disease and possible treatment options. This significantly helps the patient to be more engaged with their care and have more meaningful conversations with their healthcare providers. Moreover, individualized patient education has a potential to assist patients in their postoperative care. Mobile technology has revolutionized the availability of knowledge. A study at the Mayo Clinic demonstrated that regardless of age, mobile technology allows high rates of knowledge consumption and highly effective delivery of customizable patient information (65). For this reason, we included the variable "owning a smartphone or computer" in our statistical analysis as a surrogate of technology use.

4.4. Charlson Comorbidity Index

Data on all patients' comorbidities was collected prospectively upon enrolment of patients. The Charlson comorbidity index was calculated as well as the ASA (American Society of Anesthesiologists) physical status grading. However, to avoid redundancy, we only included the Charlson comorbidity index in our analysis as it includes a weight to each comorbidity and it is an appropriate measure to use in risk adjustment and to compare outcomes (45, 46). A large cohort study showed that the addition of ASA to models already including the Charlson comorbidity index did not substantially change parameter estimates when assessing confounders (66).

4.5. Satisfaction Questionnaire

The Affordable Care Act has stimulated all healthcare organizations to make significant efforts to emphasize patient-centeredness when evaluating patient care. The Surgical Quality Alliance, formed by the American College of Surgeons, developed a survey specific for surgical patients to measure satisfaction. The Consumer Assessment of Healthcare Providers and Systems (CAHPS) Surgical Care Survey (or S-CAHPS) underwent extensive evaluation and validation and is now recognized as a validated measure of satisfaction in patients undergoing general surgical procedures (50). As the original S-CAHPS contained items not relevant to the RCT study, 4 statements were developed, adapted from the original questionnaire to reflect the purpose of the RCT: (1) I felt well informed about the activities/tasks that I had to undertake to improve my recovery in the first days after the surgery; (2) I felt motivated to undertake the activities/tasks required to improve my recovery in the first days after surgery; (3) I felt confident while undertaking the activities/tasks required to improve my recovery in the first days after surgery; (4) I felt satisfied with my recovery in the first days after the surgery (appendix 4).

4.6. Length of Stay

The variable length of stay (LOS) was modified into a dummy variable. A median of 3 days was chosen as a cut-off as this is the target discharge date for the colorectal pathway. A recent study by our research group also reported a median length of stay of 3 days and furthermore demonstrated that time-to-readiness for discharge (ie time to meet discharge criteria) was also 3 days in patients undergoing colon and rectal surgery (67).

4.7. Choice of Regression Model

A logistic regression model was used in the analysis of predictors of emergency department visits as the outcome (ED visits within 30 days of surgery) is a binary outcome (occurrence or not of at least one ED visit). Although in our cohort, presence of complications and the CCI were the only statistically significant predictors of ED visits, we decided to perform a multivariate regression model that included variables known to be predictive of the outcome in the research literature. Charlson comorbidity index was included as the presence of multiple comorbidities as it is associated with a higher use of the healthcare system and a larger proportion consultations (68). Patients with malignancies, particularly colorectal cancer, have a higher hospital use than patients with benign diseases due to the complexity and the higher rates of complications associated with their disease process (69).

CHAPTER 5: CONCLUSION AND FUTURE DIRECTION

5.1 Conclusion:

Patient engagement is increasingly recognized as a critical component of high quality patient care. It is a key predictor of the use of adherence with preventative measures, maintaining self-management behaviours and avoiding complications in chronic patients. Patient activation is a behavioural concept elucidated in the last decade that includes the core components of patient engagement. It comprises of knowledge, skills, belief and confidence for managing health and health care. There are very few tools developed to measure patient activation, and the patient activation measure (PAM) survey is the most commonly used. Previous research has demonstrated that patients with higher levels of activation have better outcomes, lower rates of healthcare system utilization and ensue lower costs. However, patient activation has mostly been assessed in patient with chronic medical conditions, with very few studies in surgical patients. In this pilot study, we found no association between lower level of activation and higher use of the emergency department within 30 days of surgery. However, patients with lower levels of activation were less adherent with postoperative enhanced recovery care processes and were less likely to be discharged early. Moreover, highly activated patients felt more informed and more motivated in their care than poorly activated patients. Although the cohort included in this study is small, this is the first study assessing the role of patient activation in a general surgery population.

5.2 Future Direction:

Based on these data, we will design a large prospective cohort study of patient activation in patients undergoing a variety of thoracic and abdominal surgeries, including emergency procedures. Targeting a 1.75 incidence risk ratio of 30-day post-discharge hospital utilization between patients with low and high levels of activation, with an α of 0.05, a power of 80% and with 2-sided testing, the sample size of a prospective study requires 650 patients. We hope such a study will give us a broader perspective on the role of patient activation in a more diverse surgical population. Our aim is to assess the impact of patient activation on emergency department use after hospital discharge and to identify vulnerable patients who may benefit from a more targeted and individualized discharge plan.

APPENDICES

APPENDIX 1: Patient Activation Measure Survey

Name	
ID	
Date	

Below are statements people sometimes make when they talk about their health. Please indicate how much you agree or disagree with each statement as it applies to you personally.

Circle the answer that is most true for you today. If the statement does not apply, select N/A.

1.	When all is said and done, I am the person who is responsible for taking care of my health.	Strongly Disagree	Disagree	Agree	Strongly Agree	N/A
2.	Taking an active role in my own health care is the most important thing that affects my health.	Strongly Disagree	Disagree	Agree	Strongly Agree	N/A
3.	I am confident I can help prevent or reduce problems associated with my health.	Strongly Disagree	Disagree	Agree	Strongly Agree	N/A
4.	I know what each of my prescribed medications do.	Strongly Disagree	Disagree	Agree	Strongly Agree	N/A
5.	I am confident that I can tell whether I need to go to the doctor or whether I can take care of a health problem myself.	Strongly Disagree	Disagree	Agree	Strongly Agree	N/A
6.	I am confident that I can tell a doctor concerns I have even when he or she does not ask.	Strongly Disagree	Disagree	Agree	Strongly Agree	N/A
7.	I am confident that I can follow through on medical treatments I may need to do at home.	Strongly Disagree	Disagree	Agree	Strongly Agree	N/A
8.	I understand my health problems and what causes them.	Strongly Disagree	Disagree	Agree	Strongly Agree	N/A
9.	I know what treatments are available for my health problems.	Strongly Disagree	Disagree	Agree	Strongly Agree	N/A
10.	I have been able to maintain (keep up with) lifestyle changes, like eating right or exercising.	Strongly Disagree	Disagree	Agree	Strongly Agree	N/A
11.	I know how to prevent problems with my health.	Strongly Disagree	Disagree	Agree	Strongly Agree	N/A
12.	I am confident I can figure out solutions when new problems arise with my health.	Strongly Disagree	Disagree	Agree	Strongly Agree	N/A
13.	I am confident that I can maintain lifestyle changes, like eating right and exercising, even during times of stress.	Strongly Disagree	Disagree	Agree	Strongly Agree	N/A

APPENDIX 2:

Reasons for unplanned ED visits within 30 days of surgery
Data presented as number of patients.

30-day emergency department (ED) visits	19
Anastomotic leak	1*
Bowel obstruction	1*
Bowel perforation	1*
Intra-abdominal abscess	1*
Rectovaginal fistula	1
Enterocutaneous fistula	1
Gastrointestinal bleeding	5
Constipation or diarrhea	3 (*1)
Incisional bleeding or infection	3
Mild abdominal pain	1
Trial of void after removal of urinary catheter	1

*Patient readmitted

APPENDIX 3:

Criteria to define adherence to patient-dependent ERP elements on POD1 and POD2

Early mobilization	Out of bed for 4 hours on POD 1 and 6 hours on POD 2
Gastrointestinal stimulation with chewing gum	Chewing gum for 30 minutes three times per day
Consumption of oral liquids	Consumption of ≥800 ml water per day
Breathing exercises	Using the spirometer at least 3 times per day
Nutritional drink supplements	Consumption of at least 2 protein drinks per day

APPENDIX 4: Patient Satisfaction with Enhanced Recovery Program Questionnaire

Participant ID _____

Satisfaction

Date form _____

1. I felt well informed about the activities/tasks that I had to undertake to improve my recovery in the first days after surgery.

◯ Strongly disagree ◯ Disagree ◯ Neither agree nor disagree ◯ Agree ◯ Strongly agree
◯ unavailable

2. I felt motivated to undertake the activities/tasks required to improve my recovery in the first days after surgery.

◯ Strongly disagree ◯ Disagree ◯ Neither agree nor disagree ◯ Agree ◯ Strongly agree
◯ unavailable

3. I felt confident while undertaking the activities/tasks required to improve my recovery in the first days after surgery.

◯ Strongly disagree ◯ Disagree ◯ Neither agree nor disagree ◯ Agree ◯ Strongly agree
◯ unavailable

4. I felt satisfied with my recovery in the first days after surgery.

◯ Strongly disagree ◯ Disagree ◯ Neither agree nor disagree ◯ Agree ◯ Strongly agree
◯ unavailable

Assessor/Data entry _____
(name/initials of the assessor/data entry person)

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