COMMENTARY:
Tele-ICU Development and Application

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BACKGROUND

The demand for intensivist care aimed at the critically ill in ICUs is ever-growing as life expectancy increases, creating a tension in supply and demand.[1] With the aging population rapidly expanding and there being a lack of new board-certified critical care specialists, it is predicted that there will be a shortage of staff in the intensive care unit.[2,3] Part of this scarcity can be attributed to the aging nurse population as the number of RNs under the age of 30 has seen a major regression.[4] Also, lack of physicians in rural areas has caused a decline in the quality of health care offered to patients who reside in these areas. It is estimated that 20% of US citizens live in rural areas and only 9% of its physicians practice there.[5] To counter this decline in specialists and lack of access to those who live in rural areas, the industry has turned to alternative forms of care, much of the substitute being technology based; also known as telemedicine.[6]

APPLICATION

Telemedicine is defined as the exchange of medical information from one site to another through electronic communications, to improve a patient's clinical health status.[7] This new technology allows organizations to transcend past the boundaries of geographic space and time to offer their services.[8] There are a variety of applications as telemedicine is a general term, such applications include: two-way video, email, smartphones, remote monitoring, and robotic presence.[7,9]

The idea of telemedicine can be traced back to as early as the 1800s when electronics such as the telegraph became available for public use.[10] When the telephone was invented in the early 1900's, it became a quick way for physicians to communicate and is still one of the primary forms of communication in the medical world.[11] Modern telemedicine systems, in particular remote-monitoring, can be linked to the National Aeronautic and Space Administration (NASA). The respiratory and circulatory function of the human body when in space was questioned during the early times of manned flight. This prompted the development of the Integrated Medical and Behavioral Laboratories and Measurement Systems (IMBLMS) program in 1964. The IMBLMS expanded upon the measurements system that allowed the biometrics of the astronauts to be monitored during critical times.[12] The updated technology aided in the case of emergencies when return to earth wasn't possible. Not only would biometric data be transmitted to the base, but also guided medical treatment by non-physicians when made available. In medical emergencies mid-flight, only the crewmembers were there to help.[13]

Around the time of the development of remote-monitoring, the development of two-way video communication emerged. A clinical trial for two-way video took place at the University of Nebraska in the early 1960's when neurological examinations were transmitted across campus to medical students. Next, group consultation was tested and a telemedicine link was set up between the University and Norfolk State Hospital. Speech therapy, neurological-examinations, diagnoses and consultations were successfully provided.[14,15]

ROBOTIC TELEPRESENCE

Within recent years the use of robotic telepresence has seen major growth. Robotic telepresence is the incorporation of video conferencing equipment onto mobile robotic devices, which is then controlled from a remote location, including mobile devices like iPad and smart phones.[16] This new technology allows for more timely responses from specialists, which has been seen in other tele-ICU applications. The primary headquarters for the robotics is InTouch Health located in California, which is integrated with Global Care Quest. A study done at UCLA from 2005-2006 set out to test the effectiveness of telerobotics in the ICU. Observations were made during nighttime rounds where physicians and attendants would determine if any patients seemed unstable. Physicians, via the robotic presence, then monitored these patients determined to be unstable. From a remote location the physician could control the movement of the robot to examine patients as well as speak to them, asking them to perform certain tasks as part of the neurological examination. The results showed that the length of stay for patients admitted into the ICU was reduced which in turn also cut costs for the ICU by $1.1 million during the year the trial took place.[17]

TELEMEDICINE IN THE ICU

A clinical trial conducted by Grundy et. al.[16] published in 1977 reveals the success telemedicine has on patients in critical care who have limited access to specialists. The project set up took place between a large university hospital and a small inner-city hospital. An intensivist provided consultation from the remote hospital via a two-way audiovisual link and camera. The results showed that telemedicine could provide a valuable link between smaller and larger hospitals to deliver better quality care. The

program was however shut down due to funding costs. A similar study conducted by Breslow et. al.[17] yielded positive results as well. From the years 1999-2001, 2,140 patients in two adult ICUs of a large tertiary care hospital were provided with a supplemental remote care program. It was concluded that the additional supplement improved clinical outcomes and hospital financial performance. It was then concluded that telemedicine may be an alternative to provide quality care with fewer intensivists needed on-site.

TELENEURO-ICU/ TELESTROKE

The development of teleneuro and telestroke ICU is still fairly new. The idea behind teleneuro-ICU is to optimize the diagnosis and treatment of neurological emergencies. Most neurological emergencies such as acute ischemic strokes are extremely time sensitive and require specialist diagnosis.[18] Ischemic stroke in particular is a major problem that has low treatment rates. The conflict between distribution of specialists and incidence of stroke presentation greatly affects the accessibility to timely and appropriate care.[19] In a study done in Burgundy, France the safety and effectiveness of telemedicine for acute ischemic stroke was evaluated. The outcomes measured at 3 months by a modified Ranking scale score and case fatality concluded that the use of regional telemedicine was effective in the treatment and management of acute ischemic stroke. It was then determined that the percentage of patients who benefit from thrombolysis will increase.[20]

THE FUTURE OF TELEMEDICINE IN NEURO ICUS

The future for teleneuro and telestroke is promising as the application and promises of telemedicine in the neurocritical-ICU increase as a whole. Telestroke has the potential to enhance stroke education through patient and health-care professional interaction. Not only is education enhanced from this aspect, but also through the ability to use telecommunication-links to provide classes on interactive stroke care and prevention to locations that are limited otherwise.[21]

Economically, telestroke has been shown to be cost-effective from both societal and hospital perspective. The drawbacks to telestroke use come from the need for state licensing and credentialing of physicians. Also from a technical aspect, telestroke and telemedicine in general require a minimum network bandwidth; some regions don't have access to this yet. These issues can however be mitigated as technology expands to the more rural regions and licensing becomes easier to acquire as the application of telemedicine and telestroke continues to expand.[22]

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