

## Chapter 31

# An Overview of Telemedicine Technologies for Healthcare Applications

**P. S. Pandian**

*Defence Research and Development Organization (DRDO), India*

### ABSTRACT

*Medical care generally relies on the face-to-face encounter between patients and doctors. In places where face-to-face encounters are not possible, telemedicine technologies are relied upon to link patients to specialist doctors for consultation and to obtain opinion. The telemedicine technologies provide improved health care to the underprivileged in inaccessible areas at reduced cost. Telemedicine also improve quality of health care and more importantly reduce the isolation of specialists, nurses and allied health professionals. This review papers discusses the telemedicine technologies and its history, the communications technologies that are being used. The paper also covers the advantages and benefits of telemedicine. Also the recent advances that are going on in telemedicine in the areas of m-health, Wearable Physiological Monitoring System (WPMS), Wireless Body Area Networks (WBAN). Finally, the paper concludes with some of the drawbacks or issues of telemedicine technologies.*

### 1. INTRODUCTION

Healthcare should ensure good quality treatment and provide timely accesses to healthcare at a very reasonable cost. In places where people do not have access to quality healthcare telemedicine technologies have been relied on to provide healthcare. In cases where face-to-face encounter is not possible the telemedicine technologies have been relied upon to provide health care. Telemedicine in general is defined as “the use of telecommunication and information technologies to exchange health information and provide health care services across geographic, time, social and cultural barriers”. It includes both, the clinical (diagnosis, treatment and medical records) and academic medicine (research, education and training).

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By the use of telemedicine technology, it is possible to have access to improved healthcare for the underprivileged in inaccessible areas at a reduced cost and improve the quality of healthcare. By use of telemedicine, the professional isolation of specialists, nurses and allied healthcare professionals is reduced. The rapid developments in the electronics, computers and communication technologies have enabled the telemedicine to grow tremendously in the developed and developing countries to provide quality health care to their citizens (Fong et al., 2010; Combi et al., 2015; Nyamu et al., 2015; Ronie et al., 2001).

In 1906, Einthoven first transmitted ECG signals over telephone lines and later in 1920, radios were used to communicate medical information from ship-to-shore to link physicians at shore stations to assist in any medical emergencies arising at sea. In 1955, the first Telepsychiatry services were practiced in the Nebraska Psychiatric Institute. In 1959, a two way video conferencing microwave link was established between University of Nebraska Medical School and a state mental hospital (Bauer & Ringel 1999). In 1967, the first telemedicine system was installed connecting the medical station at Boston's Logan Airport and Massachusetts General Hospital. In 1970, satellite based telemedicine systems were used to link remote Alaskan and Canadian villages with hospitals in distant cities. During the period 1972-1975, NASA used two-way microwave transmissions to link personnel in mobile and fixed stations with medical experts in Tucson and Phoenix. In 1972, there were 7 telemedicine research and demonstration projects funded by Health Care Technology Division of U.S Department of Health, Education and Welfare. In 1973, U.S National Science Foundation (NSF) funded telemedicine projects for Boston Nursing Home and Miami's Jackson Memorial Hospital. In 1978, about 30 veteran administrations and 8 non-veteran administration hospitals were linked via satellites. In 1986, satellite network for interactive video conferencing were initiated between Canada, Kenya and Uganda. In 1989, MedPhone Corporation operated the first interactive telemedicine system over standard telephone lines for diagnosing and treating of cardiac patients (Bauer & Ringel, 1999).

Until the late 1980's, the telemedicine systems were limited to just video conferencing systems using low bandwidth communication networks. But, during 1990's, the rapid growth of computer technologies had enabled the telemedicine technologies to grow in a more complex way with value added services. The recent advances in telemedicine technologies are propelled by advances in Internet, telecommunication technologies and increased demand to have access to high-quality medical care irrespective of location or geographical mobility. The earlier telemedicine systems used public switched telephone network, ISDN, satellite links to deliver healthcare. The earlier telemedicine systems were restricted only to places where infrastructure was available. With the wireless communication systems in use, telemedicine systems have provided flexibility for wider coverage and value additions were made available in healthcare (Pattichis et al., 2002). The wireless telemedicine system provides better healthcare delivery, regardless of any geographical barriers, time and mobility constraints (Laxminarayan and Istepanian, 2002).

The satellite communication systems are capable of supporting different data rates and have global coverage. The Very Small Aperture Terminal (VSAT) satellite communication systems provide a wide variety of data rates with small sizes of antenna. The IP based VSAT communication systems support simultaneous transmission of data and video conferencing. The advantage of the satellite communication technology is the availability of allocated bandwidth and is also secure compared to other modes of communication technologies (Dennis, 2001).

Wireless telemedicine is a new and evolving research area that exploits recent advances in wireless telecommunications networks. Currently they are being developed to have connectivity with VSAT's,

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