

Privacy in Anonymous Social Media
(Technical)

**The Impact of the da Vinci Surgical System in the Medical and Medical Education Fields
and Whether It's Worth the Investment**
(STS)

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On my honor as a University Student, I have neither given nor received
unauthorized aid on this assignment as defined by the Honor Guidelines
for Thesis-Related Assignments

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Introduction

My technical project will be focused on improving anonymity on social media outlets. In recent years, “anonymous” social media sources have become increasingly popular, with the rise of sites like Reddit, where true identities are typically masked with usernames. With this comes the need to scan the content you post, making sure it doesn’t reveal anything about your identity. Our goal with this project is to create a tool that allows users to scan their desired images and text pairings to see whether it reveals too much personal information about themselves (represented by a privacy score). The applications of such a tool can be expanded to all forms of social media, allowing users to control the amount of information they are sharing with the world. The technical subject of the STS prospectus and the technical topic for the Dept. of Computer Science is not related.

My STS research will be focused on the effective use of the da Vinci Surgical System and whether or not it’s worth the money used to invest in its development and integration into the medical field. The da Vinci Surgical System allows the surgeon to complete tasks within a surgery that exceed human capabilities, such as being able to rotate the surgical system’s wrist like arms in ways the human wrist cannot. However, the problem lies within its cost and learning how to use the machine itself. This robot is a huge advancement in the medical technology field, but it can also cause changes to medical education; if it takes off, more surgeons must be equipped to use the system. My research will discuss the comparison of robotic-assisted surgeries and hands-on surgeries while also providing details on mechanical malfunction occurrences during surgery and how often they occur. I will also discuss the potential changes in the medical education system that the robot would cause if it were to become a staple in the medical field. In my conclusion, I hope to expand on the overall pros and/or cons of

implementing the da Vinci Surgical System into the medical field and if it's worth continuing its development.

Technical Topic

With the rise of sites like Reddit, where individuals' personal names and information are hidden behind anonymous usernames, “anonymous” social media services have increased in popularity. However, how much information can usernames really shield? With this form of communication, to remain truly anonymous, the information from your “profile” cannot be used to determine who you are. However, with the ever-increasing data-driven world we live in, it seems the tools to link your anonymous profile with your public profiles such as Facebook, LinkedIn, and Twitter seem more and more likely. With this realization in mind, we hope to develop a tool that indicates how much personal information individuals give away in an anonymous social media post. We hope to provide a baseline for how much information anonymous social media users are giving in both a specific base and their “profile”: the culmination of all their posted information.

In the technological age of today, privacy becomes a more and more valuable commodity. With so many companies that live off the idea that information is money, it becomes increasingly concerning the amount of an individual's information that is public. It is public in every sense of the word, not just to a group of people, but to the whole world. Consider the constant data scandals that plague our technological world. Whether it is Facebook, Google, or governments, someone is always getting caught selling, collecting, or losing data that many consider infringes on their privacy. Therefore, as stewards of these technologies, we must

develop preemptive ways of protecting the privacy of the individual in an information-based world focused on the collective. The heterogeneous nature of society, especially with respect to privacy, makes the perspective vary greatly from person to person. This study shall focus on Reddit, an anonymous social media since individuals within anonymous social media communities tend to view anonymity as some form of privacy and therefore tend to care about it. In order to understand the perspective and definitions of privacy, privacy needs to be analyzed in the context of a society.

STS 4500 Prospectus

Introduction:

I will be researching whether the cost of integrating the da Vinci Surgical System into the medical field is worth the benefits through comparisons of hands-on surgeries to robotic-assisted surgeries, as well as theorizing how it would change the medical education system requirements as it would need to create a course that would teach medical students how to use the da Vinci Surgical System. This is an important topic that requires STS investigation because it will allow us to evaluate whether or not money is being wasted or efficiently used on this surgical machine based on the impact it makes in the medical field. If there are less internal scars, less post-op recuperation time needed, and minimal system failures that affect the outcome of the surgery, then the da Vinci Surgical System will be considered worth the money invested into the machine.

Research Questions:

1. How is using the da Vinci Surgical System more beneficial than hands-on surgeries?

What to focus on: Are robotic-assisted surgeries faster to recover from? How or how not?

What causes robotic-assisted surgeries to be more costly? Do robotic-assisted surgeries create less internal/external scars? How or how not?

2. How often do system failures occur and what impact do they make to the procedure if there were to occur?

3. How will implementing the da Vinci Surgical System affect medical education?

What to focus on: If the surgical system is implemented into the medical field, how will functioning the machine be learned? Will da Vinci Surgical System curriculums be implemented? Would this create a gender and/or race gap if one type were to grasp the understanding of the machine better than the other? How difficult is it to use the da Vinci Surgical System?

Literature Review:

The following articles relate to the value of Robotic-Assisted Surgeries:

Abrishami (2020) investigates the qualitative value profile of the da Vinci Surgical System through review of 2 decades of extensive clinical use and research alongside the controversies of such evidence. With controversies around innovation-based, market-based, science-based, or practice-based ideals of technology introduction, it's undecidable whether or not the value profile of the da Vinci Surgical System is positively or negatively impacting the medical field.

Mukherjee and Kingshuk (2020) explores the possibilities of maximizing clinical outcome benefits while also minimizing the costs of robot assisted surgeries. Data was compiled of all medical expenses, money spent on resources to use the da Vinci Surgical System, and the outcomes of robot assisted surgeries versus manual surgeries. An underlying issue with the da Vinci Surgical System is the great expense that must be paid, however not only from the machine alone. Money must be used to get training for surgeons to effectively use the surgical system to achieve said benefits of robot assisted surgeries. This is something that would be

looked into for universities all over the world as training courses for the surgical system would be required for med students if the da Vinci Surgical System were to be commonly utilized.

The following articles relate to occurrences and effects of failures/malfunctions:

Kim (2009) analyzes the mechanical failures and malfunctions of the da Vinci Surgical System between July 2005 and December 2008 and evaluates the solutions for them. 1797 robotic surgeries were reviewed with 43 of them having some type of mechanical failure or malfunction. On top of that, only 3 conversion surgeries were needed (1 open and 2 laparoscopic). The low failure rate with an even lower conversion rate exemplifies the safety of the da Vinci Surgical System in its current state and the overall success that it could bring to the technological medical field.

Rajih (2017) evaluates the effects of malfunctions that occur with the da Vinci surgical system during a robot assisted surgery. 1228 robotic surgeries between January 2012 and December 2015 in urology, gynecology, and thoracic surgery were reviewed by the author. Of all 1228 surgeries, 61 had malfunctions occur during the surgery; this is a relatively small percentage of surgeries. With only 4.97% of surgeries containing malfunctions, it's hard to fight against the use of robotic assisted surgeries. The author concludes that although malfunctions can be considered not infrequent, rarely they are consequential, meaning that the patient is not negatively affected in the outcome of the surgery.

The following article relates to the comparison of Robotic-Assisted Surgeries with other types of surgeries:

Xie (2020) compares the differences in safety and effectiveness between open procedures, laparoscopic procedures, and robot-assisted procedures regarding choledochal cyst excisions. The author analyzes choledochal cysts procedures between January 2015 and December 2018 with the data including demographic information of the patients, their type and size of cyst, operative details, and postoperative outcomes. Out of all three types of operations, laparoscopic took the longest to complete while open procedures created more intraoperative bleeding. This shows the balance of robot-assisted procedures and the benefit of moderate completion time with minimal blood releasing incisions.

The following article relates to the learning tools of the da Vinci Surgical System:

Abhilash (2019) examines the robotic recording and playback accuracy for movements of the da Vinci Surgical System. The author is ideally trying to create training modules for surgeons by using recording and playback features of the surgical system. His research concluded that the recording and playback feature was very accurate with the source only being off by an average error distance of 4mm. When it's fully developed, surgeons will not need to be trained on the spot and would already have pre-existing knowledge on how to operate the robotic surgical systems through a tutorial curriculum.

The following article relates to gender gap:

Chiu (2020) examines the difference in performance of robotic suturing between male and female medical students. The author uses virtual reality robotic simulations and robotic dry-laboratory simulation training as a means to compare the aptitude of the two test groups. 39 males and 19 females were used in this experiment, which is not ideal as there is a difference in the sample size between the two groups; this will cause skewed data as there are fewer female testers which can mean less failures or less successes compared to the male group. The experiment resulted in females outperforming the males in both the VR and dry-lab portions. However, the experiment should be conducted more times with a more balanced set of test groups to achieve a better analysis of the results.

The following articles relate to the difficulties of using robotic surgeons:

Eslamian (2020) examines different camera controlling algorithms of the da Vinci Surgical System. Through his experiment, he used 20-participant test subjects to try an autonomous camera algorithm, a standard clutched control, and an experienced camera operator using a joystick. He was able to conclude that the autonomous camera algorithm was the best option. Manual control of the camera creates an increase of workload for the surgeon controlling the robot as they have to worry about moving the camera into place for their tool arms which disrupts the surgery altogether. This adds on to the difficult learning curve of using robot surgeons compared to hands-on surgeries.

Dal Moro F. (2012) researches the effective learning curve of using robotic-assisted laparoscopic radical prostatectomy and reached a conclusion that efficiency improvements

plateaued after 60 consecutive robotic procedures, thus showing how improvements in using the da Vinci Surgical System are capped due to effective port placement.

Sumi (2013) also researches the effective learning curve of the da Vinci Surgical System by comparing the effective use of the machine between a new and experienced user. She concludes that the learning curve is steep and the effective use is plateaued which is shown when the new user is able to reach the same capabilities as the experienced user after only 1 training program for creating 5 internal stitches on non-surviving animals.

STS Framework (Hughes' Prospective) and Method:

The system builders for the da Vinci Surgical System is Intuitive Surgical. They developed the da Vinci Surgical System to help enhance rehabilitation by allowing surgical methods that are incapable for the human body to perform. Such methods include a rotating wrist-like arm that is able to twist and maneuver around in ways that surpass the way a human arm is limited to. This allows surgeons who control the robot to cause less internal bleeding by creating less incisions within the body, which also leads to less stitches that need to be made so that the patient can have less parts of their body that need tissue healing. Even though there is criticism behind the da Vinci Surgical System, such as the pricing of the overall robot, the innovation capabilities push big advances in the medical industry and opens the path of robotic and medical hybrid collaboration.

The reasoning behind the high price is due to the technical features that are implemented; it vastly improves both the quality of surgical procedures and the visual aspect for the surgeon. The da Vinci Surgical System is equipped with a high quality 3-D visual camera that is

controlled by the surgeon and gives them greater control over the surgery at hand. Due to the high needed knowledge of the system itself, the system's expansion is solely in the hands of its creator, Intuitive Surgical.

The main reverse salient of the da Vinci Surgical System is the tough learning curve. The system itself is hard for users to learn and uses a proprietary system which doesn't allow any modifications to the surgical system. This creates a limitation to the operation system and stunts the growth of the system overall. This best way for this reverse salient to be removed would be allowing the system to be modified, allowing others to supply inputs on how to further improve the system and help the development of the da Vinci Surgical System overall.

The leading argument of why the da Vinci Surgical System is a needed improvement in the medical field is that it helps reduce the recovery time for patients. This is a tempting reason for many to use this new technology, but the cost of these surgeries is the main reason it's not fully accepted into society.

My choice of research method is solely document analysis. I believe this is the best method for my topic as I do not have access to any participant observations due to COVID and with the lack of networking in the medical field, I would be too complicated for me to try to get an interview with someone experienced with the da Vinci Surgical System. Lastly, there is not much to survey on regarding my topic, so that was not considered as well.

Timeline:

For my research plan, I have studied the da Vinci Medical System by first making sure there's enough information out there for me to engage with. I then searched for different material such as books, articles from electronic databases, and articles/news by searching on Google. Then I evaluated all the material, making sure they are first all factual, second credible, and third reliable. Currently, I am still taking notes from all of the approved material and compiling them into my final thesis. Lastly, next semester, I will determine how much the system is more beneficial than hands-on surgeries based on statistical facts such as faster completion time, less incisions needed, less recovery time, amount of system failure occurrences, etc. and see if medical education would need to be changed if the da Vinci Surgical System rises in use.

Conclusion:

Overall, my research on the da Vinci Surgical System is to determine the opportunity cost of using robotic-assisted surgeries and if it's worthwhile over hands-on surgeries. Alongside that, I will explore the effects of robotic-assisted surgeries becoming popular within the medical education system. Through my research, I expect to conclude whether or not robotic-assisted surgeries are better than hands-on surgeries through analysis of data, statistics, and opportunity cost. My research will contribute to the debate regarding the da Vinci Surgical System and help provide evidence for either side's point of view.

Bibliography:

Abhilash Pandya, Shahab Eslamian, Hao Ying, Matthew Nokleby, & Luke A. Reisner (2019, February 1). A Robotic Recording and Playback Platform for Training Surgeons and Learning Autonomous Behaviors Using the da Vinci Surgical System. *Robotics*, 8(1), 9.

Abrishami, P., Boer, A., & Horstman, K. (2020, December 1). When the Evidence Basis Breeds Controversies: Exploring the Value Profile of Robotic Surgery Beyond the Early Introduction Phase. *MEDICAL CARE RESEARCH AND REVIEW*, 77(6), 596 - 608.

Chiu, H., Kang, Y., Wang, W., Tong, Y., Chang, S., Fong, T., & Wei, P. (2020, January 1). Gender differences in the acquisition of suturing skills with the da Vinci surgical system. *Journal of the Formosan Medical Association*, 119(1), 462 - 470.

Dal Moro F, Secco S, Valotto C, Artibani W, & Zattoni F (2012, December 1). Specific learning curve for port placement and docking of da Vinci(®) Surgical System: one surgeon's experience in robotic-assisted radical prostatectomy. *Journal of Robotic Surgery*, 6(4), 323 - 322. Retrieved from <https://doi.org/10.1007/s11701-011-0315-2>

Eslamian S, Reisner LA, & Pandya AK (2020, April 1). Development and evaluation of an autonomous camera control algorithm on the da Vinci Surgical System. *The International Journal of Medical Robotics + Computer Assisted Surgery : MRCAS*, 16(2), e2036 - 1. Retrieved from <https://doi.org/10.1002/rcs.2036>

Kim, W. T., Ham, W. S., Jeong, W., Song, H. J., Rha, K. H., & Choi, Y. D. (2009, January 1). Failure and Malfunction of da Vinci Surgical Systems During Various Robotic Surgeries: Experience From Six Departments at a Single Institute. *Urology*, 74(6), 1234 - 1237.

Mukherjee, U. K., & Sinha, K. K. (2020, January 1). Robot-assisted surgical care delivery at a hospital: Policies for maximizing clinical outcome benefits and minimizing costs. *JOURNAL OF OPERATIONS MANAGEMENT*, 66(1-2), 227 - 256.

Rajih, E., Tholomier, C., Cormier, B., Samouëlian, V., Warkus, T., Liberman, M., ... Zorn, K. C. (2017, May 1). Error reporting from the da Vinci surgical system in robotic surgery: A Canadian multispecialty experience at a single academic centre. *Canadian Urological Association Journal*, 11(5), E197 - 5.

Sumi Y, Dhumane PW, Komeda K, Dallemagne B, Kuroda D, & Marescaux J (2013, March 1). Learning curves in expert and non-expert laparoscopic surgeons for robotic suturing with the da Vinci(®) Surgical System. *Journal of Robotic Surgery*, 7(1), 29 - 28. Retrieved from <https://doi.org/10.1007/s11701-012-0336-5>

Xie, X., Li, K., Wang, J., Wang, C., & Xiang, B. (2020, April 28). Comparison of pediatric choledochal cyst excisions with open procedures, laparoscopic procedures and robot-assisted procedures: a retrospective study. *SURGICAL ENDOSCOPY AND OTHER INTERVENTIONAL TECHNIQUES*, 8.