THE ROLE OF VIDEO TECHNOLOGY IN TELEMEDICINE

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1. INTRODUCTION TO TELEMEDICINE

• What is Telemedicine?

- There is no one definitive definition of telemedicine. Many definitions highlight that telemedicine is an open and constantly evolving science, as it incorporates new advancements in technology and responds and adapts to the changing health needs and contexts of societies.
- Telemedicine is broadly defined by the World Health Organization as the delivery of healthcare services at a distance by all healthcare professionals using information and communication technologies (ICT) to exchange valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for continuing education of healthcare providers.









• History of Telemedicine

- Telemedicine using telephone and video technology started in the 1960s driven by the military and space technology sectors.
- In the early days of telemedicine, health professionals used this technology as a way to reach patients living in rural areas.
- In the past, poor telecommunication infrastructure and lack of resources limited the widespread implementation of telemedicine.
- With the advancement of Internet in the 1990s, the adoption of telemedicine was accelerated.
- Telemedicine and telehealth are used interchangeably.
 - Telemedicine is often referred to as an older term focused on clinical applications.
 - Telehealth includes a broader consumer-facing approach. It extends the scope of telemedicine by incorporating a broader set of activities, including patient and provider education in addition to patient care.







• Evolution of Telemedicine

The evolution of ICT has played a major role in the development of all ICT health domains.

➢ Widespread applications of Internet, smartphones, wearable devices and highspeed mobile networks lead to expanding the scope of telemedicine to encompass Web-based applications (e.g., e-mail, teleconsultations and conferences via Internet) and multimedia approaches (e.g., text, audio, digital imagery and video) in order to cover a wide spectrum of applications.

To cope with such an evolution, it can be better to refer telemedicine (or telehealth) as virtual health which is independent of time or location and is personalized healthcare without borders.







2. TELEMEDICINE MODALITIES

There are 4 types of telemedicine services.

- Real time or synchronous telemedicine requires the involved individuals to be simultaneously present for immediate exchange of information, as in the case of videoconferencing with a clinician.
- Asynchronous/store-and-forward telemedicine may encompass review of prerecorded data such as clinical information through an electronic consultation, or of pathology and/or radiology images, etc.
- Remote patient monitoring also known as telemonitoring, allows patients to be monitored in their homes using mobile devices that collect data about temperature, blood sugar levels, blood pressure or other vital signs.
- Mobile health (m-health) refers to healthcare applications and programs patients use on their smartphones, tablets, or laptops. These applications allow patients to track health measurements, set medication and appointment reminders, and share information with clinicians.

 \triangleright In the above cases, the transmitted information can be text, audio, video, or still images.

3. ADVANTAGES AND DISADVANTAGES OF TELEMEDICINE

Advantages

- Telemedicine delivers secure virtual healthcare and allows doctors to visit their patients in a virtual manner. In doing so, it is typically billed at a lower cost than in-person visits and allows to provide affordable healthcare services.
- Patients using telemedicine do not need to travel to medical centers, take time off work, or spend time waiting for providers. Thus, remote care and diagnosis offered by telemedicine can benefit patients and healthcare systems with the reduction of travel costs for specialist care and the associated time and stress when compared to the case of in-person visits. Health outcomes are improved.
- The use of telemedicine can avoid costly hospitalizations and can help patients in healthcare through remote patient monitoring and incorporating patients and family members into the care process. This can allow patients to seek earlier treatment and improve the quality of life for patients who have chronic conditions.
- By delivering healthcare remotely, in-person care can be focused in the hospital to only those patients who really need it. This in turn allows to scale healthcare systems, protect lives, and safeguard economic activity.
- Telemedicine applications not only can improve healthcare systems, but also create an interconnected global health network responsive to humanitarian crises.

Disadvantages of Telemedicine

One possible consequence of using tele-consultations or video link is a breakdown in the patient/healthcare professional relationship. Communication breakdown can result from poor interpersonal skills.

Cybersecurity: As with any technology that involves electronically transmitting patient data, telemedicine systems are susceptible to hackers and breaches. Healthcare organizations remain one of the biggest targets for online criminals.

Inability to prescribe medications: A physical examination or evaluation may be required before a physician can write a prescription for a patient.

Technical training and equipment: Providers need to be trained on how to use telemedicine equipment. There are also the associated costs of the equipment,

4. VIDEOCONFERENCING SYSTEMS FOR TELEMEDICINE

- Real time uninterrupted video streaming is required by synchronous telemedicine.
 Videoconferencing is one of its main supporting technologies.
- The use of live interactive video can enhance patient-provider communications.
- Video technology can effectively facilitate the growth of telemedicine. Virtual visits are more important than in the past due to the COVID-19 pandemic and physical distancing requirements. Video conferencing enables healthcare providers to set their own schedules and maintain patient contact with less travel and less pressure. This can include new-patient visit, follow-up visit, and on-treatment visit, respectively.
- Videoconferencing systems can be used for diagnosis and prescription of medical treatment for patients at remote locations, for remote clinical consultations between medical professionals, and for education and training of medical staff, etc. Telemedicine can be a realtime interactive video examination of a patient conducted by physicians remotely to quickly diagnose the symptoms and suggest immediate action, or bring in specialists around the country to provide instant care.

The use of two-way video communications for telemedicine can reduce travel costs and time In waiting rooms, improve patient care outcomes. Face-to-face online interactions are also useful for patients. Telemedicine delivered over secure cloud-based video conferencing pervices will help shape the future of healthcare industry.

5. CONFIGURATION OF A TELEMEDICINE VIDEOCONFERENCING SYSTEM

Videoconferencing systems use video and communication technologies to transmit medical information such as audio, video, and graphics between two or more sites. Therefore, the main components of a telemedicine videoconferencing system generally include

- ➢Codec
- Viewing monitor(s)
- ➤Camera(s)



Control/user interaction devices (e.g., mouse, keyboard)
 Input devices (e.g., document scanner, medical scopes)
 Output and storage devices (e.g., printers, CD-ROM drives, USB).
 It is expected that video conferencing can speed up a shift of telemedicine into homes.

6. DISPLAY TECHNOLOGY

High-performance displays are very important for videoconferencing applications.

- To make confident diagnoses and to improve detection, the high resolution of a color display is required to show high-quality or perfect images over time. This can, e.g., help radiologists in checking the smallest clinical details to make confident diagnoses and to improve detection. Thus, suspicious findings can be detected in the earliest stage.
- High-resolution display is required to train surgeons in how to use the advanced tech to perform leading edge procedures on hard-to-reach and small spaces in the body. It can be also used to conduct robotic surgery.



Evolution of Display Technology

Display technology has evolved from early cathode-ray tube (CRT) monitors to plasma display panels, and recently, to flat-panel displays using liquid-crystal display (LCD) or light-emitting diode (LED) technology. These were primarily utilized for TV and computer applications in the past. Moreover, recent advances in display technology have enabled new form factors for mobile and wearable displays, such as flexible and transparent displays, to support novel applications.

- CRTs are a vacuum glass tube with electron gun(s) and a phosphor-coated screen, which have a dependence of tube length on the screen size and normally occupy a considerable amount of desk space. Flat-panel displays with light weight have replaced CRTs.
- Plasma display panels are also a type of flat-panel displays and were used for large-screen HDTV application. Plasma TV production was discontinued in the consumer market.
- Energy-efficient, cost-effective LCD screens are widely used in today's TV sets, computers and various handheld devices.
- Organic LED (OLED) displays are a kind of emissive display technology, which are currently used in digital cameras, smartwatches, high-end TVs, and flagship smartphones, etc.

7.8K IMAGE MONITOR FOR TELEMEDICINE **APPLICATIONS**

Ultrahigh-definition (UHD) TVs with 8K resolution (7680×4320 pixels) are commercially available, which use LCD and OLED displays, respectively.



the wall behind it so that the TV is almost

the same pattern as





The screen is rolled up in the aluminium base when not in use.

Since high-performance 8K displays are able to show lifelike images and to ensure an immersive viewing experience closer to reality, they can be used in telemedicine videoconferencing systems to significantly improve the quality of healthcare services.

- Sharp company already reported to deliver the world's first 8K image monitor in November 2017 to the medical field with an 8K rigid endoscope system.
- By transmitting UHD and realistic images in real time to remote areas and by viewing on a large screen 8K image monitor, this can be applied to telemedicine and medical education. The recorded 8K surgical video of a leading surgeon can be also used for education of young doctors.
- Pixel perfect surgical displays are very important for safe image-guided surgery.







Sharp's 8K image monitor with 8K rigid endoscope system. (a) Image of 8K endoscopic surgery displayed on the screen. (b) 8K image of boundary between normal cells and cancer cells.

What you see in closeup is still a lifelike image so real that it even gives out a sense of depth instead of pixels

8. FUTURE WORK

- Cost reduction of telemedicine videoconferencing systems.
 Improvement of security of patient information and video communications.
- Use of 5G and UHD video to improve the performance of videoconferencing systems.
- Development of ultrahigh-speed networks to efficiently support telemedicine applications.

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9. CONCLUSIONS

 Telemedicine can be used to effectively overcome the distance and time barriers between healthcare providers and patients, which is very useful for people with reduced mobility or who live in rural and remote areas.

- Videoconferencing is regarded as one of main supporting technologies for telemedicine applications. Healthcare professionals and patients can be connected via live interactive video, thus enhancing patient-provider communications.
- To significantly improve the image quality and service performance of telemedicine videoconferencing, advanced monitors with ultra-high definition should be used, and their new applications are described.
 - 5G and UHD video communications can be used to improve the performance of videoconferencing systems.

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Thank you very much.