

The Impacts of Technology on Surgery

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Over the last decade, technology has become more frequent in our lives. Specifically, the medical field has increased the amount of technology that they use. They store medical information, and they use technology effectively in surgery with the use of cameras, analytical software, and by having robots do the surgery. This issue is important because mechanical error could occur and human operating errors could occur as well, allowing this topic to be controversial in the medical field. Robots have impacted surgeries in a positive way by improving the accuracy and precision of surgery, by decreasing the time a surgery takes, by increasing the productivity of the hospitals, and by decreasing the amount of blood loss and infection in surgery.

Robots have improved the accuracy and precision of surgery by providing exact measurements and they improve the sight capabilities that surgeons eyes would not be able to see when doing the surgery, by allowing the surgeon to see microscopic parts of the eyes with help from machinery. For example, in an eye surgery, doctors use a sixty times magnification to see the parts of the eye that we would not be able to see without technology: “Panoramic photograph of fluorescent images obtained using confocal laser microscopy (original magnification x60) after immunostaining of extension specimens with mouse anti-rhodopsin, and showing each laser spot” (Foltynski 2). As the author states, the magnification extends the visibility of the human eye and will show parts we are not able to see in surgery. Not only is precision and accuracy seen in surgery, but it can also be seen in the recovery of surgery. In an article about knee replacement surgery, it discusses the use of technology for skin grafts and stitches that are needed after the initial surgery takes place. The app called Planimator utilizes the numbers that doctors put into

the app to identify the exact amount that the doctors need for skin grafts and stitches. The use of this app has greatly improved the precision of surgery and the author states that, “The medians of REs for the Visitrak device, the SilhouetteMobile device, the AreaMe software, and the Smartphone Camera were significantly higher than the median of REs for the Planimator app (Table 1), therefore the measurement with the Planimator app is more accurate than with any of these listed before methods” (Foltynski 3). This app can analyze data faster than a human can without it, which will greatly improve the time that a surgery will take. Also, this app can keep track of the data associated with patients, so if there were a need for another surgery, all the data would be there for future use. Another example of accuracy being seen through the addition of robots in surgery is in spine surgery. Spine surgery is one of the most critical surgical procedures to be precise in because of how the impacts of a small mistake. In an article about robots and spine surgery, the authors state, “Schizas et al., reported a 95% accuracy rate vs. 92% for robot-assisted vs. fluoroscopic-guided lumbosacral pedicle screw instrumentation, and Kantelhardt et al. similarly showed 95% accuracy vs. 92% using Spine-Assist and conventional fluoroscopy respectively” (Menger 218). This quote shows that the accuracy of robot-assisted surgeries is higher than ones that are not assisted by machines. This data helps show the impacts of technology on surgery because of the increase in accuracy and precision. Overall, technology has greatly improved the precision and accuracy of surgical procedures.

Surgeons have now started using cameras in surgery to help them improve their vision throughout the procedure, which helps the surgery be more efficient and take less time. In surgery, the recent use of cameras has allowed surgeons to see more of what they are doing surgery on, which makes it easier and faster for the surgery to take place. In this article, researchers used the Smart Eye Camera to look into the eyes of rats as a test trial. The author

states that the camera is used by, “We therefore invented a portable attachment, referred to as the “Smart Eye Camera.” This device can connect to any smartphone and take images and videos of mouse eyes, and it has the ability to resolve many of the issues mentioned above. For instance, it is portable and easily operated by a single person and has an adjustable focus and low manufacturing cost” (Shimizu 1). This article discusses the portability of the camera and how the camera can solve many issues that may occur in the eyes. Since doctors can use cameras with surgery, this will greatly improve the amount of time needed for surgery and can help solve problems in the body using the cameras. With the addition of the camera being a low cost, this can also lower the cost of surgery for many people, making healthcare more affordable. The use of cameras can also be important in the training of other doctors. In some cases, a surgery may be recorded from the surgeon’s point of view to help teach students in medical school and residents working in the hospital. The video that the surgeon creates will allow future surgeons and doctors to explore the area of surgery before they become doctors. To allow this to happen, the surgeon will wear a head mounted camera on the top of their head to show the process of the surgery being done: “The GoPro® was head mounted with elastic bands and oriented to the surgeon's perspective using the application of video preview function to be installed in smartphone, tablet or computer system” (Shimizu 2). In this article, the surgeons use GoPro cameras to show the surgery from their perspective, which can then be viewed on another electronic device.

Robotic surgeries cost less than surgical procedures done without robots. The robots used in surgeries lower the cost of the procedure by having less error and by not needing additional assistants. A recent study comparing the prices of spinal surgery before and after robots showed that the price without robots was significantly higher than the assistance of machines: “The

average DRG for thoracolumbar procedures was calculated at \$25,057 for Robotic surgeries and \$42,096 for human-led surgical procedures for the hospital system. This incorporated both disease pathology as well as medical comorbidities” (Menger 220). This quote shows the thoracolumbar procedures, also known as spinal procedures, are outstandingly less expensive if the presence of machines is available. Not only is it more cost effective for a robotic spinal surgery, but other surgeries are also more cost effective. For example, within the past twenty years, medical professionals have been implicating cardiovascular robotic surgical machines to help with heart procedures. The cost effectiveness of these heart surgeries has been greatly impacted because of the aftercare. In a regular heart surgery, doctors will need to split the chest and do more surgical work to get to the heart. With the machine, it is easier to get to the heart without doing as much surgical work because of the small parts of the robot that can get into the heart in a more effective way. This will allow the aftercare to be less expensive and better for the patient. In the article, “Reviewing Clinical Effectiveness of Active Training Strategies of Platform-Based Ankle Rehabilitation Robots,” Xiangfeng Zeng states, “Postoperative savings can be accrued by two primary mechanisms, decreased utilization of resources for a comparable uncomplicated postoperative course, or a decrease in complication rates compared to the traditional approach. Comparative studies have suggested that robotic-assisted surgery does indeed decrease resource utilization in the postoperative period and is associated with a decrease in some perioperative complications” (Zeng 4). Perioperative, also known as the time the patient spends in the hospital after the surgery, is decreased, meaning the patient will spend less money on the time they spend in the hospital after the surgery. Overall, the cost effectiveness of the addition of robots in surgery is very high and robots should be used in surgery for this reason.

Surgical procedures involving robots and involving cameras are used to allow for the patient to be in less pain, will cause less scarring, which leads to less complications overall. With smaller

incisions and less scarring for the patient, they will be in less pain and will need less hospitalization time: “the surgeon performs operations using small ‘keyhole’ incisions, through which cameras and laparoscopic instruments are passed. This removes much of the abdominal access trauma, resulting in numerous benefits for patients, including less postoperative pain, shorter hospitalization, quicker return to normal function, and improved cosmetic effect” (Randell 3). This quote describes the impacts of robots by including information regarding the patient's wellbeing and the benefits associated with the surgery. Small incisions for the cameras to go into the patient will allow for less trauma, which will eventually lead to less pain and more precision overall. If a camera is used in surgery, the surgeons will be able to see the surgical area in a closer proximity. Consequently, the surgeons will be able to make fewer mistakes and make more exact cuts throughout the procedure. Due to the smaller incisions, there will be less trauma to the rest of the body when doing the surgery. For example, in a heart surgery, the doctors will open the chest of the patient so they can see the whole heart. If a camera is used, the doctors will not need to open the chest, but instead can operate using a camera inside the body to see what they need to do a procedure on: “complex valve repair and replacement can now be performed through small incisions in the right chest without disturbing the skeleton. Minimally traumatic surgical approaches offer patients gold standard results with fewer complications and a faster recovery, ensuring that despite the growth of transcatheter technologies, patients and cardiologists will not have to make the choice of trading long-term efficacy for short-term gains” (Moss 33). This quote presents the idea that heart surgery is less traumatic with the use of smaller incisions, which will eventually cause fewer complications and a faster recovery time. In conclusion, robot assisted surgeries allow for patients to have less scarring and fewer complications after surgery than they do with non-assisted surgeries.

With less complications after surgery and smaller incisions being made, there is a decrease in infection rates and blood loss with the robotic surgical procedures. As previously mentioned, smaller

incisions are less likely to become infected because there is less surface area for the infection to get into the body. Also, with the robotic surgery, since it is a faster procedure, the incision will be in the open air for a fraction of the time, which means there is less time for pollutants in the air to get into the body. An article about surgical procedures states that robotic surgery is often less likely to become an infection: “There are many local factors that may play a role in the development of SSIs during open prostatectomy including a larger incision with more tissue exposed to the air than in the robotic approach” (Osmonov 305). This quote describes SSIs, which are surgical site infections, stating that with a larger incision, there is more surface area exposed to the contaminated air than a robotic surgery will have. Along with the smaller incisions, there will be less blood loss with the robotic surgical procedures. When the incision is larger, there is going to be more blood flow and with an open wound, more blood will be lost. With the robots, the camera and tools are inserted into a small incision, which does not leave a large wound and less blood will be lost overall: “A recently published meta-analysis of 602 patients across 10 studies demonstrates reduced intraoperative blood loss among patients” (Menger 221). This study showed that there is proof among many patients and at least ten studies about less blood being lost in surgery. Overall, the smaller incisions being made by robots in surgery will decrease the amount of blood loss in patients and will decrease the rate of infection.

With the recent technological advancements, robots can support patient care at hospitals and at home by dispensing medication. An example of a machine called Hero. This machine will connect to a mobile device to dispense medication, which is controlled by the caregiver. The caregiver will allow the machine to dispense the pills needed for the patient. This is especially helpful in hospitals because some surgeries are more prone to infection, and with the addition of a robot dispensing the pills needed to the patient, there is less contamination by a nurse in the room. Also, dispensing medication through a machine will result in less error regarding

medication use, since the medication only comes at certain times of the day in a certain dosage: “The implementation of a robotic original pack dispensing system substantially decreased the rate of dispensing errors and optimized stock management. Minimizing the number of drugs out of the dispensing robot is critical when attempting to maximize the benefits of its implementation” (Rodriguez-Gonzalez 30). This quote describes the decreased rate of errors and the machine dispensing the correct amount of medication to the patient in need.

Although there are many positives to robotic surgery, others may argue that mechanical error may occur, and human operating error may occur during a surgical procedure. In a focus group of nurses who were working alongside robotic surgery, they believe that mechanical error is a big risk factor of this procedure: “Participants stated that they spent enough time making sure the robot was working properly before surgery. Some nurses checked the robot system the day before surgery to ensure that it was working well. They said that if it did not work after the morning verification, there would not be enough time to fix it” (Kang 153). This quote demonstrates that in robotic surgery, there needs to be more verification and tests run on the machinery to ensure safety for the patient during their hospital stay. If the machine has an error while the patient is being operated on, this could cause many complications, like excessive bleeding, needless injury, and it could be fatal. Also, mechanical error could happen in a power outage scenario or if the machine has problems during a procedure. This could be avoided by going through tests with the machine and by checking the machine when needed, but things can happen without warning. The companies associated with the machines say, “An engineer from the robot company told me that the robot can be stopped (not operate), and an error message will appear on the monitor, which they should follow and call the engineer from the robot company if help is needed” (Kang 155). This quote describes the safety measures associated with the mechanical errors that may occur. In addition, there is a chance that mechanical error could happen, human error could occur as well. For example, the surgeon could

forget to sanitize the machinery which could infect the patient with other contaminants that are present in their workspace. A nurse who works in the robotic surgery department states that, “Although I am very careful when moving and handling the robot system, I am afraid of dropping the accessories when connecting parts and contaminating the sterile parts, which might cause extra expense” (Kang 152). This quote shows the human error that could occur based on the humans involved with the surgery. The nurse is afraid of not connecting parts correctly and of dropping accessories, which both factors could greatly decrease the reliability of robotic surgery. Also, contamination of sterile parts could lead to many risks in the patient, which may allow others to not be supportive of robotic surgery. Yet, contamination can occur without the use of robots as well, because sterile instruments used by surgeons can be dropped as easily as a robotic part can be dropped. Although mechanical error and human operating error may occur in robotic surgery, doctors can make mistakes without the addition of robots. There can be error in the operating room whether robots are present or not, and robots being added to surgical procedures would not increase the number of mistakes.

Overall, robotic surgery has become more available around the world and has become more popular in many hospitals worldwide. With the recent studies showing the blood loss reduction, less risk of infection, decreased price for both hospitals and patients, less pain and scarring for the patient, and improving accuracy and precision, robotic surgery should be used in every hospital and is beneficial to healthcare overall. Although others may disagree with this argument by saying that robotic surgery may have human operating error and mechanical error, there are many more beneficial possibilities associated with robots. Technology should be increased in hospitals around the world.

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