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Review Article

Evolution of new technology and teamwork in an operating room in aspect of patients' safety in public health-experience from Poland

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Abstract: Seen as an essential element of patient safety, teamwork is often less than ideal. From the intensive care unit to the operating room, physicians and nurses hold diverging views on the quality of communication and collaboration among team members. Too often, medical teams are plagued by poor team interaction, communication breakdowns and role confusion. Despite the growing awareness of this, the trend continues to exist in the modern (high-tech) operating room. Given the link between well-functioning teams and uses of advanced technology (robotics) in an organization (those with exceptional safety procedures), improving the functioning of teams in healthcare has become a priority. Collaborative practice in operating room, including teamwork and communication are two of the four competency domains that students and doctors need to learn through practice in the face of rising importance of new technologies.

Keywords: Quality of care, robotics, safety, communication, technology in operating room

Introduction

Technology has already driven many changes in healthcare and acquisition of knowledge and information and their distribution multiply and exponentially. Robotic simulation in medical education and the treatment itself provided a safer environment for students and doctors working in an operating room. The challenging question for all medical staff leaders in the future will be how much simulation is too much? How important is human contact to learning the art, being a professional doctor and in the treatment process itself?

The advent of electronic and computer-enhanced technologies has led to the exponential growth of robotic assisted surgery since its introduction in 1995 [1, 2]. The beginning was physical service robots which could wash patients and help in feeding and carrying patients. Many studies have reported on their easy adaptability as well as the favorable surgical outcomes that they offer [3-5]. Robotic systems have been used in many fields (cardiology, surgery, ginecology) where advanced surgical procedures are required [1, 6, 7]. Also, patients positively assess this treatment method. The tendency that can be observed today is to turn to a more sophisticated method utilizing robot assisted surgery as a gold standard in medical treatment. Providing patient with minimally invasive surgical procedures that utilize state-of-the-art equipment, like the da Vinci® Robotic Surgical System, it underscores commitment to high quality patient care while enhancing patient safety. The advantages include minimal scarring, less pain and bleeding, faster recovery time and shorter hospital stay. The move toward less invasive and less morbid procedures and a need to re-create the true open surgical experience for training purposes have paved the way for the development and application of robotic and computer-assist-

ed systems in surgery all over the world including Poland [8]. Robotics in healthcare will continue to develop and enter other areas of medicine beside surgery.

Paro, a robotic seal developed in Japan since 2003, responds to patting by closing its eyes and moving its flippers and is already being used as a therapeutic device for those with autism and Alzheimers. Kansei (emotion) robots are being developed and are programmed for key words triggering facial expressions.

Considering those changes, the new challenge for doctors and nurse leaders in healthcare now, will be balancing technology and the human element. Technology can supplement but not replace doctors and nursing care. Combining teamwork personal care for patients and new technologies in healthcare are crucial issues for every country, including Poland. Many reports (check list) coming from doctors in operating rooms call for improved collaboration between team members, which seems to be a key strategy in healthcare renewal. A healthcare system that supports effective teamwork in modern operating room can improve the quality of patient care, enhance patient safety, and reduce workload issues that cause burnout among healthcare professionals [9, 10].

To support the movement to make teamwork a reality in operating room (with uses it new technology), this paper helps to answer three questions: What are the characteristics of an effective team and how do we measure the effectiveness of a team (through increased job satisfaction, workload share, reduction of stress, error-free procedures etc.)? What interventions have been successful in implementing and sustaining teamwork in healthcare? To what extent has teamwork, linked with technology, been implemented in healthcare settings in Poland? What are the barriers to implementation?

This paper retrospectively reviews the progress of new technology and the evolution of various types of robotic-assisted procedures in aspect of teamwork and safety procedures. The focus of this paper is to predict the sustainability of newly introduced surgical technologies in different fields in medicine in aspects of teamwork in healthcare. Moreover, the paper proposes to evaluate the most appropriate use of robotic surgery in different surgical fields and describes the potential direction of teamwork and application of robot-assisted procedures.

Reports of the use of robotic surgery suggest that a number of factors are important for successful integration, such as having a highly motivated [11] and/or dedicated robotic team [12-14] and additional staff [15].

The successful performance of a surgical operation is dependent on collaboration amongst staff from different professional groups, including surgeons, anaesthetists, nursing staff, and operating department practitioners (ODPs). There is a complex division of labour that requires the various team members to use their different skills collaboratively to accomplish a single, principal activity [16]. Improved teamwork and collaborative care with use of new technology and robotics have been shown to improve performance in many aspects of the healthcare system, including primary healthcare and public health [17]. Recent reports from hospitals have suggested that teamwork might be an effective way of improving the quality of care and patient safety as well as reducing staff shortages and stress and burnout among healthcare professionals [17-22]. Other research has shown that teamwork can significantly reduce workload, increase job satisfaction and retention, improve patient's satisfaction; and reduce patient's morbidity [23-25].

To prepare this paper, authors analyzed many reports. In addition, an interprofessional research team conducted in-depth interviews with key informants and undertook a wide-ranging survey of peer-reviewed literature on the components of teamwork, effectiveness of teams, types of interventions and uses of new technology (- include robotic surgery), healthcare team dynamics, and the impact of government infrastructure and legislation in healthcare. The analysis of subject in detail revealed the lack of a common definition of teams and teamwork on healthcare, but also confirmed the link between teamwork and uses of new technology (robots and advanced technics in operating room), showed the spectrum of collaboration in healthcare organizational factors affecting teamwork and the implications of current policy, regulations, and legislation for

medical teams. The fundamental change in healthcare system, required to support teamwork hinges on a collaborative effort. Leadership and commitment are needed at all levels of the healthcare system to implement and maintain teamwork over the long term, especially when the use of newest methods of treatment. There is employed already a number of projects involving different health providers, introduced across the country, and we can learn from the preliminary findings. For instance, teamwork is the most effective when the team has a clear purpose, good communication, co-ordination, protocols and procedures in place, and effective mechanisms to resolve conflict when it arises. Teams function better when they work in an organizational culture that supports teamwork and when they have strong leadership and effective administrative support. Other studies underscore that the task defines the team, with the make-up and functioning of teams varying with the patient and the complexity of his or her needs. With this flexibility, health professionals need training to learn new ways of working together and to become aware of the roles and responsibilities of all team members in an innovative operating room.

Trends in robotic surgery, current options and teamwork

Patients in Polish healthcare institutions are offered all the three options of surgery: open surgery, laparoscopy, and robotic surgery. For all those medical procedures patient safety is essential. The delivery of health care, by its nature, requires that organizations providing such services act as high-reliability organizations (HRO). Patients expect error-free care [26] and for to accomplish this teamwork is an essential component of HROs. Although it is not the sole determinant of high reliability, HROs are typically comprised of teams embedded in multiteam systems, and effective teamwork is critical for success in environments that demand high reliability [27]. It is worth noting, however, that health care is not as safe as it should be [28]. The fact that the health care system is fraught with accidents, errors and mishaps was brought to the attention by the Institute of Medicine's 1999 report, to Err Is Human: Building a Safer Health System. As a result, patient safety is the number one priority throughout the health care industry today.

In the U.S the patient safety movement is marked by numerous federal, state and private initiatives [29]. As early as 1998, the Joint Commission, the U.S predominant standards-setting and accrediting body in health care, began addressing wrong-site surgery in an effort to improve patient safety in hospital operating rooms [30]. Since that time, many new organizations and associations, such as the National Quality Forum, and also the Institute for Healthcare Improvement, have arisen with similar missions: to protect patients, promote quality of care and promote teamwork in healthcare. As of October 2007, 26 states now have mandatory adverse event reporting requirements.

Protecting the safety of patients, promoting the quality of care and teamwork in healthcare with use of robotics assisted surgery and automated systems create a new trend. Robotics is being used for minimally invasive surgery (MIS) on various organs. However, there is limited literature on robotic surgery in general. Since robotics have been used in the medical field for more than fifteen years, it is time to revisit their utility in different types of common surgical procedures and find out how different robotic procedures and their frequency of use have changed over time in aspect of teamwork, communication and working in organizational culture in healthcare.

Robotic surgery (thyroidectomy) showed that woman seem to prefer it over traditional surgery more often than men. This can be explained by the visible surgical scar left on the neck by the corresponding conventional or laparoscopic procedures. Female predominance is also confirmed by the experiences from United States hospitals which show, that each year about one million people will undergo gallbladder removal surgery and 40% of them are women between ages 18 and 44 [31]. In fact, postoperative scarring can have a great impact on the quality of life and even more so in younger patients with longer life expectancies [32].

According to several recent studies, robotic surgery provides superior cosmetic satisfaction when compared with conventional thyroidectomy and gallbladder removal [31, 33, 34].

Moreover, it reduces post-operative neck discomfort, and leads to lower morbidity rates [31, 35, 36]. Because of these advantages, the proportion of robotic thyroidectomy increased dramatically within a short span of time and continues at these high rates.

Medical Robotics and Computer Assisted Surgery (MRCAS) is used in a growing number of operating rooms around the world, largely as a result of the growing popularity of minimally invasive surgical techniques (MIS) [8]. Also, in the aging populations around the world there is an increasing demand for a wide range of age-related surgical procedures such as heart, spine, general and orthopedic surgery.

Orthopedic surgery definition

Orthopedic (sometimes spelled orthopaedic) surgery is surgery performed by a medical specialist, such as an orthopedist or orthopedic surgeon, trained to deal with problems that develop in the bones, joints, and ligaments Technological advances have expanded the range of surgical procedures that can be performed using minimally invasive techniques, making them accessible and safe to even more people. All robotic systems, such as da Vinci system, in the operating room allow for improved outcomes for patients, such as minimal blood loss and tissue damage, smaller incisions, less scar tissue, decreased length of hospital stay and recovery time, diminished post-operative pain, and faster return to normal activities. These are important facts from patient's point of view.

Data from the scientific literature suggest four trends in the proportion of utilization of robotic surgery in the operating room in the future: (thyroid, stomach surgery). These trends can be explained by the predominance of young women among patients and aspects of aesthetics. The aging population appreciates the added safety in more specific or sophisticated cardiac and neurosurgery procedures. Assessing the facts and analyzing the literature one can observe a strong need to introduce automated systems for operating theatres that improve surgeon's comfort of work and patient's safety. Patient's safety during treatment process in combination with high-tech equipment indicates professional team and affects the faster recovery of the patient.

In Poland public health insurance system does not cover the cost of robotic surgery. Patients pay for robotic surgery additionally and because of this the more advanced medical technology, can only be granted to patients who have the financial means to afford it. This is a potential disadvantage to the faster implementation of this technology in Poland.

The barriers for robotic surgery implement in operating room

There is a trend that can be observed in of robotic surgery, -a decreasing trend-, that is related to its high cost. The high costs of purchasing and maintaining robotic equipment are well-known barriers to everyday use of robotic surgery [37, 38]. The greatest impact of this high cost is on the cost-effectiveness of robotic gastrectomy and gallbladder removal which, despite minor benefits [39-42] offers the same post-operative outcomes and complications as laparoscopic gastrectomy, and cholecystectomy; therefore, the significantly higher cost of robotic surgery tilts the balance in favor of its laparoscopic counterpart [43-45].

More advanced technologies (robotics) are more likely to develop particularly in areas requiring greater precision and more and better imaging (modeling of structures, organs). These domains include: cardiac surgery, cardiology, neurosurgery, gynecological oncology and transplantation. In these areas of medicine precision and team work alongside three-dimensional imaging-assisted new technology are just as important. Robotic procedures in these fields seem to be already well established because of their obvious benefits in areas with difficult surgical access. According to the 2012 Consensus of the Society of Gynecologic Oncology (SGO), robotic surgery is preferable to open surgery; however, its peri-operative outcomes are equivalent to those of laparoscopic surgery [26, 27, 46, 47].

Findings from the systematic literature review also underscored that interventions related to the development of team-based structures (including mechanisms to improve communication through the introduction of communication protocols and interdisciplinary rounds during robotic surgery) produced significant results in the short term among patients and health professionals [48, 49]. However, these studies

often assessed localized health teams and did not have a theoretical base [24, 25]. Other intervention studies focused on the impact of the size of healthcare teams and patient outcomes [50, 51]. Better teamwork and communication in a team influence better patient's outcome.

Experience from various European countries shows that the use of robotics and minimally invasive tools (technic) in the medical profession allows one to create an effective teamwork. In addition, analysis of error-free and procedures performed by a team reduces stress, increases satisfaction in a team of doctors performing these procedures. Advanced technologies are a useful element in building functional teams in the operating environment.

Conclusion

We have examined the general evolution of new technology from its inception to its implementation at present in aspect of teamwork. We have reviewed the strengths and weaknesses of advanced technology (robotic surgery) and analyzed their outcomes in order to predict future trends in operating room. This paper has the potential to provide general guidance to institutions that are attempting to implement teamwork and new technology systems in operating rooms.

Experience with robotic surgery shows that the effectiveness of a team, measured by increased job satisfaction, shared workload, reduction of stress and error-free procedures, is increased with the use of modern and more advanced technology in the treatment of a patient. Currently, the trend of linking technology and the human factor is more prominent in those medical fields that require greater precision during surgery (gynecological oncology, cardiology). In these areas we also observe a more successful implementing of robotic systems and maintaining teamwork in healthcare. Those trends will be changed in the near future, and we will be observing how the medical staffs balance the technology.

Analysis and application of robotics in the operating room should be carried out taking into account the human factor. One cannot only evaluate the costs of the medical procedures performed by surgical robot. Benefit analysis should be carried out in three-dimensional terms: the patient and the outcome, comfort and safety of a doctor, teamwork; demand for services and the cost of the procedure (Patient-Healthcare services-Cost).

Disclosure of conflict of interest

None.

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