LAPAROSCOPIC COLECTOMY TRAINING: A QUASI-EXPERIMENTAL COMPARISON OF SIMULATORS TO TRADITIONAL TRAINING

by

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ABSTRACT

The purpose of this quantitative, quasi-experimental study was to measure the relationship of surgical training with simulators with the acquisition of surgical skills, and with the cost and effectiveness of surgical training program on laparoscopic colectomy. The aim was to help health care leaders identify new, effective training methods and teaching curricula. The sample of the study was eight surgeons who performed 96 laparoscopic colectomies. Participants were equally split in two groups, the experimental and the control group and had similar level of surgical experiences. Both groups attended the didactic sessions, participated in 72 assisted-surgery training cases, and completed three laparoscopic colectomies as the primary surgeons. In addition, the experimental group went through simulation training. The findings of the study indicated that simulation training had an impact on the effectiveness of laparoscopic colectomy training programs and on the cost of the laparoscopic colectomy. The patients of the experimental group had statistically significant better results in 1) the days of bowel function return, 2) the days of clearance from liquid diet, 3) the degree of post-operative pain, 4) the incidences of post-operative bleeding, 5) the days of gastric protection medication intake, and 6) the days of hospitalization compared to the patients of the control group. The results indicated that simulation training should be incorporated as a standard method of training in existing surgical curricula for laparoscopic colectomy because it could increase the adoption of laparoscopic colectomy technique, which has proven benefits against open colectomy, and could also offer qualitative results to the patients while containing health care costs.

DEDICATION

I would like to lovingly dedicate this to the man of my life, Mike, who inspired me, supported me, and has endured my stress, and my moments of anxiety. I thank him deeply for standing by me so patiently, for giving me the drive to tackle hard moments with determination, and for helping me to develop a new philosophy about life.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

PREFACE

This dissertation is the original unpublished work of the author Evgenia (Jenny) Matsiota.

The effort in Chapter 1 is to identify the background of the problem and the literature gap that concerns the problem, which is the low penetration of laparoscopic colectomy as a surgical method. Chapter 1 also includes and analyses briefly the research method and the study design that will test certain hypotheses and answer specific research questions.

In Chapter 2 an extensive literature review takes place, presenting existing knowledge about training methods of laparoscopic surgery and more specifically about laparoscopic colectomy training. This chapter also analyses the use of simulators as a training tool and funnels down the bigger theme of surgical training to the lack of literature and knowledge about the value of laparoscopic colectomy training with simulators.

Chapter 3 contains the research method, the appropriateness of this method and the appropriateness of the research design. The population and sampling methods are analysed together with the intervention and data collection and analysis methods.

The work of Chapter 4 presents the results of the laparoscopic colectomy training program that six surgeons split in two cohorts realized.

Finally, Chapter 5 is the refinement of the whole research work and presents the conclusions and the recommendations that may trigger future research and more analysis for educational leaders, surgeons, and leaders in health care organizations.

Chapter 1

Introduction

The health care sector is under the magnifier worldwide. Governments place much emphasis and stricter control on health care spending and increasing health care costs (Owens, Qaseem, Chou, & Shekelle, 2011). The aim of contemporary health care systems is to offer high quality of care at a low cost. Experts support that the future of health care relies on value maximization, which is the product of the equation Value=Quality/Cost (The future of U.S. health care, 2009). High quality of care results from continuous training, education, and technological advancements. Avedis Donabedian developed a framework that presents quality of care as the result of three important dimensions: structures, processes, and outcomes (Leake & Urbach, 2010). Structures concern the health care organizations' and teaching institutions' infrastructure that incorporates technology and processes relevant to operative techniques physicians employ to offer care and quality treatment (Leake & Urbach, 2010). Processes are about the operative techniques and efforts health care leaders employ to offer care and quality of treatment (Leake & Urbach, 2010). The output is the result of both structures and processes, and relates to the effectiveness of a health care program or strategy. Similarly, the effectiveness of training and educational program depends on the structure and processes of a health care teaching institution.

The introduction of laparoscopic surgery was the result of revolutionary medical devices and computer visual technologies. Health care leaders developed training and educational curricula to promote laparoscopic surgery as a new surgical method. The most common training processes have been relying on animal labs, cadavers, and in-operating room training (Laschinger et al., 2008). Operating room training is the basic training method health care educators employ. The other training methods had complementary role and have never been the norm of training as the operating room training is.

Laparoscopy is a surgical technique where surgeons use a laparoscope, a small fiber optic instrument, to get in the abdominal area of the human body through small insertion ports. The laparoscope is connected to a camera to allow visualization of the inner body. Laparoscopic surgery is minimal invasive technique that offers less trauma, less postoperative pain, shorter in-hospital stay, quicker recovery, and improved cosmetic results as opposed to open surgery (Ilbeigi & Munver, 2006). It required continuous training and intense effort from the surgeons' side to develop those skills necessary to offer better quality of care to their patients through laparoscopic surgery. Health care leaders invested much time, effort, and resources to enhance the effectiveness of both the teaching and learning processes of laparoscopic surgery to offer better results for the patients. Laparoscopic cholecystectomy has evolved as the most common laparoscopic surgery (Traverso, 1976).

Although the most common method of training remains the in-operating room training, simulators played a significant role in enhancing laparoscopic training. In fact, training systems and needs for minimal invasive surgery, mainly laparoscopy and arthroscopy, were the main drivers for the development, and increasing adoption of virtual simulators in surgical training (Székely, 2003). The most common application of simulation training was laparoscopic cholecystectomy (Gallagher et al., 2005). Evidence has shown that the use of virtual reality simulators in laparoscopic surgical training has contributed to the improvement of existing training methods and decreased the learning time necessary to perform laparoscopic surgical operations (Bashir, 2010).

Although the benefits of simulation training receive increasing recognition, their adoption is limited. Since the introduction of simulators in surgery in 1991, the acceptance and adoption of virtual simulation as a standard training method has been slow (Neary et al., 2008). Simulation training has not received broad acceptance and in most cases is not part of formal educational curricula or training processes that teaching institutions develop (Satava, 2001). Health care leaders and educators recognize and appreciate the value of simulators in surgical training but yet the endorsement of simulators as a standard training process in surgery is limited. The most common training methods remain to be animal labs, cadavers, and in-operating room training with the last method remaining the most common among residents and inexperienced surgeons (Laschinger et al., 2008). Health care leaders need to challenge the status quo of training and identify methods that can increase learning and surgical skills effectiveness, while improving quality of care and reducing health care cost. Astute leaders need to be visionary, to aspire, to drive, to communicate clearly, and to bring change (Northouse, 2007). One aspect of change has its roots in existing teaching and training surgical methods.

Background of the Problem

Of major importance for general surgeons is their clinical knowledge as well as their surgical skills competency that relate to the quality of operative and post-operative results patients realize. Furthermore, surgeons extend their leadership role beyond clinical and surgical practice to resources utilization, cost management, and organization (McAlearney, Fisher, Heiser, Robbins, & Kelleher, 2005). As new medical devices are evolving, laparoscopic surgery becomes a norm, and robotic surgery, and tele surgery come to the fore. New technology requires new surgical skills and different allocation and utilization of resources. New technology may relate to increased cost and health care spending. Governments emphasize cost control without repulsing new technologies that improve quality of care. Surgeons as leaders need to develop a strong, justifiable saying on new technologies that are cost-effective and improve patients' safety and quality of health care. To achieve this, surgeons need to develop communication and managerial skills for a better cooperation with insurers, administrators, and other health care stakeholders. Surgeons need to pursue continuous training and education to keep abreast with the latest technological innovations (Fiolka, Gillen, Meining, & Feussner, 2010). The American Board of Surgery requests surgeons to go through a recertification process every 10 years (Leake & Urbach, 2010). In this context, the American College of Surgeons and the Association of Program Directors in Surgery have endorsed training with simulators in an effort to enhance continuous medical training and education to ensure patient safety and quality of care (Hope & Stefanidis, 2011).

Experienced specialized surgeons, medical students, residents, apprentices, and other health care practitioners need to receive training to acquire or develop surgical skills. The Resident Review Committee has suggested training with simulators as mandatory before allowing residents to put hands on patients (Hope & Stefanidis, 2011). Traditionally, training has been taking place through hands-on patient practice, a concept of learning by doing (Kneebone, 2003). Other forms of training involve cadavers, animal labs, videos, assisted-surgery, and more recently virtual simulators (Pitiakoudis, Michailidis, Zezos, Kouklakis, & Simopoulos, 2011). Surgeons usually learn from a senior surgeon who is a doctor from the same institution who acts as a preceptor. If the institution does not have an internal preceptor, surgeons cover their training needs through attending fellowship programs or through visiting specialized centers for certain period.

The evolution of technology has brought the new paradigm of simulators training. Educators call for a shift from the traditional Halstedian model of training, which relies on the "see one, do one" concept, to the simulation training model that takes training outside the operating room whereas the cost of training is high and the patient's safety under question (Hope & Stefanidis, 2011). Advocates of simulators support that simulators offer a safe learning environment to develop and improve surgical skills. These skills in combination with the right clinical knowledge and professional attitude add value to the quality of care surgeons, and consequently health care organizations offer to patients (Kneebone, 2003). Some argue that virtual reality simulator models, like the endoscopic-laparoscopic interdisciplinary training entity (ELITE), improve surgical skills and are particularly important to any surgical training protocol (Fiolka, Gillen, Meining, & Feussner, 2010). Others claim that there are two simulator types, physical and virtual, and that surgeons acquire better skills through physical models of training rather than through virtual models (Avgerinos, Goodell, Waxberg, Cao, & Schwaitzberg, 2005). Minimal invasive surgery has been the key driver for the evolution of surgical training with simulators (Székely, 2003). Although there is an increasing acceptance of simulators, which are becoming an integral part of surgical training, the use of simulators as a standard training method is still limited (Neary et al., 2008). Especially limited is the training with simulators on laparoscopic colectomy surgery. The limited use of simulators may be the result of lack of familiarity or acceptance health care leaders display regarding this new form of training.

Competent surgeons need to have muscle strength, speed, dexterity, spatial perception, precision, poise, and endurance during a surgical operation (Kaufman, Wiegand, & Tunick, 1987). All these skills constitute surgeons' psychomotor ability. Psychomotor ability is innate and differs from surgeon to surgeon. Therefore, training programs should provide appropriate and adequate training to eliminate as much as possible the difference of psychomotor skills among students and trainees (Kaufman, Wiegand, & Tunick, 1987). The surgical practice has taken a different perspective since the advent of minimal invasive and laparoscopic surgery in the 1980s (Waters, et al., 2010). Laparoscopic surgery requires surgeons to develop certain psychomotor skills and go through a demanding learning curve until they reach a point of gaining expertise on the type of surgery they are performing.

The learning curve of any laparoscopic surgery has three main phases. The first is the initiation phase whereas the surgeon starts practicing on the new method of surgery; the second is the point at which the surgeon improves the time it takes him or her to perform the surgery; the third is the level that the performance competencies stabilize (Raja, 2008). At the third level, the surgeon has improved skills and techniques to perform asymptote surgery at a better time than in phases one and two (Raja, 2008). Training on video interfaces is not that adequate in laparoscopic surgery because they do not help surgeons develop psychomotor skills and acquire special perception, which is an important parameter in laparoscopic surgery (Seymour et al., 2002). Spatial perception, instrument grasping, motion smoothness, and response orientation are important kinematic parameters that surgeons need to have in laparoscopic surgery (Stylopoulos & Vosburgh, 2007). In laparoscopy, although surgeons see the abdominal cavity on a screen, they still need to have the same tactile sense as if performing the operation in an open surgical technique, which is the most challenging and demanding task in laparoscopy. Thus, it is crucial that surgeons develop those skills that allow them to perform laparoscopic surgery in a safe and effective way.

Training on animals raises concerns about the cost and animals' welfare. Although animals have been serving as the basis of surgical training for undergraduate medical doctors over the years, there is an increasing emphasis on animals' welfare around the world over the last 50 years (Medina, 2008). The tendency is for computers to replace animals for training needs. In accordance with this trend, simulators replace animals for surgical training and ultimately contribute to significant cost reduction