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Robotic Surgery in the Medical Field

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Introduction

For generations, robots have been used to entertain kids on cartoon network shows, but not perceived as serious mechanisms aiding the future of the real world. With that said however, in today's society, robots have acquired a more critical role in the lives of many people. Confusion and misconception have created a lot of questions as to what robots really are and their purpose in this world. What many do not realize is that we as people are living amongst robots which carry out specific tasks every day. Although deemed irrelevant by many people, the robot has made some eye-opening breakthroughs as a useful tool to the world, especially in the important field of medicine.

Robotic surgery is a new and emerging technology that is useful for numerous types of surgeries. Controversy between robot manufacturers and surgeons continuously challenge its operational feasibility and legitimacy. This research supported essay will provide in-depth information in order to increase awareness and understanding about robotic surgery. Additionally, areas such as legal and ethical issues, social consequences, and security concerns will be addressed. As a result of reading, the reader will receive a wealth of information regarding the world changing phenomena that is, robotic surgery.

Background

In 1985, the first robot, "Puma 580" performed the first neurosurgical biopsies, which is taking a smear of the brain to perform a diagnosis on the brain's condition. In 1988, "Puma 580" performed another surgical procedure, on the prostate, where it earned its name "PROBOT." "PROBOT" provided researchers a gateway to the "ROBODOC," which was a machine that helped perform hip replacement surgeries with superb precision (Lanfranco, Castellanos, Desai, & Meyers, 2004). "ROBODOC" became the first surgical robot to be approved by the Food and

Drug Administration (Meadows, 2002). Years later, researchers collaborated to invent a “Telepresence Surgery System,” which allows the surgeon to perform surgeries on patients from distance. “Telepresence” allowed for the creation of the “Telemanipulator”-used in hand surgeries to give the surgeon a real feel of their patient (Holt, Zaidi, Abramson, Somogyi, n.d.). After recognizing the value in robots, the US government funded the company, Computer Motion, Inc. to invent an “Automated Endoscopic System for Optimal Positioning,” a voice controlled robotic arm used by the surgeon to maneuver an endoscopic camera inserted into the patient (Lanfranco, Castellanos, Desai, & Meyers, 2004). Since the invention of “ROBODOC,” robotic surgery has revolutionized the surgical world.

More recently, new inventions of robots with multiple arms have been approved by US Food and Drug Administration to be used in surgical settings (Meadows, 2002). Two notable specific robotic systems, the “Da Vinci” and “Zeus System” are widely used in different types of surgeries (Holt, Zaidi, Abramson, Somogyi, n.d.). Both systems have two arms that mimic the surgeon’s hand, 3D cameras on the third arm that has an image-processing computer, a movable cart, and voice commands among their features. Most importantly, they contain the master console where the surgeon sits and gives directions to the robot. These systems, along with other robot technologies are used in neurosurgery, cardiac surgery, pediatric surgery, endovascular surgery, and continue to grow and develop in other medical fields.

Potential Benefits

Since its conception, many people and companies have conducted studies to discover the continuous benefits of robotic surgery. Many scientists have concluded that robots assisted surgery offers: 3D visualization for the surgeon that increase magnifications, improved agility of hand movements so the surgeon can manipulate the instruments well, increase geometric

accuracy which eliminates possible mistake, use multiple sensory in control, it's stable and does not get tired, easily sterilized, it's resistant to multiple types of infections born in the surgery room (PubMed, 2004). Another potential advantage is the ability of robotics to perform Telesurgery, also known as, "Remote surgery," (Lanfranco, Castellanos, Desai, & Meyers, 2004), which is a computerized system that uses telecommunication lines that allows a surgeon to operate on a patient from a different location. Telesurgery allows complicated surgeries that are difficult and geographically far to occur.

Surgeons benefit tremendously from robotic surgery as well. The surgeon can perform while seated, which delays fatigue, eliminates distractions and excess body movement. In special cases, the surgeon will be protected from potential radiation damage and infections. Lastly, computerized precision allows the surgeon to pin-point problem areas and makes incisions accordingly.

Legal and Ethical Issues

As robotic surgery expands, the legal and ethical issues that follow it also grow in number and complexity. One major concern is the culture of health care. The goal of healthcare is to respect the patient's decision, not cause any harm to the patient quality of life, and to benefit the patient using medicine. Patients rely ultimately on their doctors and surgeons to achieve their desired outcomes. The addition of robotic surgery requires a whole new level of trust on behalf of both parties. That brings up ethical questions such as: are robots replacing humans and are humans in danger of losing their jobs to robots (Dickens, 2006)? Can people refuse robotic surgery and opt for an actual surgeon? Is the surgeon trained enough to operate the machine? These are just some of the ethical concerns that have been on the rise. Other ethical concerns include, if robots are negatively affecting the doctor-patient relationship because it takes away

from face to face interaction, and, if the machine can deliver a reliable and effective outcome while prioritizing safety of the patient and surgical team and keep the patient's treatment confidential (Dickens, 2006).

As mentioned before, robotic machinery is a new technology that is being investigated and is on an experimental trial which can create a conflict with patients and involve the law. It is required that patients are informed of all aspects of their surgery and if a robot is being used. In the event of mishap, liability falls on the physician, the hospital, and the manufacturer of the robot. There is much heightened risk in the acceptance of using robots to perform surgery. Predominantly, risk and liability are at the decision of the doctor. For example, Dickens' (2006) states, "Telesurgery" have raised legal issues because when physicians get their license, they get a specific license to practice in a specific area (p. 75).

Altogether, robotic surgery creates many controversies and in order to address many of these legal and ethical issues, many people from different fields of study will be required to read into Code of Ethics to make sure they do not compromise ethical rules of healthcare. It certainly will take a long time to address all of the ethical questions because robotic surgery needs to prove that it is safe and effective.

Security Concerns

Concerns regarding patients' security raise questions of its own. Can the machine ensure confidentiality of the patient's record? Dickens' (2006) states, "Confidentiality is at risk due to means of electronic eavesdropping" (p. 77). This is due to the machine collecting and entering patient's data, it is especially more risky if the machine is sending patient's information via telecommunications line for the surgeon to access it. Another concern is the possibility of machine and technical failure during an operation which can lead to serious medical malpractice.

Similar to legal and ethical issues, it will take long to conclude if robotic surgery will raise additional security concerns.

Social Problems

Robotic surgery has sparked up social problems with patients, physicians, scientists, and the general public. Everybody's first concern is safety and its reliability, which some people agree and others disagree. The second concern is how experienced is the surgeon in robotic experience. There is no set standard of how many operations that needs to be done to master the robotic machine, which concerns people because it is unknown how qualified the surgeon is (Quintero, 2010). Nonetheless, physicians states that patients should look at the surgeon's credentials and surgical experience instead of machine they use. Dr. Patel once stated, "Any tool in the hand of a doctor is a bad tool if they're not well trained. If they're well trained, robotic surgery is a wonderful way to have surgery" (Quintero, 2010).

Further Required Research

At the moment, there are numerous research and investigation occurring to eliminate the hurdles and to understand the full potential of the robot. Dr. Lanfranco (2004) states, "The future of robotics in surgery is limited only by imagination," (par.34), because there are new robotic systems being developed. It is speculated that the future system will do most of the work while the surgeon supervises. Thus, only time will tell whether robotic surgery will become the primary way of operating or if operating manually will continue as is.

Conclusion

Despite many obstacles and concerns, robotic surgery is growing at a tremendous speed due to its advantages and is generating eye-opening breakthroughs as a useful tool in the medical field. Just like any new invention, robotic surgery begun only twenty years ago, and it has

already received great attention and created serious concerns in wide arrays of law, medicine, and the society. Additionally, ongoing investigations of robotic surgery have not stopped inventors from creating improvement to surgical robots. As a result, it will never cease to elevate additional legal, ethical, social, and security concerns in the medical field. After all, it is up to research scientists and physicians to determine if the benefits outweigh the cost, and only time will tell if every operating room will utilize robotic surgery.

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References

Dickens, Bernard (2006). Legal and Ethical Issues in Telemedicine and Robotics. *International Journal of Gynecology and Obstetrics*. 94, 73-78. Retrieved February 15, 2013 from <http://ssm.com/abstract=944833>

In Dickens' article, the author investigates legal and ethical concerns that come along with robotics. He goes in depth of giving an example of a legal issue that occurs with telemedicine and telesurgery where surgeons are able to operate from remote locations. On the other hand, he examines the Code of Ethics for physicians and applies the main principles to see if robotics will interfere and raise ethical concerns and security concerns. The author's information was accurate because there were research studies included to support his argument, and there were many references that used this article as their resource. I found this article very helpful because it was relevant to my topic and I was able to use Dickens' quotations to provide information for my research paper.

Fitzgibbons, S. (2010, May). Robots Don't Leave Scars: What's New in Medical Robotics? *Analog Science Fiction & Fact*, 130(5), 28–35. Retrieved February 8, 2013 from <http://search.proquest.com.mutex.gmu.edu/pqrl/docview/215338369/13C5A0A3F341514345A/4?accountid=14541>

Fitzgibbons discusses the topic of medical robotics, when it first appeared in the medical field and the use of endoscopes, which are the cameras used during surgery that are inserted in the patients. Furthermore, she discusses the cost of the robots and its advantages it offers for patients and surgeons. I found her information to be very helpful because she described everything in detail, provided case study examples, and scenarios of robotics surgery. Overall, her article provides relevant to the information I am seeking,

it provides a clear purpose of informing the audience, and it's presents current information because it was written in 2010. Lastly, at the end of the article, the author's credentials are found which supports that she has the authority to report on the topic.

Holt, D., Zaidi, A., Abramson, J., & Somogyi R. Telesurgery (n.d.) *Advances and Trends. Technology Review*. Retrieved February 5, 2013, from <http://utmj.org/archive/82-1/REV.pdf>

This article was written by multiple authors who discuss telesurgery, its advantages, technical and financial issues that come along with the new technology. The authors provide multiple black and white pictures of the robotics machine to show their audience what the machine looks like. This article provides information in a well organized manner, provides accurate information by reporting research studies done by scientists and physicians, and has a clear purpose that comprehensible by the reader.

Lanfranco, A. R., Castellanos, A. E., Desai, J. P., & Meyers, W. C. (2004). *Robotic Surgery. Annals of Surgery, 239(1)*, 14–21. Retrieved on February 10, 2013 from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1356187/>

This article defines robotic surgery, deliberates the effectiveness of telesurgery, and disadvantages of the new technology. It provides a research study conducted by the authors to see if surgery centers are utilizing robots and if the robots are effective.

I was able to use quotations from the information provided on the website for the section of benefits and further required research. The information provided was well described and relevant for the audience who is interested in learning about robotic surgery in depth.

Meadows, M. (2002, June). Robots lend a helping hand to surgeons. *FDA Consumer, 36(3)*, 10–5. Retrieved February 2, 2013 from

<http://search.proquest.com.mutex.gmu.edu/pqrl/docview/227038816/13C50F12969D7144BB/7?accountid=14541>

Meadow's scholarly journal discusses background history of robotic technology, its benefits, disadvantages, and current clinical application of robotic surgery. Moreover, it provides specific information of when the Food and Drug Administration approved robotics surgery to be utilized in specific areas of surgery. I found that specific information highly helpful because it provided me with new information I can include in my background history portion of my research paper. All together, the information from her article provided me relevant and accurate information and similar details from other journals regarding robotic surgeries.

Quintero, F. (2010) Robotic surgery: How safe is it? Retrieved February 20, 2013, from

<http://phys.org/news196450509.html>

The author of this article that is published on the newspaper reports on the Da Vinci robotic system and a specific case of patient who had to make a decision to receive surgery via a robot. I was able to get information of physician's opinions on the effectiveness and safety of the robotic machine and include it in my security concerns section of my paper. This newspaper article provided current information and has clear intentions of informing the public.