If You Have a Hammer (or a Robot), The Whole World is a Nail, The Law of Instrument

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Abraham H. Maslow popular "hammer" is used with slight modification as a title in this viewpoint and the following write up elaborates on it in context of surgical practice.[1] The world we live in is changing faster than ever before. What was considered "science fiction" a few years back, is now our reality- a transformation at its best. Surgical research and practice are no exception. While some of the advances made are of proven and measurable value, when appropriately applied, many others are controversial. A case in point is robotic surgery.

The history of robotic surgery goes back to 2001, when surgical robots were approved for clinical use. It was the next leap in technology, built on what was already considered an important milestone in surgery-laparoscopy, which invaded clinical practice in the late 1980s. Robotic platforms offer increased "degrees of freedom" at the wrist and finger movements, that standard laparoscopy does not, allowing more precision at the surgical site and brining it so close to open surgery.[2]

Laparoscopy offered many advantages over traditional open surgery- the main impetus behind its spread like "fire in the field". This was fueled by pressure from industry, consumerism, and a desire from surgeons who were looking for practice growth. They learned the new laparoscopic techniques to gain a marketing advantage and attract more patients.[2] Robotic surgery has a lot to offer when used for properly indicated procedures;[3] stabilization of instruments within the surgical filed, additional mechanical advantages compared to standard laparoscopy, improved ergonomics for the operating surgeon, and superior visualization through three-dimensional imaging of the operative filed. However, with robotic surgery, I feel history is repeating itself. Surgeons started to use robotic platforms indiscriminately to perform all kinds of operations, even those as simple as tubal ligation, umbilical hernia, and cholecystectomy, under the pretext of gaining experience with robots.[4] However, for a robotic procedure to make sense, it must achieve balance between three basic factors; surgeon's endoscopic skill level, equipment limitation, and procedure complexity.[2] To add more to the dilemma, cost factors were not considered by most of the relevant papers that only addressed safety and feasibility of robotic surgery.

The role of robotic surgery can be looked at from two different angles; surgical practice and surgical training. Concerning practice, early experiences stressed the need for narrowing the indications for such technology combined with cost-benefit ratio evaluation.[5] While some authors found that overall, robotic surgery was cost-effective, they compared robotic surgery to open surgery rather than to laparoscopic surgery.[6] Another study found increased costs when commonly performed laparoscopic procedures were done with robot, just by looking at consumable surgical supplies; (they did not even include the initial acquisition cost, depreciation, and service contract cost).[7] A nationwide evaluation of robotic surgery concluded that although laparoscopic and robotic surgery achieved similar postoperative outcomes, there was significantly increased cost associated with robotic surgery.[8] A systematic cost assessment of robotics in general surgery indicated that under specific conditions, robotics can potentially become cost-effective through large number of procedures, industry competition and multidisciplinary team utilization.[9]

Concerning surgical training, residency programs are also jumping on the bandwagon, offering robotic experience without a proper evaluation. The hawks of robotic surgical training would not think twice before using the robots for as many procedures as they can.

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They use the same argument their compatriots in surgical practice use:

1). Superior outcomes with the robots. However, evidence suggests that any potential benefits are only meaningful in advanced surgical procedures (e.g., low anterior resection of the colon, trans-hiatal esophagectomy, total gastrectomy, radical prostatectomy, etc.).

2). Obtain experience and build confidence with the use of robots. However, this is only an assumption. It defies the notion of "deliberate practice", which is defined as "individualized training activities to improve specific aspects of an individual's performance through repetition and successive refinement."[10] This assumes that a difficult skill or procedure is broken into several steps. The learner is guided through each of the steps repeatedly until mastered before moving to the next step. If we want a trainee to master robotic total gastrectomy, we must encourage deliberate practice on total gastrectomy by breaking the procedure into several steps, not by gaining experience on robotic cholecystectomy. Adding more robotic cholecystectomies will not improve his or her skills in performing robotic gastrectomy.

3). Ergonomic advantage to the operating surgeon. However, so far, there is no solid evidence to support this notion. In one study, changes in the surgeon's postural stability and muscular strength were similar following laparoscopic and robotic surgery. Capturing and measuring surgical fatigue remains elusive.[11]

The" side effects" of training residents on robots remain a major concern. In one study, offering such experience left a significant negative impact on laparoscopic case volume. The increased operative time and hospital costs were substantial.[12] Another concern that is often overlooked is future expectations from the graduating surgical residents. A flashback from the laparoscopic era reminds us how trying to complete every cholecystectomy by laparoscopy left a major gap in the ability of the graduates to convert into open cholecystectomy when needed. Many surgical residents graduated without performing one case of open cholecystectomy, much less learning how to perform an open common bile duct exploration. Trying to do every cholecystectomy with robot will curtail the ability of the residents to perform laparoscopic cholecystectomy. Furthermore, is our healthcare system expected to provide robotic platforms to every hospital where those graduates are expected to practice? What we need is "bread and butter" general surgeons to take care of the masses, not necessarily surgeons who cannot practice in the absence of robots- our social contract with the communities we serve.

The" side effects" of the robots themselves are underreported. In a report published in the Journal of Healthcare Quality, out of almost a million robotic cases (from year 2000 to 2013), only 245 complications - including 71 deaths, were reported to the FDA. This is a relatively small number for a new and complex technology.[13] Unless a system is created to collect data independently and transparently, surgeons and systems they work in, will abuse robots in the community. Poorly trained surgeons will continue to harm patients with their "cool gadgets" because they do not want to be left behind. They feel compelled to offer what next door surgeon is offering to stay in business.

There is no question that robotic surgery is here to stay. The issue is not endorsing the technology, rather, it is the proper application of the technology to ensure high quality, cost-effective care through proper selection of patients and procedures that are best served by robotic surgery.

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