A Century of Telemedicine: 
Curatio Sine Distantia et Tempora
# Content

**Introduction**  
Chapter 1  
*Telemedicine Development Based on Main Telecommunication Technologies*  
1.1. Telegraph Communications in Telemedicine  
1.2. Radio Communications in Telemedicine  
1.2.1. The formation of Air Medical Service in Australia  
1.2.2. Marine telemedicine  
1.2.3. Radio communication in distant medical learning and management  
1.2.4. Emergency radio communication by amateurs  
1.3. Telephone Communications in Telemedicine  
References  

Chapter 2  
*Telecardiology*  
2.1. Early Stage of Telecardiology  
2.2. Telecardiology in the Middle of the 20th Century  
References  

Chapter 3  
*Videoconferencing in Medicine*  
3.1. Early Period of Development: Medical Television  
3.2. Clinical Medical Videoconferences  
3.3. Telemedicine Network of Massachusetts General Hospital (MGH), Boston, Massachusetts  
3.4. Telemedicine Projects Based on Videoconferencing in 1970-1980  
References  

Chapter 4  
*Biotelemetry*  
4.1. Aerospace Biotelemetry  
4.2. Biological Telemetry in Physiology and Sports Medicine  
4.2.1. Key Accomplishments of Dynamic Biotelemetry  
4.2.2. Sverdlovsk Bioradiotelemetry Group  
4.3. Clinical Biotelemetry  
4.4. Tele-EEG - Biotelemetry of Electroencephalogram  
References  

Chapter 5  
*Computational Telediagnosis and Development of Clinical*
Telemedicine
  5.1. Main Achievements of Computational Telediagnosis in the Middle of the 20th Century 251
  5.2. Clinical Telemedicine Formation 259
  5.3. Formation of Separate Lines of Clinical Telemedicine 267
    5.3.1. Teleradiology 267
    5.3.2. Telepathology 271
  References 272

Chapter 6 276
Telemedicine Satellite Technologies
  6.1. Transatlantic Telemedicine 276
  6.2. Polar Telemedicine 289
  6.3. Mobile Telemedicine 296
  References 301

Afterword 304
Short Biographies 309
Introduction

Dear Reader,

The book “A Century of Telemedicine: Curatio Sine Distantia et Tempora” is now in your hands.

“The Past supplies the key to the Present and Future”. These words belong to an ancient historian who understood the necessity of studying history. History tells us how we came to know what we know today. The importance of history was summarized by Marcus Tulius Cicero (106-43 BC), roman writer, politician and great orator almost 2000 years ago: “Not to know what has been transacted in former times is to always remain a child. If no use is made of the experiences of past times, the world will always remain in the infancy of knowledge”. These words are especially applicable to the necessity of studying history of medicine. The latter is much more than the history of doctors, nurses and medical discoveries. The patients are actually the most important part of the broad picture. No doubt, throughout human evolution, health and diseases always were matters of main concern and had a profound effect on human society, shaping it.

This book is an overview of the scientific research in one specific field of the History of Medicine, that one of telemedicine. It is an enriched and adapted version of two previous publications (Vladzymyrskyy A. V., 2011; Dumanskyy Yu. et al., 2013), that already clearly revealed the range and complexity of Telemedicine development over the past 100 years. Yet, the book is not just a duplication of the previous publications. Researchers of telemedicine history will not be disappointed. New facts, theories, and amazing stories from different parts of the world are included. Moreover, some of them were identified even after the present book was ready for print. For example, in 1858 Dr Jabez Baxter Upham, in cooperation with the engineer Moses Gerrish Farmer, doctor William Francis Channing, Mr. Steams, Mr. Kennard and Mr. Rogers, created a telemedical device called «sphygmosphone». It allowed fixing heart pulse as a curve and sending these data via a telegraph. On January 24, 1859 the device was successfully tested, and heart rate data of a Mr. Eugene A. Groux, who suffered from congenital sternal fissure, were sent via wires from Boston to Cambridge (USA). Ten years later, in 1869, Dr. Upham repeated the experiment at the American scientists’ conference. More details, pictures and references about this event we will publish in near future.

Perhaps, at the very beginning it is necessary to clarify what is telemedicine. Telemedicine encompasses diagnostic, treatment and prevention processes within the frame of modern health care services, which are carried out primarily by means of telecommunication and

For decades there was no internationally accepted definition of telemedicine. A study published in 2007 found 104 peer-reviewed definitions of the word (Sood S. et al., 2007). Recognizing this, the World Health Organization adopted the following broad description of telemedicine:

“The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities” (WHO, 2010).

In sum, WHO had underlined that telemedicine includes four germane elements:

- Its purpose is to provide clinical support;
- It intends to overcome geographical barriers, connecting users who are not in the same physical location;
- It involves the use of various types of information technology;
- Its goal is to improve health outcomes.

When presenting the history of telemedicine, some authors refer to the attempts to exchange messages related to medical topics by post, sound alarm (drums, bells) and even smoke alarms, in ancient times and in the middle ages. However, we consider such approach incorrect, as we firmly believe in the ultimate connection between telemedicine and electrical and/or electronic telecommunication tools. Thus, when conducting the research on telemedicine history, we have intentionally limited ourselves to the period 1850-1990. We consider that the initial use of modern telemedicine technologies began towards the end of the 1980’s and were further developed in the 1990’s. This complex process of new and recent history deserves a separate, thorough research, and is a topic for another publication. We have predominantly focused our attention on the events and processes that took place before 1990, but it should still be underlined that only the most significant facts were taken into consideration.

In each time period only the most advanced technologies were applied in telemedicine. The development of distant delivery of health care services is the prime result of progress in telecommunication facilities. Thus, history of telemedicine may be presented as the sequence of stages following the progress of telecommunications and of the remote information exchange. In brief, the development of clinical telemedicine could be classified as:
• **Telemedicine development based on telecommunication tools:**
  o Telegraph;
  o Telephone;
  o Radio;
  o Television (cable television, with slow scanning, wireless, black-and-white to colour television);
  o Satellite-link communication;
  o Computer networks, internet;
  o Wireless networks and data transfer protocols.

• **Telemedicine development based on clinical application forms:**
  o Teleconsultations with oral or short written description of clinical evidences;
  o Distant learning (elearning);
  o Teleconsultations with medical data remote transfer;
  o Computing telediagnosis;
  o Biotelemetry;
  o Telemonitoring;
  o Comprehensive clinical telemedical systems;
  o Individual telemedicine (tele-homecare).

No doubt, both tracks are rather conventional, most stages interlace or can exist concomitantly. It is important to emphasize that "the distant delivery of medical aid and healthcare provision by means of telecommunication" itself started to being applied worldwide many years before the idea and understanding of telemedicine were formulated, and the term came into use.

Prior to describing the succession of events and processes, it is necessary to clarify the appearance of the term "telemedicine".

Nowadays the term "telemedicine" is applied for remote delivery of medical services and healthcare provision via computer and telecommunication technologies at any given location, in other words, wherever geographical distance is a critical factor. When this terminology appeared is an interesting question. It is obvious that the application of various electrical and electronic telecommunication tools for medical purposes started in the late 19th century; but the appearance of the specific term marks the semantic start of this phenomenon’s concept.

The Latin prefix "tele-", designating the remote delivery of medical service, was introduced by Willem Einthoven in 1906, when he suggested the term "telecardiogramme" (Vladzymyrskyy A., 2008; Bashshur R., Shannon G., 2009). It should be pointed out that already in the early 1950’s Jacob Gershon-Cohen suggested the term "telegnosis" and "videognosis" designating facsimile X-ray patterns that were received remotely by phone,
radio or television connection (ibid). Around the same time Albert Jutras offered the term "telefluoroscopy" (ibid). However, all these definitions covered a very narrow scope, referring only to radiology, and for this reason they did not reach a wide circulation. The above mentioned scientists will be discussed more in detail in the adequate chapters.

In the 1960s the term "telediagnosis" appeared. It meant distant diagnosis and follow-up of pathology with telecommunication technologies (Fabris U., Ravara A., 1968; McLaughlin L., 1969; Murphy R. Jr, Bird K., 1974). Yet, the obvious incomplete semantic constituent blocked its wide application.

What is to be said about the term "telemedicine"? Many authors dated its origin in 1974, referring to the article of R. G. Mark (Mark R., 1974). However, as we have mentioned in other publications (Vladzymyrskyy A., 2011; Vladzymyrskyy A. et al., 2012 a; b) the term "telemedical technique/technology" was used by R. L. Murphy et al. in 1970 (Murphy R. et al., 1970). But, further historical investigations have forced us to revise even this discovery. In 2014, while working with reference sources, we found that the term "telemedicine" had been used as far back as 1927!

A column of the retrospective articles and letters to the editors were published on page 47 in the newspaper "Greeley Daily Tribune", Greely Town, Colorado, USA, on November 16, 1970. They cited the story of Geo W. Gale “Wants Plane to Change Weather Here”. This information represented a rather doubtful discourse concerning meteorological changes that could be caused by planes. However, the last paragraph was of special interest as the author unexpectedly quotes the following: "If we have telephotography, why can't we have telemedicine, so that you could walk up to the radio machine, drop your dollar in the slot, take down the particular receiver required and apply it to that part of your anatomy where the pain is? (doctors, please snicker)” (Gale G., 1970) (Fig. 1). The cited article was dated December 29, 1927.

It is obvious that this material is not a scientific article. Nevertheless, we record that the term “telemedicine” was used for the first time in a publication in December 1927.
In the scientific literature we have recorded the first use of the term "telemedicine" (to be more precise "telemedical technique/technology") in the article by R. L. Murphy, D. Barber, A. Broadhurst and K. T. Bird, published in the journal "American Review Respiratory Diseases" in November 1970 (Murphy R. et al., 1970) (Fig. 2).

In December 1972 the term "telemedicine" appeared in the description of the telemedical project of the Arizona Medical University (Arizona TeleMedicine Network: Engineering Master Plan, 1972). It was also mentioned in the works of R. G. Mark (1974) and J. S. Gravenstein et al. (1974), in February and July 1974, respectively. Later it was used in numerous publications on space medicine, telemedical system in Puerto-Rico in 1975, NASA reports since 1977, etc.
The term "teleconsultation", more specifically "teleconsultation center" was for the first time met in Russian-language literature in the publication of Zigmas I. Yanushkevichus "Teletransmission of phonocardiograms" in 1966 (Yanushkevichus Z., 1966). In 1974 this word was used the publication by E. Quinn (Quinn E., 1974). Later, "teleconsultation" appeared also in NASA reports (since 1977) and several other publications.

Thus, in following years, the remote application of medical care or services was defined by adding the Latin prefix "tele-" ("teleradiology", "telecardiology", "telesurgery", etc.) to common terminology ("radiology", "cardiology", "surgery", etc.). Yet, let’s not forget that this construction was introduced by Willem Einthoven in 1906 ("telecardiogram"). The word "telemedicine" appeared in a publication in 1927 by Geo W. Gale, and it was introduced into the scientific literature by R. Murphy, D. Barber, A. Broadhurst and K. T. Bird in 1970 (Murphy R. et al, 1970; Murphy R., Bird K., 1974).

In sum, telemedicine was brought to life by changes of technology and offered enormous possibilities to improve both access to and the standard of healthcare, and thus to close the gap between the demand for affordable, high quality healthcare to everyone, at any time, everywhere, and the lack of medical personal. Chapters in this book reveal various national and cultural points of view on how telemedicine solutions were developed and implemented in earlier decades.

Finally, the authors would like to underline that:

- The content of the book is divided in chapters covering various areas of telemedicine.
- In the text, after the title of cited papers, a maximum of 3 co-authors are listed, while the rest are marked as “et al.”
References lists are added at the end of each chapter. They contain only the details of the sources cited in the body of the chapter.

The cited sources are listed in an alphabetical order. Part of referring sources is in Cyrillic. In these cases the names of the authors are translated in English. The titles of the references are also translated in English and included in square brackets with a language descriptor at the end. In addition, the source titles and authors’ names are also given exactly as they appear in the original language.

In order to shorten repeated references in the text 2 abbreviations are used. One is “ibid” originating from Latin ibidem, i.e. "in the same place". This repeats the previous author/s and title/s and whatever else is identical. The other one is “idem” from Latin idem "the same". It also indicates the repetition of the previous author/s.

At the end of the book a separate chapter provides a comprehensive directory of people – doctors, engineers, technicians, scientists, etc., that contributed a lot to the development of telemedicine. In several lines their works and achievements are highlighted, while their photos are usually included as illustrations in the chapters.

Despite the amount of information included in this book, no doubt that many events and facts are still out-of-sight. We hope to be able to fill in this gap in the near future.

We hope that everyone involved in telemedicine and eHealth will find this book not only interesting, but most valuable as well. We are open for collaboration, comments and joint researches. Let’s make the origin of telemedicine better known.

Enjoy your reading!

Anton Vladzymyrskyy, Malina Jordanova and Frank Lievens

References

