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Systematic review

Telesurgery Robotics and Easy Access to Quality Healthcare Services

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Abstract

Background: Due to the existing shortage of surgeons as well as other conditions that limit access to affordable and quality surgical care, there is an increasing need to embrace alternative technologies, such as telesurgery, that provide the flexibility, reach and quality desired. ***Objective:*** To evaluate the role of telesurgery in improving efficiency and increasing access to delivery of quality surgical healthcare services, as well as to stimulate the adoption of telesurgery in increasing access to quality surgical healthcare services. ***Research Design and Methodology:*** The study employed a descriptive design and was qualitative in nature. This involved a review of 29 peer-reviewed literature published on various topics on telesurgery. ***Research Findings and Limitations:*** The study established that telesurgery can help deal with the shortage of surgeons, eliminate the geographical barriers that hinder access to healthcare, and also improve the time access to affordable and quality surgical care through enhanced surgical accuracy. The study is limited to the available number of relevant peer-reviewed scholarly articles on telesurgery. ***Discussion and Conclusion:*** The research indicated significant potential in enhancing access to affordable and quality surgical healthcare. However, challenges due to high initial costs of equipment and staff training, as well as lack of adequate legal support, limit the possible adoption of telesurgery. Therefore, to mitigate the slow uptake of telesurgery, there is a need to have goodwill from relevant policy developers so that they can create a favorable legal framework to accelerate the development and uptake of telesurgery.

Keywords: ***Telerobotic, telesurgery, telehealth, telemedicine, remote surgery, rural, robotics surgery, robotically-assisted surgery, surgical robotics, and surgical robots.***

Introduction

Over the years, there have been efforts to overcome different barriers in the field of medicine that are caused by natural human limitations and those that relate to the shortage of medical practitioners, such as surgeons [1] and the geographical barriers that limit access to quality healthcare services in particular areas [2-4]. In this regard, science and technology have been applied to provide solutions that improve the quality of healthcare and its access throughout the globe, which is one area of medicine that has been the center of focus in the field of surgery [5]. This led to the emergence of the field of telesurgery.

Telesurgery is an emerging field of medicine that leverages robotic systems and telecommunication technologies to perform surgical procedures. By enabling remote surgery, telesurgery overcomes the challenges of conventional surgery, such as the geographical barriers, the infection risks, the surgeon's fatigue and stress, and the scarcity of specialized skills in some areas [6-7]. Moreover, it provides advantages such as travel cost reduction, outcome improvement, access expansion, and education and training enhancement [6-8].

Telesurgery is a revolutionary technology transforming the field of surgery, allowing surgeons to operate on patients remotely using a robotic system. This has many benefits for both patients and surgeons. Telesurgery not only fills the gap left by a shortage of surgeons but also helps eliminate the geographical barriers that have prevented timely and high-quality surgical interventions, in addition to reducing the financial burden due to surgery and sometimes risky and costly travel [6].

According to current reports, telesurgery also improves surgical accuracy and surgeon safety. It does so by using high-definition (3D) cameras that show the surgery site in detail, robotic arms that reach hard-to-access areas, such as the pelvis, which are preferred by urologists, colorectal and abdominal surgeons, and accelerometer technology that cancels out the surgeon's tremor and reduces anxiety, improving dexterity and precision [9-6-7].

Despite its usefulness, huge potential, and benefits to the field of surgery, the adoption of telesurgery has faced challenges related to high equipment and technology costs, lack of adequately trained personnel, and other legal barriers that limit its adoption [10-11]. As such, this section of the study seeks to explore the subject of telesurgery and provide an overview consisting of a background of existing knowledge and data on telesurgery and includes the purpose of the study.

Background

The idea of telerobotic healthcare was most likely conceived sometime in the early 1970s in one of the studies by the National Aeronautics and Space Administration (NASA) as a means to provide surgical care for astronauts using remote-controlled robots [12]. Since this time, many ideas have been developed, prototypes made, and trials done to establish the application of tele-operational systems of different surgical robots. For example, based on the

principle of improving the capabilities and dexterity of the surgeon, the concept of Minimally Invasive Surgery (MIS) was born [12]. Further, at the beginning of the early 1990s, computer-integrated surgery (CIS) and telemedicine grew as engineers and surgeons worked to create systems and networks for improving patient care by advancing the capabilities of surgeons [12].

Many advances have been made in robotic telesurgery since the beginning of the 21st century. Studies indicate that robotic surgery is now present in nearly all subspecialties of surgery and, in some cases, has replaced procedures in open oncology [13]. Besides, while it has been established that there are mixed results in the outcomes of robotic telesurgery programs, most of the results have improved significantly in quality and accuracy [12]. Reports also indicate that using robotic systems in telesurgery enhances precision, flexibility, and control during the operation [12]. Besides, telesurgery, in general, has been established to make it possible to conduct surgical procedures remotely in cases where the patient and the surgeon are in different locations.

Despite the advances and potential benefits of robotic telesurgery, there are potential threats to adopting the technology as barriers exist from a legal and logistical perspective [7]. Besides, a massive gap in education and curriculum will require more surgeons to be trained to keep pace with the technology. Also, as increasing adoption of robotic telesurgery is realised in different fields of surgery, there is a consequent call to improve surgical performance by making use of telemonitoring and simulation as a means to accelerate the acquisition of knowledge of using this technology as well as improving readiness for surgical operations through virtual reality warm-ups and rehearsing before surgery. However, these improvements must be considered based on improving patient outcomes and cost efficiency [14]. As such, it is necessary to adequately explore how robotic telesurgery can be used efficiently and consider its impacts on increasing access to quality healthcare services.

Statement of the Problem

According to a 2019 report by the Association of American Medical Colleges (AMMC) on the complexities of physician supply and demand, which provided projections from 2017 to 2032, there is adequate evidence that the shortage of surgeons not only in the USA but also globally is increasing [29-1-15]. By 2032, the United States will lack nearly 23,000 surgeons. In addition, populations continue to grow significantly among vulnerable people, such as older people, who are likely to have challenges moving from one place to another to find the needed care. This implies that there will be a continued need for alternative means to provide quality surgical care to such patients. Telesurgery presents a viable option as it has proven to have the capability to support the provision of surgical care through the combination of networking and robotic equipment [6].

Despite the already-seen benefits of telesurgery, its clinical acceptance has been met with numerous challenges that have limited the benefits the technology could deliver in improving access to timely and quality surgical operations [10-11]. According to Choi and colleagues, there is an existing gap in telerobotic technology being able to demonstrate measurable benefits to the healthcare system in relation to improving clinical results, enhancing the efficiency of operations, and realizing cost-effectiveness [6].

In addition, there is an inadequate publication of randomized clinical trials proving the real clinical benefits of telesurgery and domination by a few key players that have made it difficult to access such technology or equipment [16]. Furthermore, the average hospital cost in the US is a staggering $3,949 per day, and the average hospital stay costs $15,734 [17]. This is a huge burden for many patients and their families, implying that many more individuals cannot afford to stay in hospitals to access much-needed medical care, such as surgical operations [13].

Therefore, this paper seeks to address the problem of the slow take-up of robotic telesurgery for use in various surgical operations. The study considers that such technology is expensive to manufacture and procure and requires skilled surgeons or operators to enable it to function. Despite appreciating these challenges, studies have sufficiently demonstrated that telesurgery has substantial potential benefits concerning improving access to surgical care. As such, this study considers the existing and projected shortage of surgeons as a significant reason to explore alternative options, such as robotic telesurgery, to fill the gap.

Purpose of the Study

As a solution to the existing and looming problem of shortage of surgeons, this study seeks to establish the efficient uses of robotic telesurgery and its impacts on increasing access to quality healthcare services. Specifically, the study seeks to answer the question of how robotics telesurgery can improve efficiency in the delivery and access to quality surgical services. The study will also seek to provide adequate support for the hypothesis that robotics telesurgery helps deal with the shortage of surgeons, eliminates geographical barriers that hinder access to healthcare, and improves timely access to high-quality surgical intervention through improved surgical accuracy.

Literature Review

The subject of robotic surgery has gained much fame since its inception several decades ago [12]. Robotic surgery has broad applicability in the health care setting. However, some misconceptions about the concept still make most patients who need surgery skeptical about the technique. Therefore, it is necessary to conduct a literature review of the existing literature to better understand robotic surgery and its application in telesurgery. Some of the aspects that must be looked into are the benefits and shortcomings of the technique. It is also essential to review the existing literature to identify the trends in robotic surgery. Analyzing the trends will also help to understand any future trends that may be expected in this field.

A critical aspect of this field is communication during robotic surgeries. A systematic model of virtual control is instrumental during the apprenticeship phase and should be continued even with the acquisition of experience [15]. However, with technological improvement, virtual simulation presents an alternative form for future surgeon training in a safe environment [18].

Therefore, while there is a need for verbal control during the training of robotic surgeons, it can also happen virtually. Regarding communication, a review done by a set of researchers indicates that robotics in surgery has improved within the last 30 years [19]. The combination of verbal communication with the virtual combination could be one of the subsequent improvements in this field.

According to several articles, one major limitation to using robotic surgery in the health care setting is the cost in relation to effectiveness. For instance, Choi and colleagues believe that the use of telerobotics in the healthcare industry is currently limited by cost-effectiveness, clinical results, and operational effectiveness [6]. However, the situation is not hopeless since these limitations can be eliminated. For instance, the high costs of using this technique are currently due to expensive technology. If the technology can be improved, the costs of the technique can quickly gain clinical acceptance. This highlights the need for training.

Avgousti et al. [20] hinted that physicians could acquire new skills to better telesurgery robotics by conducting relevant training, especially in medical schools, as future trends in the field will depend heavily on the improvements made in telerobotic technology [6]. Already, a technique has been developed to assess the level of surgical skills possessed by different surgeons who perform robotic

surgery. The technique evaluates the robotic surgical skills curriculum based on virtual reality for any evidence of construct validity [21]. Therefore, the training suggested by the other literature materials is possible because progress can be measured effectively.

Studies indicate that robotic-aided surgical operations are improved when computer applications are used effectively [22]. Therefore, it is valid to propose training for surgeons involved in robotic surgery. From an analysis done by Conolly et al. [21], experienced surgeons significantly outperform novice surgeons in most metrics while performing robotic surgery in different situations.

However, a different study contrasts those supporting the idea that the costs of robotic surgery are high. According to Cazac and Radu [23], the benefits of implementing robotic surgery outweigh the costs incurred during the implementation. However, the authors explain that there is a need to lay out a working telemedicine infrastructure, as in the case of Romania. Additionally, the issue of costs is dismissed using the analogy that telesurgery has some unique benefits. For instance, using robotic surgery will eliminate the need for having several surgeons who are highly paid and allow surgical support to areas that are difficult to access [8]. Some inaccessible areas mentioned in the literature include ships, space crafts, and other remote areas. Patel et al. [24] also argued that the technique provides good value for money as the benefits truly outweigh the cost.

The other current trend concerns the public perception of robotic surgery. According to Boys et al. [25], over 55% of their study population still prefer conventionally minimally invasive surgery to robotic surgery. This is a surprising indication since over 72% of the population, according to the authors, agree that robotic surgery offers better results since it is faster, safer, and less painful [25]. Choi et al. [6] also confirm these findings and insist that robotic surgery will only gain better public perception if patient education addresses people's misconceptions. One such misconception is that robotic surgery is costly and cannot be afforded by most patients. However, studies have already indicated that robotic surgery costs are not as high as people perceive, especially compared to its effectiveness [23].

The popularity of robotic surgery is greatly attributed to its advantages in the healthcare setting, and several authors have addressed these advantages in their literature. According to Reichenbach et al. [26], robotic surgery has the main advantage of increasing precision during surgical operations. Other researchers support this claim. Bulosan [22] attributes this advantage to the ability of the robotic system to enhance precision, flexibility, and control during the operation and allow physicians to see the site better than traditional techniques. This advantage makes robotic surgery lucrative since it increases the chances of successful surgery. However, for this advantage to be fully enjoyed, researchers point out that surgeons must be trained to use the machinery involved [18].

In continuation, Kayani et al. [27] stated in their study that the technique allows healthcare professionals to deliver a specific healthcare plan to patients. Different patients have different needs, and developing ways to use robotic surgery to meet the needs of each patient is essential in the healthcare industry. However, there is a need to take advantage of the precision nature of robotic surgery for this to be actualized [19]. Controlling the robots involved in telesurgery helps to aid in this patient-specific care.

Different authors have evaluated ways of improving the control of these robots to improve their applicability. One suggested way of improving the control of the robots is through the use of off-the-shelf wireless components to control in vivo robots and their control boards [26]. However, this approach has some limitations, such as the interference of the wireless signals, the components' power consumption, and the data transmission's security. Therefore, Reichenbach et al. [26] conducted studies to evaluate the feasibility of this proposal. The studies indicated that basic off-the-shelf components could transmit video feeds through wireless transmission. This implies that there is a promise of a better future when it comes to the control of robots during telesurgery. The improvement will yield even better results than has already been achieved. According to Ghezzi and Corleta [19], this technique could enhance robotic surgery's performance and safety.

In summary, the available literature has exhaustively discussed the subject of robotic surgery and its applicability in health care. One main advantage of the technique is the precision and effectiveness of using the method. Other advantages include developing patient-centered plans and conducting fast, less painful surgeries [22-26]. Most authors quote the cost of robotic surgery as a disadvantage. However, a case study conducted in Romania indicates that the costs of performing robotic surgery are low relative to its effectiveness [28]. It is expected that the use of robotic surgery will pick up in the near future. This is because of promising technological improvements, such as using off-the-shelf components to control in vivo robots and accessing remote areas [26]. However, there is still the need to train surgeons on how to use this technology and create awareness among patients on the benefits of technology.

Methodology

The fundamental research in this study is via Sacred Heart University (SHU) Library by considering several options such as searching from peer-reviewed articles, limiting the articles to articles written and published in English, and the articles' range dates between 2013 and 2022. In addition, 29 articles have been found helpful in this study, and eleven articles were published recently after 2019. The terms that used to find articles are as follows:

- Telerobotic, or Telesurgery, or Telehealth or telemedicine
- Remote surgery or rural
- Robotic surgery, or Robotically-assisted surgery, or Surgical robotics or Surgical robots

These articles were collected from the following databases and journals:

- ScienceDirect
- MEDLINE
- Business Source Premier
- PubMed
- Nursing & Allied Health Source
- Journal of the American Medical Informatics Association (JAMIA)

Articles selection

In the primary search through the Sacred Heart University (SHU) Library website using the above search term, 168 articles were found. After a thorough article selection process, 18 articles were included in this study. The articles used in this study are supportive and associated with telesurgery robotics and easy access to quality healthcare services.

Indeed, these articles have been selected based on standards that support telesurgery robotics, focusing on the benefits of telesurgery robotics and the future of telesurgery robotics. However, the research avoided non-peer-reviewed articles, non-English articles, and articles published before the year 2014 due to the evolution of the healthcare industry and articles that talk about the medical side of using telesurgery, specifically on the part of the body.

Results

The study aimed to establish the efficient uses and impact of robotic surgery in increasing access to quality healthcare services. It was

hypothesized that robotic telesurgery helps deal with the shortage of surgeons, eliminates geographical barriers that hinder access to healthcare, and improves timely access to high-quality surgical intervention through improved surgical accuracy. As such, the study has considered various peer-reviewed relevant research that would help answer the questions presented in the hypothesis.

Cazac and Radu [23] established that there is a need for robotic telesurgery to meet the gaps in the delivery of quality healthcare services. According to this study, the need for robotic telesurgery is necessitated by the fact there is an existing shortage of surgeons, and the trend will continue in the coming years. This is supported by the findings of a 2019 report by the Association of American Medical Colleges (AMMC), indicating that by 2032, the United States will face a shortage of nearly 23,000 surgeons [29-15].

In addition, Cazac and Radu [23] also found out that due to the shortage of surgeons, especially in rural Romania, most patients who need this type of medical care have to travel long distances and struggle with expensive healthcare costs. It was established that in the current healthcare system in Romania, and this is the case in many other nations, there are multiple challenges, which include a lack of qualified medical personnel, lack of medical equipment, lack of medical consumables, lack of research opportunities, lack of jobs and emigration of physicians. The result of this is indicated in Figure 1. As such, there is a valid case for the need for telesurgery.

Moreover, the study also considered the various ways to implement telesurgery that would benefit both the surgeon and the patient concerning improving efficiency and outcomes of the delivery of healthcare services. The authors also established telerobotic surgery helps surgeons by reducing or eliminating surgical physiological tremors. Besides, it provides increased maneuverability around the blood vessels and increases surgical precision during surgical procedures. It also helps reduce the percentage of damaged tissue after surgery and ensures a faster recovery rate after operations. Through telerobotic surgery, surgeons can also enjoy increased collaboration with other surgeons across the globe. Besides, the surgeons will likely face a reduced risk of traveling to remote or war-prone areas. Also, telesurgery increases the opportunity for getting new jobs and the possibilities of research[23].

Furthermore, the study has established that telesurgery has varied benefits to patients. First, patients can benefit from national and international coverage by having a national and perhaps a global telesurgery network. Besides, with telesurgery, patients no longer need to travel long distances to access medical care. Also, patients can benefit from getting the services of better-qualified surgeons they could not access in everyday situations due to high costs and extensive geographical distances. In addition, due to the increased surgical precision provided by robotic telesurgery, patients benefit from improved recovery rates after the surgery, lower operation costs and enhanced efficiency at medical facilities [23].

Similarly, in their review of the prospects of telesurgery in delivering healthcare in remote areas, Shahzad et al. [8] established that the technology that makes telesurgery possible works by enabling haptic feedback. Haptic feedback is critical in surgery as it enables the surgeon to feel the consistency of tissue, which forces the surgical instruments to adjust accordingly. This is important as it shows some of the benefits of robotic surgery, including enhanced dexterity, hand tremor filtration, and high-quality 3D visualization with almost 10 X magnification. Also, customizable sensitivity settings improved natural hand-eye movement. Therefore, the authors stated that telesurgery is beneficial as it allows specialized surgeons' expertise to be available to patients nationally or globally, especially in underserved areas, without travelling away from their local hospitals. This is beneficial specifically in risky transfer conditions, and time delays in making the transfer can be counterproductive. Shahzad et al. [8] also revealed that telesurgery can provide surgical care to mobile military units even in areas difficult to access due to war or geography (2019). The same can be extended to providing surgical services to ships or space units.

Furthermore, Choi et al. [6], in their review, considered the past, present, and future of telesurgery. The authors established that technology is beneficial as it provides high-quality surgical intervention, limiting complications and improving the time taken to heal after surgery. They stated that telesurgery is beneficial as it makes it possible to cancel the operator's physiological tremor in real-time using accelerometer technology. Besides, telesurgery also improves surgical accuracy and reduces the damage caused to adjacent healthy tissues during the operation. This is a generally improved positive outcome for the patient as the minimized damage to the healthy tissues implies that patients recover quicker. In addition, Choi and colleagues also established that telesurgery provides high-quality surgery to medically underserved areas such as battlefields, rural areas, and spacecraft, confirming the findings of Cazac and Radu [23], which indicate telesurgery eliminates the need to travel for long distances as well as travel-related financial costs and potential dangers for both the patient and the surgeon.

However, even if most of the findings indicate that telesurgery helps improve access to healthcare services, reduces the cost of providing surgical care and improves the efficiency of the surgical procedure, which, in essence, confirms the hypothesis of this study, several limitations hindering the adoption of telesurgery has been identified.

The study by Boys et al. [25] sought to establish the public perception of robotic surgery, including the hospitals and surgeons that use them. They discovered that the majority (72% of the respondents) believe that robotic surgery is faster, safer, less painful, or offers better results. However, only 45% indicated they would opt for robotic surgery given the chance. Besides, about 67% of the respondents indicated they were concerned that there was a probability of the robot malfunctioning during operation and causing internal damage to them as patients. Another 15% were concerned about the robot's likelihood of operating incorrectly. The data is shown in Figure 2.

Therefore, while the findings have indicated the benefits of telesurgery, various issues have also been identified to present challenges to its full implementation in healthcare provision, as shown in Figure 2. These are public perception which indicates a reluctance to use telesurgery despite knowing its benefits, legal and ethical issues that vary across states and countries, the lack of fully developed training programs as well as standard operating protocols, issues to do with funding and expensive cost of acquiring equipment and the need to develop a global network [25].

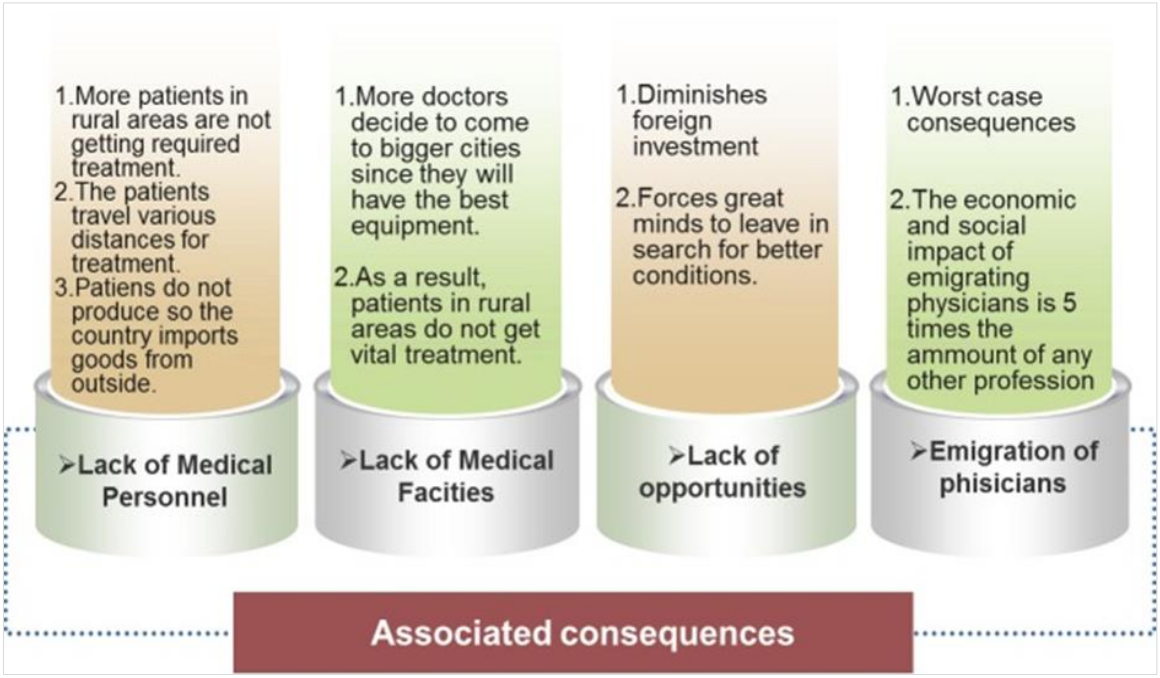

Figure1: Showing Long-Term Consequences of Lack of Telesurgery System [23]

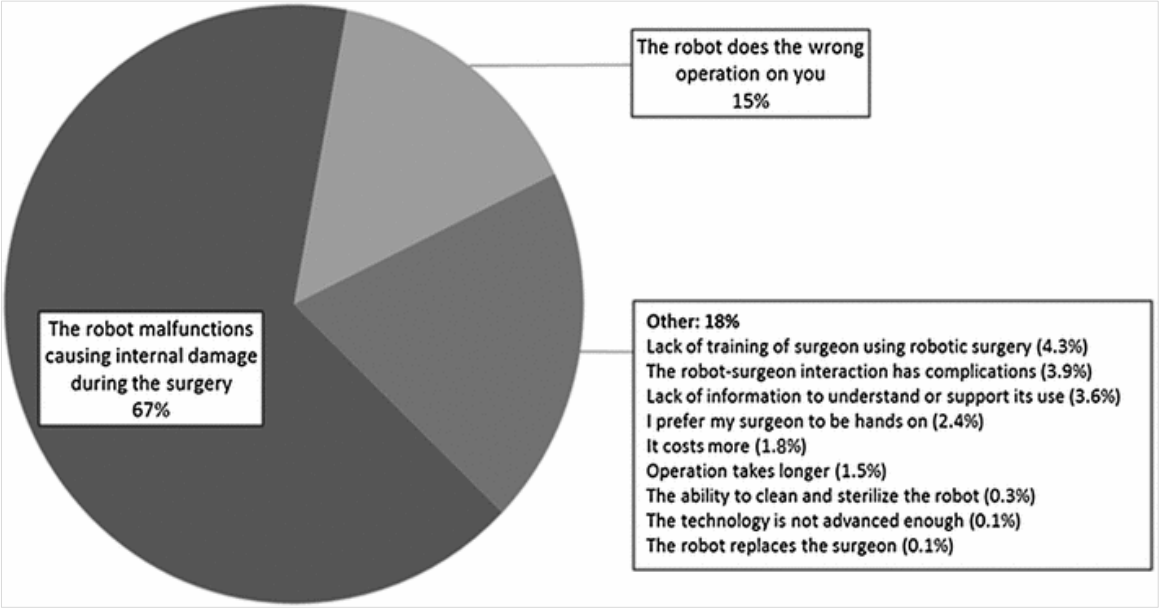

Figure 2: Showing the Concerns with Robotic Surgery [25]

Discussion

The study sought to evaluate the efficient uses and impact of robotic telesurgery to increase access to quality healthcare services. This was informed by the understanding that there is a shortage of surgeons and other healthcare professionals. Besides, patients and surgeons face various geographical accessibility challenges that limit access to immediate and high-quality surgical care and the potential costs and difficulties involved in long-distance travel. Due to the limited time and resources, the study employed a qualitative analysis as a literature review to answer its hypothesis/research question.

Based on the literature review, the study has established that robotics telesurgery helps deal with the shortage of surgeons, eliminates geographical barriers that hinder access to healthcare, and improves timely access to high-quality surgical intervention through improved surgical accuracy.

Technologies grow based on their existing demand and capability to meet various gaps in different fields. The case of telesurgery is unique to the medical field; as such, its demand can only depend on the existing market gaps it needs to fill. Cazac and Radu [23] studied the possible use of telesurgery in Romania and found an urgent need for telesurgery because of the existing shortage of surgeons in the country. Besides, this is not just a current problem; predictive statistics have demonstrated that the trend will continue. For example, the Association of American Medical Colleges (AMMC) has already established that there will be a shortage of not less than 23,000 surgeons in the US alone. These numbers could be higher in some areas, especially those with higher populations. This implies that telesurgery provides an alternative solution to an already existing problem and a future one. This is, therefore, a solution that various governments should take up to help address the shortage of surgeons within their countries [29-15].

Moreover, telesurgery is needed because it helps overcome the geographical barriers that may hinder the delivery of surgical healthcare to rural populations that need the services. This is also relevant to the populations in war-torn areas, which are difficult and dangerous to access. Due to the existing conditions, surgeons are likely to shy away since going to such areas puts their lives in danger. Therefore, as Cazac and Radu [23] established, patients in

these areas, primarily rural locations, must travel long distances, incurring serious risks and still having to deal with expensive healthcare costs. These patients need an alternative option, and telesurgery can meet this gap.

In addition, the lack of telesurgery produces other associated consequences, such as a lack of medical facilities where more doctors opt to move to the bigger cities because they will have the best equipment [8]. This leads to further disparities in the patient-surgeon population, so the patients in the rural areas cannot get the vital treatment they are looking for. Also, due to poor working environments caused by not having proper systems such as telesurgery systems, many physicians are likely to flee the country to look for better conditions in other places. This would further worsen the situation in such a nation, and the effects could extend beyond the medical field to include other social and economic sectors within the country. Therefore, the need for telesurgery is justified in any nation as the shortage of surgeons is growing globally.

This study has also established that telesurgery can be implemented in various ways such that benefits accrue both to the surgeon and the patient regarding delivering quality healthcare and improving efficiency. For example, robotic telesurgery helps surgeons eliminate or reduce surgical physiological tremors [23]. Also, telesurgery increases the maneuverability around the blood vessels, besides significantly increasing surgical precision during surgical procedures.

Maneuverability in surgery refers to the ability to move within various organs or blood vessels during an operation. Robotic telesurgery enhances this process mainly by increasing the precision during the operation. These are advantages to the surgeons as they enhance the success rate of their operations by reducing the number of errors they could make during the process. They should, therefore, consider employing telesurgery to improve their work. This benefits the patients as it significantly improves the quality of healthcare that they can access/receive [23]. Through telesurgery, surgeons can also avoid travelling long and difficult terrain and sometimes risky areas because they can deliver surgical services remotely from anywhere, they are as long as there are working connections.

Moreover, telerobotic surgery also reduces the percentage of damaged tissue after surgery and ensures a faster recovery rate for the patients after operations [6]. These advantages accrue to the patient and can increase their confidence in an operation. Telesurgery also allows patients to select from a global pool of expatriates if connected to a telesurgery system with national and global coverage [6]. Due to this, patients can select the best bargain for them based on their ability to afford it, which implies that many more patients can access high-quality surgical care. This has a trickle-down effect on an economy as it results in the increase of healthy people, which increases the productivity of a country, leading to economic growth and expansion. Patients also save on costs since they no longer need to travel long distances. This increases their savings on healthcare and related costs, leaving them with more disposable income. This can be invested in different sectors of the economy other than increasing the purchasing power of the people. Telesurgery also provides increased surgical precision, improving patients' recovery rates.

The study has also noted that robotic telesurgery is not being used significantly despite the general public's perception that 72% believe it is safer, faster, less painful and offers better results. Only 45% of people believe that they would opt to use robotic surgery provided the chance. They mentioned several reasons, including the concern that there is a chance that the robot could malfunction while undergoing an operation and possibly cause internal damage to them as patients. Besides, there is still a concern that robots could perform the wrong operation. Due to these issues and the legal and ethical requirements surrounding the adoption of telesurgery, there is an urgent need to provide education on the benefits of this technology [25]. The study has proven that telesurgery has great potential in improving access to quality surgical healthcare.

Limitation of the Study

The study employed a qualitative research methodology in the form of a literature review. A literature review solely relies on previously published peer-reviewed scholarly articles on the subject of interest. This implies that there is a possibility that the study inherited some of the biases in the previous studies, and this could affect the quality of its findings. In addition, since the study was limited to articles published only in English, there is a possibility that it missed some relevant and recent studies that were published on this subject and could have been influential in informing this study.

Also, since some studies were published as early as 2014, there is a possibility that their findings could be different if the studies were to be conducted today or this year. Therefore, there is a likelihood of using redundant findings. As such, it will be necessary to conduct new studies that involve original research in the coming studies.

Conclusion

Indeed, the existing challenge of the lack of adequate surgeons continues to limit access to affordable and quality surgical care. As the results of the study have indicated, this trend is likely to get worse in the coming years, and as such, there is an urgent need to adopt an alternative technique that will not only ensure that patients have access to surgeons but also ensure getting high quality and affordable surgical care. The study has since established that telesurgery has been used previously, albeit in a limited or trial capacity, to provide surgical care to patients.

This study has established that telesurgery helps mitigate the shortage of surgeons by eliminating the geographical barriers that hinder access to healthcare. This has been proven in relation to the findings of a study conducted in Romania on the possible use of telesurgery in that country. It is also essential to appreciate that the lack of surgeons also has other related consequences, such as a shortage of medical equipment and other facilities, resulting in more surgeons moving into bigger cities and countries with more opportunities and better pay. As a result, there is increased disparity, especially for those living in rural areas and countries with shortages.

As such, even though there is adequate evidence that robotics telesurgery helps in dealing with the shortage of surgeons by eliminating geographical barriers that hinder access to healthcare besides improving the timely access to high-quality surgical intervention through improved surgical accuracy, there is a need to involve relevant government leaders, institutions and policymakers so that they can create a favorable legal framework to accelerate the development and uptake of telesurgery. This will significantly benefit the industry as it will create room for large-scale manufacture of telesurgery equipment, lowering their costs and improving availability. Consequently, there will be increased access to surgical care.

Declarations

In the next sections, the author should declare all individuals who contributed to this research project, scientific and ethical approvals, the funding agencies, and a list of abbreviations used in the research.

Authors' contributions

The research was submitted to the Ministry of Health, based on a systemic review which doesn't obtain ethical approval because the research isn't contain data collection.

Scientific and Ethics approval

The research was submitted to the Ministry of Health, based on a systemic review which doesn't obtain ethical approval because the research isn't contain data collection.

Sources of Funding

This research did not receive any fund and the researcher declare no conflict of Interest.

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