At the organizational level, improving current methods for managing healthcare delivery processes to maximize value for patients is a central challenge. According to Porter (2010), “this objective is what matters for patients and it unites the interests of all actors in the healthcare system.” Value is the patient’s utility for a combination of quality of care and improvement in the patient’s health condition.

Surgeons and the healthcare systems in which they work are increasingly required to provide evidence of (health) value in the services they offer to patients. Optimizing value requires the surgeon to achieve the best possible outcomes for patients as well as thoughtful use of resources, so that the medical expenditure creates the most benefit. Strong evidence and common sense support the idea that volume could be a measure of surgical competency. Based on these findings, many researchers and policy groups advocate centralizing procedures at a small number of hospitals to take advantage of the volume effect. Recently, leaders at Dartmouth-Hitchcock Medical Center, The Johns Hopkins Hospital and Health System, and the University of Michigan Health System have taken the volume pledge agreeing not to perform high-risk procedures if they don’t have the volume. It aims to reduce complications linked to insufficient practice by hospitals and surgeons (Clark, 2015).

In this paper, we consider the problem of finding the surgeons’ volume over a given period that maximizes the Total Patient Value (TPV) subject to satisfying the patient demands and restrictions on the number of patients seen by surgeons. TPV is the patients’ surplus per dollar spent on healthcare resources. The input to this optimization problem consists of the patient costs from the day of admission to surgery and ending the day of discharge (full treatment cycle), the patient’s value of health improvement (in monetary terms), patient demand, and the
maximum number of patients per surgeon. The problem is formulated as a nonlinear programming model with linear constraints. Solutions to this optimization model would address an important issue in finding the surgeons’ volume, i.e. different patients may have different health needs so they cannot be seen as a single patient class.

One can apply the model to Laparoscopic-Assisted Surgery (LAS) and possibly in other surgical procedures such as Laser-Assisted in Situ Keratomileusis (LASIK) eye surgery. In both LAS and LASIK, surgeons are connected with technology when they operate on patients. The highly technical nature of these procedures and the rapid rate with which new instruments are introduced and new surgical techniques using those instruments are developed, require a high intensity of surgical training even for the experienced surgeon. Moreover, medical outcomes such as the number of intraoperative laparoscopic-related complications (bleeding, perforation, contamination), conversion rate to open surgery and morbidity and mortality rates have been shown to decrease in surgeon volume. In other words, learning by doing improves medical outcomes and optimizing the surgeons’ volume could create more health value for patients.

Learning occurs when the improvement in the outcome of an activity results from the accumulation of prior experience performing the activity. In a hospital setting where surgeons see acute patients requiring medical procedures with varying levels of difficulty, allotting not only the right volume of patients, but also the right mix of patients to surgeons could make a difference in the TPV. For example, when more difficult cases are seen by experienced surgeons, less experienced surgeons miss the opportunity to improve their skills. Assigning these patients to less experienced surgeons, however, could cost both the hospital and patient (e.g. with extended stays) more. It is this tradeoff and how the TPV is impacted by the number and mix of patients seen by surgeons that we study in this paper.
The contributions of this paper are: (i) the model that integrates 3 dimensions of decision making in healthcare which the majority of the existing literature has studied separately, i.e. healthcare cost, medical outcome and health value; (ii) a solution approximation procedure to solve the model using the Lagrangian optimization technique; and (iii) intuitive results from model solutions that are based on published and simulated data. We show the impact on TPV, surgeons’ volume and case mix of: (1) random assignments of patients to surgeons; (2) constraining the surgeons’ volume; (3) patient demand patterns; (4) homogenous surgeons; and finally, (5) demand uncertainty.

Our results show that: (1) depending on cost, medical outcome and health value, the optimal surgeons’ volume could have fewer patients allotted to less experienced surgeons; (2) when the surgeons’ volume is constrained, TPV is maximized when experienced surgeons see more difficult patients; (3) surgeons that are performing surgery on a balanced mix of difficult and easy patients gain the highest TPV, while surgeons performing surgery on a larger number of difficult patients gain the lowest TPV; and finally, (4) TPV decreases in demand variability.

References:
