Role of Causal Information in Patient Education: An Experimental and Clinical Approach

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Abstract

It is somewhat paradoxical that few patient education interventions actually consider the processes by which individuals best learn health-related information. The paucity of empirically validated teaching strategies impedes efforts to improve the delivery of care in cardiovascular rehabilitation and secondary prevention (CRSP) programs. The main goal of this dissertation was to examine whether explaining how illness pathophysiology, symptoms and health behaviour are interconnected (i.e., causal information) enhances the effectiveness of patient education materials.

This question was first addressed in a laboratory setting (Study 1) in which younger and older adults read about a fictitious disease under two conditions. Younger participants who read about how health behaviours were causally linked to illness pathophysiology and symptom reduction were better able to apply their knowledge than those who read this information in a non-integrated manner. However, this effect was not observed in the older sample. These findings were followed up in a cluster randomized controlled trial, in which causal information about connections among endothelial pathophysiology, cardiac risk factors, symptoms and health behaviours were integrated into a group education session at a Cardiac Rehabilitation and Secondary Prevention (CRSP) program. Results from Study 2 indicated that the addition of causal information was associated with deeper levels of knowledge about cardiovascular management and enhanced efficacy beliefs about the CRSP program. Study 3, which focused on participants' behaviours, showed that the intervention did not impact patients' likelihood to enroll into CRSP nor their physical activity levels four months into the program. The intervention group was marginally faster at completing prerequisites for program entry, but baseline characteristics, including anxiety and male gender, were stronger predictors of this behavior.

The present dissertation is the first to provide empirical support for the inclusion of causal information into patient education curricula. Findings indicate that patients' depth of understanding warrants more attention in patient education contexts. Taken together, results from this dissertation serve as a stepping-stone towards enhancing provider-patient collaboration by demonstrating that patients have a better understanding when they are told

why they are being asked to follow the cardiovascular management recommendations rather than simply being told *what* to do.

Keywords

Patient education, causal reasoning, cardiac rehabilitation, knowledge, health information, patient adherence, behaviour change, levels of processing, physical activity, cardiovascular disease management.

Co-Authorship Statement

This dissertation was prepared and written by Ms. Karen Zhang in collaboration with her advisors, Dr. John Paul Minda and Dr. Leora Swartzman. Although the dissertation is mainly the work of Ms. Zhang, Dr. Minda, Dr. Swartzman and other members of Ms. Zhang's supervisory committee contributed to the design and/or editing of each chapter.

The manuscripts submitted for publication may involve revisions as per journal reviewers' feedback, and thus, may differ from the versions presented in this dissertation. The first manuscript submitted for publication is co-authored by Ms. Zhang's advisors, as well as Drs. Robert Petrella and Dawn Gill who provided input on the initial study design. Along with Ms. Zhang's advisors, the second and third manuscripts are co-authored by Dr. Peter Prior, a co-investigator who contributed to the design, analyses and write-ups of the studies. As well, Ms. Karen Unsworth and Dr. Neville Suskin also provided feedback on the design of the second and third manuscripts, and are co-investigators on the study.

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We are looking for volunteers to participate in a research study that helps us design health information materials.

Participation Involves:

- Two sessions (1st session: 20-30 min; 2nd session: 20-30 min)
- Read a health information booklet
- Answer questionnaires

Eligibility:

- 65 years or older
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5

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If you have Alphabet Disease, here are a few ways for you to take control of your condition:

High carbohydrate drinks
Consume 3-4 glasses of natural juices and energy drinks each day

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Eye drops
Use eye drops prescribed by your doctor every night before you sleep

Prescription shampoo
Wash your hair everyday using a shampoo that contains the amino acid, Cysteine

Limit protein in diet
Consume no more than 15g of protein per day

Vitamin ABC supplements
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Chapter 1

1 General Introduction

Before the widespread establishment of hospitals in the mid-1900s, physical ailments often were treated in patients' homes under the charge of their family members (Dreeben, 2010). It was therefore important for healthcare providers to instruct caretakers on how to properly manage patients' illnesses. Although the provision of health information has always been inherent to the practice of medicine, the concept of 'patient education' was not recognized as an integral part of healthcare until the 1950s (Falvo, 2005). Patient education is defined as "the process by which health professionals and others impart information to patients that will alter their health behaviours or improve their health status," (Kongstvedt, 2001). Traditionally, it was thought that the healthcare professional, and not the patient, determines the type and amount of information that should be discussed (Goldstein et al., 1998). However, since the introduction of the American and Canadian patients' bill of rights in the 1970s, the approach to patient education has shifted from a paternalistic 'disease-centred' perspective to one that is more 'patient-centred' (Breslow, 1985).

Accordingly, patient education programs are based on the premise that people are autonomous thinkers capable of taking active roles in medical decision-making (Falvo, 2010). The ultimate goal of patient education is to enhance patients' management of their illness (Kongstvedt, 2001; Smith et al., 2011). However, the challenge is to deliver information in a way that is most useful and meaningful to patients. Simply providing patients with information is not sufficient to induce behaviour change (Falvo, 2010).

Adherence to behavioural regimens, such as exercise, dietary changes and smoking cessation, are particularly important for the management of cardiovascular disease. Cardiovascular disease (CVD) refers to a range of disorders of the heart and blood vessels, with the most common problem being blockage or build-up of a fatty substance in the coronary arteries (WHO, 2016). CVD affects approximately 1.3 million Canadians and is one of the three leading causes of death for both men and women in North America (Go et al., 2014; Murphy, Xu, & Kochanek, 2013; Statistics Canada, 2011). According to the American and Canadian practice guidelines, the management and prevention of coronary and atherosclerotic vascular disease can be achieved through Cardiac Rehabilitation and Secondary Prevention (CRSP) programs (Smith et al., 2006; Smith et al., 2011). The aims of CRSP programs are to facilitate physical and psychological recovery following a cardiovascular event and to prevent future risk of cardiovascular problems. Targets of intervention include smoking cessation, limiting lipid and alcohol intake, regular physical activity, weight management, blood pressure control and taking medications that lower blood pressure and cholesterol (Heart & Stroke, 2011). Patient education is one of the core components in CRSP, as having relevant information is necessary for managing CVD (Balady et al., 2007; Buckley et al., 2013; Grace et al., 2014; Thomas et al., 2007).

1.1 Non-adherence in Cardiac Rehabilitation

A large number of controlled studies have demonstrated that CRSP programs extend survival rates, decrease the likelihood of recurrent CVD events, minimize the need for revascularization procedures, increase blood pressure control and improve patient quality of life (Anthonisen et al., 2005; Mosca, Christian, Mochari-Greenberger, Kligfield, & Smith, 2010; Murphy, Cannon, Wiviott, McCabe, & Braunwald, 2009; Rutledge, Redwine, Linke, & Mills, 2013; Smith et al., 2006; Whelton, Chin, Xin, & He, 2002). Despite the well-documented benefits of CRSP (Lau et al., 1992; Taylor, Wilson, & Sharp, 2011), only 45-67% of patients eligible for CRSP are referred to the programs, and of those, only 27-41% actually attend (Beswick et al., 2004; Cooper, Lloyd, Weinman, & Jackson, 1999; Jackson, Leclerc, Erskine, & Linden, 2005). Adults 65 and older are more likely to underutilize the service than younger patients, as it is estimated that less than 30% of elderly patients are enrolled in CRSP programs (Thomas et al., 2007). The uptake of CRSP is a cause for concern because individuals who attend less than 25% of sessions at cardiac rehabilitation have a 58% higher risk of mortality than attenders, after adjusting for gender, age, diagnosis, employment status, diabetes and family history (Beauchamp et al., 2013).

Another challenge is that even among patients who regularly attend CRSP programs, many do not adhere to prescribed regimens, such as medication, exercise and diet (Karmali et al., 2014). Poor patient compliance is associated with illness exacerbation, excessive health care cost burden, a higher rate of hospitalization re-admissions, and high mortality rates (Ho, Bryson, & Rumsfeld, 2009; Jackevicius, Li, & Tu, 2008; Rasmussen, Chong, & Alter, 2007;

Sokol, McGuigan, Verbrugge, & Epstein, 2005). Kravitz and colleagues (1993) found that while 90% of patients with heart disease were adherent to their medications and 60% followed their diet recommendations, a smaller number participated in their prescribed regular physical activity (24%) and even fewer quit smoking (9%). Although many factors could account for low adherence rates to CRSP programs, it has been asserted that lack of understanding about CVD and its treatment is a major barrier (Karmali et al., 2014; Menezes et al., 2014).

1.2 Patient Education in Cardiac Rehabilitation and Secondary Prevention

In light of the problems associated with non-adherence to CRSP programs, it is important that patient education be effectively delivered. That is, if patients do not understand *what* they need to do, the likelihood of behavior change is low. Although systematic reviews and meta-analyses generally indicate that patient education interventions in CRSP are effective, some effects are equivocal. For example, some studies have shown that patient education improves adherence to physical activity and dietary recommendation but has little impact on smoking cessation, medication adherence and psychological wellbeing (Ghisi et al., 2014; Karmali et al., 2014). Schadwaldt and Schultz (2011) found that although patients perceived that their health status improved after CVD-related education and counseling, the intervention did not have lasting effects on their health behaviors and cardiac risk factors. In contrast, Brown and colleagues (2012) found that, relative to receiving no information, patients who received the educational component of a CRSP program had a higher perceived quality of life, fewer hospital re-admissions and engendered lower healthcare expenditures. In regards to clinical outcome, the effects of patient education on cardiac morbidity and mortality are mixed (Brown, Clark, Dalal, Welch, & Taylor, 2013; Dusseldorp, Van Elderen, Maes, Meulman, & Kraaij, 1999).

It is difficult to pinpoint which educational approaches are most effective for optimizing patient care in CRSP because the interventions often are poorly described in the literature (Brown et al., 2013; Dusseldorp et al., 1999; Smith et al., 2011). In a systematic review of 360 studies evaluating the effectiveness of patient education for chronic disease management, it was noted that the pedagogical features of the interventions were described in only 27% of the studies (Lagger, Pataky, & Golay, 2010). Furthermore, little is known about the teaching component and design principles that guide the development of patient education in CRSP (Ghisi et al., 2014). This impedes the advancement of patient education interventions in improving patient knowledge and inducing behavioural changes.

Of more concern is that few patient education interventions are theoretically and/or empirically-driven (Brown et al., 2013; Ghisi et al., 2014; Schadewaldt & Schultz, 2011). Evaluations of the few theory-informed programs that do exist have not yielded promising results. For instance, Meng and colleagues (2014) compared an educational program grounded in the Health Action Process Approach (HAPA) to a traditional lecture-based program in an inpatient cardiovascular rehabilitation setting. HAPA is based on the premise that people need to take an active role in the learning process to engage in health behavioural change (Schwarzer, Luszczynska, Ziegelmann, Scholz, & Lippke, 2008). Interventions guided by this framework aim to enhance motivation and volition through helping patients form intentions and action plans for behavioural change. In Meng and colleagues' study, patients in the intervention group participated in five interactive sessions that included group discussions and group work. In addition to receiving information about coronary heart disease, patients selected their relevant risk factors and devised an action and coping plan with a health professional. In contrast, the control group received two to four information sessions about cardiovascular disease in a lecture format with opportunities to ask questions. At discharge, the intervention group was more knowledgeable about CVD and its management, as gauged by true/false questionnaire. However, group differences in knowledge were not evident at six-months post-discharge, nor did groups differ with respect to compliance to their dietary and medication regimens. There was a small effect of the intervention on physical activity but this was marginally statistically significant. As such, the prediction that a patient-oriented program would be superior to a traditional lecture-style program was only partially supported (Meng et al., 2014)

In another CRSP patient education trial based on the HAPA model (Ghisi, Grace, Thomas, & Oh, 2015), the intervention group received 24 weekly group education sessions that contained group activities, behavioural-based action planning, and assessment of motivation and confidence to implement lifestyle changes. Patients in the control condition received a traditional 24-week education program that was similar to the intervention condition in curricular content (e.g., about exercise safety, nutrition, risk management, medications, and stress management) but without activities to increase motivation and self-efficacy. Findings showed that the intervention and control condition were equally effective at improving patient knowledge and exercise behaviour. Therefore, similar to that of Meng and colleagues (2014), this study indicated that the integration of strategies to increase motivation and volition did not lead to benefits above and beyond traditional lecture-based educational programs.

The aforementioned findings may seem surprising given that patients' motivation, values, goals and self-efficacy are central tenets in many health behaviour theories. More specifically, the HAPA (Schwarzer, Lippke, & Luszczynska, 2011), Sociocognitive (Bandura, 2006a), Health Belief (Stretcher & Rosenstock, 1997), and the Common Sense Model of Illness Perceptions (Leventhal, Diefenbach, & Leventhal, 1992) are based on the postulate that beliefs about self-efficacy, treatment expectancy and/or illness management are the most proximal and powerful predictors of behavioural change. Knowledge is often the precursor that influences these variables (Hagger & Orbell, 2003). Although increasing patient knowledge about CVD and its management is one of the main goals in CRSP programs, only 11% of cardiac educational interventions have actually assessed for patient knowledge post-treatment (Ghisi et al., 2014). Therefore, it is possible that interventions aimed at leveraging patient motivation and/or perceptions were unsuccessful at changing behaviour because they failed to determine whether patients had fully understood the need for implementing cardiovascular management. This suggests that the movement towards counseling approaches may have inadvertently neglected the most fundamental aspect of patient education- enhancing patient knowledge about cardiovascular disease. Accordingly, the development of effective programs warrants a closer look at whether the patient education curriculum is conducive for patient learning (Falvo, 2010).

1.3 Adult Learning Concepts

Adult learning principles have gained increasing attention among health educators (Russell, 2006; Syx, 2008). Knowles (1979) was the first to describe the conditions under which adults benefit most from an educational setting. There are six principles that characterize the optimal learning climate for adults (see Table 1.1), all of which are highly relevant for enhancing adherence to behavioural recommendations in CRSP programs. For instance, the extent to which patients perceive CVD management to be practical and relevant is predictive of program attendance (French, Cooper, & Weinman, 2006). As well, maintenance of behavioural change is contingent on cardiac patients' goal orientation and sense of autonomy (Rothman, Baldwin, Hertel, & Fuglestad, 2011). Finally, the ability to draw from one's own experience to manage CVD is an important factor for developing expertise in CVD management (Lynggaard, May, Beauchamp, Nielsen, & Wittrup, 2014).

Table 1.1: Adult Leaner Principles According to Knowles (1970).

Characteristics:
• Autonomous and self-directed
• Accumulated a foundation of experience and knowledge
• Goal oriented
• Relevancy oriented
• Practical
• Need to be shown respect

According to Knowles, the key difference between adult and school age learners is the degree of motivation, prior experiences and the applicability of the knowledge to real-life situations. In particular, adults are motivated to learn new information when they are confronted with a life experience that requires change (Russell, 2006). For example, cardiac patients who have angina would be more inclined to gather information about how to manage these symptoms than individuals who do not experience angina symptoms. As well, patients' previous success in reducing their symptoms may also determine whether they would be receptive to new information. In general, the main emphasis in adult learning principles is that individuals must first perceive the need to acquire certain knowledge before they are ready to learn (Knowles, 1980).

Adult learning principles have been integrated into in two CRSP interventions. Lynggard and colleagues (2014) adopted a 'learning and coping' approach to help patients make personal meaning out of illness management recommendations. This method entailed a narrative approach; patients who had previously completed CRSP shared their experience-based knowledge about heart disease with newly diagnosed patients. In addition to receiving information from healthcare professionals, the goal of this educational approach was for the 'graduates' to motivate and connect with new patients through personal anecdotes. Results of this trial are pending. However, the authors expect that that the focus on building partnerships between patients and health professionals in the intervention condition will facilitate better adherence to CRSP, as well as decrease morbidity and mortality rates.

Moreover, Ghisi and colleagues (2015) also have incorporated adult learning principles into their educational intervention by encouraging patients to identify their individual cardiac risk factors and formulating a behavioural action plan with health care professions. However, as noted earlier, this approach did not lead to more favourable outcomes than the standard lecture-style educational program. Given these two sets of findings, it is unclear whether the inclusion of adult learning principles into the design of patient education interventions is advantageous for increasing behavioural change. Another problem with adult learning principles is that the theory is focused on optimal learning conditions and not on the cognitive process by which individuals acquire new knowledge.

Other research in patient education has focused on the utility of instructional aids, such as the use of computer technology versus in-person delivery, for increasing patient knowledge (Friedman, Cosby, Boyko, Hatton-Bauer, & Turnbull, 2011). However, instructional aids are not synonymous with teaching strategies (Falvo, 2011). The former are supplemental tools that help deliver the information, and do not influence the learning process. As such, educational strategies and/or methods that can help enhance the acquisition and application of cardiovascular management knowledge remains largely unknown. It has been argued that the inclusion of principles from cognitive psychology may lead to more effective patient education programs (Brown & Park, 2003).

1.4 Levels of Information Processing

According to research in cognitive psychology, the depth at which an individual learns about a concept affects how well the information subsequently can be retrieved and used (Minda, 2015; Tulving, 2002). In one study, participants learned a list of words under various instructions (Craik & Tulving, 1975). Individuals in the control condition answered yes or no to the question, "Is the word in capital letters", which did not require them to think about the meaning of the word. Participants in the other two conditions were either asked whether the target word rhymed with another word in a given sentence (phonemic condition) or they were asked something about the object in the word itself (semantic condition). When given a surprise recognition test, individuals in the semantic condition, who processed the information at a deeper level, remembered more words than those in the other two conditions This pioneering study was the first to demonstrate that depth of information processing enhances its recall.

One method used to gauge depth of processing is an expert-reasoning task, the Forced Choice Task (Chi, Feltovich, & Glaser, 1981; Johnson & Mervis, 1997; Lin & Murphy, 2001; Murphy & Medin, 1985). In this task, a target is presented and individuals are required to match the target to one of two choices. The two choices contain either a *surface* or a *deep* feature. Matching choices based on surface feature refers to classifying objects by similarities in external appearance without knowledge of the context in which the objects are presented, and this is reflective of surface level processing. Deep level processing is indicative of deep feature matches, which are based on knowledge of contextual and/or conceptual information about the object. To better demonstrate this task, suppose one is shown the target of a GREEN ZUCCHINI and then asked to match to either GREEN CUCUMBER or ORANGE PUMPKIN. The pairing of GREEN ZUCCHINI with GREEN CUCUMBER could be considered a surface feature match, as they are similar in appearance (i.e., shape and colour). However, one might choose to match the GREEN ZUCCHINI with ORANGE PUMPKIN because they are from the same taxonomic genus, *Cucurbita*, whereas GREEN CUCUMBER is from the genus, *Cucumis.* The latter match is considered a deep feature match because it requires conceptual knowledge, whereas the surface feature match does not.

The Forced Choice Task has been applied in research on expert-novice physician ability. Devantier and colleagues (2009) showed medical students and practicing endocrinologists profile triads and asked them to match one of two hypothetical patients with the target patient. One of the profiles matched the target patient on surface features (e.g., similarities in age and gender), which are not critical to forming clinical impressions about how patients manage their illness. The other profile matched the target patient on deep features (e.g., similarities in difficulty with injecting insulin) that were important for clinical decision-making. Results showed that medical students were less likely to match the profiles based on deep features than endocrinologists. This suggests there are significant variations with regards to how individuals process and extrapolate information to solve a problem that is indicative of their level of knowledge.

The research just reviewed suggests that depth of processing affects memory recall, and level of expertise on the subject matter. In a similar way, it could be that the depth to which cardiac patients process cardiovascular information might influence how knowledge is applied for cardiovascular management. That is, patients who have a deeper conceptual understanding of their condition may be more able to generalize and use their knowledge in different situations than those who have simple factual knowledge. Incorporating teaching strategies that help patients form a deep and coherent conceptual representation of cardiovascular disease and its management might optimize the efficacy of patient education interventions. The provision of causal explanations is one strategy that has been demonstrated to improve the application of newly learned information in different domains through facilitating deeper levels of information processing (De Kwaadsteniet, Kim, & Yopchick, 2013; Goldszmidt, Minda, Devantier, Skye, & Woods, 2012; Woods, Brooks, & Norman, 2007).

1.5 Causal Information

Causal explanations, to be used interchangeably with causal information, refer to explanations about *why* an effect occurs or *how* things work (Keil, 2011; Murphy & Medin, 1985). It has been posited that causal information can improve acquisition of medical information among novice learners (Neufeld, Norman, Barrows, & Feightner, 1981).

For example, non-medical students were asked to learn the features of a series of fictitious diseases and later make a diagnosis based on clinical symptoms (Woods et al., 2007). Students in the experimental group were informed about the causal links between disease features, whereas those in the control condition studied a list of disease features without causal explanations. Students who received causal explanations about disease pathophysiology made more accurate diagnoses at a 1-week delayed testing than those in the control condition. Goldszmidt and colleagues (2012) also examined the benefits of causal information in medical teaching. Compared to students who received standard information about how to perform a percussive respiratory examination, individuals who received additional causal information about why physical sounds occurred during the medical test were better able to interpret the examination results. The benefits of integrating causal information into clinical training have been replicated in studies on the diagnostic decision-making processes of medical students (Woods, Brooks, & Norman, 2005), physicians (Patel & Groen, 1986) and clinical psychology students (De Kwaadsteniet et al., 2013).

Causal information is proposed to facilitate connections between individual health concepts, which in turn, help people form a coherent cognitive representation of the information (Rehder & Hastie, 2001). Given the promising results of incorporating causal explanations into clinical training, one might hypothesize that the introduction of this pedagogical feature would improve cardiac patient education. CRSP patient education programs are well positioned to integrate causal information because in CVD, the associations between health behaviours, risk factors, pathophysiology, and symptoms are inherently linked (Raitakari & Celermajer, 2000). In medical teaching, the linkage between endothelial health, behaviours, and cardiac risk factors is known as flow-mediated dilation (FMD). Within the context of CVD management, patients might better appreciate the need to exercise if they understood that physical activity stimulates the inner linings of the coronary arteries, which in turn helps the coronary arteries to expand. Over time, this re-conditioning of the arteries will lead to fewer angina symptoms and less risk of future cardiac events due to overexertion. Parallel explanations about FMD can readily be made for other behavioural targets of CRSP, which include dietary changes, smoking cessation and stress management.

There is some indication that providing causal explanations can improve adherence. In a marketing study, Taylor and Brown (2004) demonstrated that compliance with product instructions was improved when the causal link between adherence and the desired outcome was explained. Participants in this study received instructions that either stated or did not state why they should wear gloves before handling a plant fertilizer (i.e., it would prevent skin irritation). Those who were told *why* they were being asked to wear gloves were much more likely to put them on (65.4%) than those who simply were told to wear the gloves (32.7%). This finding suggests that explicitly linking the cause of the problem to how it can be alleviated may help mitigate problems with non-compliance. However, this study was with a non-clinical sample being asked to put on a pair of gloves before watering a plant. It remains unclear how much of an impact providing causal information has for improving adherence to CRSP programs.

1.6 Summary

Patient education is a core component of cardiac rehabilitation. However, its implementation often is suboptimal (Brown et al., 2013; Ghisi, Abdallah, Grace, Thomas, & Oh, 2014; Schadewaldt & Schultz, 2011). Despite the substantial need for evidence-based strategies to help patients understand the benefit of cardiovascular management, few programs have focused on the learning process and degree of knowledge acquisition that takes place in patient education (Ghisi et al., 2015). Research in cognitive science has demonstrated that there are different levels of information processing that can influence how individuals interpret, learn and later use the acquired information (Devantier et al., 2009; Minda, 2015). Educational strategies that can help individuals learn at a deeper level may lead to more positive patient outcome. It has been demonstrated that integrating causal explanations into medical teaching induces deeper processing of new information, and consequently, better application of the knowledge in diagnostic decision-making (Goldszmidt et al., 2012; Woods et al., 2007). It is thus possible that providing an explanation about the causal links among health behaviours, symptoms and illness pathophysiology may similarly benefit patient learning. The utility of this teaching approach has not been previously examined in patient education contexts.

1.7 Overview

The dearth of data on empirically validated teaching strategies in patient education severely limits efforts to improve the delivery of care to patients. The broad goal of this dissertation was to examine the merit of using cognitive science principles to inform the design of patient educational materials. The present dissertation was premised on past findings that provision of causal information helps trainees learn and effectively use medical/clinical information (Devantier et al., 2009; Goldszmidt et al., 2012; Woods et al., 2007). The specific objectives were to determine whether the provision of causal information would:

1. Increase knowledge acquisition of new illness management information.
2. Benefit depth of knowledge acquisition and enhance treatment efficacy beliefs in a cardiac rehabilitation context.
3. Lead to greater uptake of the CRSP and behavioural changes among cardiac patients.

These objectives were addressed through three studies. Study 1 (Chapter Two) was a controlled experimental paradigm with a non-patient sample, designed to isolate the effects of causal explanations on knowledge. Participants were given information about a fictitious disease (Alphabet Disease). In the experimental condition, the pathophysiology, symptoms and illness management behaviours were causally linked. In the control condition, these three elements were presented separately. Building on the results from Study 1, the subsequent studies were clinical investigations on the impact of causal explanations on patient knowledge and adherence in a cardiac rehabilitation setting.

Study 2 (Chapter Three) was a cluster randomized controlled trial at an outpatient cardiac rehabilitation setting that examined the effects of causal information on cognitive factors. Cardiac outpatients referred to a CRSP program either attended an educational session with (intervention condition) or without (control condition) causal information. The main aim of Study 2 was to determine whether learning about the causal links among endothelial pathophysiology, symptom reduction, cardiac risk factors and health behaviours would help patients process cardiovascular information at a deeper level. The primary outcome variables were deep and factual knowledge. Given that many health behaviour models postulate that patient beliefs are the most proximal predictors of behaviour change, the effect of the intervention on treatment efficacy beliefs was the secondary outcome variable.

Study 3 (Chapter Four) followed participants from Study 2 after they participated in the educational session and examined the impact of causal information on patient adherence. In particular, this study examined whether the provision of causal information would go beyond influencing knowledge and affect behaviour. The outcome variables were latency to complete CRSP prerequisites, enrolment into the program, and the level of physical activity once enrolled in CRSP.

In the final chapter (Chapter Five), the results of the three studies as a set are discussed.

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Chapter 2

2 Explaining the Causal Links between Illness Management and Symptom Reduction: Development of an Evidence-based Patient Education Strategy

2.1 Abstract

Objective: To determine whether explaining the causal links between illness management and symptom reduction would help younger and older adults learn and apply health information.

Method: Ninety younger and 51 older adults read about a fictitious disease with or without explanations about the cause-and-effects (causal information) of illness management. A knowledge test was administered immediately and 1-week following the presentation of health booklets. Reading comprehension, working memory and health literacy were also assessed.

Results: For younger adults, receiving causal information facilitated the comprehension and applied of health information across time F (1, 88) = 10.89, $p < .001$. Reading comprehension, and not the provision of causal information, influenced the test performances of older participants, $r(47) = .25$, $p <.05$. In the combined sample, the receipt of causal information explained 9% of unique variance in test performance after controlling for age and cognitive factors, $F\Delta$ (1, 131) = 24.75, $p < .001$.

Conclusions: Providing an explanation of why illness management is effective for reducing symptomatology can help improve knowledge and application of health information for younger individuals. For older adults, lowering the verbal demands of patient education materials may be a better way to help them learn new health information.

Practice implications: Use of causal information as a teaching strategy in patient education may enhance individuals’ ability to learn about and implement self-care strategies.

2.2 Introduction

There is a growing emphasis to develop education interventions to improve patient knowledge and their adherence to chronic illness management (Lagger et al., 2010; Nielsen et al., 2010). However, a number of studies have found that education alone is not sufficient for changing patient health behaviors and clinical outcomes (Commodore-Mensah & Himmelfarb, 2012). One of the reasons for the mixed findings could be due to the diverse methods and strategies used to administer patient education programs (Friedman et al., 2011; Ghisi, Abdallah, et al., 2014). While most patient education programs have focused on evaluating the format of delivery (i.e., lecture-based, written material, computer-technology etc.), little is known about the process by which patients learn the information (Smith, Mitchell, & Bowler, 2007).

In a systematic review, Lagger and colleagues (Lagger et al., 2010) found that across 360 studies evaluating the effectiveness of patient education interventions, only 27% reported on the pedagogical features. Furthermore, only 4% of these studies provided enough information to enable replication of the education program, which limits the generalizability of findings. This lack of focus on the content of the patient education program is surprising given that didactic programs outside of the patient context is curriculum-driven and based on cognitive learning theories. For example, medical education is oriented towards developing basic science and clinical curricula to foster students' and residents' abilities to integrate professional competencies (Irby, 2011; Schmidt, Vermeulen, & Van Der Molen, 2006).

It is problematic that few patient education interventions mention effective strategies for explaining illness management concepts (Commodore-Mensah & Himmelfarb, 2012; Smith et al., 2007). Patients, like medical trainees, are expected to process medical information and apply their knowledge to perform health care behaviors. Accordingly, failing to consider the cognitive processes involved in the acquisition and retention of health information limits one's ability to develop effective patient education interventions (Brown, Clark, Dalal, Welch, & Taylor, 2013; Morrow, Carver, Leirer, & Tanke, 2000; Syx, 2008). This is a particularly salient issue for the large proportion of older patients who experience age-related cognitive changes that can compromise their ability to understand medical information (Hopp, Thornton, Martin, & Hopp.; Martin, 2010).

Although there is a lack of research-informed strategies to address cognitive factors in the patient education domain, supporting evidence in the literature on clinical reasoning suggests that increasing knowledge of causal relationships can help individuals retain and apply new medical information (Woods et al., 2007). Causal information refers to explanations about why an effect occurs or how things work (Keil, 2011; Murphy & Medin, 1985). One study investigated whether explaining the cause-and-effect of a percussive lung exam to non-medical students would improve their test performance (Goldszmidt et al., 2012). Compared to students who received standard information about how to perform the exam, individuals who received additional causal information about why physical sounds occurred during the medical test were better able to interpret respiratory exams. Moreover, experienced clinical psychologists and trainees were found to be more accurate in their diagnostic and treatment decisions than novice students by integrating causal information about the etiology of a psychiatric condition (De Kwaadsteniet et al., 2013). Taken together, these findings suggest that explaining the rationale behind a medical decision may help individuals form a coherent conceptualization of the presenting issue, which in turn enhances the diagnostic process. Given that causal information improves clinical judgment, it is plausible that explaining how and why illness management can help with reducing symptomatology would similarly benefit patients' understanding of their medical conditions.

Accordingly, the goal of this study was to determine whether providing causal information explaining how elements of a self-care regimen alleviate symptoms of a medical condition improves individuals' understanding of illness management. We used a controlled experimental design to investigate the effects of causal information on younger and older adults' ability to learn novel health information. We predicted that: 1) Causal information would enhance the abilities of both younger and older adults to interpret (i.e., apply/use) and recall health information; and 2) Causal information would be a significant predictor of the ability to apply medical knowledge after controlling for demographic and cognitive factors.

2.3 Methods

2.3.1 Participants

Younger participants were 90 undergraduate students recruited from Department of Psychology subject pool at Western University. Fifty-one community-dwelling older adults, aged 60 years and older, also took part in this study. Recruitment of older adults took place at a community seniors centre, an aging-and-exercise program, and/or through posting of study flyers at grocery stores and malls (Appendix A). The inclusion criteria for both older and younger adults included fluency in English and no prior training in medical professions. Participant characteristics are shown in Table 2.1. Older adults were offered $20 (CAD). Younger adults completed the study as part of the research requirements of the undergraduate course in which they were enrolled. The study protocol was approved by the Non-Medical Research Ethics Board at Western University (Appendix B).

2.3.2 Materials

2.3.2.1 Health Information Booklet

The symptoms and self-care recommendations of three metabolic conditions (Urea Cycle Disorder, Biotin Deficiency and Short-chain acyl-CoA Dehydrogenase Deficiency) formed the basis for the learning materials. Consistent with the content of most health education brochures (Harris, Bhattacharyya, Dyck, Hayward, & Toth, 2013; Harrison, Toman, & Logan, 2013; Smith et al., 2007), the resultant health booklets described the pathophysiology, prevalence, symptoms and self-care management of a fictitious disorder, 'Alphabet Disease'(Appendix C). The first two sections about the triggers and prevalence of the target illness were presented in the same fashion for both learning conditions. The sections about symptoms and self-care management were the tested components. In the causal information condition (experimental group), the health booklet explained self-care management in the context of the disease pathophysiology (Appendix D). That is, it explained what patients are required to do to manage a condition and how this management approach in necessary for symptom improvement. For participants in the control group, information about symptoms and self-care behaviors was not explicitly linked. See Figure 2.1 for sample excerpts of the two booklet conditions.

2.3.2.2 Comprehension and Retention of Health Information

A 25-item multiple-choice Health Knowledge Questionnaire (HKQ; Appendix E) was created to test participants' understanding and retention of information about Alphabet Disease. The HKQ contained 10 *factual* items on content that was presented in the same format for both booklet conditions (e.g., "Who is more at risk for developing Alphabet

Disease?"). The remaining 15 *applied* items tested knowledge of self-management, strategies, which were explained differently for the two conditions. The applied items required patients to make inferences about how to apply self-management strategies based on the information they had read (e.g., "If someone with Alphabet Disease forgets to take their vitamin ABC supplements, what should they watch out for?"). These items were included to examine a deeper and more actionable understanding of the material than the factual items. All factual and applied items included four response choices and a point was given for each correctly answered item. The total number of correct responses was tallied for the total (Cronbach's $\alpha = .82$), applied (Cronbach's $\alpha = .85$), and factual (Cronbach's $\alpha = .81$), sets of items for a measure of comprehension. To examine the extent to which an individual item correlated with performance on its respective scale (applied vs. factual), bivariate correlations were calculated for the Item-to-Scale. Higher correlation values indicated that items were more discriminating, such that participants who answered an applied item correctly were more likely to have a higher applied knowledge score. The same applies for control items. As shown in Appendix K, all items significantly corresponded to its intended scale ($p < .05$), suggesting that the HKQ was good at discriminating between applied and factual knowledge.

The HKQ was administered immediately after presentation of the health booklets to gauge participant comprehension of the information. Participants also completed the HKQ after a 1-week delay as a measure of retention of health information. See Figure 2.2 for sample items.

Sample Causal Information

Presented on one page:

How Can I Manage the Symptoms and Complications of Alphabet Disease?
Feeling Tired (fatigued)

What to do: Consume 3-4 glasses of **high carbohydrate drinks** each day
Why: Alphabet disease makes it difficult for your body to produce essential fats and carbohydrates that give you energy. Consuming high carbohydrate drinks will supply you with the energy you need.

Sample Non-Causal Information

Presented on separate pages:

What is Alphabet Disease?	What are the Symptoms and Complications?	How Can I Manage My Alphabet Disease?
Alphabet disease occurs when your liver has difficulty breaking down Alphabetin into vitamin ABC. Your body needs vitamin ABC to metabolize proteins, keep your immune system strong and produce fats and carbohydrates. As a result, individuals with Alphabet disease have a build up of proteins and not enough fats and carbohydrates.	• **Feeling tired (fatigued)** (...)	**High Carbohydrate Drinks** Consume 3-4 glasses of natural juices and energy drinks each day

Figure 2.1: This figure shows an example of how the learning material was presented in a causal (experimental condition) and non-causal (control condition) way. The dotted line represents information that was shown on a separate page in the booklet.

Sample Applied Item:
What should someone with Alphabet Disease do when they are feeling tired? a. Rest b. Take vitamin ABC supplements c**. Drink fruit juice** d. All of the above
Sample Factual Item:
Who is more at risk for developing Alphabet Disease? a. Women b. Men **c. Men and women are equally affected** d. I don’t know

Figure 2.2: This figure shows an example of one applied and one factual item. The correct answers, which are not presented to participants, are shown in bold-face text.

2.3.2.3 Cognitive Ability

The Rapid Estimate of Adult Literacy in Medicine-Short Form (REALM-SF; Arozullah et al., 2007) is a seven-item word recognition task used to assess participant health literacy. Scores range from 0 (no words pronounced correctly) to 7 (all words pronounced correctly). The Backward Digit Span task from the Weschler Adult Intelligence Scale-IV (WAIS-IV; PEARSON, 2008) was used to assess working memory. This task required participants to recall a progressively longer series of digits in a backward order. A higher number of correct trials recalled reflect a larger working memory capacity. Finally, two passages from the Nelson-Denny Reading Test (FORM H: Brown, Fisheon, & Hanna, 1993) were used to assess participants’ reading comprehension. The test required participants to read narrative passages and answer 10 multiple-choice items, each with 5 answer choices. The number of correct responses was summed for the total score, which ranged from 0 (no correct answers) to 10 (all answers were correct).

2.3.3 Procedure

Participants were randomly assigned to one of two booklet conditions. The study was completed individually or in groups of up to three individuals, in two sessions held one week apart. Testing for younger adults took place in the Categorization Lab at Western University. Older participants completed the study at either a senior's community center or in a research office. After providing informed consent, participants were asked to read and study the health information booklet to the best of their abilities. They were told that the material would not be shown again during testing and that they could take as much time as they needed to learn the information. Following the methodological approach used in a study of a similar intervention (Goldszmidt et al., 2012), the HKQ was administered immediately after participants returned the booklet (Time 1), and after 1-week delay (Time 2). The administration of the remaining battery of cognitive measures took place during either the first or second testing session, depending on the participant flow. Younger adults took between 20 and 30 minutes to complete each testing session, whereas older adults took approximately 30-45 minutes to review the material.

2.3.4 Statistical Analyses

Statistical analyses were carried out using PSAW 23.0 software package (IBM, n.d.). Participant characteristics were described using chi-square and independent t-test analyses for the experimental and control groups. The mean proportion correct on the HKQ was calculated for factual, and applied item sets at both Time 1 and Time 2. Due to the unequal sample sizes, HKQ differences were analyzed separately for each age group using 2x2x2 mixed factorial ANOVAs with Bonferroni correction. Booklet condition (experimental/control) was entered as the between subjects factor, and the within-subject factors comprised of time (Time 1/Time 2) and item type (Factual/Applied). Pearson-moment correlations and hierarchical regressions were also conducted to determine the effects of booklet condition on knowledge retention after controlling for demographic and cognitive predictors. Age was entered as a continuous variable in the first step, reading comprehension, working memory and health literacy were entered in the second step, and provision of causal information was dummy coded and entered in the final step. HKQ scores at Time 1 were covaried out in regression analyses to assess retention of health information after controlling for initial test performance.

2.4 Results

Table 2.2 shows the mean proportion correct on applied and factual items across age group and time. Younger adults outperformed older adults on the applied items at both Time 1 $t(139) = -9.23$, $p < .001$) and at Time 2 ($t(139) = -8.79$, $p < .001$). Similarly, performance on factual items was higher for younger adults than the older age group at both Time 1 ($t(67.29) = -7.09$, $p < .001$) and Time 2 ($t(139) = -8.60$, $p < .001$).

Table 2.1: Participant characteristics

	Younger Adults			Older Adults		
	Control (*n* = 45)	Intervention (*n* = 45)	*p*-value[a]	Control (*n* = 26)	Intervention (*n* = 25)	*p*-value[a]
M(SD)						
Age	19.60 (4.09)	18.54 (1.28)	.11	72.19 (7.41)	69.83 (6.47)	.24
Years of Education	13.30 (2.01)	13.04 (0.89)	.45	14.00 (2.34)	14.58 (3.48)	.50
(%)						
Female	71.10	65.90	.65	57.70	64.00	.65
Non-white ethnicity	42.20	44.40	.83	19.20	8.00	.24
With partner	4.40	4.40	1.00	61.50	60.00	.91
> 60,000 Household income	64.50	77.80	0.40	15.00	33.33	.17
Has a diagnosis of a chronic illness	6.70	9.10	.67	57.70	62.50	.73

Note: n = group sample size; M = mean; SD = standard deviation; *ns* = non-significant, $p < .05$

[a] *p*-value compares control and experimental conditions.

2.4.1 Performance of Younger Adults

Among younger adults (Table 2.2), results of a 2 (time) x 2 (item type) x 2 (booklet condition) ANOVA showed higher HKQ performances at Time 1 (*F* (1, 88 = 12.52, *p* = .001, η^2 = .13), for the factual items (*F* (1, 88) = 94.93, *p* < .001, η^2 = *.52*), and for the experimental condition *F* (1, 88 = 6.60, *p* = .012, η^2 = .07). A significant item x booklet interaction showed that both the experimental and control groups did equally well on factual items but participants who received causal information scored significantly higher on applied items than the control group, *F* (1, 88) = 36.33, *p*< .001. The effect size for this group difference was large, (η^2 = .29).

There was a significant three-way interaction of booklet condition x item x time, *F* (1, 88) = 10.89, *p* < .001, η^2 = .110. Pairwise t-tests were conducted for each booklet condition to determine the effects of time on the proportion of correct applied and factual items. The experimental group showed a decrease in proportion of correct applied (*t*(44) = 3.39, *p* = .001) and factual items (*t*(44) = 2.37, *p* = .022) between Time 1 and Time 2. For the control group, there was a decline in performance for factual (*t*(44) = 3.36, *p* = .002) but not applied items (*t*(44) = .22, *p* = .827) at Time 2. However, the proportion of correct applied items was still significantly higher for the experimental than the control group at Time 2, (*t*(88) = -2.12, *p* = .037). This suggests that although there was a decline in performance over time for the experimental group, they still outperformed the control group in recalling the self-management information. Overall, these findings show that, among younger adults, difficulty with answering applied items contributed to the comparatively poorer performance of those in the control relative to the experimental condition. Figure 2.3 displays the results for younger adults.

2.4.2 Performance of Older Adults

With regards to older adults (Table 2.2), there was a significant interaction of item type x time, such that the passage of time compromised the recall of applied items, *F* (1, 49) = 8.60, *p* = .005, η^2 = .15. Performance was significantly better during Time 1 than Time 2 and for factual compared to applied items, *F* (1, 49) = 29.87, *p* < .001, η^2 = .38, *F* (1,49) = 40.53, *p* < .001, η^2 = .45, respectively. Contrary to our predictions, there was no effect of booklet condition, suggesting that causal information did not facilitate acquisition of information for older adults, $F(1,49) = 1.97$, $p = .167$. Results for older adults are displayed in Figure 2.4.

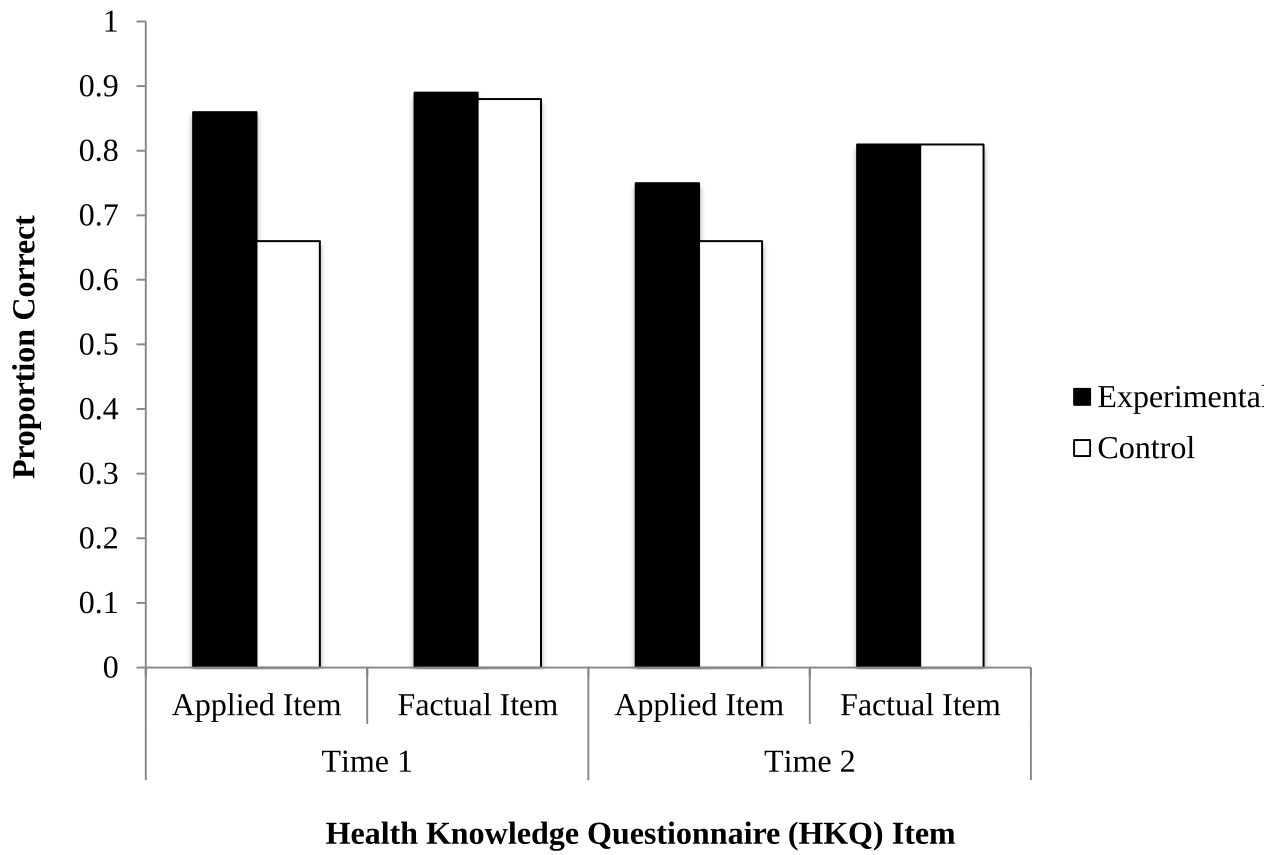

Figure 2.3: Bar graph illustrating the proportion correct on the Health Knowledge Questionnaire for younger adults across booklet conditions, time and test item type (*n* =90).

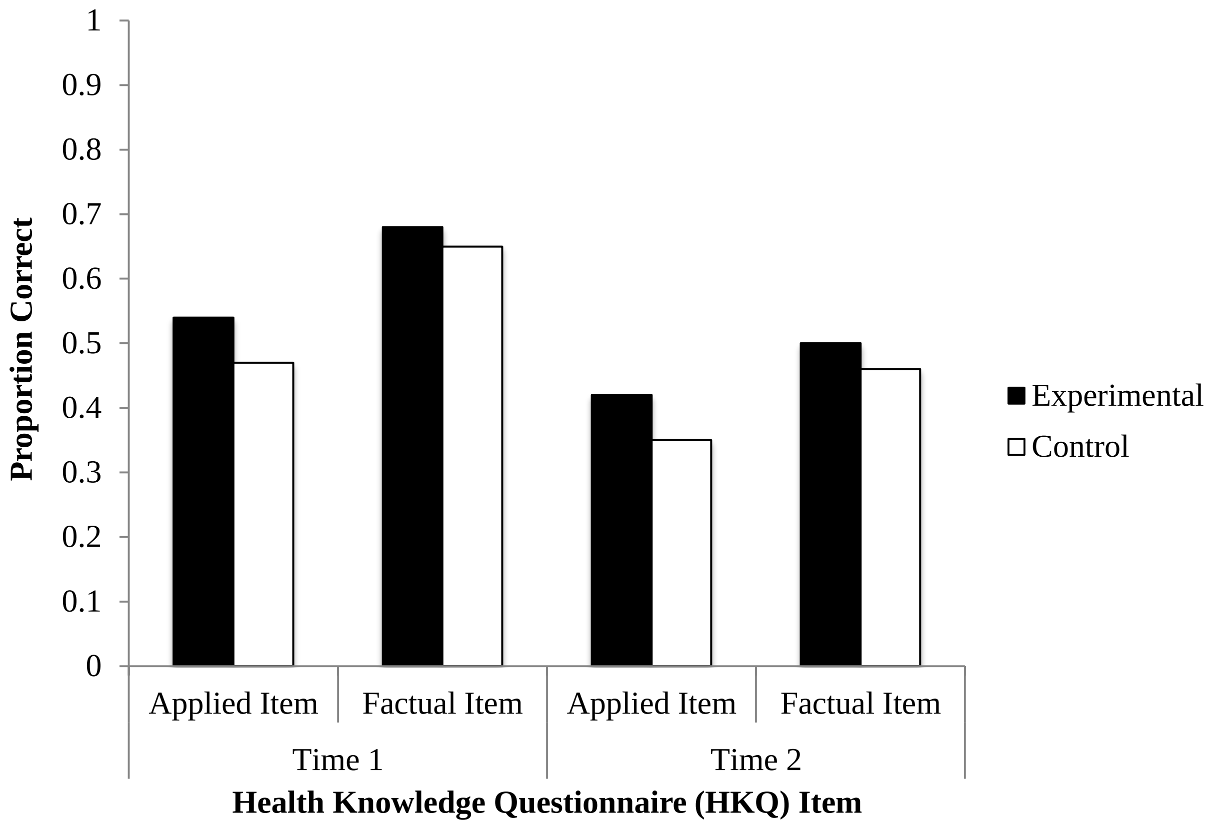

Figure 2.4: Bar graph illustrating the proportion correct on the Health Knowledge Questionnaire for older adults across booklet conditions, time and test item type (*n* = 51).

Table 2.2: Mean proportion correct on Health Knowledge Quiz at time 1 and time 2

	Item Type	Group	Time1 *M (SD)*	Time 2 *M (SD)*	*n*
Younger Adults	Applied	Control	0.66 (.16)	0.66 (.19)	45
		Experimental	0.86 (.11)	0.75 (.23)	45
	Factual	Control	0.88 (.11)	0.81 (.11)	45
		Experimental	0.89 (.11)	0.81 (.275	45
Older Adults	Applied	Control	0.47 (.11)	0.35 (.19)	26
		Experimental	0.54 (.17)	0.43 (.17)	25
	Factual	Control	0.65 (.21)	0.46 (.24)	26
		Experimental	0.68 (.20)	0.50 (.21)	25

Note: *M*= mean; *SD* = standard deviation; *n* = group sample size

2.4.3 Predictors of Knowledge Acquisition and Retention

Bivariate correlations indicated that several cognitive factors were also associated with performance on the knowledge questionnaire (Table 2.3). Among older adults, health literacy, working memory and reading comprehension were positively correlated with acquisition of health knowledge at immediate recall (Time 1). Reading comprehension and years of education was highly correlated with HKQ scores at Time 2. Older adults' age and booklet condition did not impact performance. In contrast, for younger adults, booklet condition and reading comprehension were positively associated with test performance on applied items at both time points (Table 2.3).

Results from a hierarchical regression (Table 2.4), pooling data from the older and younger adults, indicated that age explained 37.0% of variance in overall performance on the applied items at Time 1, $F\Delta$ (1, 135) = 78.28, $p < .001$. The inclusion of reading comprehension, working memory span and health literacy in the second step significantly improved the model by adding 10% explanatory variance, $F\Delta$ (3, 132) = 8.76, $p < .001$. Finally, the provision of causal information accounted for a significant amount of additional variance (9%) in the ability to apply health knowledge above and beyond age and other cognitive factors, *F*Δ (1, 131) = 24.03, $p < .001$. Combined, the predictors explained 55.0% of the variance in knowledge of critical items for Time 1, which was a large effect.

At Time 2 (Table 2.5), age accounted for 35% of the variance in performance on critical items, *F*Δ (1, 135) = 72.58, $p < .001$. To examine the amount of information recalled at Time 2, test performance at Time 1 was next entered into the model to control for individual differences in initial test performance. Initial test performance explained 22% of unique variance, *F*Δ (1, 134 = 66.44, $p < .001$). The addition of other cognitive predictors did not add significant explanatory variance, *F*Δ (3, 131) = 2.06 $p = .108$. Finally, the provision of causal information did not contribute significant explanatory variance at Time 2, *F*Δ (1, 130) = 2.33, $p = .130$. This suggests that causal information helped individuals to acquire actionable (i.e., applied) information but it did not accrue any further advantage with respect to its retention. The overall model has a R^2 of 59.2%, which is a large effect.

Table 2.3: Bivariate correlations between predictor and outcome variables

	Age	Years of education	Booklet condition	Reading comprehension	Health literacy	Working memory
Older Adults						
Time 1						
HKQ Applied	-*.02*	*.23*	*.24*	***.35****	***.28****	*.35**
HKQ Factual	-*.11*	*.24*	*.07*	*.20*	***.35****	***.32****
Time 2						
HKQ Applied	*.00*	-*.01*	*.22*	***.62*****	*.00*	*.16*
HKQ Factual	*.04*	***.31****	*.10*	***.65*****	*.21*	*.16*
Younger Adults						
Time 1						
HKQ Applied	-*.04*	-*.07*	***.57*****	***.25****	*.04*	*.17*
HKQ Factual	*.04*	-*.02*	*.06*	***.24****	*.12*	*.02*
Time 2						
HKQ Applied	*.04*	-*.01*	***.22****	***.21****	*.11*	*.05*
HKQ Factual	*.00*	*.02*	*.00*	*.13*	*.14*	*.06*

Note. **p*< .05, ***p < .01; HKQ= Health Knowledge Quiz*

Table 2.4: Hierarchical regression analysis on the predictors of performance on applied items for time 1 (*N* = 137)

	Step 1		Step 2		Step 3	
Predictors	β	SE (B)	β	SE (B)	β	SE (B)
Age	-.61***	-.005	-.51***	-.004	-.53***	-.000
Reading comprehension	--	--	.25***	.08	.16*	.01
Working memory			.18**	.06	.14*	.01
Health literacy			.06*	.02	.10	.02
Group condition (0 = control; 1 = experimental)		--	--	--	.30***	.03
Total R^2	.37***		.47***		.55**	
$R^2\Delta$	.37***		.11***		.09***	
$F\Delta$	78.28**		8.76***		24.03*	

Note. SE (B)= standard error of unstandardized coefficient; $R^2\Delta$ = change in R^2; * $p < .05$; ** $p < .01$; *** $p < .001$

Table 2.5: Hierarchical regression analysis on the predictors of performance on applied items for time 2 (*N* = 137)

	Step 1		Step 2		Step 3		Step 4	
Predictors	β	SE (B)	β	SE (B)	β	SE (B)	β	SE (B)
Age	-.59***	-.006	-.24**	-.002	-.24**	-.002	-.21*	-.002
HKQ Test 1	--	--	.58***	.72	.54***	.09	.59***	.10
Reading comprehension	--	--	--	--	.16*	.01	.17**	.01
Working memory					-.02	.00	.01	.02
Health literacy					-.06	-.02	-.02	-.03
Group condition (0 = control; 1 = experimental)		--	--	--	--	--	-.10	-.05
Total R^2	.35***		.56***		.57		.57	
$R^2\Delta$	.45***		.22***		.02		.007	
$F\Delta$	72.58***		66.44***		2.11		2.27	

Note. SE (B)= standard error of unstandardized coefficient; $R^2\Delta$ = change in R^2; HKQ = Health Knowledge Quiz; * $p < .05$; ** $p < .01$; *** $p < .001$

2.5 Discussion and Conclusion

2.5.1 Discussion

The present study aimed to determine whether explaining how the recommended self-care behaviour reduces illness-related symptoms would improve uptake of novel healthcare information. This study is among the first to investigate causal information as a patient education strategy for both younger and older adult health users. Our broad goal was to address the gaps in the literature regarding effective teaching strategies that can address individuals' learning process in patient education.

Our results showed that performance on a test of novel health information was significantly enhanced for younger adults who received patient education booklets that explained the cause and effects of illness self- management. Specifically, the provision of causal information led to higher accuracy on applied items, which were questions that required participants to make decisions about how to manage a hypothetical symptom flare-up. Younger adults who received causal information answered approximately 85.6% of these applied items correctly compared to 66.4% in the control condition. For items that required participants to recall verbatim factual information, both the experimental (88.9%) and control (87.6%) groups achieved similar levels of accuracy. This suggests that causal information benefitted health users' acquisition of knowledge by enabling them to apply this information to problem-solve different situations. Although younger adults in both groups showed a decline in performance over time, the experimental group still maintained more medical knowledge than the control comparison after one-week delay. Hence, causal information appears to help with the consolidation of unfamiliar health information, and the advantage of receiving this information is robust.

The present findings are consistent with previous reports that incorporating basic sciences in medical curricula in a way that emphasize causal connections in medical exams, helps to improve the diagnostic skills of inexperienced trainees (Devantier et al., 2009; Woods et al., 2007). It is likely that information about self-care strategies becomes more salient for individuals who receive explanations about the connection between illness causes and outcome. Our data therefore support the notion that causal information facilitates connections between individual health concepts, which in turn help form a coherent cognitive representation of the information (Rehder & Hastie, 2001). However, contrary to our predictions and in contrast to the results with younger adults, there were no significant differences in proportion of correct applied items between elderly individuals in the experimental (54.0%) and control (47.0%) groups. Rather, reading comprehension was the best predictor of older adults' level of medical knowledge acquisition.

A recurrent finding in the literature is that older adults are more prone to confuse medical information than younger counterparts due to age-related cognitive changes (Sayers et al., 2007). The current results showed that younger adults answered approximately 78.9% of the HKQ items correctly across both time points, while older adults only achieved 50.7% accuracy. This study, along with others (Brown & Park, 2003; Liu, Kemper, & McDowd, 2009; Morrow, Leirer, Carver, Decker Tanke, & McNally, 1999), indicate that older adults are less able to understand and retain health information than younger individuals. Our findings suggest that one of the barriers to comprehension of medical information among the older age group may be related to cognitive changes in reading comprehension. As such, there is a need to re-evaluate patient education strategies for the older patients that can accommodate for cognitive declines in understanding written health information (Evangelista et al., 2003; Sloan & Pressler, 2009).

Several methodological limitations may affect the interpretation of the study's findings. First, the intended novelty of the health booklets may have inadvertently interfered with any potential benefits of causal information for older adults., The health recommendations for Alphabet Disease were designed to be counterintuitive so that individuals could not guess the correct answer based on common knowledge. This likely was a disadvantage for the older group because past research showed that older adults are more resistant to adopting new accurate medical information that counter previous beliefs (Adams, Rogers, & Fisk, 2011; Hancock, Fisk, & Rogers, 2005; Okun & Rice, 2001; Rice & Okun, 1994). It should be mentioned that some of the recommendations in the booklet were designed to counter common knowledge about health behaviour changes. Second, the design of the health information booklets and knowledge test may advantage individuals with higher reading comprehension. Presenting causal information in a non-written format may increase its utility in patient education. Finally, it is difficult to gauge the intrinsic motivation for participants to learn the health information. Patients in clinics, unlike research participants, may be more inclined to learn about their actual diagnosis and therefore, may be more sensitive to the presentation of health information. Although there were several disadvantages to using education material about an artificial disease, implementing a controlled experimental design allowed for the singular effects of an educational strategy to be evaluated.

Overall, results from this study suggest that causal information can improve the comprehension of novel health information. This effect is significant even after controlling for age, reading comprehension, working memory span and health literacy. Therefore, it is possible that causal information may improve the delivery of patient education for older adults if this strategy was used in combination with approaches that reduce the verbal complexity of healthcare information. For example, providing face-to-face education sessions in addition to written-information alone, and reducing the reading level of text information may counter deficits in reading comprehension among older adults (Biuek-sawhney & Reicherter, 2005; Goeman, Jenkins, Crane, Paul, & Douglass, 2013). In this study, participants were required to memorize the health information. However, this would not be the case in a clinical context where patients could refer to the given educational material at will. Without the cognitive load associated with memorizing the information, the benefit of using causal information to help older adults learn medical information may be more pronounced.

2.5.2 Conclusion

This experimental study suggests that making it clear for patients why and how recommended lifestyle changes will reduce their symptoms may enhance their acquisition and use of healthcare knowledge. This strategy helps individuals to better understand the rationale for performing specific self-care behaviors in response to symptom flare-up. In particular, providing causal information in a manner that is verbally easy to understand may have the potential to help older adults interpret medical information. If learning about the cause-and-effect of illness management leads to improved application of the information, then this may serve as a crucial stepping-stone towards optimizing patients’ self-management of their illness condition.

2.5.3 Practice Implications

Providing explanations for *why* patients should follow illness management strategies, rather than prescribing *what* they should do, is aligned with a patient-centred approach. The integration of causal information in patient education programs can help increase individuals' ability to learn and use health information. Future research should determine the effects of providing causal information in actual health care settings with regards to improving patient knowledge and uptake of self-management strategies. This translation of experimental findings into clinical practice would contribute to the need for evidence-based care in patient education. The regard for patients as capable learners in the medical setting brings us closer to building provider-patient partnerships in chronic disease management.

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Chapter 3

3 Explaining Causal Links among Risk Factors, Cardiovascular Pathophysiology, Symptoms and Health Behaviours: A Randomized Controlled Trial to Enhance 'Deep' vs. 'Surface' Level of Knowledge

3.1 Abstract

BACKGROUND: Implementation of patient education in cardiac rehabilitation and secondary prevention (CRSP) programs has often been suboptimal. It was hypothesized that providing causal information that draws connections among risk factors, coronary endothelial pathophysiology, symptoms and health behaviours would enhance patients' depth of knowledge about their cardiovascular disease management and perceptions of the CRSP program.

METHODS: Weekly group education sessions at outpatient CRSP program entry were randomized to standard care with (intervention) or without (control) causal information. Depth (surface vs. deep) of knowledge was gauged with an adapted expert-reasoning task. Patients' general cardiovascular knowledge and beliefs about the efficacy of the CRSP program were assessed using standardized questionnaires.

RESULTS: After controlling for education level, patients in the intervention group had deeper knowledge about cardiovascular management than did those in the control condition, $p = 0.027$, Cohen's d = 0.50. The intervention group also had more factual knowledge than their counterparts after covarying education, occupation status and BMI, $p = 0.031$, Cohen's d = 0.53. Participants in the intervention condition rated the CRSP program as more credible than those in the control condition, after controlling for age, $p = .05$, Cohen's d = 0.50. Deep knowledge mediated the relationship between group conditions and perceived credibility of CRSP (β = 0.39, CI = 0 .033 to 1.20).

CONCLUSION: Causal information enhanced patients' understanding of cardiovascular disease management and their perceived treatment credibility of the CRSP program.

3.2 Introduction

Although patient education is a core component of cardiac rehabilitation and secondary prevention (CRSP) programs (Balady et al., 2007; Buckley et al., 2013; Grace et al., 2014; Smith et al., 2006; Smith et al., 2011), several systematic reviews and meta-analyses suggest that the delivery of educational interventions for cardiac patients is suboptimal due to the lack of empirically-based pedagogy (Brown et al., 2013; Dusseldorp et al., 1999; Ghisi, Abdallah, et al., 2014; Ghisi, Grace, Thomas, & Oh, 2015; Karmali et al., 2014; Lagger et al., 2010; Tawalbeh & Ahmad, 2014). Cognitive scientists would argue that it is important to consider the depth of information processing in educational contexts, as it has implications for how this information can later be retrieved and used (Craik & Tulving, 1975; Minda, 2015). Shallow processing refers to learning at the surface level, typically in a rote manner. This type of processing enables acquisition of *factual knowledge*, which is associated with recalling facts verbatim (Mayer, 2002). In contrast, deep processing, based on knowledge of conceptual information about the subject matter is a more useful form of learning. Individuals who process information at a deep level (i.e., experts) can better apply their knowledge to solve problems (Chi et al., 1981; Devantier et al., 2009; Murphy & Medin, 1985; Shafto & Coley, 2003). Arguably, educational programs that foster deeper levels of processing may better help patients use the acquired knowledge to manage their cardiovascular disease (CVD).

The explanation of *why* an effect occurs or *how* things work, termed *causal information* (Keil, 2011; Murphy & Medin, 1985), is one strategy used in medical education to enhance depth of knowledge acquisition among trainees (Goldszmidt et al., 2012; Woods et al., 2005, 2007). This approach was recently tested in a non-clinical sample by creating two versions of a health education booklet about a hypothetical disease (Zhang et al., submitted). Undergraduate students who learned about the causal link between health behaviours and underlying pathophysiology and its associated symptoms were better able to apply their knowledge to answer questions about managing symptom flare-up than the control group. In the domain of CVD management, the association between health behaviours and vascular endothelial function is a form of causal information that highlights the cause-and-effect of behavioural intervention on cardiovascular pathophysiology. This knowledge of flow-mediated dilation (FMD) facilitates physicians' diagnostic decisions and prescriptions of pharmacological and non-pharmacological treatments (Charakida, Masi, Lüscher, Kastelein, & Deanfield, 2010; Flammer et al., 2012; Harris, Nishiyama, Wray, & Richardson, 2010).

In the same way that knowledge of FMD is useful in clinical practice, this information may help patients better understand the rationale for CVD management. That is, providing patients with a clear explanation of the links between the health behaviours, cardiac risk factors, symptoms and endothelial pathophysiology might enable them to extrapolate and use this information for CVD management. Patients with increased awareness of how these elements fit together might be more likely to find the CRSP program logical (i.e., treatment credibility) and to believe that it will improve their health and functioning (i.e., treatment expectancy) (Devcich, Ellis, Gamble, & Petrie, 2008; Devilly & Borkovec, 2000; Janssen, De Gucht, Van Exel, & Maes, 2013). To the best of our knowledge, no research to date has assessed the merit of using causal information to enhance depth of knowledge and acceptability of the CRSP programs.

Accordingly, the goal of this study was to examine whether integrating causal information would increase cardiac patients' level of knowledge and treatment efficacy beliefs. We hypothesized that, relative to those receiving standard care (the control group), those receiving standard care augmented by causal information (the intervention group) would demonstrate higher levels of: 1) factual knowledge; 2) deep knowledge; and 3) treatment credibility and expectancy. We also predicted that increased deep and factual knowledge would mediate the relationship between group condition and treatment credibility and expectancy.

3.3 Methods

3.3.1 Study Design:

This study was a pragmatic cluster randomized controlled trial (cRCT) undertaken at the outpatient CRSP Program at St. Joseph's Hospital, London, Canada between July 2015 and January 2016. Prior to enrolment into the program, all newly referred cardiac patients were invited to attend a 90-minute didactic education session aimed at educating patients about CVD management and orienting them to the services available at CRSP. At the beginning of this session, take-home survey packets containing the study measures were administered to all attending patients. Patients who were interested in participating in the study returned their completed surveys prior to enrolling into the CRSP program. On average, survey packets were returned 17.12 days (*SD* = 16.23) after the education session. The protocol was approved by the Western University Health Science Research Ethics Board (HSREB) and the Lawson Health Research Institute (#106383; Appendix F).

3.3.2 Randomization

Twenty-one weekly patient education sessions were randomized either to standard care plus causal information (intervention group) or standard care only (control group). Randomization of education sessions was based on a computer-generated number sequence that produced an even allocation ratio (1:1) of intervention and control groups within blocks of four. A study-blind administrative assistant consecutively assigned patients to education sessions based on clinic flow. Patients did not know that they were receiving one of two versions of the educational program. Treatment fidelity was monitored to ensure no crossover between the control and intervention conditions.

3.3.3 Participants

A total of 418 cardiac outpatients were referred to the CRSP program between July 2015 and January 2016, and of those, 297 attended an education session. Inclusion criteria for participant recruitment were: 1) meets eligibility requirements for CRSP participation (Canadian Association of Cardiac Rehabilitation, 2009), as assessed by a physician; 2) attended an education session at the program during the study period; and 3) sufficient oral and written fluency in English as determined by their ability to complete program questionnaires. All eligible patients were given a take-home survey packet and letter of information at the education session. Return of the completed survey packet denoted informed consent.

The sample size calculation was in accordance with standard criteria for a cRCT (Campbell, Mollison, & Grimshaw, 2001; Campbell, Thomson, Ramsay, MacLennan, & Grimshaw, 2004; Donner & Klar, 2000). An inflation factor of 1.2, derived from a mean cluster size of five participants per cluster and an estimated intra-class coefficient (ICC) of

0.05 was used to account for cluster randomization. The ICC was estimated to be low (< 0.05) given that the same presenter conducted all sessions in one clinic setting. Based on these parameters, a sample size of 100 (50 per group) would provide 80% power at the 5% significance level to detect a medium effect size (Cohen's d = .5) between the two conditions.

3.3.3.1 Standard Care

The standard patient education session at CRSP included a 60-minute presentation, designed in accordance with best practice guidelines (Canadian Association of Cardiac Rehabilitation, 2009), which provided information about the difference between chronic and acute conditions, cardiac risk factors, recommended lifestyle changes and the aims of the CRSP program and its associated services. The formal presentation was followed by a 30 minute questions and answer period. A multidisciplinary team delivered the presentation. Patients also received a two-page brochure outlining the services available at CRSP.

3.3.3.2 Intervention

Patients in the intervention group received an additional 15-minute presentation (75 minute presentation; 15 minute question and answer period) and a two-page brochure explaining the mechanisms underlying endothelial pathophysiology and its link to cardiac risk factors, symptoms and health behaviours (Appendix G). The presentation and brochure were created by a team of psychologists, a clinical psychology graduate student (first author), cardiac rehabilitation specialist and cardiologist.

The program psychologist delivered the 15-minute add-on presentation, which contained five Powerpoint slides. Patients first learned about the two qualities of a health artery: 1) no blockage and 2) dilates in response to physical exertion due to release of nitric oxide in the endothelium. They next learned about how these two qualities are compromised in CVD and the limitations of medical interventions for ‘fixing’ the diseased endothelium. Finally, the causal link between a range of health behaviour and their impact on endothelial pathophysiology, cardiac risk factors and symptom reduction were explained. See Figure 3.1 for the causal explanation for exercise. The mechanisms by which dietary changes, smoking cessation, stress management, and medication adherence affect the endothelium also were explained.

3.3.4 Measures

3.3.4.1 Patient Medical Chart Review

Sociodemographic and clinical information was obtained from outpatient medical charts.

3.3.4.2 Treatment Fidelity

Two independent observers attended six randomly selected sessions (three control and three intervention). Treatment fidelity checklists (Moncher & Prinz, 1991; Appendix H) were completed to assess treatment integrity (i.e., treatment delivered as intended) and treatment differentiation (i.e. no cross-over between treatment conditions).

"When you exercise, your muscles require increased flow of blood and your heart would work harder to pump that blood. Increased blood flow tugs at and stimulates the inner lining of your coronary arteries, also called the endothelium. This gradually reconditions the endothelium to enhance its ability to create and release nitric oxide. As you have learned earlier, the release of nitric oxide allows the artery to expand in response to physical activity. Therefore, with regular exercise, you will begin to experience fewer angina symptoms and your artery will begin to restore its health. When this happens, there is fewer plaque build-up which then means you'll have a lower chance of future heart problems"

Figure 3.1: This is an example of an explanation that includes causal information about the linkage between flow-mediate dilatation, cardiac risk factors, symptoms and health behaviours.

3.3.4.3 Primary Outcome Variables

The 23-item Coronary Heart Disease Awareness and Knowledge Questionnaire (CHDAK; Kayaniyil et al., 2009) was used to measure participants' factual knowledge about CVD. A higher percentage of correct answers indicated higher factual knowledge. The CHDAK has good internal consistency, with Cronbach's alpha of .88.

The Patient Profile Task (PPT; Appendix I) was an adapted expert reasoning task (Devantier et al., 2009; Rabinowitz & Hogan, 2008) used to assess deep knowledge about CVD management. The task had ten hypothetical patient profile triads (Person A, Person B, and Person C) describing how patients manage their symptoms and heart disease condition. The attending physician, cardiac rehabilitation specialist, and multidisciplinary team at CRSP came to a consensus on the suitability of each profile individually, and each triad as a whole. The triads were designed so that 'Person A' matched one of the other profiles on a surface feature (e.g., demographic information) and the other profile on a deep feature (e.g., actions taken to manage CVD). The deep feature match required participants to first think about whether the action taken in a given profile was appropriate for managing cardiac risk and/or symptom and then match the profile based on concordance of adherence behaviour. A higher percentage of deep feature matches was taken to reflect better problem-solving abilities and depth of knowledge. Figure 3.2 shows an example of a profile triad. The task demonstrated good internal consistency, with a Cronbach's alpha of .85 in our pilot test with graduate and undergraduate university students.

3.3.4.4 Secondary Outcome

The extent to which patients believed in the efficacy of the CRSP program was assessed using an adapted Credibility/Expectancies Questionnaire (CEQ; Devilly & Borkovec, 2000; Appendix J). Summary scores for the two scales were derived by summing all items, with higher scores reflecting more positive treatment expectancy and better credibility. The CEQ has been shown to have high internal consistency (Cronbach's alpha of .86), test-re-test reliability and validity (Devilly & Borkovec, 2000).

Person A:
Mr. Garrison is a *retired mechanic* who had *2 stents placed 2 years ago*. He has been doing well since but sometimes experiences heaviness in his chest when he does physical activity. After seeing his doctor, **he signed up for swim classes at a community centre to stop the symptoms from getting worse.**

Please select the person that best matches Person A:

☐ Person B: Mr. van Der Wal is a *retired electrician* who had *2 stents placed 2 years ago*. Mr. van Der Wal is doing well but experiences chest pains after physical activity. **To avoid feeling worse, Mr. van Der Wal has decided to rest more often and cut down on vigorous activities.**	☐ Person C: Ms. Spencer is an *accountant* who underwent bypass surgery *5-years ago*. Recently, she has been feeling more tired than before after physical activity. **She is unable to do vigorous exercise, like running or cycling, but she walks 20 minutes everyday.**

Figure 3.2: This is an example of a patient profile triad. The surface features, which are demographic information, are underlined. Deep features are bolded and pertain to cardiovascular disease management-related actions. Person A matches Person C based on deep feature, and to Person B based on surface feature.

3.3.5 Statistical Analysis

All statistical analyses were performed using SPSS version 23.0 with PROCESS Macro by A. Hayes, and following previously described methods for cRCTs (Donner & Klar, 2000; Foster, Sawyer, Smith, Reddel, & Usherwood, 2015). Differences in participant characteristics between the intervention and control groups were assessed using *t*-tests for continuous variables and chi-square tests for categorical variables, with adjustment for the clustering of patients within education sessions. This adjustment was made by dividing the calculated test statistic by the inflation factor (IF) based on an estimated ICC of .05 and an average cluster size of 4.474 (Wears, 2002). Pearson product-moment correlations were conducted to examine the relationships between demographic and outcome variables at the participant level. Demographic variables that correlated with the outcome variables were entered as covariates in subsequent analyses.

Treatment effects between the intervention and control groups were evaluated separately for the outcome variables using 2-level multilevel modeling (MLM) with maximum likelihood estimates to account for clustering within the education session. The models were adjusted for sociodemographic covariates that correlated with outcome variables. Upon determining that the ICCs for the primary outcome variables were generally low (<0.05), the method for multiple mediation analysis as suggested by Hayes (Preacher & Hayes, 2008) was conducted at participant level (level 1). Mediation analysis using bootstrapping method with bias-corrected confidence estimates (95% confidence interval, 1000 bootstraps resamples) was conducted to determine the potential mediating roles of applied and factual knowledge on the relationship between group condition and treatment credibility and expectancy scores. Statistical significance was defined as $p \leq .05$ (two-sided) and effect sizes for all analyzes were computed using Cohen’s d (Cohen, 1988), based on the pooled standard deviation.

3.4 Results

3.4.1 Treatment Fidelity

There was good inter-rater reliability between the two independent observers across six observed sessions (Cohen’s kappa = .90). The three orientation sessions in the control condition did not contain any of the 14 key intervention components focused on causal links between cardiovascular pathophysiology and risk factors, symptoms and health behaviours, indicating good treatment differentiation. On average, the intervention conditions contained 97% of the key intervention components, indicating high treatment fidelity.

3.4.2 Participant Demographic Characteristics and Outcome Variables

Out of the 252 patients (120 in control and 132 in intervention) who received a study survey, 94 (49 in control and 45 in intervention condition) returned a complete survey package, for a response rate of 38.4. Figure 3.3 shows participant flow. There were no significant group differences in demographic characteristics (Table 3.1).

As shown in Table 3.2, higher body mass index (BMI) and retirement/unemployment (not working) status were associated with lower CHDAK (i.e., factual knowledge) scores. The CHDAK and PPT (i.e., deep knowledge) were positively correlated with higher education. PPT and CHDAK were not correlated (r = .08). CHDAK was positively correlated with treatment credibility but not expectancy, whereas the PPT was associated with both higher perceptions of treatment credibility and expectancies. Age was negatively correlated with treatment credibility and expectancy PPT and CHDAK scores were not significantly correlated with each other.

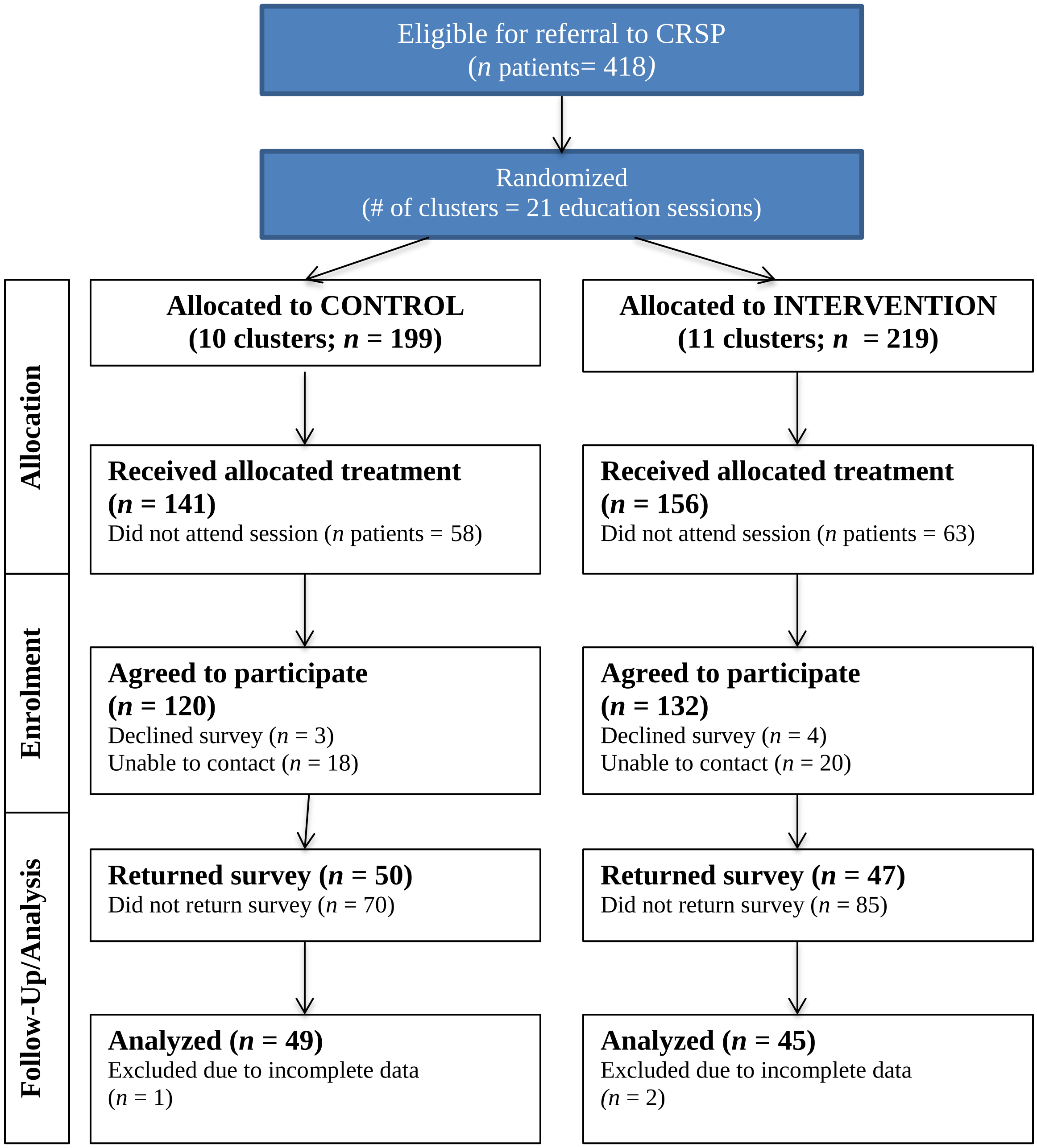

Figure 3.3: CONSORT participant flow diagram. Please note CRSP = cardiac rehabilitation and secondary prevention.

Table 3.1: Patient demographic characteristics

	Control (N = 49)	Intervention (N = 45)	Total	*p* – value[a]
Response Rate	49/120 (40.83)	45/132 (34.09)	94/2532 (37.30)	.300
Social Demographic Variables	n (%)	n (%)	n (%)	
Age (*M(SD))*	67.80 (8.81)	64.60 (10.59)	66.27 (9.78)	.110
Sex, female	19 (38.8)	10 (22.2)	29 (30.9)	.108
Non-white ethnicity	4 (9.5)	3 (7.7)	7 (8.6)	.787
Without partner	6 (14.6)	8 (20.5)	14 (17.5)	.489
> secondary education	25 (59.5)	25 (62.5)	50 (61.0)	.799
Occupation Status				.113
Employed (F/T or P/T)	5 (11.9)	13 (32.5)	18 (22.0)	
Unemployed/Disability	5 (11.9)	4 (10.0)	9 (11.0)	
Retired	32 (76.2)	23 (57.5)	55 (67.1)	
Referral Reasons	*n (%)*	*n (%)*	*n(%)*	
Referral event				.910
MI	25 (51.0)	21 (46.7)	46 (48.9)	
ACS	9 (18.4)	7 (15.6)	16 (17.0)	
Stable CAD	6 (12.2)	9 (20.0)	15 (16.0)	
Valve repair	6 (12.2)	5 (11.1)	11 (11.7)	
HF	1 (2.0)	2 (4.4)	3 (3.2)	
Other	2 (4.1)	1 (2.2)	3 (3.2)	
Referral intervention				.541
CABG	17 (34.7)	22 (48.9)	39 (41.5)	
PCI	17 (34.7)	12 (26.7)	29 (30.9)	
Valve surgery	5 (10.2)	5 (11.1)	10 (10.6)	
Medication only	8 (16.3)	6 (13.3)	14 (14.9)	
Other	2 (4.1)	0 (0)	2 (2.1)	
Prior cardiovascular event	5 (10.2)	4 (8.9)	9 (9.6)	.841
Risk Factors	*n (%)*	*n (%)*	*n(%)*	
BMI (*M(SD))*	27.85 (5.35)	29.17 (4.62)	28.50 (5.02)	.231
Dyslipidemia	25 (59.5)	20 (50.0)	45 (54.9)	.423
Hypertension	24 (57.1)	29 (72.5)	53 (64.6)	.179
Current Smoker	3 (7.1)	7 (17.5)	10 (12.2)	.136
Sedentary	1 (2.4)	1 (2.5)	2 (2.24)	.977
Family History	24 (57.1)	27 (67.5)	51 (62.2)	.371

Note: M = mean; SD = standard deviation; n = sample size; MI = myocardial infarction; ACS = acute coronary syndrome; CAD = coronary artery disease; HF = heart failure; CABG= coronary artery bypass grafting; PCI = percutaneous coronary intervention; BMI – body mass index

[a]*p* values were comparisons between intervention and control groups, with adjustment for clusters.

Table 3.2: Bivariate correlations between demographic, primary and secondary outcome variables.

	Deep Knowledge (PPT)	Factual Knowledge (CHDAK)	Treatment Credibility	Treatment Expectancy
Deep knowledge (PPT)		.08	**.27***	**.28***
Factual knowledge (CHDAK)			**.21***	.01
Treatment credibility				**.73*****
Gender (0 = male; 1 = female)	-.029	-.067	-.162	-.143
Age	-.074	-.146	**-.253***	**-.253***
Minority (0 = Non minority; 1 = minority)	-.178	.013	-.018	.057
Marital status (0 = with partner; 1 = without partner)	.188	.039	.188	.173
Education (0 = ≤higher school; 1 = > high school)	**.300***	**.226***	.113	.010
Occupation (0 = not working; 1 = working)	-.100	**-.269***	-.152	-.149
# of risk factors	.080	.076	.077	.070
Body mass index	.043	**-.221***	-.059	.177

* $p < .05$; ** $p < .01$; *** $p < .001$

3.4.3 Deep and Factual Knowledge

Group conditions, along with the covariates of education, BMI and occupation status were entered into MLM to predict performance on the CHDAK (see Table 3.3). Provision of causal information was associated with higher factual knowledge. The difference in CHDAK scores between the intervention and control groups was significant, corresponding with a medium effect size (Cohen's *d* = .5).

In a mixed model, with group condition and education as predictors, receipt of the intervention predicted higher scores on the PPT. As shown in Table 3.3, patients who received causal information made significantly more deep-feature matches (67.9%) than individuals in the control condition (57.2%; Cohen's *d* = .5).

Table 3.3: Comparison of Primary and Secondary Outcomes between Group Conditions[1]

	Intervention *M* (SE) *n* = 45	Control *M* (SE) *n* = 49	Difference (SE)	95% CI of the difference	*p* value	ICC
Factual Knowledge	70.81 (1.40)	66.31 (1.36)	4.51 (1.99)	.54 to 8.46	.026*	.006
Deep Knowledge	67.94 (3.61)	57.17 (3.51)	10.77 (5.04)	.02 to 21.52	.048*	.02
Treatment Credibility	23.91 (0.66)	21.98 (0.68)	1.96 (.95)	.02 to 3.80	.050*	.112
Treatment Expectancy	22.77 (0.75)	21.01 (0.73)	1.76 (1.05)	-.42 to 3.95	.107	.132

Note: *M* = mean, *SE* = standard error, n = sample size, CI = confidence interval; ICC = intra class coefficient

[1] Controlling for covariates.

*$p \leq .05$

3.4.4 Treatment Credibility and Expectancy

Provision of causal information was associated with higher treatment credibility, β = 1.93, $t(22.21) = 2.12$, $p = .05$, 95% CI = .02 to 3.90, but not with higher treatment expectancy. The effect size of the between group comparison was medium, Cohen's d = .50. The multiple mediation analysis (Figure 3.4) indicated that group condition (0 = control, 1 = intervention) was positively related to treatment credibility (β = 1.96, $t(92) = 2.32$, $p = .022$), PPT (β = 9.25, $t(92) = 2.02$, $p = .0461$) and CHDAK (β = 4.823, $t(92) = 2.46$, $p = .016$). Moreover, PPT (β = .042, $t(90) = 2.21$, $p = .03$), but not CHDAK (β = .0667, $t(90) = 1.36$, $p = .177$), was related to treatment credibility. After controlling for PPT, group condition no longer predicted treatment credibility, (β = 1.25, $t(90) = 1.42$, $p = .160$). The indirect effect of group condition on treatment credibility, with PPT (i.e., deep knowledge) as the mediator, was significant (β = .39, 95% CI = .033 to 1.20). Based on the ratio of indirect to total effect, deep knowledge mediated 20.0% of the relationship between group condition and treatment credibility.

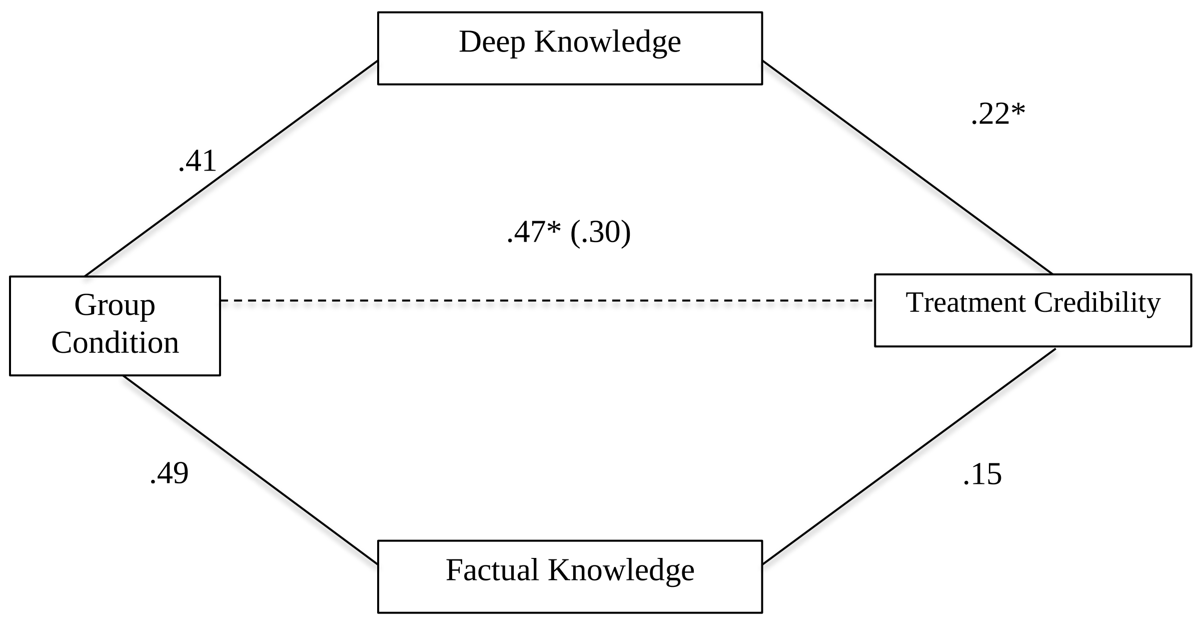

Figure 3.4: This figure shows the multiple mediation model of predicting treatment credibility scores. Values next to the lines represent the standardized coefficient of each path. Number in the bracket is the direct effect (c') of group condition (0 = control; 1 = intervention) on treatment credibility after controlling for the mediator.

3.5 Discussion and Conclusion

3.5.1 Discussion

This pragmatic cRCT indicates that integrating causal information into a patient education program improves deep and factual knowledge about CVD. Higher levels of deep knowledge mediated the relationship between provision of causal information and enhanced perceptions of CRSP program credibility.

Past research has shown that patients who learned about CVD pathophysiology, causes, symptoms, risk factors, and health behaviours get an average of 10.5% (*SD* = 1.91) more questions correct on the CHDAK (measure of factual knowledge) than those who did not receive any patient education (Tawalbeh & Ahmad, 2014). This study indicates that explicitly linking the association between FMD and CVD management information further enhances patients' factual understanding above and beyond that achieved through a standard education session. Moreover, there was a medium effect size of treatment on factual knowledge, which is comparable to the outcomes attained in more costly interventions involving multiple educational sessions, individual patient-provider interactions, provision of counseling, and/or use of computer assisted technologies (Ghisi, Grace, Thomas, Vieira, et al., 2015; Meng et al., 2014; Mosca et al., 2010; Ng & Fai, 2001).

The most notable and novel finding was that integrating causal information into patient education enabled them to process CHD-related information at a deeper level. This result is consistent with previous observations that causal information enhances problem-solving abilities among trainees and enables an expert-level of reasoning (Goldszmidt et al., 2012; Woods et al., 2007). It has been posited that causal information has a facilitatory effect on one's ability to apply newly-acquired knowledge because it links otherwise fragmented concepts into a coherent cognitive representation (Rehder & Hastie, 2001). Having a more cohesive set of concepts increases ones' ability to extrapolate and use information to solve a real-life problem (Freyhof, Gruber, & Ziegler, 1992). Thus, it could be that patients who received causal information were better at perceiving matches in deep features (actions taken to manage CVD) because learning about the connection between multiple aspects of CVD management helped organize their knowledge structure. In turn, this may have made it easier for patients to access and apply the relevant information pertaining to health behaviours that target cardiac risk factors and/or symptoms.

It is worth noting that deep and factual knowledge were not significantly correlated, which is consistent with the assertion that these reflect different levels of information processing (Mayer, 2002). We also found that deep but not factual knowledge mediated the relationship between the provision of causal information and higher treatment credibility. As previously noted, deep knowledge is acquired through a more meaningful learning, which involves integrating incoming information with existing knowledge (Mayer, 1999, 2002). It could be that in addition to facilitating a more organized knowledge structure, explaining the linkage between FMD and CVD management may enable patients to better perceive the importance of CRSP. Employing educational strategies that can increase treatment credibility beliefs has the potential to improve patient adherence (Hundt et al., 2013; Nock, Ferriter, & Holmberg, 2007).

There were several study limitations that could impact the interpretation of our findings. It is possible that patients who were inclined to participate in CRSP may have been more likely to respond to our survey than individuals less interested in the program. As we do not have data on the CRSP non-participants, there might have been a selection bias that limits the generalizability of our findings to other cardiac populations. Another limitation is that we did not measure patient knowledge prior to assessing treatment beliefs, which violates the temporal assumption of a mediation analysis (Preacher & Hayes, 2008). However, the treatment of deep and factual knowledge as mediators rather than as outcome variables is theoretically justified in that several health behavioural models stipulate that knowledge acquisition precedes the formulation of efficacy beliefs (Fisher & Fisher, 2002; Schwarzer et al., 2008; Vallerand et al., 1992). Finally, one cannot rule out the possibility that the observed group differences were simply due to the fact that the intervention was longer (by 15 minutes) and contained more information than control condition.

3.5.2 Conclusion

The results of this cRCT suggest that explaining the causal link among FMD, cardiac risk factors, symptoms and health behaviours improves knowledge acquisition among cardiac patients. This strategy appears to help individuals process information about CVD management and the rationale for CRSP at a deeper and more meaningful level. The provision of causal information facilitated patients' ability to use the information and better recognize appropriate actions to manage their cardiovascular condition. This coherent understanding of CVD management enhanced patients' perceptions about the credibility of the CRSP program. It is reasonable to predict that these effects on cognition and attitude may translate into adherence behavior.

3.5.3 Practice Implications

Helping patient understand *why* cardiac rehabilitation is important for illness management, rather than simply telling them *what* to do, can help patient-provider partnerships in CVD management. Incorporating cognitive science and educational theories into the design and development of patient education interventions is consistent with the view that patients are capable learners who are experts in their own experience. This trial demonstrated the efficacy and efficiency of a single teaching strategy, which can be combined with other educational approaches to improve the delivery of patient care in CRSP. We are continuing to investigate whether causal education affects patient behaviour.

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Chapter 4

4 Does Patient Knowledge Translate into Practice? Behavioural Effects of Integrating Causal Information in Cardiac Rehabilitation

4.1 Abstract

BACKGROUND: Explaining the causal connection among endothelial pathophysiology, cardiac risk factors, symptoms and health behaviours (causal information) has been shown to enhance patients' depth of knowledge and efficacy beliefs about the cardiac rehabilitation and secondary prevention (CRSP) program. This study investigated whether the provision of causal information would lead to: 1) faster completion of CRSP entry prerequisites (uptake latency), 2) an increased likelihood of enrolling in the program, and 3) higher levels of physical activity once enrolled.

METHODS: Group education sessions ($N = 94$ patients) at CRSP program entry were randomized to either standard care with (intervention) or without (control) causal information. Multilevel modeling was used to detect group differences in uptake latency, enrolment and physical activity, controlling for baseline characteristics and clustering.

RESULTS: Patients in the intervention group completed program entry requirements marginally faster ($\beta = 25.49$, $t(77) = 1.94$, $p = .056$) than did those in the control condition. However, there were no group differences in the likelihood of enrolling ($\beta = .20$, $t(73) = .28$, $p = .78$, OR = 1.22, 95% CI = .30 to 5.07) nor in physical activity level once enrolled in the program ($\beta = 4.38$, $t(90) = -.77$, $p = .44$, 95% CI = -11.94 to 5.24). Faster uptake latency was associated with greater likelihood of enrolling ($r(78) = -.25$, $p = .024$) and higher levels of physical activity in CRSP ($r(83) = -.30$, $p = .009$). Baseline characteristics, such as lower anxiety, higher exercise capacity, male gender, and better perceived treatment credibility of CRSP were associated with enhanced uptake latency and physical activity.

CONCLUSION: Provision of causal information alone did not induce health behaviour change. It is possible that the impact of this educational strategy could be augmented if used

in tandem with other approaches aimed at reducing anxiety and enhancing treatment efficacy beliefs.

4.2 Introduction

Many studies have demonstrated the efficacy of cardiac rehabilitation and secondary prevention (CRSP) programs in extending survival rates, decreasing the likelihood of recurrent cardiovascular events, minimizing the need for revascularization procedures, increasing blood pressure control, and improving the quality of life of patients (Mosca, Christian, Mochari-Greenberger, Kligfield, & Smith, 2010; Murphy, Cannon, Wiviott, McCabe, & Braunwald, 2009; Rutledge, Redwine, Linke, & Mills, 2013; Smith et al., 2006; Whelton, Chin, Xin, & He, 2002). However, despite the well-documented benefits (Lau-Walker, 2007; Taylor, Wilson, & Sharp, 2011), only 27-41% of patients referred to CRSP actually enrol into the service (Beswick et al., 2004; Cooper, Lloyd, Weinman & Jackson, 1999; Jackson, Leclerc, Erskine, & Linden, 2005). The low uptake of CRSP is a cause for concern because individuals who attend less than 25% of sessions at cardiac rehabilitation have a 58% higher mortality risk than attenders, after adjusting for gender, age, diagnosis, employment status, diabetes and family history (Beauchamp et al., 2013). As well, increasing enrolment in CRSP programs is associated with lower healthcare costs (Go et al., 2014).

Of additional concern is that many patients, once enrolled into CRSP programs, do not adhere to the prescribed regimens (Karmali et al., 2014). While management of all cardiac risk factors is necessary, regular physical activity level is especially important for reducing symptoms, increasing quality of life, lowering hospital re-admissions and reducing risk of mortality (Lawler, Filion, & Eisenberg, 2011; Shepherd & While, 2012; Taylor & Bower, 2004; Thomas et al., 2007). It has been reported that only 24% of patients engage in the recommended level of physical activity, which suggests that the majority of individuals are not deriving the full benefits of CRSP (Kravitz et al., 2012). In light of the evidence that patient knowledge is associated with better behavioural adherence in CRSP (Ghisi et al., 2014), practice guidelines have emphasized the need to help patients understand *why* cardiovascular management is important, rather than telling them *what* they need to do (Grace et al., 2014).

Similarly, research in cognitive science indicates that causal information, defined as explanations about how or why things work (Keil, 2011; Murphy & Medin, 1985), enhances knowledge acquisition and problem-solving abilities (Goldszmidt et al., 2012; Woods et al., 2007). In a study with a non-clinical sample learning about a hypothetical disease, we found that undergraduate students who were informed of the causal connections among illness pathophysiology, symptoms and health behaviours were better able to answer questions about managing symptom flare-ups than those who received the same information presented in a non-causal manner (Zhang, Swartzman, Petrella, Gill, & Minda, submitted). This suggests that causal information might have the potential to improve the efficacy of patient education.

The aforementioned study was followed up with a cluster randomized controlled trial (cRCT) comparing two versions of an education session aimed at orienting patients to the CRSP program (Zhang et al., 2016). Patients in the standard care condition learned about cardiac risk factors, symptoms and elements of the CRSP program, whereas those in the intervention condition received this information plus additional information about flow-mediated dilation (FMD). This information about FMD served to causally link health behaviours (i.e., reducing risk factors) with endothelial pathophysiology. Compared to the standard care group, individuals in the intervention condition retained more information, processed it at a deeper level and perceived the CRSP program to be more credible. However, it has yet to be determined whether these enhancements in cognitive outcomes could translate to behaviour change.

Based on the aforementioned findings, this second phase of the cRCT examined whether providing causal information had an impact on patients' health behaviour prior to and following entry into the CRSP program. CRSP program entry entails a two-step process that occurs *after* the education session. First, patients get their blood work requisition completed as a program prerequisite requirement. Next, they attend an intake appointment, which formalizes their enrolment into the service. It was predicted that, compared to patients receiving standard care, individuals in the education session with causal information would complete the enrolment prerequisite more quickly (uptake latency), would more likely to enrol into the program, and once enrolled, would engage in higher levels of physical activity. Moreover, we predicted that if a treatment effect were to be observed for any of these variables, the effect would be mediated by deep knowledge and beliefs about treatment efficacy.

4.3 Methods

4.3.1 Study Design

Details of the study protocol and participants are described more fully elsewhere (Zhang et al., 2016). In brief, all newly referred cardiac outpatients were invited to attend a 90-minute education session at St. Joseph's Hospital, London, Canada. This lecture-based session was designed to educate patients about CVD management and orient them to the services available at CRSP. Randomization of the 21 education session clusters was based on a computer generated number sequence that produced a 1:1 (intervention to standard care) allocation ratio within blocks of four. An administrative clerk blind to the randomization sequence, assigned patients to the education sessions based on the date of scheduled clinical appointment. Patients did not know that they were being assigned to one of two conditions, and researchers were blind to the assignment of patients into education groups. The study was conducted in accordance with the CONSORT statement for cRCTs (Schulz et al., 2010).

Study recruitment took place between July 2015 and January 2016. The majority of variables were measured at one of three points of time: At the beginning of the education session (Time 0 or Baseline), at program entry (Time 1) and approximately four months into the CRSP program (Time 2). Level of physical activity was assessed at Time 0 and Time 2. Ethics approval was obtained from both the Western University Health Science Research Ethics Board (HSREB) and the Lawson Health Research Institute (#106383).

4.3.2 Participants

The 94 cardiac outpatients who completed the survey for the first phase of cRCT constituted the study sample (see Figure 4.1 for participant flow). Inclusion criteria for participant enrolment were: 1) met eligibility requirements, as assessed by a physician, for cardiac rehabilitation based on practice guidelines (Canadian Association of Cardiac Rehabilitation, 2009); 2) attended an education session during the study period; and 3) had sufficient oral and written fluency in English, as determined by their ability to complete program questionnaires. All eligible patients were given a take-home survey packet and a letter of information. Return of completed survey packet denoted informed consent. Participants who chose to enrol into the CRSP were followed up to 4-months after their intake appointment date to assess their level of physical activity during the program. We also assessed physical activity levels prior to enrolment (i.e., at Time 0 – Baseline).

The study was powered in accordance with the objectives of the initial phase of the cRCT, which was focused on knowledge acquisition (Zhang et al., 2016). The standard sample size was based on the calculation criteria for clustered data (Campbell, Mollison, Steen, Grimshaw, & Eccles, 2000; Campbell, Thomson, Ramsay, MacLennan, & Grimshaw, 2004; Donner & Klar, 2000).

The majority of the sample was male (69.1%), married or with partner (82.5%), had attained more than a high school education (61.0%) and was retired (67.1%). Participants were on average 66.27 years old (range from 38 to 84 years). Most were referred to CRSP after a myocardial infarction (48.9%) and/or coronary artery bypass grafting (41.5%). There were no group differences in sociodemographic and/or clinical characteristics (see Table 4.1).

4.3.2.1 Standard Care

Consistent with the recommended model of delivery (CACR, 2009), cardiac patients referred to CRSP were invited to attend a group-based education session that oriented them to the service prior to program enrolment. The 60-minute lecture portion of the session included an explanation of the difference between chronic versus acute conditions and a description of cardiac risk factors, recommended lifestyle changes and services provided through CRSP. This was followed by a 30-minute question-and-answer period. Patients also received a two-page take-home brochure outlining the services available at CRSP. A multidisciplinary team delivered the presentation.

4.3.2.2 Intervention

Patients in the intervention group received, in addition to standard care, a 15-minute presentation delivered by the program clinical psychologist. The total duration of the didactic component of the educational session was 75-minutes, and was followed by a 15-minute question-and-answer period. Moreover, patients were given a two-page information booklet explaining the mechanisms of FMD and its linkage to health outcomes. In both the presentation and booklet, the qualities of a healthy versus diseased artery were compared with regards to blockage and endothelial health. The limitations of medical interventions were then reviewed. Finally, the causal links between health behaviour and changes in endothelial pathophysiology, cardiac risk factors and symptom reduction were explained. See Figure 2 for the causal explanation for physical activity. The mechanisms by which dietary changes, smoking cessation, stress management and medication adherence affect the endothelium were similarly explained. The study authors collaboratively created the presentation and the booklets.

4.3.2.3 Treatment Fidelity

Two independent observers attended six randomly selected sessions (three control and three intervention) and completed treatment fidelity checklists (Moncher & Prinz, 1991). Inter-rater reliability was high (Cohen's kappa= .90). None of the three control sessions contained any of the 14 references to causality that were built into the experimental sessions (i.e., high treatment differentiation) and these references appeared in the experimental session 97% of the time (i.e., high treatment integrity).

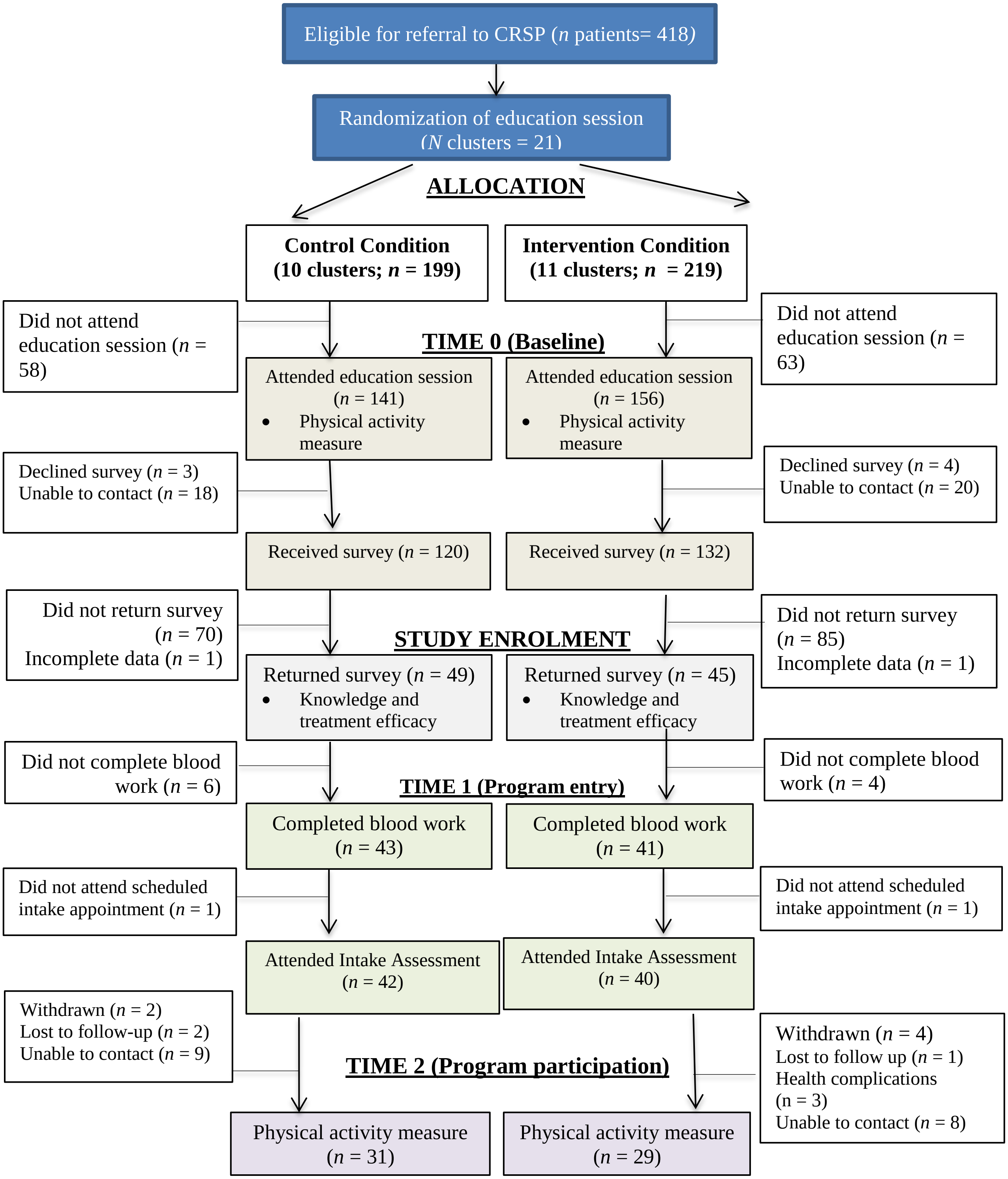

Figure 4.2: Participant flow diagram. Please note CRSP = cardiac rehabilitation and secondary prevention.

4.3.2.4 Sociodemographic and Clinical Information

Information about age and gender were extracted from outpatient medical charts. Other sociodemographic characteristics, such as education level, occupation status, marital status, education level and ethnocultural background were assessed through a self-report survey administered at the intake appointment. Exercise capacity at baseline, denoted by changes in aerobic capacity in metabolic equivalents (METs), and other clinical characteristics (i.e., body mass index, presence of cardiac risk factors) also were measured during the intake appointment. In addition, depression and anxiety symptoms were measured at the education session using the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983).

4.3.2.5 Cognitive Variables

Deep Knowledge. Deep knowledge was assessed using the Patient Profile Task (PPT), an adapted expert-reasoning task (Devantier et al., 2009; Rabinowitz & Hogan, 2008). The task consists of ten hypothetical patient profile triads (Person A, Person B, and Person C) varying with respect to how well patients managed their symptoms and heart disease condition. The triads were designed so that Person A matched Person B or Person C with respect to either a surface (demographic information) or deep (actions taken to manage CVD) feature. Participants were asked to indicate which of Person B or C was more similar to Person A. The proportion of time a participant selected on the basis of deep features constituted the measure of deep knowledge. The task demonstrated good internal consistency, with a Cronbach's alpha of .85 in our pilot test with graduate and undergraduate university students. The PPT was included in the take-home survey, which was distributed during the education session.

Treatment Efficacy Beliefs. The extent to which patients believed that the CRSP program would be effective was assessed using an adapted Credibility/Expectancies Questionnaire (CEQ; Devilly & Borkovec, 2000), which was distributed in the survey packet. Three items assessed patient beliefs about the credibility of CRSP treatment and three items assessed expectancies for treatment. Summary scores for the two scales were derived by summing all items, with higher scores reflecting more positive treatment expectancy and better credibility. The CEQ has been shown to have high internal consistency (Cronbach's alpha of .86), test-re-test reliability and validity (Devilly & Borkovec, 2000).

4.3.2.6 Program Entry Variables

Entry into the CRSP program entailed a two-step process. After the education session, patients signaled their interest in participating in the CRSP program by completing a blood work requisition at a time and laboratory/clinic setting of their choice. Those who did not complete the blood work requisition were not contacted further. After receiving patients' completed blood work requisition from the laboratory, the CRSP program administrative assistant contacted the individual to schedule an intake appointment. On average, participants completed their blood work requisition within 7.29 days (*SD* = 10.43) and attended the intake appointment 46.51 days (*SD* = 16.51) after the education session. Patients who attended their intake appointment were deemed enrolled into the program and were followed for six to eight months.

Uptake latency. The date that a participant had visited a lab and/or clinic to complete their blood work was recorded. The number of days that had elapsed between the education session (Time 0) and when a participant visited the lab/clinic served as the measure of uptake latency. Response latency has been used in prior research examining health behaviour and/or attitudes toward health recommendations and/or behavioural change (Kane, Iwata, & Kane, 1984; Mayerl, 2013).

Program enrolment. Program enrolment was operationalized as the proportion of patients who attended the intake appointment.

Table 4.1: Patient demographic characteristics

	Control (*N* = 49)	Intervention (*N* = 45)	Total	*p* – value[a]
Response Rate (%)	40.83	34.09	37.30	.300
Type of Exercise (*n*(%))				.353
Home-based	21 (42.90)	15 (33.30)	36 (38.30)	
Supervised	20 (40.80)	25 (55.60)	45 (47.90)	
Did no enrol	8 (16.30)	5 (11.10)	13 (13.80)	
Social Demographic Variables	n (%)	n (%)	n (%)	
Age (*M(SD))*	67.80 (8.81)	64.60 (10.59)	66.27 (9.78)	.110
Sex, female	19 (38.8)	10 (22.2)	29 (30.9)	.108
Non-white ethnicity	4 (9.5)	3 (7.7)	7 (8.6)	.787
Without partner	6 (14.6)	8 (20.5)	14 (17.5)	.489
> secondary education	25 (59.5)	25 (62.5)	50 (61.0)	.799
Occupation Status				.113
Employed (F/T or P/T)	5 (11.9)	13 (32.5)	18 (22.0)	
Unemployed/Disability	5 (11.9)	4 (10.0)	9 (11.0)	
Retired	32 (76.2)	23 (57.5)	55 (67.1)	
Referral Reasons	*n (%)*	*n (%)*	*n(%)*	
Referral event				.910
MI	25 (51.0)	21 (46.7)	46 (48.9)	
ACS	9 (18.4)	7 (15.6)	16 (17.0)	
Stable CAD	6 (12.2)	9 (20.0)	15 (16.0)	
Valve repair	6 (12.2)	5 (11.1)	11 (11.7)	
HF	1 (2.0)	2 (4.4)	3 (3.2)	
Other	2 (4.1)	1 (2.2)	3 (3.2)	
Referral intervention				.541
CABG	17 (34.7)	22 (48.9)	39 (41.5)	
PCI	17 (34.7)	12 (26.7)	29 (30.9)	
Valve surgery	5 (10.2)	5 (11.1)	10 (10.6)	
Medication only	8 (16.3)	6 (13.3)	14 (14.9)	
Other	2 (4.1)	0 (0)	2 (2.1)	
Prior cardiovascular event	5 (10.2)	4 (8.9)	9 (9.6)	.841
Risk Factors	*n (%)*	*n (%)*	*n(%)*	
BMI (*M(SD))*	27.85 (5.35)	29.17 (4.62)	28.50 (5.02)	.231
METs (*M(SD))*	7.52 (3.21)	7.61 (3.61)	7.56 (3.39)	.912
Dyslipidemia	25 (59.5)	20 (50.0)	45 (54.9)	.423
Hypertension	24 (57.1)	29 (72.5)	53 (64.6)	.179
Current Smoker	3 (7.1)	7 (17.5)	10 (12.2)	.136
Sedentary	1 (2.4)	1 (2.5)	2 (2.24)	.977
Family History	24 (57.1)	27 (67.5)	51 (62.2)	.371
Anxiety (*M(SD))*	5.98 (4.41)	5.66 (3.82)	5.83 (4.11)	.712
Depression (*M(SD))*	4.08 (3.80)	4.61 (3.87)	4.34 (3.82)	.509
Predictors	*M (SD)*	*M (SD)*	*M (SD)*	
Deep Knowledge	56.53 (24.80)	65.78 (18.89)	60.96 (22.53)	.044
Factual Knowledge	66.28 (10.48)	71.11 (8.30)	68.59 (9.76)	.016
Treatment Credibility	22.04 (4.73)	24.00 (3.27)	22.98 (4.19)	.023
Treatment Expectancy	21.12 (4.87)	22.84 (3.78)	21.95 (4.44)	.060

Note: M = mean; SD = standard deviation; n = sample size; MI = myocardial infarction; ACS = acute coronary syndrome; CAD = coronary artery disease; HF = heart failure; CABG= coronary artery bypass grafting; PCI = percutaneous coronary intervention; BMI – body mass index; METs = Metabolic equivalent of a task SCORE

4.3.2.7 Physical Activity

Level of physical activity was measured through the Godin Leisure-Time Exercise Questionnaire (GLTEQ; Godin & Shephard, 1985), which is comprised of three items tapping the frequency and duration of strenuous, moderate and light physical activity. A total score was calculated by multiplying the frequency of strenuous activity by 9, moderate activity by 6 and mild activity by 3 and summing the scores across domains. This measure has been widely used in CRSP settings (Meng et al., 2014) and has good reliability (Cronbach's alpha ranges from .74 and .84) and validity (Godin, 2011; Joseph, Royse, Benitez, & Pekmezi, 2014). As noted earlier, the GLTEQ was administered during the education session (Time 0; GLTEQ-baseline) and at 3-4 months post intake appointment (Time 2; GLTEQ-progress). The latter was administered by the program kinesiologists either over the phone and/or during a supervised exercise session. Due to the variability in when the GLTEQ-progress was measured, the interval (number of days) between orientation attendance (Time 0) and administration of the GLTEQ- progress (Time 2) was entered as a covariate in subsequent analyses.

4.3.3 Statistical Analysis

All statistical analyses were performed using SPSS version 24.0 and SAS 9.4 following previously described methods for cRCTs, with adjustments for clustering by education session (Forster et al., 2015; Donner & Klar, 2000). Analyses of the program entry and physical activity outcome variables were conducted on the intention to treat population, defined as all patients who were exposed to the treatment conditions and returned the survey questionnaires ($N = 94$). It should be noted that comparison of patients who enrolled into the CRSP program versus those who did not indicated no differences in GLTEQ-baseline, $t(88) = -.85$, $p = .398$. As such, the multiple imputation method (10 imputations; number of cardiac risk factors, METs, and GLTEQ-baseline were entered as predictors) was used to replace missing GLTEQ-progress data (n missing = 34) for the intention to treat population. Results are reported for the pooled estimate. Multiple imputations were not conducted for cognitive and program entry variables due to the small portion of missing values (< 15%).

Bivariate correlations were conducted to examine the relationships between the demographic and outcome variables. Chi-square and *t*-test analyses with adjustment for clustering (Wears, 2002) were conducted to examine group differences in categorical and continuous sociodemographic variables, respectively. The effects of group condition controlling for sociodemographic covariates were entered into separate multilevel binary logistics or linear models with maximum likelihood to predict uptake latency and program entry (Time 1) and level of physical activity (Time 2). Knowledge and treatment efficacy belief variables were entered as an interaction term if they correlated with an outcome variable. Confidence interval adjustments were made according to the Sidak approach. Statistical significance was defined as $p \leq .05$ (two-sided) and effect sizes for all analyzes were computed using Cohen's d (Cohen, 1988).

4.4 Results

4.4.1 Participant Demographic Characteristics and Outcome Variables

Bivariate correlations between the outcome variables and the sociodemographic, clinical and cognitive variables are presented in Table 4.2. Patients who took longer to get their blood work done were less likely to enrol ($r(78)=-.25$, $p = .024$), had lower baseline METs ($r(78) = -.283$, $p = .012$) and higher anxiety scores ($r(82) = .26$, $p = .018$). Gender was significantly correlated with program enrolment ($r(94) = -.23$, $p = .027$), with men more likely to enrol than women. Furthermore, a higher GLTEQ-baseline score was associated with higher METs ($r(79) = .47$, $p < .001$), fewer depressive symptoms ($r(89) = -.22$, $p = .037$) and lower number of risk factors ($r(82) = -.29$, $p = .009$). Interestingly, GLTEQ- progress score (i.e., at Time 2) was not associated with any of the baseline sociodemographic or clinical characteristics.

4.4.2 Deep Knowledge, Treatment Efficacy Beliefs and Outcome Variables

Also shown in Table 4.2, higher level of treatment credibility was significantly associated with shorter uptake latency, $r(84) = -.22$, $p = .045$. There was a trend showing that increased credibility was associated with program enrolment, $r(94) = .20$, $p = .057$. Contrary to prediction, neither deep knowledge nor treatment expectancy beliefs were associated with any of the outcome variables. Due to these null effects, no further analyses were conducted to examine the relationship between knowledge, treatment efficacy beliefs and level of physical activity.

Table 4.2: Bivariate correlations between outcome variables and sociodemographic, clinical, and cognitive variables.

	Uptake latency	Program enrolment[a] (0= no; 1 = yes)	GLTEQ-baseline	GLTEQ-progress
Program enrolment	**-.246***			
GLTEQ-baseline	.194	.134		
GLTEQ-progress	**-.301****	N/A	-.008	
Deep knowledge (PPT)	-.059	187	.042	.036
Treatment credibility	**-.219***	.197	-.042	.162
Treatment expectancy	-.110	.046	-.008	.233
Gender (0 = male; 1 = female)	.184	**-.228***	-.072	.189
Age	-.136	.094	-.202	.011
Minority (0 = Non minority; 1 = minority)	.107	N/A	.165	-.055
Marital status (0 = with partner; 1 = without partner)	.098	N/A	-.059	.041
Education (0 = ≤higher school; = > high school)	-.113	N/A	-.094	.041
Occupation (0 = not working; 1 = working)	-.133	N/A	-.072	.140
# of risk factors	-.090	N/A	**-.285***	-.076
BMI	-.048	N/A	-.115	-.127
METS	**-.283***	N/A	**.469****	.234
Anxiety	**.260***	.107	-.188	-.133
Depression	.074	.015	**-.222***	-.161
Intake wait time	-.028	N/A	-.036	-.163

[a] Only select sociodemographic and outcome information were available for individuals who chose not to enrol into the program.
Note: N/A = not available; BMI = body mass index; METS = metabolic equivalents of a task
p < .05; ** *p* < .01; *** *p* < .001

4.4.3 The Association between Program Uptake and Physical Activity

The GLTEQ-progress was completed, on average 214.52 days (*SD* = 158.40, range = 90 to 1362 days) after attendance at the education session. Shorter enrolment latency was significantly correlated with higher GLTEQ-progress scores (Table 4.2; $r(83) = -.30$, $p = .009$). GLTEQ-baseline was not associated with scores at GLTEQ-progress. GLTEQ-progress (*M* = 32.39, *SE* = 2.06) was significantly higher than GLTEQ-baseline (*M* = 23.13, *SE* = 2.39), $F(1, 89) = 8.24$, $p = .005$.

4.4.4 Group Difference in Uptake Latency

There were no group differences in uptake latency ($\beta = 1.10$, $t(84) = .49$, $p = .627$, 95% CI = -3.39 to 5.60). To control for potentially confounding variables, anxiety, MET scores, group condition, treatment credibility as well as the interaction of group and treatment credibility were entered into a mixed model to predict uptake latency (Table 4.3). There was a trend towards group differences in latency to program uptake after accounting for covariates ($\beta = 25.49$, $t(77) = 1.94$, $p = .056$), with patients in the intervention group taking fewer days to complete their blood work requisition(*M* = 6.16, *SE* = 1.33, 95% CI = 3.52 to 8.81) than those in the control group (*M* = 6.34, *SE* = 1.26, 95% CI = 3.83 to 8.85). Moreover, higher anxiety ($\beta = .72$, $t(77) = -3.14$, $p = .002$) and lower METs ($\beta = -.56$, $t(77) = -1.99$, $p = .050$) predicted longer latency uptake. There was also a marginally significant interaction effect of group by treatment credibility ($\beta = -1.07$, $t(77) = -1.97$, $p = .053$), suggesting that the association between credibility scores and latency uptake differed between treatment groups. Test of simple slopes indicated that treatment credibility predicted uptake latency for the control ($r(43) = -.32$, $p = .034$) but not for the intervention group ($r(41) = .02$, $p = .893$). Treatment credibility did not predict uptake latency after accounting for other predictors.

Table 4.3: Results of a multilevel model analysis for the predictors of uptake latency (*N* = 82).

	β	*SE*	*t*	95% CI of the difference	*p* value
Group condition (0 = control; 1 = intervention)	25.49	13.13	1.94	-.66 to 51.64	.056
Group*Treatment Credibility	-1.07	.55	-1.97	-2.17 to .014	.053
Treatment Credibility	.35	.45	.77	-.55 to 1.26	.442
Anxiety	.72	.23	3.14	.26 to 1.18	**.002**
METs	-.56	.28	-1.99	-1.12 to -.00	**.050**

Note: METs = metabolic equivalent of a task score

Table 4.4: Results of a multilevel logistics regression for the predictors of program enrolment (*N* = 94).

	β	*SE*	*t*	Odds Ratio	95% CI	*p*-value
Male Gender	1.41	.70	2.02*	4.10	1.02 – 17.22	**.048**
Deep Knowledge	.03	.02	1.66	1.03	1.00 – 1.06	.11
Treatment Credibility	.22	.11	1.93	1.25	.99-1.56	.057
Treatment Expectancy	-.18	.12	-1.32	.84	.66-1.08	.190
Intervention Group	-.14	.75	-.19	.87	.20 – 3.85	.85

4.4.5 Group Difference in Program Enrolment

A slightly higher proportion of patients in the intervention (88.9%) than control (85.7%) group enrolled into the CRSP program, but this difference was not statistically significant, $t(73) = .28$, $p = .78$, $\beta = .20$, OR = 1.22, 95% CI .30 to 5.07.

To examine which factors uniquely predicted uptake latency once the other associated factors were controlled, gender, deep knowledge, treatment credibility and expectancy scores were entered into a multi-level binary logistics regression with treatment group as a level 2 predictor (Table 4.4). Male gender was a significant predictor of program enrolment (OR = 4.10, 95% CI 1.02 to 17.22, $p = .048$). Finally, there was a trend indicating that patients who found the CRSP program to be more credible were more likely to enrol (OR =1.25, 95% CI .99 to 1.56, *p* = .057). Age, deep knowledge and treatment expectancy did not predict program enrolment.

4.4.6 Group Differences in Level of Physical Activity

Table 4.1 shows no group differences in the type of exercise program (home-based, supervised or not enrolled) chosen by patients. There were no differences in physical activity at Time 2 between the control (*M* = 29.89, *SD* = 3.15) and intervention group (*M* = 33.25, *SD* = 3.29), β = 4.38, *t*(90) = -.77, *p* = .44, 95% CI = -11.94 to 5.24. To account for other predictors, a multilevel linear analysis with imputed values was conducted for GLTEQ-progress as the dependent variable and uptake latency, time, treatment group, GLTEQ-baseline and the interaction of GLTEQ-baseline*treatment group entered as predictors. As shown in Table 4.5, when the other variables were entered as covariates, the intervention (*M* = 32.66, *SE* = 3.23, 95% CI = 26.31 to 39.02) and control group still did not differ in activity scores at Time 2. However, after controlling for the other variables, shorter uptake latency was associated with a higher level of physical activity during the CRSP program, (β = -.68, *t*(83) = -2.78, *p* = .006, 95% CI = -1.16 to -.20).

Table 4.5: Results of a multilevel model analysis with imputed values[a] for the predictors of physical activity level during program enrolment (*N* = 89).

	β	SE	*t*	95% CI of the difference	*p* value
Group condition (0 = control; 1 = intervention)	-2.44	6.58	-.37	-15.37 to 10.48	.710
Group*GLTEQ-baseline	-.03	.23	-.17	-.48 to .42	.91
GLTEQ-baseline	.04	.16	.24	-.27 to .34	.813
Time	-.01	.02	-.29	-.04 to .03	.769
Uptake Latency	-.68	.24	-2.78	-.1.16 to -.20	**.006**

[a] Reported results reflect the pooled estimate of the imputed values (10 imputations).
Note: GLTEQ = Godin Leisure Time Exercise Questionnaire; Time 0 = baseline

4.5 Discussion

The translation of patient knowledge into behaviour rarely has been examined in a CRSP setting. This study is among the first to investigate whether implementing an educational approach grounded in cognitive principles increases the likelihood of program enrolment and levels of physical activity.

Contrary to our predictions, integrating causal information into a patient education session did not augment program uptake or level of physical activity four month post-enrolment. Difficulties increasing CRSP enrolment through systematic interventions have been widely reported in the literature (Brown et al., 2009; LaBresh et al., 2007; Mehta et al., 2000). There is recent evidence that scheduling an entrance appointment at patient bedside and using patient navigators to follow individuals upon hospital discharge are effective strategies for increasing CRSP enrolment rates (Grossman, 2015; Scott, Gravely, Sexton, Brzostek, & Brown, 2013). It should be noted, however, that the enrolment rates in these successful interventions (15 to 81.2%) were quite a bit lower than that observed in our sample (87.3%). It could be that because data were only available for patients who returned the survey packets, we had a sampling bias towards more committed participants. This likely made it more difficult to improve upon program enrolment and thereby observe group differences in the present study.

Overall, patients in our sample engaged in more physical activity during the CRSP program than before entering the service. Our findings are similar to that of another study that found no difference in physical activity level between a modified and traditional education curriculum (Ghisi, Grace, Thomas, Vieira, et al., 2015). Yet, in an earlier systematic review, Ghisi et al. (2014) concluded that provision of patient education was associated with increased physical activity level. These discrepant findings might be a consequence of differences in the method of education delivery and/or what constituted the control group (i.e., no education vs. standard care). Our intervention was only 15 minutes longer than the control intervention, whereas in most CRSP studies, the differences between the experimental and control conditions is much more pronounced in terms of intensity, duration, frequency and mode of delivery. Moreover, the treatment effect of the 15-minute intervention might not have been strong enough to be sustained over the long lag (on average

46 days) between the education session and entry into the program. Perhaps this intervention could be bolstered through increasing the number of sessions and addressing other predictors of program entry and physical activity adherence, such as self-efficacy (perceived competence) and motivation (D'Angelo, Pelletier, Reid, & Huta, 2014).

Although we found no differential effects of the intervention on uptake latency, program enrolment and level of physical activity, some of the associations between these variables and patient baseline characteristics are illuminating. For instance, patients with higher exercise capacity (METs), lower anxiety and those who found the program more credible at baseline enrolled in the program more quickly. Uptake latency, in turn, was itself the strongest predictor of level of physical activity once in the program. It may be the case that the association between uptake latency and physical activity could be explained by the influence of a third variable, such as commitment to the recovery process and/or personal life demands (De Vos et al., 2013; Karlsson et al., 2007). Nonetheless, these findings suggest that attending to how long it takes for patients to complete program prerequisites might help identify, in advance, individuals who would have difficulty adhering to the CRSP program. Since anxiety predicts uptake latency, implementing early anxiety interventions for patients with high anxiety might be one way to foster initial engagement with the CRSP program (McGrady, McGinnis, Badenhop, Bentle, & Rajput, 2009).

Our finding, along with those of others (Allen, Scott, Stewart, & Young, 2004; Colella et al., 2015; Parashar et al., 2012; Samayoa et al., 2014), that male patients were more likely to enrol into the CRSP program than their female counterparts suggests that efforts need to be made to reduce the gender disparity in CRSP utilization. For women, barriers to program enrolment include lack of transportation, family responsibilities and experiencing physical activity as aversive (Grace et al., 2014). There is evidence that providing women-only programs helps female patients to feel more comfortable (Andraos et al., 2014), but it is not yet known whether offering these gender specific services would increase CRSP enrolment.

Another noteworthy finding is that more positive beliefs about the program predicted shorter uptake latency for those in the control but not the intervention condition. This result may seem puzzling given that our earlier study showed that learning about causal connections was associated with enhanced treatment credibility beliefs (Zhang et al., 2016). However, ancillary analyses indicated that the credibility score were moderately skewed to the left for the intervention condition only (skewness = -1.83), suggesting a ceiling effect for that group. Further research is warranted to determine whether treatment efficacy belief is a mechanism by which providing patient education can increase CRSP program enrolment.

4.5.1 Limitations

The study sample size (94) was not large enough to yield sufficient power to detect changes in health behaviours, which were the secondary outcome variables in our cRCT. Another limitation is that this was a single site study, which may have limited the generalizability of our results to other cardiac patient populations. Moreover, we measured patient knowledge and treatment efficacy at only one time point after the education session. It is possible that the impact of causal information on patients' understanding and perceptions diminished over time; thus, it did not have any impact on behavioural outcomes. Finally, the self-reported level of physical activity should be cautiously interpreted because it may be susceptible to response bias. Using objective measures of physical activity, such as metabolic equivalents of a task, at the end of the CRSP program may provide a more accurate measurement of patients' physical activity adherence.

4.5.2 Conclusions

Educating patients about the causal connections among endothelial pathophysiology, cardiac risk factors, symptoms and health behaviours did not affect the likelihood of enrolment in a CRSP program, latency to complete program prerequisites, nor their physical activity once enrolled. However, this approach might have a positive influence on health-related behaviours if used in tandem with other strategies aimed at reducing anxiety and enhancing efficacy beliefs. The window of time prior to entry into the CRSP program may serve as an important indicator of subsequent adherence behaviour, and therefore should be a target in education programs. Employing patient education interventions anchored in evidence-based strategies is a step towards reducing and preventing CVD-related risks and complications.

4.6 References

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Chapter 5

5 General Discussion

The overarching goal of this dissertation was to apply methods and constructs from experimental cognitive science to clinical practice in a cardiovascular rehabilitation and secondary prevention (CRSP) education setting. This translational research was focused on determining whether providing patients with causal information about the links between illness pathophysiology, risk factors, symptoms and the recommended illness management behaviours would 1) enhance knowledge acquisition, 2) increase the depth of processing of cardiovascular information, 3) make the CRSP program more credible to prospective patients, 4) improve latency to fulfill prerequisites for program enrolment, 5) increase uptake of service, and 6) increase their physical activity levels during the program. Study 1 was conducted in a laboratory setting with a non-clinical sample. Studies 2 and 3 were based on a cluster randomized controlled trial (cRCT) that took place in a CRSP setting.

Findings from the first study confirmed the hypothesis that learning about the causal connections among illness pathophysiology, symptoms and health behaviours would enhance the acquisition of and ability to apply new health information. However, this enhancement effect was observed in young adults (mean age = 19.08, *SD* = 3.08, range = 17.00 to 37.00) but not older adults (mean age = 71.06, *SD* = 7.00, range = 55.00 to 93.00). The null findings for the older sample could be because the written format of the causal information was cognitively taxing for older individuals, or because the hypothetical nature of the experiment was confusing to this age group. Following up on these findings, in Studies 2 and 3, causal information was integrated into an oral and written presentation delivered during an education session for cardiac rehabilitation patients. The findings from Study 2 indicated that learning about the explicit links among endothelial pathophysiology, cardiac risk factors, symptoms and health behaviours enabled patients to process cardiovascular management information at a deeper level, which, in turn, strengthened the acceptability of the CRSP program to them. The aim of Study 3 was to determine whether the enriching effects of causal information on knowledge and efficacy beliefs influenced patients' behaviour. The provision of causal information had a modest effect on increasing the speed with which patients fulfilled the program entrance requirements (i.e., blood test completion) but did not influence the likelihood of enrolment in the CRSP program nor in level of physical activity once enrolled.

5.1 Causal Information as a Patient Education Strategy

Taken as a whole, the results of the three studies suggest that providing patients with a rationale for elements of the CRSP program (i.e., explaining the *why* and not only the *what*) enhanced their knowledge acquisition. According to Bloom's taxonomy of learning (Anderson & Krathwohl, 2001; Bloom, 1956), there is a hierarchy that differentiates depths of learning and the associated ability to transfer knowledge into new domains (Adams, 2015). The ability to recognize and recall information constitutes lower/basic levels of learning whereas comprehension and the ability to apply information reflect higher levels of learning. The findings from these studies suggest that traditional methods of separately explaining illness causes, symptoms and management behaviours in patient education may only be conducive to generating surface level knowledge. Receiving causal information that links these domains appears to help patients evolve from this surface level of knowledge to more complex knowledge categories in the taxonomy (i.e., comprehension and application). This progression, indicative of increased flexibility and expertise on the content matter (Krathwohl, 2002), arguably should be incorporated into education curricula.

Indeed, the education of medical students focuses on the translation of knowledge into clinical competencies by first facilitating learning of biomedical concepts in the classroom setting and then shifting focus to the acquisition of clinical skills in clerkship rotations (Irby, 2011; Patel & Kaufman, 2000). Several studies in cognitive psychology have provided evidence for the benefit of causal information in helping medical students retain and apply diagnostic information (Goldszmidt et al., 2012; Woods et al., 2005, 2007). Research in clinical reasoning also indicates that expert physicians use their knowledge of basic science causal mechanisms to solve difficult cases (Norman, Eva, Brooks, & Hamstra, 2006; Norman, Trott, Brooks, & Smith, 1994; Norman, 2005; Verkoeijen, Rikers, Schmidt, Van De Wiel, & Koorman, 2004). These findings make a compelling case for integrating causal information into the medical education curriculum (Finnerty et al., 2010; Irby, 2011).

In a parallel fashion, the results of this dissertation indicated that cardiac patients were better at extrapolating and making inferences about their illness management when biomedical information (i.e., about flow mediated dilation) was framed within a causal model. Accordingly, a similar case also can be made for the inclusion of information about the causal mechanisms underlying illness management patient education programs. This dissertation lays the groundwork for further exploration on the impact of causal reasoning on patients' learning and behaviour.

5.2 Predictors of Behaviour Change

The observation that knowledge alone does not drive behaviour change is consistent with the well-observed pattern in the patient education literature (Dreeben, 2010; Falvo, 2010; Ghisi, Britto, Motamedi, & Grace, 2014; Lagger et al., 2010). Based on a systematic review of the literature, Schadwaldt and Schulz (2011) concluded that changes in patients' views of their health status in response to CVD-related education did not necessarily translate to changes in their CVD management behaviours. Similarly, although the current CRSP education intervention led patients to have a deeper understanding of CVD management and more positive perceptions of the program, this knowledge and outlook did not have significant impact on adherence. These findings highlight the multifaceted nature of patient behaviour change. That is, despite gains made during patient education, these are not strong enough to have a large impact on patient behavior.

Besides knowledge, motivation and self-efficacy also have been shown to predict attendance and adherence in cardiac rehabilitation (Beswick et al., 2004; D'Angelo et al., 2014; Janssen et al., 2013; Ng et al., 2012). Self-efficacy, defined as perceived confidence (Bandura, 2006b), is important for initiating behaviour change, whereas motivation is necessary for maintaining that behaviour (Rothman et al., 2011). As discussed in Chapter 1, patient education interventions targeting self-efficacy and/or motivational factors alone do not yield promising outcomes in CRSP (Ghisi et al., 2015; Meng et al, 2014). However, it is plausible that interventions leveraging self-efficacy and motivation could be made more effective by integrating causal information as an educational component.

According to adult learning principles, motivation goes hand-in-hand with knowledge application (Russell, 2006). It has been posited that adults are keen to learn and apply new information when they are confronted with situations that require a specific type of knowledge (Knowles, 1980). Whereas the current results introduced an effective education strategy for enhancing patient knowledge and perceptions, it was beyond the scope of this dissertation to investigate motivational factors. However, motivation likely played an important role in shaping patients' learning in this study. It was assumed that patients attending the CRSP education session would find CVD management information relevant because they all had suffered a cardiac event. In hindsight, the extent to which patients believed that the education actually applied to their case might have varied widely across individuals. For example, learning about the causal links between physical activity and reduction in angina symptoms might have facilitated deeper knowledge about the need to exercise. However, patients who had never experienced shortness of breath would unlikely to apply this knowledge into practice despite their depth of understanding.

Considering the aforementioned shortcoming, one might predict that tailoring education content to patients' particular illness concerns might enhance the translation of knowledge into behaviour. However, it previously has been shown that customizing information to fit patients' specific cardiac symptoms is not enough to propel behaviour change (Meng et al., 2014). Given that patients' behavior has proved difficult to change, there is a need to investigate a wider set of factors that may contribute to CVD management adherence. Exploring motivational factors outside of the health context hold promise in this regard.

Zhang and colleagues (2015) found that heart failure patients highly valued being able to adequately self-manage their illness. However, the importance to which they rated this goal did not predict self-reported compliance with the recommended exercise regimen. Rather, the best predictor of compliance was the extent to which patients saw exercise as compatible with valued non health-related goals (e.g., taking care of their family and loved ones, having control over how they live their life). This finding indicates that cardiac patients do not exist within a healthcare vacuum; they have life demands besides their health that warrant their (and health care providers') attention. The findings from this dissertation reveal a similar theme in that sociodemographic and psychosocial characteristics, such as gender and anxiety level, were strong predictors of physical activity during the program. It is possible that patients who learned about the causal links between management behaviours and endothelial pathophysiology understood that the CRSP program was important for recovery but may not have complied with program recommendations if they had competing values and/or goals. As such, to better set the stage for behavior change, it may be important for the development of patient education programs to consider and gauge a broader range of motivational factors.

Counselling approaches that can bridge the gap between patients' current behaviour and their desired goals may help address motivational barriers to adherence (Fortier, Sweet, O'Sullivan, & Williams, 2007; Thompson et al., 2011). Motivational interviewing (MI) is one such approach; it elicits and then incorporates individuals' *own* goals into their action plans for behaviour change (Miller & Rollnick, 2002). Providing causal information could be a good complement to MI strategies by first inculcating the rationale behind cardiovascular self-management. Conversely, the use of MI may uncover areas of misunderstanding among patients by highlighting areas of ambivalence. Causal information can therefore be introduced to enrich patients' understanding and perhaps propel their readiness for behaviour change.

5.3 Optimizing Patient Education Delivery

It might be premature to conclude that causal information has absolutely no impact on patient behaviour. Treatment effects were found for outcome measures (i.e., knowledge and beliefs) assessed shortly after the education session delivery. However, there were no group differences in physical activity, which was gauged several months after the education session. It is plausible that the effect of this single-session intervention diminished over time. If this is indeed the case, then one additional key factor to consider when integrating causal information in patient education is the dose, intensity and timing of the intervention.

The findings from this dissertation, as well as those of other studies (e.g., Ghisi et al., 2015) can inform the curriculum development of patient education interventions. However, there currently are no guidelines on the optimal setting, intensity, duration, and/or mode of education delivery in CRSP settings (Ghisi, Britto, et al., 2014; Lagger et al., 2010). Providing causal explanations throughout patients' participation in the CRSP program may be one way to stimulate health behaviour change and ultimately, health outcome.

Furthermore, this study examined the effect of a single educational strategy. The advantage of this approach is that it illuminates the 'black box' of patient education interventions (Ghisi et al., 2014; Lagger et al., 2010). Rather than employing a plethora of strategies, the design enabled one to map the processes and mechanisms to specific outcomes. However, the narrow focus on causal information may inadvertently have made it less likely for the intervention to show a differential impact on patient behaviour relative to standard care. 'Realists' would argue that the design of randomized controlled trials (RCTs) fail to consider the complexity of situational and individual factors that underlie patient behaviour change (Bonell, Fletcher, Morton, Lorenc, & Moore, 2012; Pawson & Tilley, 1997). That is, certain intervention strategies may only be successful for some individuals under specific conditions. How to maximize the benefits of causal information for cardiac patients is still unclear. However, these contextual factors are arguably important for future interventions to consider. In addition to the format of patient education delivery, there could be a ‘window’ of time that would maximize the saliency to which causal information may affect patient behaviour. In this study, patients received the causal information just prior to their participation in the CRSP program. It could be the case that the continual delivery of causal information once patients start behavioural interventions (i.e., exercise) might help maintain adherence. Moreover, it also could be argued that this information should be provided much earlier on, namely when patients are hospitalized for their cardiac event (Fonarow 2003). The value of these ‘teachable moments’ to change health behavior has not been put to many empirical tests (Lawson & Flocke, 2009).

5.4 Limitations

There are several limitations with regards to the translation of basic science to clinical research that warrant discussion. First, although results from the second study indicated that older cardiac patients benefitted from causal information, it is possible that there was a sampling bias for those with higher reading comprehension. Being able to take the survey home allowed patients to review the items before agreeing to participate. It is possible that those who felt better able to answer the questions correctly were the ones who chose to return the survey. In the first study, it was easier to monitor for this response bias because the study was conducted in a controlled laboratory setting. As well, the elderly age group sampled in the first study (mean age = 71.06, *SD* = 7.00, range = 55.00 to 93.00) was older than the clinical sample in Study two and three (mean age = 66.27, *SD* = 9.78, range = 38.00 to 84.00), which may account for differences in findings. As such, the benefit of causal information for older adults still warrants further exploration.

Another study limitation is that the pragmatic nature of the cluster randomized controlled trial (cRCT) limited the number of measures that could be administered to gauge program fidelity. A treatment fidelity checklist was used to ensure no overlap between the two treatment conditions and adherence to the intended protocol. However, it was not possible to assess participants’ responsiveness (i.e., their engagement during the education session) and their degree of exposure to the interventions (i.e., whether they referred back to the causal information booklet) because of logistical constraints.

A further limitation is that there were several programmatic changes in the CRSP service during the study period. First, while the program psychologist always presented the causal information, the other presenters varied from week to week owing to changes in the clinic schedules, which may have produced more error variance. Moreover, the CRSP program experienced a shortage of cardiologists, which delayed the intake appointments for some patients. Using multivariate models to control for clustering of the education sessions was one way to help control for these extraneous variables. As shown in Table 3.3 of Chapter 3, the intracorrelation coefficient was relatively small for the primary outcome variables (ranging .006 to .132). That said, it is possible that systematic variables such as differences in presenter styles, team dynamics and wait time could have influenced patients' perceptions of the program.

5.5 Future Research and Final Remarks

To the best of my knowledge, these studies are the first to explore the role of causal information in patient education. The dissertation findings suggest two broad avenues for future research. Although provision of causal information enhanced knowledge and beliefs after a single didactic session, this effect was either not sustainable over time and/or was not powerful enough to affect behaviour. It would be interesting to explore strategies to augment this effect. The use of MI, mentioned earlier, is one such option. Additionally, biofeedback training, such as the monitoring of heart rate variability, has previously been used in behavioural interventions to reduce stress and depression among cardiac patients (Nolan et al., 2005). The CRSP program where Studies 2 and 3 took place is currently evaluating the benefit of using a biofeedback device to provide patients with information about their endothelial health. One might predict that this feedback could further heighten patients' appreciation of the causal link between health behaviour and cardiovascular pathophysiology. Using causal information as an adjunct to other behavioural and counselling interventions to improve adherence to CRSP may be one promising area for future research.

As mentioned earlier, patient education interventions may benefit from considering patients' goals and roles in other life domains apart from the health context. The efficacy of causal information may be further optimized if delivered in an individual counseling context. This may allow the provider to assess patients' specific concerns and explain treatment in a way that is relevant to the individual's circumstances. Examining the utility of causal information in therapeutic interventions, rather than as a didactic education tool, might be another area for future study.

Furthermore, one avenue of future research is to elucidate how causal information can be tailored to address age-related cognitive decline among cardiac patients. Age-related cognitive decline is highly prevalent among older cardiac patient population (Hopp, Thornton, Martin, & Hopp.; Martin, 2010; Tsuyuki, Shibata, Nilsson, & Hervas-Malo, 2003) and is associated with poorer health outcome (Cameron, Worrall-Carter, Riegel, Lo, & Stewart, 2009). This dissertation indicated that age-related factors, such as reading comprehension, influenced the extent to which older adults can benefit from health education materials. It is possible that the delivery of causal information for older patients could be made more effective if it was used in conjunction with strategies that help elderly individuals learn new information. Past studies have indicated that older adults require organized and explicit medical information (Morrow, Hier, Menard, & Leirer, 1998; Park, Willis, Morrow, Diehl, & Gaines, 1994; Rice & Okun, 1994), assistance with distinguishing correct and incorrect beliefs about a health topic (Adams, Rogers, & Fisk, 2011; Hancock, Fisk, & Rogers, 2005; Okun & Rice, 2001), slower delivery of auditory information (Schneider, Daneman, & Murphy, 2005; Stewart & Wingfield, 2009), and support for building confidence in their learning ability (Price, Hertzog, & Dunlosky, 2010). Future studies should investigate ways to help older adults understand the causal connections among illness pathophysiology, symptoms, risk factors and self-management behaviours.

In summary, this series of studies indicate that patients are capable learners and that their cognitive processes warrant consideration. The use of causal information offers opportunities for patients to gain similar knowledge as their healthcare providers and become more knowledgeable about their cardiovascular disease management. As such, the field of cognitive psychology offers much to guide the development of interventions. Adopting this lens is likely going to help propel patient education towards understanding the individual fully, and as more than just consumers of health care.

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Appendices

Appendix A: Recruitment Flyer

Western

RESEARCH PARTICIPANTS WANTED!

We are looking for volunteers to participate in a research study that helps us design health information materials.

Participation Involves:

- Two sessions (1st session: 20-30 min; 2nd session: 20-30 min)
- Read a health information booklet
- Answer questionnaires

Eligibility:

- 65 years or older
- Can speak and read in English

You will receive a $20 honorarium for your time and a chance to win $100!

For more information, please contact:

[redacted]

Appendix B: Ethics Approval Documentation for Study 1

Western Research

Research Ethics

Use of Human Participants - Initial Ethics Approval Notice

Principal Investigator: Dr. Jean Paul Minda
File Number:104363
Review Level: Delegated
Protocol Title: The influence of causal knowledge on older adults' comprehension and retention of health information
Department & Institution: Social Science\Psychology,Western University
Sponsor:
Ethics Approval Date: October 08, 2013 **Expiry Date:** October 31, 2014

Documents Reviewed & Approved & Documents Received for Information:

Document Name	Comments	Version Date
Instruments	Appendix G - Digit Span Task	2013/09/06
Instruments	Appendix B- Demographics Questionnaire	2013/09/06
Instruments	Appendix I- Mini Mental Status Examination	2013/09/06
Recruitment Items	Appendix H- Telephone Script	2013/09/06
Instruments	Appendix F- Health literacy	2013/09/06
Instruments	Appendix E- Health knowledge questionnaire	2013/09/06
Instruments	Appendix D- Health booklet Con. Group	2013/09/06
Instruments	Appendix C- Health booklet for Exp. Group	2013/09/06
Western University Protocol		2013/09/10
Response to Board Recommendations	Response to NMREB Recommendations	2013/10/03
Recruitment Items	Revised study flyer	2013/10/03
Instruments	Revised questionnaire (SSME)	2013/10/03
Instruments	Revised Questionnaire (REALM)	2013/10/03
Revised Letter of Information & Consent	Revised Letter of Information-younger adults	2013/10/03
Revised Letter of Information & Consent	Revised Letter of information -older adult version	2013/10/03
Recommendations Form	Recommendations	2013/09/23
Letter of Information & Consent	Consent Form	

This is to notify you that The University of Western Ontario Research Ethics Board for Non-Medical Research Involving Human Subjects (NMREB) which is organized and operates according to the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans and the applicable laws and regulations of Ontario has granted approval to the above named research study on the approval date noted above.

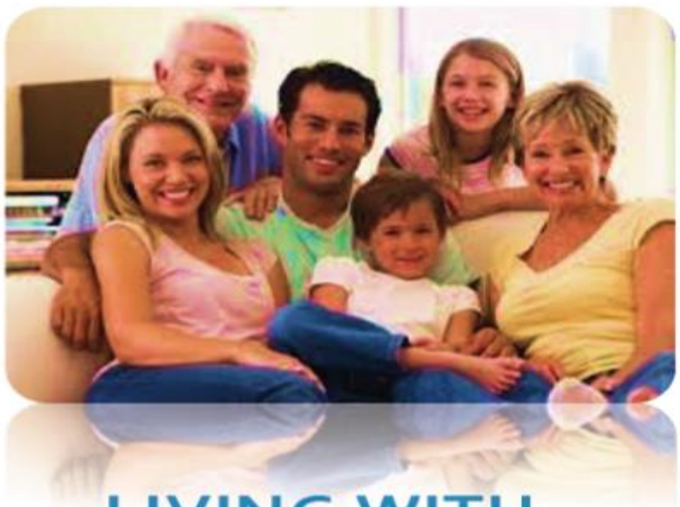
This approval shall remain valid until the expiry date noted above assuming timely and acceptable responses to the NMREB's periodic requests for surveillance and monitoring information.

Members of the NMREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussions related to, nor vote on, such studies when they are presented to the NMREB.

The Chair of the NMREB is Dr. Riley Hinson. The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000941.

Appendix C: Booklet Condition Without Causal Information (Control Condition)

THE CANADIAN ALPHABET DISEASE ASSOCIATION



LIVING WITH ALPHABET DISEASE

A guide to feeling better and staying healthy.

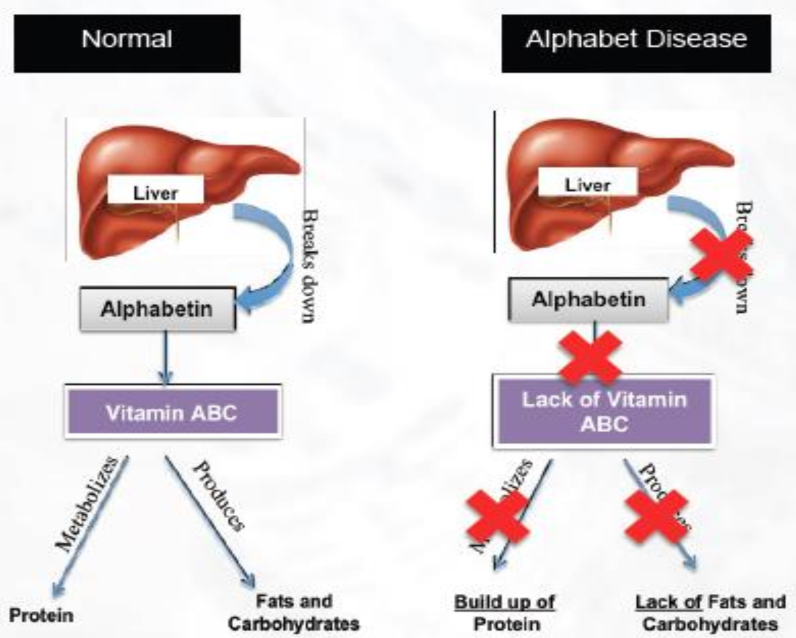
WHAT IS ALPHABET DISEASE?

Alphabet disease occurs when your liver has difficulty breaking down Alphabetin into vitamin ABC. Your body needs vitamin ABC to metabolize proteins, keep your immune system strong and produce fats and carbohydrates. As a result, individuals with Alphabet disease have a build up of proteins and not enough fats and carbohydrates.

Fats and carbohydrates produced from vitamin ABC help supply energy and maintain muscle tone. In Alphabet disease, these functions cannot be carried out because Alphabetin is not properly converted in vitamin ABC. Instead, the excess Alphabetin accumulates around the white of the eyes and causes yellow spotting.

The inability for vitamin ABC to be produced also means that protein cannot be metabolized into amino acids. The build up of protein causes ammonia levels, a toxic substance, in the blood stream to be high. This may lead to a dangerous condition called hyperammonemia, which can cause brain damage in the long run.

Alphabet disease does not go away but you can learn to manage it!



WHO GETS ALPHABET DISEASE?

Signs of Alphabet disease do not appear until adulthood. Every year, approximately 1 in 5,000 Canadians between 18 and 85 years of age are diagnosed with this condition. Individuals of all genders and ethnic backgrounds can be affected.

WHAT CAUSES ALPHABET DISEASE?

The exact cause of Alphabet disease is unknown but there are two main risk factors:

- Genes that make you more likely to develop this condition
- Viral infections due to common flus

WHAT ARE THE SYMPTOMS AND COMPLICATIONS?

- Hair Loss
- Feeling tired (fatigued)
- Low muscle tone (loose or floppy muscles)
- Yellow spots in the white of the eyes
- Hyperammonemia (excess ammonia in the blood)
- Weakened immune system

HOW CAN I MANAGE MY ALPHABET DISEASE?

If you have Alphabet Disease, here are a few ways for you to take control of your condition:

High carbohydrate drinks

Consume 3-4 glasses of natural juices and energy drinks each day

Physical Activity

Practice exercises that work all muscle groups, such as pilates and yoga, 3-4 times/week

Eye drops

Use eye drops prescribed by your doctor every night before you sleep

Prescription shampoo

Wash your hair everyday using a shampoo that contains the amino acid, Cysteine

Limit protein in diet

Consume no more than 15g of protein per day

Vitamin ABC supplements

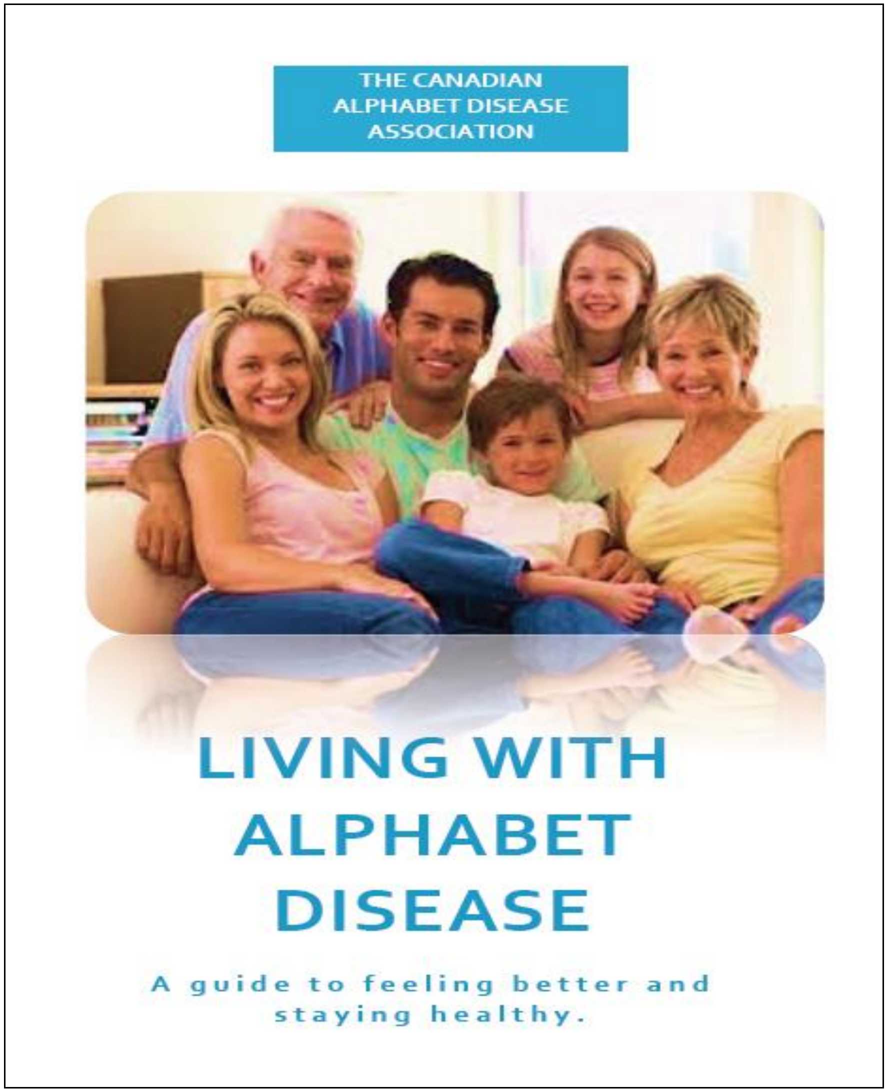
Take vitamin ABC supplements twice a day

JUST REMEMBER..

It is important to ask questions and stay informed about Alphabet Disease. Talk to your doctor about the Canadian Alphabet Disease Association's recommendations for managing Alphabet Disease.

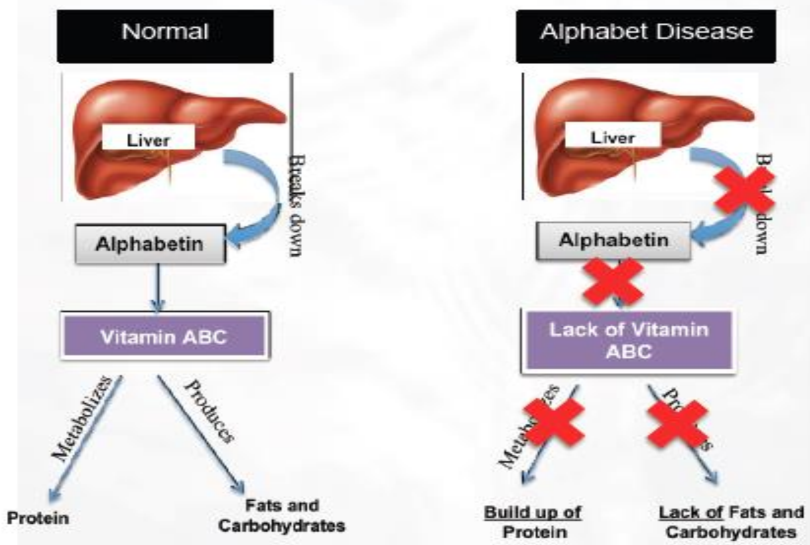
Published by: The Canadian Alphabet Disease Association

Appendix D: Booklet Condition with Causal Information (Intervention Condition)



WHAT IS ALPHABET DISEASE?

Alphabet disease occurs when your liver has difficulty breaking down Alphabetin into vitamin ABC. Your body needs vitamin ABC to metabolize proteins and to produce fats and carbohydrates. As a result, individuals with Alphabet disease have a build up of proteins and not enough fats and carbohydrates. If Alphabet Disease is not properly managed, it can lead to brain damage and a weakened immune system. Alphabet disease does not go away but you can learn to manage it.



WHO GETS ALPHABET DISEASE?

Signs of Alphabet disease do not appear until adulthood. Every year, approximately 1 in 5,000 Canadians between 18 and 85 years of age are diagnosed with this condition. Individuals of all genders and ethnic backgrounds can be affected.

WHAT CAUSES ALPHABET DISEASE?

The exact cause of Alphabet disease is unknown but there are two main risk factors:

- Genes that make you more likely to develop this condition
- Viral infections due to common flus

HOW CAN I MANAGE THE SYMPTOMS AND COMPLICATIONS OF ALPHABET DISEASE?

If you have Alphabet Disease, here are a few ways for you to take control of your condition:

FEELING TIRED (FATIGUED)

What to do: Consume 3-4 glasses of **high carbohydrate drinks** each day

Why: Alphabet disease makes it difficult for your body to produce essential fats and carbohydrates that give you energy. Consuming high carbohydrate drinks will supply you with the energy you need.

LOW MUSCLE TONE

What to do: **Practice muscle strengthening** exercises 3-4 times/week

Why: Defects in the production of fats, such as the case in Alphabet disease, usually lead to loose or floppy muscles. Doing exercises that work all the main muscle groups, such as yoga or pilates, is most effective for strengthening muscle tone.

YELLOW SPOTS IN EYES

What to do: Use **prescription eye drops** every night before bed

Why: When Alphabetin is not properly broken down, it can build up and cause yellow spots in the white of the eyes to appear. The special eye drops prevent this accumulation from forming.

HAIR LOSS

What to do: Wash your hair daily using a **prescription shampoo**

Why: Amino acids produced from the breakdown of protein are essential for hair growth. This process is disrupted in Alphabet disease. Using a shampoo that contains the amino acid, Cysteine, will help stimulate hair follicles at the scalp.

HYPERAMMONEMIA (EXCESS AMMONIA IN THE BLOOD)

What to do: **Limit protein** to 15 g/day

Why: A build up of ammonia, a toxic substance, occurs when protein is not properly broken down in ABC disease. Consuming a low-protein diet will prevent hyperammonemia, which can cause brain damage.

WEAKENED IMMUNE SYSTEM

What to do: Take **vitamin ABC supplements** twice a day

Why: Extremely low levels of vitamin ABC can cause your immune system to weaken and increase your risk of developing infections and diseases. It is important that you take vitamin ABC supplements to prevent these complications.

JUST REMEMBER..

It is important to ask questions and stay informed about Alphabet Disease. Talk to your doctor about the Canadian Alphabet Disease Association's recommendations for managing Alphabet Disease.

Published by: The Canadian Alphabet Disease Association

Appendix E: Health Knowledge Questionnaire

General Information about Alphabet Disease

You may or may not be familiar with the items below, but please try your best to answer each question by circling one of three options. <u>All answers will be kept private</u>.

1. Which statement is true about Alphabet disease?

    a. There is a build up of proteins, fats and carbohydrates in the body
    b. There is a lack of protein and a build up of fats and carbohydrates in the body
    c. There is a build up of proteins and lack of fats and carbohydrates in the body
    d. There is lack of protein, fats and carbohydrates

2. Why is it important for individuals with Alphabet disease to exercise regularly?

    a. Because exercise helps burn fat

    b. Because exercise improves your muscle tone

    c. Because exercise improves your metabolism

    d. Because exercise helps burn carbohydrates

3. What is the recommendation for consuming high carbohydrate drinks?

    a. Less than 3 glasses per day because it will cause fatigue

    b. Between 3-4 glasses per day because it will supply energy

    c. At least 4 glasses per day because it is the most important part of the diet for someone with Alphabet disease

    d. High carbohydrate drinks should be avoided

4. Which of these statements is true for someone with Alphabet Disease?

    a. When there is yellow spotting in my eyes, it means I need to change my diet

    b. When there is yellow spotting in my eyes, it means I need to use eye drops

    c. When there is yellow spotting in my eyes, it means that I should avoid the sun

    d. When there is yellow spotting in my eyes, it means that I need to wear special eyeglasses

5. Which of the following foods should someone with Alphabet Disease <u>avoid</u>?

a. Lean sirloin steak

b. Sugary drinks

c. White bread

d. None of the above

6. Which of the following is NOT a symptom of Alphabet disease?

a. Hair loss

b. Shortness of breath

c. Feeling tired

d. Low muscle tone

7. What does it mean to have Alphabet Disease?

a. Alphabetin cannot be broken down into vitamin ABC

b. Vitamin ABC cannot be absorbed from foods

c. There is not enough Alphabetin in the body

d. Alphabetin is blocking the respiratory tracts

8. Why do you experience hair loss when you have Alphabet disease?

a. Because of side effects from vitamin ABC deficiency

b. Because your body has difficulty breaking down proteins into amino acids

c. Because your body has difficulty producing fats and carbohydrates

d. I don't know

9. What is the <u>best</u> exercise for someone with Alphabet disease?

a. Upper leg exercises

b. Pilates

c. Bicep curls

d. Abdominal exercises

10. How can you prevent someone with Alphabet disease from developing a weakened immune system?

a. Reduce the amount of alcohol intake

b. Take vitamin ABC supplements

c. Get regular flu shots

d. Quit smoking

11. What should someone with Alphabet disease do when they have high levels of ammonia in their blood stream?

a. Increase the amount of exercise

b. Eat less protein

c. Consume high carbohydrate drinks

d. Use prescription shampoo

12. What should someone with Alphabet Disease do when they are feeling tired?

a. Rest

b. Take vitamin ABC supplements

c. Drink fruit juice

d. All of the above

13. Which of the following is not a likely cause of Alphabet disease?

a. Genetic factors

b. Viral infections

c. Smoking

d. All of the above

14. What is the main organ that is involved in Alphabet disease?

a. Heart

b. Lungs

c. Liver

d. Kidney

15. How does someone develop brain damage as a result of Alphabet disease?

a. Failure to limit protein in diet

b. Failure to take daily doses of vitamin ABC supplements

c. Failure to use prescription shampoo

d. Failure to exercise

16. How many Canadians are affected by Alphabet Disease each year?

a. 1 in 50

b. 1 in 500

c. 1 in 5,000

d. 1 in 50,000

17. If someone with Alphabet Disease forgets to take their vitamin ABC supplements, what should they watch out for?

a. Viruses

b. Yellow spots in the white of the eyes

c. Dangerous levels of ammonia in the bloodstream

d. Foods that are high in fat

18. Who is more at risk for developing Alphabet Disease?

a. Women

b. Men

c. Men and women are equally affected

d. I don't know

19. What could cause the yellow spots in the white of the eyes to get worse?

a. Taking supplements to increase levels of Alphabetin

b. Consuming high calorie foods

c. Not wearing sunglasses

d. Viruses

20. What should be the key ingredient in prescription shampoos for Alphabet disease?

a. Vitamin ABC

b. Amino acid, Cysteine

c. Essential fatty acids

d. Alphabetin

21. If you notice that your muscles are becoming 'loose' or 'floppy', it means that:

a. You should avoid fats in your diet

b. You should perform certain exercises

c. You should drink high carbohydrate drinks

d. You should only eat lean meats

22. What does hyperammonemia mean?

a. Too much ammonia in the blood stream

b. Too little ammonia in the blood stream

c. Too much ammonia in the liver

d. Too little ammonia in the liver

23. When do signs of Alphabet disease appear?

a. At birth to early child hood

b. Early childhood late adolescence

c. Adulthood

d. Anytime

24. How often should someone with Alphabet Disease practice muscle strengthening exercises?

a. Never because it causes fatigue

b. Three-four times per week because it helps maintain muscle tone

c. Every day because it will help detoxify ammonia

d. I don't know

25. How often should individuals with Alphabet disease wash their hair?

a. Every other day

b. Twice per day

c. Once per day

d. Once per week

Appendix F: Ethics Approval Documentation for Studies 2 and 3

Western Research

Research Ethics

Western University Health Science Research Ethics Board
HSREB Delegated Initial Approval Notice

Principal Investigator: Dr. John Paul Minda
Department & Institution: Social Science\Psychology,Western University

HSREB File Number: 106383
Study Title: Approaches to Improve Patient Education in Cardiac Rehabilitation and Secondary Prevention: A Quality Improvement and Program Evaluation Study
Sponsor:

HSREB Initial Approval Date: April 30, 2015
HSREB Expiry Date: April 30, 2016

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Recruitment Items	Survey Invitation Letter Clean	2015/04/22
Instruments	Clean copy of Cardiac Knowledge Questionnaire	2015/04/25
Western University Protocol	Revised Western Protocol- clean copy	2015/03/28
Instruments	Revised Appendix L- Paper survey Cover Letter	2015/03/14
Instruments	Appendix K- Debriefing Script	2015/03/14
Instruments	Revised Appendix J- online survey cover letter	2015/03/14
Instruments	Revised Appendix G- Program credibility and expectancy measure	2015/03/14
Instruments	Revised Appendix E- Forced choice triads	2015/03/14
Instruments	Appendix D- treatment fidelity checklist	2015/03/14
Instruments	Revised Appendix B- CRSP causal info presentation	2015/03/14
Instruments	Appendix A- tracking sheet	2015/03/14
Letter of Information & Consent	Letter of Information and Consent- clean version	2015/03/14

The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the above named study, as of the HSREB Initial Approval Date noted above.

HSREB approval for this study remains valid until the HSREB Expiry Date noted above, conditional to timely submission and acceptance of HSREB Continuing Ethics Review.

The Western University HSREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use Guideline for Good Clinical Practice Practices (ICH E6 R1), the Ontario Personal Health Information Protection Act (PHIPA, 2004), Part 4 of the Natural Health Product Regulations, Health Canada Medical Device Regulations and Part C, Division 5, of the Food and Drug Regulations of Health Canada.

Members of the HSREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Appendix G: Cardiac Rehabilitation Patient Education Brochure with Causal Explanation

3

About the Cardiac Rehabilitation and Secondary Prevention Program

The Cardiac Rehabilitation and Secondary Prevention Program is a six-month program for men and women with known heart disease. The purpose of the program is to provide a safe and effective way for individuals to:

- Overcome some of the physical complications of heart disease
- Reduce future risk of heart trouble
- Assist with return to an active social or work schedule
- Improve psychological well-being

The Cardiac Rehabilitation and Secondary Prevention Program is about getting the heart and blood vessels back to a healthy state and to maintain it there through:

- Medical evaluation
- Exercise program
- Psychological services
- Smoking cessation
- Patient care coordination

Hours:

8:30 am - 4:00 pm
Monday - Friday

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Renowned for compassionate care, St. Joseph's is one of the best academic health care organizations in Canada dedicated to helping people live to their fullest by minimizing the effects of injury, disease and disability though excellence in care, teaching and research.

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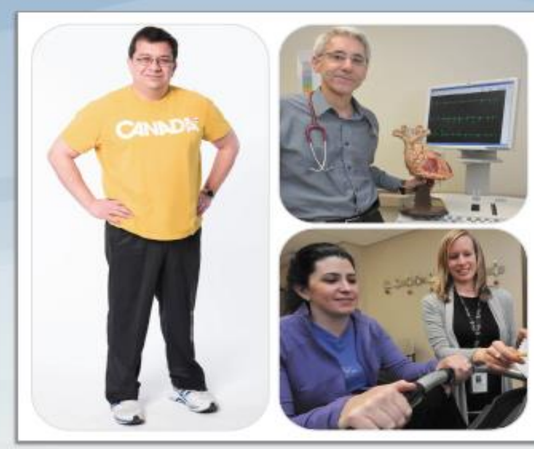
Cardiac Rehabilitation and Secondary Prevention:

Why is it Necessary for Recovery?



ST JOSEPH'S HEALTH CARE LONDON

1

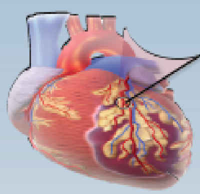
2

Risk of Coronary Artery Disease Can Be Managed and Prevented!

About Coronary Artery Disease

A. About the Heart

The heart is a very active muscle that pumps blood to supply the whole body with oxygen and nutrients. In order to work properly, the heart also needs its own blood. The *coronary arteries* are the heart's own circulatory system that supplies blood and oxygen. A healthy heart has healthy arteries.

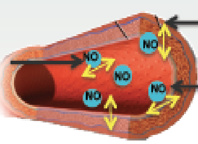


"Blausen 0463 HeartAttack" by Blausen Medical Communications, Inc. - Donated via OTRS, see ticket for

A healthy coronary artery has two qualities:

1. It is clear, with no blockage.
2. It can provide enough blood to the heart during times of demand (e.g., climbing stairs).

Both of these qualities depend on the inner layer of the artery, called the ***endothelium.*** When the endothelium is in good shape, blood traveling along its surface creates a tug. This tugging causes the endothelium to release ***nitric oxide***, which relaxes and widens the artery. As a result, blood flows easily and there is no shortage in blood supply.



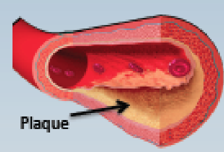
Blausen.com staff. "Blausen gallery 2014". Wikiversity Journal of Medicine. DOI:10.15347/wjm/2014.010. ISSN 20018762.

B. A Damaged Artery

Over time, the endothelium may become damaged due to "risk factors". Risk factors include: high blood pressure, high cholesterol, excess weight, diabetes, smoking, lack of exercise and emotional distress.

Damage to the endothelium causes it to become inflamed, just like how a splinter can cause a finger to become inflamed. This creates two problems for the arteries:

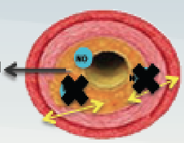
1)



Blausen.com staff. "Blausen gallery 2014". Wikiversity Journal of Medicine. DOI:10.15347/wjm/2014.01

The inflammation causes build up of a fatty material, known as **plaque.** Plaque narrows the arteries, restricts blood flow, and may even create blood clots that lead to a heart attack.

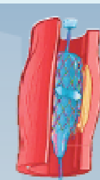
2)

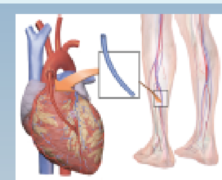


The damaged endothelium produces **less nitric oxide**. Without nitric oxide, the artery cannot relax and widen in response to physical exertion.

C. How to Help a Damaged Artery

Due to the lack of nitric oxide, some people experience angina (pressure, pain, heaviness) and shortness of breath. Nitroglycerine is an artificial source of nitric oxide that can relieve these symptoms.





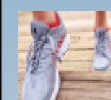
Medical procedures such as angioplasty, stents and bypass surgery can clear or bypass the blockage in the arteries. This helps to increase blood flow, as well as lessen angina, shortness of breath and other complications.

If medical procedures can get rid of symptoms then why are lifestyle changes needed?

Although blockage is removed, the endothelium is still damaged. That means there remains a shortage of nitric oxide and an inflamed artery.

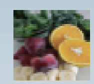
D. Managing Coronary Artery Disease

Fortunately, heart disease can be effectively controlled and prevented. As you have learned, the key to managing heart disease is to keep the endothelium healthy. Here are a few ways for you to prevent further injury to the endothelium and blood vessels:



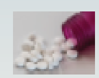
Regular physical activity is very important for managing heart disease.

During exercise, the movement of your muscles helps to stimulate and repair the damaged endothelium. When this happens, more nitric oxide is produced, which allows for more blood flow to the heart.

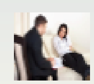


A **healthy diet** low in cholesterol and fat can keep fatty materials from irritating the endothelium and from forming into plaque.

Avoid **cigarette smoke** to stop further damage to the endothelium.



Taking **medications as prescribed** can help you stop risk factors, such as cholesterol and blood pressure from injuring the endothelium.



Take care of emotional stress to keep blood flow stable and to avoid sudden demands for blood supply.

Appendix H: Treatment Fidelity Checklist

Date:
Duration of session:
Presenters:

Present		The session...	Occurred during...	
___ Yes	___ No	Described two qualities of a healthy artery: no blockage; blood supply meets demand.	__Presentation	__ Q&A
___ Yes	___ No	Discussed the risk factors that the damage endothelium (alcohol, tobacco...)	__Presentation	__ Q&A
___ Yes	___ No	Mentioned that damage to endothelium causes inflammation in arteries.	__Presentation	__ Q&A
		Outlined two problems in a damaged/inflamed artery:		
___ Yes	___ No	1) Plague builds and block blood flow.	__Presentation	__ Q&A
___ Yes	___ No	2) Nitric oxide is no longer produced so artery cannot widen in response to physical exertion.	__Presentation	__ Q&A
___ Yes	___ No	Provided overview of complications; angina; shortness of breath; heart attack.	__Presentation	__ Q&A
		Limitations of treatment is discussed:		
___ Yes	___No	Treatment can clear blockage but endothelium remains damaged.	__Presentation	__ Q&A
___ Yes	___ No	No nitric oxide is produced.	__Presentation	__ Q&A
___ Yes	___ No	Plaque can still develop.	__Presentation	__ Q&A
___ Yes	___ No	Future risk of cardiac events.	__Presentation	__ Q&A
___ Yes	___ No	Explained that lifestyle changes help keep endothelium healthy.	__Presentation	__ Q&A
___ Yes	___ No	Movement of muscles stimulate and repair damaged endothelium.	__Presentation	__ Q&A
___ Yes	___ No	Nitric oxide is produced again, which allows for more blood flow to the heart.	__Presentation	__ Q&A
___ Yes	___ No	Other lifestyle changes can help prevent further injury to the endothelium by managing plaque build up.	__Presentation	__ Q&A

Appendix I: Patient Profile Matching Task (PPT)

Instructions:

You will read 10 short descriptions of people who are managing their heart conditions. The descriptions will be presented to you three at a time (Person A, then Person B and C). Your task is to decide whether Person B or C is most similar to Person A.

Try not to think too hard about the match- there are no right or wrong answers. We simply wish to gather insight on how people think of heart disease.

1.

<u>Person A:</u>

Mr. Garrison is a retired mechanic who had 2 stents placed 2 years ago. He has been doing well since but sometimes experiences heaviness in his chest when he does physical activity. After seeing his doctor, he signed up for swim classes at a community centre to stop the symptoms from getting worse.

Please select the person that best matches Person A:

☐ <u>Person B:</u>

Mr. van Der Wal is a retired electrician who had 2 stents placed 2 years ago. Mr. van Der Wal is doing well but experiences chest pains after physical activity. To avoid feeling worse, Mr. van Der Wal has decided to rest more often and cut down on vigorous activities.

☐ <u>Person C:</u>

Ms. Spencer is an accountant who underwent bypass surgery 5-years ago. Recently, she has been feeling more tired than before after physical activity. She is unable to do vigorous exercise, like running or cycling, but she walks 20 minutes everyday.

2.

<u>Person A:</u>

Ms. Cho is a 39-year old account manager for a large company. Her job has become increasingly more stressful. A year ago, she had a heart attack, and needed several stents installed. Ms. Cho returned to work right away but feels more tired and irritable than before. She now takes more frequent smoke breaks at work to cope with her stress.

Please select the person that best matches Person A:

☐ <u>Person B:</u>

Ms. Tabrizi is a 38-year old owner of a taxi company. Her work responsibilities doubled 6 months ago when her partner left the company. Ms. Tabrizi had a heart attack 2 months ago and needed several stents. Since returning to work, she feels more easily overwhelmed. Ms. Tabrizi has decided to take time off work and to see a psychologist for stress management.

☐ <u>Person C:</u>

Ms. Simpson is 75-years old and recovering from her heart surgery at home. She lives with her husband, who is in poor health. Prior to her surgery, Ms. Simpson spent most of her day caring for her husband, babysitting her grandchildren and maintaining the household. Although Ms. Simpson feels stressed, she is trying to push herself harder to get back to her regular routine.

3.

<u>Person A:</u>

Mr. Miller's has Type 2 diabetes and his angina is well managed on medication. He had two stents placed a year ago and was told to make dietary changes. Recently, he started to cut back on his sugar and uses olive oil when he cooks. Mr. Miller is slightly overweight and is trying to lose weight.

Please select the person that best matches Person A:

☐ <u>Person B:</u>

Ms. Kolowski had a heart attack 2 months ago. She has joined the Cardiac Rehabilitation program and wants to make some lifestyle changes. She has been filling half of her plate with vegetables, and makes sure that she does not skip meals. Ms. Kolowski is also working on cutting down on smoking.

☐ <u>Person C:</u>

Mr. Chan is diagnosed with diabetes Type 2 and has angina. He is doing well with medication, and had a stent placed last year. He has been making changes to his eating habits by following a popular new diet. Mr. Chan eats a lot of red meat and high-protein foods but stays away from dairy products.

4.

Person A:

Three years ago, Mr. Andre experienced shortness of breath and heaviness in his chest during his usual 3km run. He was referred to a heart specialist and had a stent placed for his 80% blocked artery. Mr. Andre now gets out of breath when he runs. He changed his routine to 30-minute walks, 5 days a week.

Please select the person that best matches Person A:

☐ Person B:

Mr. Patel suffered from a heart attack 4 months ago. After a brief hospital stay, Mr. Patel returned home and took a week to rest. When he felt better, Mr. Patel started swimming 3 times a week. He also takes his medications regularly and has cut down on his drinking to 1 glass per day.

☐ Person C:

Two years ago, Mr. Berger experienced heaviness in his chest during his usual bike ride. Later, he found out that he needed a stent for his 90% blocked artery. He often gets out of breath during his usual bike rides. He has decided to cycle once every two-weeks then rest for the remaining days.

5.

Person A:

Mr. McKelvey is a 50-year old police officer who has coronary artery disease. Since the time of his diagnosis 3 years ago, he has lost 30 lbs. Mr. McKelvey's symptoms, such as dizziness and shortness of breath, have improved since his weight loss. Mr. McKelvey often enjoys his favourite snack, which are roasted almonds.

Please select the person that best matches Person A:

☐ Person B:

Mr. Graham is a 51-year old firefighter who has coronary artery disease. He has lost 20 lbs since his diagnosis and noticed that he is less prone to physical exhaustion. Now that his symptoms are under control, Mr. Graham started to join his coworkers again for his favourite wing nights at the station.

☐ Person C:

Mr. Murji is a 38-year old truck driver who is at high risk for developing heart disease. He is currently taking medication to lower his blood pressure. Although Mr. Murji is a slim gentleman, his doctor is concerned about his eating habits. Mr. Murji does not want to lose weight but has been careful about watching his meal portions.

6.

Person A:

Mr. Heikidas is 66-years old and had a heart attack last year. He received bypass surgery and was given heart medications. Since the procedure, Mr. Helkidas lost 45lbs through exercise and diet. He has been feeling more energized and has decided to stop taking his cholesterol medications to avoid side- effects. Mr. Heikidas sticks to his daily 30 min walks.

Please select the person that best matches Person A:

☐ Person B:

Mr. Dahl is 68-years old and had a heart attack last year. Since having a bypass surgery, Mr. Dahl exercises regularly and avoids high fat and cholesterol foods. He has lost 30lbs and has not experienced any painful symptoms. Mr. Dahl takes blood pressure medication, and tries to maintain his regular exercise routine.

☐ Person C:

Ms. Eldon is 78-years old and was diagnosed with heart failure 15 years ago. She has been following a low salt diet, and balancing exercise with rest. Recently, her doctor mentioned that she is managing her heart condition very well. Ms. Eldon decided to cut down on her medications, and continues to stay away from salty foods.

7.

Person A:

Ms. Martin joined the Cardiac Rehabilitation program after having a heart attack. She likes to walk but does not have a regular exercise routine. Her cholesterol levels and blood pressure are normal and she does not have diabetes. Since her heart attack, she has been careful about watching her diet. She drinks 1 glass of wine with dinner and is a non-smoker.

Please select the person that best matches Person A:

☐ Person B:

Mr. Chomyn is at risk for developing heart disease and was told to make some lifestyle changes. He tries his best to follow a healthy diet but he does not like to exercise because of his bad knees. Mr. Chomyn is cutting down on smoking and does not drink alcohol.

☐ Person C:

Ms. Belanger had a heart attack 3 months ago and has joined the Cardiac Rehabilitation Program. She attends the exercise classes at the YMCA regularly, and has been following a healthy diet. She is a non-smoker and drinks alcohol on social occasions.

8.

<u>Person A:</u>

Ms. Townsend is 65-years old and has been experiencing leg pain. She was told by her doctor that she has peripheral artery disease and was given cholesterol-lowering medications. After taking her medications and following a diet for 8-months, Ms. Townsend was pain free. She now feels that she can enjoy her favourite fast foods again.

Please select the person that best matches Person A:

☐ <u>Person B:</u>

Mr. Connors is 50-years old and has Type 2 Diabetes and coronary artery disease. Mr. Connors was given medications and started a new exercise regime. He no longer feels sluggish and tired all the time. Although it was recommended, Mr. Connors has not made any diet changes because he feels pretty good.

☐ <u>Person C:</u>

Ms. Stitt is 62-years old and has been experiencing cramping in her legs. Her doctor diagnosed her with peripheral artery disease. And she was given medication to manage her high cholesterol. She also changed her eating habits and avoids high fat foods. Now that she is pain free, Ms. Stitt can enjoy walking again.

9.

<u>Person A:</u>

Mr. Bacino has had a rough year. Around the time of his heart attack 5 months ago, he was let go at his job due to company downsizing. Two months following, his house was severely damaged from a kitchen fire. Lately, Mr. Bacino has been having difficulty sleeping and does not take pleasure or interest in anything. His wife encouraged him to speak to a psychologist but he doesn't think this is necessary.

Please select the person that best matches Person A:

☐ <u>Person B:</u>

Mr. Thomas has been going through a stressful time. He recently lost his mother to cardiac arrest, and his wife has been diagnosed with stage I colorectal cancer. Mr. Thomas suffered from a heart attack 4 months ago. He has lost interest in his hobbies despite his best efforts to keep busy. He plans to speak to a professional to help him snap out of his blues.

☐ <u>Person C:</u>

Ms. Garcia was diagnosed with unstable angina 2 years ago. Although Ms. Garcia underwent a successful bypass surgery, she still experiences racing heart and shortness of breath. Her doctor said that her symptoms are likely anxiety-based, and that she should see a psychologist. Ms. Garcia does not think this is true and asked her doctor to do more medical tests.

10.

Person A:

Ms. Schulman is slightly overweight and has a family history of heart disease. She does not have a regular exercise routine because it does not seem to make a difference for her cholesterol levels. Ms. Schulman had a stent placed 1 year ago and is currently on heart medications. Recently, her family doctor referred her to a dietician because he is concerned about her diet.

Please select the person that best matches Person A:

☐ Person B:

After having two stents inserted into her coronary arteries, Ms. O’Hara has been referred to see a dietician. Everyone in her family has high cholesterol and struggles to manage their weigh. Ms. O’Hara started to go swimming twice a week, and is taking her heart medications regularly. She also is seeing a nurse to help her manage diabetes.

☐ Person C:

Ms. Papadopoulos was surprised to hear that one of arteries is 90% blocked. She has always been careful about watching her diet. She experiences pain in her leg when she exercises so she has decided to stop. However, Ms. Papadopoulos’ doctor said that her cholesterol levels and blood pressure are managed well with her medications.

Appendix J: Credibility and Expectancy Questionnaire (CEQ)

1. At this point in time, how much *sense* does the Cardiac Rehabilitation and Secondary Prevention Program make to you?

1	2	3	4	5	6	7	8	9
Not a lot of sense				Some sense				A lot of sense

2. At this point in time, how *successful* do you think this program will be in reducing your symptoms and future risk of heart disease?

1	2	3	4	5	6	7	8	9
Not at all Successful				Somewhat Successful				Very Successful

3. How *confident* would you be in recommending this program to a friend experiencing the same heart condition as you?

1	2	3	4	5	6	7	8	9
Not at all Confident				Somewhat Confident				Very Confident

4. By the end of the program, how much of an improvement in your symptoms and risk of heart health do you really *feel* will occur?

1	2	3	4	5	6	7	8	9
No Improvement				Some Improvement				A lot of Improvement

5. By the end of the program, how much of an improvement in your symptoms and risk of heart disease you *think* will occur?

1	2	3	4	5	6	7	8	9
No Improvement				Some Improvement				A lot of Improvement

6. At this point in time, how much do you really *feel* that the program will help you reduce your symptoms and risk of heart disease?

1	2	3	4	5	6	7	8	9
Not at all				Somewhat				Very much

Appendix K: Inter-item Correlation for Health Knowledge Questionnaire

Table K1: Item analysis for applied items on the Health Knowledge Questionnaire (HKQ) across time points.

Item	Item-to-scale Correlation	
	Time 1	Time 2
1	.571**	.506**
2	.422**	.623**
3	.444**	.686**
4	.602**	.673**
5	.523**	.662**
6	.382**	.555**
7	.311**	.566**
8	.558**	.637**
9	.430**	.295**
10	.402**	.483**
11	.503**	.382**
12	.555**	.499**
13	.505**	.660**
14	.461**	.621**
15	.512**	.704**

**$p < .001$

Table K2: Item analysis for factual items on the Health Knowledge Questionnaire (HKQ) across time points.

Item	Item-to-scale Correlation	
	Time 1	Time 2
1	.585**	.630**
2	.505**	.620**
3	.527**	.684**
4	.580**	.584**
5	.186*	.555**
6	.471**	.654**
7	.421**	.634**
8	.586**	.648**
9	.553**	.646**
10	.329**	.425**

* $p < .05$; ** $p < .001$

Appendix L: Coronary Heart Disease Awareness Knowledge Questionnaire

CHDAK Questionnaire

1. What is Coronary Heart Disease (Check one)
   - ☐ Chest pain
   - ☐ A valve problem
   - ☐ Reduced blood flow to the heart
   - ☐ Malfunction of the heart
   - ☐ Don't know
   - ☐ Other (specify): ______________________________

2. What do you think is the leading cause of death in men? (Choose one)
   - ☐ Prostate cancer
   - ☐ Cancer (general)
   - ☐ Heart disease/heart attack
   - ☐ Don't know
   - ☐ Other (specify): ______________________________

3. What do you think is the leading cause of death in women (Choose one)
   - ☐ Breast cancer
   - ☐ Cancer (general)
   - ☐ Heart disease/heart attack
   - ☐ Don't know
   - ☐ Other (specify): ______________________________

4. Please circle T (true) or F (false) for each of the statements below:

a. People who are physically active on a regular basis can cut their risk of heart disease in half.	T	F
b. Heart disease is as dangerous for women as it is for men.	T	F
c. It does not help to quit smoking after many years because one's health is already damaged.	T	F
d. If one stops smoking but gains weight as a result, one's health is not benefitted.	T	F
e. Heredity is a risk factor of heart disease that you cannot change.	T	F
f. Indigestion may be a symptom of a heart attack.	T	F
g. Everyone who has a heart attack experiences chest pain.	T	F
h. A heart attack is caused by the blocking of the blood flow to a part of the heart.	T	F
i. A heart attack results in damage of the heart muscle.	T	F
j. Hardening of the arteries begins with the accumulation of fat deposits within the arterial wall.	T	F
k. Small changes in what you eat can lower blood cholesterol.	T	F
l. High density lipoprotein (HDL) can lower one's risk of coronary heart disease.	T	F
m. A person can reduce their changes of dying from heart disease through lifestyle changes.	T	F
n. To get cardiac benefit from exercise, you need to get sweaty and	T	F

out of breath.		
o. Nitroglycerin is of great help in a heart attack.	T	F
p. Beta blockers are drugs that reduce heart rate and blood pressure.	T	F
q. Daily aspirin is often recommended to reduce heart disease risk.	T	F
r. A percutaneous coronary intervention (PCI) is used to diagnose CHD.	T	F
s. An angiogram can improve blood flow through narrow or blocked arteries.	T	F
t. Coronary bypass surgery cannot improve blood flow through blocked arteries.	T	F

Curriculum Vitae

Karen Michelle Zhang, M.Sc
Ph.D. Candidate, Clinical Psychology Program
Western University

EDUCATION

2012- Present

Doctor of Philosophy, Clinical Psychology
Western University, London, ON

Advisors: Dr. Leora Swartzman, PhD, C.Psych.
Dr. John Paul Minda, PhD

2010- 2012

Master of Science, Clinical Psychology
Western University, London, ON

Advisor: Dr. Leora Swartzman, PhD, C.Psych.
Thesis: Impact of Goal Compatibility on Self-Care Adherence Among Patients with Heart Failure

2005-2009

Bachelor of Science, Honours Psychology
Queen's University, Kingston, ON

Advisor: Dr. Dean Tripp, PhD, C.Psych.
Thesis: Pain Estimation Accuracy and Empathy in Culturally Concordant and Discordant Dyads

ACADEMIC AWARDS AND HONOURS

London Regional Psychological Association Award for Outstanding Contributions by a Psychology Student	2015
Ontario Graduate Scholarship ($15,000)	2014
Nominated for Graduate Student Teaching Award	2014
Graduate Thesis Award ($750)	2013
Mitacs Accelerate Research Internship Program ($15,000)	2012
Meritorious Student Award for Society of Behavioural Medicine	2011
Canadian Institute of Health Research (CIHR) Canada Graduate Scholarship: Master's Research Award ($17,500)	2010
Queen's University Dean's Honours List	2009

RESEARCH EXPERIENCE AND ACTIVITIES

Research Associate, Child and Adolescent Mental Health Care Inpatient Program
(Sep 2012 to Oct 2015)
London Health Sciences Centre, London, ON

- *Supervisor:* Dr. Heather Jacques, PhD, C. Psych.
- Implemented a program evaluation study evaluating the effectiveness of using a Collaborative Problem Solving (CPS) theoretical framework on an interdisciplinary inpatient child and adolescent mental health unit

Data Analyst, Division of Respirology (Sep 2013 to Jun 2015)
London Health Sciences Centre, London, ON

- *Supervisor*: Dr. Christopher Licskai, M.D.
- Provided consultation on the research design of a multi-site study that aimed to establish the gold standard for asthma diagnosis using clinical symptom measures and objective testing (e.g., spirometry tests and methacholine challenge)

Research Intern, Telehealth Division (May 2011 to Dec 2011)
Sykes Assistance Services Corporation, London, ON

- Supervisor: Dr. Kathleen Dindoff, PhD
- Designed and developed coaching Telehealth scripts for a smoking cessation and wellness program offered to employees in participating companies; Telehealth scripts were informed by the Transtheoretical Model and Motivational Interviewing principles

Research Lab Manager, Psychosocial Medicine Lab (May 2009 to Jun 2010)

Ryerson University, Toronto, ON

- *Supervisor:* Dr. Tae Hart, PhD, C.Psych.
- Involved with the conceptualization, development and implementation of two large multi-site studies on the psychosocial adjustment of multiple sclerosis and breast cancer patients
- Collaborated on the writing and development of 3 research projects for national research grant submissions

Volunteer Research Assistant, Pain Research Lab (Sep 2006 to May 2009)
Queen's University, Kingston, ON

- *Supervisor:* Dr. Dean Tripp, PhD, C.Psych.

Volunteer Research Assistant, Comprehensive Pain Program (May 2007 to Aug 2008)
Toronto Western Hospital, Toronto, ON

- *Supervisor:* Dr. Keith Nicholson, PhD, C. Psych.

Volunteer Research Assistant, Queen's School of Business (Sep 2006 to Apr 2007)
Queen's University, Kingston, ON

- *Supervisor:* Dr. Ana Oritz de Guinea Lopez de Arana, PhD

Volunteer Research Assistant, Brain and Behaviour Lab (Apr 2006 to Sep 2006)
Ontario Institute for Studies in Education- University of Toronto, Toronto, ON

- *Supervisor:* Dr. Marc Lewis, PhD

PUBLICATIONS AND PRESENTATIONS

Peer-Reviewed Publications

Zhang, K. M., Dindoff, K., Arnold, J. M. O., Lane, J., & Swartzman, L. C. (2015). What matters to patients with heart failure? The influence of non-health related goals on self-care adherence. *Patient Education & Counselling, 98*, 927-934.

Zhang, K. M., Swartzman, L. C., & Minda, J. P. (2014). The influence of causal knowledge on the comprehension and retention of medical information among younger and older adults. *Proceedings of the 34th Annual Conference of the Cognitive Science Society. Hillsdale, NJ: Lawrence Erlbaum Associates.*

Hart, T. L, Coon, D. W., Kowalkowski, M. A., **Zhang, K**., Hersom, J. I., Goltz, H. H., Wittman, D. A., & Latini, D. M. (2014). Changes in sexual roles and quality of life for gay men after prostate cancer: Challenges for sexual health providers. *Journal of Sexual Medicine, 11*, 2308-2317.

Manuscript Submitted

Zhang, K. M., Swartzman, L. C., Petrella, R. J., Gill, D. P., & Minda, J. P. (2016). Explaining the causal links between illness management and symptom reduction: Development of an Evidence-based Patient Education Strateg7. *Manuscript submitted.*

Published Abstracts

Zhang, K. M., Swartzman, L.C., Arnold, J.M. O., Dindoff, K., & Lane, J. (2013). Impact of goal compatibility on self-care adherence among patients with heart failure [Abstract]. *Annals of Behavior Medicine (Annual Meeting Supplement), 45*(5), s15.

Zhang, K. M., Gryfe, N., & Swartzman, L. C. (2011). Getting vaccinated against H1N1: The relative roles of perceived risk, anticipated regret and medical scepticism [Abstract]. *Annals of Behavior Medicine (Annual Meeting Supplement), 41*, s189. *Selected as a Meritorious Student Abstract*

Zhang, K., Crangle, C., Hart, S. L., & Latini, D. M. (2010). Predictors of satisfaction with care for gay men with prostate cancer [Abstract]. *Annals of Behavior Medicine, (Annual Meeting Supplement) 39,* s232.

Hart, S. L., Latini, D., Belanger, J., Donia, J., **Zhang, K**., & Varma, M. (2010). Initial reactions to colorectal cancer diagnosis are associated with later decreased fear of recurrence [Abstract]. *Annals of Behavioral Medicine (Annual Meeting Supplement), 39*, s256.

Paper Presentation

Zhang, K. M., Prior, P.L., Swartzman, L. C., Suskin, N.G., Unsworth, K., & Minda, J. P. (2016, Oct). *Explaining causal links among risk factors, cardiovascular pathophysiology, symptoms and health behaviours: A randomized controlled trial of patient education strategies to enhance 'deep' vs. 'surface' level of knowledge.* The Heart of the Matter: 2016 Canadian Cardiovascular Congress, Montreal, QC. ***Selected as a 'Highlighted Presentation.'***

Zhang, K. M., Swartzman, L. C., & Minda, J. P. (2014). *The influence of causal knowledge on the comprehension and retention of medical information among younger and older adults*. Paper presented at the 34th Annual Conference of the Cognitive Science Society, Quebec City, QC.

Hart, S. L., Latini, D., Belanger, J., Donia, J., **Zhang, K**., & Varma, M. (2009). *Initial reactions to colorectal cancer diagnosis are associated with later decreased fear of recurrence.* Paper presented at the 31st Annual Meeting & Scientific Sessions of the Society of Behavioral Medicine, Seattle, WA.

Poster Presentations

Zhang, K. M., Swartzman, L. C., Petrella, R., & Minda, J. P. (2014). *The effects of* *causal explanation on older adults' ability to recall novel medical information.* Landscapes of Aging, the 43rd Annual Scientific and Educational Meeting of the Canadian Association on Gerontology, Niagara Falls, ON. *Nominated and presented at the CIHR-IA Student Poster Competition.*

Jacques, H., **Zhang, K. M**., Kizilbash, K., & Small, H. (2013). *Adopting the collaborative problem-solving model on an inpatient unit: One-year progress report of staff variables.* Poster presented at the Child and Adolescent Psychiatry Research Half Day, Victoria Hospital, London, ON. ***Selected as 'Best Research Poster.'***

Zhang, K. M., Swartzman, L., Arnold, J. M. O., & Dindoff, K. (2013). *Valued goals of heart failure patients: Does self-care management matter?* Poster presented at the 74th Annual meeting of the Canadian Psychological Association, Quebec City, QC.

Lane, J.E.M., **Zhang, K.,** & Swartzman, L. (2013). *Measuring the Impact of Burden and Self-efficacy of Adhering to Self-care Behaviours in Patients with Congestive Heart Failure.* Poster presented at the 74th Annual meeting of the Canadian Psychological Association, Quebec City, QC.

Zhang, K. M., Swartzman, L. C., Arnold, M., & Dindoff, K. (2012). *Impact of competing goals on self-care adherence among patients with congestive heart failure-Preliminary Findings.* Poster presented at the Canadian Psychological Association's 73rd Annual Convention, Halifax, NS.

Gryfe Saperia, N., **Zhang, K. M.,** Swartzman, L. C. (2011). *Sick with regret: How anticipated emotion influences the inclination to get the H1N1 shot.* Poster presented at The Canadian Psychological Association's 72nd Annual Convention, Toronto, ON.

Swartzman, L., McAskile, C., Smith, J., Norman, R., **Zhang, K.** *(Presenter)* (2011). E*mpathy helps and pity hinders the willingness to interact with those prone to depression: A Vignette Study.* Poster presented at The Canadian Psychological Association's 72nd Annual Convention, Toronto, ON.

Zhang, K. M., Hart, S.L., Kowalkowski, M., & Latini, D.M. (2010). *Predicting Health Quality of Life for Gay/Bisexual Men with Prostate Cancer.* Poster presented at the Association for Behavioral and Cognitive Therapies 44th Annual Convention, San Francisco, CA.

Zhang, K., Hart, S.L., Belanger, J., & Crangle, C. (2009). *Neuroticism of newly diagnosed colorectal cancer patients and their partners predicts patient depressive symptoms and quality of life.* Poster presented at the Association for Behavioural and Cognitive Therapies 43rd Annual Convention, New York, NY.

Hsieh, A.Y., **Zhang, K.M.** & Tripp, D. A. (2009). Impact of culture on pain estimation accuracy. Paper presented at the 7th Annual Pain Day, Queen's University, Kingston, ON.

Crangle, C., Hart, S. L., Belanger, J., & **Zhang, K.** (2009). *Communication and social constraint as predictors of relationship satisfaction and post-traumatic stress symptoms in newly diagnosed colorectal cancer patients and their partners.* Poster presented at the Association for Behavioural and Cognitive Therapies 43rd Annual Convention, New York, New York.

Zhang, K., Hsieh, A., & Tripp, D. (2009). *Observer pain estimation and empathy in cultural concordant and discordant dyads*. Poster presented at the 39th Annual Undergraduate Thesis Conference, McMaster University, Hamilton, ON.

Hsieh, A., Tripp, D., O'Connor, K., Haley, T., Tam, M., & **Zhang, K.** (2008). *Ethnic and gender differences in the facial expression of pain*. Poster presented at the 12th World Congress on Pain, Glasgow, Scotland, UK.

Other Professional Presentations

Zhang, K.M., & Prior, P.L. (2016). *Mind-body dualism? Psychology in Cardiac Rehabilitation and Secondary Prevention.* Presentation for Interprofessional Education Grand Rounds, Schulich School of Medicine, London, ON.

Zhang, K.M. (2015). *Anxiety in the medical setting.* Presentation for Family Medicine Resident Teaching Rounds, London Health Sciences Centre, London, ON.

Zhang, K.M. & Mitchell, J. (2015). *Caring for our minds to reduce the risk of diabetes.* Presentation for Patient Education Workshop in the Community, London Health Sciences Centre, London, ON.

Zhang, K.M. & Purcell, B. (2015). *Introduction to Mental Health Issues in Later Life.* Presentation for Professional Development at Strathmere Lodge Long-term Care, London Health Sciences Centre, London, ON.

Zhang, K.M. (2015). The *Mind-Body Connection.* Presentation for Advocacy through Action Group “Finding Your Way” Public Lecture Series, London Public Library, London, ON.

Zhang, K.M. & Petter, M. (2014). The *Mind-Body Connection.* Presentation for Advocacy through Action Group “Finding Your Way” Public Lecture Series, London Public Library, London, ON.

Zhang, K.M. (2013). *Introduction to Emotion Regulation.* Presentation for the Laura Evans Lecture Series on Mental Health, Western University, London, ON.

Zhang, K.M. & McDermott, R. (2013). The *Psychology of Eating.* Presentation for

Advocacy through Action Group "Finding Your Way" Public Lecture Series, London Public Library, London, ON.

Zhang, K.M. & McDermott, R. (2012). The *Psychology of Eating.* Presentation for Advocacy through Action Group "Finding Your Way" Public Lecture Series, London Public Library, London, ON.

TEACHING EXPERIENCE

Head Teaching Assistant for Statistics and Research Methods- Psychology 2820 Sep 2014 - Apr 2016
Western University, London, ON

- Developed course content that focused scientific writing and statistics
- Coordinated eight lab sections and liaised between students, teaching assistants and professor

Teaching Assistant for Statistics and Research Methods- Psychology 2820 Sep 2011-Apr 2014
Western University, London, ON

- Instructed students on course content

Teaching Assistant for Clinical Psychology- Psychology 3300 Jun 2012-Aug 2012
Western University, London, ON

Teaching Assistant for Psychology of Health and Illness- Psychology 2036 Jan 2011- Apr 2011
Western University, London, ON

Designer for Interactive Classroom Demonstrations Sep 2010-Apr 2011
TopHat Monocole, Waterloo, ON

Teaching Assistant for Psychological Aspects of Life Skills- Psychology 2035 Sep 2010- Dec 2010
Western University, London, ON

SUPERVISION EXPERIENCE

Honours Thesis Research Advisor for Student, K. McKenzie (Aug 2015 to Apr 2016)
Western University, London, ON

- *Supervising Faculty Member:* Dr. Leora Swartzman, PhD, C.Psych.
- *Project title:* "The Effects of a Cognitive Learning Strategy on Patients' Perception of Cardiac Rehabilitation Program Credibility"

Student Supervisor, Cardiac Rehabilitation and Secondary Prevention Program (Sep 2015 to Aug 2016)
St. Joseph's Health Care, London, ON
- *Supervisor:* Dr. Peter Prior, PhD, C. Psych.
- Trained two graduate students in the M.I.N.I International Neuropsychiatric Interview (MINI)

Research Supervisory Student, Swartzman Lab (Aug 2014 to Aug 2016)
Western University, London, ON
- *Supervising Faculty Member:* Dr. Leora Swartzman, PhD, C.Psych.
- Supervised all research volunteers and junior students

Student Supervisor, WaitList Clinic (Sep 2014 to Jul 2015)
Canadian Mental Health Association, London, ON
- *Supervisor:* Dr. Felicia Otchet, PhD, C. Psych.
- Provided group and individual supervision to over 16 undergraduate and Master's-level students in a supportive counselling centre

Honours Thesis Research Advisor for Student, J. Baer (Aug 2014 to May 2015)
Western University, London, ON
- *Supervising Faculty Member:* Dr. Leora Swartzman, PhD, C.Psych.
- *Project title:* "Making Sense of Illness: the Impact of Causal Information on Patient Illness Beliefs and Perceptions"

Honours Thesis Research Advisor for Student, D. Smith (Aug 2014 to May 2015)
Western University, London, ON
- *Supervising Faculty Member:* Dr. Leora Swartzman, PhD, C.Psych.
- *Project title:* "Improving Self-Efficacy in Cardiac Patients Using Causal Information"

Honours Thesis Research Advisor for Student, J. Lane (Aug 2011 to May 2012)
Western University, London, ON
- *Supervising Faculty Member:* Dr. Leora Swartzman, PhD, C.Psych.
- *Project title:* "Measuring the Impact of Burden and Self-efficacy of Adhering to Self-care Behaviours in Patients with Congestive Heart Failure"

Co-Supervisor for Honours Thesis Student, S. Balint (Sep 2009 to May 2010)
Ryerson University, Toronto, ON
- *Supervising Faculty Member:* Dr. Tae Hart, PhD, C.Psych.
- *Project title:* "Predictors of Posttraumatic Positive Growth in Patients with Colorectal Caner"

SUPERVISED CLINICAL EXPERIENCE

Psychology Resident (Sept 2016 to Present)
St. Joseph's Healthcare Hamilton, Hamilton, ON

- Director of Clinical Training: Dr. Heather McNeely, PhD, C.Psych

Psychological Services- Student Development Centre (Feb to Jun 2016)
Western University, London, ON

- *Supervisor:* Dr. Naomi Wiesenthal, PhD, C. Psych.

Paediatric Psychology (Sept 2015 to Feb 2016)
London Health Sciences Centre, London, ON

- *Supervisor:* Dr. Erica Gold, PhD, C. Psych

Psychometrist, Dr. Darlene Elliott-Faust and Associates (Jun 2015 to Mar 2016)
Private Practice in Child and Adolescent Psychology, London, ON

- *Supervisor:* Dr. Darlene Elliott-Faust, PhD, C. Psych

Cardiac Rehabilitation and Secondary Prevention Program Practicum (Mar 2015 to Present)
St. Joseph's Health Care, London, ON

- *Supervisor:* Dr. Peter Prior, PhD, C. Psych

Psychometrist, Cardiac Rehabilitation and Secondary Prevention Program (Mar 2014 to Aug 2016)
St. Joseph's Health Care, London, ON

- *Supervisor:* Dr. Peter Prior, PhD, C. Psych

Byron Family Medical Centre (Apr 2015 to Aug 2015)
London Health Sciences Centre, London, ON

- *Supervisor:* Dr. Carey Anne DeOliveira, PhD, C. Psych.

Geriatric Mental Health (May 2015 to Aug 2015)
London Health Sciences Centre, London, ON

- *Supervisor:* Dr. Bonnie Purcell, PhD, C. Psych.

Behavioural Medicine Service (Sep 2014 to Jul 2015)
London Health Sciences Centre, London, ON

- *Supervisor:* Dr. Felicia Otchet, PhD, C. Psych.

Waitlist Clinic (Sep 2014 to Jul 2015)
Canadian Mental Health Association, London, ON

- *Supervisor:* Dr. Felicia Otchet, PhD, C. Psych.

Child and Adolescent Mental Health Outpatient Care (Sep 2014 to Feb 2015)
London Health Sciences Centre, London, ON

- *Supervisor:* Dr. Kerry Collins, PhD, C. Psych.

Geriatric Stress Management Workshop Series, 'Breathe Easy', (Apr 2014 to Jun 2014)
Prince George's Retirement Residence, Lucan, ON
- *Supervisor:* Dr. Kate Partridge, PhD, C. Psych.

Comprehensive Pain Program, (May 2014 to Aug 2014)
St. Joseph's Health Care, London, ON
- *Supervisor:* Dr. Heather Getty, PhD, C. Psych.

Southwest Centre for Forensic Mental Health Care (Sep 2013 to Jun 2014)
St. Joseph's Health Care, St. Thomas, ON
- *Supervisor:* Dr. Rod Balsom, PhD, C. Psych.

Acquired Brain Injury Clinic (May 2013 to Sep 2013)
St. Joseph's Health Care, London, ON
- *Supervisor:* Dr. Margaret Weiser, PhD, C. Psych.

Psychological Services- Student Development Centre (Sep 2012 to May 2013)
Western University, London, ON
- *Supervisor:* Dr. Elspeth Evans, PhD, C. Psych.

Thames Valley District School Board (Feb 2012 to Jun 2012)
Western University, London, ON
- *Supervisor:* Dr. Deborah Reitzel-Jaffe, PhD, C. Psych.

Operational Stress Injury Clinic (Feb 2012 to May 2012)
St. Joseph's Health Care, London, ON
- *Supervisor:* Dr. Charles Nelson, PhD, C. Psych.

UNIVERSITY AND PROFESSIONAL SERVICES

Member of the Program Planning and Research Committee, Ontario Psychological Association (Feb 2011 to Present)
- Conceptualized and organized a graduate student workshop, "Let's Talk about Matching" that has continued to run for the past two year; coordinated and organized activities for the workshop

Member of the Undergraduate Curriculum Committee, Western University (Sep 2014 to Present)

Executive Member, Advocacy through Action (Sep 2010 to Sep 2015)
- **Advocacy through Action is a student-run initiative that strives to make** psychological research, information and resources available to the community. Each year our group offers a series of public lectures ("Finding your Way:

Psychology in Everyday Life") on various topics related to mental health and well-being

Director of Graduate Student Affairs- Board of Directors, Ontario Psychological Association (Feb 2012 to Feb 2014)

- Served as a liaison between graduate students in Ontario and the Board of Directors

Ontario Psychological Association (OPA) Representative, London Regional Psychological Association (Feb 2012 to Feb 2014)

- Served as a liaison between the OPA the Board of Directors and the London Regional Psychological Association

Student Representative for the Graduate Affairs Committee, Western University (Sep 2012 to May 2013)

- Advocated for the interests of graduate students on issues related to the psychology graduate curriculum

Executive Member of the Psychology Graduate Students' Association, Western University (Sep 2011 to Aug 2012)

- Organized and hosted student social events; oriented new students to the program

Psychology Councillor, Society of Graduate Students (Sep 2010 to Aug 2011)

- Attended monthly meetings and voted on issues relevant to graduate students

PROFESSIONAL AFFILIATIONS

2015- Present	Student Member of the American Psychological Association
2011- Present	Student Member of the Ontario Psychological Association
2011- Present	Student Member of the London Regional Psychological Association
2012- 2014	Student Member of the Canadian Psychological Association
2010-2013	Student Member of The Society of Behavioral Medicine
2009-2010	Student Member of the Association for Behavioral and Cognitive Therapy