

Effects of Telemedicine on Medical Clinical Assets during Pandemic

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Description

Recent COVID-19 pandemic has brought back the attention of the world towards the significant role telemedicine can play in the healthcare sector. We need telemedicine more than ever to deliver the healthcare services not only in emergency situations but also for non-emergency health care situations. Such a prolonged pandemic has taught us that we should be prepared for the worst, and that we cannot fight such pandemic by only disinfecting our environment but also minimizing human-to-human contact. In contrast, 21st century demands that we are always connected to function and progress in this global economy. Therefore, there is a sudden peak in interest in telemedicine services by healthcare industry and researchers. In general, telemedicine can encompass a wide range of services delivered over a distance which can include something as basic as a telephone consultation by a physician or more advanced such as ultrasound imaging. These services can be delivered using devices such as master-slave surgical systems, digital stethoscopes, robotically driven imaging systems, or even a simple installation of customized software applications over our mobile phones. These developments motivated us to review and understand the recent technological developments that have transpired in the last ten years in the field of telemedicine devices. The objective of this study is to review the existing telemedicine systems developed by research groups and those available commercially. The primary goal is to understand the technical advancements in the field of telemedicine devices that have been applied to different fields of medicine. We have classified these systems based on telemedicine devices developed for surgery, diagnosis, monitoring and consultation.

Search Method

The literature search includes peer-reviewed articles and book chapters published during August 2012-August 2022. For commercial medical devices used in telemedicine, relevant websites were reviewed. In this article, we limited our review for this duration as it represents a decade of research and development enabling a reader to observe the trend and future direction. Moreover, during our study we noticed that there

were significant advancements in the field of telemedicine devices during this era. Additionally, the COVID-19 pandemic has diverted the attention of the medical community at large towards the development of remote medical facilities and this inspired us to review and understand the technological advancements in this field. This will aid the researchers and medical professionals to predict the potential future direction and understand the gaps that exist. It will enable them to identify the requirements for further development to fully equip ourselves for a world with widespread availability of telemedicine enabled devices. The rest of this article has been organized as follows. Search Method section explains the criteria applied to select and include an article for this review. The sections Telemedicine devices in surgery, Telemedicine devices for diagnosis and monitoring and Telemedicine devices for consultation, respectively review the corresponding robotic medical devices developed for these applications. Discussion and Conclusion section discusses the authors observation based on the articles reviewed and comments on the potential trend.

Telemedicine Devices in Surgery

Conventionally the term tele implies that a device is being controlled from a distance. In surgical realm this concept has been referred as master-slave system where a master device is used to control and operate a slave device connected through wires or over a wireless network. A master device commands a slave device to perform certain tasks. Depending on the requirement, the slave may reside on-site or off-site with respect to the master. In broader perspective, since the surgical task is being performed over a distance, whether small or large, using the master-slave architecture, such devices can be categorized as a part of telemedicine devices. At the beginning of the 21st century, in 2001, we witnessed the first ever long distance telesurgery that was performed over a distance as large as across an ocean. This transatlantic surgery was performed from New York on a female patient located in Strasbourg, France. A master-slave type telesurgical system was used that was connected *via* high-speed fibers optics connection with a time delay of 155 milliseconds. This was the only transatlantic surgery ever performed on a human and it has been almost a

quarter century since then that any such surgery has been performed, even though the technology has rapidly evolved and currently we have more internet bandwidth than ever. To

explore these advancements, in the rest of this section we review several telesurgical systems that has been developed in last ten years.