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A Century of Telemedicine: *Curatio Sine Distantia et Tempora* A World Wide Overview – Part III

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Content

Moving Forward

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Instead of a Preface

This is the third volume of the series "A Century of Telemedicine. Curatio Sine Distantia et Tempora: A World Wide Overview", presenting a historical approach of Telemedicine and eHealth in four countries – Bolivia, Denmark, Iran and Poland.

The chapters reveal different national and cultural points of view on the development and implementation of Telemedicine/eHealth solutions for the treatment of patients and wellbeing of citizens. The book provides a glimpse and summarizes the best practical achievements, governmental policies, existing solutions and experiences in these countries.

The editors are convinced that this volume provides useful information to those who are preparing to expand Telemedicine/eHealth in their regions or countries. It will allow them to rely on the experience of the others and make them aware of the benefits and problems that encountered during and after implementation of systems or services, and as such, will help to possibly avoid mistakes and reduce potential problems.

It is necessary to remind that as in previous books:

- Each chapter covers various areas of Telemedicine/eHealth in one country;
- The countries presented in the volume are chosen on basis of a random selection method;
- Chapters are listed alphabetically, following the countries names;
- The original style of the authors was respected as much as possible;
- Despite the amount of information included in each chapter, no doubt that many services, projects and facts are still out-of-sight. We hope to be able to fill these gaps in the later editions.

We hope that everyone involved in Telemedicine/eHealth will find this book not only interesting, but most valuable as well.

Often colleages asked us, why we dedicate so many efforts and time to prepare and publish this series. The answer is simple. We firmly believe in

the neceesity to studying and knowing history and in the benefits of international cooperation and collaboration.

Knowing History

"The Past supplies the key to the Present and Future". These words belong to an ancient historian. History tells us how we came to know what we know today. Marcus Tulius Cicero (106-43 BC), a roman writer, politician and great orator almost 2000 years ago, summarized the importance of history:

"*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 the 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.

More than a hundred year ago, E. F. Cordell, the President of the Medical and Chirurgical Faculty of Maryland, USA, while giving his presidential address to the Faculty chosed the topic "The Importance of the Study of the History of Medicine". In his speech, he criticized the lack of formal teaching of the history of medicine. His words explicitly summarize the necessity of knowing it [1]:

"… since history is ever repeating itself, it is manifestly the part of wisdom to make it the object of our closest study, that we may profit by its lessons, both of success and of failure; for what others have done or have failed to do should point the way to their successors, whether in search of individual, social or national guidance."

Time proved that knowing history of medicine not only contributes to the improvement of clinical healthcare but it provides everlasting lessons in the dominion of medical ethics, gives an appreciation for the profession, shapes every aspect of our commitment to patients and medicine .

The history of Telemedicine/ eHealth is part of medical history. Although it lasts for only 150 years, we still have a lot to learn. The field is in its childhood and is rapidly developing. Even its nomenclature is not yet developed! A standardized nomenclature serves as a common language for recording and reporting information at all levels of health care for the entire range of uses. It supports patient safety; allows exchange of information between medical professionals, comparisons and measurement of the same vital parameters, etc. Standardized nomenclature is essential for defining

and naming innovative technologies. As a nomenclature is not available, we have to start with an outline of the terminology, used in the book.

Terminology

Telemedicine

What is telemedicine? Telemedicine encompasses diagnostic, treatment and prevention processes within the frame of modern health care services, carried out primarily by means of telecommunication and computer technologies. Its history goes back to over 150 years [2-4].

For decades, there was no internationally accepted definition of telemedicine. A study published in 2007 found 104 peer-reviewed definitions of the word [5]. Recognizing this, the World Health Organization [6] 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".

In sum, WHO has underlined that telemedicine includes four interrelated elements: (1) clinical support; (2) usage of various types of information technology thus leading to the (3) improvement of health outcomes and (4) overcoming the geographical barriers, connecting users.

When did the term telemedicine appear? This 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.

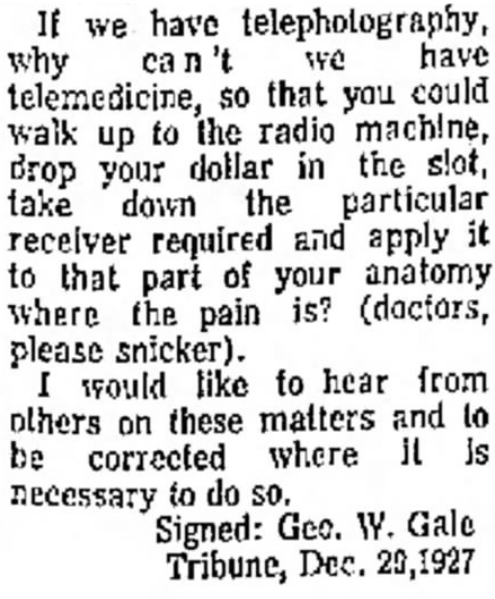
Willem Einthoven introduced the Latin prefix "tele-", designating the remote delivery of medical service, in 1906, when he suggested the term "telecardiogramme" [7-8].

Many authors dated the origin of telemedicine to 1974, referring to the article of R. G. Mark [9]. However, as we have mentioned in other publications [4] in the scientific literature the term "telemedical technique/technology" was used by R. L. Murphy et al. in 1970 [10]. Further historical investigations have forced us to revise this information. 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)" [11] (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.


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).

I would like to hear from others on these matters and to be corrected where it is necessary to do so.

Signed: Geo. W. Gale

Tribune, Dec. 29,1927

Fig.1. Fragment of the note with the term "telemedicine" dated 29.12.1927

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.

eHealth

With more involvement of the electronic communication systems, the major international organizations, European Union (EU), International Telecommunication Union (ITU) and European Space Agency (ESA) have officially adopted the denomination "eHealth" [12].

"*eHealth refers to the use of modern information and communication technologies to meet the needs of citizens, patients, healthcare professionals, healthcare providers, as well as policy makers*".

eHealth provides a new method for using health resources such as information, money, and clinical services. With time, it should help to improve the efficient use of these resources. The Internet also provides a new medium for information dissemination and for interaction and collaboration among institutions, health professionals, health providers and the public. That is why WHO underlines that eHealth is "the transfer of health resources and health care by electronic means" and incorporates three main areas:

- The delivery of health information, for health professionals and health consumers;
- The use of IT and e-commerce to improve public health services, through the education and training of health workers;
- The use of e-commerce and e-business practices in health systems management.

In 2005, the World Health Assembly recognized eHealth as the way to achieve cost-effective and secure healthcare and urged its Member States to consider drawing up long-term strategic plans for developing and implementing eHealth services and infrastructure in their health sectors.

It is necessary to mention one more term – mHealth. mHealth or "mobile health" is a component of eHealth. It involves the provision of health services and information via mobile technologies, such as mobile phones, tablet computers and Personal Digital Assistants.

Recently, the following two terms are also often used:

Telehealth & Telecare

Telehealth is the means by which technologies and related services, concerned with health and well-being, are accessed by people or provided for them, irrespective of their location [13].

Telehealth involves the use of telecommunications and virtual technology to deliver health care. The part of telehealth, requiring access only to telecommunications, is the most basic element of eHealth [14].

Is telehealth different from telemedicine? The answer is "Yes". The reason is that telehealth refers to a broader range of distant services as compared to telemedicine. Telemedicine focuses on clinical services, while

telehealth may include lots of non-clinical services as for example administrative activities as meetings or management support, educational activities, training seminars, access to literature and medical knowledge, etc. Telehealth includes various forms of surveillance, health promotion and public health functions.

The second term is telecare. Telecare is the support and assistance provided at a distance using information and communication technology. This is an automatic, non-stop remote monitoring of users. It enables and supports citizens living in their own homes or in institutions. Telecare helps to minimizing risks. To fulfil its goals it relies on sensors. These sensors are either part of a telecare system and send the information to the monitoring service or a "stand along" devices that the user or the caregiver have. The latter are not connected to the community system. For example, sensors for smoke and gas or floods are part of telecare devices. In addition, telecare services may include reminders to take medicines on time, help in real time emergencies like falls, contacting help centers automatically, if and when needed; may organize quick contact with family members, doctors, emergency services, etc. It is also able to arrange home visit when needed, etc. Telecare systems are able to alarm the user for possible or emerging problems by sound alarm, flashing lights or vibration.

Yet, during this last decade, the buzzword is Digital Health.

Digital Health

Is digital health something new? What is it? No doubt, digital healthcare technologies are leading the way and their implementation is increasing. However, defining digital health is not easy as there is no consensus on its definition.

Recently, the term digital health was introduced as "a broad umbrella term encompassing eHealth (which includes mHealth), as well as emerging areas, such as the use of advanced computing sciences in 'big data', genomics and artificial intelligence" [15].

The World Health Assembly Resolution on Digital Health approved by WHO Member States in May 2018 underlined the recognition of the value of digital technologies to contribute to advancing universal health coverage (UHC) and other health aims of the Sustainable Development Goals. This resolution urged all ministries of health "to assess their use of digital technologies for health […] and to prioritize, as appropriate, the development, evaluation, implementation, scale-up and greater use of digital technologies..." [15].

Recent studies revealed that Artificial Intelligence (AI) and Big Data techniques contribute significantly to digital health. Their successful

application is due to up-to-date computer resources and the availability of massive datasets. Both AI and Big Data can improve the management of information therefore supporting a more precise and advanced patients' treatment and supervision.

What is the correct terminology? Which term to use – telemedicine or eHealth? Or, may be telehealth or digital health? To this very moment, the terminology has neither been agreed in Europe nor at worldwide level. That is why we have let the authors to choose the terminology they used, based on their preferences and mainly on what is universally acceptance in their countries.

International Cooperation

As already mentioned, the second reason to dedicate time and efforts in publishing this series is that we believe in the benefits of international cooperation and collaboration.

Today Globalization is shaping our world. It is moving closer together - trade, technology and investment increasingly connect countries and people around the globe. People and products move, time and distance are no longer obstacles; ideas do spread faster than ever before. Nowadays we are talking about Global health, i.e. health problems, issues, and concerns that transcend national boundaries, which may be influenced by circumstances or experiences in other countries, and which are best addressed by cooperative actions and solutions.

The globalization and wide application of telecommunication technologies influence healthcare in one more aspect. Healthcare systems are due to serve diverse populations. This never happened before in human history.

The diversity goes far beyond a language barrier. It includes culture, gender, sexual orientation, religious beliefs, and socioeconomic aspects. Attitudes toward what is acceptable and what is not in health care and treatment may vary among different populations. Medical staff has to provide care that acknowledges and recognizes these differences. This will be achieved only through international collaboration and cooperation.

To summarize

The goal of the series, and of this book in particular, is to present different national and cultural points of view on the development and implementation of Telemedicine/eHealth and to share the information with international, other national and regional institutions and policy makers as well as with all groups and individuals involved with healthcare.

The series "A Century of Telemedicine. Curatio Sine Distantia et Tempora: A World Wide Overview" provides directions of a wide variety

of decisions, able to affect the form and functioning of the healthcare sector over the next decades. It offers clues towards the expected future of health organization at community level. The results and guidelines presented apply to all – national and local administration, individual practitioners, group practices, healthcare systems, as well as to providers of health-related services where there are Telemedicine/eHealth interactions either directly to the patient or from provider to provider for the purpose of healthcare delivery.

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Telemedicine in Bolivia

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Introduction

Bolivia is a country that is in the central zone of South America with a territorial extension of 1.098.581 square kilometers. It limits to the North and the East with Brazil; to the South with Argentina; to the West with Peru; to the Southeast with Paraguay and to the Southwest with Chile. Its geography is very varied and diverse and is divided into three regions:

- **Andean zone or high plateau (altiplano):** It covers 28% of the national territory with an estimated area of 307.000 square kilometers. This area is located at more than 3.000 meters above sea level, and it is located between the two great Andean branches: The Western and Eastern or Royal Mountain Chain, which present some of the highest peaks in the Americas.
- **Sub-Andean zone or valleys:** Intermediate region between the altiplano and the eastern plains that covers 13% of the territory and includes the valleys and the Yungas (at 2.500 meters above sea level average). It is characterized by its agricultural activity and its temperate to warm climate (15 to 25ºC).
- **Eastern zone or eastern plains:** It covers 59% of the national surface and is located at north of the Eastern or Royal Mountain Chain, which extends from the foot of the Andes to the Paraguay River, it is a land of plains and low plateaus, covered by extensive jungles rich in flora and fauna. It records an average annual temperature of 22 to 25ºC.

The Bolivia population is 11.307.000 inhabitants, of which, men represent 50,4% and women 49,6%. At the national level, the main axis of the country (La Paz, Cochabamba and Santa Cruz) concentrates 71,5% of the total population [1].

In Bolivia, rugged geography hinders access to health services. The geographic accessibility represents a problem for the population that lives in the rural area and has low income. Also, there is a large gap between urban and rural areas due to the lack of inclusion of indigenous populations in the care systems and health promotion programs [2]. Considering this

problematic situation, the proposal of Telehealth could be a great ally to provide health services to the entire Bolivian population.

Telehealth is the use of Information and Communication Technologies (ICT) to exchange and provide health care services, solving geographical, temporal, social and cultural barriers. While the term "Telemedicine" is limited to direct medical care services, Telehealth denotes a broader definition. The World Health Organization (WHO) characterizes Telemedicine for providing clinical support, connecting users who are not in the same physical location, and involving several types of Information and Communication Technologies (ICT), to improve health outcomes [3].

Today, Telemedicine is applied in many countries. The uses and needs of Telehealth vary between developed and developing countries, since the latter struggle with transmissible and nontransmissible diseases, and with very few resources. There are many Telehealth projects throughout Latin America, Asia and Africa, but still with little published evidence [4]. Latin America is considered one of the emerging regions worldwide and has major growth challenges in various socio-economic aspects, including the health area, especially universal access to health services [5].

Approximately, 20% of the Latin American population lives in rural areas or remote areas. The inhabitants have very limited access to specialized health services. These communities do not have large medical infrastructures, and access to hospitals or health centers is hampered by the enormous distances and topography of the regions.

In Bolivia, people in rural areas do not have access to specialized health services, since, although there is a first level health center in place, there is only one general practitioner who is not a specialist in diagnosis and treatment of specific diseases [6].

To solve the problems mentioned above, the company Medspazio SRL, in collaboration with the Arco Iris Hospital from La Paz city, developed between 2011 and 2013 the RAFT (Réseau en Afrique Francophone pour la Télémédecine) Altiplano project, which consists of the implementation of a telemedicine network in the highlands of Bolivia, to improve access to medical care and continuing training in rural areas [7].

Likewise, the Government of Bolivia, through the Health Ministry, implemented the "Telehealth for Bolivia" Project. As such, the government guarantees access to the use of state-of-the-art medical devices in the 339 municipalities of the country, with 340 technological equipment implemented in health facilities, through which early detection of chronic nontransmissible diseases, disability, and prevalent diseases in endemic areas is made possible. The medical staff of this Telehealth project participates in

health fairs for respective socialization that takes place in regions far away from the national territory [8].

The main aim of this project is to use advanced telemonitoring devices. Similarly, not only will work be done on the use of remote devices and specialized medical care, but also in the prevention of diseases and promotion of health services. One of the most important qualities of this project is to be able to carry out complementary remote studies and interconsultations free of charge, through technological equipment.

In this chapter, the state of the art of Telehealth in Bolivia will be developed, describing the technologies installed in the country, as well as the results of its application.

ICT, Telecommunications and Services Growth in Bolivia

During the last few years, it is clear to see how the industry of telecommunications networks and services, and the New Information and Communication Technologies (NICT) have evolved rapidly and with great influence on the economy, advances in information technology, Internet and changes in telecommunications policies. The growth can also be noticed in institutions or companies that offer services related to information technology and communications, Internet, mobile applications and WEB based, programming in the Cloud and Big Data.

The latest data on the ICT development of the International Telecommunication Union in its publication **Measuring the Information Society Report 2018 - Volume 1**, shows a continuous progress in connectivity and the use of ICT. There has been a sustained growth in the availability of communications in the last decade, led by growth in mobile cellular telephony and, more recently, by mobile broadband [9]. The growth in fixed and mobile broadband infrastructure has stimulated Internet access and use for almost any task or service of current societies. This situation is evident both in the use of the Internet and in connectivity. More than half of households around the world now have access to the Internet. Households in developed countries are almost twice as likely to be online as those in developing countries. Young people have made the cloud and the Internet their new area of existence, it is estimated that the proportion of people between 15 and 24 years old that are online exceeds 70% worldwide, compared to only 48% of the general population. This phenomenon and the sustained growth of the availability of communications in the last decade have encouraged the access and use of ICT, developing new technologies such as the Internet of Things and access to services and applications based on WEB and the Cloud.

According to the International Telecommunication Union (ITU), through its ICT Development Index (IDI), which is a composite index that combines 11 indicators in a reference measure that can be used to monitor and compare the development of ICT among member countries and developed by the ITU, in response to the request of the Member States of the ITU to establish a general index of access to ICT, presented for the first time in the **Report on the measurement of the Information Society 2009** [10] and published annually since then; we observe in the results of the IDI 2017, that the upward trend in the penetration and application of ICTs indexes has been maintained, which has been evident since the beginning of this index, but they also show that there continues to be large differences in the levels of development of ICT among countries and regions around the world. The average value of the IDI among the 176 economies - including Bolivia- in 2017 was 5,11; an increase of 0,18 points (3,72%) compared to the 2016 IDI. In this index, Bolivia has ranked 117th for several years, compared to Argentina, which ranks 64th, and Chile, 66th. It can be clearly shown that in our country there is still a gap that should be considered as an opportunity for the development of companies related to ICT and thus to meet this global demand for information technologies [9].

At present it can be considered that there is a growth of telecommunications and services in our country, according to the report of the Authority for Regulation and Control of Telecommunications and Transport - ATT [11], which indicates that access to the Internet in Bolivia in 2017 reached to 8.817.749 of fixed and mobile connections, of which it totals, 7.939.275 are in smartphones connected to the Internet. The number of these phones that access the mobile Internet represent 90% of the total Internet connections. The technology with the fastest growth was access through broadband networks over optic fiber, it experienced a growth of 214,9% since 2016 with a total of 141.920 connections to 2017.

The mobile Internet traffic service shows exceptional growth during the last year and a half, from 6,2 Peta bytes in years prior to 2015, to 12 Peta bytes in the period 2015 to June 2017, in data consumed by mobile terminals, smartphones and modems. Access to applications, social networks and the visualization of video content are the main drivers of consumption and support the traffic growth. The ATT also reports on its official website through a press note on 07/09/2018, that in the first quarter of that year, there are 11.323.497 mobile lines enabled in the country, the departments with the highest concentration are: La Paz 29%; Santa Cruz 28% and Cochabamba 18%. Regarding access to the global network, Bolivia has more than 9,4 million Internet connections in the first quarter of 2018. The growth of Internet connections, at a national level, increased in the first quarter of 2018

in a 6,8%, with respect to the 2017 management. Similarly, in this analysis, it is highlighted that the population's access to the Internet is preferably through their mobile, reaching 95%; while in fixed 4% and another 1% of the universe of connections.

For a decade, in Bolivia the net revenues of the mobile telephony and Internet service have greatly exceeded the rest of the services in the telecommunications sector. From the 2017 management, the Internet access service generated the largest economic flow in the se ctor, with 5.420 million Bolivianos (Bs.) of net income, greatly exceeding the mobile service, which reached 3.134 million Bolivianos, in closed data of the supervisor entity.

It is important to note that in 2010 the Bolivian Space Agency (ABE) was created to promote the development of satellite and space projects. In 2013, Bolivia put into orbit the first Bolivian satellite called Tupac Katari, with in order to provide communication, Internet and satellite television services to the general population, in addition to work on other satellite projects such as "Telehealth for Bolivia "[12].

In Bolivia, there are two earth stations to perform satellite telemetry, which are in the town of La Guardia (Fig. 1), located at 25 km from the city of Santa Cruz, and Amachuma (Fig. 2), located at 35 km from the city of La Paz.

These high growth rates show the importance of the current service, and explain why this has strengthened as one of the markets of greater competition and dynamism, becoming a platform for information and communication technologies development through the Internet.

Figure 1. La Guardia earth station

Figure 2. Amachuma earth station

RAFT Altiplano

The RAFT-Altiplano Project was born as an extension of the RAFT Project in Latin America, thanks to the initiative of Dr. Alejandro Vargas, with the help of Prof. Geissbuhler of the Cantonal Hospital from Geneva in Switzerland; Dr. Reynaldo Vargas from Medspazio S.R.L. from Bolivia; and the Swiss watch company PIAGET. The RAFT project (Africa), created 13 years ago under the direction of Prof. Geissbuhler, with the aim of helping professionals and students in places of greatest need, began its activities in the Republic of Mali, and over the years it extended to more than 60 hospitals in 20 countries in Africa. In this project activities of Teleconsultation, Teleradiology and distance learning are carried out [13].

In 2011 the experience acquired in the RAFT network extended to Latin America as the Telemedicine project - "RAFT-Altiplano" - and began in the Titicaca Lake region with the implementation of equipment and Internet connection at the "Hospital de Clínicas" of La Paz (reference hospital) and four peripheral centers (H. de Patacamaya; H. de Tiquina; H. de Copacabana, and the Yumani Health Center - Isla del Sol), institutions that were pioneers when implemented in Bolivia, in addition to the adding of mobile offices (Fig. 3).

By the year 2012, the network extended to Potosí - Altiplano South - to the Uyuni Salt bank region (Health Center of Uyuni, Llica and Colcha-k), having

as a reference the Daniel Bracamonte Hospital from Potosi. In the same year, Arco Iris Hospital enters the network and becomes the headquarters of the Project. In 2013, the network was extended to the department of Oruro in the health centers of Orinoca, Curahuara de Carangas, Challapata and the General Hospital of Oruro (as reference center) [14].

Figure 3. Mobile consultation RAFT Altiplano Project

The objectives of the project are mentioned below:

- To develop and to use Internet connections between regional and national health institutions;
- To develop a Teleconsultation system using computer services such as email, Teleconferences and a Telemedicine portal;
- To Implement the *Dudal* Teleteaching system for user training that needs little broadband;
- To evaluate the viability of a long-distance collaboration for clinical consultation and continuing medical education.

Being a collaborative project, the largest equipment part was donated to the health centers, among this equipment are the items mentioned in Table 1:

Table 1. Donated Items for RAFT Altiplano Project

Equipment
Laptop

Web camera
Portable echograph
Electrocardiograph
Digital photographic cameras

The format of all the material obtained must be digital, with the aim of acquiring the clinical data electronically and sending them to the reference centers specialists. The data obtained is stored in a central server. For the information sending and management, a platform that can be integrated with other technologies was developed, which is made with Microsoft technology, its main functions are: content management, search engine, electronic document management and creation of statistical forms. In addition, it can connect to a RIS (Radiology Information System)/PACS (Picture Archiving and Communication System) server, which is specially adapted to perform Teleradiography in agreement with international standards.

The personnel dedicated to carrying out this work becomes a key piece for its operation, the functions that should be carried out and the personnel in charge of it would be the following [7]:

1. A health professional trained to use telemedicine tools.
2. Medical specialists who ensure diagnoses and treatments.
3. The coordination team, formed by professionals in medical informatics, who supervise work flow and trainings.
4. The technical support and maintenance team.

The network infrastructure used for connections at the national level are based on Internet technology that is available in the national market. The teleteaching system used is *Dudal*, which allows the production and diffusion of online courses and conferences using very little broadband (less than 30 Kbits/s) with easily accessible material. It was specially developed by the University of Geneva with these characteristics, it displays the slides while the exhibition is being carried out (audio and video) and provides the functionality of interacting with the exhibitor through instant messages.

Teleconsultation Workflow

The workflow begins with the opening of a clinical case by the consulting professional (may be a doctor, nurse, nursing assistant, intern or resident) on the telemedicine platform, who accesses with a user account for security, and to preserve the confidentiality of medical data. The relevant demographic and clinical data of the patient, diagnostic impressions, treatments until the moment of the teleconsultation, questions asked to the specialist and recommendations about the patient's care are recorded. Next, digital

photographs and digital echographic image files are recorded in the central server via web (Fig. 4) [7].

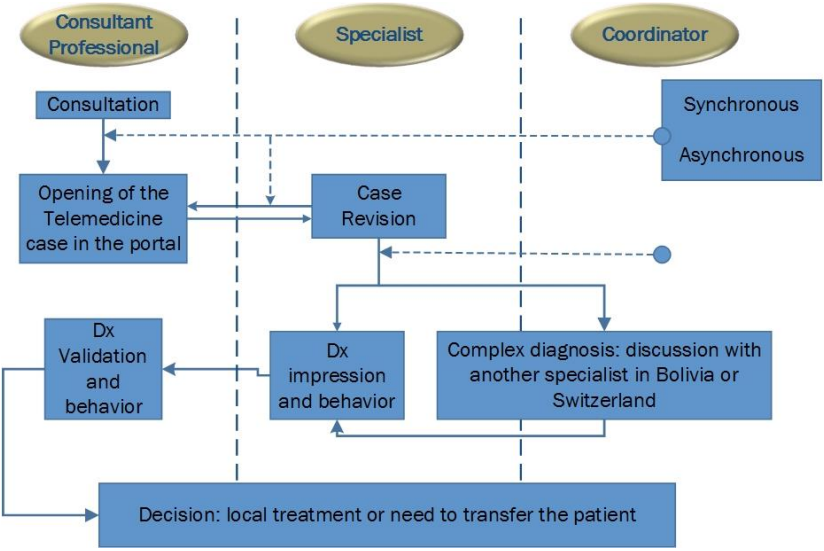

Figure 4. RAFT Altiplano Project teleconsultation workflow

Afterwards, the specialist doctor opens the clinical case, studies the medical information, files sent, answers the questions, gives a diagnostic impression and makes recommendations about the treatment guidelines that should be followed with the patient. This process can be synchronous (in real time) or asynchronous (if it responds within 24 and 48 hours after the initial consultation). The coordination team oversees the process that ensures the data is clear, legible and adequate to respond to the consultation properly. This workflow requires the continuous training of all professionals.

Since the beginning of the project until 2013, it has been possible to establish a national telemedicine network based in the Arco Iris Hospital, which connects more than 20 health institutions in three departments of the Bolivian highlands (La Paz, Oruro, Potosí). This network respects the structure and organization of the current health system in Bolivia, and, consequently, the work is carried out in coordination with the staff of the health centers (of levels I, II and III), the departmental health service, the Health Ministry and Vice Ministry and the municipal governments.

According to the estimations, the beneficiary populations are mainly rural, with an average of 10,000 inhabitants each. The target population is more than 200,000 potential patients, and to date, only in rural areas the average

number of consultations/year amounts to 700. In addition, the medical staff of these centers (more than 100 participants) has been trained in the use of telemedicine equipment and tools.

Currently, it works with more than 15 medical specialties covered by the experts of the Arco Iris Hospital and some reference centers (of level III) to respond to the requests of three departments of Bolivia. 10 centers in La Paz among which the following are cited [15]:

- Hospital de Clínicas;
- Arco Iris Hospital;
- Child's Hospital;
- Women's hospital;
- Korea Hospital in El Alto;
- Isla del Sol;
- Tiquina;
- Copacabana;
- Patacamaya;
- Coroico.

Four centers in Potosí, which are:

- Daniel Bracamonte General Hospital;
- Llica;
- Colcha-k;
- Uyuni.

And four centers in Oruro, which are:

- San Juan de Dios General Hospital;
- Orinoca;
- Challapata;
- Curahuara de Carangas.

Up to April 2014, 954 Teleconsultations were notified, a fluctuation in their number was observed due to social problems and the end of the year season (Fig. 5). The maximum activity has been registered in the department of Potosí (50%); followed by the city of La Paz (32%), and Oruro (13%) (Fig. 6). It should be noted that Oruro was the last one to start carrying out the activities in telemedicine. The largest number of Teleconsultations per center was registered in the centers of Llica (13.2%), Colcha-k (13.2%) and Isla del Sol (10%) [7].

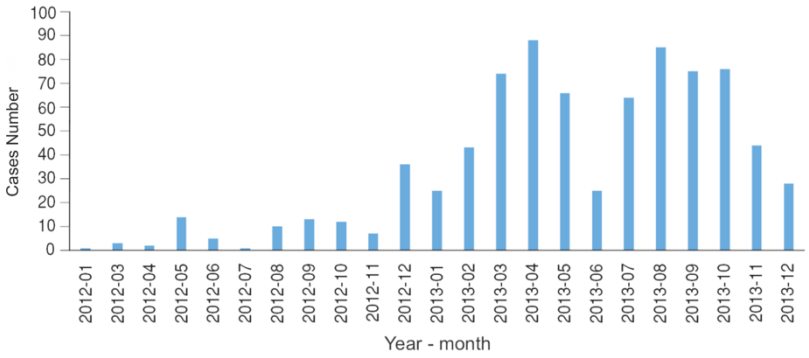

Figure 5. RAFT Altiplano Project Teleconsultations carried out by month and year

These data show that the greatest activity takes place in the most remote centers, where there is more need and in which the referral of a patient to the next level of care lasts between 4 to 10 hours.

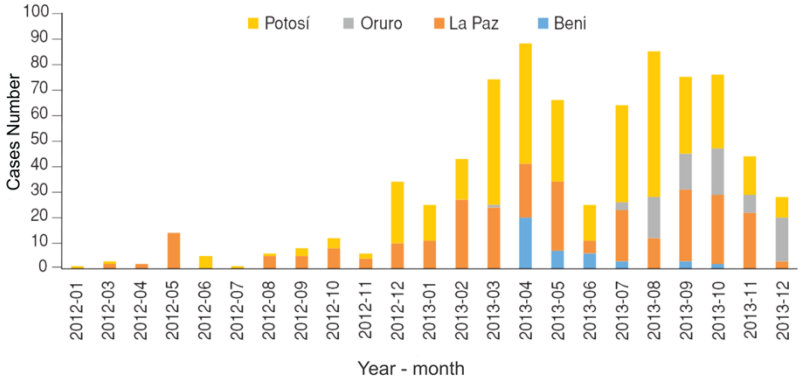

Figure 6. RAFT Altiplano Project Teleconsultations carried out by month, year and department

Among the most consulted specialties are dermatology (42,3%), internal medicine (15%), and obstetrics (obstetric ultrasound 10%). In Figure 7, the Teleconsultations made by medical specialty are presented.

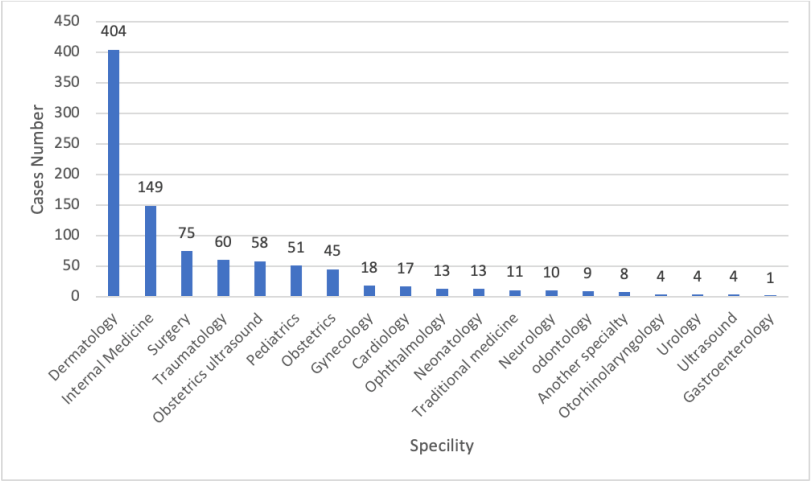

Figure 7. RAFT Altiplano Project Teleconsultations performed by medical specialty

This is explained because in the altiplano, located at 3.600 meters above sea level, dermatological diseases are frequent. On the other hand, ultrasound controls are requested for prenatal control. 24% of consultations were made with children under the age of five (from the SUMI insurance); 10% with adults over 65 (from the SSPAM insurance); and 66% with patients between 5 and 65 years old (without insurance).

In the Teleteaching system, to date, 86 courses have been registered in the telephone database, 55% of which were provided by professionals from the Arco Iris Hospital. 25% are courses that are part of the programs of the international congresses of telemedicine and medical informatics, and the rest have been carried out in many other centers [7].

Telehealth for Bolivia

The great advance in the technologies related to medical assistance and the accelerated Telecommunications growth have managed to promote Telemedicine worldwide, causing a technological advance in the health system. Bolivia can become the solution to expand access to health services, mainly in geographically distant areas or in rural areas, in order to benefit these communities with specialized medical attention favoring and improving population health.

There are different definitions of Telehealth or Telemedicine, all have three factors in common: the provision of health services, the distance between

users and the use of ICT [16]; therefore, Telehealth is not only the implementation of technology or an assistance tool, it is a process through which it is possible to provide greater access to the health system to people who are in communities far from the health centers.

The Telehealth project in Bolivia allows the use of advanced technology in the telecommunications area in order to make and facilitate the exchange of medical information of patients, both in real time and remote. In addition, it allows access to the health service regardless of distance, allowing teleconsultations, diagnosis, epidemiological surveillance and research, enabling people from remote communities to access to a health service to which they did not have access before.

Background

The Political Constitution of the State of Bolivia, through Supreme Decree No. 1182, of April 4, 2012, in its articles 35 and 37 establishes that [17]:

- The State, at all levels, will protect the right to health, promoting public policies aimed at improving the quality of life, collective welfare and free access of the population to health services.
- The State has an unwavering obligation to guarantee and sustain the right to health, which is constituted as a supreme function and first financial responsibility, prioritizing the promotion of health and the prevention of diseases.

Therefore, the executive body through the Health Ministry establishes the regulations, planning, control and coordination of all activities throughout the national territory, both in public and private institutions. Then to comply with the strategic guidelines of the National Development Plan (NDP), which was approved by Supreme Decree No. 29276 of September 12, 2007, the creation of health promotion and prevention programs was decided, as well as providing support to the most impoverished sectors of the different social levels of Bolivia, providing highly qualified advice and support, and allowing access to Public Health.

According to Ministerial Resolution No. 101 of February 21, 2013, the operational technical program in infrastructure and medical equipment, modifies its scope and states: "It will be the Project Executing Unit (PEU) responsible for the projects execution, also among its components Social assistance is mentioned to people and charities and the equipment and medicines acquisition for the projects to be executed by the program".

The Telehealth Project was created by law No. 396 of August 26, 2013, the law of modifications to the General State Budget (PGE-2013), which in article 21 cites the following:

Article 21. (Financing for the project "Telehealth for Bolivia")

I. Within the framework of the Intercultural Community Family Health Policy - ICFH, the Health and Sports Ministry is authorized to implement the first phase of the "Telehealth for Bolivia" project at the national level.

II. In order to comply with the preceding paragraph, the Economy and Public Finance Ministry is authorized, through the General Treasury of the Nation, to allocate up to Bs. 139.200.000 (One Hundred Thirty-Nine Million Two Hundred Thousand 00/100 Bolivianos), in favor of the Health and Sports Ministry; for which the Economy and Public Finance Ministry, and development planning, within the framework of its powers, must make the corresponding budget transfers that includes consultancies.

III. The Health and Sports Ministry is responsible for the execution, monitoring and evaluation of the "Telehealth for Bolivia" project, as well as the use and destination of the resources assigned in this article [18].

"TELESALUD PARA BOLIVIA" Program Aim

The main aim of the creation of the Telehealth program in Bolivia (Fig. 8) is focused on improving the quality of health care, both in time and effectiveness, for the entire public health sector, facilitating access to people who are located in geographically distant places in our country, in addition to reducing the shortage of specialized human resources, whose main effect will be reflected in the reduction of the country's mortality, especially in rural areas.

Figure 8. Telehealth for Bolivia program

In addition to reducing the geographic distance between communities, in Bolivia, the program seeks to achieve the following goals:

- To improve the care quality provided to patients, besides improving the coverage of the health system with the implementation of ICT;

- To increase specialized medical care in rural areas;
- To implement the management of a digitalized medical history;
- To perform continuous updates for health personnel;
- To increase and improve epidemiological surveillance;
- To streamline monitoring and control processes;
- To optimize information management in the public health system.

As mentioned above, this project is of great importance to obtain an improvement in medical care (Fig. 9), especially for those who are far from medical centers according to their needs, because there are communities in rural municipalities where people must walk for hours between one house and another. Since Bolivia is a country with an extensive geographic diversity - although that is a tourist attraction - in many circumstances it makes guaranteeing access to health for all the population becomes a difficult task to carry out.

Figure 9. Medical staff performing a teleconsultation

Significance

Currently, people living in rural areas away from cities, suffer from difficulties to obtain medical assistance and services. The main reason is that the existing health centers in these communities only provide basic services and do not have specialists (Fig. 10). For this reason people often have to make long-lasting trips to get the service in the cities, which causes a collapse in the third level hospitals, due to the great demand of patients.

Figure 10. Teleconsultation with the specialist in psychiatry at the San Juan de Dios, Santa Cruz Hospital and patients from Samaipata

Taking into account the Supreme Decree No. 3251 of July 12, 2017, it establishes in article 7 the following: "The Agency for Electronic Government and Information and Communication Technologies (AEGICT) has the function of elaborating, proposing, promoting, managing, articulating and update the Electronic Government Implementation Plan and the Free Software and Open Standards Implementation Plan for public sector entities; and other plans related to the field of Electronic Government and computer security "[19].

For this reason, the "TELEHEALTH FOR BOLIVIA" project proposes a system based on open standards of sanitary informatics and multimedia networks that is implemented by means of free software, as well as the specialized remote medical assistance service in real time, with the purpose

of eliminating and diminishing the barriers to obtaining medical assistance, mainly in rural areas.

It is intended to leave the passive method, in which the doctor waits for the patient in a chronic state, to an active method in which the doctor, in collaboration with the specialists and primary care doctors, follow up the patients avoiding that they could have more health complications (Fig. 11). In this way, the reduction of between forty to fifty percent of hospital admissions in the first-level hospitals is sought, allowing a more efficient organization and significantly reducing the medical care costs.

Figure 11. Patients follow-up from the Telehealth for Bolivia project

The project was carried out at the national level, it was implemented by satellite, fiber optic and microwave connections, it was installed in one hospital per municipality (Fig. 12), making a total of 339 places where a Telehealth terminal was installed, and they were distributed in three different levels called Tele 1, Tele 2, and Tele 3, which have their own characteristics according to the hospital level in which they were installed [8].

Figure 12. Health care service provided by the Telehealth project in the department of Santa Cruz, in the municipal hospital of Plan 3000

Equipment for Hospitals

As mentioned above, the Telehealth service has three levels of operation, which are distributed according to the level of the hospital, starting from the lowest level called Tele 1 in the program, continuing the intermediate level called Tele 2, and finally the most complete system called Tele 3, which are described in Table 2.

Table 2. Telehealth for Bolivia Distribution Sytem

Service Level	Telehealth Consulting	Functional Area
First level	Tele 1	Center that does not have a specialty
Second level	Tele 2	Center that do have a specialty
Third level	Tele 3	Departmental reference hospital

The difference of the "TELEHEALTH FOR BOLIVIA" project three levels is found in the equipment that each level has, then Tables 3, 4 and 5 describe the amount of equipment each one contains.

Table 3. Basic Telemedicine system (Tele 1)

Nº	Quantity	Details
1	1	Computer
2	1	Videoconference camera
3	1	Microphone
4	1	Printer
5	1	General examination camera
6	1	Otoscope
7	1	Electrocardiograph
8	1	Vital signs monitor
9	1	Ultrasound probe
10	1	Basic mobile cart
11	1	Clinical histories and videoconferences software

Table 4. Intermediate Telemedicine system (Tele 2)

Nº	Quantity	Detail
1	1	Computer
2	1	Videoconference camera
3	1	Microphone
4	1	Printer
5	1	General examination camera
6	1	Otoscope
7	1	Electrocardiograph
8	1	Vital signs monitor
9	1	Ultrasound probe
10	1	Spirometer
11	1	Colposcope
12	1	Ophthalmoscope
13	1	Basic mobile cart
14	1	Clinical histories and videoconferences software

Table 5. Advanced Telemedicine system

Nº	Quantity	**Detail**
1	1	Computer
2	1	Videoconference camera
3	1	Microphone
4	1	Printer
5	1	General examination camera
6	1	Otoscope
7	1	Electrocardiograph
8	1	Vital signs monitor

9	1	Ultrasound probe
10	1	Spirometer
11	1	Colposcope
12	1	Ophthalmoscope
13	1	Basic mobile cart
14	1	Clinical histories and videoconferences software
15	3	Computer (32” Monitor)
16	3	HD camera

Figure 13. Telehealth for Bolivia equipment

A total of 340 teams were installed (Fig. 13), of which 269 terminals are in first level service centers; 69 terminals are installed in second level service centers; and finally, 10 care centers are in third level hospitals. Of the last ten, there is a specialized team in each capital city of the different departments, and one will be in facilities of the Ministry of Health so that the corresponding follow-up to all the health centers can be carried out [20].

The equipment distribution, including the three levels, is shown in Table 6 [21], where the number of devices installed in each department of the country can be appreciated, reaching a current total of 340 stations installed around Bolivia (Fig. 14).

Figure 14. Telehealth equipment

Table 6. Telehealth equipment distribution

Nº	Departament	Tele 1	Tele 2	Tele 3	Total
1	La Paz	75	11	1	87
2	Cochabamba	39	7	1	47
3	Beni	16	2	1	19

4	Santa Cruz	36	19	2	57
5	Oruro	30	4	1	35
6	Pando	14	0	1	15
7	Tarija	7	3	1	11
8	Sucre	20	8	1	29
9	Potosí	32	7	1	40
National Total					340

Additional Services

In addition to providing teleconsultation services nationwide, the "TELEHEALTH FOR BOLIVIA" program has three platforms, which are briefly detailed below:

• *Teleeducation*

From 2015, MOODLE platform was implemented (Moodle is a learning platform designed to provide educators, administrators and students with a unique, robust and secure integrated system to create personalized learning environments [22]). With the help of this platform, courses, press releases, newsletters are introduced. To date, there are already registered users in said platform for respective courses and training, in coordination with the dependent areas of the Health Ministry.

•*Vidyo*

Vidyo's Telemedicine solutions extend far beyond the delivery of care to rural patients. We conduct clinical efficiency and continuity of care through different care environments, in order to obtain better results for patients at a lower cost for institutions [23]. It was implemented from the first phase of the project, in order to provide the connection in video and audio in real time to the different municipalities connected to the Telehealth network, allowing access and sharing of all types of data in real time between the patient and the specialist.

• *Digital-tconsult*

The medical records server was a platform implemented with a database and forms designed from the beginning of the project. In 2016, in conjunction with the medical staff in charge of the Telehealth project, a new form for the digital clinical record that satisfies the records and advances requested by Telehealth doctors and the general coordination of the project was obtained.

Implementation and Integration of Telehealth and Medical Information Systems in the Present

Currently, Medical Information Systems (HIS, LIS, RIS) and Pharmacy computer systems are being implemented in Third and Fourth Level Hospitals, as well as Social Security Systems, Medical Insurance and others, among which are integrated clinics and environments for Telemedicine, so that they can be integrated and communicated to the corresponding Health network.

Currently, in Bolivia there are public, semi-public and private short-term social security systems that, to a lesser and greater degree, have implemented patient care systems based in Medical Centers, Polyclinics and Hospitals, in which Medical Information Systems are already being applied, such is the case of Petrolero Hospital CPS (Caja Petrolera de Salud) in Obrajes, La Paz Bolivia; Hospital Santiago Segundo in El Alto, La Paz Bolivia; University Social Security in Cochabamba Bolivia, and other Social Security, this with the aim of integrating the Health network through timely medical care, as well as Health Centers or Polyclinics in provinces and remote places with hospitals in capital cities [24].

Likewise, in March 2019, the Universal Health Insurance (UHI) entered into force in accordance with the provisions of Law No. 485, which has as its object in art. 1. (OBJECT):

- Establish and regulate the comprehensive care and financial health protection of the beneficiary population described in this law that is not covered by the Short Term Obligatory Social Security;
- Establish the bases for the universalization of comprehensive health care.

Granting the definitions of coverage and scope of the present Law N° 485 in art. 3 (DEFINITIONS):

- **Health Technology:** It is the set of medicines, devices and medical or surgical procedures used in health care, as well as the organizational and support systems, within which such care is provided.
- **Mobile Health Team:** It is a multidisciplinary team of professionals and health technicians who perform care in remote places or those that are not covered by the staff of health facilities.

Therefore, the Universal Health Insurance has within its benefits mobile health teams to provide medical consultations with assistance of higher levels of health with the help of medical specialties, also has organizational and

support systems with the application of ICT, Systems of Medical Informatics and Telemedicine.

The New Hospital Centers of Second, Third and Fourth Level that are in the stage of Design (Pre-investment) and Implementation (Investment) have within their portfolio of Services and Architectural Medical Program (AMP) offices and cabinets equipped for Telehealth (Telemedicine), with the aim of integrating with health centers in the provinces and places of difficult access that will be integrated into Medical Information Systems. The latter will have a digital patient record, diagnostic studies carried out, as well as other data - medical and administrative [25].

Conclusion

The Telemedicine experience like the Bolivian one can be translated into a decrease in time between the need for specialized attention and the response time in geographically distant places, which do not have a specialized service between care and diagnosis with a qualified specialist (Fig. 15, Fig 16), consequently, avoiding the transfer of the patient to be assessed, considerably reducing the time and money invested by the patient.

Figure15. Medical specialty care through the Telehealth program

Figure 16. Specialists assessment in the Telehealth project

It is for this reason that the impact of ICT generated great interest from the Health Ministry, especially due to the great advance experienced in recent years in the development of solutions in the medical area. Therefore, throughout the project "TELEHEALTH FOR BOLIVIA" to date, the following has been achieved:

- Reduction in waiting time at the care by medical specialists;
- Identification of possible first-level complications and referral to centers with greater capacity for their care;
- Reduction of emergencies in second and third level care hospitals;
- Reduced time and economic savings for patients from remote communities;
- Decrease in the mortality rate through surveillance and monitoring of the riskiest pathologies, giving greater importance to maternal and child health;
- Training of personnel in the health area through access to ICT.

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Telemedicine in Denmark

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Introduction

Denmark is located in the Northern part of Europe and populates 5.8 million people on 42,938 km^2 (population density = 135 citizens/km^2). Life expectancy is 81 years and like many other countries, Denmark is facing an ageing population and a growing number of chronic patients.

The Danish healthcare system is universal and based on the principle of free and equal access to healthcare for all citizens with most healthcare services financed by general taxes.

The Danish healthcare system operates across three political and administrative levels: national, regional and local. At national level, the Danish Ministry of Health is responsible for establishing the overall framework for the provision of health and elderly care, the delivery of which is decentralised to the 5 regions and 98 municipalities in Denmark. The five Danish regions are responsible for hospital care and health services provided by general practitioners (GPs) and specialists in private care. The 98 municipalities are responsible for several health and social services, including e.g. homecare, prevention and rehabilitation. In recent years, the municipalities have taken over several tasks and responsibilities that have previously been managed by the hospitals and this process is continuing.

The Danish healthcare sector is one of the most digitised in the world. All hospitals, GPs and municipal health services have information technology (IT) systems, most messages are digitised (e.g. referrals, discharge summaries, laboratory test results, prescriptions, etc.), and communication and sharing of health data have been possible for a long time. This is supported by a Shared Medication Record and a national eHealth portal (www.sundhed.dk), which is accessible for patients and clinicians. Hence, workflows at hospitals, in general practice and in municipal health services are already highly digitised. However, the demographic changes and an increasing demand for complex and coordinated healthcare services require a continued focus on a more efficient provision of healthcare, and, there-

fore, substantial efforts have been - and still are - made when it comes to digitisation, including the use of telemedicine.

Strategies for eHealth and Telemedicine in Denmark

Strategy and Policy for eHealth in Denmark

Denmark has had national eHealth strategies since the late 90's. The strategies focused initially on digitisation of the healthcare sector with special attention given to the development and implementation of electronic health records in the hospitals and electronic medical records in primary care. Today, Denmark is highly digitised and has a sound foundation on which to continue the digitisation.

Over the years, national eHealth strategies have built upon some basic policies:

- A multi-vendor environment, meaning that each healthcare organisation is free to choose eHealth applications of its own choice. Consequently, there is a diversity of systems in the healthcare sector, and as the IT systems used are not integrated, national exchange formats and standards have been developed and made mandatory in the entire Danish healthcare sector to support the sharing and exchange of health information between different applications and sectors.
- All healthcare organisations must adhere to and implement commonly agreed interfaces, standards, terminologies and classifications to maintain both technical and semantic interoperability for data exchange purposes.
- Profiles and exchange interfaces for electronic communication in the healthcare sector are developed in a process of consensus.

National Action Plan for Implementation of Telemedicine, 2012

Telemedicine has been a part of the national eHealth strategies since 2008, but the first major national telemedicine action plan was launched in 2012 [1]. With the plan, the Danish Government, municipalities and regions took the first large step to speed up the use of telemedicine solutions. Five telemedicine initiatives were selected for test and deployment on a large or small scale:

1. Clinically integrated home-monitoring;
2. Home-monitoring for Chronic Obstructive Pulmonary Disease (COPD) patients in the North Denmark Region;
3. Demonstration and implementation of telepsychiatry;
4. Demonstration of internet psychiatry;
5. Implementation of telemedical assessments of ulcers to all regions and municipalities.

Since then, the healthcare system has worked strategically with deploying of telemedicine and welfare technologies that support work procedures for employees and better care and treatment for the patients.

Today, home monitoring for COPD patients is being implemented throughout the country and digital solutions exists for people with mental health problems, including telepsychiatry. In October 2017, the five regions in Denmark decided to offer internet-based psychological treatment of anxiety and mild to moderate depression as a two-year pilot project across the country. Finally, telemedical assessments of ulcers is implemented throughout the country.

Organisation of eHealth in Denmark

The governance and operation of eHealth in Denmark rest within several organisations. The National Board of eHealth is the highest authority in Denmark regarding eHealth matters. The board advises the Minister of Health regarding IT strategies and IT architecture along with national demands and standards for eHealth.

The operation of eHealth rests within several organisations that are responsible for development and implementation of the efforts and goals of the national strategies. Under the Ministry of Health, the Danish Health Data Authority operates as a governmental body. At regional level, Danish Regions is the joint association of the five regions, and at local level, Local Government Denmark operates as a joint association for the 98 municipalities. Furthermore, there are two eHealth organisations, which are governed by the state, regions and municipalities:

- ***sundhed.dk***, which is an official online portal for public Danish healthcare services and enables citizens and healthcare professionals to find citizen-related information and communicate, as well as the organisation
- ***MedCom*** that facilitates the cooperation between authorities, organisations and private firms linked to the Danish healthcare sector. MedCom contributes to the development, testing, implementation and quality assurance of electronic communication and information exchange in the entire healthcare sector in Denmark, including telemedicine.

Telemedicine Centres

In Denmark, three regional telemedicine centres have been established, each serving a different region.

Centre for Telemedicine, Central Denmark Region

In 2012, Central Denmark Region established a Centre for Telemedicine [2] as part of the strategic development of the telemedicine area and a vision

of “A patient-centred healthcare service”. The centre was established to ensure dissemination of the best telemedicine solutions by supporting and helping healthcare professionals in the region to succeed with telemedicine. Furthermore, the purpose was to ensure that the solutions offered provided high value for both citizens, healthcare professionals and society.

The Centre for Telemedicine and Telehealthcare has six strategic focus areas:

1. To disseminate sustainable telemedicine solutions;
2. To build bridge across healthcare sectors ensuring continuity of treatment;
3. To promote user-oriented solutions and IT development;
4. To prevent disease and exacerbation, e.g. through home-monitoring and empowerment of patients;
5. Being a knowledge forum for telemedicine;
6. Securing large-scale operation of telemedicine.

Examples of the tasks performed by the centre includes:

- Knowledge gathering and sharing about telemedicine through workshops, conferences, newsletters, homepages etc. and facilitation of telemedicine network meetings;
- Provide guidance tools on telemedicine for healthcare professionals (quick guides e.g. on development, regulatory and legal issues, implementation etc.);
- Sharing knowledge about design processes (methods) and user experience;
- Coordination and ensuring consistency with other eHealth efforts and strategic focus areas;
- Clearing the way for deployment of telemedicine at large scale – both on regional and national level.

The Central Denmark Region considers telemedicine to be an important tool for involving citizens in their own treatment and for promoting patient empowerment. Also, telemedicine is considered a powerful tool for securing continuity of care across sectors as well as efficient treatment of high quality. A list of the region's telemedicine projects can be found in Table 1. Some are at project stage while others are operating on a large scale and in daily practice.

Table 1 Telemedicine initiatives in Central Denmark Region [2]

Implemented and in operation
Tele-interpretation
Telemedical assessment of ulcers
Telemedicine for patients with heart disease. Visitation via telemedicine in the ambulance
Internet treatment for patients with health anxiety. Online-based self-help programmes based on psychological principles often combined with support from psychologists or other health professionals
Telemedicine in psychiatry. All citizens in the region associated with psychiatry and the social area can receive treatment through video consultations and individual treatment support
Telemedicine for pregnant women with complications. Implemented and operational in one department. Same solution is now used in other departments, e.g. for home-treatment of infectious diseases
Telemedicine home-monitoring for citizens with COPD. A collaboration between hospitals, municipalities and GPs in the region
Decision support for patients with haemophilia A and B and healthcare professionals
The Common Service Centre for telehealth: Common Service Centre is a support function for eHealth. The service centre wants to make it easier and more efficient for healthcare professionals across sectors and citizens to use telemedicine
Patient Reported Outcomes (PRO) for 23 different diagnostics areas
Projects
Infrastructure for telehealth on regional level. The project is linked to the national work on 'Joint development of telemedicine' (FUT)
Internet treatment of patients with bodily distress syndrome; patients with gambling addiction; cancer patients suffering from anxiety; patients with sleeping disorders etc.
Telemedicine for patients with heart disease – home-monitoring/holter-

monitoring for patients in general practice
Decision support and communication tool for children and youth with diabetes
Patient Reported Outcomes (PRO) for 7 diagnostics areas
Digital treatment plan for patients with COPD and Diabetes – however built for generic use

Centre for Telepsychiatry, Region of Southern Denmark

In 2013, Centre for Telepsychiatry [3] was established as the first of its kind in Denmark. The centre is part of the Regional Psychiatry in the Region of Southern Denmark and focuses on research and development within mental health services. They aim to promote the use of telepsychiatry and e-mental health to improve quality and accessibility of care for people with mental health problems. The centre utilises digital technologies such as video-conference, online programmes, websites, apps, sensor technology and virtual reality.

In addition, the Centre for Telepsychiatry offers internet-based therapy for patients with mild to moderate depression and anxiety, outpatient video-consultations, mobile applications for mental health and web-based interventions to improve wellbeing among young people.

The Centre for Telepsychiatry has in collaboration with the University of Southern Denmark established a research unit for Telepsychiatry and E-mental Health in 2015 and is the leading research unit within their field. The research unit collaborates closely with the psychiatric departments in the Region of Southern Denmark, with universities in Denmark and internationally as well as with private companies.

Selected activities and projects from the Centre for Telepsychiatry are presented in Table 2.

Table 2 Selected activities and projects in Centre for Telepsychiatry [3]

Video consultations	Every outpatient psychiatric department in the Region of Southern Denmark offer video-consultations, where it is considered appropriate.
Internet psychiatry	Since March 2018, internet psychiatry is offered to citizens throughout the country
Apps	Testing apps that help create structure in everyday life and act as a crisis tool for psychiatric patients

	both during and after admission to psychiatric daytime services
Mindapps.dk	Mindapps.dk guides patients and clinicians in choosing high quality apps for specific mental health problems and target groups
Mindhelper.dk	Mindhelper.dk provides articles, videos and an advice column to promote mental health among adolescents

Telemedicine Knowledge Centre, Capital Region of Denmark

The Telemedicine Knowledge Centre [4] was established in 2012 to promote the use of telemedicine in the Capital Region of Denmark.

The Telemedicine Knowledge Centre has six focus areas:

1. Knowledge sharing;
2. Support for telemedicine initiatives;
3. Collaboration across;
4. Contribution to research and innovation;
5. Involvement of the patient perspectives;
6. Promotion of telemedicine.

Examples of tasks performed by the centre includes:

- Support, coordination, problem solving;
- Yearly mapping of use of telemedicine;
- Development of tools for telemedicine initiatives (business case, evaluation etc.);
- Identification of needs for telemedicine;
- Facilitation of telemedicine initiatives;
- Strategical decisions;
- Cooperation – cross-sectorial, cross-regional, nationally and internationally – on initiatives and research;
- Reporting and collection of new research about telemedicine;
- Clarification of legal, economic and security aspects of the use of telemedicine;
- Patient involvement;
- Facilitation of conference and other events about telemedicine.

The Capital Region of Denmark has many good experiences in specific areas of chronic disease management, telemedicine treatment of patients with COPD, diabetes and cardiovascular disease.

When establishing telemedicine initiatives, it is important for The Capital Region of Denmark that models and methods are ensured for measuring

effects based on national or international evaluation models, e.g. the Model for Assessment of Telemedicine (MAST model).

Table 3 Telemedicine initiatives in the Capital Region of Denmark [4]

Implemented and in operation
Telemedical ulcer assessment
COPD 2019
Pregnant without or at risk for complications
HIT 2 – Home-monitoring of patients with heart failure
Hypertension – Home-monitoring of patients with high blood pressure
EGastro adults – Home-monitoring
Tourettes Syndrome: Home-training via video, eTics training
Cystic fibrosis: Home-monitoring as well as video-consultation for out-patients
WebPatient - Patient Reported Outcomes in General Practice
RADMIS - To investigate the effect of smartphone-based treatment for patients with unipolar and bipolar disorder
Young with diabetes - App to support young people's communication with clinicians as well as a diary
SCAUT - Remote reading of pacemaker / ICD and PRO

Mapping Telemedicine Projects in Denmark

In Denmark, telemedicine initiatives have been mapped in an open accessed database since 2013. The database enables organisations wanting to make use of telemedicine to find other actors with similar projects. This makes for a faster start by reusing already established solutions, just as it helps guide the authorities in e.g. the use of specific technologies and enables longitudinal monitoring.

The idea of mapping telemedicine projects in Denmark was part of a 'National Action Plan for Dissemination of Telemedicine', launched in August 2012 [1]. The national action plan had three focus areas: 1) Starting point: Great challenges – new possibilities; 2) Paths to dissemination; and 3) Bet-

ter framework for telemedicine, including an 'overview of telemedicine technologies and solutions in use'. A total of 80 million Danish Krone (approx. 11 million EUR) were allocated to completely or partially finance the initiatives in the action plan.

Collecting Data

The development, establishment and now maintenance of the database is carried out in a collaboration between representatives from the Danish regions (representing the public hospitals), the municipalities, regional data consultants (representing general practice), researchers and decision makers/officials and managed by the organisation MedCom - comprising 'the working group'. Since the launch of the database in 2013, reporting of initiatives for the telemedicine map has taken place continuously. Everyone is permitted to register an initiative in the database as it only requires registering as a user. Every initiative in the database is recorded with the data categories presented in Table 4, and most data fields consist of predefined data categories with predefined multiple-choice items, improving filtering and search options when extracting data and easing data processing. The reporting and updating of initiatives are voluntary but supported by different reminder and information services sent automatically by email to contact persons registered in the database. Furthermore, a proactive effort to collect new data and to keep data valid and actual is made by the working group, who also ensures that initiatives to increase data quality and usability are implemented on an ongoing basis. The data collection process and strategy are thoroughly described in [5].

Applicability

All initiatives registered in the database are presented in an interactive map (see Fig. 1), with data (in Danish and English) freely available to the public [6]. A search function makes it possible to specify the results/initiatives shown, and data can be presented and downloaded in an Excel sheet for further analysis. Subscribing to a specific search is also possible.

It is intended and assumed that healthcare professionals use the database for knowledge sharing and cooperation, i.e. for sharing experiences about using telemedicine in specific contexts and for gaining easy access to further information (contact information). Google Analytics tracking is used to monitor the use of the telemedicine database but does not reveal how data is used.

Table 4 Data categories

Data category	Examples of data items
Type of initiative	Project, Deployment, In operation
Master data	Title, Purpose, Start and End date, Volume, Contact person(s), Links etc.
Participants	Regions, Hospitals, Municipalities, General practices etc.
Used by	Patients, Doctors, Nurses etc.
Health domains	Mental health, Respiration, Cardio-vascular etc.
Used for	Diagnostics, Monitoring, Conference etc.
Technologies	Hardware, Software, Integrations
Editors	

It is also intended and known that decision-makers, officials, researchers etc. use data from the database for statistical and decision-support, as it provides easy access and opportunity to monitor the actual state of telemedicine in Denmark as well as the trends of telemedicine over time. Reference [7] used data from the telemedical map to study Danish telemedicine projects in operation with particular focus on the *aim* of the telemedicine projects, the *actors involved*, the specific *activities* and the applied *technologies*. Reference [8] used data from the telemedical map to study the *progress, purpose* and *current activities* of telemedicine in Denmark, as well as *differences* in characteristics of telemedicine projects across the Danish regions. Among other things, the study revealed that Denmark's efforts catered to a broad range of medical disciplines but that there was a significant uneven diffusion of established telemedicine services and reasoning for using telemedicine between regions.

Finally, MedCom once a year publishes descriptive statistics based on data from the telemedicine map. Examples of the statistics included are: which sectors are using telemedicine (hospitals, municipalities, general practice); how many initiatives are mono- or cross-sectorial; which clinical conditions the solutions are used for; which activities the solutions support (teleconferencing between healthcare professionals, home-monitoring, pa-

tient/healthcare professional conferencing etc.); and which technologies are used. In the report from 2018 [9], longitudinal monitoring from 2013-2018 also shows how the number of telemedicine initiatives in Denmark has developed (see Fig. 2) and how the status of the initiatives has changed from mainly being pilot project to mainly being 'Deployment' or 'Operational' (see Fig. 3). One of the objectives with the national action plan for rolling out telemedicine [1] was to overcome the challenge of not having a national overview of the many telemedicine projects and their learning outcomes to be able to coordinate and scale up well-proven initiatives rather than starting new pilot projects for testing. The database helps the authorities gain an overview of the development of telemedicine initiatives. Several other studies have used data from the telemedicine map to study distributions and trends within telemedicine in Denmark [10 - 13].

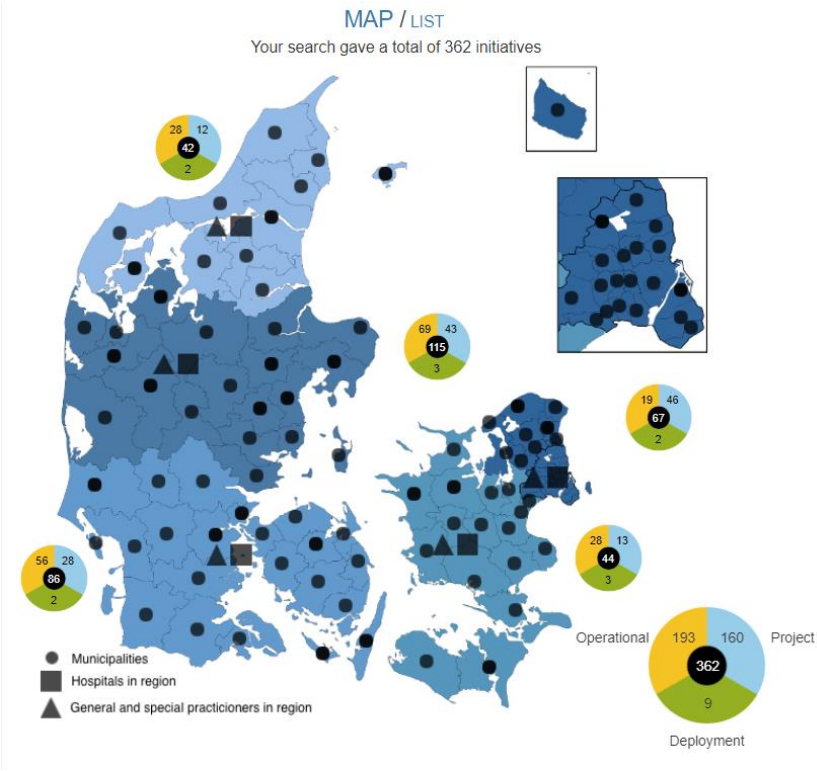


Fig. 1 Every initiative in the database is presented in a map

As reporting of initiatives is not mandatory or strictly regulated, guarantee cannot be given that all telemedicine initiatives in the Danish healthcare sector have been entered into the database and that the initiatives are updated at a given point in time. However, different data collection strategies are implemented, ensuring that most initiatives are updated regularly. Data validity and actuality of the database are discussed in [5].

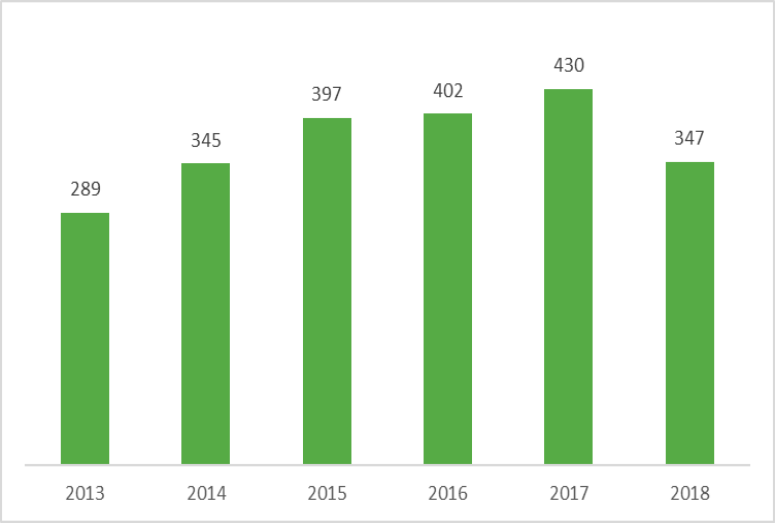


Fig. 2 Number of telemedicine e initiatives registered in the telemedicine database from 2013-2018

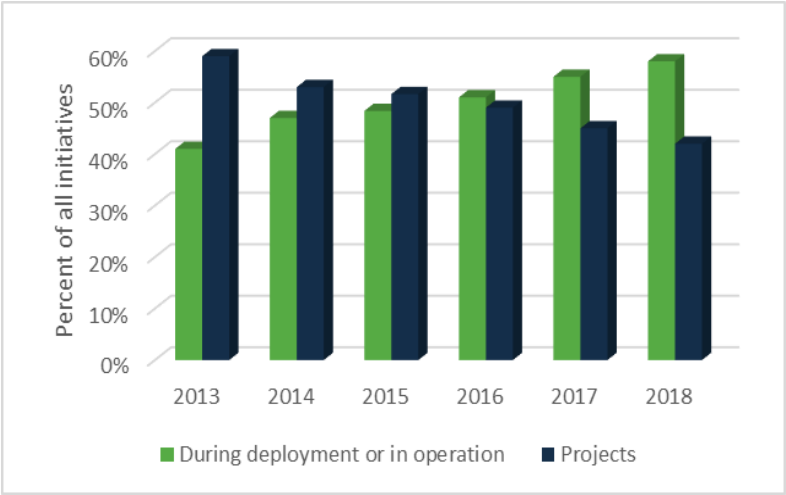


Fig. 3 Initiatives during deployment or in operation compared to pilot project from 2013-2018

Examples of Telemedicine in Denmark

Ulcer Treatment at Home

In Denmark, the number of people with diabetes and decreased functions of the venous system, respectively, is increasing. The diseases are often associated with the development of ulcers that heal very slowly, have added risk of severe complications and require several treatments. This places an increasing strain on the healthcare resources and the public finances and implies a need for more efficient ways to treat these patients' ulcers.

Home-based ulcer treatment was one of the first telemedicine projects selected for national cross-sectorial implementation in Denmark [1]. Today, the solution is used by all 5 regions and 98 municipalities in Denmark and every month the telemedicine solution is used in the treatment of approximately 6,000 patients with ulcers [14].

The telemedicine solution allows patients with ulcers to receive specialist treatment at home instead of travelling to hospital. The solution involves a community nurse specialised in ulcers, who supervises the patient in his or her own home and sends pictures of the ulcer to the specialist at the hospital via a digital platform (Pleje.net). This allows the specialist to assess whether the ulcer is healing as planned or whether some other treatment must be initiated. Based on that assessment, the specialist guides the community

nurse and the patient in the further treatment, without requiring the patient to go to the hospital.

The solution was implemented between 2012 - 2015 and the evaluation of the project showed high satisfaction with the telemedicine solution [15].

For example, community nurses found that their own competences were upgraded, and the close cross-sectoral cooperation made the specialists at the hospital more comfortable with assigning different tasks to the community nurse. In addition, the hospital staff found that the number of routine checks decreased and that their resources and time were better utilised, enabling them to focus on the more complex ulcers (see also Table 5).

Many patients were satisfied with not having to go to the hospital as often as they used to. Working patients felt that they could now better manage their jobs. The elderly were satisfied with not having to travel as much, leading to increased quality of life. The patients also felt more involved in their treatment by having access to the data and pictures in the online platform (see also

Table **6**).

Because of the close dialogue and cooperation between community nurses and specialists at the hospital, both clinicians and patients felt more comfortable as treatments could be initiated and adjusted faster.

Even though the evaluation of the project was not able to document a decrease in time and resources in the municipalities and/or at the hospitals, the evaluation suggests that home-based ulcer care improves the quality of the treatment, quality of life and gives the experience of a safe and coherent treatment across primary and secondary care.

Table 5 Evaluation results (clinicians) [3]

Statement	Community nurse	Hospital staff
Found the quality of the treatment improved	83%	75%
Found that their own qualifications to assess and treat ulcers improved	85-88%	82-85%
Found that their ability to make independent decisions improved	86%	77%

Table 6 Evaluation results (patients) [3]

Patient experiences
The treatment is initiated and adjusted faster
The number of visits at the hospital is minimised
The treatment feels safer and more coherent
Higher degree of patient involvement and transparency

Home-monitoring for COPD Patients

It is estimated that the number of Danes with Chronic Obstructive Pulmonary Disease (COPD) will increase by 45% in 15 years, reaching 253,600 in 2030 [16]. On average, COPD patients have twice as many contacts with general practice, twice as many outpatient visits and three times as many hospitalisations compared to the general population [17]. From a health economic perspective, great potential exists in reducing the number of contacts and hospitalisations for this group.

Since 2012, COPD patients in the North Denmark Region have been offered telemedicine treatment as part of a cross-sectorial project called the TeleCare North Project. The telemedicine solution equips the COPD patient with a tablet and devices used for measuring saturation, heart rate, blood pressure and weight. Using the equipment, the patient's measurements are automatically sent to health professionals in the municipality or at the hospital, who monitor the patient's measurements and contacts the patient in case of conspicuous fluctuations.

The TeleCare North project organised their research as block-randomised trials with an inclusion and a control group. 1,225 patients were in total included in the clinical trial. The research had four perspectives: health-related effects, health literacy, cross-sectoral cooperation and health economic effects. Research in patient-related effects showed positive effects with telemedicine. 62% of the patients experienced an increased control of their disease, 72% felt safer and better able to cope with their illness, and 27% experienced more freedom using telemedicine. On average, quality of life decreased less in the telemedicine group compared to the control group. Research in health literacy showed no correlation between the patients' health literacy levels and their experience of feeling safe. Concerning cross-sectorial cooperation, especially community nurses and general practitioners

experienced a strengthened professional dialogue. The health economic research showed that telemedicine increased Quality Adjusted Life Years (QALY) for most patients. However, the increase came at extra costs when telemedicine was offered to all COPD patients. By focusing on patients with very severe COPD, a positive effect in QALY *and* an economic saving was found [18]. The scientific reporting of the project can be found in www.clinicaltrials.gov (NCT01984840).

Today, national agreements have been made to implement home-monitoring for COPD patients nationally, partially based on the positive research outcomes from the TeleCare North Project. As part of the agreement, four projects have been chosen as precursors for national deployment, including a national IT-infrastructure integrated with patient administration systems in municipalities, hospitals and general practice.

Patient Reported Outcomes (PRO) in General Practice

It has long been evident that the quality and effectiveness of clinical work are increased if reliable measurements and patient reported outcomes are made by patients at home. General practitioners in Denmark have for many years prescribed paper-based forms for home-measurements and questionnaires to be manually filled-in by the patients. The manual and paper-based workflow is, however, time-consuming for general practice and pose a risk of adverse events in connection with miscalculations and mis-entries. For example, the practice when using paper-based PRO for home-measurement of blood pressure is to manually calculate 3 average values based on 36 measurement results and then record the calculated results with use of the correct laboratory response code in their own electronic patient record system.

As part of the Danish Government's objective of strengthening collaboration and ensuring a close and coherent health service, the Ministry of Health initiated the establishment of the project "Patient Reported Outcomes (PRO) in General Practice" in 2016 with the aim of expanding the use of an electronic PRO system for managing patient reported outcomes in general practice [19].

In the last 3 years (2016-2018), the common PRO system has been implemented in 63% of all general practices in Denmark (see Fig. 4) and the use of PRO in general practice shows positive results from both general practitioners' and patients' points of view.

The workflow for PRO is visualised in

Fig. **5**. When using the PRO-system, the general practitioner orders a PRO-questionnaire through a joint laboratory requisition system. The patient is then automatically notified through SMS or email. The notification contains information about:

- The general practitioner who has prescribed the PRO questionnaire and expiration date of the questionnaire;
- What to do and how to forward/submit the result of measurements and answers;
- Link to the PRO system.

The patient then carries out the measurements and returns the data through the PRO system. The PRO system validates, calculates and sends the results to the general practitioner's system as a laboratory response.

So far, general practice can prescribe 15 different electronic PRO questionnaires in the categories of home-measurements and questions (see

Table **7**).

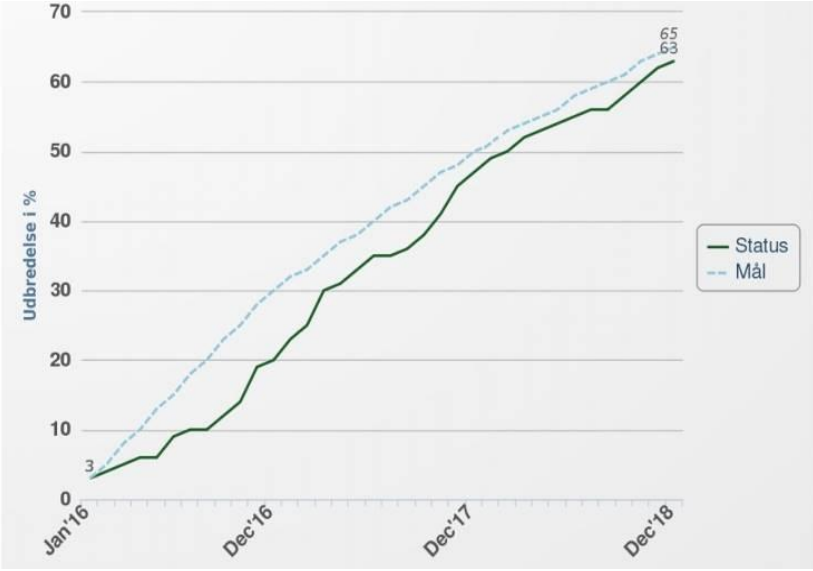


Fig. 4 Implementation of WebPatient in percentage of general practice

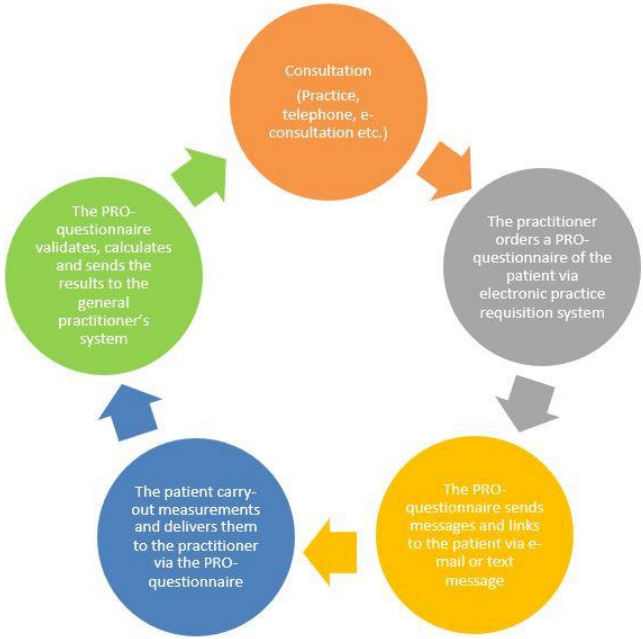


Fig. 5 Workflow when using PRO system

Table 7 Electronic PRO questionnaires

Home-measurements	Questionnaires
Blood pressure	MDI depression
Blood sugar profile	Anxiety
Body measurement	Stress
Urination schedule (adult)	Danish Prostate Symptom Scoring Scheme (DAN-PSS)
Urination schedule (child)	COPD Assessment Test (CAT)
	Common Mental Disorder Ques-

	tionnaire (CMDQ) Nutrition, smoking, alcohol and exercise MRC-Dyspnea scale

More than 160,000 PRO questionnaires have been requisitioned during the 3-year project (2016-2018) of which 70% were for home-measurement of blood pressure.

The evaluation of the project 'PRO in General Practice' shows positive results in respect to both general practitioners and patients [20]. Some results were:

- Save time: The majority of GP's and other practice employees believe they save time and that their job, in relation to PRO, has been made easier;
- Increase data quality: The majority believe that data quality is increased with the PRO system;
- Reduce risks: Most of the practice staff believe that the risk of adverse events is reduced with the PRO system;
- Increase the cooperation and patient involvement: Most of the patients believe that PRO improves the co-operation with their own practitioner and around half of the patients feel more involved in their treatment after the implementation of the PRO system.

The evaluation was carried out in a cooperation between The Ministry of Health, The Danish Organisation of General Practitioners, MedCom and Centre for Innovative Medical Technology at Odense University Hospital (OUH). The report investigated the experiences gained within general practice (GPs and other staff) and by patients.

Fig. 6 PRO system evaluation results

The positive results of the project evaluation provide a good foundation for both implementation of PRO and increased realisation of gains from digitisation in general practice in Denmark.

Interpretation Service over Video

Prior to the start of the project, the need for interpretation assistance in the healthcare sector increased due to population changes, as many refugees, immigrants and asylum seekers from different parts of the world came to Denmark.

The purpose of the project was to ensure national deployment of interpretation service over video (video-interpretation) to 90% of all relevant hospital departments in all five regions. Secondary, to gain further experiences through pilot testing in municipalities and in general practice.

The project was responsible for establishing a national Joint Video Infrastructure (VDX) via the Danish Health Data Network, in order to ensure secure video connections.

Video interpretation was implemented in the hospitals in cooperation with the five regions in the period 2009-2013 and is now in operation. Before the project became a reality, there were estimated 150,000 interpreted consulta-

tions every year in Danish hospitals and general practices and no video equipment at the hospitals.

As part of the implementation strategy, all hospital departments were given a card containing five good reasons for using video interpretation.

The five good reasons for video-interpretation were (see Fig. 7):

- Improved contact between the health professional and patient;
- The interpreter becomes more neutral;
- Easy access to several languages;
- Improved access in emergency situations;
- Cost savings due to no expenses for interpreter's transportation.

The regions have after the end of the project, completed a national tender for interpretation services in hospitals and general practice. The chosen vendor offers video interpretation, telephone interpretation and attendance interpretation. Currently, the regions are working on a national interpretation centre, which is intended to cover acute interpretations.

Since the project was completed, self-payment for interpretation has been introduced if the patient has lived in Denmark for more than 3 years and continues to have difficulty conducting a conversation and understanding information. This could affect the number of interpretations.

Fig. 7 Card with five good reasons for using video interpretation

Fig. 8 Video interpretation at OUH Odense University Hospital

The project was evaluated early 2013 and the outcomes are based on the achieved results from the project period (2009-2012) and not on its potential over time [21]:

- There is no difference in the amount of time health professionals spend on consultations with either face-to-face or video interpretation;
- Both patients and health professionals regard video interpretation as a valid and satisfactory form of interpretation;
- It appears that there is no large economic gain when shifting from face-to-face to video interpretation;
- Economic gains can be achieved by better negotiating the price for the service at the regional supply of video interpretations. In addition, also by increased use of video interpretation.

Telepsychiatry

The project "Demonstration and Deployment of Telepsychiatry" was one of the five initiatives in the National Action Plan for Telemedicine [1]. The project was completed in the period October 1, 2012 to December 31, 2014 and is now in daily operation.

The demonstration project focused on the use of video conferencing between psychiatric services, hospitals and various municipal areas, e.g. assessment and residency. Five municipalities participated in this pilot project. Overall, the evaluation of the demonstration project showed that video conferencing is a meaningful tool in the cross-sectorial collaboration [22].

From the outset, the deployment project has focused on cross-sectoral conferences between psychiatric departments and outpatient clinics but has also encouraged the use of video conferencing for other areas as well.

The evaluation of the project [23] showed that many different types of meetings across different professional groups can be held via video conference. Furthermore, it became clear that the roles as meeting participant and meeting leader, respectively, had a different character in video-meetings compared to meetings where video was not used. In addition, more discipline is required for a video-meeting as well as more consideration for the people participating via video conference.

The evaluation results also showed that the location of the video equipment has an impact on how much the equipment is used and that users find it easier to schedule meetings, when they are held via video conference.

Several participants in the evaluation expressed a desire to have an extended collaboration over video with the municipalities. Social workers are mentioned as possible users of video conferencing, as these have a wide network. The Danish Prison Service is also mentioned as a possible partner, just as the general practitioners are.

Overall, the conclusion of the telepsychiatry project is that video conferencing is a useful tool and a good alternative to meeting in a traditional way. When video conferencing is first implemented and becomes an everyday tool, there is a tendency for the departments to use the equipment for other purposes and with multiple partners.

Video-consultations in general practice

There are not many experiences from Denmark, where the general practitioner uses video conferencing for purposes other than interpretation, but some initiatives are in progress. For example, North Denmark Region has employed a general practitioner to consult patients via video conference; the Region of Southern Denmark has the Telepsychiatry Centre, which e.g. uses video conference in the treatment of patients at home and the Capital Region of Denmark has under its territory, the remote but large island Bornholm, where they use video-conferencing across sectors: hospitals, municipality and general practice.

Among the five regions, there has been a long-standing aspiration to use video conferencing more widely in general practice. A pilot project to test the use of video conferencing broadly in general practice has therefore been

initiated in 2019 for a period of minimum 6 months and with the participation of 7-10 general practices and specialist practices from each region [24].

The purpose of the project is to test video consultations in general practice for several different purposes. The project divides video consultations in to the following categories:

- *Video consultation with the citizen;*
- *Video conference with two and more parties.*

Each general practice can, in cooperation with the region, choose which partners to have a video conference with, for example, the citizen at home, the hospital, the municipality, the nursing home etc.

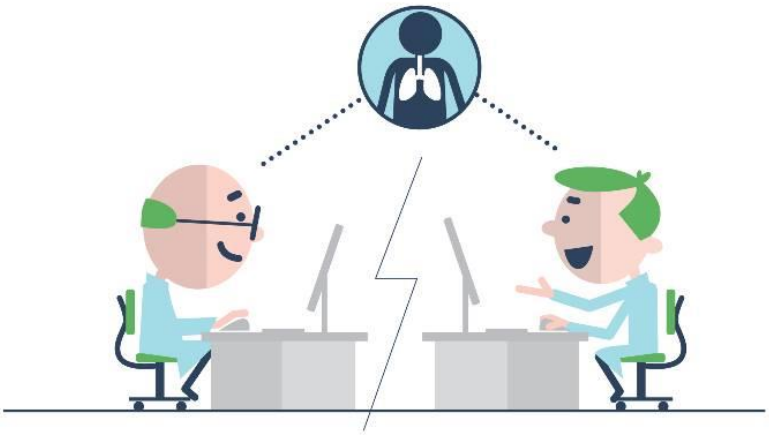


Fig. 9 Illustration of video-consultation

The overall goal of the project is to assess the benefits of using video consultations in general practice. Furthermore, to understand better when quality increases with the use of video consultations.

The project advocates that the general practitioners use video conferencing broadly for both the patient at home, partners involved in the patient's course of treatment and specialist counselling. This will make the video-equipment an everyday tool, which the general practitioner becomes familiar with and can experience as a help in a busy day.

The project develops a technical solution to identify the patient when the general practitioner has a video consultation with the patient at home.

Finally, the project will conduct an evaluation, including a business case for the general practitioner's overall use of video conferencing. The evaluation will only shed light on the general practitioners' inclinations for use of

video conferencing, as the evaluation does not have a control group, among other things.

The evaluation is conducted according to the MAST model (Model for Assessment of Telemedicine, see the section 'MAST – evaluating telemedicine'). The MAST model describes the following areas:

- Technology,
- Security,
- Clinical effect,
- The citizen's / patient's perspective,
- Economy,
- Organisation,
- Law, ethics and socio-culture.

A Telemedicine Infrastructure

During and following a decade of a vast variety of telemedicine initiatives, national coordination and deployment are now in focus. In 2013, a national reference infrastructure for sharing data recorded by and/or at the citizen's home was developed through national consensus [25]. This strategy points to the infrastructure elements and standards recommended to facilitate national sharing of telemedicine health information. Furthermore, Danish profiling of Health Level 7 Clinical Document Architecture (HL7 CDA) standards [26] for exchange of telemedicine data was developed along with the national infrastructure supporting sharing of this data among the different healthcare applications and systems throughout the entire Danish healthcare sector.

Building upon the implemented telemedicine infrastructure, several national initiatives are now being rolled out.

MaTIS – Maturing Telemedicine Infrastructure

A national IHE (Integrating the Healthcare Enterprise) affiliate domain has been established. This includes a home-monitoring IHE Cross Enterprise Document Sharing (XDS) repository and a national IHE-registry enabling national download of home-measurements and answers to questionnaires to local clinical systems. This infrastructure is fully tested and CDAs from local applications are uploaded. The MaTIS infrastructure will be the back bone for all future national sharing of telemedicine data. The infrastructure is a part of the overarching National Service Platform (NSP) that, among other services, provides a Document Sharing Service used for the telemedicine infrastructure.

The National COPD Telemedicine Initiative

A national initiative providing telemedicine support for citizens suffering from COPD is currently being rolled out. Through five combined municipal and regional programmes, local telemedicine applications supporting citizens and clinicians are being built. Also, a coordination platform is being implemented. This platform will be integrated with the MaTIS infrastructure in order to share telemedicine data collected in the local applications on a national level. The telemedicine components (Common Development of Telemedicine (FUT)) will be fully operational by summer 2020.

PRO infrastructure and questionnaire repository

As earlier mentioned, standards for exchange of data from questionnaires administered to citizen (PRO data) have been developed in order to shed light on their health condition and follow up on health interventions. The basis for this development has been HL7 standards (QFDD and QRD CDA formats). The national adaptation was developed through a national consensus effort. By having national standards for PRO data, it is now feasible to develop a National Questionnaire Repository. This will be managed by The Danish Health Data Authority. The Questionnaire Repository will serve as a reference for all national harmonised healthcare related questionnaires and provide reference to understand and interpret QRD document (Questionnaire response form – CDA document) shared through the national telemedicine infrastructure.

MAST - Evaluating Telemedicine

Assessment of the Value of Telemedicine

When healthcare decision-makers in Denmark consider investing in new telemedicine services, they request information about the value of the services and the impact on the patients and the healthcare system. This is consistent with the general aim in the healthcare system to make evidence-based decisions when investing in new health technologies.

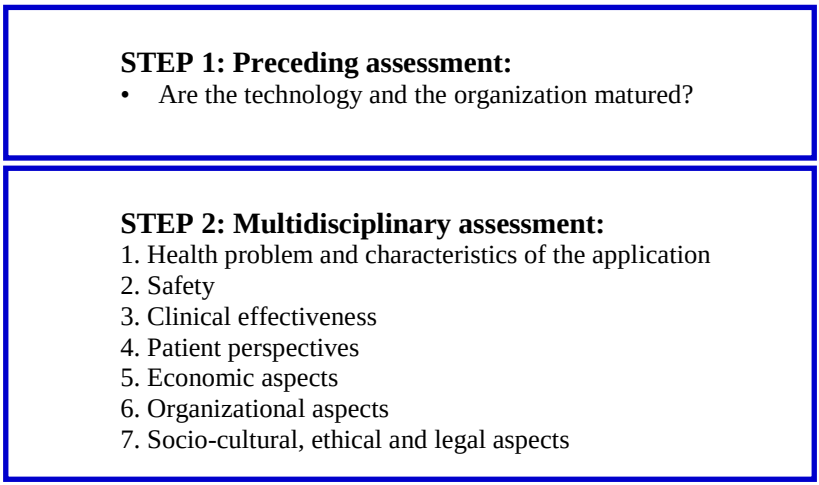
Since 2012, several studies of the value of telemedicine services have used the Model for Assessment of Telemedicine (MAST) as a framework for collecting the data needed in an assessment as described in [27]. The aim of MAST is to assess telemedicine applications, to describe their effectiveness and contribution to the quality of care and to produce a basis for decision-making. MAST is based on the EUnetHTA core model (see [28]) and is defined as a multidisciplinary process, which summarises and evaluates information about the medical, social, economic and ethical issues related to the use of telemedicine in a systematic, unbiased and robust manner [27]. Thus, MAST attempts to include all important outcomes of telemedicine applications for patients, clinicians, healthcare institutions and society in general. In addition, the definition of MAST implies that assessment of

the effectiveness of telemedicine should be based on scientific studies and methods and on scientific criteria for quality of evidence. This means that the description of results should follow guidelines for reporting health research, health economic evaluations, etc. as described by [29].

The Three Steps of MAST

MAST was developed in 2011 based on a series of workshops with key stakeholder groups from various European healthcare systems, in which the stakeholders described their needs concerning information about telemedicine services.

As described in Fig. 10, MAST divides the assessment into three separate steps. In the first step, called the preceding assessment, the maturity of the telemedicine technology and the organisation planning to implement the intervention should be ensured before an assessment of the effectiveness of the technology is carried out. For instance, if the development of a telemedicine service is still at an early stage, formative studies, including participatory design studies, prototype studies, usability studies and feasibility studies, must be carried out. An example of the first step of MAST can be found in [30], describing a feasibility study of a telemedicine rehabilitation application for individuals with COPD. If a telemedicine application is still in a development phase and needs further improvement, a multidisciplinary assessment of the effectiveness of the application should wait till more development has taken place.



STEP 3: Transferability assessment:
- Cross-border
- Scalability
- Generalizability

Fig. 10 MAST's three steps in assessment of telemedicine

In the second step of MAST, a multidisciplinary assessment of the effectiveness of the technology is carried out. To assist the healthcare professionals and researchers who produce the assessments, the potential outcomes of telemedicine have been divided in to seven groups or domains. Table 8 defines the different domains and describes topics that could be included within each domain. It should be noted that the relation between the domains are strong, e.g., the description of the use of resources in the organisational domain and the estimated costs in the economic domain. Therefore, the division of outcomes into domains may be challenging in practice and the description of effects in one domain may supplement the description of outcomes in other domains.

Table 8 The seven MAST domains

Domain	Definition	Topics
1. Health problem and description of the application	Description of the health problem of the individuals with chronic impairments expected to use the telemedicine application and the application being assessed	• **Health problem of individuals with chronic impairments** • **Description of the application** • **Technical characteristics**
2. Safety	Identification and assessment of harms	• **Clinical safety** • **Technical safety (technical reliability)**
3. Clinical effectiveness	Effects on individuals with chronic impairment's	• **Effects on mortality, disability,**

	health	**health related quality of life** • **Behavioural outcomes (e.g. exercise)** • **Utilisation of health services**
4. Individual with a chronic impairment's perspectives	Issues related to the perception of the individual with a chronic impairment or the relatives of the telemedicine application including the individual with chronic impairment and their relatives' acceptance of the technology.	• **Satisfaction and acceptance** • **Ability to use the application** • **Access and accessibility** • **Empowerment, self-efficacy**
5. Economic aspects	A societal *economic evaluation* comparing a telemedicine application with relevant alternatives in terms of costs and consequences and a *business case* describing the expenditures and revenues for the healthcare institutions using the telemedicine application.	**Economic evaluation:** • **Amount of resources used** • **Prices for each resource** • **Related changes in use of healthcare** • **Clinical effectiveness** **Business case:** • **Expenditure per year** • **Revenue per year**
6. Organisational aspects	Assessment of what kind of resources have to be mobilised and organised when implementing a new technology, and what kind of changes or consequences the use can further produce in the organisation.	• **Process** • **Structure** • **Culture – perception of staff** • **Management**

7. Socio-cultural, ethical and legal aspects	The socio-cultural aspects include the social-cultural environments where the individual with a chronic impairment lives and acts during use of the application. The ethical analysis appraises the ethical questions raised by the application itself and by the consequences of implementing it or not. Legal aspects focus on the legal obligations, which must be met and any specific legal barriers that may exist to the implementation of the application.	• **Ethical issues** • **Legal issues** • **Social issues**

In the final and third step, an assessment should be made of the transferability of the results found in the second step. For example, if the multidisciplinary assessment is based on a literature review and includes data from studies in other countries, the relevance of the results for the specific institution considering implementation of the service should be considered.

The face validity of MAST has been tested and described in a Delphi study by [31] in which a sample of 13 managers from hospitals or regional health authorities and six researchers were asked to assess the importance of the different MAST domains. The study confirmed the face validity of all MAST domains, since all domains were considered moderately or highly important by more than 80% of the respondents.

The results from assessments of telemedicine services using MAST are often described in 2-4 scientific publications because the studies of clinical outcomes, patient perception, economic evaluation and organisational impact are presented in separate studies, even though they are based on the same study in the same location. Three publications have been made, for example, based on a study of a telemedicine intervention for patients with diabetic foot ulcers describing the clinical results [32], the economic aspects [33] and the organisational aspects [34].

MAST is currently the most widely used framework for assessing the value of telemedicine services in Europe and a review by [35] describes twen-

ty-two empirical studies of telemedicine services using MAST as the foundation.

When using MAST in practice, it is important to notice that not all seven domains are relevant in assessment of all types of telemedicine services. MAST should be used as a checklist describing potentially relevant domains and topics but for each telemedicine service, the relevant domains should be selected. For example, some services might aim to increase the patient's feeling of security and satisfaction with a treatment but with no expectation to have an impact on the morbidity or mortality of the patient. In that case, the clinical outcomes should not be part of the assessment. In other cases, telemedicine is used only for communication between healthcare professionals and is not expected to have any impact on patient perception. Hence, it is not relevant to collect data on the patients' view of the telemedicine service.

Similarly, the research design and the level of evidence in studies of telemedicine should reflect the content and expected consequences of the telemedicine intervention. If a telemedicine service can be implemented at very low cost and is not expected to have any clinical impact, then a pragmatic research design (e.g. interview about user experiences with a small cohort of patients) is often sufficient. However, if a telemedicine service could potentially affect the mortality or morbidity of patients, e.g. because the patients have severe COPD with a high mortality rate, then a randomised controlled trial should be considered as described by [36]. The data collection needed in an assessment of the value of a telemedicine service based on MAST reflects, therefore, the content of the telemedicine service, the state of health of the patients using the service and potential risks for the patients' safety and clinical outcomes.

Current Strategy for Digitisation and Telemedicine in Denmark

Telemedicine continues to be part of the national eHealth strategies in Denmark. Where the earliest eHealth strategies focused on digitisation in its most obvious form, new challenges are to be solved today and new focus areas are put in to play. Over the next thirty years, the percentage of people in Denmark aged 75 or more is expected to nearly double and the number of people with chronic diseases to increase equally, meaning that more people will need healthcare services. Consequently, there is an obvious interest in preventing illness in the first place but also reduce hospitalisation, for instance by using telemedicine.

"Digital Health Strategy 2018-2022 - A Coherent and Trustworthy Health Network for All" [37] is the current common digitisation strategy from the Ministry of Health, Ministry of Finance, Danish Regions and Local Gov-

ernment Denmark. It defines five focus areas (see Fig. 11) for achieving the objective of putting patients' needs first and making daily workflows easier for healthcare professionals. Telemedicine is mentioned as an important tool in 2 out of 5 focus areas (focus area 1 and 3).

In focus area 3 (Prevention), continued roll-out of home-monitoring is one of the specific efforts for preventing deterioration and hospitalisation. Part of the effort consists of rolling out home-monitoring for pregnant women with complications before the end of 2020 and for patients with COPD. The strategy states that the aim in the long run is for telemedicine to be offered to other relevant target groups as well, for example patients with heart failure or multimorbidity [37].

Fig. 11 Focus areas in "Digital Health Strategy 2018-2022" [37]

Denmark is also engaged in international activities within the telemedicine domain. One example is that the health authorities in Denmark and Mexico made an official agreement in 2015 on mutual exchange of knowledge and best practices. In this cooperation, the Danish delegation contributes with experiences in implementing international standards and telemedicine services, cross-sectorial cooperation and evaluation of eHealth and telemedicine solutions. Recently, the Danish delegation visited Mexico to focus on the use of telemedicine solutions in psychiatry and on initiating a pilot project in the Mexican state of Durango.

Summary

Denmark has, over the last two decades, continuously had a national eHealth strategy and the country's health sector is today highly digitised. Telemedicine has been a part of these strategies since 2008. One of the first large action plans for telemedicine came in 2012 and the purpose was to speed up the use of telemedicine, focusing on five selected initiatives. The plan was very successful and all five initiatives from the action plan are currently being deployed or are operating at a full scale.

In addition, one of the focus areas in the National Action Plan was to create an overview of telemedicine technologies and solutions in use. This overview has been available since 2013 and is known as the Telemedicine Map. A working group has been set up to take care of the development, establishment and maintenance of the database. Everyone is permitted to register an initiative in the database, and everyone can access the information about the registered initiatives subsequently. Once a year, MedCom publishes descriptive statistics based on data from the Telemedicine Map.

In Denmark, telemedicine is used in many different settings:

Home-based ulcer treatment allows patients with ulcers to receive specialist treatment at home instead of travelling to the hospital. A community nurse sends pictures of the ulcer to the specialist at the hospital through a digital platform.

Home-monitoring for COPD patients started as a local cross-sectorial project in the North Region Denmark called the TeleCare North project. Today, home-monitoring for COPD patients is being implemented nationally. The patients are equipped with a tablet and devices for measuring saturation, heart rate, blood pressure and weight. The patient's measurements are automatically sent to a healthcare professional. Patient Reported Outcomes (PRO) are available to the general practitioners through their own requisition system. The general practitioner orders a PRO questionnaire via the requisition system and the patient is automatically notified through SMS or email. The patient performs the measurements and returns them through the

PRO system. The measurements are validated, calculated and transmitted to the GP system as a laboratory response.

A video interpretation service was implemented in the Danish hospitals in the period 2009-2013. The project established a national Joint Video Infrastructure (VDX) on the Danish Health Data Network to ensure secure video connections. Through the project, video equipment was made available at the hospital departments with the possibility of using it for multiple purposes.

The Telepsychiatry project included a demonstration project and a deployment project. The demonstration project focused on the use of video conferencing between psychiatric hospitals and municipalities. The deployment project focused on the use of video conferencing between hospital departments and outpatient clinics and has now become operational.

Video consultations in general practice is a pilot project started in 2019 testing the use of video conferencing broadly in general practice.

Denmark is also engaged in many international telemedicine activities, both in cooperation with European countries and currently also with Mexico.

Three regional telemedicine centres have been established through the years:

- Centre for Telemedicine, Central Denmark Region;
- Centre for Telepsychiatry, Region of Southern Denmark;
- Telemedicine Knowledge Centre, The Capital Region of Denmark.

Based on a vast variety of telemedicine initiatives, national coordination and deployment are now in focus. In 2013, a national reference infrastructure for sharing data recorded by and/or at the citizen's home was developed through national consensus. Infrastructure elements and standards are recommended to facilitate national sharing of telemedical health information.

Along the way, there has been a demand for a solution to evaluate the outcomes of telemedicine projects. The Model for Assessment of Telemedicine (MAST) was developed in 2011 based on workshops with key stakeholder groups from different healthcare systems in Europe. The aim of MAST is to assess telemedicine applications and to describe the effectiveness and contribution to quality of care and to produce a basis for decision-making. MAST divides the assessment into three steps: 1) Preceding assessment; 2) Multidisciplinary assessment with seven domains; and 3) Transferability assessment based on the results found in the second step. Several initiatives in Denmark have been evaluated using MAST and knowledge of MAST is shared with other countries.

Telemedicine continues to be part of national eHealth strategies. However, the focus changes as the development progresses and as several telemed-

icine initiatives are already operating at large scale now. Today, the focus is increasingly directed at disseminating and deploying well-proven telemedicine solutions nationally and at establishing better national infrastructure for sharing information from e.g. PRO.

The current common digitisation strategy "Digital Health Strategy 2018-2022 - A Coherent and Trustworthy Health Network for All" from the Ministry of Health, Ministry of Finance, Danish Regions and Local Government Denmark defines five focus areas, of which telemedicine is specifically included in two of them.

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IRAN

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A Brief Introduction of Iran

The History of Iran

Iran also called Persia and officially the Islamic Republic of Iran is a home to one of the world's oldest civilizations, beginning with the formation of Elamite kingdoms in the fourth millennium BCE. Furthermore, the county is situated in Western Asia with over 81 million inhabitants. Comprising a land area of 1,648,195 km2, which makes it the second largest country in the Middle East and the 17th largest in the world. The official language is Farsi and although the state religion is the Shia branch of Islam, a Sunni minority can be found throughout the nation. It's worth mentioning that besides Islam other religions such as Christianity, Judaism and Zoroastrianism practice their faith freely. Iran has large reserves of fossil fuels which include the world's largest gas supply and the fourth largest oil reserves. The sovereign state of Iran is a founding member of the UN, ECO, NAM, OIC and OPEC.

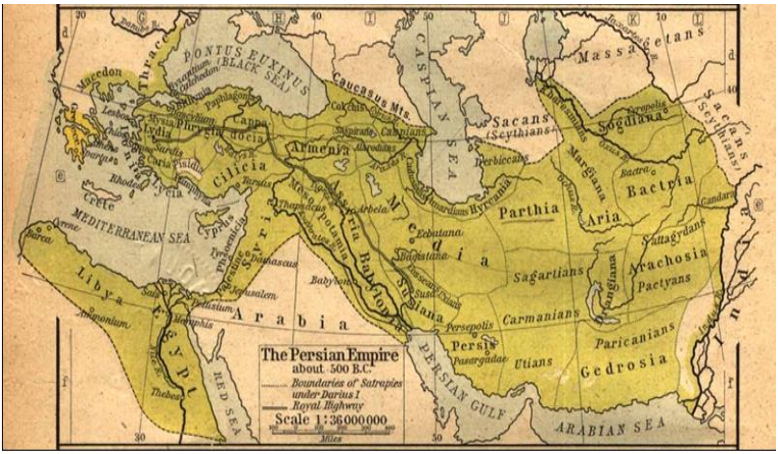

Fig. 1 Iran https://commons.wikimedia.org/wiki/Atlas_of_Iran

Tele-Medicine in Iran

Tele-Medicine in Iran (if we distinguish this concept from Information and communication technology) goes back to the ancient medical practices, where physicians consulted one another by using couriers to send their letters. In fact, we can say that Telemedicine in ancient Persia, much like other countries around the world, revolved around consultations over long distances and letter correspondence between the Colleagues. More information about this kind of Telemedicine can be found in Avicenna's journal in a more documented format (Persian post).

In the modern history, Iran was seeking to enter the medical informatics and Telemedicine fields after the Cultural Revolution (and as a result it led to the foundation of medical universities in 1987) exactly during the time where personal computers had made their way in the country. The tireless efforts of the Academic Center for Education, Culture and Research with the close collaboration of medical universities, paved the way for enrichments of more practical medical informatics methods (not academic) and Telemedicine. Although medical informatics was formally brought to universities in 2010 as a major field of study in MA and PhD Medical Informatics levels, by building more medical universities and the growth of computer usage throughout the country from 1988 to 2010, countless of activities were pursued in order to establish modern Telemedicine. In a more chronological order we will discuss about Iran's endeavors toward the establishment of Telemedicine.

Conferences and Gatherings Related to Telemedicine

1. In November 2006, the first international Telemedicine and eHealth conference was held in Iran and the following topics were discussed:
    a. eHealth;
    b. Telemedicine and the patient;
    c. Telemedicine and the diagnosis;
    d. Medical decision-making systems.
2. In the second domestic Medical Informatics Seminar, which was held at the Shahid Beheshti Medical University in 2011, one of the items that were discussed during the conference was Telemedicine.
3. Under Professor Seyed Shahabeddin Sadr's presidency of the Iran medical council, the first International eHealth congress was held in 2013 by that organization. The Nature of the conference revolved around:
    - eHealth Business model (in developed and developing countries);
    - Challenges of eHealth planning;

- Processing health information and data (data mining, web surfing and meaning deep analysis with extension to documents and health databases);
- Mobile health systems;
- eHealth and information management;
- Bio-informatics and medical informatics;
- Revaluating and educating eHealth in medical field;
- eHealth services in the medical field;
- Social media, consultation and health;
- Robotics and eHealth medical equipment;
- Medical ethics, regulations and rules of eHealth;
- eHealth and cognitive science technology;
- eHealth technology and prognostication for the future;
- Technological infrastructure in eHealth;
- Clinical decision making support systems and challenges on implementing them in health systems;
- The best administrative experiences regarding eHealth.

Purposes of the Above Conference

1. Encouraging and expanding the knowledge regarding eHealth;
2. Presenting the latest international achievements to Iranian scientists;
3. Exchanging views among Iranian and foreign scientists;
4. Channeling domestic research projects to foreign scientists;
5. Professor Joseph Tan (Faculty professor at University of Mac Master) attended this conference and was among the key speakers.

4. In 2013 another conference on Telemedicine was held at Amirkabir University and the following issues were discussed.

1. Telemedicine, diagnosis and treatment;
2. Telemedicine and family medical reference system;
3. Telemedicine and eHealth document;
4. Practical software for Telemedicine;
5. Designing information Structure and communication in Telemedicine;
6. Telemedicine's standards;
7. Telemedicine's data security and access;
8. Rules, regulations and morality in Telemedicine;
9. Telemedicine in military and astronomy fields;
10. Telemedicine and health tourism;
11. Medical Intelligent Systems;

12. Economy and Management in Telemedicine;
13. Modern Telemedicine technology and devices.

5. While Professor Seyed Shahabeddin Sadr was President of the eHealth Association in 2016, the Second International eHealth conference was held by the Association itself. The following issues were discussed:

1. Robotics and health;
2. Bio-Informatics and medical informatics;
3. Social eHealth, consultancy and health;
4. Developing and prospecting on Health;
5. Best practices;
6. Processing health data (data mining, web and surfing meaning deep analysis with extension to documents and health databases);
7. Clinical decision making support systems and challenges on implementing them in health systems;
8. eHealth Business models;
9. Data and eHealth management;
10. Optimization, engineering and mobile health systematical informatics;
11. Challenges of eHealth programs;
12. Technological infrastructure in eHealth;
13. eHealth and cognitive science technology;
14. Mobile health systems;
15. Medical ethics, regulations and rules of eHealth;
16. Traditional Medicine and eHealth;
17. Computer crimes in eHealth;
18. Resilience economic and eHealth;
19. Tourism and eHealth;

6. During the first domestic Medical Informatics Conference in 2016, one of the items that was discussed was “Mobile Health and long distance diagnostics” in relation to Telemedicine.

7. Till now two more conferences regarding Telemedicine were held by the Telemedicine Association: one in 2017 and another one in 2018 respectively. The items revolving around the first & second conferences were:

1. “Bed to Bed Management”;
2. Economy and Management in Telemedicine;
3. Design and implementing of international education curriculum (webinar);

4. Merging Medical field with IT equipment tools in computer networks such as the internet and video conference systems and etc.;
5. Medical intelligent web sites;
6. Medical Standards.

Introducing the Associations

eHealth Association

The eHealth Association with the approval of the Ministry of Science, Research and Technology, was founded (Authorization No: 3/117461) by Professor Seyed Shahabeddin Sadr in 2014, and consequently began to work, also as a member of the International Society for Telemedicine and eHealth. Yet, before the founding of our national Association, eHealth was neglected and little attention was given to it. After the foundation measures were taken such as holding international conferences and regular meetings in the Medical Sciences Academy with Professor Seyed Shahabeddin Sadr presiding over this matter, and eHealth became the focus of many and politicians began to show interest. Furthermore, on the subject of Telemedicine and its impact on achieving health justice, attentions are on the rise.

Association board Meeting at Academy of Science of I. R. Iran

Medical Informatics Association

Medical Informatics was founded in 2013 with authorization No: 4268/5 from the Ministry of Health, Treatment and Medical Education with Dr. Hamid Moghaddasi as its president. Paying particular attention toward Telemedicine and its effects on medical activities. Hygiene justice, was one of the important items that this Association followed since its foundation.

Telemedicine Association

Iran's Telemedicine Association began its work on 2016 with Dr. Fatemeh Nemat Allahie and Dr. Sirous Momenzadeh's much appreciated endeavor. This Association has got its activity license from the health ministry. Association's activity revolves around:

1. Bed to Bed Management;
2. Economy and Management in Telemedicine;
3. Design and implementing international education curriculum (webinar);
4. Merging medical field with technological tools in computer networks such as the internet and video conference systems and other medical tools.

Long Distance Medical Research Center

This center was founded as a means to develop research, education and giving medical services in order to elevate society's hygiene level and health by using the latest long distance medical technologies.

The request for founding this center was approved by Shahid Beheshti's Medical Science University in 2008 and then by the Ministry of Health, Treatment and Medical Education in 2009. The current president is Dr. Lida Fadaiezadeh, who is an anesthesiologist.

This Association Center has 10 researchers in a science committee and 8 researchers in a non-science committee.

The greatest achievement of this Association /Center since its founding is establishing long distance medical consultancy.

Visit Center and Long Distance Care

Visit Center and Long Distance Care

For providing health services (especially in less developed areas) and expanding social justice and development, economy and services by the providers in the medical field and non-binding communication between medical centers in villages and cities with clinics and hospitals that are covered by the Tehran University of Medical Sciences, with the help of v-Learning Faculty, latest communication technology and equipment in the long distance medical field provided specialized treatment services have been put into place.

In the pilot stage of this proposal that started in 2018 specialized children and toddler physicians with other hospital colleagues, with the purpose of visiting children below the age of 12 were established at the Child Medicine Center to give specialized services for the health pilot patients of Alghadir and Anbia.

The v-Learning Faculty by conducting long distance diagnosis in order to realize the health motto of "Health for all patients across the country" in the fourth phase of its action plan which coincided with the international kidney day on Match 14th, 2019, diagnosed some of the diabetic patients who suffered from kidney disease in Islam Shahr.

Long Distance Consultancy

In the present time, the most common usage of this technology is medical consultations, which is being done quite easily. Since long distant consult is easy and broad in use, it contributes much of Telemedicine by itself. In long distant consult all manner of communication tools such as telephone, fax, email and Skype are being used.

Long Distance Surgical Operation

In Iran long distance surgery is merely used to mentor and teach medical residents. However, in some hospitals in Tehran, Shiraz and Mashhad some operations with aid of Tele-Video is being done. An example of such operation will be given.

Jahat University is the leading front in establishing long distance medicine in Iran

After the foundation of several medical hospitals in the country, meaningful activities in the medical field and the most important of these activities were using communication technology to expand the quality of patient care and developing health justice. Some of these of these activities were:

Long Distance Treatment at Home

With establishment of long distance service centers offered to patients by Management Center and Medical Academy of Tehran in 2000 with the name "Dam" it was made possible for physician to keep their patients under surveillance anytime anywhere.

The current Dam center provides service so that when a patient calls, one of the operators, usually a nurse, gives free consultation and if a physician, dentist or psychiatrist is needed, he or she will visit the patient residence. Patients have POC's equipment available in their homes such as digital thermometer device that no matter where the attending physician is, he or she will have access to patient charts and can establish a diagnosis and starting to treat, provided that he or she has internet access. The Dam center also provides Tele-Homecare for those who need a prolonged period of care.

Long Distance Patient Monitoring

Long distance patient monitoring is another service that the Medical Academy Center with the help of Medical Universities do provide.

Long Distance Facilities in the Jahat Sterility Center of Qazwin

In 2016 with collaboration of the Jahat Academy of Qazwin province and communication center of the said province, this Sterility center was set-up and equipped with Telemedicine and the speed, quality and cost of provided services in this center was improved dramatically.

It's worth mentioning that in the present time in the Jahat sterility center of Qazwin, a close video communication was installed with the Qom Sterility center and all the first aid and prescription is done there. Furthermore, a long distance Intelligence center with the help of two groups is currently being developed.

Presidential Strategic Technology Development Center

The Presidential Strategic Technology Development Center began in 2018 a nationwide survey to evaluating the existing startup programs in the field of e-Health.

Some of these startups are involved in long distance appointment making, consultancy and education.

Additional Readings

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Poland:
National Network of Teleaudiology

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Introduction

Telemedicine is a term commonly associated with healthcare services provided to patients through a telecommunication medium. Activities are conducted locally, regionally, nationally and globally.

Fig. 1 Institute of Physiology and Pathology of Hearing, World Hearing Center

Telemedical solutions in the field of audiology and otolaryngology has been used more and more commonly in clinical practice and in the Institute of Physiology and Pathology of Hearing for almost 20 years. In order to popularize telemedicine, the Institute has implemented the first in the world - National Networ of Teleuadiology. Currently, it includes 16 domestic and

7 foreign centres. The network enables the implementation of: teleconsultation, telediagnostics using imaging and electrophysiological methods, remote setting of parameters of hearing aids and hearing implants, as well as rehabilitation of patients with hearing prostheses, tinnitus and voice disorders. Another important application is hearing screening in schoolchildren and adults. This chapter describes the development of teleaudiology in Poland over the last 20 years [1].

Year 2000 - First Teleconsultation

Telemedical consultations can be divided into two types, related to the way information is exchanged:

a) Pre-recorded consultations,
b) Real-time consultations [2].

The first type of telemedicine consultations consists in recording an image (e.g. an X-ray image) and sending it by means of a data exchange medium to a specialist or a centre where the consultations take place. After receiving the patient's data, the specialist makes a description and sends his or her comments and conclusions in the same way. The advantage of this type of medicine is the possibility of obtaining consultations without the need to involve many specialists at the same time. Clinical practice in various medical specialties shows that there are patients who require immediate consultation with a specialist located at a significant distance from the office in which the patient is examined. For this purpose, a second type of consultation is used - in real time - to obtain an immediate diagnosis. However, to ensure good quality and speed of information exchange, it is necessary to have an appropriate IT infrastructure and technological solutions to achieve this quality. The seemingly high costs associated with the provision of appropriate technology compensate for the access to services at the highest level.

In 2000, Prof. Henryk Skarzyński and his team developed and implemented a modern telemedicine program in Poland. One of the first telemedicine consultation programmes was implemented, in which the ear image in the form of video-otoscopy was sent via the Internet to other centres [3].

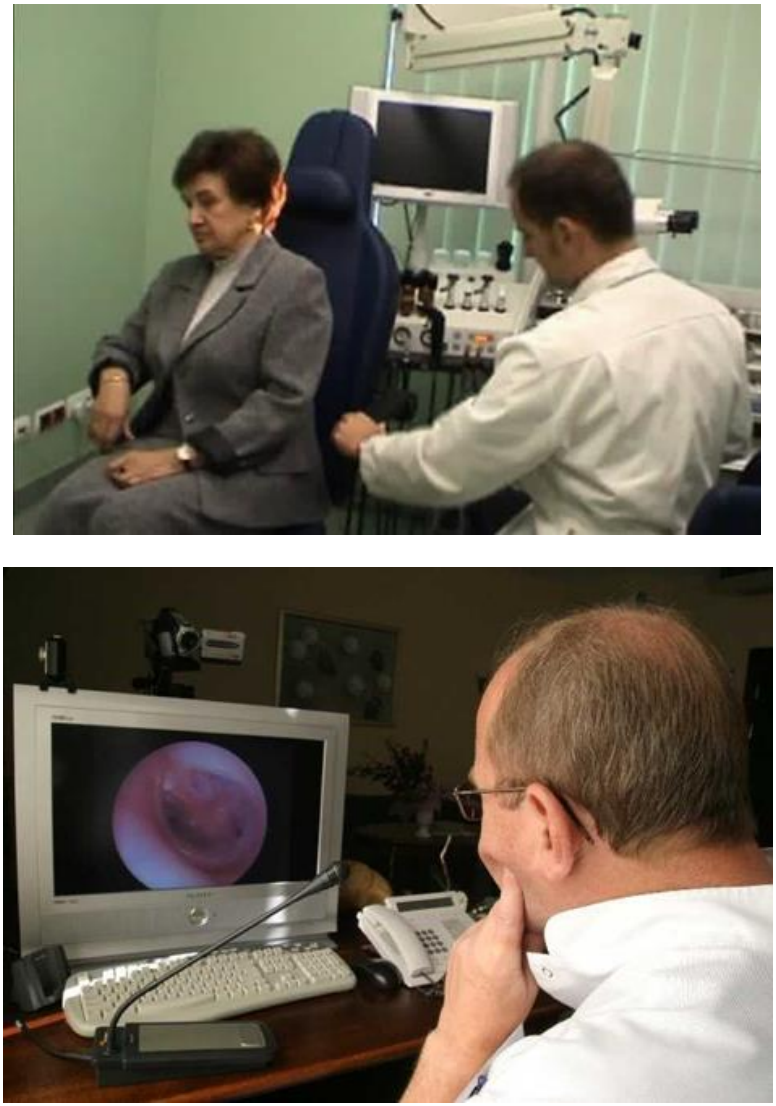

Figure 2. First remote consultation.

In 2004, the first transmission of the ear video-otoscopy image to the smartphone screen was made. It was one of the early attempts to explore a new field of medicine called mHealth. This application provided early support for modern telemedicine applications and is one of the first

applications of the mHeatlh system. This innovation became a catalyst for the then activities of the Institute for the development and promotion of the field of teleaudiology and telemedicine in Poland. Such a prelude met with great interest and was widely described in the local media [4].

Figure 3: Transmission of the image from the operating microscope to the mobile phone.

Year 2001 - TeleHealth Internet Platform

In 2000, modern multimedia tools for screening tests was developed. As a result, thousands of Polish children were screened using the multimedia computer program "I Can See, I Can Hear, I Can Speak", which monitors their vision, hearing and speech skills. Children and youth were the main recipients of the program. The hearing test consisted of an automatic analysis of hearing audiometric stimuli and a speech intelligibility test in noise. Vision and speech were tested in a similar, easy and effective way. The following systems were developed and are now available:

a) "I CAN HEAR": The system is designed for hearing screening, especially in children and adolescents. The test is based on automated survey analysis, audiometric tone testing and speech intelligibility in noise.
b) "I CAN SPEAK". - The Universal System for Research and Rehabilitation of Speech "I Can Speak..." is a multimedia Internet system devoted to the problems of pronunciation. The aim of this service is to improve the effectiveness and availability of diagnostic

and rehabilitation methods in the field of phoniatrics and speech therapy through the dissemination of applications in these areas of computer tools. The "I CAN SPEAK" module helps clinicians and patients work together to alleviate difficult communication disorders even when clinicians and patients are separated by long distances.

c) "I CAN SEE" - The system is designed for visual screening, especially in children and adolescents. The system also includes a rich information service on visual hygiene, causes of visual sense diseases and diagnostic and rehabilitation methods used in ophthalmology [5, 6].

Year 2004 - Home Rehabilitation Clinic

In 2004, the Home Rehabilitation Clinic was established, whose primary goal was to increase the effectiveness of rehabilitation of children with impaired hearing. Additionally, it was important to reduce the costs of medical and educational care for children. The successful development of the Home Rehabilitation Clinic proved that effective results were achieved when teleconsultation, telerehabilitation and teleeducation are used together to achieve therapeutic goals [7].

Following the idea of a "Home Rehabilitation Clinic" at the Institute of Physiology and Pathology of Hearing, various types of materials were developed and published for parents who sometimes find it very difficult to leave their jobs, home and other duties and regularly visit specialists in the clinics - often from long distances. So far, it has been the only opportunity to learn how to work with a child in order not to waste valuable time. The aim of our activities was to equip parents with various carriers of necessary information, which they can use at home. We do not suggest limiting or stopping contacts with specialists or with the child's peers. He or she needs both. We know that books, films and computers cannot replace something that is most important in rehabilitation - contact with another person, because only in such a relationship can the language and speech of a child develop.

Success in rehabilitation will be achieved by the family in which the child is born, if they:

- Learn to use his or her auditory leftovers,
- Masters the mother tongue passively (understanding of speech and language),
- Master the mother tongue in an active way (speaking, using the mother tongue in all forms of language communication).

The essence of the process, which we call the rehabilitation of a child with hearing loss, is to accompany him/her in the development of his/her mother tongue. This work takes place not only in the clinic, but also in the home,

where the child stays permanently, i.e. from morning to evening, 365 days a year. This task can be performed by parents who are appropriately prepared in terms of content and emotion [8].

Figure 4: Tele-rehabilitation by a speech therapist (right) from the World Hearing Center.

Parents will more easily achieve their goals in cooperation with a multidisciplinary team of professionals. Unfortunately, today there are many obstacles to systematic use of specialist advice in the clinic. Hence the need to support parents' activities in the family home. The Home Rehabilitation Clinic wants to meet the specific needs and fill in the gaps that exist in the field of providing competent and effective assistance to the family raising a child with hearing loss.

Forms of work of the Home Rehabilitation Clinic are:

- Preparation of publications - books, brochures, materials to be reproduced,
- Developing and disseminating practical information,
- Preparation of educational aids for speech therapy and supporting cognitive development of the child (on CDs),
- Providing consultations for parents and children without the need to travel to a distant specialist facility (telephone, fax, post),
- Internet usage - educational materials on websites,
- Online consultation [9].

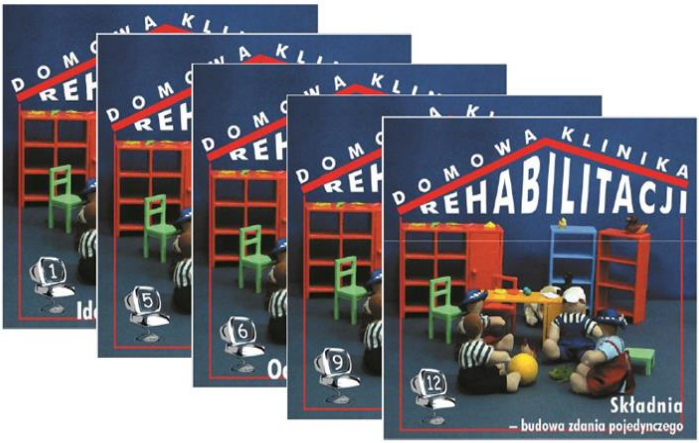

Fig. 5: Plates being a part of the Home Rehabilitation Clinic.

Year 2005 - Tele-education

Educational and training activities of the Institute of Physiology and Pathology of Hearing are conducted for students and specialists dealing with hearing, balance, voice, speech and language disorders. These activities are carried out in cooperation with Polish and foreign research centres and universities. Some of the teaching activities are also conducted for patients and their families. The arena of the Institute's educational activities is wide and includes not only Polish specialists, but to an increasing extent, from Europe, Asia, South America, North America and Africa.

The Institute of Physiology and Pathology is based on modern methods of education using a hybrid form of information model. Courses are conducted both in traditional conditions and at a distance (teleducation). The Institute has two modern teleconference studios, which used for educational activities supporting teleeducational programs. In addition, the Institute conducts classes and seminars, which are configured with seven conference rooms and seating for a total of 800 participants. It is the largest conference venue in Poland, which enables health care professionals to access services and educational opportunities. The facility is equipped with two multimedia studios for telemedical classes and a spacious exhibition area. All the stands are equipped with modern audiovisual equipment and interactive video systems with fast internet connection.

A unique feature of this facility is the ability to transmit 3D images obtained from the operating room to the conference rooms for educational purposes. In addition, the surgical room has an interactive video connection with a

modern and surgical laboratory built for training purposes. This laboratory can accommodate large groups of participants, allowing them to observe an instructor demonstrating surgical techniques in the operating room. Observing these surgical techniques, the participants can simultaneously perform the same procedures on temporal bone preparations [10].

Figure 6: Participants of the courses for specialists during practical exercises in the surgical laboratory

The Most Important Courses Organized by the Institute of Physiology and Pathology of Hearing

2006 LION Global Otology Neurotology (Live International Otolaryngology Network - LION)

Course launched in 2006. It is devoted to the use of the latest teleconferencing technologies for the continuous education of otolaryngologists around the world. The LION includes a permanent, interactive global training network that provides direct access to medical consultations with international experts in otology and neurology. These consultations are available to any physician who has a computer and Internet access. A key element of this program is the annual presentation at a video conference with otology surgeons representing leading centers around the world. Readers interested in the current activities of the LION Group should go to the following web address: http://lion-web.org/ [11].

Figure 7: Live broadcast of the operating theatre during the LION 24.05.2012 World Hearing Center

Year 2007 - WAW- Window Approach Workshop

Workshops dedicated to otorosurgeons specializing in or wishing to specialize in the field of hearing implants. During the workshops, the Institute of Physiology and Pathology of Hearing presents original methods of cochlear implantation in cases of partial deafness and middle ear implants in cases of mixed hearing loss using a surgical approach through a round cochlea window. Participants of the courses have the opportunity to familiarize themselves with surgical techniques presented by Prof. H. Skarżyński and the Oto-Ryno-Laryngosurgery Clinic Team, and to listen to lectures prepared by specialists from the Institute. During the laboratory

exercises, the participants learn how to perform individual stages of cochlear implant placement on temporal bone preparations on their own.

The programme of the workshops includes:

- Lectures prepared by specialists from the Institute of Physiology and Pathology of Hearing,
- Demonstration operations transmitted from the operating theatre to the conference room, with a presentation of each case and discussion,
- Laboratory exercises on fresh temporal bone preparations.
- Since 2007, a total of 46 editions of the course have been held [12].

Figure 8: Window Approach Workshop participants during lectures.

Year 2007 - Telefitting

Thanks to the development of new surgical methods and modern hearing prostheses, such as cochlear implants, modern medicine is able to restore the hearing ability of more and more patients. However, further use of this possibility requires intensive rehabilitation, which leads to the reduction of communication problems in everyday life. Auditory rehabilitation is a long and laborious process that requires a high level of commitment, comprehensive knowledge, experience and continuity of care. In patients using hearing aids or implants, one of the most important stages of this process is the selection of the working parameters of a hearing prosthesis. Optimal fitting of the hearing implant system or hearing aid is essential for the correct transmission of ambient sounds, including speech, to the patient's auditory pathway. The application of these therapeutic methods, the adjustment of hearing prosthesis parameters and the implementation of a coordinated rehabilitation process require the close cooperation of experienced specialists from many fields of science and medicine, including doctors, clinical engineers, hearing care professionals, speech therapists, pedagogues, psychologists and others. Such a team of specialists is available at the Institute of Physiology and Pathology of Hearing. The care is often supplemented by speech therapy in the patient's place of residence. Visits to the Institute for many patients involve a long and time-consuming journey. Often the patient is a young child and they come to the visit tired of traveling,

which adversely affects their ability to focus and reliable results of examinations. This, in turn, adversely affects the effectiveness of the therapy and causes significant difficulties in the optimal selection of the parameters of hearing prostheses. The need for the patient to come to the Institute is also connected with travel costs, which in many cases are a heavy burden for the patient's family [3, 10, 13].

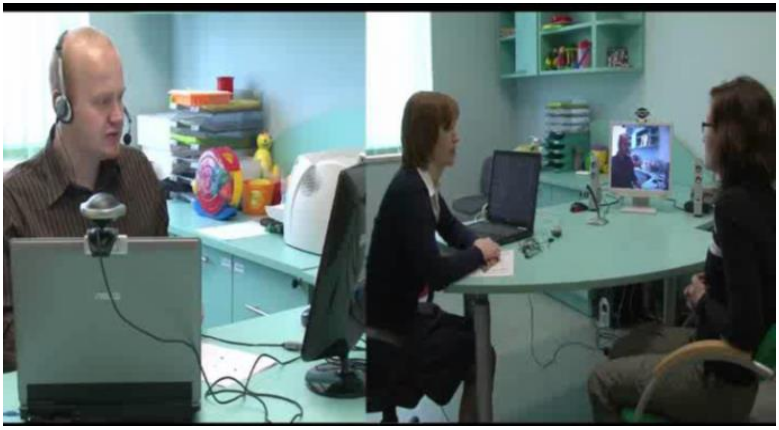

Figure 9: Remote adjustment of the cochlear implant system.

Remote Adjustment of the Cochlear Implant System

Four personal computers (PCs) are used for the remote fitting method: two on the patient side (local side) and two on the specialist side (remote side). One PC on each site is configured with webcams, microphones and speakers to ensure communication between the patient and the specialist. The second computer at the patient's premises is equipped with a cochlear implant interface capable of handling speech processors and implants. The National Network of Teleaudiology (NNT) Center in Kajetany is fully configured for remote computing and interactive video services in order to complete the telephoning services. It should be noted that in each set, one of the computers is configured for local cochlear implant tuning [14].

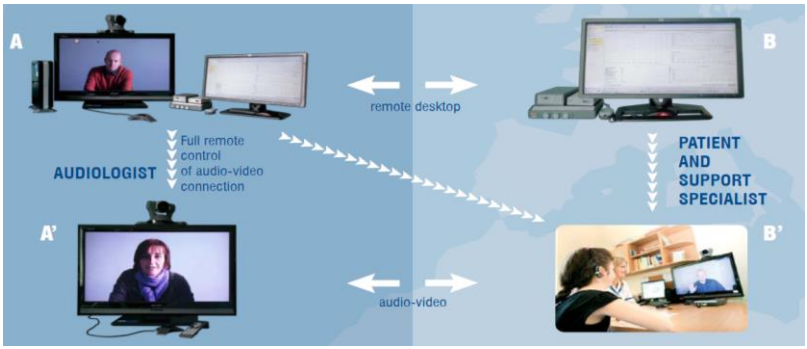

Figure 10: Schematic diagram of the remote cochlear implant fitting.

Alignment of Cochlear Implants with the Remote Calculation Application

In order to perform telefitting for cochlear implants remotely, the patient's speech processor is connected to a clinical interface on a computer in a local NNT clinic. The fitting specialist working on the computer in Kajetany obtains control of the patient's computer via a high-speed Internet connection and remote processing software. Once these actions are completed, it is possible to open the software, perform all the actions necessary to measure, and change parameters. Communication between the specialists and the patient takes place via a secure Internet connection via an interactive video system available in local and remote locations. On the patient side, there are also support specialists (speech therapists), who help in the process of communicating with the specialists. Although this is technically complex, the remote computing process has a face-to-face feeling and is achieved using commercially available remote computers. At the end of the session, the support specialist on the patient side disconnects the device from the interface and provides the patient with a newly programmed processor. Once the tuning has been validated, the NNT staff completes the remote computing session [15].

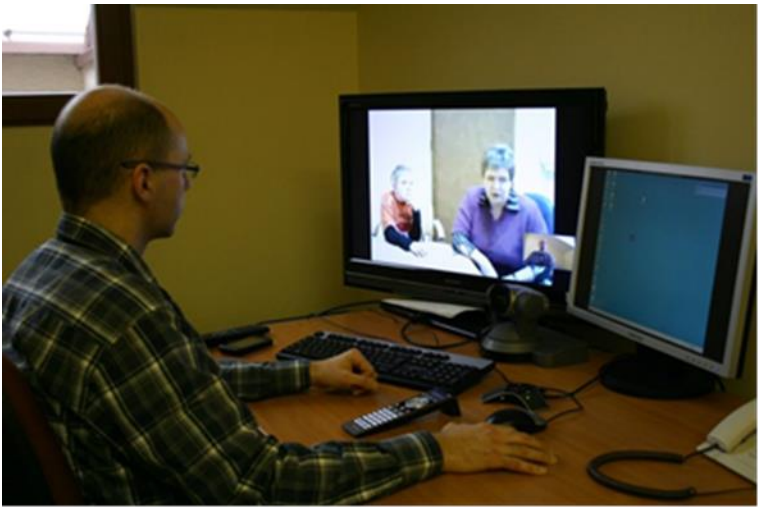

Figure 11: Clinical engineer performing a telephotometric adjustment of an implant system on a patient in another city.

While the above text describes a typical telefitting session, it should be noted that NNT provides a wide range of ICT services for cochlear implant and hearing aid users. These services include:

- Telemetric measurements to check the internal part of the system,
- Programming of electrical stimulation parameters in the patient's speech processor,
- Activation of the speech processor in live mode,
- Consultation on how to use the new settings in your speech processor,
- Remote target measurements (Electrically-evoked Compound Action Potential or ECAP; Electrically- evoked Stapedial Reflex or ESR, telemetry),
- Remote psychophysical measurements (function of amplitude increase, threshold detection) [16].

Year 2008 - Sense Examination Platform

In 2008, the Institute of Physiology and Pathology of Hearing and the Institute of Sensory Organs created a platform for screening of adults and children. The Sense Examination Platform is a portable device used for screening sight, speech and hearing in children, adolescents and people with special educational needs. Such disorders, undetected at an early stage, can disturb the harmonious development of the child. In addition, the Platform

makes it possible to collect survey data for epidemiological studies. The type of data and the form of the survey can be adapted to the requirements of the organisers of various types of screening programmes [17].

Fig. 12. Sense Examination Platform

The Sense Examination Platform is built on an advanced, central IT system and portable computers, which are equipped with audiometric headphones and a button for the examined person. Computers communicate with the central database via the Internet. The platform enables the transmission of research results to the central system, which has been equipped with modern IT solutions, enabling the management of the program and current supervision over the quality and number of performed tests. Test results are automatically evaluated and classified and those that do not meet specific conditions may be sent to specialist doctors for further evaluation [18, 19].

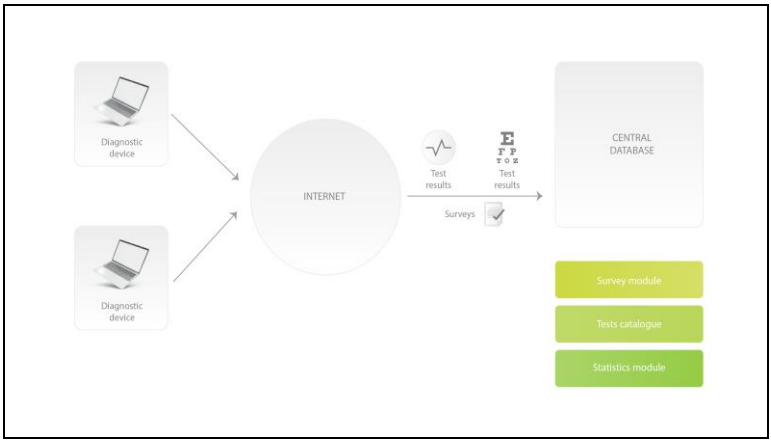

Figure 13: Connection diagram between the diagnostic device and the central system.

Thanks to the applied on-line solutions, it is possible to make the statistics available to individual users of the Platform and directly send them information about recommendations for persons whose research results were incorrect. For the convenience of users, diagnostic devices have been equipped with an automatic software update mechanism. Thanks to this solution, the user has a guarantee that the latest version of the program and the current version of the survey template is installed on his device. In order to have an automatic update, you only need to connect the device to the Internet. All procedures related to checking the software version and possible updates are performed automatically without the need for any action on the part of the user.

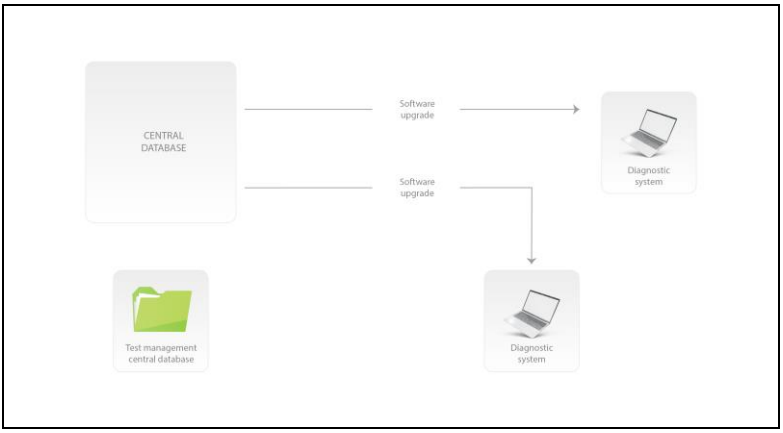

Figure 14: Scheme for updating the diagnostic system of the Sense Examination Platform

Available Tests

The device enables the following examinations and tests to be performed: - audiometric examination "Audiogram 2009"; hearing test "I can hear 2009"; speech screening "I Speak"; Vision Screening "I See"; Audiological Survey: - Survey; DDT Test and GDT Test. Below is a full description:

„Audiogram" - this function enables the performance of an audiometric test for air conduction, for each ear separately, in the frequency range of tones from 250 to 8000 Hz, for losses not exceeding 80 dB HL. The result of the test is an audiogram displayed on the screen of the device,

„**Hear" -** This function allows to perform a hearing screening test for tones in the frequencies 1000, 2000 and 4000 Hz and dB HL as well as speech in noise,

„I say" - the speech research is conducted in such a way as to obtain as much reliable information as possible on the subject:

- The quality of verbal behaviour of a child (including a child with a disability),
- The degree of speech development (or possible delays),
- Pathological linguistic phenomena occurring in the child's speech,

„I See" - the vision test is based on a contrast differentiation test, a colour vision test and a stereoscopic vision test.

„The Survey" - the 2009 Survey module allows conducting a general survey of hearing, vision and speech. Specialists based on

many years of experience developed the questionnaires. It is a solution that allows continuously improve the form of the interview with the patient,

„DDT”- is a test of hearing in the ear. During the test, pairs of numbers are presented to both ears, and the task of the test person is to repeat what he or she heard in one or both ears,

„**The GDT”** is a test to assess the perception of noise interruptions. The test shows the noise in which interruptions of variable length appear [20].

System of Integrated Communication Operations: "SZOK" ®

Any large-scale project involving children or adults provides a significant opportunity for early detection of congenital or acquired disorders. In response to social needs related to early detection of birth and acquired birth disorders, the Institute of Physiology and Pathology of Hearing has implemented a project called Integrated Communication Operations System "SZOK" ®. The project used a system for the first evaluation of patients using remote computer technology. These results were then passed on to doctors for interpretation at the World Hearing Center in Kajetany. The project leaders put forward a hypothesis that the evaluation of patient data using the SZOK system in the telehealth paradigm would reduce the waiting time for patients to visit the centre (or other specialist partner institutions). In addition, it would provide more access for patients, as the barriers commonly associated with distance would be reduced.

Between 2007 and 2019, the Institute of Physiology and Pathology of Hearing examined over one million students from the first and sixth grade of primary school in Poland and almost five hundred thousand children worldwide. This experience enabled a significant number of school-age children to be tested in order to prototype and validate the SZOK system. Moreover, the SZOK project has created an international screening infrastructure that provides an effective solution even in remote rural areas [17].

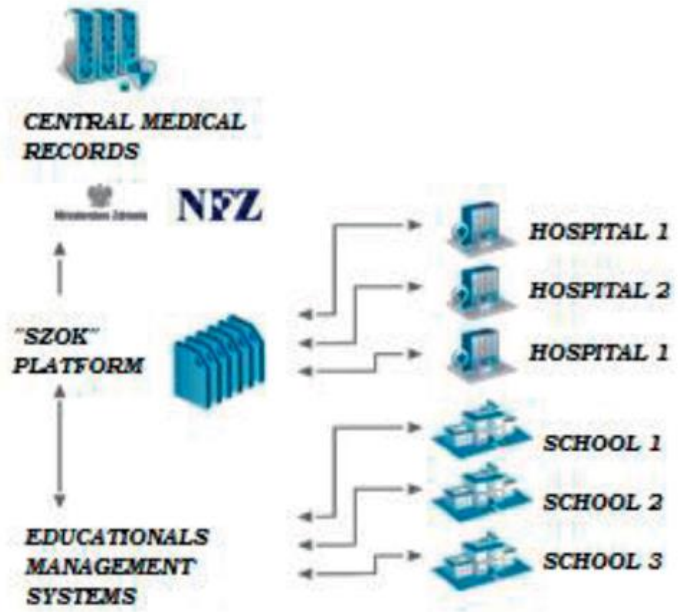

Figure 15: System of integrated communication operations: "SZOK" ®.

The large-scale screening programme SZOK required an agreement on a European scientific consensus, which was developed and ratified by the European Federation of Audiology - Meeting of Associations (EFAS). As a result, a number of pilot screening programmes were launched in different countries. Below (tab.1) we present the countries in which the team from the Institute for Physiology and Pathology of Hearing in Kajetany runs or has run these programs.

Country in which IFPS conducted hearing screening	Children's age	Number of tested children	Universal Newborn Hearing Screening in this country
Armenia	6–9	200	No information
Azerbaijan	6–8	200	No screening program
Cameroon	5–15	220	No screening program
Columbia	6–8	150	In some district
Congo	6–8	200	No screening program
Ivory Coast	6–8	130	No screening program
Kazakhstan	7–8	212	No screening program
Kyrgyzstan	6–7	300	No screening program
Moldova	6–7	179	No information
Nigeria	4–7	200	Pilot project
Romania	6–7	130	No screening program
Russia	6–12	166	No screening program
Rwanda	6–15	195	No screening program
Senegal	6–10	200	No screening program
Tajikistan	7–8	143	No screening program
Tanzania	6–11	200	No screening program
Ukraine	6–11	184	No screening program

Table 1: Hearing screening programs in the world conducted by the Institute of Physiology and Pathology of Hearing

Some of these countries have established cooperation with the National Teleaudiology Network. To this end, IT, software and storage solutions are shared with partners. The main center in Kajetany coordinates seven centers outside Poland: Odessa, Kiev (Ukraine), Brest (Belarus), Bishkek, Osz (Kyrgyzstan) and Dakar (Senegal), Shymkent (Kazakhstan) [19, 21].

2009 - National Network of Teleaudiology

In order to provide services on a large scale, in 2009 the National Network of Teleaudiology was established in the World Hearing Center. The project was supported by Norway and co-financed by Norwegian Financial Mechanism [4].

Objectives of the National Network of Teleaudiology:

a) Comprehensive care for patients with cochlear implants, brainstem implants, middle ear implants, bone conduction implants and modern digital hearing aids. The network is equipped with modern computer systems to provide comprehensive healthcare for people with hearing loss, enabling highly personalised services for each spider,
b) Enable coordination of the hearing rehabilitation process, which is essential for the development of sound reception and perception skills and through systematic training, the strengthening of verbal communication skills,
c) Implementation of social, educational and professional development programmes based on the knowledge of a multidisciplinary team of specialists from the Institute of Physiology and Pathology of Hearing
d) Disseminating knowledge on cochlear implants and the rehabilitation process [4].

Technical Equipment of the National Network of Teleaudiology

The National Network of Teleaudiology consists of a central unit located with the World Hearing Center and cooperation centers located in Poland and abroad. These centres offer state-of-the-art software and equipment for videoconferencing, which enables the performance of unique procedures for testing, measuring and programming cochlear implants. The National Network of Teleaudiology enables specialists from many fields, including clinical engineers, physicians, speech therapists, psychologists and audiologists, to work together to provide the best post-operative care for patients with cochlear implants.

The multi-point control unit (Polycom RMX2000 video conferencing system) is the master unit that enables audio and visual connections between two or more centres at the same time. Sixteen telemedicine centres in the National Network of Teleaudiology are configured with Polycom HDX8006 videoconferencing bridges and LCD panels for interactive video viewing. In addition, computers with Internet access are equipped with clinical diagnostic equipment and associated software for local and remote telemedicine services. Videoconferencing systems provide high-quality video and audio streaming tailored to your Internet connection. In addition, cochlear implant software is available via a video network computer system, allowing qualified clinicians to program the patient's cochlear implant systems over the Internet using remote computational solutions. The central point of the facility is the modern Telemedical Studio OTX300, which allows simultaneous communication with several other centres, so that many teleconsultations can occur simultaneously. All units of the system are connected by fast internet

speeds, which ensures high quality video conferences and trouble-free sessions [3, 4, 14].

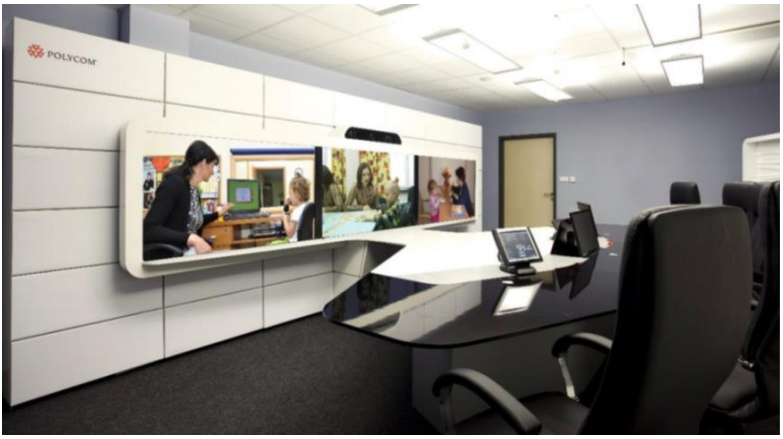

Figure 16: The OTX 300 telemedicine studio at the World Hearing Center in Kajetany.

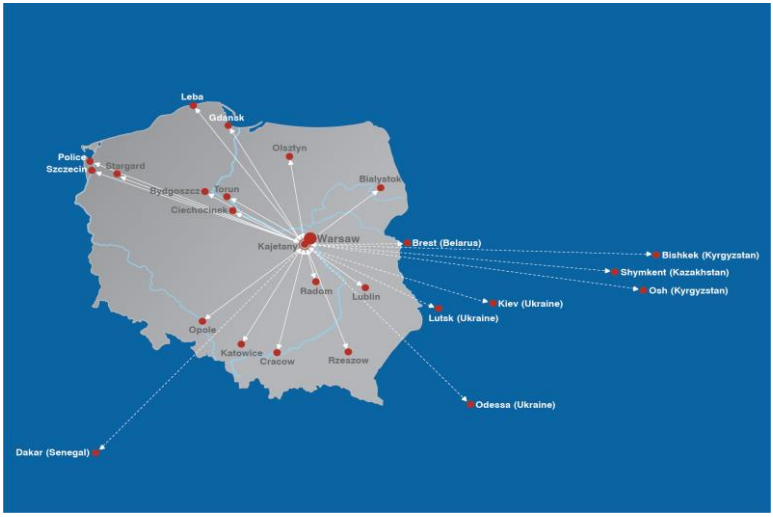

Figure 17: Diagram of the National Teleaudiology Network. [whc.ifps.org.pl/for-patients/telefitting-i-telerehabilitation/ [1].

Medical Centres of the National Network of Teleaudiology

The general objective of the National Network of Teleaudiology is to provide a wide range of telehealth applications, such as telefitting, telediagnostics, telerehabilitation and teleeducation. Currently, the Network consists of 16 cooperating centres in Poland and 7 abroad.

Year 2010 - First Continental Connections

Telefitting allows patients to do hearing rehabilitation at a distance. Patients no longer need to visit the hospital every few months. All they need to do is to get to one of the centers located closer to their home using a teleconference system with the Clinic in Kajetany. Every year, several thousand patients use the facilities of telemedicine solutions. Thanks to the telephoning system, the visit does not differ from the one held personally, only that the patient and the doctor can see each other on the monitor screen. The use of the best, for years proven remote methods of fitting and rehabilitation gives measurable material benefits - saving time and money of patients, as well as better use of time of medical staff. Access to audiological services is a serious problem in fast developing countries. Lack of properly trained staff and costs mean that children and even adults are unable to diagnose hearing loss. Parents may not be able to see or detect their child's hearing difficulties. Most patients who have received a cochlear implant will not be able to fit it properly in the local environment. This requires a long journey to a specialist clinic, which is both time-consuming and expensive.

Although the Odessa facility is well equipped, cochlear implant programming cannot be performed there due to a lack of trained specialists and their limited experience. In order to overcome this problem, it is proposed to "filter" the cochlear implant [22].

Year 2018 - First Intercontinental Calls

After more than eight consecutive years of work, it was possible for the first time to establish a link between Africa and Europe. On 26 August 2018 in Dakar, Senegal, the first telefitting conducted by specialists from Poland from the Institute of Physiology and Pathology of Hearing and the International Hearing and Speech Centre "Medincus" in Kajetany took place. An interdisciplinary team of doctors and engineers participated in the first connection between Poland and Africa by means of the telephoning system. In Dakar, the consultation was conducted by Aissa Diaga Ngom, an audiologist from Senegal under the supervision of Polish specialists, Prof. Dr. Piotr H. Skarżyński and Dr. Łukasz Bruski, while in Poland the session was supervised by specialists from the World Hearing Centre.

The patient taking part in the teleconsultation is a 7-year-old boy from Senegal with congenital hearing loss, who in 2016 was operated on in a clinic

in Kajetany. The telephoning system is a globally unique solution for remote fitting of cochlear implants, providing greater accessibility to treatment for hearing impaired patients and more effective rehabilitation. During the visit of the Polish delegation to Senegal, meetings with local specialists were also held to integrate the Dakar facility into the world's first Network of Teleaudiology.

Polish otolaryngologists, during their many years of cooperation with specialists from African countries, received proposals to conduct joint scientific research. At the beginning, we managed to organize hearing screening tests in Ghana, Cameroon, Morocco, Algeria, Ivory Coast, Congo, Tanzania, Senegal and Rwanda. African specialists also come to Poland to learn about the knowledge offered by the Polish school of otolaryngology in the field of diagnostics, treatment and rehabilitation of hearing [23].

Year 2018 - Sensory Research Capsule

Screening programmes are an important element of public health. Early detection of disorders and treatment significantly reduces healthcare costs. Today, there is no such system in the world that can test the most important sensory and speech organs in one place in a short period of time. In order to diagnose further organs, patients have to visit several centres - this means many visits and often long months of waiting for consultations. For many, diagnosis is so burdensome that they give up research and treatment. In response to the demand, an innovative diagnostic and rehabilitation capsule has been created.

The Sensory Research Capsule is the world's first integrated device for testing human senses. It includes infrastructure, equipment and standardised tests for screening and diagnostics. It was developed by a consortium. The leader of the project co-financed by the National Centre for Research and Development within the STRATEGMED project was the World Hearing Centre of the Institute of Physiology and Pathology of Hearing in cooperation with teams from the Warsaw University of Technology, Medical University of Warsaw, Collegium Medicum in Bydgoszcz, the Institute of Sensory Organs and the International Hearing and Speech Centre "Medincus" and Greenfusion sp.z o.o. Until now, in order to diagnose individual organs, patients had to visit several specialist centres. Thanks to a mobile capsule, which can be placed in a shopping centre, for example, screening tests are simpler and more efficient than ever before. The capsule allows performing tests of hearing, sight, smell, taste, balance, speech and processing functions. Its main task is to:

- Early detection of sensory disorders,

- Early capture of prognostic factors predicting the development of neurodegenerative diseases,
- Early implementation of mental and motor training,
- Dissemination and improvement of access to preventive examinations for persons with disorders of many sensory organs, as well as their rehabilitation.

In addition, the SENSE EXAMINATION Capsule:

- Contains modern and standardised diagnostic tests;
- Enables quickly to perform tests;
- Provides optimal conditions for testing;
- Has a modular design for mobility;
- Promotes and facilitates access to preventive medical check-ups;
- Is suitable for both school children and adults;
- Is adapted to persons with reduced mobility;
- Is easy to use;
- Enables teleconsultation with specialists;
- Has a dedicated portal for users and doctors [24].

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