

# What Medicine can Teach Operations: What Operations can Teach Medicine

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This essay/editorial represents a discussion between Ken Boyer (KB) and Peter Pronovost (PP), with excerpts from his book. The places where it is explicitly one or the other talking in first person, will be marked as appropriate (KB or PP).

There has been much debate and discussion recently about how to reduce costs and improve quality of healthcare in both the U.S. and around the world. This is a debate we are all interested in. The purpose of this essay is to examine how professors, teachers and researchers in the business field of operations management can contribute to improving quality and reducing costs of care. Management researchers have a unique set of skills that can contribute to substantial improvements in a wide range of medical situations and organizations. At the same time, there is much that can be learned by operations management professionals by engaging with medical professionals beyond simply being patients.

KB: My own opinions have been shaped by two experiences. First, I have been a type I diabetic since the age of 12. Largely I have been blessed to have gotten this chronic disease in the late 1970s – well after the discovery of insulin and on the cusp of series of transformations in the care of diabetes – including but not limited to widespread blood testing, the development and refinement of numerous types of insulin, the development of insulin pumps and continuous glucose monitors. Had I been born 50 years earlier, I likely would have died before becoming a teenager, so I am very lucky. On the other hand, diabetes is one of many “operationally intensive” or chronic diseases that require constant monitoring. Diabetics must deal with multiple daily shots and blood tests, while calibrating their body against numerous factors. I have often mentioned to friends, family, colleagues and students that I am a walking statistical process control chart. As such, I have spent a considerable amount of time in various medical offices, laboratories and hospitals. As is true to my own nature, and I believe common among academics in our field, I have spent much time observing and pondering various medical procedures, systems and practices and wondering about their relative efficacy and efficiency. Were it only my own musings and thoughts, I would not feel comfortable writing this essay for publication. However, the second major factor shaping my experience has been a recent exposure to several thought leaders in the expanding field of patient safety within medicine.

The second experience shaping my opinions started when I ordered a book a couple of years ago (Gawande, 2008) from Amazon simply because it looked interesting. It turns out that the book was as much about the operations management of healthcare as the medical science. Written by Atul Gawande, a Harvard surgeon, public health expert and MacArthur Genius the book described systemic issues in medicine from something as simple as hand washing – medical science has long known that handwashing is a critical component in preventing infections – and yet it is an enormous problem. This is

not because of a lack of knowledge, it is because washing one's hands becomes a very repetitive event in a hospital and human nature tends to cause people to forget, take shortcuts or use other workarounds. Daily and persistent attention to detail is what we operations management professionals teach. I was hooked. Over the past two years, I have pored over Gawande's other two books (Gawande, 2003 and Gawande, 2009), as well as the new book by Peter Pronovost, a Johns Hopkins physician, patient safety expert and MacArthur Genius (Pronovost and Vohr, 2010). I urge you to read any/all of these books because they are both very interesting reading and also may serve to inspire you to find ways to contribute your skills to reducing preventable errors in medicine.

## **What Operations can Teach Medicine**

### Culture matters

PP: Physicians have an enormous responsibility – cutting open a human body means they literally hold a patient's life in their hands. In part, this enormous responsibility, coupled with the substantial education and training required, has resulted in a culture in which physicians have an air of authority and are largely unquestioned. However, I strongly believe and advocate that developing a culture of inclusiveness and teamwork in medicine is one of the first and most important steps in error reduction. Over the last decades, medicine has advanced from offering little more than hand holding to saving lives with complex therapies requiring a carefully orchestrated choreography of technology and clinicians. As a result, no one clinician can do it all. Physicians must work in and rely on teams. One of the core tools developed for changing culture in medicine is labeled Comprehensive Unit-based Safety Program (CUSP)(Pronovost and Vohr, 2010). Checklists and basic operational tools for reducing errors in medicine are important components of improved patient safety – yet without a supportive culture these tools are insufficient. It is clear that whether in the operating room, the ICU, a neurology unit, or anywhere teams have to work together to care for patients, bad culture, communication, and teamwork have a negative effect on that care. The CUSP program is designed to address this culture and improve teamwork and communication. With this goal in mind we designed CUSP to focus on our most basic team structure – the work unit, where culture lives.

KB: This is a journey that operations professionals have taken or are on. Starting from the highly quantitative roots of operations in Taylorism and operations research following World War II, our field has gradually embraced the role of culture. In particular, operations scholars have studied, benchmarked and served as advocates of such influential business trends as quality management, lean, and most recently, the linkage of numerous organizations in something approaching a coherent supply chain. In each of these endeavors, operations professionals have implicitly or explicitly recognized that while we can often mathematically model many things such as the relationship between arrivals and queue length or the size of an inventory order and the amount of time between orders, there is a key cultural or behavioral element wherein human behavior simply cannot be described in purely rational terms. In other words, the inventory model may say order 100, but often the human being will order 500 because of some marketing discount or such. In short, while business is a science, we have learned

that it is most definitely a social science – models without the incorporation of human behavior are unrealistic. Similarly, while medicine is more of a pure science, the delivery of care becomes a social science in that a patient in a hospital is touched by scores of hands. Culture for too long has been unrecognized as a primary influence on patient outcomes. In medicine, as in business, the technical skills must be matched by an appropriate culture.

### Standardization matters

KB: Henry Ford had this one down. Medicine certainly has part of this – particularly in billing, registration and other back-office activities. Yet, when it comes to actual patient care health care professionals will often resort to the belief that every patient is different. The importance of standardization is one of the things that Peter Pronovost has have been tirelessly advocating, yet the message is slow to be accepted. In general, operations professionals accept that standardizing processes and products can be a great method of reducing costs and increasing quality, as Henry Ford famously said about the Model T – “you can have it in any color, as long as it is black”. However, this is not as readily accepted in medicine.

PP: A good illustration is offered in Pronovost and Vohr (2010, pp. 18-19):

“Once we [Johns Hopkins] hired a nurse practitioner to work in the cardiac surgical ICU. As part of her orientation and training, the senior residents were supposed to teach her how to place central lines. This nurse practitioner came to me distraught and said “Peter, can you help me? I am trying to learn how to place central lines. One resident showed me one way, but when I worked with a second resident, he said it was completely wrong and that I should only do it his way. Which one is correct?”

This lack of standardization is entirely unacceptable and dangerous to patients, yet it happens every day, across the country and around the world. It’s obvious that everyone should receive the same evidence-based training, yet there is no system in place to guarantee all doctors will learn how to do it correctly. We need to find a way to make the latest medical research available and easily accessible to both the country doctor working in a small community hospital and the world-renowned surgeon working at a top medical institution like Johns Hopkins. Under the current model, students watch a procedure, they do it once, and then they are supposed to be able to teach it – often referred to the “see one, do one, teach one” model. Instead of learning from the entire body of medicine, these students are only getting knowledge from one or perhaps two doctors; and there is no way of knowing if they are learning the correct procedure. In this way incorrect procedures get passed down, unchecked, through generations of physicians, creating a chain of potential errors”.

Yet, just as in business, there is much opportunity for customization. Patients vary substantially in their genetic makeup and response to therapies. Medical treatment is increasingly offering customizable treatments. Thus, there is an inherent challenge – too much standardization limits customized treatment. Too little standardization results in harm and waste.

KB: We specialize in teaching standardization, thus operations management professionals should be able to assist in changing this culture.

### Value stream mapping matters

KB and PP: The average patient in the hospital has as many as 100 procedures (blood drawing, x-rays, heart rate monitoring, etc.) performed per day, which generates as many as 400 data points. Each of these in and of itself is likely fairly simple, but as we teach every day – many simple things quickly become complicated. As a patient and a visitor to hospitals, I have often watched with curiosity, wonder and horror at the system used to collect and manage patient data. There are many inputs and outputs, yet there seem to be numerous faulty handoffs and opportunities for error. By and large, the system works, but this is largely attributable to numerous workarounds on the part of nurses, physicians, aides and administrators. As has been demonstrated many times, in many industries, value stream mapping is a tremendous tool for several things:

- Raising awareness of all the pieces and contributions to the system
- Fostering a culture of moving from first order problem solving (workarounds) to second order problem solving (fixing the system so that errors are less likely to recur) as Tucker and Edmondson (2003) have eloquently described.
- Promoting standardization. Often two people or teams will do the same procedure in slightly different ways. When they are medically interchangeable this is fine – until in a handoff one provider thinks another is going to do the procedure using method A, when actually method B is used. Neither method is incorrect, but putting the wrong two halves together does not add up to a whole.

Value stream mapping is something that many operations professionals teach often yet few medical professionals have been exposed to.

### Measurement matters

KB and PP: On first thought, it would seem like this is a strong suit of medicine. After all, every time you go to a physician, your weight, height, blood pressure and pulse are taken and measured. There certainly is no shortage of tests in medicine. However, a three part argument can be made. First, often too much effort is expended on the wrong measurement. Second, too little effort is made on other key factors. Third, often the data is not linked together in a systematic manner and little action is taken on an aggregate or system wide basis.

PP: To illustrate a data deficiency and an effective, yet simple solution, consider the following regarding line infections in one individual unit at Johns Hopkins:

“Patients generally stay much longer in the MPCU-4 than they do in the ICU. Given this extended stay many of these patients have a central line in for a much longer period of time. These central line catheters are connected to a secondary long tube that runs to a medication pump that delivers drugs to the patient. Studies have shown that the secondary tube needs to be

replaced every three days because of a risk that it will spread infection to the patient. Each tube is labeled with a little sticker that has a date on it. When that date is three days old, the nurse is supposed to change it out. However, at one of our CUSP meetings, one of the nurses pointed out that many of these tubes were often left in past the expiration date, putting patients at greater risk of developing bloodstream infections. To confirm this, the unit ran a test and found that the tubes were being replaced on schedule only 30 percent of the time.

So the CUSP team sat down and brainstormed on how to fix this problem and came up with a bright idea. The team surmised that the reason tubes were not being changed on time was because nurses had to look at the date on the tube, quickly do the math, and figure out if three days had passed. This might not seem difficult, but given the hectic pace of the hospital and all the other things nurses have to monitor and the dates they have to remember, it was a likely place for error.” (Pronovost and Vohr, 2010, pp. 164-164)

KB: Operations professionals should recognize the next step - the team came up with a poke-yoke. Instead of labeling the tubes with the date when they were placed, they were labeled with the date they expired. Furthermore, the labels were color-coded to specific days of the week – thus all the tubes with a red label needed to be changed on a Tuesday, while those with a blue label needed to be changed on a Wednesday.

A few pages later, Pronovost and Vohr (2010) describe a partnership with the New Jersey Hospital Association (NJHA) and the desire on the part of administrators there to use the Plan Do Study Act model. Pronovost and his team did not want to employ this “twenty-five year old generic model”. Which approach is not as important as how it is implemented. Yet, operations professionals work on systems related measurement and using data to drive systematic change all the time.

### Medicine is a supply chain

KB and PP: While some medical professionals may recoil at the idea of describing medicine as a supply chain, there are some key similarities. First, medical care has generally moved far from the days when a physician carried a little black bag and made house calls. Care is complex in that it involves many parties (nurses, physicians, medical assistants, insurers, employers and the government) that are often working with different goals, incentives and systems. In business, individual supply chain partners will often voice the belief that all parties are working for the common benefit of the customer, while individually believing that most of the profit should end up in their own pocket. Similarly, in healthcare all providers commonly state that their only goal is the excellent care of the patient, while acting in a manner that, while not appearing to harm the patient, works to channel more money into their own or their organization’s pocket. Neither of these approaches is incorrect – it is natural to look out for one’s own self interest while also expressing a desire for the greater good. However, many operations professionals studying supply chains have discovered that finding a win-win solution to the problem is a substantial challenge, but by working incrementally organizations and systems can be modified to improve results and outcomes for all. In particular, physicians and insurers appear to be the equivalent of the Wal-Mart and Toyota of the medical supply chain. Both groups clearly

justifiably have a huge amount of influence. Yet, logical arguments can be made that often this influence is exerted in non-productive and self-defeating ways.

Operations professionals have a great deal of experience in encouraging and working with organizations to find ways to improve the entire supply chain while benefiting individually. We also have the advantage of not having being developed and educated within the medical system. Thus, we can bring to the discussion an ability to ask many why's and to encourage a re-examination of how many things in medicine are done. For example, clinicians spend much of their days recovering from defects (what Tucker calls first order problem solving). They spend little to no time learning defects, reducing the risks that future patients will be harmed (what Tucker calls second order problem solving). As done in the CUSP program, healthcare needs to spend much more time learning.

KB: At the same time that operations professionals can contribute to medicine, there is also a great deal that we can learn from medicine.

## **What Medicine can Teach Operations**

### Clinical Care matters

KB and PP: Academics in most business schools are conflicted – we teach for a living but publish for glory. Top business schools reward scholars for publications in premier journals and make tenure/promotion decisions more on the basis of research than teaching. There are good and bad points to this.

Medicine – particularly at academic medical centers with medical schools shares some similarities with operations management in academia. There are thousands of medical school professors who teach students, see patients and conduct research. Often reward systems can send conflicting messages about what is most important. The Nobel Prize in medicine has always gone to a laboratory researcher. Most of the medical world admires a researcher that discovers new knowledge more than a clinician who treats thousands of patients a year effectively. Yet, a majority of medical professors spend a substantial portion of their time as clinicians with patients. This is changing – many medical professionals are promoting the critical importance of patient safety – that while new medical knowledge is important, it is equally or more important to execute and provide safe, standardized care. Another indicator of this change is the recent nomination by President Obama of Donald Berwick to run the Centers for Medicare and Medicaid Services – the largest health system in the U.S., serving 102 million elderly, low-income and disabled Americans. Berwick is a Harvard professor and physician, as well as the founder of the influential Institute for Healthcare Improvement (IHI) and a leading authority on quality of care

It is often difficult to measure outcomes in medicine. Yet in healthcare, we will all die one day. Separating which harms are on the causal path to death and which are preventable is often difficult. This is why, epidemiology and clinical research are so important to measuring quality. Medicine is primarily a service (as opposed to a manufactured good), this measuring outcomes is challenging in the same way that service quality has challenged operations management research in ways that manufacturing based research has not.

KB: Bottom line – medical research advances science and finds new cures, but better operations in the exam room saves lives. It is similar to business research – important, yes, but not more important than teaching. Our biggest influence as professors is, and always will be, the thousands of students we teach.

### People Matter

KB and PP: This point seems so obvious that it doesn't seem necessary to make – and yet it does. In medicine, there is a culture of arrogance that leads to mistakes. provide a painful example of this:

“I remember speaking to a nurse who had been working with a surgeon for two decades. The surgeon had just left the room and she had tears in her eyes. I asked her what was the matter and if I could help. She said, ‘I have worked for twenty years with him, I have bent over backward to make this place and his work better, and he does not even know my name’”. (Pronovost and Vohr, 2010, p. 83)

KB: A large part of a broad push to improve medical care is working to value all team members better in medicine. This is what we teach in business schools. And yet, we also publish thousands of mathematically based articles that make limiting assumptions about “rational people”. I would like to meet some of these rational people, because I don't think I know any. Behavioral economics is a growing sub-field within economics – a specialty that performs experiments on real people to ascertain how their behavior influences their economic decisions. In operations, there has recently been a growing group of Behavioral Operations researchers, which I think is great. Only, I disagree with the term – the vast majority of the articles published in JOM over the past twenty years either explicitly or implicitly include human behavior as a core element of their research on operations. I believe that the proper term is that we have a growing body of Experimental Operations management research, which is one relatively new form of research within a larger body of behavioral operations.

### See Many, Synthesize, Teach Many

KB: As described earlier the medical school teaching philosophy is “See one, Do one, Teach one”. The basic elements of this are something every operations professional should recognize: observe, practice, teach. Students often learn more by teaching. Yet, this approach has also been criticized by Pronovost. It seems to me that this philosophy can be adapted to operations. Many researchers have discussed their research in terms of knowledge generation and building knowledge. Yet, I have personally never agreed with that term. It seems to me that the really new ideas in business come from the Henry Fords, Bill

Gates, Sam Waltons, Michael Dells and Larry Pages of the world, not from the academics. What we academic researchers do is watch many organizations and filter/synthesize the data to explain what works in which situations. We have the advantage of being somewhat removed from the daily pressures of making a profit and can thus examine numerous organizations using a number of approaches – i.e. SEE MANY. We can then use our research to SYNTHESIZE knowledge across a broad array of organizations. For example, we have a high degree of confidence that lean works in a wide variety of organizations – this is in large part because many researchers have students lean applications, tools and culture in many different situations and synthesized the knowledge to provide a template for managers to follow.

Finally, our primary contribution is never going to be the major, game changing idea, instead our contribution is to synthesize the knowledge of many and then TEACH MANY people how to use that knowledge. Perhaps with a few exceptions, no one in academia, has made huge contributions to developing new lean techniques. Instead, we have synthesized the knowledge and have taught many students how to employ these proven techniques.

One of the challenges of operations is that it is the function that requires the hands and brains of many since it is the engine of the enterprise – many textbooks have noted that 80 – 85% of the employment in business organizations is in operations, yet often the finance or marketing experts get the attention.

KB and PP: This is not that different from medicine, where many researchers get attention and some win Nobel prizes, yet those dedicated to the everyday, hands-on care of clinicians and patient safety often feel under-appreciated. Consider the following:

“Still, in spite of this success, states were not calling. We knew one of the main reasons was money. States didn’t have the funding they needed to implement the program, nor did we. We had a little money from the U.S. government; but aside from that, we were going it alone. If this program were a drug or device we would have enormous support from government or industry. If we had found the cure to AIDS or cancer the world would be beating a path to our door with checks in hand. But safety and quality control are hard to quantify. This kind of work is often invisible. Two and a half million people died from hospital-acquired bloodstream infections in the United States over the last twenty-five years, yet the entire budget for the Agency for Healthcare Research and Quality was only \$300 million<sup>1</sup>. One of the main reasons for this lack of funding is that patient safety is largely invisible.” Pronovost and Vohr (2010, p. 188):

KB: In closing, I urge you, the operations professional – read any of the references in this essay. If nothing else, they are interesting reading. Then, if you feel so inclined, reach out in your community to a medical professional and start with a conversation – you never know where it will lead. Likewise, I urge you, the medical professional – contact someone at a nearby business school. There is much in medicine that is operational and cultural. A simple conversation can lead to great things.

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<sup>1</sup> The Michigan study in 103 hospitals was supported by a \$1 million grant from AHRQ. The study has been estimated to have saved 2,000 lines and over \$200 million – a year. The original report on this study can be found at Pronovost et al. (2006).

#### FURTHER READING:

- “Learning Accountability for Patient Outcomes”, Peter Pronovost, *Journal of the American Medical Association*, July 14, 2010, V. 304, N. 2.

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**Addendum:** Peter J. Pronovost, MD, PhD is a practicing anesthesiologist and critical care specialist physician at Johns Hopkins Hospital and a researcher and professor at Johns Hopkins University. He is a Professor in the School of Medicine in the Departments of Anesthesiology and Critical Care Medicine, and Surgery, and is Medical Director for the Center for Innovation in Quality Patient Care. He also is a Professor in the Bloomberg School of Public Health (Dept of Health Policy and Management) and in the School of Nursing. He established the Quality and Safety Research Group in 2003 to advance the science of safety and serves on a number of other safety organizations. He has won several national awards in addition to the MacArthur Fellowship. Pronovost is the author of more than 200 articles and chapters in the fields of patient safety, ICU care, quality health care, evidence-based medicine, and the measurement and evaluation of safety efforts.

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