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

2018

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Preface

Dear Reader,

The second volume of the series “A Century of Telemedicine. Curatio Sine Distantia et Tempora: A World Wide Overview” is in your hands.

The book presents a historical approach of Telemedicine and eHealth in the following six countries – Chile, Finland, Georgia, Japan, Peru and USA. 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 goal is 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 book offers a wide range of bottom-up and top-down approaches and solutions as well as a logical follow-up of the previous two publications, i.e. Vladzimirsky A., Jordanova M., Lievens F. A Century of Telemedicine: Curatio Sine Distantia et Tempora. Sofia, Bulgaria, 2016 and Vladzimirsky A., Jordanova M., Lievens F. (Eds.) A Century of Telemedicine: Curatio Sine Distantia et Tempora. A World Wide Overview – Part I, 2017, Sofia, Bulgaria, ISBN 978-619-90601-2-4. These books are available (open access) on the website of the International Society for Telemedicine and eHealth (ISfTeH), section “Telemedicine/eHealth History”

https://www.isfteh.org/media/category/telemedicine_ehealth_history.

The present volume provides directions of a wide variety of decisions, able to affect the form and functioning of the healthcare sector over the next decades, and 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 purposes of healthcare delivery.

Telemedicine/eHealth offers enormous possibilities. The technological solutions are available and ready for implementation. If carefully realized, taking into account the needs of the community, cultural frames and economic development, Telemedicine/eHealth is able to improve both access to and the standard of healthcare, and thus to close the gap between

the demand and supply of affordable, high quality healthcare to everyone, at any time, everywhere.

The editors are convinced that this book will provide useful information to those who are preparing to introduce or expand Telemedicine/eHealth in their regions or countries. It will allow them to rely on the experience of the demand and supply of affordable, high quality healthcare to everyone, at any time, everywhere. others and will make them aware of the benefits and problems that were encountered during and after implementation of systems or services, and as such, will help them to possibly avoid mistakes and reduce potential problems.

Yet, it is necessary to underline that:

- The content is divided in chapters. 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. An exception is the chapter presenting the Digital Library at the website of the International Society for Telemedicine and eHealth;
- The original style of the authors was respected as much as possible;
- “How”, “Where”, “When” are only part of the questions that authors are trying to answer;
- 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 firmly believe that everyone involved in Telemedicine/eHealth will find this book not only interesting, but most valuable as well.

Enjoy your reading!

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Chile

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Introduction

Chile is a long and narrow country, with an extremely diverse geography and plenty of natural barriers. Its population (17 373 831) [1] is unevenly distributed along its territory. Most Chileans live in the middle third of the country, while the far north and extreme south are relatively underpopulated.

The health care system is a mixed public and private one. The Ministry of Health (MINSAL) formulates policies, provides regulation, and supervises the 29 Servicios de Salud (Health Services, SS). These are the regional healthcare administration entities, conforming to the public system, each responsible for ensuring healthcare delivery in their area through a network of hospitals and other facilities for the provision of primary, secondary, and tertiary levels of care. The local municipalities usually administer most of the primary care facilities. The private system includes hospitals and facilities that, in some cases, may be part of private healthcare networks. The healthcare system is funded mainly through insurance providers. Several private insurances (ISAPRES) cover only part of the population, while the public insurance, Fondo Nacional de Salud (FONASA), covers most of the Chilean population (currently ca. 77%).

Despite the fact that Chile performs relatively better than most neighboring countries in several population health indicators and rankings, many issues related to healthcare access and quality still need improvement. As a result, around 2005, the so-called AUGE system (Universal Access Explicit Guarantee) [2] was launched. It aimed at improving public healthcare service quality by initially selecting 56 health problems (currently includes 80 conditions) for which specific guarantees would be made to patients such as care provision in accordance to clinical guidelines; waiting no longer than preset periods for diagnosis, treatment, and follow-up. It also established that, in case that the healthcare provider and insurance could not provide the services within the established timeframe,

the insurance would have to pay the healthcare provision from other providers, usually private ones with the available capacity.

The AUGE plan was a relevant and important milestone. Nevertheless, its setup experienced some difficulties and inconsistencies that somehow lowered care and attention to the other health conditions, not included in its coverage. Furthermore, population aging, chronic conditions, and other healthcare challenges are on the rise, similar to other more developed countries [3]. Despite of this, the country's healthcare infrastructure has recovered from the 2010 8.8 magnitude earthquake. In recent years, it has been making further investments, increasing both infrastructure and human resource allocation, especially in the public healthcare system. Yet, the demand for healthcare services, provision costs, and hospital debt are increasing [4]. The number of physicians is proportionately low (1.0331 physician per 1000 population) [5]. The longer waiting lists to see a specialist are often given public attention. The overall patient satisfaction is relatively low [6]. The actual access and timely delivery of healthcare services, especially to underserved and rural areas of the country, due to the complex geography and uneven population distribution still remains a big challenge. It has only being partially covered by the new infrastructure investments of recent years. In this scenario, innovation through Telemedicine has great potential to contribute to access and efficiency of the healthcare system.

Several telemedicine pilots and projects started in Chile around 1996 [7] and in the following years, most of which were experimental.

Around the year 2000, the Universidad de Chile joined the Argonauta Program (Austral On Line Network for Medical Auditing and Tele assistance), an International program, co-funded by the European Union, involving several other countries aimed at the remote monitoring of patients in Antarctica. In the following pages, we will attempt to describe or at least mention, the most relevant nation-wide telemedicine programs the country has implemented in the past few years, as well as relevant local telemedicine projects and initiatives contributing to healthcare delivery in the country. Despite the authors' effort to include all relevant projects, there is no guarantee all projects will be covered in this release. On this specific matter, on September 29th, 2017, the Chilean Health Informatics Association (ACHISA), together with

The Chilean Health Informatics Symposium (IS Chile),

- The Center for Biomedical Informatics of the Faculty of Medicine Universidad del Desarrollo,
- Nodo RITMOS Chile-Universidad Austral de Chile and

- The Telemedicine Unit of the Faculty of Medicine Universidad de Concepción

launched a call for the setup of a public national registry of telemedicine projects and programs. The latter that will be available by June, 2018 (est.) <http://telemedicina.achisa.cl>. All partners understand the value of knowledge and experiences sharing in Telemedicine and the necessity of establishing a model for the update and sustainability of such registry over time.

Tele-ECG

Among the health conditions covered by the AUGE health reform, launched in the year 2005 (see Introduction), the Ministry of Health (MINSAL) set a specific guideline related to ST segment elevation myocardial infarction (STEMI) diagnosis and treatment. It requires that patients with suspicious acute myocardial infarction get a diagnostic confirmation by means of a 12-leads electrocardiogram (ECG) ideally within 10 minutes of arrival to the healthcare facility, while also setting “*an ECG within 30 minutes from suspicion*” as the KPI (Key Performance Indicator) goal for 100% of patients in such conditions.

The guideline itself admitted “Telemedicina” (actually meaning “tele-ECG”) as a way to comply with such a requirement and the government allocated funding in a systematic and persistent manner in the last 12 years. This led to the deployment of a nation-wide tele-ECG service, gradually covering several hundred health care settings. Currently there are more than 470 primary care settings or low-level hospitals from which ECG is transmitted for remote interpretation. One of the most important tele-medical centers providing such service, both for public and private healthcare facilities, has reached, over time, the capacity to receive and interpret more than 50 000 tele-ECGs per month [8], having peaks of 2500 tele-ECGs per day. Approximately 40-50% of the ECGs come from the public healthcare system. It also interprets at distance ambulatory blood pressure monitoring (ABPM), Holter, and spirometry among other studies.

It is worth mentioning that a “side-effect” of this nationwide tele-ECG service is that it has led to the build-up of a database containing millions of measured and interpreted ECGs. The database has enabled several studies and research, ranging from the prevalence of ECG Brugada Pattern [9], long QT patterns [10] up to the impact of the 2010 Earthquake in the incidence of subepicardial lesions [11]. Nevertheless, the most remarkable impact of this tele-ECG service is in terms of its contribution to the AUGE STEMI diagnosis protocol confirmation that has brought mortality due to STEMI

down from 12% to 8.6% (adjusted for other variables) thanks to the AUGÉ plan implementation [12].

Tele-processes “Galileo Program”

Starting in 2009, a series of pilot projects under the umbrella of the initially so-called “Galileo Program” took place in the Biobío Region. It began with a Cardiovascular Telemedicine program, connecting remote medium-low complexity healthcare facilities (e.g., San Carlos, Curanilahue among others) that belong to the Cardiovascular Macro-network of Biobío Region, referring patients to the high-complexity Las Higueras Hospital (Servicio de Salud Talcahuano). A store-&-forward teleconsultation platform was set up allowing general practitioners (GPs) to send electronic “interconsultas” requests to cardiology specialists at Las Higueras Hospital, including patient summaries and lab test results. Many cases were managed remotely, avoiding unnecessary, long patient waiting lists and traveling to physical appointments with cardiologists [13].

Gradually, the program added tele-ECG, holter, and other medical devices to remote medium-low facilities that could further enrich information provision, thus enhancing the clinical guidance and suggestions that could be provided at a distance, as such studies were directly sent to tele-ECG and CardioPACS platforms residing at Las Higueras Hospital.

Soon after that, a telepresence platform was also implemented (Fig.1), allowing real-time tele-consultations. The latter, together with the store-&-forward teleconsultation platform, enabled other specialties to join the “tele-process” program. Gradually, telepsychiatry, tele-child-psychiatry, tele-nephrology, tele-neurology, and, more recently in 2015, tele-geriatrics were established. This led to the formal definition and setup of the “High Complexity Telemedicine Units” at Tomé, San Carlos, Chillán, Angol, and Las Higueras Hospital. The sixth unit will be installed very soon at the Curanilahue Hospital as well. The goal is to have a “High Complexity Telemedicine Unit” available in every community with a population of 50,000.



Fig. 1 Telepresence platform. Hospital Las Higueras de Talcahuano, Biobío, Chile

Table 1 Teleconsultations from 2012 to May 2016 provided by Unidad de Teleprocesos, Hospital Las Higueras de Talcahuano (Servicio de Salud Talcahuano) to their own network and to other macro-regional healthcare services (source: Unidad de Telemedicina, Universidad de Concepción).

Teleprocesos macrorregión sur y Maule
(Período 2012-Mayo 2016)

Establecimientos	Tele-interconsultas (4 especialidades) store & forward	Exámenes	Tele-presencias (4 especialidades) real-time	Total tele-transacciones
SS Talcahuano	4,396	34,071	1,612	40,079
SS Ñuble	3,905	19,863	1,337	25,105
SS Maule Sur	2,162	239	1,122	3,523
SS Araucanía Norte	2,242	2,801	1,642	6,685
SS Arauco	601	470	15	1,086
TOTALES	13,306	57,444	5,728	76,478

Telenephrology

Early diagnosis and prompt nephrology referral are key steps in treating chronic kidney disease (CKD). Prevention protocols and AUGES Ministry of Health guidelines recommend that any patient with a Glomerular Filtration Rate (GFR) below 60 ml/min should be referred to a nephrologist. Unfortunately, there is a lack of specialists, both regionally and nationally, leading to long patient waiting lists. In 2012, Servicio de

Salud Concepción, led by Dr. Carlos Zuñiga, launched a tele-nephrology program using a combination of a store-&-forward platform (SINETSUR) and a video-conferencing real-time equipment to perform both tele-education and tele-consulting, including lab results transmissions from primary care settings to nephrology specialists at the Hospital Guillermo Benavente Grant (SS Concepción).

The pilot started with Coronel Hospital and, soon after, the Family Health Care Centers (CESFAM) Carlos Pinto Fierro, Lagunillas, and Yobilo joined. On average, the virtual consultation was performed within 8.5 days. A prompt case prioritization was achieved and the waiting list numbers dropped in a significant way. Thanks to better prioritization and achieved efficiency, cases actually requiring a physical referral to Hospital Guillermo Benavente Grant saw a waiting time reduction from a prior average of 213 days, down to 52.3 days [14].

Teledermatology

Early experiences in teledermatology were carried out by Dr. Lobos, Clínica Las Condes (Santiago), and Robinson Crusoe Island. They date back to 1998-1999. In the year 2000, Servicio de Salud Metropolitano Sur started piloting a store-&-forward dermatology teleconsultation service based on e-mail. GPs from primary care outpatient facilities could send clinical case descriptions to specialists located at Barros Luco Hospital. Case information included anamnesis, physical examination and attached skin lesions pictures.

What was learned from that experience was brought in 2009 to the Ministry of Healthcare by Dr. Héctor Fuenzalida and used as a basis to develop a teledermatology store-&-forward platform. The resulting platform enabled a standardized and user-friendly teleconsultation process by means of a defined protocol, digital cameras, and the provision of a set of dermatology drugs to primary care settings. A formal pilot was then started involving the regional healthcare services of Chiloé, Magallanes, and Metropolitano Sur.

Currently, the teledermatology service is deployed as a standard process of care in 28 of 29 regional healthcare services (Servicios de Salud). As a result of several coordinated strategies and plans, aimed at providing patients timely access to dermatology care (patients' waiting lists management), support to primary care clinicians, continuous remote learning, and further support to local primary care networks regarding this medical specialty is achieved.

Analysis of data between January and June 2015 (a six-month period), showed 63.7% of dermatology referrals were managed and solved at

primary care level by means of teleconsultation, avoiding unnecessary patient travel. Over the same period of time, concordance between general practitioners' diagnostic hypotheses and specialists' assessments was equal in 72.6% of the cases, compared to 68.5% of concordance between January and June 2014 (first semester of previous year). This might be considered as an indicator of the learning effect of the remote interactions between GPs and dermatology specialists through the platform itself.

The graph below (Fig.2) shows the increasing trend on the number of teleconsultations in dermatology since 2010, reaching 18,183 by the end of 2016.

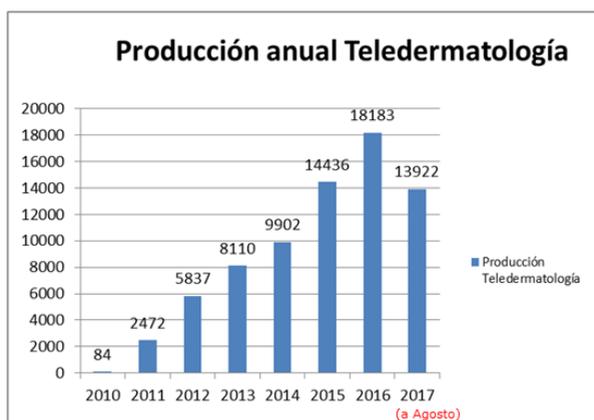


Fig. 2 Number of teledermatology consultations per year managed through the Ministry of Health Teledermatology platform (from 2010 to August 2017)

Teleradiology

With some pilots and experiences already taking place at the end of the 1990s, followed by the Universidad de Concepción, a Teleradiology network started in 2005 [15]. Teleradiology went mainstream more recently (2011-2012) as many public healthcare facilities were equipped with digital image acquisition devices, i.e. either computer radiology (CR) or digital radiology (DR). Many tenders from the Ministry of Health and individual Public Healthcare Services (Servicios de Salud) have been regularly launched since then, by means of the government public e-procurement platform www.mercadopublico.cl, aimed at the provision of remote general radiology and CT (computerized tomography) scans interpretation among

others. Usually these services are meant to satisfy the need of hospitals with no radiologist on staff (or no radiologist shifts at night), with the requirement to have a report within two hours time-lapse. Also, private clinics and healthcare networks implemented tele-radiology even earlier. One example, Clínica Alemana Santiago, has a regular service with Valdivia and Temuco among others. Tele-radiology is now a standard care option, both for private and public healthcare systems.

Teleassistance

Starting in 2012, the Ministry of Health gradually equipped several hospitals with mobile video-conference equipment, allowing low-complexity hospitals to request assistance from higher level hospitals for decision support, better beds management, and to allow better communication and coordination between healthcare facilities at higher levels in case management. By 2014, there were approximately 125 hospitals equipped with such devices and, during that year, 13,467 teleassistance sessions took place. Unfortunately, only partially updated information about teleassistance has been recently released.

Teleophthalmology

During the past years, the Ministry of Health (MINSAL) enhanced the diabetic retinopathy (DR) screening program for diabetic patients that were also under cardiovascular control programs in order to achieve wider early diagnosis and stop DR progression to blindness, a condition covered by the AUGE (Universal Access Explicit Guarantee) system. The Ministry of Health Clinical guideline for diabetic retinopathy recommends a dilated funduscopy with examination of the posterior pole using slit-lamp biomicroscopy every two years in Diabetes Mellitus II performed by an ophthalmologist or a screening with mydriatic or non-mydriatic digital retinal imaging.

Since 2013, most of the existing Primary Ophthalmological Care Units (UAPOs) were gradually equipped with a non-mydriatic digital camera to perform retinography. Images are stored in a web platform available for remote interpretation and reporting by an ophthalmologist (Fig. 3). Such tele-ophthalmology program is an alternative to reach people with diabetes having adequate sensitivity and specificity for the diagnosis of Diabetic Retinopathy (DR), increasing the coverage to those patients that are most at risk.



Fig. 3 Teleophthalmology screening for DR workflow

As an example of this, between October 2014 and June 2015, the Telemedicine Unit of the University of Concepcion participated in evaluating and reporting on 7,382 retinographies from the Family Health Care Centers of the Health Service Concepcion, accounting for 26.4% of the diabetic population under treatment who are beneficiaries of the 5 UAPO Health Services: patients from Concepción, Coronel, Lota, Chiguayante, San Pedro de la Paz, Florida, Santa Juana and Hualqui. This screening experience shows the need for timely and appropriate referral of these patients, 7.7% of whom are at significant risk of loss of vision and blindness.

In 2016, 171,600 tele-ophthalmology DR reports were performed throughout the country. By June 2016, it accounted for 27.4% of the expected target population coverage [16].

Telemedicine for Patients on Oral Anticoagulant Therapy (OAT)

In 2014, telemedicine was used to monitor patients under oral anticoagulant treatment (OAT). Patients attending peripheral Curacaví Hospital were remotely monitored from secondary and tertiary care Hospital San Juan de Dios (Santiago). Both hospitals belonging to Servicio de Salud Metropolitano Occidente. Telemedicine allowed close relationship between remote medical facilities, and it was fully validated for OAT monitoring, also getting high acceptance from patients [17].

Los Ríos Region's Virtual Care Network

Since 2014, Valdivia's regional healthcare service (SS Valdivia) established "Los Ríos region's virtual care network," a network based on five pillars:

1. Reference and Counter-reference system: a web platform for *store-&-forward* telemedicine aimed at multiple areas and specialties: cardiology, dermatology, internal medicine, nephrology, gastroenterology, pulmonary medicine, orthodontics, and a pilot for urology.
2. Teleradiology round-the-clock services for medium-low-complexity hospitals in the region.
3. A videoconference network embracing 13 connected rooms aimed at remote learning and teleassistance serving several regional primary care facilities and two low-complexity hospitals.
4. An electro-cardiology network and related information management system connecting 41 ECGs, 31 Holter, and 6 Ambulatory Blood Pressure (ABPM) devices assigned to primary care facilities of 12 counties and 3 cardiac stress test systems that are assigned to hospitals in the region.
5. E-Learning platform for the continuous delivery of basic and updated knowledge to primary care clinicians about teleconsultation guidelines and protocols established by the regional telemedicine network.

High Resolutive Primary-Emergency Care Services

As mentioned in the introduction, Chile has been investing in the public healthcare system in terms of both infrastructure and human resources. As an example of this, brand new emergency primary healthcare facilities, called "*Servicios de Atención Primaria de Urgencia de Alta Resolutividad*" (*SAR or S.A.R.*), established by the Ministry of Health (MINSAL) in the year 2015 and recently formally approved by means of MINSAL Res. Ex. 20, Jan 9th, 2017, have been deployed (Fig.4).

SARs are meant to have high resolutive capacity for patients with non-life-threatening conditions that can be managed by the local facility, thus helping to decrease the demand and pressure on the emergency departments of higher-level hospitals.



Fig. 4 S.A.R. Dr. Víctor Manuel Fernández - Concepción - Chile (picture: from/courtesy of MINSAL)

<http://plandeinversionesensalud.minsal.cl/atencion-primaria-de-salud/sar-servicios-de-urgencia-de-alta-resolutividad/>

Service is available from 05:00 p.m. to 08:00 a.m. on regular business days and 24 hours a day on holidays. Each SAR is equipped with basic lab test kits, x-rays, and hardware/software equipment to access Telemedicine services (e.g. tele-consultation). MINSAL announced having already built 32 SARs (March 2017) out of the 132 SARs planned to be ready by the year 2018, as one of the efforts to further strengthen primary health care in the country.

Virtual Palliative Care Boards

Since 2016, the Palliative and Continuous Care Unit of the Hospital Clínico de la Universidad de Chile, Santiago has engaged in a series of virtual palliative care boards through video-conference reviewing cases and exchanging knowledge with other palliative care colleagues and other health professionals from Family Health Care Centre (CESFAM) Lago Ranco and Valdivia, Ancud, Puerto Montt, Osorno, Lanco, Coyhaique, Sótero del Río, Quilpué, Juan Noé de Arica, and Gustavo Fricke de Viña del Mar Hospitals (Fig.5).

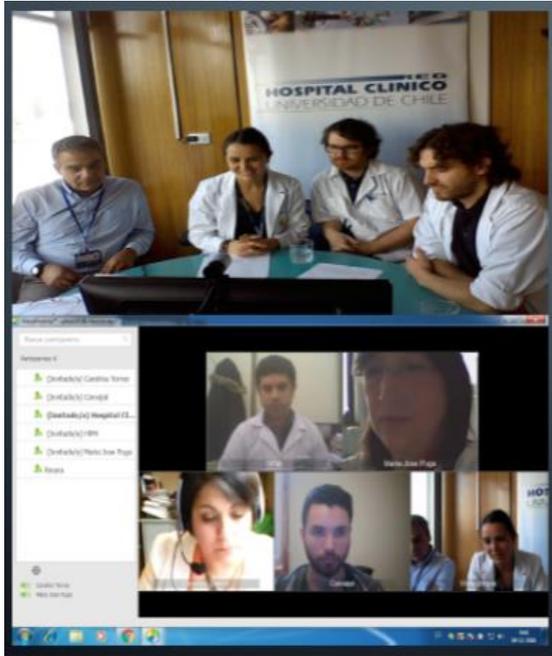


Fig. 5 Virtual Palliative Care Board session from Hospital Clínico Universidad de Chile (2016).

This experience will lead to the development and validation of a model and a set of protocols for carrying on virtual palliative care boards that could fit into the public healthcare system, in order to enhance clinical activities and continuing education for all participants. It will be developed by means of collaboration between clinicians and academics from M.D. Anderson Cancer Center (USA), Universidad Austral, Universidad Andrés Bello, and Ministry of Health, led by Dra. Alejandra Palma Behnke from the Palliative and Continuous Care Unit of the Hospital Clínico de la Universidad de Chile (Faculty of Medicine).

Virtual Tumor Boards - Instituto Nacional del Cáncer (INC)

Since April 2017, the National Cancer Institute (Instituto Nacional del Cáncer, INC), located in Santiago, has established regular virtual tumor boards through video-conference to review oncology cases submitted from Rancagua Regional Hospital. The latter also gets patients from Santa Cruz and San Fernando Hospitals. By August 2017, more than 100 cases were

reviewed through virtual tumor boards. On September 2017, Hermina Martín Clinical Hospital (Chillán) joined together with the Complejo Asistencial Dr. Víctor Ríos Ruiz (Los Angeles).

These boards are organized to review patients that might require radiotherapy, hemato-oncology cases, or complex cases. Each virtual tumor board session has the capacity to review up to seven cases per video-conference-hour, and they are held once a week. This initiative resumes a previous short virtual tumor board piloting experience that was held in 2015 between the National Cancer Institute (INC) and Talca Hospital.

Chile Participating with the Telemedicine Development Center of Asia (TEMDEC)

In the last years, Clínica Alemana, Hospital Clínico Universidad de Chile, and Universidad Católica de Chile joined the teleconference series of The Latin American Endoscopy Teleconference, organized by the Telemedicine Development Center of Asia (TEMDEC), Japan, thus actively participating in the knowledge sharing in the gastroenterology specialty. Other Latin American countries (Brazil, México, Colombia, Ecuador, Argentina and Costa Rica) also participate.

Education Programs Related to Telemedicine

Unidad de Telemedicina – Facultad de Medicina - Universidad de Concepción

In 2002, the Faculty of Medicine at Universidad de Concepción (UdeC) started a Telemedicine Project aimed at including Information and Communication Technology (ICTs) in the healthcare professional's education curricula. One year later, UdeC was awarded a Project for the Quality Improvement of Higher Education MECESUP UCO 0003: “*Nuevo Currículo para la Carrera de Medicina, centrado en el alumno, integrado y orientado al aprendizaje profundo, Facultad de Medicina y Facultad de Ciencias Biológicas*” [18]. This project aimed at innovating the curriculum of Medicine for Universidad de Concepción. In this context, relevant resources are allocated to acquire technology and connectivity in order to implement telemedicine first in academic context and then in clinical context.

One of the main goals was to enable a Telemedicine Network, allowing communication between the Faculty of Medicine main facilities (Concepción) and the distant or remote healthcare settings in the region.

During the years 2004-2005, the Telemedicine Commission of the Faculty of Medicine UdeC was created, formulating the bases of the new Telemedicine Unit (Unidad de Telemedicina).

As a result of this workgroup, the following works are published:

- Telmed-UdeC: Un Nuevo Horizonte de Integración de las TIC en la Salud Chilena. 2005. Villalobos, E.; Careaga, M.; Opazo, J.; Avendaño, A.; Ramírez, J.; Pérez, H; Bordon, D. *Revista Salud.com*, Vol. 1, N° 3, 2005, Págs. 1-8. Disponible en:
<http://www.revistaesalud.com/revistaesalud/index.php/revistaesalud/issue/view/3>
- Mise en place d'un reseau de Telemedicina et Teleradiologie dans la Region du Bio-Bio. Resultats preliminaires. Concepción Chili. 2005. Opazo, J.; Avendaño, A.; Villalobos, E.; Careaga, M. Disponible en: www.sfrnet.org/JFR'2005

In 2005, the Telemedicine Unit (Telmed-UdeC) was created, with the goal to foster and develop telemedicine in several areas. A multidisciplinary team including doctors, healthcare professionals, engineers, administrators, and students work together in the Telemedicine Unit to develop and validate the use of ICT in clinical processes, education, and research.

The first milestone was the fiber optic connection between the Faculty of Medicine of UdeC and the Concepción Regional Clinical Hospital to allow the transmission of surgery and clinical procedures in real time (Obstetrics and Neonatology) from the surgical pavilions of the Hospital (Fig. 6) to the Telemedicine Unit. This was developed within the context of the Project N°06-041 managed by the UdeC Dirección de Docencia with the title: "Integración curricular de videoconferencias aplicadas a la docencia clínica de obstetricia y neonatología".

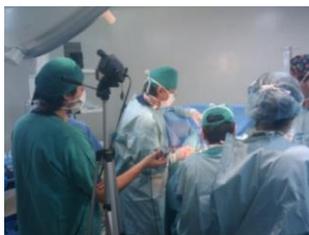




Fig. 6 Live transmission from the surgery pavilions of the Hospital Regional de Concepción to the Facultad de Medicina-UdeC.

Currently, Telmed-UdeC has established five areas of interest: undergraduate, postgraduate, continuing education, research, and clinical assistance. Thus supporting care management, improving access to specialized care for users and patients of the Chilean healthcare system, implementing telemedicine services like tele-ophthalmology, teleradiology, teledermatology, telecardiology, tele-nephrology and tele-consulting in gastroenterology, endocrinology, among others, have performed more than 25,000 teleconsultations. Graphs and tables below show production performed by Telmed-UdeC over time.

Table 2. Semester Tele-Radiology Reports about patients from Arauco and San Pedro de la Paz. Source: Telmed-UdeC.

Semester	N° Reports
2015-1	2 175
2015-2	4 990
2016-1	5 739
2016-2	5 336
2017-1	2 107
TOTAL	20 347

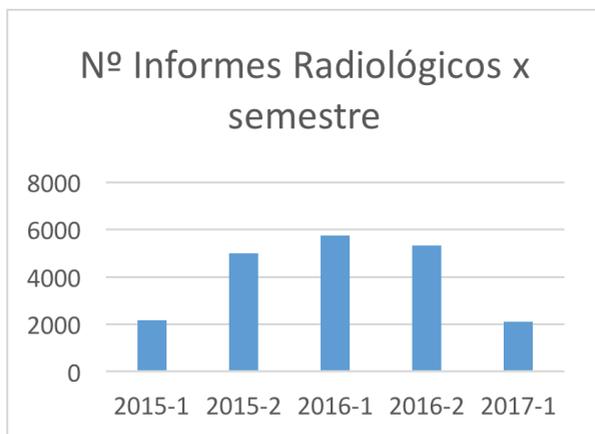


Fig. 7 The same information as Table 2 in the form of a graph

Table 3. Retinography reports performed by the Telemedicine Unit of UdeC
Source: Telmed-UdeC.

Originating Healthcare services	Retinography reports (tele-ophthalmology)
SS Concepción	7382
SS Arauco	464
SS Arica	249
SS Chiloé	1673
Total:	9768



Fig. 8 A set of pictures from Telecardiology. Acrux-operation, Chiloé 2017. Source: Telmed-UdeC



Fig. 9 A set of pictures from Telegastroenterology. SS Arauco and DAS

Chiguayante. Source: Telmed-UdeC



Fig. 10 A set of pictures from Teleradiology. SS Arauco. Source: Telmed-UdeC

Telmed-UdeC carries on two lines of research: Knowledge Management in Telemedicine and Impact of Telemedicine Strategies (Teleradiology and Tele-ophthalmology). It has consistently participated in related international events as well as national and international workgroups, together with the Chilean Health Informatics Association (ACHISA), University of Bristol (UK), and the Asociación Iberoamericana de Telesalud y Telemedicina (AITT).

Books and book chapters have been published as a result of doctoral studies such as:

- Telemedicina y Gestión del Conocimiento Modelo GC+T. Angélica Avendaño Veloso. Editorial Académica Española, ISBN 9783846578049
- Diseño y validación de un Modelo de Gestión del Conocimiento aplicado al desarrollo de la Telemedicina, en la Universidad de Concepción, Chile. Capítulo publicado en: Innovación y Gestión del Talento. Gallego, D. y Alonso, C. Ed. Extremadura Business School, España ISBN 978-84-614-9144-5 Pág. 601-612.

The Telemedicine Unit (Telmed-UdeC) has actively participated in national and international congresses, communicating the progress of the different strategies implemented, such as:

- *Desarrollo de la Telemedicina, basado en la Gestión del Conocimiento*
Avendaño Angélica
Comunicado en Congreso Internacional de Gestión del Talento GESTALENT, Yuste, España, 2011
- *Tele dermatología como estrategia de colaboración docente-asistencial*
Alarcón R., Avendaño A., Parada F., Sanhueza N.
I Congreso Iberoamericano de Telesalud y Telemedicina. Lima, Octubre 2014
- *Tele oftalmología como apoyo a la atención primaria en salud en la pesquisa de la retinopatía diabética*
González R., Cadejan B., Avendaño A., Parada F., Cabezas A.
I Congreso Iberoamericano de Telesalud y Telemedicina. Lima, Octubre 2014
- *Modelo de Gestión del Conocimiento para desarrollar la Telemedicina aplicada a la formación de profesionales de la salud*
Avendaño A., Careaga M., Parada F.
I Congreso Iberoamericano de Telesalud y Telemedicina. Lima, Octubre 2014
- *Integración curricular de Telemedicina a través de videoconferencia para estudiantes de Medicina y Obstetricia de la Universidad de Concepción*
Olivari A., Avendaño A., Díaz E., Parada F., Escobar D.
I Congreso Iberoamericano de Telesalud y Telemedicina. Lima, Octubre 2014
- *Red de Telemedicina y Diagnósticos Radiológicos en Contextos Interculturales*
Avendaño A., Careaga M., Escobar D.
III Congreso Internacional de Educación e Interculturalidad: Descolonización, Pueblos Indígenas y Afrodescendientes. Universidad de Tarapacá, Chile, Septiembre 2015
- *Telemedicina y formación de profesionales de la Salud*
Ponente en Mesa de expertos N° 8 Visión estratégica: Profesionales. Formación continuada.
Avendaño A.

II Congreso Iberoamericano de Telesalud y Telemedicina, XIII Reunión Foro de Telemedicina de la SEIS y XII Reunión del Fórum Ibérico de Telemedicina
Sevilla, España Noviembre 2015

- *Implementación de la Teledermatología como herramienta de apoyo diagnóstico en*

Atención Primaria

Avendaño A., Parada F., Escobar D., Cabezas A., Garcés E., Alarcón R.

II Congreso Iberoamericano de Telesalud y Telemedicina, XIII Reunión Foro de Telemedicina de la SEIS y XII Reunión del Fórum Ibérico de Telemedicina
Sevilla, España Noviembre 2015

- *Sistema de Telerradiología, Unidad de Telemedicina UDEC y Hospitales Provincia de Arauco CHILE*

Concha A., Muñoz K., Avendaño A., Estay O., Parada F., Toledo C., González R., Peirano

II Congreso Iberoamericano de Telesalud y Telemedicina, XIII Reunión Foro de Telemedicina de la SEIS y XII Reunión del Fórum Ibérico de Telemedicina
Sevilla, España Noviembre 2015

- *Teleoftalmología: Estrategia para Diagnóstico Oportuno de Retinopatía Diabética en Atención Primaria*

González R., Avendaño A., Parada F.

II Congreso Iberoamericano de Telesalud y Telemedicina, XIII Reunión Foro de Telemedicina de la SEIS y XII Reunión del Fórum Ibérico de Telemedicina
Sevilla, España Noviembre 2015

- *Integración curricular de la Telegastroenterología como herramienta de enseñanza en Medicina Interna*

Parada F., Ortiz P., Avendaño A.

II Congreso Iberoamericano de Telesalud y Telemedicina, XIII Reunión Foro de Telemedicina de la SEIS y XII Reunión del Fórum Ibérico de Telemedicina
Sevilla, España Noviembre 2015

- *La telemedicina en la Gestión del Conocimiento y sus aplicaciones en contextos clínico-universitarios, Webinar: Telemedicina en Chile*

Avendaño A, Careaga M, García M.

Organizado por AMD Global Telemedicine y la Asociación Iberoamericana de Telesalud y Telemedicina (AITT)

Junio 2016

- *El modelo Pedagógico e Incremental de Prototipos Aplicados para Formar Profesionales de la Salud como Expertos en Telemedicina*
Avendaño A., Parada F., González R., Careaga M.
XIII Congreso Internacional de Tecnología, Conocimiento y Sociedad. Universidad de Toronto, Canadá Mayo 2017
- *Integración curricular de la Telemedicina en Gastroenterología como herramienta de enseñanza en Medicina Interna*
Parada F., Avendaño A., Ortiz P.
XIII Congreso Internacional de Tecnología, Conocimiento y Sociedad. Universidad de Toronto, Canadá Mayo 2017

Telemedicine Undergraduate Course – Universidad de Concepción

In 2008, the Telemedicine Unit created the course “Introduction to Telemedicine” (code: 278002) aimed at all healthcare degrees of the Faculty of Medicine (Medicine, Nursing, Obstetrics and Childcare, Medical Technology, Speech Therapy, and Kinesiology). It is an elective course that earns three credits (SCT-Chile) and allows students to gain basic knowledge in ICT utilization in healthcare and its contribution to learning. It includes lectures, videoconferences with international professors, group assignments, healthcare settings field visits, workshops, and the use of telemedical devices.



Fig. 11. Pictures from Workshop and international lecture from the course “Introducción a la Telemedicina”. UdeC

Telemedicine and Information Technology in Healthcare Diploma - Universidad de Concepción

The Diploma in Telemedicine and Health Information Technology is an education and training program for professionals from the health sciences,

engineering, computer sciences, bioengineering, and other related areas. Its purpose is to extend competencies in telemedicine and the use of ICT in the healthcare context, enabling professionals to improve their performance in their respective roles by means of interdisciplinary and collaborative work.

The program started in its first version in 2016. It is delivered through blended learning, 156 hours, 6 modules/courses. It includes topics such as telemedicine, clinical applications, requirements and standards, ethical aspects, tele-health project formulation, and management. It has the participation of national and international teachers.

Centro de Informática Médica y Telemedicina (CIMT) - Universidad de Chile

In 2015, Universidad de Chile Faculty of Medicine established the Center for Medical Informatics and Telemedicine (CIMT) that soon led to the development of two new elective courses that were added to the Medicine undergraduate curriculum: “Introduction to Medical Informatics” (2016) and “Telemedicine” (2017). The CIMT also engaged in collaboration with the Hospital Clínico Universidad de Chile (HCUCH) that led to the setup of a Telemedicine Project within HCUCH itself, the setup of a Telemedicine Room for the Hospital and several other initiatives led by HCUCH Dirección Académica.

Final Remarks

Despite significant advances and the Ministry of Health engaging in the process of developing a National TeleHealth Program [19], many regulatory, reimbursement, and organizational challenges remain to be solved in order to trigger the “organic growth” of telemedicine on a wider scale. The results of a report arising from a series of round tables coordinated by the Corporación de Fomento de la Producción (CORFO) regarding Telemedicine, held on February 2016 (Mesas de trabajo Telemedicina) within the Programa Estratégico Nacional “Salud+Desarrollo”, provided several hints and suggestions on what should be pursued to foster telemedicine development in the country. For instance, there is a need for better coordination and knowledge sharing. That is why the Chilean Health Informatics Association (ACHISA) together with other relevant stakeholders, is setting up a public national registry of telemedicine projects and programs that will be made available by June, 2018 (est.) <http://telemedicina.achisa.cl> as already mentioned in the Introduction of this chapter.

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Appendix

This chapter represents an outline of telehealth initiatives, programs and activities in Chile. More information is available via the following websites:

1. National Registry of Telemedicine projects and programs in Chile. c/o Asociación Chilena de Informática en Salud (ACHISA) and other organizations: <http://telemedicina.achisa.cl> (est. June 2018)
2. Simposio Chileno de Informática en Salud: <http://www.ischile.org>
3. Unidad de Telemedicina, Universidad de Concepción: <http://www.telmed-udec.cl/>
4. Centro de Informática Médica y Telemedicina, Universidad de Chile: <http://cimt.uchile.cl/>
5. Centro de Informática Biomédica, Instituto de Ciencias e Innovación en Medicina, Facultad de Medicina, Universidad del Desarrollo: <http://medicina.udd.cl/ci3/>
6. Grupo RITMOS Chile, Red Iberoamericana de Tecnologías Móviles en Salud: <https://ritmoschile.cl>
7. Ministerio de Salud, Chile, eSalud: <http://www.salud-e.cl/>
8. Centro Nacional de Sistemas de Información en Salud (CENS): <http://www.cens.cl>
9. Red Universitaria Nacional (REUNA): <http://www.reuna.cl>

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- [6] Universidad Andrés Bello - SIP - VIII Encuesta Nacional de Salud ISPAB - August, 2017. Available from: <http://www.ispandresbello.cl/viii-encuesta-nacional-salud-ispab-usuarios-evaluan-negativamente-acceso-la-salud-chilena/> Accessed Sept 26, 2017
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<http://www.mecesup.cl/usuarios/MECESUP/File/2014/publicaciones/Mecesup-Memoria-2000Nov2006.pdf>
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<http://www.salud-e.cl/prensa/minsal-inicia-la-elaboracion-participativa-del-programa-nacional-de-tesalud/>



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Telemedicine and eHealth in Finland

On the Way to Digitalization – from Individual TeleHealth Applications to Connected Health

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Introduction

Finland is a relatively sparsely populated country (5.5 million inhabitants) with a highly advanced technological infrastructure. Like in other Nordic countries, the health care system in Finland is mainly based on public health care providers. Municipalities, through taxes, finance most of the health care and the government is providing additional support. There are additional private services based on insurances and service fees. All the primary health care centres, secondary and tertiary hospitals as well as private service providers obey the same general health care and medical treatment guidelines and patient documentation policies, which has contributed positively to the opportunities offered by Telemedicine and eHealth [1].

In this article the authors share the Finnish history of telehealth development with strategical and national guidance, the Finnish as ‘first-timers’ in the change and modernizing health care into eHealth, our national FSTeH (Finish Society of Telemedicine and eHealth) association, evaluative research, development and education, example of private eHealth provider, and current situation in Finland with the experimental development attitude, and future.

National Guidance Over Two Decades – Health Care as Part of Public Administration

The first Finnish national strategy for applying information technology to health care and social welfare in 1996 focused on developing and implementing technologies that would help answer the needs for efficient, accessible, affordable and high-quality health care [2]. The latest Information Strategy for Social and Health Care 2020 was published at the end of 2014 [3]. The objective of the newest strategy is to support the renewal of the social welfare and health care sector and the active role of citizens in maintaining their own well-being by improving information management and increasing the provision of online services. To achieve these goals, the strategy states that it is essential to make active use of information related to social welfare and health care services and to refine it into knowledge that will support both the service system and individual citizens [3].

The strategy consists of six thematic areas. The strategic objectives and measures to meet the objectives are described. The thematic areas are:

1. Citizens as service users – Doing it yourself,
2. Professionals – Smart systems for capable users,
3. Service System – Effective utilization of limited resources,
4. Refinement of information and knowledge management – Knowledge-based management,
5. Steering and cooperation in information management – From soloists to harmony, and
6. Info Structure – Ensuring a solid foundation [3].

The national development of healthcare information systems and its continuous scientific evaluation is reflected against this new overall strategy.

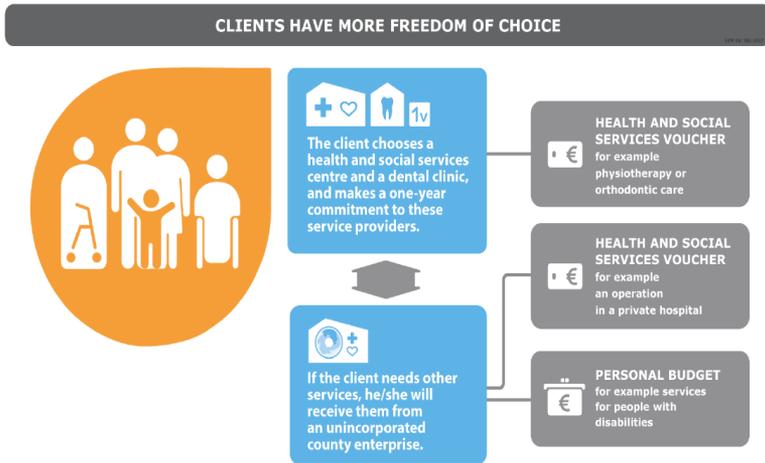
When comparing the development of the strategies over the past 20 years, one can notice that now all stakeholders are covered. Information technology and eHealth have a strategic role in health care service delivery. Integration of health and social care as well as citizens' active role are clearly written within the strategy. Furthermore, the future social and health care reform will continue supporting the 'client's choice-principle' (Figure 1) [4].

New eHealth Service Structure, National Kanta Services and Virtual Services for Citizens - Realisation of Government's National Digitalisation Programme

In order to facilitate modern health and social care, a comprehensive restructuring of care towards eCare is needed. Finland has taken bold initiatives to build a comprehensive and standardized eService architecture, which then enables various and individual eServices to citizens and to

professional use. The accumulated digital data is at the same time valuable resource for research and innovation [5]. The last ten years period has been a success story, involving both national and local authorities, as well as public and private service providers.

Figure 1. Finnish national reform enhances client participation [4]



In 2016, the Finnish Government has launched nine principles, leading to national digitalisation reform, relating all fields of administration. The principles guide information sharing and interfaces, operating models, rapid service development and preparedness, for example [6] (Figure 2).

Figure 2. Finnish principles of national digitalisation guidelines [6]



These nine principles are the jointly agreed rules for digitalisation in all public administration, including health care. The overall aim is to enhance productivity, user-orientation and the primarily digital role of all public services [6].

Today in Finnish health care, the documentation of patient data is carried out by electronic means at all levels of care. This means that the government has to launch new legislation and revise new strategies to respond to the future development needs. The Ministry of Social Affairs and Health produced in 2015 the National Finnish eHealth and eSocial Strategy 2020, which aims to support and guide the social and health care reform and promote the active citizenship in maintaining one's own wellbeing by improving data management and boosting electronic services [3].

Finland has done a lot of national development as how to make the best of the new technologies in the health care. Since 1996, Finland has acknowledged the need for information society policy development, and it has built a national strategy how to develop information and communication technology (ICT) in the field of health care. For nurses, main emphasis of the policy was the possibility to gain education related to ICT [2].

For the time being, numerous new strategies have been devised to manage the digital change. Both the Ministry of Finance and the Ministry of Social and Health have published strategies [6, 3] and a Europe 2020 strategy [7], which envisage smart, sustainable and inclusive growth in Finland as well as well functioning services for citizens. In addition to the digitalisation, European Union member countries signed a new roadmap, which says that the digital transformation of the public administration is EU-countries' collective endeavour at national, regional and local levels within EU-countries as well as by the EU institutions, respecting the division of competences. The joint collaboration aims to facilitate international collaboration, interoperable solutions and sharing of good practices throughout public administrations and across country borders [8].

Brief History of Finnish TeleHealth Presenting Some Success Stories

Pioneering Telemedicine Activities

Tele-Radiology was the first known form of traditional telemedicine in Finland.

In 1969, the television network of the Finnish broadcasting corporation was utilized to send x-ray images between university towns of Oulu and Helsinki, at a distance of 600 kilometers [9]. Because of the high costs, the system was however not applicable for routine clinical use, though the technical quality of the transmitted images was considered adequate for basic diagnosis.

At the same time, one channel electrocardiograms (ECG) sent over a telephone line were tested in remote health care centres in Northern Lapland (unpublished).

It has also been customary for a long time to have telephone consultations, discussing difficult cases in secondary care [10]. Similarly, primary care physicians (general practitioners) have also been in contact with their patients by telephone [11].

The Beginning of Modern Telemedicine

Modern digital telemedicine networks in Finland started to emerge in the beginning of 1990s. This was enabled by digital telephone and ISDN (Integrated Services Digital Network) connections even to remote locations and followed by fast network backbone connections. Early adaptation of ATM (Asynchronous Transfer Mode) technology made rapid transfer of huge datasets like medical images possible. An excellent example, digital Tele-Radiology networks were initiated quite simultaneously in the university hospitals of Turku, Tampere and Oulu [12, 13, 14, 15]. The first widespread Tele-Radiology network connecting various hospitals and primary health

care centres for consultation purposes was established by the Oulu University Hospital in Northern Finland by 1996 [16].

Taking care of different health care areas was important in our sparsely populated country. Mielonen et al at Oulu University Hospital [17] first developed videoconsultations for Tele-Psychiatry. Tele-Orthopedic consultation services were pioneered simultaneously in Pori central hospital [18] as well as between Pyhäjärvi primary health centre and Oulu University Hospital [19]. In South Western Finland, the Pori Central Hospital established a virtual Telemedicine development centre with various services [20] and in the northernmost part of the country, the Lapland County built a comprehensive Telemedicine consultation network between the central hospital in Rovaniemi and all the primary health centres in the region [21].

First International Telemedicine Network Using Internet

International Nordic collaboration in telemedicine started already in 1992, when research teams from university hospitals of Oulu (Finland), Reykjavik (Iceland) and Tromsø (Norway) joined their forces in order to build a Tele-Radiology consultation network via NORDUnet (Nordic University network) that was a subset of the forthcoming Internet [22]. Regular consultations of magnetic resonance images (MRI) were successfully performed. To our knowledge, this is the first published international Tele-Radiology network that utilized Internet technology even before Internet was made widely commercially available [23].

From Wireless to Mobile Telemedicine, From Distant Consultations to Tsunami Disaster

Some medical specialities, such as neurosurgery, are depending on image information before they can give their consultation. The development of mobile Tele-Radiology in Oulu started in 1993 and already in 1995 a system based on a laptop computer and portable digital GSM phone was taken into clinical feasibility studies [24]. The overall weight and bulk of the system did not yet permit its widespread use. Then in 1997, the new Nokia 9000 smartphone made the dreams possible and Reponen et al. [25] managed to communicate Tele-Radiology images for consultation purposes into a pocket-size smartphone. The development for the first in the world medical application for smartphones was then started [25].

During the years 1998-2000, the European Union provided financial support for the Mobile Medical Data (MOMEDA) project, which, according to our knowledge, provided the first pocket-size multimedia electronic patient record (EPR) terminal and mobile app for physicians. This system made a revolution to the concept of having patient information at the point

of care, even outside the hospital. When a request for a consultation came, the system sent patient images with relevant referral text from the hospital EPR to the smartphone terminal. All the diagnostic image manipulation could be made using the smartphone and additional data requests could be performed through a secure web browser to the cloud based hospital EPR system. Finally, the consultation answers and further advice for patient care could be communicated back to the hospital information systems. The communication channel was separated from the hospital systems with secure host computers and the mobile terminal safety was carefully considered [26]. The MOMEDA smartphone terminals were taken into clinical use at the department of neurosurgery of the Oulu University Hospital [27]. They were also used successfully for helping the victim recognition by forensic dental image transmission after the Thailand tsunami disaster in 2004 [28].

During the years 2002-2004, the European Union supported the Professional Mobile Data Systems (PROMODAS) project, which further developed the ideas of medical mobile smartphone terminals and applications to new platforms. The new applications enabled to see more of the patient information and displayed it faster at the point of care with a user-friendly graphical interface [29, 30].

From Telemedicine to eHealth – EPR as a Backbone

By the end of the millennium, the main emphasis had changed from separate Telemedicine solutions to more comprehensive eHealth entities. EPRs were built as a backbone of services, together with picture archiving and communication systems (PACS) and laboratory systems [31]. Public healthcare providers developed and purchased EPR systems with integrated laboratory and imaging components. Oulu University Hospital was the first tertiary care institution in Finland to develop a modern, private cloud based and portal type EPR with seamless integration of images and laboratory data [32]. Other hospital districts followed with their digital solutions and at the same time primary care centres turned digital very quickly. By 2007 all the medical records as well as images and laboratory data in public secondary care sector were in digital format and this was also the case for the public primary care facilities with only a few exceptions [33]. Finally, by 2010 all major private sector service providers had comprehensive EPR systems, too [34].

The digital backbone made new type of services possible: the regional usage of image archives started since the new law in 2011 has made separate Tele-Radiology connections unnecessary. This meant that remote reading and image interpretation was using existing archives. Laboratory data were also regionally available, making treatment consultations easier than before

[34]. When primary care and private sector had their own EPRs ready, they could start sending electronic referrals to specialist secondary hospitals [35, 36]. Many of these electronic referrals could be answered by an electronic consultation advice, without transferring the patient. Thus, Telemedicine in Finland was structurally built into the eHealth infrastructure.

In addition, health services for pregnant women were developed, i.e. services, which could utilise internet-based platform. In the Beginning of Life project, one health care service chain (maternity service path) was being used as a model, and the pattern was renewed with the help of the most advanced and recent information and communication technologies (ICT) in 2000. The project developed a new service, Maternity and Infant Clinic on the Net (Net Clinic), which was piloted in authentic environment via Internet to users. The project gathered and studied all the participants' experiences on the new practice including the pilot families, public health nurses, midwives and doctors. There is a presentation of the Net Clinic [37], how it works, what the benefits or hindrances are and how it influences on one's health. The project was a development start to many today's online service e.g. Hyvis-services in the middle-east of Finland [38].

Assessment and Benchmarking of Telemedicine and eHealth

The Finnish Office for Health Technology Assessment (FinOHTA) initiated projects for assessment of Telemedicine services already in the 1990s. Ohinmaa et al [39] published the Finnish assessment guidelines for the cost-benefit analysis of telemedicine services. A national Telemedicine evaluation network, including university hospitals in Oulu, Turku and Helsinki, was established and Tele-Radiology, Tele-Orthopedics, Tele-Psychiatry and electronic referrals resulted most from the research data [39, 41]. After the year 2000, many academic thesis have discussed various aspects of Telemedicine, e.g. remote video-consultations of a primary care physician [42], Tele-Rehabilitation [43], and reorganizing neurological consultation services with remote consultations [44].

The University of Oulu founded the FinnTelemedicum research unit for the evaluation of eHealth services in 2003. Together with the National Institute of Health and Welfare (THL), the FinnTelemedicum has performed a longitudinal study in order to follow the availability and intensity of use of EPR systems and eHealth services since 2003 [45].

Every three years all public health care institutions are contacted as well as the most important private health services providers. This series of surveys gives a precise portrait of eHealth development in Finland, using the whole country as a living lab [46].

The Finnish Medical Association together with the University of Oulu, the Aalto University and the National Institute of Health and Welfare has since 2010 made a research of the usability and the user experience of EPRs from a physician's perspective. This series of surveys has reached the largest base of respondents in the world for its kind of studies (approx. 4000 respondents in each of its three editions). The results have been published both in national and international publication series and they have been used for the development eHealth tools [47, 48].

These above-mentioned studies of the eHealth availability, intensity of use and usability have grown to a large joint research program called STEPS 2.0 [49], which also includes nowadays surveys of citizen's experiences and usability issues from the perspective of nursing staff. The eWelfare aspects of the electronic social care are included in the study program, too. This research program is supervised by the National Institute of Health and Welfare and financed by the Ministry of Social Affairs and Health. This Finnish eHealth and eWelfare research program gives now a comprehensive image of the national development.

The Nordic eHealth Research Network (NeRN) was established in 2012 as a joint forum for the policy makers and researchers in the eHealth domain [50]. The network has performed eHealth policy analysis and developed common eHealth performance indicators for the Nordic countries (Denmark, Finland, Iceland, Norway and Sweden). The indicators have been used for benchmarking eHealth development in participating countries. Most recently, common eHealth indicators from a citizen's point of view have been suggested. The work has been done in close collaboration with similar activities of WHO (World Health Organisation) and OECD (Organisation for Economic Co-operation and Development) [51].

Society and Publication Activities in Telemedicine and eHealth

The Finnish Society for Telemedicine and e-Health (FSTeH) was founded on the 11th of January 1995 and it is the second national Telemedicine society formed after the American Telemedicine Association. The aims of the society are according to its statutes twofold: 1) to promote population health through telecommunications and 2) to disperse expert knowledge within health care. The society is multi-professional and its membership is open to individual persons, corporations, other organizations and supporting members. Discussion within the organization benefits from the different backgrounds of the members, e.g. physicians, nurses, engineers, business people, researchers, educational staff, and health administrators. The FSTeH is a founding member of the Nordic Telemedicine Association (NTA) and the new International Society for Telemedicine and eHealth (ISfTeH) [52].

The main activity of the FSTeH is the Finnish National Conference on Telemedicine and eHealth, which had its 23rd edition in 2018, in conjunction with the 23rd ISFteH International Conference (#eHealth2018). Since 1995, the Finnish National conference has brought together the newest innovations and hottest discussions in Telemedicine and eHealth. Every other year the conference has an international focus, when it is programmed as a cruising conference on a ferry between the capitals of Finland and Sweden. The conference has visited even Estonia and it has been organized in its turn together with the NTA as the official Nordic eHealth conference. The results of the previous conferences have been published with English texts or abstracts in proceedings books and on the society website [53].

The Finnish Journal of eHealth and eWelfare (FinJeHeW) is a scientific journal established by the Finnish Social and Health Informatics Association (FinnSHIA) and the Finnish Society of Telemedicine and eHealth (FSTeH). It was established in 2009 according to the vision of late adjunct professor Ilkka Winblad, who also served as the first editor-in-chief of the journal [54]. The journal publishes high quality peer reviewed research articles on information and communication technology of social and health care, Telemedicine, eHealth, and eWellbeing. It includes also a news section and a discussion forum. FinJeHeW is mainly a Finnish language journal, but it also publishes articles in English and includes English abstracts of most Finnish language articles. It presents a most convenient tool to keep updated about what is taking place in Finnish eHealth and eWelfare research and education. There are four issues annually, they are all published online (available by way of passwords issued by the related associations or author passwords, free access three months after publication date) with special printed issues for conferences [55].

eHealth Education for Health Care Personnel

Medical doctors have long been missing a formal education in eHealth and Telemedicine. As both disciplines are becoming more and more important part of daily medical practice, a reform was needed. In Finland, the target was approached from two viewpoints: a special competence program for already qualified physicians and basic eHealth education package for medical students.

Special Competence of Healthcare Information Technology for Medical Doctors and Dentists

Finland was, to our knowledge, the first country in Europe to establish a professional special competence for healthcare information technology (eHealth) since 2012 to physicians [56] and since 2015 to dentists [57]. The special competence requires two years full time service in healthcare

information technology related positions and approved theoretical studies after a qualified medical specialist consultant status or a relevant experience as a dentist. There is a national coordinating committee and the fulfilment of the competence is testified with a peer-reviewed portfolio. Those who have earned the title are thus already experienced doctors and dentists. The new competence gives them an ability to utilize their knowledge about health care processes for the benefit of the new eHealth and mHealth services. By the end of 2016 a total of 87 professionals have been enrolled to the program and 58 physicians and three dentists have already graduated. Those who have graduated with the special competence have found positions as leading healthcare information technology experts in enterprises or in administrative tasks in regional or national healthcare information technology projects. This professional eHealth special competence program is a joint effort of the Finnish Society of Telemedicine and eHealth, the Finnish Medical Association and the Finnish Dental Association [58].

Oulu as a Pioneer: eHealth for Medical Students

The Faculty of Medicine at the University of Oulu was the first in Finland to offer medical students a special training package of eHealth since 2016 [59]. The regular springtime two days training is targeted to the fifth year medical students, who are eligible to work in primary health care centres during the following summer. The education starts with a half day of lectures including up-to-date process sets and future possibilities in eHealth from video consultations to artificial intelligence. Then during the second part of the thematic day, all the 130 medical students meander between the stands of thirty digital companies at Oulu University Hospital's Testlab. They can try the work of a virtual doctor over a chat application, use the electronic stethoscopes or wellness applications. The secrets of electronic patient record and various sensors, connected to decision support tools, are explained to them. Finally, the students write a short course essay and evaluate the products from a perspective of a primary care physician. According to a student's comment this type of education is a real eye-opener, e.g. about the possibilities of artificial intelligence for processing the ever increasing amount of medical data. Finally, the eHealth theme is completed during the second day with a hands-on training in a real electronic patient record environment [60].

The New Strategy Guiding Nurse's Education and eHealth Competences

Furthermore, information systems important role is to support nurses' daily work via better informed decision making. The user-friendly digital tools will be part of every nurse's work and enhance nurses' operation

models, which are agreed in organisational level. Simultaneously as the technology develops, new competences and working ways are necessary to fulfil the nursing mission. Information Society reflects to all health care field. As nurses are the biggest group of health care professionals, they should be actively involved in planning and creating eHealth services in conjunction with other professions and the public. According to Staggers et al [61] and TIGER initiative [62] nurses need technical skills and knowledge with respect to the basic computer competency, information literacy and information management. All nurses must have possibility to get enough education and training related to digitalized tools, including updated privacy and data security issues.

To attain these objectives, it is crucial to benefit health care information, which can be used to forecast and prepare for the future working life.

In 2015, FNA (Finnish Nurses Association) wanted to create a National eHealth Strategy for Finnish nurses. FNA published its eHealth Strategy 2015-2020 [63].

The development of the Strategy was as follows: ten experts' group from various fields of nursing, e.g. nursing practice, higher education, nursing research and administration, were invited to write the national strategy. Along with experts' knowledge, also the strategical papers from the ministerial and as well as all-international, e.g. European Union, publications, guided the strategic work right from the beginning. The experts operated closely with the FNA and the change of information and opinions was essential during the process of Strategy building. The main goal of the expert group was to describe nurses' contribution to the national strategy concerning digitalization of health care development and implementation in national level. The group searched for answers, discussed strategic issues, wrote drafts, and sent texts for open commentary circles. One leading issue was that the technology is and will be growingly support patient/client participation. This supports the today's situation because in all Nordic countries the health care becomes more and more patient-centred (Figure 3).

The chosen themes of the eHealth strategy deal with the role of the client, nursing practice, ethical aspects, education and eHealth competences, nursing leadership, knowledge management, research and development.

Figure 3. eHealth supporting nurse and patient towards multi-professional collaboration [64]

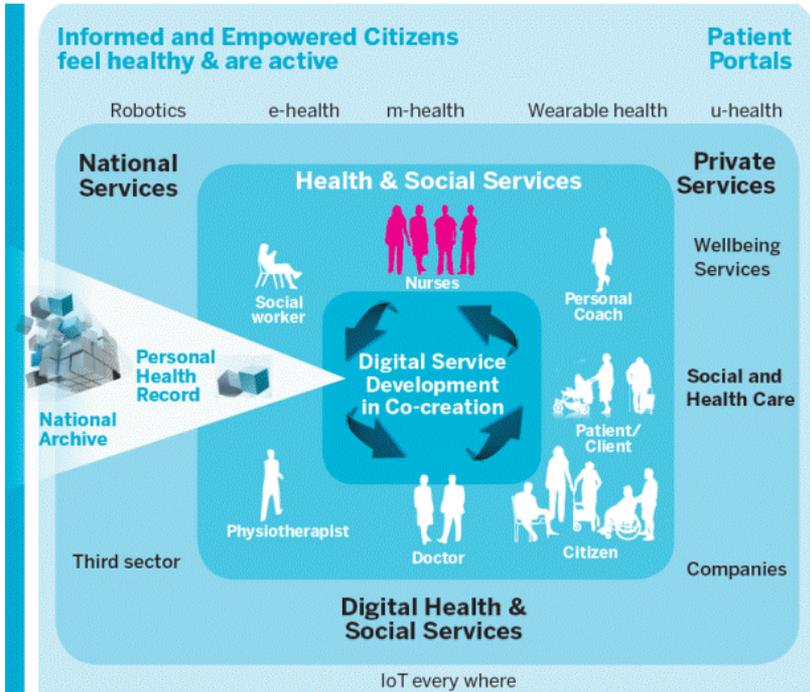


Figure 4. Six components of eHealth Strategy [63]



In FNA's strategy nurses eHealth Competences are one main themes (Figure 4). There are two main objectives for nurses competencies as first: "Nurses know how to use information and communications technology in

nursing effectively and responsibly.” and as second: “Nurses have basic skills in using technology as well as data literacy and information/knowledge management skills for functioning in eHealth services.” The FNA’s strategic target is that nurses would have the opportunity to deepen their knowledge of eHealth services in specialised studies, master’s degrees at universities of applied sciences and universities, so that they can operate in specialist duties in informatics, both in clinical work and teaching and research in the field of informatics. The second target is that nurses are able to demonstrate their expertise by applying for the title of specialist from the FNA. The third one is that nurses actively participate in the multi-profession discussion of eHealth service expertise with the aim of broadening it nationally and internationally. Employed nurses have the opportunity to deepen their expertise in this field [63].

Nurse Education in Digitalised Health Care

In Finland, we have versatile offers for the advanced nurse education. According to Stagers [61] there are four levels of eHealth competency that are based on experience and training.

Level 1: New nurses, have basic competence and skills in informatics and health literacy, as well as in the use of various types of technology. The main mean is that students taking upper secondary qualifications in nursing at all universities of applied sciences acquire competence and skills to use eHealth service procedures in informatics in patient care planning and care. They must be equipped to participate in the development of work processes and tools in their work community and to use of eHealth service tools as intended.

Nurses can also take optional study module about eHealth and health informatics content. There are many variations, and one example is Developer of Digital Health and Welfare Services Studies, with 15 European Credit Transfer System (ECTS) credits in multidisciplinary group [65].

Level 2: Experienced nurses are proficient in their own area of specialisation and will be highly skilled in informatics. They will use information technology to support their work and in cooperation with nurses specialised in for improving various procedures.

Universities of Applied Sciences (UAS’s) in Finland are having specialisation training e.g. Developer of social and health services, 30 ECTS credits.

There the core contents are developing services and leading process as example: Renewal of social and health services, Customer-oriented social and health services, Digitalisation and eServices, Quality of service and

impact assessment and Social and Health Economics. These studies are in European Qualifications Framework (EQF) level 6.

Level 3: Nurses specialised in informatics are experts in this field, trained in both nursing and informatics. They are involved in the development of the information systems used by their organisation, drawing on their own specialist knowledge. There are two ways to have level 3 and 4 competence. The one is master degree in UAS, where the student's need to have three years working period after bachelor level of studies. In health informatics, there are different variations in different UAS's to develop competence in this area. In Laurea UAS there is a master degree program where the main focus is in change leadership in social and health care of future management. In particular, it appears as a proactive transformation management in the development of public and private social and healthcare environments. In addition, different forms of leadership are studied through courses, for example: process management, information management, and the development and management of digital services. During the studies, the capacity for investigative development will also be improved [66].

In September 2017 Savonia university of Applied Sciences launched a new master education, Master's Degree Programme in Digital Health (90 ECTS credits) which offered online. The programme provides the graduates with skills needed for innovative development of advanced social and health care services, service production, expert organisation management and for the development of digital service quality and management. The studies also prepare the participants for planning, implementing and evaluating the social welfare and health care reform in different operational environments. The programme is available to health care staff, engineers and business and administration personnel working near eHealth field [67].

Level 4: Informatics innovators are information management developers, who research and develop theories and superintend information management practices and research. All nurses have the resources and will to use currently existing electronic information management equipment, to further the good care of clients, and the health and wellbeing of citizens.

Nurses have a possibility to have doctoral studies in eHealth at the University of Eastern Finland. The Master Program of Health and Human Services Informatics started in 2000 and it's the only one in our country. The aim of the education based on the expertise of the content of social and health care services is to provide experts and researchers in social and health care information management by creating the skills needed to design, manage, implement and evaluate the exploitation of information resources in social and health care organizations. Health and Human Services Informatics studies lead to a degree in Health Sciences (MNSc) or Social Science (M.Sc.,

Social Management Science/Health and Human Services Informatics). There is also a possibility to complete a doctoral degree from this programme [68].

The Finnish Nurses Association has launched the standards for special competences of nursing informatics (NI) specialty Certificate. The Certification may be admitted to a registered nurse working in Nursing Informatics (including eHealth) and demonstrating the required merits via electronic portfolio in following in following areas: Working experience, Formal education Cooperation and developmental work. The requirements of the certification are all together worth 200 ECTS credits. The Certification has to be updated every five years [69].

One of them is COPE - Competent workforce for the future project. There is a research area “how digitalisation requires a shift in professional identity, attitudes, roles and work processes”. The project collecting feedback on the use of electronic services to identify factors supporting efficient use. Willingness to use a service is enhanced by how useful it is perceived to be, how easy it is to use, how suitable it is for existing work processes and how the service is implemented in the organisation [70].

In Finland social and health care needs to have reform and division of labour and requirement for the reassignment of the labour. One of the reasons is the growing field of digitisation, but the main reason is to achieve customer oriented processes. This means new kind of agreements on the professions competence. It means also new combined professions [71].

Multi-professionality in eHealth

Advanced health care and engineering have found each other. In Turku University of Applied Sciences, a Bachelor’s degree in Engineering in a university of applied science requires 4 years of full-time studies (240 ECTS credits). The studies are divided between basic and vocational studies, industrial work placement and a thesis project. The overall goals of a degree program are defined as a set of competence requirements that a graduate of the program shall meet. These competencies are divided in general competence requirements common to all Bachelor’s programs in the Finnish universities of applied science and in subject specific competencies common to specific degree programs. Moreover, an additional set of competencies are usually defined for each specialization, too. The subject specific competencies of the degree program in Information Technology are mathematical and scientific skills, hardware expertise, and software expertise, proficiency in ICT business and proficiency in ICT engineering [72]. The subject-specific competence requirements set for the specialization

in Health Informatics are proficiency in healthcare and well-being and information system expertise, for example.

National eHealth Backbone – The Kanta Services

Over the decades, the health care field has actively followed national and EU strategies. According to a government act in 2007 [73] it has been mandatory for health care service providers to join into the national eHealth infrastructure. Finland has built a common national health information exchange (HIE), the Kanta services. The main components are Patient data repository services, Patient data management services, ePrescription services and other national infrastructure services like National code server, Certification services and Health care professionals register. The infrastructure is based on international standards like e.g. Health Level 7 Clinical Document Architecture release 2 for medical records, (Digital Communication in Medicine) DICOM for medical images and Integrated Healthcare Enterprise (IHE) profiles for information exchange. The access to the services exists through secure communications for public hospitals and primary care centres, for private health care organisations and pharmacies as well as for individual health care professionals [74]. In addition, connections to other European countries take place through the Kanta infrastructure. This has been piloted in European epSOS project between Finland and Sweden [75].

For the citizens of Finland there is a special interface to the service, called the My Kanta pages. Every citizen has a secured digital access to his or her own medical information, can read his/her own visit summaries, diagnoses, test results and medication lists. Citizens even have an access to the log data, so they can follow which health professionals have accessed their prescribed medication lists or other health data. The patients can manage their own consent and decide if other than their original service providers can see their health history [76]. Today, My Kanta pages are among the most valued and trusted Internet services in Finland [77].

The enrolment of Kanta services has been a success. Since 2017, only electronic prescriptions are used in Finland. The citizens can collect their prescriptions from any pharmacy, because all pharmacies are connected to the system. All the public health institutions and all but the smallest private health service providers have joined the Patient data repository [78, 79]. This means that the medical history follows the patient even to future service providers [80]. The next phase will be the inclusion of social care data to the same national infrastructure. The rollout is scheduled to take place in 2018 [81].

The newest addendum to the Kanta system is My Kanta Pages Personal Health Record (PHR). PHR is a national database in which citizens may enter information on their health and wellbeing. Health and wellbeing information refers to the citizens' measurement, lifestyle and activity records directly or indirectly related to their wellbeing and promoting their health. Using the service is voluntary [82].

Citizen Centred Virtual Services

Virtuaalisairaala 2.0 (The Virtual Hospital 2.0) is a project aimed at developing client-oriented digital healthcare services. It is a joint effort of all five Finnish University Hospitals (Helsinki, Turku, Tampere, Oulu and Kuopio). The different areas of the project are:

1. Production and implementation of services: the Terveysylä.fi ('Virtual village') service offering information, advice, self-care, symptom navigators, digital treatment pathways, and tools for citizens, patients and professionals;
2. Innovation farm: innovation workshops, piloting, and research plus the required researcher's tools; and
3. Development of services and changes in operation: development model, developer network and centres of expertise [83].

The project's central outcome is the Terveysylä.fi ('Health Village') digital health service. It provides information and support for citizens, care for patients and tools for professionals. The service comprises various themed virtual houses, some of which are already open. By the end of 2018, more than 20 houses and services will be available for more than 30 groups of patients.

The project makes digital healthcare services available to all Finns regardless of their place of residence and income level, thus improving the equality of citizens. Digital services are especially well suited for monitoring the quality of life, symptoms and lifestyle, and also for living with a long-term illness before and during treatment and in the monitoring stage of the treatment. The services thus complement the traditional treatment pathways [83].

Another project for developing intelligent digital health care services is ODA – Digital Self-care services. The ODA project aims to build a personal healthcare clinic at home in order to acquire and implement digital, device-independent service package including electronic well-being check-up and training, smart diagnosis, estimates about need for services, and electronic well-being plan. The ODA service package will be integrated with electronic patient records and other electronic services (e.g. appointment, laboratory test results). In addition, the ODA service package enables the utilization of

data collected and entered by the client himself/herself. Smart combination of data from different sources provides fluent, automated self-care service chains and guides the user to receive timely services. Primary healthcare units of major cities in Finland run the ODA project. The project is a continuation of already existing self-care and appointment services, bringing more intelligence into those services. Both ODA project and the Virtual Hospital 2.0 project collaborate in order to build a seamless service interface to citizens [84, 85].

Private Health Care

Case: Terveystalo – Contact a Doctor Online 24/7. Can You Treat Patients Chatting with Them?

Terveystalo is the largest private healthcare service provider in Finland. With its 170 units, 17 hospitals, 7000 healthcare professionals and 4 million annual visits, it provides a unique nationwide network that uses one common electronic medical record (EMR). Terveystalo operates in two major business areas – occupational health care and outpatient clinics that serve private customers [86].

Finland has uneven distribution of service availability and delivery. Today the country has 311 municipalities that provide tax-funded healthcare services for its residents either alone or in joint operations with other municipalities. The uneven division of population – and tax payers – has, over the years, led to an uneven distribution of services. This, in many places, can be seen as shortage of availability in healthcare. There has also been a tendency to reduce acute primary healthcare services outside office hours, which has led to increased demand of services in the private sector.

Finland is undergoing a major reform of social- and health services. The cost of public services in this sector has risen dramatically over the past few decades. This combined with an aging population and migration to urban areas has led to an unequal distribution of services and growing dissatisfaction of public services. The small municipalities have been seen as too small to organize social and healthcare services. The aim of the upcoming reform is to achieve better services that are not only more customer-oriented, effective and cost-efficient than before but also better coordinated. There is also a strong intent toward increasing the citizens' freedom of choice. This will be organized by opening service delivery for competition.

Today, in addition to tax-financed healthcare services for all citizens, every employee is entitled to preventive occupational health care financed and arranged by the employer. The provision of medical care is voluntary for employers, but most employers do provide medical care. Kela (The

Social Insurance Institution of Finland), national sickness insurance authority, funds parts of occupational healthcare costs [87].

The public health care services and occupational healthcare are complemented by private healthcare services funded by both private insurances and out-of-pocket of the end users. The main reason for using private healthcare services are shortage of availability in public services and the wish to directly consult a specialist – or the wish to choose one’s own doctor, which is not often the case in the public sector. In public healthcare, general practitioners (GPs) function as gatekeepers e.g. when consulting specialists.

Both the public and the private sector have seen digitalization as one possibility to tackle the uneven distribution of services. Digitalization of public services is even one of five strategic priorities of the Finnish government [3]. One of the ways to achieve this strategic goal has been deregulation, which means that bureaucratic barriers have systematically been removed from preventing the implementation of new services and innovations. From the point of view of providing online healthcare services, the most visible barrier was removed in late 2015. The National Supervisory Authority for Welfare and Health (Valvira) then approved of providing healthcare services online, e.g. by means of a video call or a smartphone. Valvira assigned a set of rules that define the baseline for online healthcare services for every provider. The rules include data protection and cyber security, patient safety and the proper training of the healthcare professionals delivering online care [88].

Doctor Online

This decision made it possible for Terveystalo to launch a new service, chat with a doctor online. During the relatively short service design period, it became evident that there is both customer need and the possibility to treat certain medical conditions via a direct chat discussion with a doctor without compromising high standards of quality and patient safety [86].

The service was initially aimed at occupational healthcare customers. The service was at first provided on weekdays from 8 am to 8 pm only. Very soon, the customers expressed their need to use the service also on weekends and in the night when it is almost impossible to get attention to non-critical health issues elsewhere. Five months from the launch the service was extended to 24/7 availability and it also started to serve out-of-pocket private customers.

With over 200 general practitioners and occupational healthcare physicians in the virtual team, online chat has served tens of thousands of patients during the first year. The amount of customers first rose slowly, but

steadily, and after the first year, it served as many patients on one day as does a traditional health centre with 15 to 20 full-time physicians.

The physicians are private practitioners who have volunteered to do a novel kind of work. They are mostly not in the beginning of their careers – online consultations demand highly experienced professionals who are comfortable with their clinical skills and decision-making. It is also of essence to be able to manage different care options without the possibility to examine the patient themselves. It also requires a certain level of technical ingeniousness to be able to handle the different software programs. They are trained to use the software at online sessions or using a manual. One assistant is responsible for resourcing (nights, national holidays).

Usually the physicians also take care of traditional on-site patient visits and pick patients from a virtual queue when they have time between appointments or before and after the day at the office starts. They can also be in their own homes or even travelling themselves, as long as data security has been taken care of. The Finnish Patient Insurance Centre also demands that both the doctor and the patient should be in Finland during the online visit in order to be valid. All the online physicians form a virtual community, with the ability to consult one another, discuss various topics and create a sense of a common target – to deliver high quality medical care in a new environment.

From the customer's point of view, there are many advantages with an online session with the physician. Firstly, queueing time is very short, usually the response time is around a few seconds. The access of the service has nothing to do where in Finland the customer is, and it has helped tremendously in areas with low availability of physician resources. Around 80 % of the chat appointments last less than 12 minutes, and during the chat session it is possible to have medicines prescribed and referrals done. In Finland, there is the obligation to prescribe medication via an online system, which functions well in an all-online environment.

When designing the service, there was a preconception of the customer need for video visits. This proved to be wrong – using the video connection was not what the customers wanted – or the physicians needed in order to make treatment decisions. The customers expressed the need to discuss their problems real-time, from where they are – at home, in their offices, in meeting rooms, airport lounges etc. Physicians, too, said they seldom needed video contact when they had access to previous EMR information and could discuss with the patient further. Much more often there is a need to send pictures, e.g. of skin lesions or an inflammation of the eye.

There are several indications in which the online chat appointment works especially well. The most common reasons for consulting the online chat are and typical considerations for the physician are listed in Table 1.

Table 1. Main reasons for the Online Doctor

Common reasons for visiting online chat	Customer need for virtual appointment	Examples of considerations
Acute respiratory symptoms – cough, sore throat, fever, running nose etc.	Need for an expert opinion, is it safe to treat symptoms or is further diagnostics or antibiotics required	Sometimes requires diagnostics such as strep test, C-reactive protein (CRP) or radiology. Prescription of antibiotics not allowed at virtual clinics
“Red eye” – acute conjunctivitis and other acute symptoms of the eye	Acute symptoms, which typically are not severe. Need for prescription medicines	Differential diagnostics – possible severe conditions. Contact lenses users need to be examined
Urinary tract infections	Acute, but familiar symptoms in female patients	Male gender, pregnancy, general symptoms, allergies
Allergies and skin manifestations	Acute symptoms, need for recommendations on self-care, prescription renewal	Correct diagnosis, pictures, follow up
Prescription renewal	A chronic disease, such as high blood pressure, cholesterol or asthma. No new symptoms or side effects, no need to meet a doctor	Background information on the patient usually readily available in the EMR. Often need to check laboratory tests etc., that can be ordered online. Need to plan future care and communicate it with the patient
Family planning / birth control	Need to consult on different options. Renewal of prescriptions	Consider need for gynecology status + mammography

Sexually transmitted diseases (STDs)	Fear of STDs or need to have an expert opinion on self-testing	One STD does not rule out other STDs. Consider further testing
Erectile dysfunction	Sensitive issue, wish to discuss without face-to-face contact. Renewal of prescriptions	General health status, e.g. coronary artery disease. Underlying conditions, co-morbidities
Mental health and traumatic experiences	Sensitive issues, wish to discuss without face-to-face contact. Often first point of contact	Plan ahead, consider care options, check for suicidal symptoms. No prescriptions of central nervous system (CNS) affecting drugs online
Malaria prevention and other travelers medicine	Need for prescriptions and vaccine information prior to travelling	Check interactions, ask about other medications and possible underlying mental health issues (malaria prevention)
Headaches and migraines	Usually the diagnosis is clear, and the customer needs a prescription or a second opinion	Serious underlying reasons have to be excluded. No prescriptions of CNS affecting drugs online

The session starts with strong authentication of the patient via a patient portal. The first available physician picks the patient from the queue and starts the discussion with an open question. During the chat, the physician considers a variety of issues, such as certainty of the diagnosis, need to further diagnostics or a physical examination, availability of services if there is a worsening of the situation, the patient's readiness to follow instructions etc. When the physician has concluded his/her opinion, he/she instructs the patient on next steps: medication, follow up, sick leave, laboratory tests, imaging or consultations. Medicines are prescribed and ready for pickup at the nearest pharmacy. The patient is encouraged to contact the chat or a traditional appointment if recovering does not happen as planned.

We measure the quality of the online services with different indicators:

- Response time,
- Aborted sessions because of technical faults,
- Use on antibiotics (should never be prescribed online in upper respiratory tract infections),

- Use of medicines affecting central nervous system (should never be prescribed or renewed online),
- Feedback from customers.

There are several lessons learned from the first year of this new service. The patients are satisfied with the speed and reachability of the new service. It seems that there are several medical indications in which chatting with the physician are more than sufficient, without compromising patient safety. From the point of view of the ongoing social and healthcare reform, these kinds of service innovations would be game changers. The new allocation of resources would save face-to-face time for those most in need, e.g. in primary healthcare receptions or emergency rooms. The new way for a physician to organize the working days and being a part of the online community creates an unprecedented flexibility to working life.

The competitive advantages Terveystalo has in the field of online healthcare services are:

- The amount of physicians – sufficient to deliver service 24/7, 365 days a year;
- The network of traditional units that complement the online services, e.g. laboratory and imaging;
- One electronic medical record that helps in decision making and planning ahead [86].

Ethical and patient safety issues must be closely considered during the innovation and implementation of any new service. Several issues must be taken into account, like data privacy, cyber security, training the physicians, and pricing, marketing and resourcing the service. The triage of patients must be given thought. Collecting feedback from both the physicians and patients is of essence in continuous improvement. An ongoing discussion between the service development and the online community of physicians has proven extremely helpful. The physicians in the virtual team regard it as their working place, and it has become their go-to place with all their work-related questions. In this sense, it has increased the overall work-related wellbeing of the physicians in a way we did not take into account when implementing the service. The online chat cannot turn into a place where drug addicts seek their daily fixes or drug dealers get their stock. This is why we have, from the beginning, ruled out any prescriptions of sleeping pills, strong painkillers and tranquilizers. It has also been important to maintain high standards in the use of antibiotics in order to fight resistant bacteria and other unwanted effects, and this is why we have followed closely their use. It cannot be stressed enough how important it is to have experienced physicians delivering the service.

The digital era gives us plenty of possibilities to create meaningful, high quality services. The problem is not really technology – other industries use much more complicated and sophisticated solutions. The complexity comes from understanding the process from both the customers’ and professionals’ point of view and designing a service that creates value for both.

What Is Happening Today in Finland

Experimentation Culture

Promoting good health calls for new global solutions to keep people healthy and active for longer. This requires new approaches, more agile and flexible social development methods alongside with proper planning, preparation, foresight and preparedness. Experimentation culture is one method to find new solutions and is one of the Finnish Government’s key projects [89]. Experimentation culture is quite typical for digitalisation and provides more agile and flexible development methods alongside with proper planning, preparation, foresight and preparedness that are more common in healthcare.

This new way of doing challenges healthcare and at the same time it provides an advantage of digitalisation in modernizing services effectively. Experimentation culture highlights the importance of decision-making, managerial and personnel commitment as well as new business in order to achieve permanent changes as well as open-minded and forward-thinking attitude.

Through its experimentation culture, Finland has a vision to become a nationwide living lab and testbed for developing future healthcare solutions in an authentic healthcare environment. For example Oulu [90] and Kuopio [91] regions have started living lab services (university hospital and primary healthcare), where companies receive information about the usability of their solutions, while healthcare providers get information about the benefits of the latest solutions and their cost-effectiveness.

Games for Health – Innovative Ways to Promote Health

An emerging field, combining Finland’s long history of digitised healthcare information and the rapidly growing mainstream video gaming industry, is the ‘Games for Health’ [94]. These specialised games have desired health outcomes [95] and are used to encourage citizens to take responsibility for their own health and self-care.

The ‘Games for Health Finland’ ecosystem integrates state-of-the-art research, standardisation, safety, living labs (smart cities), user involvement and fast prototyping to promote entrepreneurship for global business [96].

Experimentation culture together with Games for Health provides very promising approach to new health innovations through game jams and hackathons with a health twist [97]. The game jams and hackathons are well-established concepts that are used globally to gather people with all kinds of backgrounds to participate to test their ideas and skills, be creative, share experiences and express themselves. In Finland, the Ministry of Social Affairs and Health is active promoting these hackathons to find ideas for enhancing future nationwide eHealth services [98]. This is an example of how cross-sectoral collaboration around new technologies such as Internet of Things (IoT) and smart cities can create innovative solutions that motivate different user groups to achieve health benefits and at the same time reduce inequalities.

mHealth Boosts Digitalization in Wellbeing and Health

The World Health Organization considers mHealth as a component of eHealth and defines mHealth as “medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices” [99]. mHealth applications (mHealth apps or health apps) are application programs that offer, for example, health-related services for smartphones and tablet PCs. Such applications can be downloaded from places like Google Play and Apple AppStore.

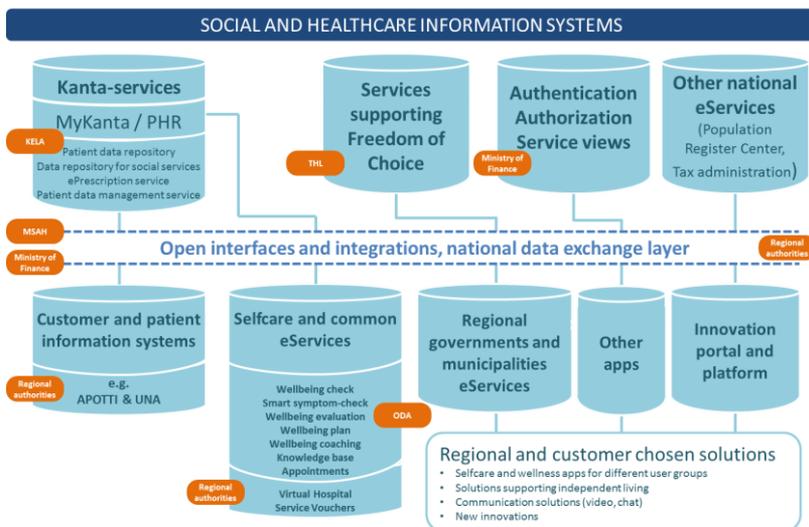
There are almost as many mobile telephone connections in the world as there are people. A vast number of mHealth apps related to health and welfare are available and can be used by mobile phones, smart phones and tablets [100]. In Finland, mHealth apps are seen as enablers of more accessible services and totally new services in future. Finland is a high user of mobile data services and has the highest mobile data usage per Subscriber Identity Module (SIM) in the world [101]. Mobile applications allow easy access to services and empowers own health management, wherever you are. The national social and healthcare information system architecture [Fig. 4, 102] builds upon open interfaces and promotes new innovative applications to be applied through innovation portal (e.g. connected to national personal health record).

Conclusions

In conclusion, Finland has developed a national backbone for eHealth services that connects currently practically all health care services providers (Figure 5). This HIE backbone makes it possible to develop further integrated, personalized and mobile services to citizens. Finland has taken patient-centric approach when developing health care services. Social care

and health care services are integrated when it is natural e.g. care of the elderly. Furthermore, the need for hybrid professionals, new jobs, is growing e.g. gamification in health is growing. IoT elements in health care are developing fast. This needs constant education and competence building for both health care staff and citizens. Multi- and interdisciplinary is shaping also eHealth education. Ethical issues, privacy and data security from hospital to home must be considered all the time in all levels. Big data is available from multiple sources. However, the huge amount of data needs new technologies and research in order to get most benefits of the collected data. The stored standardized health data will stay available even if the healthcare organizational structure will be modified in the future. The various forthcoming telemedicine services can rely on this national backbone. Finally, quality assurance and research activities can be supported by the reliable data.

Figure 5. Finnish National Social and Healthcare information system architecture



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Acting as an eHealth expert in various groups e.g. ICN's eHealth Strategic group, Ministry of Social Affairs and Health. Over 30 years expertise in healthcare technology.
Chair of Regional Cancer Association in North-Savo. Two personal medals:
The President of the Republic of Finland, Sauli Niinistö, as the Grand Master of the Orders of the White Rose of Finland and of the Lion of Finland, has awarded the order of the Knight of the Lion of Finland to Pirkko Kouri on the 6th December 2015.
City of Kuopio awarded with Kuopio silver medal-reward Nov 18th 2016.
The award was based on international work e.g. in ISfTeH has positive effect



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He has more than 27 years of experience with telemedicine and eHealth and electronic patient record systems. His team was first in Europe to develop a mobile medical app to smartphones already since 1997 and the first to perform international teleradiology consultations since 1994.

Currently, his research group at FinnTelemedicum performs assessment studies of the availability, intensity of use, usability and innovation potential of eHealth systems. In benchmarking studies, there is collaboration in national level, in Nordic eHealth Research Network and connections to WHO and OECD.



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Telemedicine/eHealth Projects and Achievements

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Introduction

The state of health of a population is a direct determinant of development. It affects productivity, the potential of children, infant and general mortality, and the allocation of resources within a family, community and the nation. Access to better healthcare services redounds to poverty reduction and increased productivity. Investment in healthcare is a prerequisite to economic and social progress [1].

Population growth and the emergence of new health problems are increasing the demand for healthcare services and for treatment that is more expensive. Increasing demand, slow economic growth and rising healthcare costs have not been in parallel with the funding of the healthcare sector in most developing countries. Healthcare infrastructure, buildings and equipment, medical staff, drugs, vehicles, is central to good healthcare requiring high investments. Healthcare services must be integrated, cost-effective and available to the people who need them. The adoption of sound policies and strategic plans that will guarantee the provision of quality, sustained and integrated healthcare services to its population are challenges faced by most governments of the developing countries today. To meet this challenge, governments and private healthcare providers must make use of the existing resources and the benefits of modern technology.

Many developing countries have inadequate healthcare and medical services. Developing countries suffer from a shortage of doctors and other healthcare professionals. The inadequate infrastructures of telecommunications, roads and transport make it even more difficult to provide healthcare in remote and rural areas and to transport patients properly [2]. Where clinics and hospitals exist, they are often ill equipped and, especially, outside urban areas, beyond the reach of normal communications.

Developing countries face various problems in the provision of medical service and healthcare, including funds, expertise, and resources, which relate to the lack of facilities and systems.

Several years ago, any talk related to the Internet, would have to be preceded by an explanation of what it is and how it works, but at present information technologies (IT) became an essential part of life and practical activity. eHealth / telemedicine is the dissemination of medical information using the digital medium. This field absolutely depends upon IT [3]. The communication technologies have two tasks in eHealth/telemedicine. First, they may serve as a repository of knowledge from which healthcare professional interested in telemedicine techniques may draw. In the field of eHealth, this aspect still has a long way to go. More importantly though, it may be conduit by which telemedicine is implemented. For most areas, the communication technologies represent the easiest existing infrastructure to use, with the World Wide Web (WWW) being best suited to multimedia applications [3].

For countries with limited medical expertise and resources, telecommunications has the potential to provide a solution to some of these problems. eHealth/telemedicine services have the potential to improve both the quality of and access to healthcare regardless of geography. Healthcare professionals can be more efficient. eHealth/telemedicine offers solutions for emergency, medical assistance, long distance consultation, administration and logistics, supervision and quality assurance and education and training for healthcare professionals and providers. eHealth/telemedicine can help fighting infectious diseases and meeting the particular requirements of dermatology, traumatology and many other medical specialties.

It is obvious, that telemedicine and eHealth have many socio-economic benefits; they can generate new sources of revenues for service providers and equipment suppliers and can optimize the use of available human and capital resources in developing countries. However, these fields need to be implemented carefully and managed well. The impact of telemedicine on healthcare structures can be significant. In this respect, eHealth can be seen as a tool to reorganize or to build up new healthcare structures. It also raises concerns about liability, confidentiality, competition and other policy and regulatory issues.

eHealth/telemedicine has a great potential however today there are unfortunately few examples of large services [4].

eHealth/Telemedicine Projects – First Steps in the Field

There were two International Telecommunication Union (ITU) supported telemedicine projects implemented in Georgia. The first one started in September 1998 and involved the connection of the Institute of Radiology in Tbilisi to the Diagnostic Imaging Centre in Lausanne, Switzerland via the Internet in order to acquire medical second opinions. In the frames of this project, Vidar VXR-12-Plus was used for digitization of images of computer tomography (CT) and magnetic resonance images (MRI).

The second telemedicine project – Telecardiology, has implemented the simple method of electrocardiography (ECG) transfer using ordinary telephone receiver. It was partly funded with excess revenues generated by the ITU Telecom exhibitions. The project enabled a trans-telephonic electrocardiogram for diagnostic and emergency services. The project was one of several others project that were implemented in selected developing countries. The projects were part of the ITU's strategy to use information technology for helping healthcare professionals solving some of the most accurate healthcare issues in developing as well as emerging economies, according to Recommendation 9 of the Valetta Action Plan adopted by the ITU in 1998. Partners in the project include the Tbilisi Cardiac Clinic GULI, Telecommunication Company of Georgia and the Telemedicine Foundation of Russia.

However, in Georgia there were other telemedicine projects implemented too. In 1996 and 1997, the National Association of Cancer Control established an email communication and conducted tele-radiology and tele-morphology conferences through financial support of the Open Society Georgia Foundation. Particularly, X-ray, histograms and cancer incidence database were transferred from Batumi (Adjara region) to the Tbilisi National Cancer Center by email.

The Heart and Vascular Clinic uses Agfa Deluxe Slide Scanner for tele-radiology. The center also transfers phonocardiograms, ECG and Video files to medical centers in Germany and USA for second opinion consultations.

Emergency Cardiology Center and National Information Learning Center are also implementing tele-coronography (tele-cardiology/tele-radiology) – transfer X-ray images for second opinion to German and Turkish colleagues (by the usage the both HP ScanJet and Apple 1 scanner as well as Olympus Camedia D-620L high-resolution digital camera).

The Center of Disaster and Emergency Medicine has developed a software and tested TelCoNet – Teleconsultation network project for emergency medicine [5].

In 2004 in Georgia, a non-governmental organization, the Georgian Telemedicine Union (Association) – GTU, has been established. The organization aims a realization of remote consultations in static (through consultation servers and emails) as well as dynamic (teleconferencing) modes. In 2005 GTU starts the implementation of a NATO Networking Infrastructure Project “Virtual Health Care Knowledge Center in Georgia” in collaboration with Dr. Thomas Schrader (Charite Hospital, Berlin, Germany). The latter aims the creation of telemedicine consultation server, organization of eLearning courses and set-up of a regional (West Georgia) telemedicine unit.

GTU also implemented the Black Sea Economic Cooperation (BSEC) project “A System to Fight HIV/AIDS, Tuberculosis and Malaria in BSEC Countries with the Help of Info-Communication Technologies” in collaboration with Russia and Ukraine.

On the background of practical activity of the Georgian Telemedicine Union, it was revealed that the probability of an incorrect handling of a relevant medical data is still dangerously high, mainly due to:

- Environmental factors – many medical organizations are not fully able to face every disease, e.g., in a peripheral hospital only the most frequent pathologies for that geographical area are treated;
- Instinctive factors – the decision making of a physician is usually mainly based on the limited number of cases in her/his experience and/or on a static knowledge available from databases of the main published studies. This factor is very variable between different specialists and general practitioners.
- Emotional factors – medical decisions are often influenced by the opinions and decisions that have been taken by physicians who have already examined the same patient.

Consequently, the probability of a serious error occurrence could be high and the probability of its recognition very low. This frequently causes a repetition of examinations in the same time or in different medical units and it slows down the diagnostic process (resources waste) and the proper treatment. Therefore, proper actions for improving the working procedures have to be taken [6].

Correct medical information management and transmission is a key point, hence the introduction of innovative IT solutions can be relevant. Furthermore, IT performance, and in particular the telemedicine bandwidth requirements are high and rather asymmetric (there are more often needs for retrieval than for entry or update of medical data). Multimedia clinical record

transmission is a suitable topic for the telemedical networks. Each actor connected to a network needs to be driven towards the most proper resources available on it, e.g., an important objective of clinical data management is the availability of common and precise data about patients treated in medical centers connected to the network [7, 8].

GTU's projects provided a new teaching/learning service based on collaborative and bi- and multi-directional communication processes. Interest in co-operation does not affect only teaching but all intellectual and cognitive activities. A "collaborative learning" will refer to a method in which actors work together towards a common task. Physicians are traditionally responsible for their own and their fellow's learning: in this way, individual success helps all others to achieve positive results. In fact, an active exchange of ideas in between small groups does not only improve the interest in communicating but also promotes a development of more critical thinking.

The main telemedicine applications concern: remote second opinion consultations and teleconferencing (one to one and/or multipoint). On the other side, the main applications that have been implemented for eLearning are: video lessons (live and/or on-demand), a media library, and a laboratory collaborative learning environment. Since the request for more effective healthcare services has been increasing over the years, the health delivery system needs to focus on:

- Improving the performance of the healthcare services;
- Optimizing the running costs of the healthcare structures and the allocation of resources.

For this reason, health is now following a "delocalization" process: information, i.e. knowledge and skills, should be moved, rather than people or tools. The practical activity of the Georgian Telemedicine Union (Association) aims to provide an answer to such an evolution of eHealth.

In 2005 within the frame of the NATO Networking Infrastructure Project "Virtual Health Care Knowledge Center of Georgia", the Georgian Telemedicine Union (Association) in collaboration with the Charite Hospital created a teleconsultation server. eGroupWare, Moodle and Teleconsulting tools are implemented on the server.

eGroupWare is a software type that allows a group of individuals on a network to work on the same project at the same time and share documents. Within the scope of eHealth/telemedicine, teleconsulting is an important sub area, where several cases can be discussed with experts all over the world. In the frames of the mentioned project, the Simple Machines Forum (SMF) has been used for organization of teleconsulting. For eLearning a learning

management system (LMS) - Moodle has been chosen. This is a software package for the production internet-based courses and web-sites. It is provided freely as Open Source software (under the GNU Public License) [6].

It was revealed, that eHealth/telemedicine is most important for ensuring the safe primary medical care in Georgia. The first contact of patients needing medical help is the contact with the local primary care health center. Second opinions from specialists are often required in primary care health centers (i.e.: radiology, cardiology, dermatology, consultation with specialists regarding further treatment of the patient; is hospitalization needed or not? etc.). An efficient and appropriate strategy of medical care can be worked out at the initial steps of a patient's contact with healthcare. Such an approach can avoid unnecessary hospitalization, and will be a substantial contribution to the reduction of health costs.

eHealth/telemedicine has the potential for offering the country these qualitative and quantitative improvements:

1. Distance consultations, diagnosis and advice for treatment.
2. Opening up new ways for education and training. Improvement in qualification of national specialists and health technicians, by opening up international medical databases.
3. Overall improvement of service by regional centralization of resources (specialists, hardware and software packages).
4. Effectiveness and efficiency in management of actions related to the reduction of waiting times for consultations, and introduction of medical information systems.

eHealth/telemedicine could reduce health costs in the country potentially in these ways:

For the patient:

1. Cutting down on the journeys to major health centers or for specialist consultations.
2. Reduction of length of stays, and therefore cost of hospitalization, since the patient can be treated and checked at a distance.

For providers of health services:

1. Reduction of operating costs through centralization and optimization of resources (expertise, laboratories, equipment, etc.)
2. Reduction in travel cost and time for specialists visiting other hospitals and centers for consulting.

3. Reduction in costs of training and updating, improvement of specialists' qualifications through distance teaching and access to medical databases.

eHealth/telemedicine introduces added value and a positive impact on social, economic and cultural levels. Therefore, this field is beginning to have an important impact on many aspects of healthcare in developing countries. When implemented well, eHealth/telemedicine may allow these countries leapfrog over their developed neighbors in successful healthcare delivery.

Reference data and medical support services provided by the Georgian Telemedicine Union (Association) are complying in a cost-effective way to the continuity increasing healthcare professionals' needs for a faster access via internet to data and services supporting decision making in clinical practice and medical education. In particular, the services provided by the eHealth/telemedicine should be:

- Access to clinical and educational data, tutoring and eLearning functions: reference data (clinical data) and text databases for diagnostic and patient care decision support and for undergraduate or postgraduate courses and professional continuing education schemes support; educational tutoring and learning progress assessment; off-line and on-line consulting on specific issues;
- Support to the teleconsulting sessions with the above-mentioned data and workgroup function as forum. Most patient data is stored in large files. For this reason, the transfer rate of the multimedia contents in the web sites is a qualifying element to satisfy the needs of healthcare professionals, scientists and students in various medical areas.

It should be noted especially, that a medical record collects data items from direct patient examination and from medical instruments. These "events" representing significant episodes in the patient's medical history, belong to two classes: analytical events and descriptive events.

The healthcare staff worldwide needs to certify their participation in continued medical education (CME) programs. These courses have traditionally been done in the past either face-to-face or via reading materials. Web-based technologies allow courses to be available on-line. This enables healthcare operators to train themselves at any time and from any location and available information to be greatly increased. Traditional web systems are too simple to be really effective and the commercial eLearning platforms require a complex configuration and are too 'technical' for customers, furthermore, the focus of this system is often on on-line interactivity, while a

structured arrangement of educational contents must be the first priority [9-13]. For this reason, a new system will be developed having the following features:

- Structured courses: Stored in a relational database maintained by a suitable administration tool. Each course is multi-language and integrated with evaluation forms. The course structure (lessons, concepts) is easily editable and the results are immediately available.
- Innovation in content: The system is based on an object called “concept”, an innovative way to build a lesson. This concept encloses images, videos and texts that are needed to communicate educational concepts.
- On-line interactivity: Learners communicate with teachers by using audio/video/whiteboard interaction in multi-user sessions (virtual classrooms). The quality of audio/video depends on the network.
- Minimum configuration of users: The system will run on most hardware and operating systems and it needs no configuration of the user workstation. In addition, the server runs open software products to reduce costs and to increase portability and performances.

The main objective of eHealth/telemedicine service provider is the availability of a common base of medical data relevant to any organization connected to the web. Telecommunication network and proper software provide patient data in remote sites enhancing the cooperation between healthcare professionals belonging to different organizations. The system should guarantee:

- Patient assistance: The underlying idea is that the information collected during the contacts with healthcare organizations has a great importance for further treatment of the patient’s diseases. Data has to be accessible by authorized medical personnel only. The patient must not be bound, as far as possible, to working and traveling constraints. Therefore, the patient could have contacts with other organizations, possibly abroad, and her/his data must be easily accessible, provided the security permissions are verified. Medical and paramedical personnel store and retrieve relevant data coming from exams, anamnesis, therapy and any other event that is relevant to patient’s contacts with any organization joining the system.

- Decision support based on large statistical samples. The availability of a wide collection of medical cases can be very useful in determining the best decision about a new patient.
- Research activities. The dissemination of large number of medical data integrated in a single network implies that a huge amount of data will be available. This information can be used as a common base for scientific statistical analysis for medicine.
- Economic objectives. The system gives relevant economic advantages. It allows patients to be treated in remote sites, sharing the relevant data for medical decisions support and diagnosis with physicians in centers of excellence. Medical protocols and guidelines for disease treatment can be shared. Medical personnel in remote sites can join centers of excellence programs and associations. It enhances the autonomy of the remote sites hospital system, increasing efficiency and allowing quality assessment.

The patient record at eHealth/telemedicine service provider should be based on “events”, i.e., episodes that occur during the patient’s contacts with the healthcare organization. The patient’s record is the collection of all his/her events; these medical data could be heterogeneous, ranging from numerical values to radiography images. A relevant step forward is that the information is gathered during routine patient treatment, not during activities explicitly dedicated to scientific research within healthcare organizations. Educational module slides will be already collected in a central database. The particular importance of this point is:

- Data flow is asymmetric;
- There is no requirement for the session leader workstation. The roles of the participants is logically assigned by the software and not dependent on the terminal features;
- Slides are collected in a hierarchical form in a relational database. In this way structured access to courses is granted and large amounts of content are administered and maintained centrally in a well ordered way;
- Access to the contents should be granted conditionally based on the user privileges. The tutor grants access to the appropriate educational material. The system also allows dynamic on-line transmission of local images and even clipboard graphic paste of graphics in the virtual board. Of course, the asymmetric nature of the network is not efficient in this case. The program should allow user commands to be automatically sent to all the participants that

see the same window and can give commands that will be broadcasted to the others.

For the users there have been savings from:

- An operating cost reduction through the optimization of resources;
- A reduction in costs of training for the physicians through eLearning and access to medical database;
- A decrease in travel costs and time for physicians visiting other hospitals for consulting.

Therefore, the activities of Georgia in the field of telemedicine and eHealth are sporadic and project based. The standards as well legislative documents are not elaborated until now.

Telecytology, Medical Information System and Quality Assurance

Telecytology is a branch of telemedicine that consists in the exchange of microscopy digital images through telecommunication with the purposes of diagnosis, consultation, research and/or education. The concept of telecytology to provide diagnostic services to remote locations was first described in the USA in 1968, when monochrome images were transmitted in real time using a dedicated point-to-point microwave link. In little more than a decade telecytology has developed from the prototype commercial system, first described in 1986, to today's multimedia computers which can be purchased 'off the shelf' at very low prices and can be used as the basis of telecytology systems.

There are technological concerns that may prevent the acceptance of telecytology by cytologists and thus hinder its application within the routine environment. Some cytologists believe that telecytology is too expensive and that it does not have a useful role in routine cytology. Others have doubted if computer monitors could be used for making a diagnosis, although results have shown no significant difference between a cytologist's performance using a microscope and using a digital image. Many of the concerns expressed about the use of telecytology are not derived from knowledge. There is a need to involve as many cytologists as possible in the use of these systems, particularly cytologists working in routine services roles. Many cytologists believe that fast access to expert opinion is the key to reduce the numbers of diagnostic errors, which have been estimated at up to 5%. Although most of these are not necessarily critical to the patient, yet some of them could be.

There is a very clear need for the expanded application of information technology (IT) in healthcare. Clinical workflow still depends largely on manual, paper-based medical record systems, which is economically inefficient and produces significant variances in medical outcomes.

Quality assurance programs in cytology are one of the most important methods to maintain and improve the diagnostic acumen of cytotechnologists and cytologists, but there are difficulties in carrying out such programs. A long turnaround time for the circulation of glass slides is the major drawback. It is well known, that it is prolonged in the case of large number of participants and widely spread institutions. The use of photographed slides has been a partial, but unsatisfactory solution because of the costs and delays in the preparation. Nowadays digital images acquire more and more importance for morphology practice.

For the aim to realize telecytology in effective and comprehensive mode different models and schema of organization of cytology second opinion consultation has been tested in Georgia. At the beginning the telecytology consultation server has been allocated, setup and installed. The main services available on the server were Simple Machines Forum (distance consultations) and Moodle (eLearning). Using the basic methodology: idea-analysis-conception-implementation-test/deployment the server was established under the premise 'keep it small, safe and simple'. For the purpose to effectively organize distance cytology consultation, responsible person supervised every case. This process includes preparation of illustrations and documents, case uploading at server and notification of experts by email. Distance consultation implements individual management of incoming requests. Each case contains description (text data – the resume of medical history) and illustrations (microphotographs). Board-certified cytologists reviewed all cases. The conventional light microscope and 2.0 USB digital eyepiece camera of resolution 2048x1536 pixels have been used for the preparation of the virtual slides. The essential data were stored on the server and they are viewable by every authorized group and/or individual. The only software required is the widely used browser (e.g. Internet Explorer). The authorized user can comment the case and recommend the questions and requests. To ensure the case discussion, the responsible person replied to consultants and moderate elaboration of the final diagnosis. After finalization, the case is stored on the server and can be viewed by the registered users. For quality control mechanism implementation, each consultant subjectively assessed the image quality. This was to be graded on a four-tier scale, with a score of 1

being the lowest score (poor) and a score of 4 being the highest score (excellent) according to the following criteria:

1. The images are of such poor quality that no diagnosis can be ascertained from such images via telecytology.
2. The loss of high-quality resolution precludes an accurate diagnosis via telecytology.
3. The images are of high quality as to render a diagnosis via telecytology.
4. The images are of excellent quality.

The telecytology consultation server has been implemented for distance consultation of clinical cytology cases and presentation of educational cases in 2006-2008 years. During this period, 140 cases were created. The 2.0 USB digital eyepiece camera mounted at light microscope (Karl Zeiss) of resolution 2048x1536 pixels has captured the images. Adobe Photoshop adjusted the brightness and contrast of images. The average number of images per case was 4 (95 cases, 67,86%). An average number of consultants per case were 3 (105 cases, 75%). In 135 cases (96,43%) the first comment was made in less than 12 hours. In 92 cases (65,71%) the primary diagnosis has been confirmed as a result of remote cytology consultation. In 25 cases (17,86%) the diagnosis has been corrected as a result of telecytology consultation. In 10 cases (7,14%) additional laboratory investigations has been suggested. In 13 cases (9,29%) the images were of poor quality, insufficient for telecytology consultation (Table 1).

Table 1

Total number of cases	140
The average number of images per case	4 (95 cases, 67,86%)
The average number of consultants per case	3 (105 cases, 75%)
First comment made in less than 12 hours	135 cases (96,43%)
The primary diagnosis has been confirmed as a result of second opinion consultation	92 cases (65,71%)
The diagnosis has been corrected as a result of telecytology consultation	25 cases (17,86%)

Additional laboratory investigations has been suggested	10 cases (7,14%)
Cases insufficient for telecytology consultation	13 cases (9,29%)

The server has been implemented for introduction of Pap-smear technique and 2001 Bethesda System for reporting cervico-vaginal cytologic diagnosis in Georgia, too. Microscopic image capturing again has been performed accordingly with methodology described above. During 5 months (February-June, 2008) 300 cases were discussed. Local cytologist has worked out the primary diagnosis. The average number of images for each case was 8 (172 cases, 57,3%). An average number of consultants was 2 per each case (231 cases, 77%) and they presented their comments or diagnosis. In 87 cases the first comment was made in less than 8 hours (a single working day) and only in 3 cases the final diagnosis was reported in 12 hours. In 270 cases (90%) the primary diagnosis has been confirmed as a result of telecytology consultation. A definite final diagnosis with clinically unimportant discrepancies was achieved in 25 cases (8,3%). In 5 cases the diagnosis has been corrected as a result of telecytology consultation. 220 cases (73,33%) have been submitted by four different persons from three different locations (Table 2). Web-based transmission has been applied for sending cases.

Table 2

Total number of cases	300
The average number of images per case	8 (172 cases, 57,3%)
The average number of consultants per case	2 (231 cases, 77%)
First comment made in less than 8 hours	87 cases (29%)
The final diagnosis was reported in less than 12 hours	3 cases (1%)
The primary diagnosis has been confirmed as a result of second opinion consultation	270 cases (90%)

The cases with a definite final diagnosis with clinically unimportant discrepancies	25 cases (8,3%)
The cases with corrected diagnosis as a result of telectyology diagnosis	5 cases (1,67%)
Cases submitted by different persons from different locations	220 cases (73,33%)

Quality control mechanism has been implemented for all cases. These cases were related to cancer (mainly breast and cervical cancer) diagnostic.

eLearning has been implemented for realization of 15 educational programs. 14 programs (93.33%) have been implemented for realization of Continuous Medical Education (CME) of healthcare professionals and medical doctors distantly. The average number of teachers per CME program was 5 (12 programs, 85,71%). The average number of pupils per CME program was 25 (9 programs, 64,29%). Educational cases for review and consultation have been implemented in 14 CME programs (100%). The average number of educational cases per CME program was 15 (10 CME programs, 71,43%). 1 program (6,67%) from the above mentioned 15 has been dedicated to actual tasks of Pap-smear technique and Bethesda system.

Healthcare information technology models are constantly evolving as the industry expands. Medical information system (MIS) is a comprehensive solution that automates the clinical, administrative and supply-chain functions. It enables healthcare providers to improve their operational effectiveness, to reduce costs and medical errors and to enhance quality of care. The aim of MIS was and is as simple as relevant: to contribute to and ensure a high-quality, efficient patient care. The relevance of 'good' MIS for high-level quality of care is obvious. Without having appropriate access to relevant data, practically no decisions on diagnostic, therapeutic or other procedures can be made.

MIS has been launched in Georgia in October, 2008. Its primary goal is the patient management. However, the system is also targeted at creating a unified information space in the framework of the wider medical organization. Since the first practical application of the MIS arose the idea to use it for telectyology too. Our goal was to review and study the application of MIS for telectyology from the Georgian perspective. This was a pilot study.

The MIS involves a multi-user web-based approach. This ensures local (intranet) and remote (internet) access of the system and management of databases. The medical information system is object-oriented software. It is realizing client-server concept. Its architecture provides a secure, robust and extensible system for managing multiple medical terminals within a centralized depository. The medical information system has a flexible architecture that can run on numerous combinations. The recommended server-operating requirement is Windows Server 2003. Hardware recommended requirements are the following: memory – 1 GB, disk space – 1 GB. Internet Explorer 6.0+ and/or Mozilla Firefox 2.0+ can be used as client browsers. The medical information system was started to create in December 2007, and the draft version was released in April 2008. After some tests and corrections, the application of ready-for-use version of the medical information system started in October 2008 (Fig. 1).

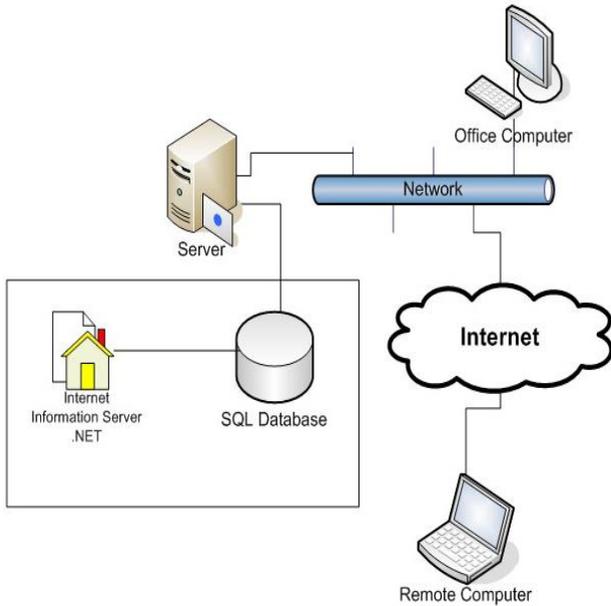


Figure 1. Software application and user interface scheme

The medical information system consists of three key modules:

1. Administration and configuration module;
2. Working module for medical personnel;
3. Reporting module.

The administration and configuration module is dedicated for setting up the users' basic rights. It allows users registration or blocking, defining, and configuring of their rights. This module generates all medical forms (consultation, clinical investigation, diagnosis, prescription, treatment, etc.) It is a database for the staff too. Each employee is provided by a unique code, alongside with gathering biographical and professional data. Using the working module, medical history can be generated, edited and updated by the medical personnel. An unique code is given to each medical history. It consists of text and multimedia files – images, video, and invoice. This module also implements planning of patient visits and schedule of the staff. Medical history and medical forms (consultation, examination report, etc.) can be fully or partially exported by the reporting module. The documents can be exported in various file formats, including pdf, rtf, and jpg. The module also implements statistical analysis of medical data (patient's age, sex, diagnosis, date of investigation, treatment parameters, etc.). It can be used for quality control of the medical services (Table 3).

Table 3. Modules of the medical information system

Module	Administration and configuration module	Working module for medical personnel	Reporting module
Function			
Users registration	X	-	-
Users blocking	X	-	-
Users right definition and configuration	X	-	-
Generation of medical history	-	X	-

Edition/update of medical history	-	X	-
Schedule of staff	-	X	-
Data export	-	-	X
Data statistical analysis	-	-	X

Since March 2010 up to January 2011, 100 cases in cytology were cared by application of medical information system. These were cases of gynecological cytology. All slides were conventional PAP tests. The slides were photographed accordingly with the above-mentioned technology. An average number of images per case were 5 (88 cases, 88%). Each series of images per case began with a general view, followed by higher magnification of diagnostically interesting and actual areas. Cytologist selected these areas. Laboratory personnel trained in the use of the camera captured the images. The images were stored in a personal computer. They were adjusted by using of Adobe Photoshop. Laboratory personnel have done this manipulation. It means the correction of image contrast and brightness. Adjusted images were uploaded to corresponding electronic medical record. All 100 electronic medical records were marked as cases for telecytology consultation. For security reasons telecytology experts have been registered as users at medical information system. Four Georgian certified cytologists were selected as experts for second opinion consultations. Cases selected for telecytology were listed at MIS home page.

For implementation of quality control mechanism, each telecytology expert subjectively assessed the image quality. The ratings of image sharpness and quality were given using a 4 level scale: 1 – “excellent”, 2 – “good”, 3 – “fair”, 4 – “poor”. An average number of consultants per case were 3 (86 cases, 86 %). In 94 cases the first comment was made in less than 8 hours. In 96 cases the primary diagnosis was confirmed as a result of telecytology consultation. In 3 cases the diagnosis has been corrected. In 1 case the images were of poor quality, insufficient for remote cytology consultation (Table 4).

Table 4

Total number of cases	100
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The average number of images per case	5 (88 cases, 88%)
The average number of consultants per case	3 (86 cases, 86%)
First comment made in less than 8 hours	94 cases (94%)
The primary diagnosis has been confirmed as a result of second opinion consultation	96 cases (96%)
The cases with corrected diagnosis as a result of telecytology consultation	3 cases (3%)
The cases with images of poor quality, insufficient for telecytology consultation	1 case (1%)

Overall, 97.5% of the cases were rated as having excellent or good image sharpness and contrast, with 2.5% being rated as fair and poor. With respect to image color, 95% of the images were rated as excellent or good, with only 5% being rated as fair and poor. There was a high positive correlation ($r = 0.83$) between color, sharpness and contrast ratings. Images with excellent or good ratings generally received excellent or good color ratings. There were relatively low correlations between color ($r = 0.27$) and sharpness/contrast ($r = 0.32$) ratings and the decision confidence values.

For the online quality assurance program in cytology we randomly selected 100 gynecological cytology cases (benign – 54; atypical squamous cells of undetermined significance (ASCUS) – 24; low-grade squamous intraepithelial lesion (LSIL) – 7; high-grade squamous intraepithelial lesion (HSIL) – 15). The randomization has been done by application of the Research Randomizer (www.randomizer.org).

Cases were diagnosed routinely by 3 certified cytologists with an experience of work with digital images and usage of medical information system who provided cytology diagnoses. All participating cytologists have more than 7 years of cytology and up to 2 years' experience to work with digital images and medical information system. The most worrisome cells or groups in each case were selected and marked by all participating cytologists. These areas were photographed. The mean number of selected fields and digital images for each case were five (range 5-7) and 20 (range 18-22), respectively. Each series of images began with a general view (magnification

x40), followed by higher magnification (x100) of diagnostically interesting areas as directed by the cytologist. The images were stored in a personal computer and uploaded at medical information system (MIS) together with necessary medical data. The upload to the medical information system was done 100% successfully. There was no image distortion identifiable after the upload process. Created cases were labeled “QA”.

One hundred electronic medical records (EMRs) with cytology diagnosis, illustrated by images and labeled “QA” were created. Email notifications that cases are available for review have been sent to cytologists who already diagnosed these cases in routine manner after creation of the EMRs. These cytologists have been registered as users at MIS.

Diagnoses of “QA” cases were recorded in four categories: (1) benign; (2) ASCUS; (3) LSIL; (4) HSIL (Table 5). Additional information, including comments on adequacy of images, total time required for review and problems encountered in diagnosing “QA” cases was added. Each participating cytologist recorded whether there was a need for low-magnification digital images.

Table 5

Cytology diagnosis according the Bethesda system	Number of cases
NILM – Negative for intraepithelial lesion or malignancy	54
ASCUS – Atypical squamous cells of undetermined significance	24
LSIL – Low grade intraepithelial lesion	7
HSIL – High grade intraepithelial lesion	15

Diagnoses of the "QA" cases correspond with initial diagnoses made in routine manner. The mean diagnostic time was 125.8 minutes (range 115-142 minutes) for glass slides and 47.3 minutes (range 38-62 minutes) for "QA" cases. Low magnification (x40) of digital images was recorded as not necessary by all participating cytologists. The inability to focus at different levels to examine the architectural and cellular details of overlapping cellular groups was recorded as an impediment to diagnosis in "QA" cases (Table 6).

Perspectives and strategies for telecytology are currently evolving, as emerging operative requirements would allow self-sustainable large-scale exploitation, while recent technological developments are available to support integrated and cost-effective solutions to such requirements. However, as far as we know, few telecytology services have proceeded to a large-scale exploitation, even after successful technological demonstration phases. Telecytology is the most important for the ensuring the safe medical care.

Table 6

Parameters	Routine diagnostic	“QA” cases
Number of cases diagnosed NILM	54	54
Number of cases diagnosed ASCUS	24	24
Number of cases diagnosed LSIL	7	7
Number of cases diagnosed HSIL	15	15
The mean diagnostic time	125.8 min	47.3 min
The necessity of low magnification (x40)	yes	no
The problems with examination of overlapping cellular groups	no	yes

Use of telecytology consultation is appearing to have many advantages over conventional light microscopy. The International Union against Cancer (UICC) has estimated that at least in 5-10% of cancer cases the cytologist need a consultation during routine work because of uncertainty. Sending glass slides or paraffin blocks by mail or courier to experts in the field, is a time consuming way, especially in critical specimens for cytologists working alone in distant hospitals with no facilities for intradepartmental consultation. Besides, the probability of loss and damage are always present. Today, telecytology, in the forms of static and dynamic, seems to be the basic solution for this major problem. Conventional cytology with glass slide has many limitations. For example they may be easily broken, their stain is unstable and could fade with time, the tissue mount can bubble and dry out

and finally certain procedure such as fluorescent stains are not stable more than few days. In this situation, it seems that the best replacement of the conventional slide cytology is telecytology, which never changes in the appearance as long as the data integrity is maintained. It is also a good approach for eLearning and is already used widely for this purpose. However, in spite of the mentioned points, telecytology in Georgia is not popular. It is used only for consultation in limited centers and only in the form of static telecytology. It has been revealed that education and clear guidelines for cytologist are essential before starting telecytology.

The use of digital images ensures the assessment of identical fields, avoiding the problem posed by differences in field selection. The main aim in cytology quality assurance programs is to test participants' ability to make the correct decision on a specific abnormal finding rather than the ability to screen an entire slide. Thus, digital images circumvent the problem of field selection and assess interpretation. The time that would be spent for searching the slide for abnormal cells is eliminated. In the present study, more than half for "QA" cases (47.3 minutes) compared with glass slides (125.8 minutes) reduced the mean diagnostic time.

It should be noted and emphasized, that the cytology quality assurance programs test participants' ability to make correct decision on a specific pathology finding. It is well known, that the specialty of cytology, the analysis of cellular morphology and architecture for the presence and nature of pathology, is involved in the care of virtually every patient who seeks medical attention. In a typical medical center studies have indicated that 70% of the clinical data in the electronic medical record are from cytology. Significantly, clinical decision support programs are highly dependent on cytology data. Much of the analysis performed in the cytology lab is visual; therefore, cytology imaging has become an important and growing area of medical imaging environment.

However, cytology imaging presents a number of unique challenges. Some of these challenges include the fact that cytology image quality is a function of many processes (many of which are outside the traditional realm of imaging). For example, image quality is a function of the processing of cellular group(s), the staining of the slide, and the ability of the microscope to form a clear, in focus image worthy of capturing. These functions and tasks are unified and standardized. Therefore, the selection of the diagnostically important area is the routine procedure during screening of the entire slide and can be easily and effectively performed by the certified cytologist. The most important is the ability to correctly diagnose the concrete pathology

finding. This ability usually correlates with a professional experience and development of this skill is the task of the cytology quality assurance programs.

Cost savings is another advantage. Implementation of quality assurance programs in cytology by usage of digital images reduces the expenses of postal or courier slide circulation and the cost and delays of photography slide preparation.

Easy and continuous access to the case material from the medical information system is yet another advantage over glass slides, which have to be returned to the owner institution. After the quality assurance exercise, the digital images are still available for reference and teaching purposes. These advantages, together with the acceptable levels of diagnostic accuracy and reproducibility, strongly support the use of medical information system and digital images for cytology quality assurance programs (Table 7).

Table 7

Parameter	Cytology quality assurance program in traditional mode	Online cytology quality assurance program
Cost saving	No	Yes
Time effectiveness	No	Yes
Long term accessibility of the case	No	Yes

As it was noted above, the practical application of the medical information system in Georgia started in October 2008. It is successfully used for:

- Clinical decision support – provides users with tools to acquire, manipulate, apply, and display appropriate information to aid in making accurate, timely, and evidence-based clinical decisions;
- EMRs (electronic medical record) – contain information about patients, from personal details (such as name, age, address, and sex) to details of every aspect of care given by the clinic (ranging from routine visits to major operations);
- Training and research – patient information is available to medical personnel for training and research in eHealth and telemedicine.

By the term "EMR" we describe a computerized legal medical record created in the clinic. Usually, however, the term "electronic health record"

(also electronic patient record or computerized patient record) is used. EMRs are a part of the medical information system that allows storage, retrieval, and manipulation of data. This is an evolving concept defined as a longitudinal collection of electronic health information about individual patients or populations. Such records may include a whole range of data in comprehensive or summary form, including demographic data, medical history, medication and allergies, immunization status, laboratory test results, radiology images, and billing information. In accordance with our model, EMRs are generated and maintained within clinic. This complete record allows managing and follow-up workflow in healthcare settings and to increase patient safety through evidence-based decision support, quality management, and outcome reporting. EMRs can be continuously updated. A centralized data server is used for EMR's storage.

It has been revealed, that the MIS has yielded significant benefits:

- Easy access to patient data. The system provides convenient access to medical records at all points of clinic. Internet-based access improves the ability to remotely access such data.
- Structured information. The data captured in clinical information system is well organized. Relevant information can be easily maintained and quickly found. The medical information system reduces the likelihood of mistakes arising from illegible writing too.
- Safe and secure exchange of medical data. This task is highly important in the case of organization of teleconsultations and online tumor boards.

Despite of such benefits, there are still barriers that prevent the medical information system from being rolled out in every healthcare organization across Georgia:

- Initial cost of acquisition. High price of the basic infrastructure is a stumbling block for many healthcare organizations.
- Privacy and security. There are still huge concerns in the healthcare industry about the privacy of patient data on computer systems and how to keep such information secure;
- Clinician resistance. Clinicians usually have 10-20 minutes to see their patients and if their use of a medical information system takes up more time than before, it leads to resistance;
- Integration of legacy systems. As elsewhere, this poses a stiff challenge for many organizations in Georgia.

Before practical application of the medical information system, education and training of staff is essential. The system is a very useful and easy-for-use tool. It ensures a situation where healthcare professionals spend more time for creating knowledge from medical information than managing of medical information. Further, medical information system holds the potential to reduce medical errors.

Therefore, the digital images are a suitable substitute for online cytology quality assurance programs. Medical information system is a useful platform for implementation of online cytology quality assurance programs. However, it should be also noted, that perspectives and strategies for medical information system and its practical application in routine work of the medical organization are currently evolving, as emerging operative requirements would allow self-sustainable large-scale exploitation while recent technological developments are available to support integrated and cost-effective solutions to such requirements. However, as far as we know, only few pilot projects have reached a level of large-scale exploitation, even after successful technological demonstration phases. Main exploitation drawbacks, problems and deficiencies have been:

1. Partial solutions approach instead of integrated total approach to healthcare assistance needs;
2. Lack of economical drive and consequently no self-sustainability for large scale exploitation;
3. Insufficient H24 (24 hours /day 365 days/year) medical support;
4. Insufficient networking approach for medical operators and scientific /clinical structures.

The medical information system is the most important background for the ensuring the safe and effective medical care through the appropriate organization of medical information storage and exchange. Instead of management of medical data and clinical workflow by itself, the medical information system has the potential for offering the worldwide medical community the following qualitative and quantitative improvements:

- Distance consultations and follow up;
- Opening up new ways for education and training of medical personnel;
- Overall improvement of service by regional centralization of resources;
- Effectiveness and efficiency in a management of actions related to reduction of waiting times for consultations;
- Effective and adequate quality assurance programs.

The medical information system is able to reduce healthcare costs in the following ways:

- Reduction of operating costs through centralization and optimization of resources (expertise, laboratories, etc.);
- Reduction in travel cost and time for specialists visiting other hospitals and centers for consulting;
- Reduction in costs for training and updating, improvement of specialists' qualifications through eLearning and access to medical databases.

The medical information system introduces added value and a positive impact at social, economic and cultural levels. As a result, it is initiating to have an important influence on many aspects of medical service in countries with low and middle income.

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Japan: Outlook on Telemedicine in Japan ~ From a Social and Popularization Strategy Perspective



The Japanese Telemedicine and Telecare Association

Introduction

The origin of telemedicine in Japan can be traced back to 1971. Up to this point, we have been developing telemedicine technologies, applying them to medicine, testing them and gathering evidence of their usefulness and effectiveness.

While telemedicine has been around for almost half a century in Japan, society is still not sufficiently aware of it, and it has not achieved a solid standing in the medical system.

Telemedicine is a critical component of the medical system, so why is it still not recognized as part of the social system? This may be a result of circumstances unique to Japan, but it could also be an issue common to the other countries of the world.

In this study, we mainly introduce the social background of telemedicine in Japan, policies aimed at its popularization, and trends in telemedicine research. This paper is expected to promote the exchange of information related to the popularization of telemedicine in other countries and policies for establishing telemedicine as an integral part of the social system.

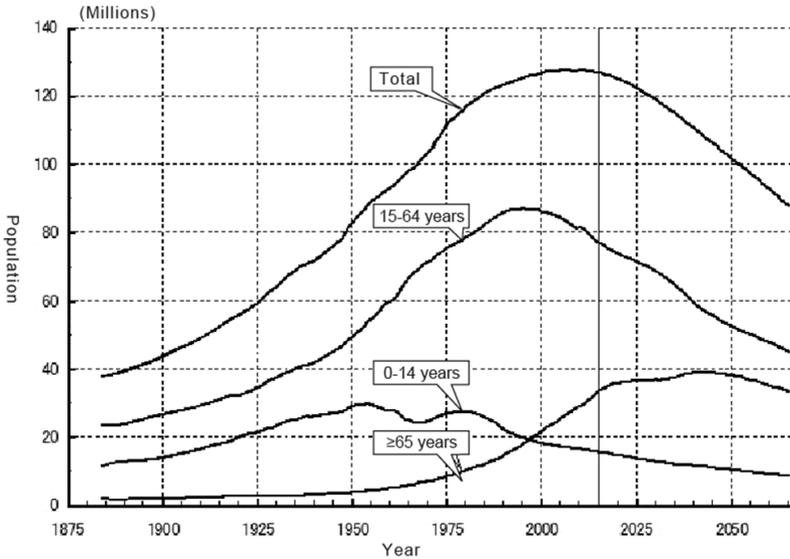
Society and Telemedicine

Social Background of Telemedicine in Japan

Aging Japan

The population of Japan is presently aging at an unprecedented pace, which is expected to still increase in the future (Figure 1).

Fig. 1. Annual change in the Japanese population of three age groups (2015)



The Japanese lifespan has steadily increased as a result of not only a decreased birth rate in recent years but also due to the rapid economic development after World War II. The latter is leading to the establishment of social resources such as the water and sewage system, improvements in sanitation, implementation of the National Health Insurance System and regular health checkups, nutritional improvements, lifestyle/customs guidance and medical developments.

The average lifespan of both men and women in Japan has been one of the highest in the world since the 1950s, and the average lifespan in 2016 was 87.14 for women and 80.98 for men, second in the world next to Hong Kong (Figure 2). The average lifespan is expected to increase even more in the future. Therefore, dealing with the problem of aging has become an urgent matter.

In 2014, medical costs per citizen according to age group (Figure 3) increased for each 10-year age stratum, with the lowest costs being for persons in the latter half of their 20s. Most medical costs were associated with elderly persons. Medical costs were higher in each 10-year age stratum (except for persons aged 100 years or older) than in 2010, reflecting the spike in treatment drugs, and the aging of society is expected to lead to further increased medical costs. In the future, more cost-effective medical treatment

will be required, particularly for elderly people, and telemedicine is expected to contribute greatly to it..

Fig. 2. Annual change in the mean lifespan in developed nations (2016)

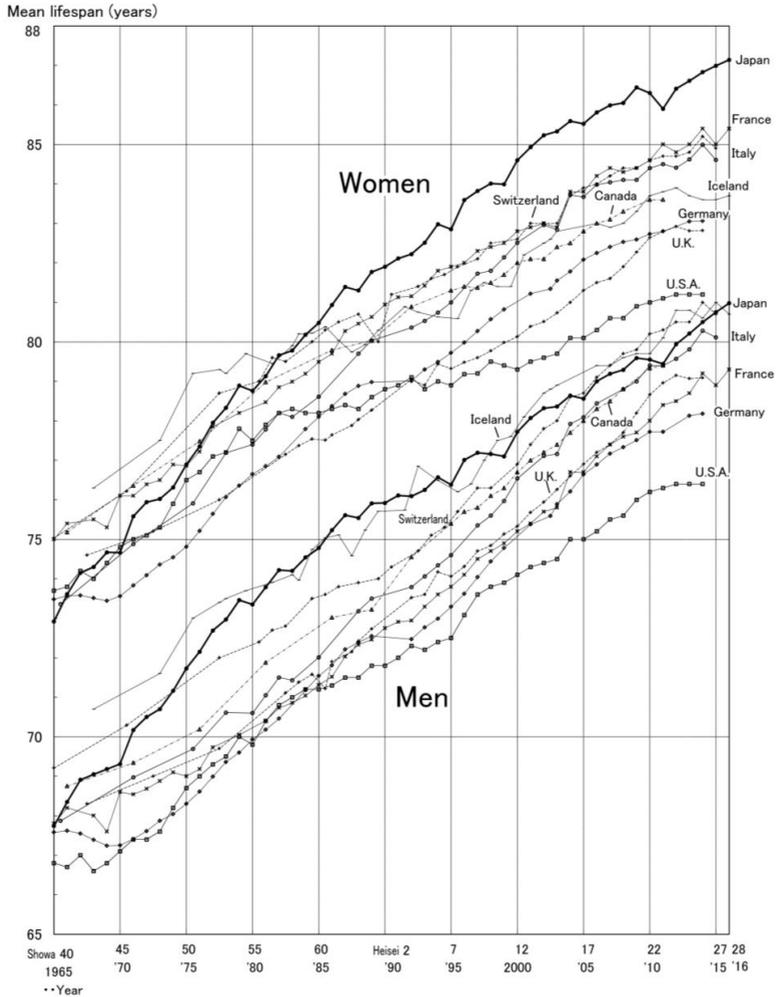
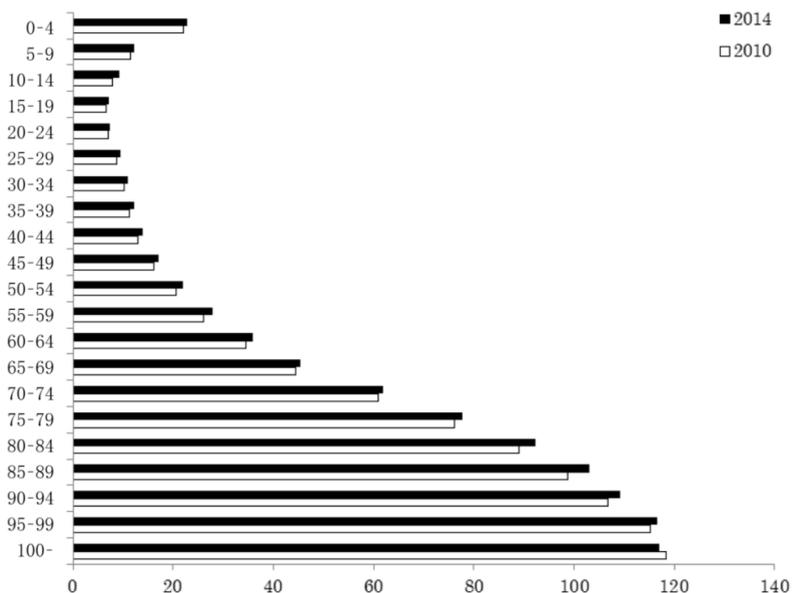


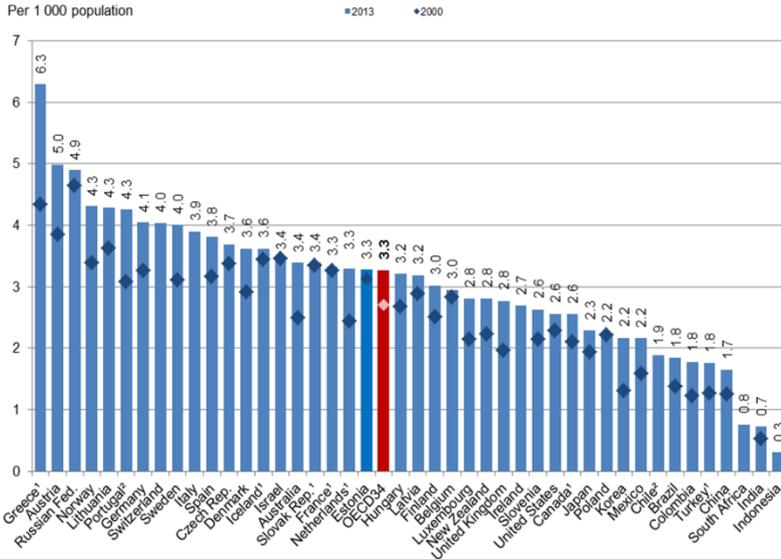
Figure 3. Medical costs (10,000 yen/year) per citizen according to age stratum in 2010 and 2014



Shortage and Uneven Distribution of Physicians

Currently, there are not enough physicians to meet the increased demand for medical treatment caused by Japan’s aging society. According to the statistics from the Organization for Economic Co-operation and Development (OECD) (Figure 4), there are 2.3 physicians for every 1,000 patients in Japan, a figure much lower than the OECD’s mean of 3.3. This number is the lowest among the Group of Seven (G7), which includes Japan and Western powers, and is the 12th from the bottom among OECD member countries. Meanwhile, Japan exceeds the OECD’s mean number of nurses of 9.1 nurses for every 105,000 persons in the population, ranking 13th from the top.

Fig. 4. Number of physicians in countries around the world (2015)



The quota on the number of students entering medical school (Figure 5) increased as a result of the Resolution Initiative for Prefectures without Medical Schools from the Cabinet Decision of 1973, and the quota increased to 8,280 from 1981 to 1984. However, with the Cabinet Decisions of 1982 and 1997, the quota was lowered again to 7,625 from 2003 to 2007 to prevent an excess of physicians in the future. After that, there was an obvious shortage of physicians, so the quota was increased in a regional framework in 2008 by the Cabinet Decision of 2008, and in the year 2017, the quota was 9,420 students, 1.24-fold greater than the quota in 2007 (a 1,795-student increase). However, because physicians cannot be fully active in a clinical setting until they have completed a total of 8 years of study (6 years of medical school plus 2 years of initial clinical training), the effect of the 2004 quota increase will not be realized until 2016.

A maldistribution in the number of physicians by prefecture occurred in 2010 in relation to such factors as the population, number of medical schools, number of years established, and medical school quotas, with there being more physicians in Western Japan than in Eastern Japan (Figure 6). This trend may have become even more pronounced as a result of the Great East Japan Earthquake of March 11, 2011.

Fig. 5. Annual changes in the medical school enrollment quota

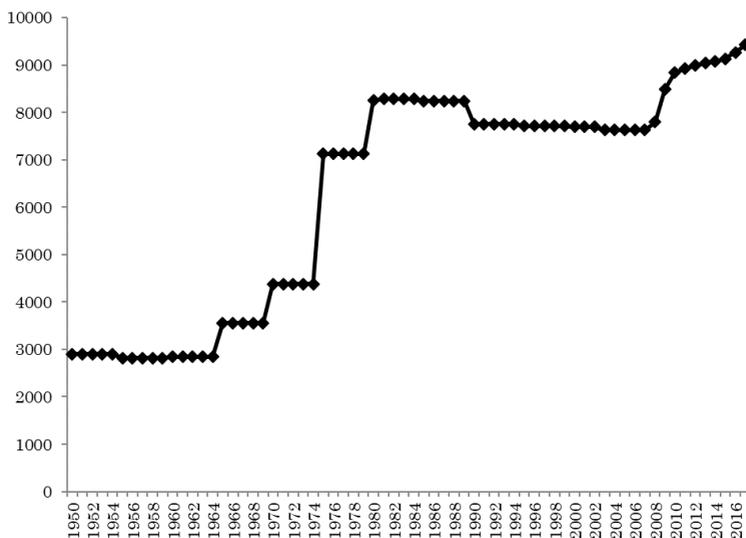
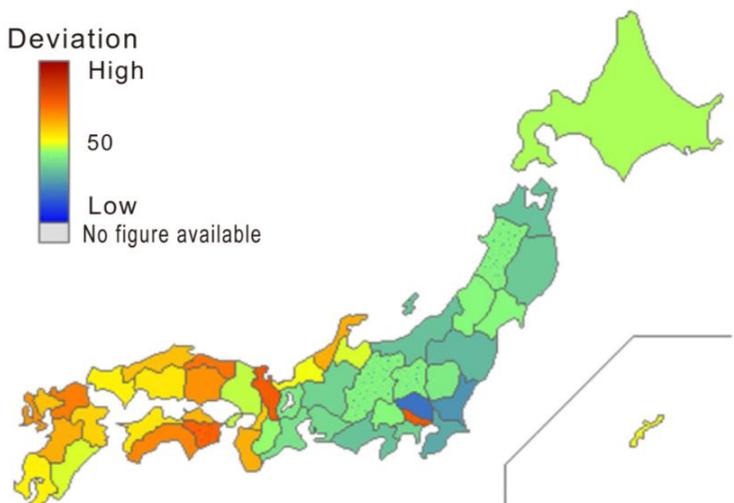


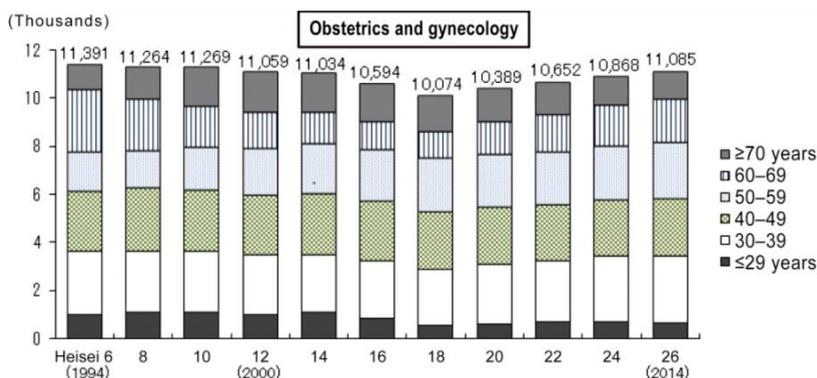
Fig. 6. Total number of physicians by prefecture (2014)



The physician clinical training system, that was made a requirement beginning in fiscal year (FY) 2004, may also be a factor in the regional maldistribution of physicians in which there are more physicians in the cities than in less populated areas. This is because many resident physicians went to clinical research designated hospitals in metropolitan areas and there were fewer younger physicians at university hospitals as a result of fewer residents there, and fewer physicians are being dispatched to regional hospitals. The quota was revised in FY 2009, and in July 2011, a study was begun on revising the physician clinical training system in such a way that would contribute to resolving the maldistribution of physicians while continuing to ensure the quality of the system. In September 2012, prefectures began using the Regional Medical Support Center, which was intended to resolve the regional maldistribution of physicians by providing career support to promote the acquisition of physicians.

Another problem, which has been dubbed a medical specialty maldistribution, is that there are regions that lack physicians in specific medical specialties, such as pediatrics, anesthesiology, ophthalmology, radiology, emergency treatment and pathology (Figures 7-10). Indeed, the number of obstetrics and gynecology specialists and surgeons have decreased despite an increase in the total number of physicians.

Fig. 7. Annual change in the number of physicians in the departments of obstetrics and gynecology (2014)



The shortage in hospital physicians is also being spurred on by the fact that many physicians between the ages of 30 and 50, who were employed at hospitals that require night work or long hours, such as on-call, emergency medicine, and surgery, are retiring to open their own clinics. Furthermore, the

percentage of female physicians is increasing each year, reaching 20.4% in 2014. Female doctors who have given birth or are raising children value a more relaxed working environment, and some aspects of telemedicine, such as diagnostic imaging, can also be performed at home.

Fig. 8. Annual change in the number of physicians in the departments of surgery (2014)

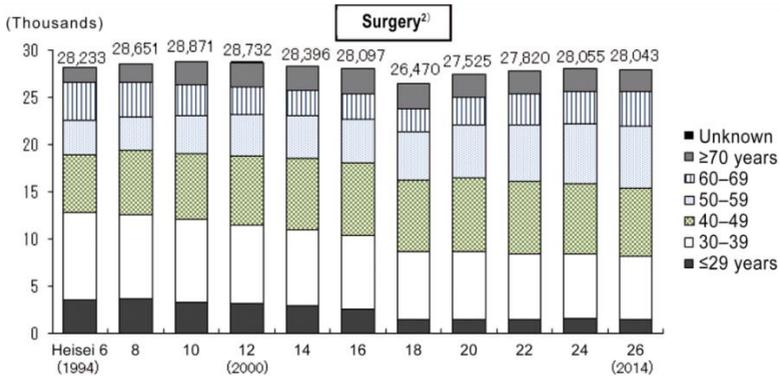


Fig. 9. Annual change in the number and mean ages of physicians working at hospitals, according to age group (2014)

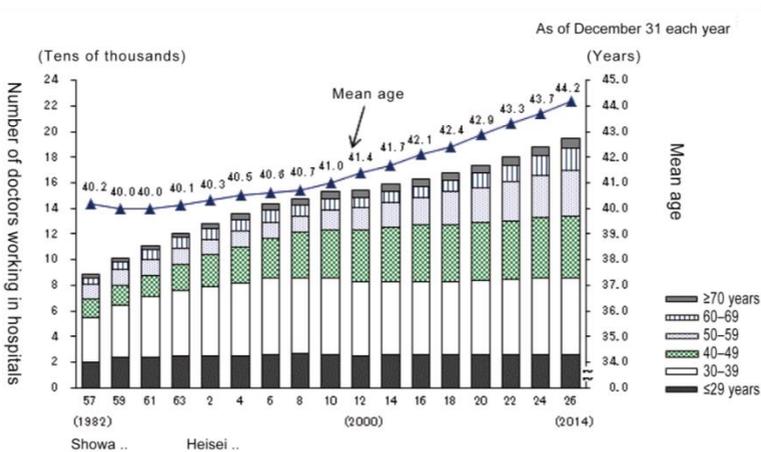
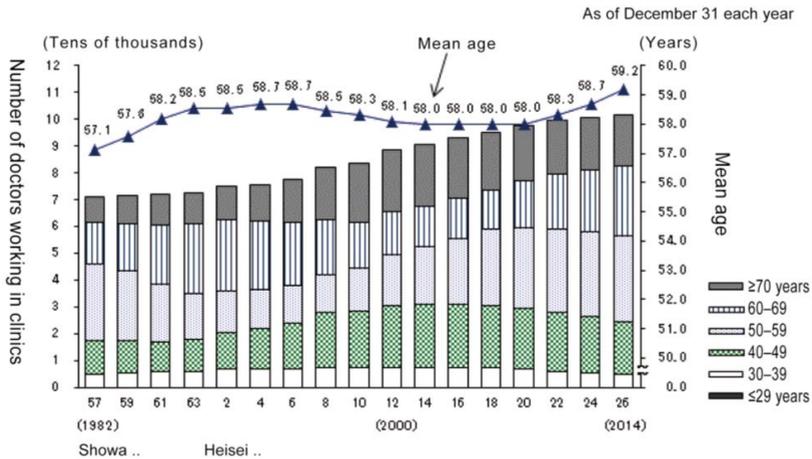


Fig. 10. Annual change in the number and mean ages of physicians working at clinics, according to age group



Less Populated Regions, Remote Islands, and Solitary Regions

Access to regional core hospitals continues to improve in mountainous regions owing to the placement and development of roadway networks. However, the rate of aging is generally higher in less populated areas, and in regions with heavy snowfall, access to medical facilities can be difficult during the winter. Furthermore, even if physicians can conduct home visits, if houses are far apart, more time is required to move between them than in metropolitan areas.

Even if the number of physicians in Japan is satisfactory in the future, it will be difficult to resolve the shortage of physicians on remote islands (Figure 11). As of April 2012, there were 418 inhabited remote islands throughout Japan. Of these, there are 305 remote islands that are subject to the Remote Islands Development Act, with the highest number being in Nagasaki Prefecture, where there are 51 such islands.

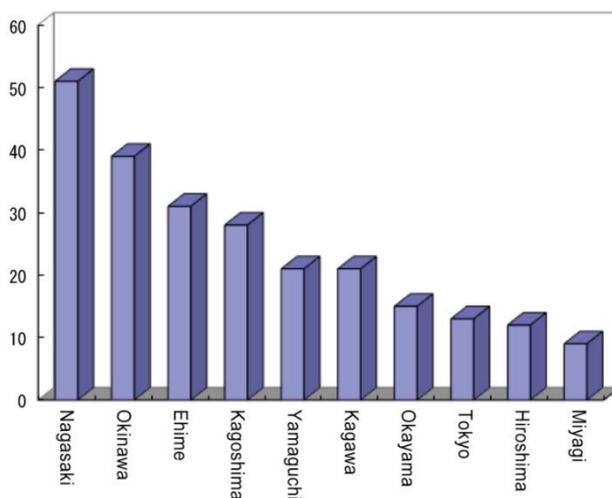
Generally, the rates of population decline and population aging increase more rapidly in remote islands than in ordinary less populated regions, making it difficult to secure physicians on these islands. On small islands, medical facilities are often nonexistent or there is insufficient equipment. The ability to transport patients by ship during an emergency is easily affected by weather conditions, and because helicopters cannot fly at night since they require visual flight, more than half of the remote islands are without

heliports. It is usually difficult for the patient him/herself to assess the urgency of a medical situation even when a rapid response is required. Therefore, the patient should make early arrangements to move to an adequate medical facility. However, it is difficult to recognize him/herself in an urgent situation.

Meanwhile, as of 2012, broadband capability is available on 96.1% of the remote islands. However, because fiber optic communication methods have not been set up on 80% of the remote islands, rapid communication is not possible. The Ministry of Internal Affairs and Communications is currently pursuing a project to develop fiber optic infrastructure, which is likely to play an important role in telemedicine in the near future when it is available. In addition, remote fetal monitoring for pregnant women is expected to be very useful in this type of environment.

Even in cities, people living alone are becoming a larger problem as the society ages. The importance of remote monitoring for safety confirmation and health maintenance is expected to increase in the future, since it creates less of a physical and financial burden on users.

Fig. 11. Inhabited remote islands throughout Japan by prefecture



Development of Medical Devices/Means of Communication

The improvement of information technology (IT) devices and communication environments has been very dramatic in recent years. Communication speed has improved markedly, and videos are now able to

be sent smoothly using popular PCs, tablets, and smartphones. In the future, technology that provides a greater sense of reality will likely be developed, such as three-dimensional videos and monitors.

Telemedicine is mainly used for interviews and visual examinations of patients at home, but electrocardiogram (ECG) monitoring technology as well as auscultation by electronic stethoscope and real-time reception of ultrasound images are becoming possible. In the near future, portable medical communication devices that can be used in place of percussion and palpation, which are currently not possible, are expected to be developed, leading to fewer quality differences between face-to-face and telemedicine consultations and enabling patients to feel confident in receiving telemedicine care.

Telemedicine Needs of Physicians

There is a large need for telemedicine as an interface not only between patients and physicians but also between physicians. With the exception of university hospitals, medical facilities with specialists from all fields are limited. Physicians often need to confirm matters regarding their patients with specialists in the given field. That is also the reason for the development of remote imaging diagnosis, in which images from techniques such as magnetic resonance imaging are interpreted, and remote pathological diagnosis, in which pathological samples obtained in surgery are diagnosed.

Visual examinations constitute a large portion of medical examinations, and in medical fields with relatively few specialists, such as ophthalmology and dermatology, telemedicine can be useful in obtaining the support of a specialist when one is not nearby. In ophthalmology, a patient can be examined remotely by a specialist operating a slit-lamp microscope, and in dermatology, an expanded display of a lesion can be depicted more clearly than would be perceived by the naked eye.

Telemedicine also has advantages for physicians who conduct regular home visits. Under the present insurance care system, if a patient who requires at least two home visits per month but whose disease is temporarily stable were allowed to utilize a home visit once per month and a telemedicine consultation once per month, time that would otherwise be spent traveling could be rolled over to the treatment of another patient, allowing more patients to be treated at home. Furthermore, the ability to share information using a cloud-based electronic medical chart would likely improve the quality of at-home care.

In emergency treatment, the ability to remotely ascertain details such as ECG monitor data and the respiratory status of the patient during emergency transport, including patient videos, means that the required treatments could be advised to the emergency paramedics more rapidly. Furthermore, in the

case of air ambulances and non-transporting emergency medical services vehicles, telemedicine can be used for remote support of the emergency physician or for preparing to receive the patient, which can be expected to improve the patient's vital prognosis.

Current Social Significance of Telemedicine and Future Outlook

The current social significance of telemedicine in Japan is summarized in the three following points:

1. Supplementary and non-specialist support in the many regions affected by the maldistribution of physicians;
2. Improvement of regional medicine in terms of at-home medical care, emergency treatment, and preventive medicine such as remote monitoring and remote lifestyle advice, which require real-time information sharing between medical professionals such as physicians and nurses;
3. The improved user-friendliness and medical efficiency for patients and medical professionals as a result of the above.

In the future, new forms and methods of telemedicine are expected to be developed in response to the rapid development of IT and changing social needs. For telemedicine to achieve a solid social standing, it must be made to respond to the needs of society, and its efficacy and safety, including information security, must continue to be checked.

Telemedicine in the Medical System

Systems Related To Telemedicine

The following are examples of the public systems related to telemedicine:

1. Medical Practitioners Law (law related to medical actions of physicians);
2. Medical Service Law (law related to medical facilities);
3. Healthcare Compensation System (public financial resources for healthcare).

The following are healthcare-related public projects or facility assistance systems.

1. Facility Maintenance Subsidy for Medical Facilities (telemedicine facility maintenance project);
2. Telemedicine Practitioners Training Project;
3. Project funded by the Regional Medical Care General Assurance Fund (Hokkaido project, for example).

Regulatory reform is also playing an important role in telemedicine for reforming the existing medical system.

Discussion of Regulatory Reform and Telemedicine

With the easing of regulations on telemedicine, various activities have been conducted over the years. Recently, efforts have been made by the Regulatory Reform Promotion Meeting (Cabinet Regulation Reform Promotion Office), and since FY 2013, the Japan Telemedicine and Telecare Association has been providing support by, for example, providing various witnesses to attend hearings and meetings.

The document entitled “Third Report on Regulatory Reform—Toward a Diverse and Vibrant Japan” that was issued as a result of the FY 2015 Regulatory Reform Meeting was the most impactful, explicitly describing the promotion of telemedicine monitoring (for example, for sleep apnea syndrome and domiciliary oxygen therapy) and clarifying the handling of telemedicine. This subsequently prompted the issuance of the Ministry of Health, Labour, and Welfare (MHLW) Health Policy Bureau Notification entitled “Medical Treatment Using Telecommunication Devices (‘Telemedicine’)” on August 10, 2015. This notification was treated by many in the media (e.g., newspapers) as “the lifting of the ban on telemedicine.”

Regulatory Reform Promotion Meeting activities related to telemedicine continued thereafter, and the Second Future Investment Meeting of the Headquarters for Japan’s Economic Revitalization was held on April 14, 2017, where the promotion of telemedicine was hammered out. The guidelines for evaluating medical treatment compensation related to the use of telemedicine for lifestyle-related diseases were indicated at this meeting. The debate at the Regulatory Reform Promotion Meeting around that time is believed to have led to the July 14, 2017, notification from the MHLW Health Policy Bureau. This notification opened the possibility for providing telemedicine using social networking sites and other media and administering remote treatment for smoking cessation with no in-person consultations.

Interpretation of the Medical Practitioners Law and Telemedicine

In the 1990s, a discussion started as to whether the implementation of telemedicine was legal. Article 20 of the Medical Practitioners Law, which describes the medical actions performed by a physician, states:

“A physician who has not himself observed the patient may not treat the patient or distribute a written diagnosis or a prescription; a physician who is not himself present at delivery may not distribute a birth certificate or a certificate of still birth; and a physician who has not himself performed an autopsy may not distribute an autopsy certificate.”

In the discussion of the legality of telemedicine, there were more than a few opinions expressed that telemedicine presents a legal conflict associated with the phrase “*has not observed*”, because in telemedicine, the physician does not meet the patient in person.

In response, the Ministry of Health and Welfare (currently, the MHLW) made the interpretation that telemedicine does not present a conflict as long as it is administered appropriately. This interpretation was represented as a notification from the Health Administration Bureau of the Ministry of Health and Welfare, but it was subsequently called the “Article 20 interpretation notification,” and it began a long period of debate on the interpretation of the Medical Practitioners Law. The language in the notification showed that the Ministry of Health and Welfare at the time was being careful about the implementation of telemedicine, for example, by specifically denoting the remote islands/land to which the notification applied. Telemedicine developed slowly after this notification was issued, so it was revised on March 31, 2003, to include specific examples of who and what the law applied to, in order to accelerate the development of telemedicine. Until this point, the only guidelines for telemedicine were those established by the MHLW.

In approximately 2008, the Ministry of International Affairs and Communications and other bodies became involved with promoting telemedicine. With awareness spreading that the MHLW regulations were stifling development, the Ministry of International Affairs and Communications and the MHLW collaboratively held the “Meeting on Strategies to Promote Telemedicine,” at which the notification was criticized for dampening the desire to develop telemedicine, leading to a second revision of the notification, issued on March 31, 2011. This revision explicitly stated that the number of diseases for which the law was applicable increased from seven to nine and that there were no restrictions on applicable regions and diseases for telemedicine that was appropriately implemented. After the 2011 revision, questions regarding the application of telemedicine subsided, but telemedicine was slow to catch on throughout the country. Considering that slowness as the “bedrock regulation” of the MHLW, the matter began to be handled in the Regulation Reform Meeting of the cabinet in 2013. The series of events leading up to this point is as previously described. Therefore, in each document, such as the Regulatory Reform Declaration, only the fact that the March 31, 2011, notice had not gained enough publicity was mentioned, without any language mentioning legal regulations.

The second revision of the notification in 2011 did not require a discussion on easing regulations further, a reflection of the fact that the notification content that had stifled the growth of telemedicine had been largely eliminated. After March 31, 2011, the Medical Practitioners Law never suppressed the progress of telemedicine again. The fact that telemedicine still did not take off is believed to be due to insufficient financial resources, such as treatment compensation, or its incompleteness as a clinical method, rather

than legal restrictions. The change in the interpretation of the Medical Practitioners Law had absolutely no effect on promoting the development of telemedicine as a clinical method. With the 2017 notification, it even became possible to use media believed to have vast qualitative restrictions as a means of transmitting medical information, such as social networking sites, so it was no longer possible that legal restrictions were hindering telemedicine.

As a legal issue, telemedicine could also have been subject to the Medical Service Law, but there is currently no specific information indicating that the Medical Service Law became an obstacle that hindered the development of telemedicine.

Current Treatment Compensation System

Stable public financial resources are essential for providing continued medical treatment to society. The Healthcare Compensation System lies at the core of this.

There are two important elements in the Healthcare Compensation System: a system of deciding the amount of compensation and criteria that establish conditions, such as facility conditions, that are required for the payment of compensation. Whether telemedicine corresponds to any of the items in the compensation system is a large issue, but another large matter is the facility conditions under which compensation can be paid. If the facility conditions are too restrictive, fewer facilities are able to utilize telemedicine; but if the facility conditions are too broad, it becomes difficult to guarantee aspects such as the quality and capability of providing care.

Not violating the Medical Practitioners Law and the ability to request healthcare compensation are separate matters.

The problem of the Medical Practitioners Law was resolved by the MHLW notification that legitimized telemedicine.

Compensation is granted when its necessity and efficacy have been clearly demonstrated and it has been approved through discussions held by the Central Social Insurance Medical Council. Healthcare compensation is granted according to competition between candidates, and the candidate deemed to have the greatest social need for the compensation is selected. The results of the deliberation of the Regulatory Reform Meeting are not directly reflected in how healthcare compensation is granted. There are also no funds for the expense of introducing telemedicine devices nor a fund for industrial development. If the clinical effect of the treatment cannot be demonstrated, it is not considered for compensation.

Medical activities are allowed to be conducted only at facilities with the necessary capabilities. There are also capability/facility conditions with respect to telemedicine, such as guidance by a specialist. These are the facility criteria for requesting healthcare compensation. In addition, there are specific

conditions for requesting diagnostic imaging management for teleradiology, and facilities that do not meet those conditions cannot make such a request. In other words, just because the facility criteria are met does not mean that telemedicine will be allowed to be implemented. There are commercial technology companies that provide remote interpretation services but because these companies are not medical institutions, they do not meet the facility criteria; therefore, compensation for imaging diagnostics management cannot be requested, even if the diagnosis was made by a specialist certified by an academic society.

Public Guidelines

Although the Medical Practitioners Law, the Medical Service Law, and Healthcare Compensation System are not rigid systems, there are guidelines issued by government agencies as standards based on those systems. Information quality, information security, and privacy protection have been important issues for medical information systems since the 1990s when telemedicine began to gain popularity. The “Guidelines on Safety Management of Information Systems,” which addresses those issues, continues to be revised by the MHLW, and as of the writing of this manuscript, the most recent version of these guidelines is the fifth version. There are also similar guidelines on protecting personal information for small-scale healthcare providers to follow. In particular, small-scale healthcare providers tend to be more relaxed about information security and privacy, and they are expected to conduct operations by referring to these guidelines.

In the realm of clinical research, many scandals have occurred at universities and companies. Therefore, guidelines on research ethics and managing conflicts of interest are being strengthened, and compliance management becomes stricter each year. Presently, data gathered in clinical research cannot be published unless these guidelines are followed. The most recent guidelines related to clinical research ethics must be followed in order to publish articles in the Japanese Journal of Telemedicine and Telecare or to present at academic conferences.

Although not a regulatory authority, the Japanese Telemedicine and Telecare Association has provided some of the materials related to medical ethics compiled and recorded by the Japan Medical Association.

Future Outlook

The problem of the Medical Practitioners Law, involving telemedicine, was essentially solved. In the future, a lack of clinical evidence and a shortage of practical support are likely to become factors that inhibit the development of telemedicine. Also, even if a legal problem were to arise, if a sudden appeal

for regulatory easing were made, there is a risk that the areas requiring substantial improvement would not be affected by such changes. It is critical to find a more realistic way of improving the situation, by first consulting with the relevant government agencies and departments. Although there are no specific problems related to the Medical Service Law at present, it would be preferable to use this method to respond to any problems that arise in the future.

The principal financial resource problems pertain to the Healthcare Compensation System, and the same procedures used to expand healthcare compensation for normal medical activities (e.g., submitting proposals based on collected evidence and expected points) should be implemented to address these problems. In addition, when considering financial resources other than those for conducting telemedicine, integrated community care project proposals based on regional comprehensive healthcare allocation funds should be considered. If there is an issue with a specific prefecture, fund commercialization is easier. For example, the Hokkaido government has implemented projects that actually put in practice telemedicine in emergency support.

Telemedicine guidelines are topics for future consideration. Inevitable problems related to the popularization and development of telemedicine, such as guaranteeing its quality and ensuring practitioner and facility compliance as well as medical safety, have not yet been considered. In the future, it is important to consider guidelines established in cooperation with bodies outside the Japanese Telecare and Telemedicine Association.

Telemedicine and Popularization Strategy

Outlook on Popularization Strategy

Overview of Popularization Strategies

Thus far, various measures have been implemented to promote the popularization of telemedicine, for example, research subsidies, validation projects, regulatory reform, law revisions, and the granting of healthcare compensation. While telemedicine has gained popularity in some areas, in many other areas, it has not caught on to the degree expected. There are specific factors underlying the slow development of telemedicine that make it difficult for the technology to spread, and the existing popularization strategies are believed to be inadequate. Both the circumstances and required methods for the use of telemedicine differ depending on the type of telemedicine, so a popularization promotion measure based on a uniform policy would be inappropriate. The capability to devise individual

popularization strategies is also lacking, and the situations for these strategies have not yet been identified.

Is Telemedicine Becoming Popularized?

It is essential to grasp actual conditions in order to plan popularization strategies, but actual condition surveys are very difficult to conduct. The authors estimate the annual number of cases in which telemedicine is used to be over 1 million for teleradiology, several tens of thousands for cardiac pacemaker monitoring, and several thousand for telepathology.

According to a general condition survey based on statistics from the MHLW, there are approximately 3,000 facilities implementing teleradiology and approximately 1,000 facilities implementing telepathology. These are rough estimates, which may be insufficient for determining the state of the popularization of telemedicine. However, there has been progress in the popularization of teleradiology and telepathology, with many instances of their use and many facilities using them, and it is even possible to request healthcare compensation for them. Further growth is expected in these areas of telemedicine in the future.

Statistics data from the MHLW indicate that 562 facilities are implementing remote home care different from the two types listed above. While this figure is believed to include facilities that implement cardiac pacemaker monitoring, the other treatment activities to which it refers are not defined. Therefore, this figure has not captured the number of patients and the number of implementing facilities, and it cannot be used to determine the actual state of telemedicine implementation. As for the various types of telemedicine not included in the MHLW statistics, such as telemedicine used in emergency support, ophthalmology, and dermatology, only the cases described in reports and presentations have been captured; therefore, appropriate popularization measures for these applications of telemedicine cannot be devised. The goal of popularization measures is for telemedicine types other than teleradiology and telepathology to meet medical needs and be self-sustainable from a financial standpoint as well.

Progress of Telemedicine Popularization Strategies

Telemedicine research began prior to the 1980s, and the types of telemedicine requiring support via popularization promotion have also changed with the times. From the 1990s to the 2000s, scientific research grants and system validation projects were important measures for promoting the popularization of telemedicine. Many telemedicine researchers applied to various government agencies to conduct validation projects, and trials were conducted in each region.

Telepathology and teleradiology rapidly transitioned from the validation testing phase to the clinical application phase. In telemedicine generally, the Ministry of Economy, Trade, and Industry and the Ministry of Internal Affairs and Communications conducted many system validation projects from the 2000s to the 2010s. New efforts including advanced medical information system and communication system building were tested in regions with the aim of having these applications take hold. Some of the cases can be referenced on the web pages of the relevant government agencies. Furthermore, quite a few facilities introduced teleradiology and telepathology equipment with assistance from the MHLW. As a result of the promotional measures during this period, the use of teleradiology and telepathology was no longer rare, and with the introduction of regional-alliance electronic medical charts in various regions supported by regional healthcare revitalization funds, domestic system validation projects came full circle and were believed to have played a central role in the popularization promotion measures implemented by the country.

Type of Telemedicine Popularization Strategy

The following are various measures to promote the spread of telemedicine, and each are considered.

1. Validation projects

Validation projects involved conducting trials for expected telemedicine applications and validating feasibility and usefulness. As mentioned previously, national system validation projects played a definite role in promoting the popularization of telemedicine. As of 2017, validation projects at the national level could flourish anew in specific districts in response to regulatory reform such as National Strategic Special Zones. However, there is a concern that simple trials will amount to no more than case collection and thus be unable to sufficiently clarify validation issues or contribute to subsequent development. Furthermore, unless the validation projects are highly novel, they will not differ substantially from previous validation projects, and the necessity of pursuing them on a national level will remain unclear.

In the future, the efficacy of telemedicine in resolving problems in each region must be verified, and we believe that validation projects must be conducted on the prefectural or municipal level. However, the barriers are high owing to the strictness of regional financial resource allocation. Academic societies and others must appeal to regional governments regarding the necessity of validation projects at the regional level.

2. Research funding

Funding for researchers in universities and other research institutions to carry out studies on different topics has been received from sources including the Ministry of Education, Culture, Sports, Science, and Technology (MEXT), the Japan Society for the Promotion of Science (JSPS), and the MHLW. Although the costs of research on systems technology and clinical studies are not directly linked to popularization, such studies have played a similar role to validation studies in the regions where they are carried out.

Progress is being made in reducing the cost of equipment and communications services, improving their performance, and commercializing devices of various types, and as there is now less need for the injection of government research funding into studies of systems technology, studies other than studies of highly advanced technology can no longer receive funding. High-level clinical studies are also underway throughout the healthcare sector, and it is now more difficult to obtain funding even for telemedicine studies other than those on advanced medical topics.

Since the Japan Agency for Medical Research and Development (AMED) was established, applications for research funding and its management have been transferred from MEXT, the Ministry of Economy, Trade, and Industry (METI), the Ministry of Internal Affairs and Communications (MIC), MHLW, and other organizations to the unified jurisdiction of AMED. The trend for funding to be focused on advanced studies is gathering momentum.

Telemedicine cannot be described as an advanced medical field, and evidence is lacking. Although gathering evidence from everyday clinical practice is essential, the fact that projects other than those eligible for government funding as advanced studies are in a weaker position is a major problem. Because government-level research funding is aimed at advanced fields, most telemedicine studies must be increasingly dependent on local sources. It must actively be made clear that prefectural and municipal authorities will have to play a major role in order to secure research funding.

3. Health insurance reimbursements

The most effective measure for popularizing telemedicine would be to enable medical procedures carried out telemedically to be reimbursed via health insurance. Research projects and other activities to make this reimbursement a reality are central to activities encouraging its popularization. Realizing health insurance reimbursements is not the

start of popularizing telemedicine, but its goal. Activities to make this a reality should be prioritized.

4. Fund for Comprehensively Securing Regional Health and Long-term Care

Although it will be difficult to make reimbursement via health insurance a reality, it may be possible to use this fund as a source of funding for important medical procedures in applicable regions. Projects to apply it to telemedicine have already been launched in some prefectures. As there are yet no established criteria for the nature of projects to be backed by the fund and no set application procedure, it will be necessary to proceed through feasibility studies and exploratory projects. Rather than waiting for someone to solicit projects publicly, the first step must be to proceed by communicating with local government officials. The burden of the various coordination tasks at the regional level is unavoidable.

5. Project grants

Grants such as local and prefectural government subsidies to small and medium-sized companies can be used to fund initial costs and some equipment costs as local development rather than research. Depending on the company, it may be possible to apply for facilities investment in hospitals and clinics and some of the start-up costs for telemedicine projects. It will be necessary to gather information on project grants, flexibly consider how to implement projects, and draw up business plans consistent with grant schemes, and it is important to look beyond scientific grants-in-aid and validation studies. The MHLW has long continued to give 50% grants for telemedicine equipment, and not a few institutions have used this to install teleradiology and other equipment.

6. Human resource development

One major issue in telemedicine is the lack of personnel with the necessary knowledge and experience. Although the emphasis tends to be placed solely on systems technology, knowledge and experience in a wide range of other areas are also essential, including frameworks, invoicing for reimbursement via health insurance, management systems (team medicine procedures), and collaborative arrangements among institutions. In the current situation, with procedures and knowledge yet to be established, staff capable of devising and launching new procedures for themselves are needed. If staff are capable of nothing more than operating the equipment, this has no future.

Procedures for human resource development are also still undeveloped. Telemedicine is not taught at the university level in medical schools or nursing colleges, and there have been no studies of curricula or other methods of medical teaching. At present, it is only mentioned in lectures on subjects such as medical informatics. There is neither a qualification system nor a professional organization, and no continuing professional development for practitioners. The only available training is the MHLW's Training Project for Telemedicine Practitioners. Since its launch in the 2014 academic year, the Japan Telemedicine Society has held three meetings. Although its efforts are preliminary, it is continuing to devise and improve a curriculum aimed at people working in the field. The details will be described elsewhere.

7. Insurance

If telemedicine becomes an everyday clinical procedure, preparations must be made to deal with a range of risks associated with the performance of medical procedures, most importantly misdiagnosis. Should claims be made for damages, this might hinder the promotion of telemedicine. Guarantees that telemedicine can be practiced with peace of mind may not be obvious, but are still essential to its popularization.

For teleradiology, which is already widely used, associations of commercial users have set up group indemnification systems. For other areas of telemedicine, consideration should be given either to insurance for individual doctors or to the setting up of indemnity schemes by associations.

8. Government support measures

Establishing a management framework for telemedicine requires knowledge and experience of areas other than medicine, such as how to deal with doubtful interpretations of applications for reimbursement via health insurance, demands for refunds from health insurers, checks by regional health bureaus and health centers as medical procedures, and applications for grants for equipment installation. In many cases, local federations are formed, and organizations such as regional medical relationship and information partnership councils are set up when this work is carried out collaboratively between institutions. Projects funded by sources such as the Fund for Comprehensively Securing Regional Health and Long-term Care are also set up as regional initiatives. If new healthcare reimbursement becomes necessary, it will be important to devise reimbursement items that are not restricted by those of the current framework when designing clinical studies.

These activities pose a high barrier to medical staff who lack knowledge, experience, and skills in dealing with the bureaucracy, but with the assistance of government officials, it will be possible for telemedicine to become established in local institutions. Conventionally, government assistance has been viewed in terms of the creation of national-level frameworks (such as deregulation and the addition of reimbursements via health insurance) and financial assistance in the form of validation projects and funding. For telemedicine, however, it is not the case that it will simply develop of its own accord provided that systems and other frameworks are put in place. Thus, there is all the more need for in-depth government support at the local level.

9. The normal mode of interaction at the national level

The future development of telemedicine in all its forms will gradually take off as a result of measures such as persuading the Central Social Insurance Medical Council to add individual additional reimbursements and consultancy fees and engaging with national-level measures to control important diseases (such as the MHLW Health Service Bureau Working Group on Cerebral Stroke, introducing Telestroke).

Future Popularization Measures

Eligibility for existing national-level popularization measures is restricted to the frameworks for advanced research or core projects. The resulting problems are not restricted to the total amount of funding available and the number of projects involved. The replacement of the personnel chiefly responsible for support measures is already underway, and the role of the national government is contracting, both in terms of the shift in eligibility for research funding and the decrease in the number of national-level validation projects. Many local governments have yet to take on an adequate role. At the municipal level, the impetus for support is even weaker.

Prefectural and municipal governments differ from the national government in terms of their capacity for planning and execution as well as in their ability to take responsibility. To enable the establishment of support frameworks by prefectural and municipal governments, it will be important for medical associations and other organizations to consider questions such as what sort of measures to promote the popularization of telemedicine are needed and what role the government should be asked to play, and to engage in more in-depth communication about local government and its role. Similarly, to community-based integrated care, measures to promote research, develop business, and support the installation of equipment in local communities should be envisioned.

As a new direction at the national level, our future strategy for encouraging the popularization of telemedicine should shift away from the promotion of highly novel research and instead focusing on everyday management measures (persuading the Central Social Insurance Medical Council to increase reimbursements via health insurance, participating in working groups by MHLW bureaus, and assisting with strategy development) to promote it as an established, that is, routine, method of healthcare.

Accumulating Evidence and Verifying Efficacy

The Need to Accumulate Evidence

There is little information showing how effective telemedicine is and for which subjects. The number of randomized control trials (RCTs) and other robust clinical trials has increased, but there have been few findings that clearly show the public the efficacy of telemedicine. Although media have been increasing their reporting on “developments in telemedicine,” caution is needed because of the lack of quantitative, verified information. Administrative officials often cite the lack of such information in opinions as to why telemedicine cannot be included in regional medical policies.

There is justification for this state of affairs. Telemedicine technology has only become widespread and subjected to clinical trials in the last decade or so. Previously, most research studies focused on technological development, and few researchers could conduct clinical trials. Technological development created opportunities to obtain limited amounts of clinical information, through surveys of patients who had experiences with telemedicine, for example. There have been calls to promote policies applicable to telemedicine, so it may be understandable that official expert panels express the view that “compensation for medical services should be based on QOL assessments.”

To justifiably promote telemedicine in terms of policies and in society, it must be shown—impartially and quantitatively—to be clinically effective, safe, economically beneficial, and suitable for patients’ needs. This is the evidence that is needed, and without it, the value of telemedicine cannot be compared to other beneficial medical practices. If telemedicine is forcibly promoted without this basis, the public will view it as undeserving of endorsement. With social welfare costs rising dramatically, efficiency is essential. Promoting medical practices that have not been shown to be effective or economically viable is considered unthinkable.

Medical care providers are trained as students to be aware of the importance of gathering evidence; further, they are educated in methods for doing so. However, engineers and businesspeople involved in telemedicine do not have a basic understanding of evidence. Telemedicine is still developing as a

means of providing medical care, so if even care providers lack important basic information, essential questions will not be raised.

What Is an Evidence?

It is often said, “To provide compensation for telemedicine, evidence is needed that shows it is more effective than comparative medical practices.” The authors have offered similar explanations at hearings and other venues since 2008. If telemedicine is not shown to have clinical superiority, safety, and economic advantages over current medical practices, then setting compensation for telemedicine should not be on the agenda of the Central Social Insurance Medical Council (CSIMC). Discussions of evidence to date have focused on “adding new items for medical care compensation,” considering only the verification of clinical efficacy through controlled clinical trials. In the effort to add new items for compensation, this condition will not change.

Yet, there has been little awareness of issues that should be studied outside of new compensation items. One such issue is evaluating whether the scale and efficacy of telemedicine is commensurate with existing medical practices. Surveys are needed to investigate the number of patients, out of the total, who are treated with telemedicine, how many times telemedicine is performed, its duration and scope, the various clinical departments and practices involved, and the number of times or the rate at which it needs to be performed to be effective. These issues have yet to be discussed at the Regulatory Reform Promotion Council or the CSIMC. Sufficient research has not even been reported to the Japanese Telemedicine and Telecare Association (JTTA). Naturally, research results do not exist for factors such as how telemedicine changes the number of patients in a region, how patient movements between secondary care settings change, or how mortality and prevalence rates change. In other words, there is a lack of quantitative information on telemedicine.

It is important to understand the state of healthcare provision systems and promote policies in areas where there are high social needs. Stated differently, the clinical efficacy of telemedicine should not only be examined as a separate method of medical care, but in terms of how it is being implemented in society.

It should be noted that improvement will not be accomplished by revisiting surveys of institutions that provide telemedicine, which were frequently performed in the early stages of telemedicine research, or by conducting surveys among all institutions. Simply asking an institution, “Do you provide telemedicine?” will not capture how it is being implemented. The Ministry of Health, Labour, and Welfare is already collecting these statistics. What is needed is more reporting from institutions that provide telemedicine in areas

regarding how often it is performed and for which diseases or medical conditions.

The State of Evidence (Japan, Overseas)

Overseas journals (Telemedicine and e-Health, Journal of Telemedicine and Telecare, and specialist journals) have published a great deal of clinical evidence, as well as systematic reviews and other reports. In contrast, only a few controlled trials conducted in Japan have been reported, and systematic reviews are even more rare. There is no prospect for a systematic review that only references domestic research. When public institutions request evidence, they sometimes ask for evidence from overseas because of the poorer quality and small number of Japanese studies.

More clinical trials on telemedicine are being conducted to meet the demand for high-level evidence. A second survey of scientific research by the health ministry found that trends have shifted from research on systems and technology to clinical studies. A number of clinical trials on telemedicine have been registered with UMIN-CTL, which indicates that more clinical evidence is coming. After the health ministry issued a memorandum on August 10, 2015, the number of interested medical care providers increased markedly, and more doctors are getting involved in surveys and studies on areas outside of systems and technology. It is hoped that these trends will continue to develop.

Telemedicine Principles, Efficacy, Evidence

1. Principles of telemedicine:

Strategies can be clarified by selecting endpoints based on therapeutic mechanisms, groupings, and other means. According to a health ministry policy promotion survey, the following two principles have been identified.

- *Remote provision of instructions and guidance based on highly specialized knowledge or implementation authority (prescribing, etc.)*

Methods are thought to exist that can achieve equivalent effects, even in the absence of a specialist. This principle holds that by having a specialist instructing a non-specialist remotely, the non-specialist can provide a diagnosis and treatment plan at the same level of capability as the specialist. On the patient side, a doctor may give instructions (e.g., prescribing) to a nurse or other non-doctor and anticipate the same level of medical care as that which would have been provided by the doctor.

- *Early intervention made possible by frequent observations performed remotely*

Monitoring of at-home patients is performed by the frequent observation of biological and other information that is communicated remotely, which can prevent conditions from becoming critical, reduce re-hospitalizations, and increase therapeutic effects. If the disease is not severe, the objective may be to keep blood pressure, HbA1c, and other vital signs stable (thereby preventing exacerbation). With severe diseases, expected effects include extending the interval between hospitalizations or reducing the number of days spent in the hospital per year.

2. Clinical research (1) instruction, guidance:

The target of comparative clinical verifications is not to compare face-to-face care with telemedicine performed by doctors of the same skill level. This kind of study would not show telemedicine to be superior. Equivalence (non-inferiority) would be the best possible result. It may be difficult to understand, but if outcomes were better with telemedicine, the indication would be that the patient would do better if the doctor did nothing (an abnormal result). Comparing doctors of the same skill level is meaningless because if such doctors could be secured, telemedicine would not be necessary. The two areas for assessment are as follows:

- *“Face-to-face care by a specialist” and “face-to-face care by a non-specialist instructed remotely by specialist” (i.e., telemedicine).*

With non-inferiority being the best possible result, this involves showing that even non-specialists can, with instruction, provide specialized medical care. If non-inferior results can be obtained by limiting medical practices, telemedicine can be performed under “limited” conditions.

It is meaningless to perform such trials with teleradiology. Because interpretation is already performed on remote monitors, even within the same institution, there is no difference in how the process is carried out. It is only meaningful to compare (economic) efficiency.

In telepathology, the use of virtual slide equipment does not apply to this kind of trial. Equivalency evaluations

between remote and non-remote care can be performed for microscopic diagnoses for the monitoring of diagnoses.

- “*Face-to-face care by a non-specialist not instructed remotely by a specialist*” and “*face-to-face care by a non-specialist directed remotely by a specialist*” (i.e., telemedicine).

If the therapeutic outcomes were to improve when non-specialists receive instruction, the efficacy of telemedicine would be verified. If there is no difference in outcomes—regardless of whether instruction is provided, the indication would be that the therapy does not require instruction (telemedicine).

Even with teleradiology and telepathology, equivalency comparisons can be performed, if the care capacities of the supporting institution can be assessed. However, if diagnosis by a specialist has clear value, there may be little need to conduct a trial. It is more important to evaluate the diagnostic capabilities of doctors who diagnose radiographs or make pathological diagnoses.

3. Clinical research (2) early intervention from frequent observations:

- *Discovering and treating (intervening) exacerbations early through monitoring*

Patients are divided into a monitoring group and non-monitoring group. If biological measurements (blood pressure, HbA1c, etc.) that serve as assessment indices are maintained or improve in the monitoring group, the effectiveness for physical management would be verified.

If the discovery of abnormalities and early intervention through monitoring reduces the number of re-hospitalizations, days spent in the hospital for re-hospitalization, or the content of therapy, the benefits would include reducing the burden of hospitalization on patients with severe chronic diseases and lowering medical costs.

Data and inquiry responses can be sent to and shared among medical institutions using biological monitors (e.g., sphygmomanometer) with or without

telecommunication functions in the form of personal health records (PHRs) or other formats.

- *Extending intervals between hospital visits through monitoring*

Extending intervals between hospital visits by monitoring patients with chronic diseases is one of the beneficial effects of telemedicine. Biological measurements of physical conditions (including the parameters of cardiac pacemakers and CPAP machines for sleep apnea syndrome) can be kept stable through remote instruction and without the patient coming to the hospital. Further, the “duration of safety” can be used as evidence and tied to factors such as the number of requests made to departments in charge of managing chronic diseases during the period when patients do not come to the hospital.

4. Fundamental evidence

Many fundamental aspects of telemedicine are unclear, such as the extent to which medical practices can be performed. In addition to measuring therapeutic effects, fundamental aspects such as the number of people engaged in telemedicine, the proportion of certain medical practices performed through its use, the duration of continuance per patient, and the number of times or number of days it is performed need to be studied.

How appropriate telemedicine is remains unclear. Even if it is unclear whether once a month is enough, negative assessments that it is performed too infrequently are sometimes given. If it is unclear how much is appropriate, it is also unclear whether or not measures for disseminating and promoting telemedicine are needed. Unnecessary effort may be being expended on promotion. Macroscopic data is needed that captures aspects such as the proportion of patients examined in regions where telemedicine is provided, changes in patient behavior, changes in regional mortality rates, and medical spending. More parties are introducing telemedicine, but because it is difficult to grasp the state of affairs, it is impossible to show the basic dynamics. It is also essential that relevant surveys be stratified such as by medical practice (clinical department, disease, organ, etc.) or by patient severity. As an example, the authors performed a multicenter study on telemedicine for at-home patients from December 2016 to March 2017 as part of a health ministry project for policy

promotion surveys. This study showed that care provided by video calls resulted in a large number of prescriptions being issued. This study represented the first opportunity to obtain basic data on telemedicine.

The Health Ministry's Health Insurance Bureau has indicated that the reduced burden on staff at medical institutions should be included when considering compensation for telemedicine. In surveys of the number of times telemedicine is performed, it is also important to investigate staff workloads and identify whether the burden on staff is reduced commensurate with the effect on medical care.

Collecting Evidence Going Forward

We have finally reached the stage whereby clinical research projects are moving forward. The matters discussed above have merely come to light. As clinical research accumulates, it should expand knowledge regarding new study designs, clinical research methods, and assessment indices. It is important that the JTTA function as a command post for macroscopic research strategies that can be used as guideposts for researchers investigating methods for accumulating evidence and targets of study. In addition, it would be advantageous for the JTTA to move in concert with a health ministry policy promotion survey that began creating a roadmap for research targets in fiscal year 2017.

Clinical Guidelines for Telemedicine

Current State of Telemedicine Guidelines

There is not much to say about how clinical and other guidelines are being dealt with and studied in the field of telemedicine. Guidelines specifically for telemedicine that have been published are either operating or ethical guidelines. None has been created for specific diseases or medical practices. The Japanese Heart Rhythm Society did not create specific telemedicine guidelines for cardiac pacemaker monitoring, which is becoming more widespread as a therapeutic method, though it has released several materials in the form of "guidelines on device therapy." In this part, in addition to discussing clinical guidelines, we consider how best to create various types of guidelines.

How to Think About Guidelines?

There are clinical guidelines that describe therapeutic methods for specific diseases, operating guidelines that describe basic therapeutic and diagnostic procedures and important points, management guidelines that address areas such as privacy and information security, and guidelines on medical ethics.

Guidelines on medical safety and quality should be part of the operating guidelines.

Because telemedicine is not yet fully understood by the public, clinical guidelines should not only provide medical care providers with a reference for selecting therapeutic methods, but they should also describe what telemedicine could do for particular diseases from the standpoints of patients and society.

Clinical Guidelines

Minds, a project for promoting the spread of evidence-based medicine (EBM) run by the Japan Council for Quality Health Care, defines guidelines as follows on its home page (referenced from the original).

A document that considers evidence on clinically important medical practices from systematic reviews and general assessments, the balance between advantages and disadvantages, and other factors to offer what are considered optimal recommendations to support the decision making of patients and medical care providers (edited by Tsuguya Fukui and Naohito Yamaguchi. Minds Handbook for Clinical Practice Guideline Development 2014. Mlgaku-Shoin Ltd. 2014.3)

Because clinical guidelines are created based on clinical evidence, the lack of evidence prohibits the creation of guidelines for telemedicine with sufficient content and standards. Moreover, because telemedicine represents only some of the therapeutic methods for a given disease, the question of whether clinical guidelines are needed only for telemedicine or for each subject area deserves careful consideration. Clinical guidelines that also cover telemedicine can be created under the auspices of the relevant field's clinical association, and cooperation among associations (or fields) could help improve the content of guidelines. Limited guidelines, which only describe important points for using telemedicine in the treatment of a particular disease, should also be studied.

Guidelines developed by the JTTA on using telemedicine for home care can be considered a midway point between operating guidelines and clinical guidelines. Even different therapeutic methods may have commonalities regarding telemedicine methods and operations. Clinical and operating guidelines that cover multiple care should also be studied. Such guidelines are being developed for teleradiology and telepathology.

The lack of evidence on telemedicine has been pointed out in terms of the development of clinical guidelines. Accumulating evidence requires not only clinical trials, but also descriptions of the care methods used. Expressions such as “perform observations via video call and provide instruction” are

insufficient. Observation targets, assessment criteria, and instruction content need to be clarified; additionally, the evidence that can be currently obtained must be described. The small amount of information that has been accumulated thus far means that low levels of evidence are unavoidable. Therefore, guidelines may need to be created based on descriptive research (e.g., case reports) or expert opinions that are not based on patient data. It is essential that any guidelines describe these conditions clearly.

Although this may fall outside the scope of the discussion on clinical guidelines, there is a lack of information in society on the methods, effective targets, limitations, and other aspects of telemedicine. Guidelines could be a helpful source of information for patients when selecting treatments. Thus, it is important that they be written so that patients can understand them.

Operating Guidelines

Describing the basic procedures of and important points related to treatment and diagnosis is an essential part of developing operating guidelines. That said, because the public's understanding of the methods of telemedicine is not yet mature, operating guidelines should not stop at merely describing clinical methods. More fundamental aspects need to be described, such as how telemedicine should be introduced, the knowledge and skills providers need, and considerations for regions and institutions that introduce it. There are concerns that telemedicine could hinder regional medical care, so operating guidelines should also address such concerns.

To create guidelines for medical safety and quality, basic data on incidents and accidents must be collected, and information is needed on areas such as safety management systems (risk management), measurable medical quality indices, and measurable operating systems. Methods and indices of medical safety management have already been established. These should be introduced and revised as needed to suit telemedicine. People involved in telemedicine will need to learn the basics about quality, medical safety, and the creation of operating systems. In the future, quality and safety management will be the major areas of development within operating guidelines for telemedicine.

Management, Other Guidelines

The health ministry and others have issued management guidelines covering areas such as privacy and information security. Other ministries and authorities have also issued guidelines. These guidelines are not exclusive to telemedicine, but people engaged in this field can reference them. Once the issues that are unique to telemedicine become clear, developing guidelines on these topics specifically for telemedicine should be considered.

Ethical Guidelines

There are guidelines on medical ethics, the Declaration of Helsinki, and guidelines on clinical research ethics. Telemedicine is a medical practice, so related clinical studies require high ethical standards. If the only viewpoints taken are of developing new technologies or promoting the industry, ethical missteps may occur. In particular, personnel who have not received a medical education are increasingly taking part in telemedicine, so everyone involved in telemedicine should study ethics.

Other Viewpoints on Guidelines

Going forward, medical policies are expected to expand into disseminating and developing telemedicine, and interpolating between medical provision systems. Accordingly, administrators need to be provided with a basic knowledge of telemedicine.

Guidelines provide information to patients, and they are also a good source of information for administrators and people involved in industrial promotions. In the future, some guidelines covering policy and industry may be needed for introducing telemedicine to a region, describing telemedicine services, etc.

Future Studies of Guidelines

Guidelines should not merely be developed individually from the bottom up by researchers or from within clinical fields. Having the various clinical associations study guidelines separately would also probably be insufficient. The JTTA needs to investigate the form guidelines should take and coordinate with other associations.

Additionally, it is also important to revisit and revise guidelines on a regular basis. It is expected that the field will progress rapidly, so problems could occur if old guidelines are left in place. The timing of next revisions should be decided in advance, and a reliable revision scheme should be put in place.

Ensuring Medical Quality and Safety

The State of Medical Safety in Telemedicine

Studies on safety in telemedicine are lagging behind medical developments. An onsite survey of leading institutions involved in scientific research for the health ministry failed to find any medical safety systems for telemedicine. It is thought that the following reasons are why medical safety in this area is not seen as a problem:

1. The targets of telemedicine are not critical diseases or conditions (non-emergencies).

2. Researchers who lecture on specialized medical care at universities dominate the activities. Few people who are considered high risk are involved.
3. It has not been performed very many times, so not even incidents have come to light.
4. It is overlooked because there is no system for incident reporting.
5. There is already a safety system in place for emergencies, so problems resulting from telemedicine are unlikely.
6. Telemedicine is merely one technique, thus falling under the management of clinical departments (e.g., cardiac pacemaker monitoring).
7. The fundamental factor is that there are no definitions for incidents and accidents in telemedicine.

Moreover, the following factors increase the risk:

1. There is a growing number of participants, and the number of times telemedicine is performed is also increasing. With it being performed more often, there is a high likelihood that accidents will come to light. Growth in the number of participants may be accompanied by an increase in personnel who are less cautious about risky actions.
2. Declarations about regulatory reform have expanded the interpretation of the Medical Practitioners Law, which has weakened checks on risky actions.

Telemedicine is receiving attention from newspapers, television, and other media, so if an accident were to occur, the field could be subject to public condemnation for not having a sufficient safety management system. Establishing one is therefore an urgent task.

Is Telemedicine Safe? What Needs To Be Done?

In the 1990s, when telemedicine was in its early stages, it was often pointed out that insufficient image information would lead to misdiagnoses. To avoid this, discussions at the time focused on matters such as improving image quality and increasing the speed and capacity of communication, which made industrial promotion an issue. Although the quality of images and other information has improved, accidents continue to occur in other medical practices. “Ensuring safety with technology” is no longer seen as a solution.

In the current state of affairs, care providers engaged in telemedicine are demanding evidence of efficacy, and they are searching step-by-step for the scope of practice possible, which may prevent them from entering into risky areas. Yet, there is every possibility that trials in risky areas will be conducted, which could lead to accidents. In the absence of official activities,

such as calling attention to the issue of safety management in clinical research, there is a severe shortage of methods for ensuring safety.

To date in medical safety, varieties of methods and formats have been established to address deaths and other accidents caused by patient mix-ups, surgical mistakes, drug mix-ups, and dosage errors. The health ministry's home page has information on official initiatives, and even the Japan Medical Association has published a medical safety manual.

The JTTA has begun studying the matter by referencing these efforts and considers it a societal duty to present some perspectives regarding safety initiatives. A variety of matters needs to be taken up quickly, including organized initiatives, incident reporting systems, and discussions and proposals on the risk of accidents in telemedicine.

Is The Quality of Telemedicine Assured? How Should This Be Viewed?

Because evidence forms the foundation for medical outcomes, there have been few results from clinical studies and not much can be assured at present. Besides clinical outcomes, there are varieties of indices of telemedicine, such as the prevention of dropouts from continuous treatment. The first step is obtaining information on expected outcomes (e.g., efficacy, safety, adverse events). Meta-studies and systematic reviews are important for specific therapeutic methods, but the first step is determining how much of the various types of evidence on telemedicine exists by surveying the overall state of affairs.

Sharing Information and Third-Party Mediation on Quality and Safety

It is important that individual institutions continue their initiatives on quality and safety, but this step alone is insufficient. Initiatives run by institutions need to share information on indices that can be evaluated easily by patient and region. In addition, it is essential that third parties certify the reliability of this information. The state of information shared over many years via various telemedicine initiatives indicates that it is not unusual to come across initiatives in which the state of affairs cannot be grasped and for which information is not very reliable. There are times when too much is shared and cases for which important information is not made public. It is not easy to spread activities like the Japan Council for Quality Health Care's initiative to evaluate hospital functions in society, but referencing such projects to continuously initiate third-party activities will encourage the spread of safe telemedicine practices. If this objective can be achieved, the public will demand greater access to telemedicine.

Future Areas of Study

It is important to examine frameworks for promoting telemedicine, such as subsidies for research on quality, methods of disclosing highly reliable

information on safety, and the establishment of support institutions. The JTTA should obtain assistance from personnel involved in medical safety in other fields and begin its own official investigations.

Progress and Challenges in Human Resource Development

What Is Human Resource Development in Telemedicine?

Telemedicine is the use of information technology to diagnose and treat patients. Information technology is also used in the training of health professionals and in providing support to patients and medical staff. Telemedicine is a tool for physicians with high professional skills to instruct young physicians in the same department. Although "telemedicine" tends to be seen as e-learning with video-streamed teaching materials because it provides guidance and instruction using information technology, it may be valuable when medical support is provided in Doctor to Doctor or Doctor to Doctor to each Patient and the progress of the case is recorded in medical records. In other words, telemedicine can be used in a variety of ways in clinical training—it is one of a number of medical education methods. In this area, there are some studies and case reports about the training of co-medical skills, departmental training and guidance, etc., through videoconferences. Future developments are expected.

Human resource development in telemedicine includes training personnel who implement telemedicine; those who plan, introduce, and manage telemedicine; and those who are responsible for the administration of telemedicine. This study introduces the agenda for the training of personnel responsible for the implementation, operation, and administration of telemedicine.

1. Training personnel who implement telemedicine

It is useful to provide instructions about telemedicine and practical issues in team medical care to physicians, nurses, pharmacists, etc. and to increase the facilities that can implement telemedicine. A critical path for liaison is also useful, as is documentation of the essential knowledge, procedures, and protocols for some implemented methods. In tele-radiology, tele-pathology, emergency telemedicine (e.g., tele-stroke) and cardiac pacemaker monitoring, implementation methods seem to have been established implicitly or explicitly. Some departments, for example medical offices, if not all departments, have their own specific procedures. Recommended procedures have become more common also in home care. Teaching materials that follow the clinical guidelines described in other chapters would be helpful.

2. Training of personnel to plan, implement, and operate

There are few established telemedicine methods. The implementation of telemedicine requires a range of creative work, from the development of methods to the establishment of community systems: even the work needed to implement telemedicine has not yet been developed. It is important to train personnel who can supervise implementation by organizing methods for introducing telemedicine that are based on practical examples. If such personnel are assigned to each region and promote the use of telemedicine, its dissemination will be accelerated. The efficient development of telemedicine cannot be expected if the introduction process is developed independently in each region. One way to achieve this is to develop regional implementation guidelines for telemedicine and to use them as teaching materials when providing training. Candidates for such training include managers of medical institutions, personnel in administrative departments, system engineers, and stakeholders in organizations who manage community-based care, such as comprehensive community care.

3. Administrative personnel

The personnel who plan and implement telemedicine are health professionals and staff in medical institutions. However, the implementation and management of telemedicine is often a task for the whole community, and it is difficult to achieve with the human resources of one institution only. Even projects restricted to one institution require knowledge of operational processes (for example, institutional support such as subsidies, etc.). The promotion of regional telemedicine and the operation of support system is smoother with government support; therefore, it would be desirable if more government personnel were able to provide appropriate assistance. The personnel who can promote telemedicine in the community and those who promote comprehensive community care seem to share similar characteristics.

Would It Be Possible To Teach Telemedicine in Schools of Medicine and Nursing?

Physicians and nurses do not have the opportunity to study telemedicine as part of their basic education. Telemedicine has not been fully established as a clinical skill. Further, it is difficult to establish telemedicine as a curriculum subject in medical schools where students learn basic clinical knowledge and skills because telemedicine is an administrative skill rather than a direct clinical skill. Even if it is established as a curriculum subject, telemedicine would lack content because telemedicine knowledge and skills have not yet been systematized or become part of the content of medical textbooks.

Some graduate schools in co-medical areas provide courses in medical informatics and related areas as a preliminary effort, but course contents are limited to an introduction to the topics.

As far as the current situation is concerned, telemedicine is not included in basic courses for undergraduate medical students. It is desirable to start discussions at conferences, etc. about whether to consider telemedicine as a subject in the basic education of medical staff in future and what to teach. This should also be recommended to administrative personnel in agencies such as the Ministry of Health, Labor, and Welfare and the Ministry of Education, Culture, Sports, Science, and Technology, and prefectural capitals.

Is a Field Education and Training about Telemedicine Provided?

Many introductory lectures on telemedicine have been provided. However, these are not designed for the systematic learning of telemedicine; rather, they are an introduction to recent topics by key persons. It is difficult to trigger subsequent actions after learning these topics unless students have sufficient ability to take independent action.

The Japan Telemedicine Society, a nonprofit organization that has been commissioned to implement Training of Telemedicine Staff. A 2014–2016 project by the Ministry of Health, Labor, and Welfare, appears to be the only organization that has a structured curriculum (Table 1). The curriculum is delivered at a workshop that is held for three days each year in Tokyo and Osaka. Many health professionals would not be able to attend it because the workshop period is three days only, and it is not held in remote areas where telemedicine is really needed. Therefore, schemes and financial resources for implementation at the local level should be considered.

Are There Curriculum Studies in Telemedicine?

The only existing structured curriculum is Training of Telemedicine Staff, which is provided by the above-mentioned nonprofit organization, i.e. the Japan Telemedicine Society. However, the preliminary curriculum was not developed from educational studies. Instead, it was developed in 2014 based on survey results and is updated based on the results of annual questionnaire survey of trainees. We would like to perform the following systematically, but a shortage of researchers hinders our progress. The main issues are:

1. Clarify the trainees, training goals, contents, etc.;
2. Develop teaching methods and materials;
3. Establish evaluation indices for the training and collect evidence.

Future Prospects for Human Resource Development in Telemedicine

The development of telemedicine systems and the communication environment has made it possible to lower the cost of establishing facilities.

Clinical data have also been accumulated. The number of types of telemedicine (such as tele-radiology, tele-pathology, cardiac pacemaker monitoring, etc.) that are routinely performed has also increased. Institutional reviews ranging from the interpretation of Medical Practitioners' Act to medical fees have also been performed using telecommunication technology.

However, human resource development cannot be accelerated by large scale, short-term investments. Future dissemination of telemedicine requires clarification of the contents of curriculums, development of teaching methods, training of teachers, and the organization of workshops. Organizations that provide education and training continuously and improve the quality of education in telemedicine are also needed. Although the Japan Telemedicine Society, a nonprofit organization, has already started a project to train telemedicine staff with the support of the Ministry of Health, Labor, and Welfare, this is not the goal, just the starting point.

Table 1. 2016 lecture courses for telemedicine staff

<i>Dates</i>	Course	Subject
<i>Day 1</i>	Introduction to telemedicine	Orientation
		Introduction to telemedicine
		The system of telemedicine (Medical Practitioners' Act; medical fees)
		Workshop (Question and Answer session; report writing)
	Community health care	Cases in a community (Hokkaido)
		Local issues; National survey and patient survey (Current situation and issues)
		Theories of community program development (An outline of community health care model)
		Information security and privacy in telemedicine

		Workshop (Question and Answer session; report writing)
<i>Day 2</i>	Basic technology	Medical ICT; system planning and construction
		Various equipment used for telemedicine and standard technologies
		Examples of projects with a telemedicine system
		Workshop (Question and Answer session; report writing)
	Monitoring	Basic monitoring; respiratory medicine (CPAP)
		Basic monitoring; home oxygen therapy
		Basic monitoring; telenursing
		Basic monitoring; diabetes and health guidance
		Guidance for chronic disease management with a monitoring device (1)
		Guidance for chronic disease management with a monitoring device (2)
	Workshop (Question and Answer session; report writing)	
<i>Day 3</i>	Institution and research	Clinical study of telemedicine
		Overview and problems of telemedicine

		Special lecture (Comprehensive community care and telemedicine)
		Workshop (Question and Answer session; report writing)
		Basic monitoring; cardiovascular medicine
	Home care; Remote diagnosis	Introduction of projects by Asahikawa Medical University
		Theory of launching telemedicine in local communities (procedures for launching home telemedicine)
		Special lecture "Telemedicine for home patients"
		Practice of telemedicine (1)
		Practice of telemedicine (2)
		Workshop (Question and Answer session; report writing)

Future Studies of Telemedicine

Future Perspectives on International Comparative Studies of Telemedicine - Discussion of Studies of Promotion Policies

Introduction

Excellent findings of telemedicine studies in other countries should be evaluated on a scale different from that in other medical practices. If the number of telemedicine implementations in a country is greater than in Japan, it does not mean that telemedicine in the foreign country is necessarily more advanced than in Japan. The country may be heavily dependent on telemedicine because the number of physicians per capita or per unit area of that country is lower than in Japan. The findings will not be useful if their

greater number of implementations simply reflects a higher demand for health care services. Appropriate findings can be obtained from comprehensive analyses of the data, including treatment methods and local information such as land, population, medical conditions, culture, and social security system. The technical level of the country's ICT should be regarded as reference information that is equivalent to or less than other factors.

While there are only a few international comparative studies of telemedicine, this study provides information that is currently available for the future expansion of the area. Although most of the information was obtained from the results of meta-analyses rather than from survey results (e.g., questionnaire surveys and structured interviews), it serves as "a glimpse that provides different viewpoints."

Classification of Telemedicine

In Japan, multicenter electronic medical records are not classified under telemedicine but as a usage mode of the medical information system. Because electronic medical records are sometimes classified as a type of telemedicine in other countries, attention must be paid in international comparative studies to the number of institutions or medical treatments that use electronic medical records.

Stakeholders of dissemination policies in Japan are interested in medical treatment of home patients using video chat, but not in multicenter support (i.e., telemedicine in the form of Doctor-to-Doctor). We often hear disappointment in the voices of community healthcare staff because community healthcare depends largely on multicenter support. There are differences in the regions of interest, and many guidelines for related societies, etc. in other countries that cover Doctor-to-Doctor.

For example, there is a gap between home care in Japan and such care in other countries. Although activities such as nursing care and home care are the subjects of telemedicine, the way they are handled differs from country to country. There also appears to be a gap between Japan and other countries such as Europe and the United States in integrated care. Therefore, care must be taken when comparing them.

Land and Population

Data such as the size of the land and the number of physicians per capita or per unit area are important. There are many countries with large areas and low population density, and few hospitals are not uncommon. In contrast, Japan is a small country, but the use of telemedicine seems relatively high. In this case, the medical standard that is generally expected in the country should be taken into account, in addition to the number of physicians per capita or

per unit area. If needs are low, the cost-benefit ratio may be good, whether there is traveling medical care or long-distance visits to a hospital.

Telemedicine also depends on the quality of transportation. The need for telemedicine is low in areas where the means of transportation are developed.

The Number of Implementations and Total Medical Expenses

The rates of implementation (in terms of the number of treatments and the total medical expenses) of telemedicine and other methods are important indicators. It is difficult to perform an international comparison using raw data, but it is possible to do so by using ratios.

Occupational Categories and the Authority of Health Professionals

In any country, physicians have great authority and responsibility, but excessive concentration of authority in physicians hinders the efficient operation of various medical practices. Telemedicine is one way to reduce that concentration, but this can be achieved even with a distribution of authority to other occupations. If there are many medicine-related occupations such as nurse practitioners and physician assistants in Japan, as in the United States, they will influence the degree of guidance and management by physicians and the need for telemedicine.

Medical Standards and Professional Skills

Low medical standards do not necessarily require telemedicine. Countries with a high demand for medical services and few health care professionals with advanced skills have a substantial need for telemedicine. The deployment and status of specialists and generalists also greatly affect medical standards. It is not easy to discuss specialists and generalists solely from the perspective of telemedicine. Telemedicine provides support to generalists in some countries that use them to maintain high medical standards across vast areas. Their role sharing is different from that of specialists and departments in Japan.

The most important factors in achieving high medical standards are not the individual functions of physicians and departments but high-level, team-based medical care and cooperation among hospitals. Even if a physician with advanced skills provides instructions to physicians in remote areas, it is not possible to achieve advanced medical care without the support of departments and medical teams. For example, it is not possible to establish tele-stroke or tele-intensive care units (ICU) in countries with low medical standards.

The Law and the Legal System

Each country has a legal system that sets out the authority and responsibility of physicians; therefore, regulations such as moral hazard control may conflict with telemedicine. In Japan, discussions on the

"prohibition of medical care without personally performing an examination" in Article 2 of the Medical Practitioners' Act continues, but there are no similar discussions in other countries.

There are regional restrictions on telemedicine in some countries. In the United States, some geographic areas are designated as Health Professional Shortage Areas (HPSA). Physicians who furnish medical care services in these geographic areas are eligible for bonus payments.

Geographic areas have certain advantages in establishing implementation standards for telemedicine. Such restrictions are likely to be misunderstood as the abolition of the community health care system in Japan and would not be considered a positive medical policy.

Social Security System

Medical fees are a driving factor in the implementation of telemedicine. The more payment items there are, the easier it is to promote telemedicine. The variety of items claimed for medical fees and ease in adding medical fees appears to be advantageous for the dissemination of telemedicine. However, many countries do not have a medical fee system as part of a social security system, and depend on free practice for the implementation of telemedicine. In other words, the presence or absence of items claimed for medical fees affects the dissemination of telemedicine in some cases. The promotion of telemedicine through free practice would not be effective in Japan because the universal healthcare system has already been developed.

There is a significant gap between systems, even in countries with an established medical fee system. Health insurance-covered medical institutions depend on insurers in some countries, while that is not the case in other countries such as Japan. The need for telemedicine increases in countries that depend on insurers when clients of specific insurers can use only a few hospitals. This seems to be one of the factors that contribute to the growth of telemedicine in hospitals run by the United States Department of Veterans Affairs. However, it does not provide useful information for the expansion of telemedicine in Japan.

Instead, a substantial number of vulnerable clients in the insurance system can be a driving factor for telemedicine. By offering uninsured, inexpensive, and convenient remote medical consultations and health consultation services, it would be possible to reduce the triage of full-scale consultation and wasteful medical burden. However, the need for telemedicine is unlikely to increase in countries where the proportion of the uninsured is low. In addition, it is difficult to perform an international comparison because the efficiency of social security expenses by triage depends on the medical insurance payments in each country.

Cooperation among Hospitals and Functional Differentiation

Functional differentiation and mutual support among hospitals and departments can be factors that promote telemedicine. If functional differentiation is high, the need for cooperation and support is high. There appears to be a significant need for cooperation between radiography and pathology departments, but not in other fields. In countries where there is strong mutual cooperation among general physicians, there appear to be many cases where mutual support to fill the gap in subspecialties in the same department leads to the development of telemedicine.

Differences among the Administrative Organizations Promoting Telemedicine

The recruitment of physicians and reduction of distribution bias sits well with telemedicine in medical administration. In the United States, a division for the recruitment of physicians and remote medical treatment in the Department of Health and Human Services promotes telemedicine. In the case of regional administration in Japan, personnel in remote medical care and physician recruiters are in charge of telemedicine in some prefectures.

Military and defense sectors also need telemedicine. Although there are no studies of the military in each country, some products for military purposes were exhibited at a corporate exhibition at an academy meeting of the American Telemedicine Association (ATA). These products showed clearly the differences in country situations.

Information Technology, Information Equipment and Information Services

Regions where inexpensive information and communication services and telecommunications equipment are available are potentially advantageous when implementing telemedicine. However, the level of the elementary technology of the equipment is unlikely to be the main factor in promoting telemedicine. There seems to be considerable differences in the marketing of telemedicine equipment among companies in Japan, United States, and Europe. Example: Companies outside Japan manufacture most of the cardiac pacemakers and device for CPAP treatment for sleep apnea syndrome. The implementation of overseas medical treatment methods and the importation of equipment appear to occur simultaneously.

Although technical standards adopted by the system tend to be a matter of concern, the social evaluation of the medical practice in the country can be a good measure. For example, even if advanced engineering technologies are used in primary care, the cost would not be covered fully by medical payments.

Conclusion

An international comparison affects the assessment of the evidence of the efficacy of telemedicine. Comparative studies by researchers in social medicine, systems, and policies are desirable.

Future Studies of Telemedicine

The Entities That Are Implementing Research into Telemedicine

As shown in the sub-chapter on dissemination measures, universities and major research institutions were the entities implementing research in demonstration projects by the ministries of Japan and system technology research and clinical research supported by subsidies. Companies were also important for system technology research. Over time, services such as high-performance devices and communications have become readily available, and the proportion of system technology research has declined and the role of telecommunication companies has shrunk, while that of clinical research appears to have increased.

Universities and major research institutions still play the major role in research supported by subsidies and demonstration projects. Future research is likely to shift from universities and large hospitals to individual hospitals, small clinics, visiting nurse stations, medium-sized hospitals, nursing homes, and geriatric health service facilities, etc. Studies of cases, events, and has operation methods, predicted that the number of implementations in small facilities other than universities will increase. The findings and research results required by telemedicine are not expected to be limited to medical research with advanced methods such as large-scale multicenter clinical research; they are likely to but expand to cases, improvements, and proposals in familiar facilities.

Financial Resources and Environments That Support Research

Although large-scale research and advanced research is largely conducted by grants-in-aid for scientific research by the Ministry of Education, Culture, Sports, Science, and Technology and research grants from the Japan Agency for Medical Research and Development (AMED), research grants from the government cannot be expected because most field case studies and studies of likely improvements suggestions do not fall into the category of advanced science research.

It appears likely that future studies will depend on the funding that is available for each hospital. In the same manner as for comprehensive community care, entities promoting telemedicine appear to be shifting to the level of municipalities and prefectures. Therefore, research support should shift to the regional level with matching funding.

An increase in the number of studies by small hospitals will depend on an increase in various aspects of research support, such as guidance about

research methods, the provision of research publication opportunities, and the acquisition of research funding, etc.

Future Research Topics and Subjects in Telemedicine

1. Medical research into diagnostic methods and treatment methods
Studies that measure efficacy and safety quantitatively are important as ever. However, as noted in the section on evidence above, it is necessary to put an emphasis on the collection of basic data such as the number of implementations and the number of continuations. In addition, the collection of case reports is also important as basic information for promoting clinical research.
Projects with high evidence levels such as systematic reviews or development of clinical practice guidelines, etc. are important goals as the next steps in the accumulation of cases and clinical research with advanced results. However, there is still a long way to go before setting up studies with a high evidence level and guideline development. Therefore, it is necessary for the entire community to promote them. Studies of clinical indicators of telemedicine are likely to be triggered by these studies. At the moment, there is not enough accumulation of data to assess the quality of telemedicine quantitatively.
2. Studies on guidance methods and management methods
One of the principles of telemedicine is to provide guidance and management to patients and medical staff on the patient, based on clinical information. Although it is important to verify the effects of guidance and management, research that clarifies the procedures and facility conditions of the guidance and management is also necessary, including studies for the development of a critical liaison path. In the case of an in-hospital critical path, quantitative development is possible using DPC information, etc. However, evaluation indices need to be developed in studies of a critical liaison path and telemedicine, and it is not possible to collect such data from DPC, receipts, etc. Research methods also need to be developed.
Research topics such as procedures for telemedicine in our own facilities, tips, and improvements that are useful in other facilities, should be pursued, rather than advanced topics. For example, when telemedicine is used for home care, even knowledge of the procedures for physicians and visiting nurses is not shared. Research results, abstracts of meetings, etc. published in other academic societies' journals (e.g., the Japanese Medical Management Society)

have a similar orientation as case reports and can be used as references.

3. Research into medical education

Studies of education targets, objectives, systems, curriculums, methods, tools, etc. are needed, but not yet undertaken. Studies are needed that are based on current evidence obtained from small-scale projects about education and training (e.g., data from questionnaires about training needs, or the degree of satisfaction, attendance rate, etc.).

4. Research into medical safety

These studies would share basic ideas and methods with those for the guidance and management mentioned in the previous section. These are issues (for example, the prevention of medical accidents and measures) of a specific area that requires organization guidance and structure as well as research. These issues also include definitions of incidents and accidents in telemedicine, proposed methods for collecting basic incident information, collection and analysis of incident/accident information, and accident prevention procedures.

5. Social medicine research such as medical fees, legal issues, and ethical issues

Research into the policy for the promotion of telemedicine is needed. There are no national, prefectural, or municipal procedures, policy planning methods, or policy evaluation methods of medical administration. There are many agendas such as schemes for larger social security systems (e.g., medical fee systems, comprehensive community care) and measures to be implemented in health care communities.

Medical ethics about these issues should also be added to the agenda. Telemedicine was posted as an item of "medical ethics" on the homepage of the Japan Medical Association. However, the procedures for medical ethics for telemedicine have not been studied adequately. Although there are currently no researchers or an environment to support research into these social issues, future studies on them by academic societies are expected.

6. Research into security and privacy

Telemedicine is based on information technology; therefore, studies of security and privacy are needed, including investigations of guaranteed levels that match current trends, standards to be observed, and surveys of the current status. They are also tightly related to medical ethics, management methods and legal systems.

Research based on evidence such as user situations and incident situations is needed, in addition to technical research.

7. System technology research

Although system technology research began as the first research into telemedicine, it was discontinued with the advancement of devices and communication services. However, this does not mean that technical research is no longer needed. Further research is expected to investigate how to use new technologies for telemedicine.

System to Promote Joint Research

Research into telemedicine should be based on findings in specialized areas, medical safety, medical ethics, social systems, and economics. "Support from telemedicine" will also be needed in specialized areas, medical administration, medical management, and other fields. Collaboration with academic societies and other academic areas will become important.

Research into telemedicine has its roots in telecommunications and medical informatics. The Japanese Telemedicine and Telecare Association originated in health science research and the Japan Association for Medical Informatics. However, it has developed in many directions, beyond the area of medical informatics. Human resources in this area originated in pathology and radiographic diagnosis; this has also developed in many different directions. Research into telemedicine needs to expand into many areas with wide perspectives.

As discussed above, the subjects of telemedicine are quite broad. It needs a "control tower" that provides direction to the research and functions as a bridge between other research areas. Therefore, further discussions are needed.

Peru

A Panoramic View of Telehealth Activities

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Introduction

Telemedicine is defined as the provision of distance medical services. Information and communication technologies are usually used for its implementation. The word comes from the Greek *τελε* (tele) meaning “distance” and medicine (from the Latin *medicus*, derived from *mederi* “caring”, “heal”). The telemedicine includes procedures that require the support of simple technologies, such as the telephone discussion of a case by two health professionals, to the use of advanced technology in communications and information technology for consultation, diagnosis and remote surgery in real time [1].

In Peru, the rugged geography makes transportation and communications difficult, limiting the access to health services. There are deep inequalities in the distribution of medical resources, both within regions and within each region. Geographical accessibility is a problem for the population living in the rural area that has low income. Telemedicine can be a great ally of the country to provide health care. Among the processes that may include the telemedicine, we have:

- Research, monitoring and management between the specialist and the patient;
- Use of electronic communication to provide support in the healthcare field, when distance separates participants;
- Digital archiving services for radiological exams, ultrasounds and others.

Peru has a National Telehealth Plan, approved by the Supreme Decree 028-2005-MTC, and a Technical Health Standard in Telehealth, approved by the Ministerial Resolution 365-2008 / MINSa (General Direction of Telehealth of the Ministry of Health = MINSa) [2]. In 2016, the Framework Law on Telehealth, a Law No. 30421, was also approved.

The first telehealth projects began in 2002. However, a national telehealth project that covers all regions of the country with the same approach and uniformity of actions and structure has not yet been implemented.

The purpose of this chapter is to build a panoramic view of the telehealth development process in Peru.

Several steps were taken to elaborate this overview. Initially, the documents referring to telehealth on legislation, projects as well as scientific articles were accessed as follows:

1. Analysis of the legislation, related specifically to telehealth from 2002 onwards and dating the creation of the national telehealth commission in Peru;
2. Analysis of the published scientific articles on telehealth in Peru from 2002 onwards;
3. Analysis of technical reports and presentations in congresses in the area of telehealth, enabling access to the content of the various ongoing telehealth projects in the country;
4. Analysis of telehealth documents available on projects' websites and published by the Ministry of Health.

Subsequently, the materials for the analyses were classified into three main topics:

- History of structuring of telehealth activities in the country,
- Main experiences and
- Current initiatives.

It was decided to present the main aspects of telehealth legislation in the period under review, as well as to structure the analysis taking into account published scientific articles and the structuring of telehealth projects. In this way, it was possible to restore the process of development of telehealth in Peru.

In order to contextualize the difficulties and potentials of telehealth in Peru, we must underline that the development of the process of incorporation of ICT (Information and Communication Technology) is slow. In 2013, only 38.4% of the population had access to the Internet, although 80.9% of the households already had mobile telephony (Figure 1).

History of Structuring Telehealth Activities in Peru

In 2003, the Supreme Resolution No. 009-2003- MTC3, established the National Telehealth Commission in Peru [3]. This National Commission is oriented to integrate the initiatives, works and projects that have been developed in relation to Telehealth in order to optimize the resources, to avoid duplication of efforts and expenses, and to develop a joint work, framed in the National Plan of Telehealth.

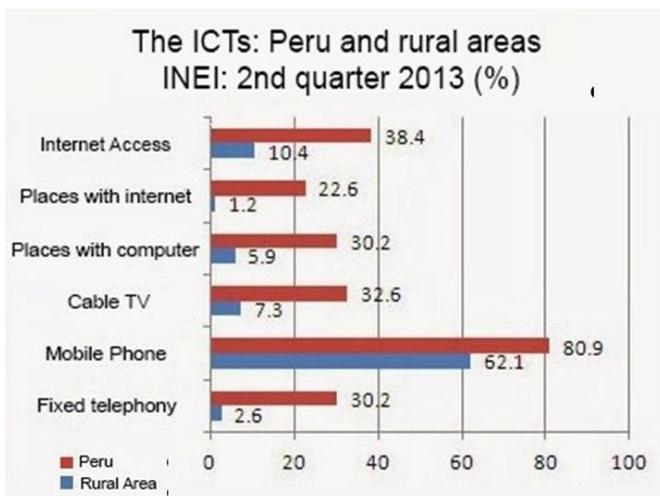


Fig. 1. Source: National Institute of Statistics and Informatics, National Household Survey, 2013

The text states that the National Telehealth Commission is in charge of preparing and proposing the necessary actions for the development of Telehealth in Peru. This commission elaborated the National Plan of Telehealth. It was approved in 2005 by the Supreme Decree No. 028-2005-MTC [1]. The plan points to the role of telehealth:

“... the incorporation of Telehealth as a Health Technology in the support of the Coordinated and Decentralized National Health System, will serve as a strategic tool to facilitate change, which uses ICT to meet the population’s health needs.”

It also emphasizes that it serves the population and the people [1]:

“... at the service of the population, bringing quality health services closer to the citizens of rural areas, dispersed populations of the sierra and the Amazon; regardless of where they are and reducing barriers to access services, promoting the equity and universality of health care.”

“At the service of health personnel, integrating the staff of the different levels of care, through a communication network in the health system, allowing them to share information and favoring the continuity of care among the levels of care. It

will also facilitate the access of the health personnel to the training and continuous updating at a distance.”

The document emphasizes that the national telehealth plan is part of the State policy and constitutes the starting point for the development of telehealth in the country, in which various sectors of society will be involved, integrating efforts so that in the future, a better level of health of the population will be achieved. The Plan proposes, as one of the main strategies, the creation of the Integrated System of Telehealth, in order to provide integral health care, based on the principles of universal health coverage, equity in access, efficacy in health production and efficiency in the use of resources.

The National Telehealth Plan 2005 emphasizes the strategic role of telehealth, situating it in the context of the development of the health system and highlighting its main potentialities to contribute to this development [1]:

“Telehealth is not only the implantation of technology, it is an entire process; it is more than a healthcare tool that allows the provision of health services at a distance. It is also a strategic organizational change tool for the National Coordinated and Decentralized Health System (SNCDS); because by encouraging the integration of information among the subsystems that compose it, it facilitates the adequate coordination between them and between the levels of attention and organization of each one at the national level.”

Jorge Cordero Valera, the president of the National Telehealth Commission and a coordinator of the elaboration of the plan in that period, lists the main aspects that guided this elaboration [1].

- a. The evaluation of the situation was made through an analysis taking into account three variables: poverty level, access to health services and access to ICTs. The departments with greater gaps in the possibility of access to both a health facility and ICT are numerous. This information is fundamental to guide the investment in Telehealth projects.
- b. The need to think about an Integrated Telehealth System (SIT), with the purpose of improving and expanding the provision of health services, benefiting the population in general, especially in the rural and dispersed regions. It has been considered convenient to name it as an Integrated Telehealth System because it will be integrated into the SNCDS as a support technology and because it will also seek the integration of all the subsystems that make it up

and the health care units at different levels of care, through a National Telehealth Network.

- c. The existence of five components that are interrelated and that are critical factors to the development of the national telehealth plan are:
 - Legal Component;
 - Organizational Component;
 - Process Component;
 - Technological Component;
 - Financial Component.
- d. Three axes of telehealth development have been structured in the country, which are the lines of application of Information and Communication Technologies in the field of health, according to the type of service provided. They are:
 - Provision of health services;
 - Information, education and training for the population and health personnel;
 - Management of health services.

According to Valera, the National Telehealth Plan initiates the development of Telehealth in the country in a planned way and in line with the priority needs of the area [1]:

“In this sense, based on a diagnosis focused on both the health situation and the field of ICTs, specific objectives, strategies and actions are set out to set the guidelines for the future Telehealth Projects. Finally, critical success factors must be considered; organizational changes, cultural and technological impact that will lead to the implementation of Telehealth.”

Next, the plan defines that its mission is to contribute to the decentralization and integration of the country’s health system and the universality of health services with quality, efficiency and equity for the priority benefit of the excluded and dispersed populations through the incorporation of information and communication technologies.

The Plan also highlights the guiding principles that underpin the Telehealth in the country [1]:

- Universality in the access to health - Telehealth seeks to make health services more flexible by taking these services to the excluded and dispersed populations.
- Equity - Reduce, through the telehealth, the existing gap in access to health services among excluded or dispersed

populations, compared to urban, so that health care is provided with equal quality and similar options.

- Efficiency – To enhance the efficiency of the health care, medical knowledge, training and information and, most importantly, to serve as an instrument that can, in many cases, represent the only means by which health care could be provided in rural areas and preferably of a social interest.
- Quality - Promote integral health care, based on the user's satisfaction, improving diagnostic accuracy and therapeutic attitudes decisions (possibility of consulting treatments with specialists), by providing distance and continuous training to health personnel, which improves their performance, facilitating continuity in the patients' care at different levels of health care.
- Decentralization - Progress towards the decentralization of the health system, using the Telehealth as a strategic tool that facilitates change, which, using ICTs, optimizes the flow of health service delivery processes.
- Social development - It promotes the development of society, allowing the population a greater access to health information, knowledge of their duties and rights in healthcare. Thus, it enhances the empowerment of people emphasizing the main subjects of their own health, the health of their family and community and creating spaces for new practices of citizen participation in the public welfare.

After analyzing the situation of morbidity and mortality in the country and the priorities of intervention of the health system, the plan makes a diagnosis of the incorporation of ICTs and telehealth. As for the strengths that the telehealth presented at that time, the text highlights the following:

- Experience of human resources in the applications of Telehealth and the execution of Telehealth Projects;
- Experience in technological solutions, adapted to our reality for its use in Telehealth networks;
- Existence of Health Infrastructure at the national level;
- Existence of the program that provides qualified human resources in rural and marginal urban areas of the country;
- Existence in the SNCDS of flexible offer in the health services;
- Existence of the virtual library in Health of Peru;

- Existence of telecommunication networks at the national level, nodes that could serve as primary skeleton;
- General policy guidelines to promote the massification of Internet access in Peru;
- Existence of laws;
- Existence of the Multisector Commission for the Development of the Information Society and existence of the National Telehealth Commission.

Regarding the weaknesses to implement telehealth actions, the following aspects stand out:

- Geographical and social gap that requires comprehensive health care due to the existence of a broad geographic space and inequity in the provision of health services;
- Concentration of the provision of health services in urban areas;
- High operating costs in the provision of health services;
- Lack of infrastructure and ICT equipment for health, and the existing one with a high degree of obsolescence and attrition;
- High costs of services in Peru in relation to the purchasing power of the population;
- Lack of standards in the information management of SNCDS members, which will generate increased costs, less information flow, etc.;
- Concentration of telecommunication services in urban areas;
- Deficient knowledge of ICT in the population and health personnel;
- Inadequate funding for telehealth projects;
- Insufficient knowledge of ICT;
- High rotation of properly trained health personnel,
- Hindering the continuity and application of health policy guidelines;
- Insufficient ethical-legal and operational norms in the exercise of telehealth;
- Cultural barriers and training (age group, digital divide, slang) on the use of ICT in medicine;
- Lack of implementation of a national telehealth program and lack of telehealth projects.

Finally, the plan details its objectives. Its general objective is to develop, orient and disseminate an Integrated Telehealth System, with the purpose of

improving and expanding the provision of health services, benefiting the general population with an emphasis on excluded and dispersed areas.

The specific objectives are:

- To promote the implementation of the national network of Telehealth and its subsequent development, integrating to health establishments;
- Implement comprehensive health care programs with emphasis for rural populations and dispersed ones through the National Telehealth Network;
- Implement distance information, education and communication programs for health professionals and the population through the National Telehealth Network; and
- Strengthen and improve the processes of management of the national health system, improving its performance using the National Telehealth Network.

The plan elaborates different strategies for the implementation of actions of Telehealth Process, as well as it proposes guidelines for the elaboration of a monitoring system of the telehealth activities in the country.

In 2008, the technical norms for telehealth were elaborated [4]. The Technical Standard in Telehealth was developed to contribute to the decentralization and integration of the health system and the universalization of health services with quality, efficiency and equity through the incorporation of Telehealth.

The general objective of the standard is to regulate, through technical and administrative provisions, the applications of the Telehealth in the management and actions of Information, Education and Communication (IEC) in the health services, as well as in the health services under the modality of the telemedicine. It has the following specific objectives [4]:

- Establish the quality and opportunity criteria for the telehealth applications in the provision of services under the modality of telemedicine;
- Define applications in the management of health services;
- Define the applications in the actions of Information, Education and Communication in the health services.

With regard to the scope of application of the Technical Standard of Health, it includes all health establishments and medical services of public and private support. On the other hand, the standard provides a set of operational definitions about the terms used in telehealth. It then provides the specific characteristics that health services must possess to offer telehealth actions from the point of view of technological capacity, the provision of health services under the modality of telemedicine (involving

telemedicine applications, areas of action, human resources, clinical history and care records, priority procedures, risk management) and remote management of health services.

The development of the national plan and the norms of the telehealth area are intended to contribute to the development process of telehealth activities in the country.

Main Experiences of Telehealth in Peru

The main experiences of telehealth in Peru have been addressed in various documents and articles. Initially, in 2005, the National Telehealth Plan document lists and describes the main experiences that exist up to that moment in the country [1].

Hispanic-American Link Project Applied to Health - EHAS Peru

It is intended to influence the health conditions of the inhabitants of rural areas of Peru through the working conditions of health personnel.

The specific objectives are the improvement of the access to information of these personnel. The project provides telecommunication infrastructure of the establishments in which the health personnel is working.

The work has two parts. The first is the generation of value-added services based on systematic accumulation, selection and processing of information. The latter has to be offered to the beneficiaries in an efficient and timely manner, in order to satisfy their demand. The second part is the development of technical solutions to the problem of data transmission under the conditions that the rural geography imposes in Peru and within the constraints of the level of rural development.

The Scientific Information Network (RIC) and Cardio-vascular Network of INCOR Telemedicine

The EsSalud Scientific Information Network (RIC) is a set of thirty-six Information Centers (computerized Libraries) interconnected through the Information and Communication Technologies (ICT), located in the main health centers of EsSalud in each one of the departments of Peru.

Its mission is to offer up-to-date biomedical information to health professionals at the national level, for its ongoing training (continuous education), updating and improving the knowledge and techniques of its respective specialties, attending their needs in order to improve or expand medical services and / or health care.

Its structure is based on a network architecture of information sources, with decentralized development and operation. They maintain distributed bases of scientific and technical knowledge in health, organized and stored

in electronic format, which is accessible through the Internet, in a compatible way with other national and international products and services.

The Telemedicine Cardiologic Network of the National Heart Institute (INCOR), provides the different health centers of EsSalud in the country with medical technical assistance, remote control and diagnostic help; with the possibility of making queries to its virtual file.

Its main services are:

- Real-time or deferred remote consultations and consultations that allow greater access to specialized services in the country.
- Consultations of second opinion by specialists in order to obtain specialized diagnostic criteria that allow better quality of patient care.
- Sending of digitized images of still and moving picture files.
- Programming of higher resolution procedures such as cardiac catheterization, interventional surgery or even cardiac surgery with exams performed previously in the place of origin.
- Access to the INCOR virtual file: clinical history, exams, procedures, and even cardiac and vascular intervention and surgery performed at INCOR, greatly expanding the information contained in the local and national counter-reference sheet.

Two other projects are *Alert*: a technological platform of communication and electronic data reporting for public health in Peru and *Infosalud*.

INFOSALUD

It was created on July 25, 2001, under the name of FONO SALUD. The following year, on February 8, 2002, it changed its name to INFOSALUD. INFOSALUD is a free information service and telephone counseling of the Ministry of Health, made up of a team of professionals (doctors, obstetricians, psychologists and social communicators). It provides comprehensive health counseling, institutional information, citizen oversight and support in emergencies and disasters.

INFOSALUD's mission is to provide a rapid and free access to information and telephone counseling to meet the communication needs in areas of integral health, public monitoring and participation, emergencies and disasters and institutional information, actively and timely contributing to strengthen the guidelines and goals of the health sector.

Alo-EsSalud

The objective of this project is to develop an effective policy of preventive health services, by absorbing specialized telephone consultations and issuing technical-scientific documents.

Between 2009 and 2012, the Ministry of Health of Peru describes the following projects [5] (Table 1):

Table 1

2012	Telemedicine in Candarave, Tacna Telecommunications Investment Fund Ministry of Health	To promote the social and economic development of the beneficiary population, using Information and Communication Technologies
2012	Care for your Mobile Health Ministry of Health	Cancer prevention through the promotion of healthy behaviors
2012	Live Birth Registration System Online Ministry of Health	A Birth Information System that helps to streamline the process of identification of newborns at the national level
2011	Mobile Emergency Care System – SAMU Ministry of Health	To fully manage emergency care and pre-hospital emergencies, for timely resolution, primarily in urban areas with greater exposure to risk events and in rural areas
2009	National Network of Virtual Technical Assistance in Neonatal Critical Care National Perinatal Maternal Institute	Contributes to the reduction of neonatal morbidity and mortality in the country, improving the resolving capacity of neonatal units
2009	Tele electrocardiography Ministry of Health	Ensures the continuity of health care and contribute to solving the health problems of the Tumbesina population

Source: National Institute of Statistics and Informatics - National Household Survey – 2013

In 2015, Altamirano [6] says that if we do a quick description of the most significant projects developed with the collaboration of MINSA, starting with the most recent, no more than six or seven projects can stand out. The author highlights the following projects as significant:

- Information and Communication Technologies for the integral development of Candarave Communities;
- “Care for your Mobile Health” Program, financed by the MINSA;
- Live Birth Registration System Online;
- Mobile Emergency Care System - SAMU;
- National Network of Virtual Technical Assistance in Neonatal Critical Care;
- Tele-electrocardiography service at the Regional Health Directorate in Tumbes and
- EsSALUD, which has articulated a National Telemedicine Center (CENATE).

The author recalls that in 2013, co-financed by MINSA and the Telecommunications Investment Fund (FITEL) of the Ministry of Transport and Communications, a Telediagnostic and Training System was implemented. It has enabled specialized medical assistance from the Victor Hospital Ramos Guardia, in Huaraz, to areas far from the Region of Ancash, in disciplines with special need of attention, such as gynecology. The system allows intranet / internet access, incorporates an education and training module, allows the real-time exam with monitors and screens that simulate the patient-medical face-to-face relationship, with a streaming TV infrastructure and high definition video streaming service and medical image quality, as well as various digitally connected medical devices.

More recently, Gozzer Infante [7], in 2015, under the auspices of the Ministry of Health, develops a systematization of telehealth experiences in Peru and concludes that there were 57 telehealth initiatives. The author managed to present details of 38 experiences (Fig. 2 and 3), of which 66 % are still in progress. The author systematizes and describes in a concise manner their characteristics, classifying the initiatives into four general groups:

- Telemanagement;
- Telediagnosis;
- Telehealth in APS and rural area and

- Telemedicine area.

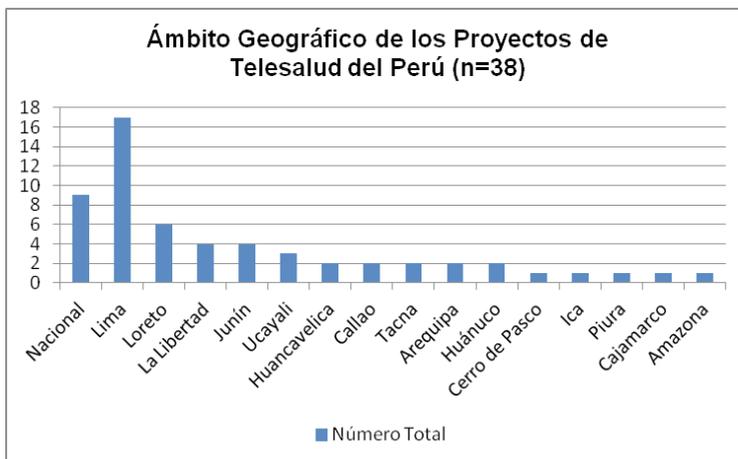
The author also points out that, from 2013, there is a significant increase in telehealth projects in the country, reversing a very low trend of project growth over time.

Fig. 2 Evolution of the number of telehealth projects in Peru 2002-2013.
Source: PARSALUD II / MINSA. “Systematization of Pilot Experiences of Telehealth in Peru”, Feb. 2014



Regarding the scope of the projects, it also states that 8 projects have national coverage, while the others are in different regions of the country. Gozzer Infante [7] identifies that the DISAMAR Alert project is the most comprehensive in the country and has been underway for twelve years.

Fig. 3 Geographic Scope of the Telehealth Projects in Peru (n=38)



Source: PARSALUD II /MINSa. Systematization of Pilot Experiences of Telehealth in Peru, Feb. 2014

The next paragraphs will make it possible to reconfigure existing telehealth initiatives.

Current Initiatives for the Development of Telehealth in Peru

In general, the maturation of an area occurs when, in addition to established training processes and a wide presence in public policies - legal and legal framework - there are national and private academic institutions and civil society organizations. Such organization is the Alexander von Humboldt Institute of Tropical Medicine (IMT AvH) of the Peruvian University Cayetano Heredia. It is a pioneer in Telehealth with decades of experience. The IMT AvH is now considered internationally as a center of excellence for infectious and tropical diseases because of its high academic quality and of the clinical skills of the multidisciplinary teams working in it.

More than 25 years ago, the first course in medical informatics was prepared. It was followed by the distance education courses in the Andean region and the Caribbean regions, publications, books, creation of software for rapid diagnosis of tuberculosis using artificial intelligence, teleconsultations, telemedicine, teledermatology etc., to cite some telehealth activities. Currently, due to the country's situation in disaster areas, the tele-trainings for the health personnel at the national level have been started from the General Direction of Telehealth of the Ministry of Health (MINSa), the Cayetano Heredia Hospital, ESSALUD, Maternal Perinatal

Hospital, Medical College and the Institute of Tropical Medicine Alexander von Humboldt of the Peruvian University Cayetano Heredia [8].

In Peru, in 2013, the Peruvian Telehealth and Telemedicine Association [9] was formed (Fig. 4). Gregorio Sancho Pérez was elected as her president. This autonomous, non-profit entity maintains the ties of identity with the Ibero-American Association of Telehealth and Telemedicine. The goal is to promote and contribute to the development of telehealth and telemedicine in Peru, to contribute to the improvement of its members and, through this, to promote the improvement of the health and life of the Peruvian community.



Fig. 4

Its main objectives are:

- To promote the development and application of new information and communication technology tools in the field of health, scientific research and administration;
- To strengthen, support, promote and disseminate the contents of telemedicine and telehealth activities;
- To promote cooperation and exchange of actions and products generated in the field of telemedicine and telehealth in both the public and private spheres at national and international levels;
- To create and maintain academic ties;
- To interact with academic scientific entities;
- To promote, organize, sponsor events and activities related to telehealth and telemedicine and

- To collaborate with the official Peruvian organizations that work in this area.

In 2016, the telehealth activities are confirmed in the context of the development of health policies and on April 2 of that year, the Telesalud Framework Law [5] was enacted. The law establishes that the principles underlying telehealth are universality, equity, efficiency, quality of service, decentralization and social development. These principles have been reaffirmed since the development of the national telehealth plan in 2005.

The articulation of health policies with the development of actions in the framework of telehealth continues to be reaffirmed after defining telehealth as a strategy to provide health services, in order to improve its efficiency and quality and increase its coverage using information and communication technologies (ICT) in the national health system.

The law establishes that the health service providers must progressively incorporate the provision of telehealth services into their portfolio of services, guaranteeing their sustainability. Therefore, the law also deals with the process of financing telehealth actions. Both public and private networks define what telehealth actions can be performed and how they will function [5].

In addition, it assigns to the Ministry of Health the role of a coordinator of telehealth implementation. The National Telehealth Commission is responsible for the process of development and monitoring of the implementation of telehealth activities in the country. Therefore, it details the attributions of the National Telehealth Commission.

The telehealth framework law also deepens the normative aspects so that institutions, both public and private, can provide telehealth services [5].

In 2015, the Prestational Code 90710, called “Telehealth Care” was created. It is focused on the institutions providing Health Services of Level I, II and III. Through Jefatural Resolution No. 161-2015 / SIS, these institutions are effectively authorized to provide telehealth services [10]. This regulation standardizes, in article 1,

The benefits that can be provided with telehealth systems;

- Establishes the procedures for action;
- Determines the need to make the Contracts and Conventions that are relevant between the Providing Entities and the Comprehensive Health Insurance (SIS); and
- Empowers its Department of Management of Irrigation and Performance Assessment to expand by means of document the performance parameters to others not contemplated in these regulations.

Currently, from an organizational point of view, the area of telehealth is institutionalized in the organization chart of the Ministry – (Fig. 5) [11]. In the context of the four major directories of senior management in the Ministry of Health, the area of telehealth is linked to one of these high directions: the deputy ministerial office of benefits and health insurance. Note the continuation to this general direction with its different directions.

Fig. 5 Structure of the Ministry of Health of Peru with the presence of Telehealth. Source: Ministry of Health of Peru

General Direction – Vice-ministerial office of benefits and health insurance
Address of Individual Health Interventions
Address of Quality in Health
Address of Donation and Transplantations of Organs, Tissues and Cells
Address of Telehealth

Regarding the specific activities in the current period, the Ministry of Health continues to develop fragmented projects, but currently works for the implementation of a national telehealth project trying to focus on assistance to the birth of children. Among the 13160 medical institutions throughout the country, 802 provide this service. Among these, 477 are out of ADSL and 3G coverage. Therefore, priority is given to the implementation of this networks, in accordance with what is envisaged in the framework law of telehealth [12].

From the point of view of connectivity, FITEC operates a major project in the process of establishing a fiber optic backbone network. The latter connects 22 capitals and 180 provinces and allows the structuring of networks in the health units. There is also a project focused on the Amazon region aimed at improving the conditions of connectivity: Loreto-San Martin integration project, which would benefit 24 health centers [12]. The Broadband Installation project is for the integral connectivity and social development of the regions of Ayacucho, Apurimac, Huancavelica and Lambayeque. The Access Network will integrate and provide broadband telecommunication services to public entities (Educational Centers, Health Establishments and Commissaries) of 304 localities in the Region.

At present, the Ministry of Health plays a very important role in the setting up of the Teletraining programs. In cases of disasters, the priority

areas of training of the health professionals are infectious diseases, mental health and chronic diseases at the national level.

Several authors detect weaknesses in the development process of telehealth activities in Peru such as:

The geographic and social gap that requires comprehensive health care due to the existence of a broad geographic space and inequity in the provision of health services;

- The concentration of telecommunication services in urban areas;
- The deficient knowledge of ICT in the population and health personnel,
- The insufficient funding to implement telehealth projects;
- The insufficient dissemination of current experiences in Telehealth and existence of Tele-education platforms;
- The insufficient development of ICT;
- The inadequate computer training courses for health personnel;
- The cultural barriers and lack of training on the use of ICT in medicine;
- The lack of effective implementation of a national telehealth program and
- The potential increase in the tax burden of telecommunications services.

Regarding the recommendations and opportunities for the development of telehealth in Peru, the following systematized aspects should be highlighted [8]:

- Take a more active role in improving the quality of health information;
- The health institutions have to be computerized;
- To train citizens in the use of ICT and to facilitate the access of all citizens to ICT;
- To promote programs with content for health care;
- To support the initiatives for a greater equity in access to telehealth programs.

All of this will result in greater access to knowledge and research.

Gozzer [7], in a systematized study on telehealth projects in Peru, identifies the need for telehealth actions to move to a different level as follows:

- The need for collaborative work,
- Institutional efforts and funds to move from innovative interventions to the local level to interventions at the

- national level with a systemic approach that enhance the already developed services and
- Promoting the new uses of the Telehealth to give a greater impact to health policies and strategies.

When systematizing his proposals for the development of telehealth in Peru, Gozzer [7] points out that:

- It is necessary that the health authority assumes the leadership both within and between sectors, defining mechanisms to order the growth of this tool for the development of health interventions. In this way, the efficiency of investments is enhanced with an adequate cost-effectiveness balance.
- There is an urgent need to review the national Tele- health standards with the accumulated national experience and the technological capacity available at present. In particular, it is necessary to renew periodically the certifications and mandatory standards that must have interventions to use information and communication technologies for health.
- Another document that needs to be updated is the National Telehealth Plan, which should include the definition of intervention priorities that will promote the development of Telehealth.
- From the point of view of technological infrastructure, there is still a need to increase the bandwidth and access coverage, particularly to populations in the Amazonian and Andean regions.
- Finally, it is observed that few actors know what others are doing. In this regard, the promotion of information exchange networks and the use of different mechanisms such as forums, exchange of experiences, symposia and periodicals are recommended.

On the other hand, Altamirano [6] affirms that there were regulations that did not focus precisely on the aspects that would allow Peru to make a big leap. Yet, the latest regulations cover an important gap for the development of Peruvian telemedicine, as it was the need to enable the financing of the necessary investments by means of payment for the health services provided by telehealth and not only by means of pilot projects and specific subsidies. Nevertheless, he asserts that this is not enough, because that gap is not the only one. Therefore, this recent norm can and should constitute a significant change in the situation of telemedicine in Peru but only if, and only if, it is

accompanied by a genuine telehealth development policy, which also addresses other pending subjects.

Altamirano systematizes the challenges and opportunities for the development of telehealth in Peru, placing five aspects that need to be faced [6]:

- The dispersion and downgrading of specific Telehealth regulations in Peru. In this regard, the author affirms that the MINSA has a new challenge with the approval of the Telehealth Project and should design the guidelines and strategies that crystallize into a new Telehealth Plan that will allow the System to be extended to the whole country, allowing that inclusion in health reaches all Peruvians. All of the legislation that precedes and is currently in force is mainly oriented towards the application of information technology to existing hospital and medical management systems. It is very good that it is so, but in most cases it is not the updating a clearly obsolete National Plan or providing adequate regulatory support for the development of a system that offers telehealth services in Peru in an efficient and sustainable manner.
- The adequate delimitation of the scope of the concept of telehealth. Legal and ethical responsibility. In this article, the author states that it is clearly seen in the processors of the National Plan that it is willing to “reorient” initiatives towards the application of ICTs to improve administrative and organizational management in the health service. This distances itself from the genuine concept of telemedicine, associated with the medical act, to distance medical care.
- The Medical Act and the Telemedicine concept. Concept and practical consequences.
- The ethical and deontological risks of an extended telemedicine concept. The author states that the exercise of telemedicine presents its own peculiarities that must lead to the reconsideration of the current codes of ethics and the development of specific regulations to satisfy these new demands. The National Plan, in this regard, is aware of this need and proposes a series of criteria that can be considered valid, but insufficient.

In systematizing the necessary actions for the development of telehealth in Peru, Altamirano [6] proposes a consolidated text that compiles all the

regulations that control some aspect that should be taken into account for the development of a Telehealth Project in Peru. The regulations that regulate Telehealth in Peru are clearly insufficient, it is out of date and it directs resources to projects that are far from the practice of the distance medical act, which is the main advantage offered by telemedicine to serve in Peru to large sectors of the population that do not have access to health services.

In addition, it also points out that the absence of specific legal instruments that support the practice of telemedicine and its reorientation towards the distance medical act can be a drag that slows down or delays the expansion of this practice in the country, with consequent damages to the patients who could benefit from it, for health systems and for private companies with the intention of investing in this field [6].

Curioso [2] affirms that despite of the limits, the telehealth in Peru is becoming a reality, as in other countries in the region and the world, favoring access to health services at all levels of care, providing technological benefits, allowing a coordinated and immediate response of care, establishing a rapid and accurate diagnosis in case of an emergency.

To summarize:

The process of the development of telehealth actions in Peru is underway, with a set of rules and actions, although fragmented, that are certainly updated frequently to try to articulate with the process of development and standardization of the complex Peruvian health system.

Correa [13] notes that the norms, referred to telehealth and ICTs, establish coincident principles such as universal access. This coincidence makes possible the important point in the development of telehealth, since it allows establishing strategies whose priorities and actions will be joint, optimizing the work for the development of Telehealth.

According to Curioso [2], the National Telehealth Plan developed by the National Telehealth Commission opened a door to the development of Telehealth in Peru. It aims to bring more people to the efficient services in the health care, to the Medical knowledge, to training and information and, most importantly, it is an instrument that can in many cases be the only means by which health care can be provided in rural areas and preferably in the social interests.

It can be observed that the latest regulations advance in relation to the initial documents. They manage to offer concrete guidelines for the process of structuring of telehealth actions in the country. These regulations involve definitions regarding the types of services that can be offered, remuneration and structuring of activities. Altamirano [6] notes this progress, but asserts that the achievements are still insufficient.

Over the time, we also see a set of telehealth projects with different approaches and experiments that are developed in Peru in a fragmented way. These are various initiatives by public bodies that have invested in the field of telehealth. However, the projects neither continue nor cover the whole country. Altamirano [6] states that this process has led to numerous pilot projects that consume many resources without significant and sustainable results.

Yet, the result is of the accumulation in the country of an important experience in the field of telehealth, which generates conditions for the existence of projects of a greater scope. In the recent years, there has been an expansion of telehealth projects in both the public and private sectors [7]. In addition, there is also an effort to prioritize the development of the health system, as evidenced by the promulgation of the Framework Law on Telehealth.

Several authors consider that the current situation advances towards the structuring of a telehealth project in Peru that is strongly articulated with policies to strengthen the health system, which contributes to improving access and quality, particularly of the population of remote regions [2, 7, 8].

Curioso [2] states that telehealth provides greater accessibility to health care personnel, especially in rural and isolated areas and areas with limited resolution capacity, through the connection with health establishments. Through the telehealth, the interaction between health personnel and the user transcends geographical and temporal boundaries by avoiding unnecessary travel, shortening the waiting times and allowing diagnosis and support via remote treatment from specialized health establishments, thus covering the gap created by the lack of qualified human resources and necessary physical resources.

Murrugarra [14] states that his development will depend on the efforts of all the actors, from the end user and the community, to health professionals, the telecommunication companies and governing institutions, respectively, which will benefit from this technological potential at low cost.

Conclusion

The telemedicine services in Peru already have a wide development background, with several ongoing experiences, quite articulated with the development of the national health policies. Since 2003, there is a national telehealth commission that promulgated series of norms contributing to the development of telehealth in the country. It is verified that, in recent years, the directives derived from these norms allow an advance in the structuring of telehealth actions in the country. However, despite its growing development, there is still no structured project of national scope. One of

the fundamental pillars that has been prioritized have to do with the modernization of the infrastructure and interconnection. This will allow telehealth to work at all levels of the country and communicate to the health staff, among other activities, like teleconsultation, telesupervision and teletraining of the staff.

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Telehealth - Telemedicine in the U.S.A.

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Introduction

Telehealth-Telemedicine (THTM) is used throughout this chapter to signify the multi-disciplinary nature of the application of information and communication technology (ICT) to healthcare. The use of mobile devices to support care delivery, or mHealth, is an important segment of the THTM environment, especially for one-on-one communications. In low- and middle-income countries, mHealth may be the only mode available. THTM is changing USA healthcare in a dramatic way. The development, application and evaluation of technology-enabled processes continues to grow in nearly all care specialties and settings. This is reflected in a steady stream of THTM books and in the regular publication of THTM content in a wide range of professional health-related journals.

The purpose of this chapter is to inform a worldwide readership about USA THTM currently and its very wide-field march toward safe and effective evidence-based technology application to healthcare. The chapter will describe the state of THTM and the body of THTM research in the USA for this moment in time. The dynamic nature of telehealth-telemedicine challenges anyone to claim a full knowledge of all technologies and applications in the healthcare environment today. The field is messy with ideas and trials and the good ideas and successful trials will continue to move THTM forward, always toward the reward of better access, greater quality and manageable costs for every person's health and healthcare in the USA and worldwide.

As to the trajectory of THTM in the future, we can already predict with fair accuracy that THTM will soon be normalized with healthcare, perhaps by the end of this 20-teens decade. Providers and those people with healthcare needs will expect state of the art technology to support healthcare over distances and barriers. It is less clear, however, what this will mean for associations, authors and journals whose primary focus is THTM. As with any disruption that changes business-as-usual, it is probable that successful associations, journal and book authors will re-shape their missions and goals to best meet the needs of their desired constituencies.

The book, "A Century of Telemedicine – *Curatio Sine Distantia et Tempora*," was published as the introductory book to a series of books describing THTM by-country [1]. Content about THTM in the USA is

plentiful in the book and reaches back to the 19th century with telegraph and telephone communications supporting healthcare over distances. Decade after decade, existing applications have been created, tested and improved, with new applications brought from ideas to reality. The creative genius and determination of early innovators deserves great respect. These innovators sparked the diffusion of new knowledge and technology throughout healthcare in specialties from cardiology to radiology and gave rise to more uses of ICT to include videoconferencing, distance learning, telecardiology, teleradiology, telepathology, telephone triage, satellite applications and space medicine. Today, every setting (e.g., primary care, intensive care unit (ICU), specialty (e.g., dermatology, mental health), and every care group from fetus/neonate to the very old can, and often will, experience and benefit from THTM.

Another recent book, “History of Telemedicine: Evolution, Context & Transformation,” has made a significant contribution to our knowledge about telemedicine in the USA, beginning with a history of the technological foundations of telemedicine and the rationale for telemedicine in healthcare [2]. Three large eras are described in the book: the pioneering era (1870 to 1972), the coming-of-age era, and the transformation of telemedicine with the need for science-based evidence that telemedicine is safe and effective. The authors aim to place the evolution of telemedicine in its proper context and to share at least an appreciation, if not outright enthusiasm for, “telemedicine’s potential to improve the human condition” [Preface].

The Agency for Healthcare Research and Quality (AHRQ) is an agency of the U.S. Department of Health and Human Services. AHRQ added to our knowledge in 2016 with a broad review of current telehealth research, “Telehealth: Mapping the Evidence of Patient Outcomes from Systematic Reviews” [3]. The purpose and method of this work were “to provide an overview of a large and disparate body of evidence about telehealth for use by decision-makers. The research approach was to create an evidence map of systematic reviews published to date that assess the impact of telehealth on clinical outcomes” [page vi]. Of 1494 telehealth citations from 2015 and earlier, 58 systematic reviews met the inclusion criteria. Two of the many highlights of the report are the (1) the levels of evidence found in the studies and (2) evidence on cost and utilization drawn from the systematic reviews that identified the intersection of the clinical focus and telehealth function (e.g., cardiovascular disease intersecting with remote patient monitoring).

Telehealth Telemedicine in the USA 2016 & First Quarter 2017

To support readability and comprehension of the breadth and depth of the work that is taking place to advance technology and care delivery in many

specialties and settings, this section has two major parts. This first part will describe the conceptual, economic and practice improvement work in the THTM environment in the USA today. The second part will describe technology research and human subjects research. It is beyond the scope of the chapter to detail the contents of every THTM publication available (in English) today. Instead, readers can see the information that is available and draw conclusions about what can be used to best meet their needs and where they might look for additional information. For example, while care providers might want information about mental health or chronic illness interventions, technology developers would look to apply and advance current technology research findings, and health leaders may find useful the practice improvement content and reports of successful system-wide programs and applications.

The traditional approach to a search of publications is to use one or several search terms and inclusion criteria with databases such as PubMed, CINAHL, PsycINFO, EMBASE, Global Health, HealthStar, ISI Web of Science, and Google. However, established databases are slow to add new journals and, with PubMed, to assign MeSH subject headings to new titles. Also, the headings for the different databases, e.g., PubMed and CINAHL, may overlap or be different. Each database indexes its own unique set of journals. Some indexes add additional materials such as books, book chapters, government publications or dissertations. Databases that use automatic term mapping make searches more difficult as the search terms are identified wherever they are in the article, making a more detailed manual search, preferably by a professional librarian, necessary after all. To look at the literature more broadly, using, but not being limited by, search terms, we repeatedly accessed tables of contents from dozens of journals that represented many health disciplines. This search method found more than 200 USA-based THTM publications from 2016 and more than 70 publications from the first quarter of 2017.

More than half of the publications found were reports of research; others were systematic reviews, literature reviews, editorials, commentaries, THTM economic analyses, and practice improvement information (e.g., practice guidelines, specialty policies, legal and ethical issues, various telehealth programs and care models). Among the many journals accessed for this chapter were several journals specifically focused on telemedicine, eHealth and telecare. The topics of the editorials in these journals were always about THTM; those editorials included here were found fit for purpose in describing USA THTM today. A few publications in the set used for this chapter had reports by authors from both the USA and another country.

Establishing THTM Knowledge and Advancing Practice

Systematic Reviews and Meta-analyses

Publications describing systematic reviews in specified areas of THTM are useful in marking the state of the issue or of the science for that topic at a moment in time. Generally, systematic reviews and meta-analyses are a more in-depth treatment of the topic than literature reviews. Systematic reviews require comprehensive synthesis of literature to determine what is known and how it can best be described, perhaps using a new explanatory model. Meta-analyses, on the other hand, use mathematical models and statistical methods to bring a set of studies into a coherent unit of analysis for generalizable findings. The distinction between a review of literature and a systematic review is often unclear. In this section, state of the science papers and author- or journal-labeled systematic reviews and meta-analyses were included.

What can we learn from systematic reviews and meta-analyses? These processes are not for the faint of heart. Four papers took on the very large topics of the empirical foundations of teleradiology and related applications [4], telemedicine interventions in primary care [5], telemedicine interventions in mental disorders [6] and telepathology [7]. The teleradiology paper described modalities of teleradiology, radiology costs and teleradiology [4]. The authors' review process was described and the accumulated references were analyzed. The lengthy text was summarized in tables emphasizing outcomes and cost, two essential benchmarks for care delivery and quality. The paper concluded with 156 references which, in addition to supporting the paper, should satisfy radiology practitioners, educators, students and researchers. Radiologists were early adopters of information and communication technology for their purposes with providers seeing the value of digitized images over physical x-rays, for transmission, consultation and storage capacity.

The primary care paper noted that many challenges face the specialty of primary care, among them insufficient numbers of practitioners and the wide scope of care delivery knowledge, skills and abilities expected of practitioners [5]. An analysis of the literature was presented in terms of intermediate effects, health outcomes of care recipients and cost of care. The paper concluded with 138 references, 86 of which represented research that could be assessed for methods and outcomes. The substantial review can support clinicians and primary care advocates as telemedicine technology supports practice and improves access and quality for people with health care needs.

The paper about telemedicine interventions in mental disorders also represented a large undertaking, not least because in the USA, and in other areas of the world, people with mental health problems are an overwhelming problem for themselves and their families, for health care systems and for the

public health [6]. The paper assessed the state of scientific knowledge about the merit of telemedicine interventions in the treatment of mental disorders in terms of feasibility or acceptance, effects on medication compliance, care outcomes and cost. Ninety-eight references were provided, with 22 papers being analyzed for feasibility or acceptability of research findings. The two prevailing systems of classification of mental disorders referred to in this paper are the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) and the International Classification of Diseases (ICD-10). Efficient and effective telehealth modalities that can be used in people with mental disorders are and will continue to be essential in dealing with this nation-wide problem.

The telepathology paper gave a history of this specialty and its instrumentation and nomenclature [7]. Innovations in telepathology system designs were described; as with any innovation, new applications came to be accepted over time. The paper described empirical evidence in telepathology outcomes, reviewing dozens of relevant publications. The review compared year, country, study design, sample size, intervention, findings and included the authors' comments. One hundred ninety-seven references completed the paper, making the publication an excellent source on the topic for providers, researchers, educators and students.

Thirteen more papers demonstrated systematic reviews and meta-analyses used to assess technology applications. It must be said, however, that the researchers doing the reviews and analyses were often limited in their ability to find substantial numbers of research reports meeting their inclusion criteria and, in those reports, sample sizes and methods were often insufficient to support valid and generalizable findings. The papers described below are in the areas of therapy for caregivers in stroke and palliative care (2 papers), outcomes in palliative care (1 paper), people with chronic disease (diabetes and cardiovascular disease) (6 papers), people with mental illness (1 paper), maternal health (1 paper), weight loss (1 paper) and remote patient monitoring (1 paper). We will see that these categories are found repeatedly in THTM publications.

Therapy for Caregivers

Caregiver outcomes were analyzed in a review of telehealth interventions when a care recipient was receiving palliative care [8]. In a review of literature from 2003 to 2015, 221 articles were found but only 9 met the study's inclusion criteria. Caregiver quality of life, satisfaction, anxiety and burden were frequent study variables but were not all used in every study. Findings were that overall there was a suggestion of caregiver satisfaction with a telehealth intervention. This paper represented the challenges of systematic reviews: few studies meeting the inclusion or exclusion criteria,

different variables measured across the studies, and small sample sizes in each study. Another review of caregiver research looked at the impact of technology-based intervention for caregivers of stroke survivors [9]. As with the previous paper, the number of studies meeting this study's criteria was small, at only 5, with a wide range of variables and small sample sizes. In their call for further research, the authors recommended consistent use of three scales that could be used for future studies of caregivers, those being scales for caregiver depression, caregiver burden and caregiver life quality. This would support multiple researchers in using consistent research designs that would allow greater ability to aggregate data and determine well-supported outcomes.

Outcomes in Palliative Care

In a systematic review of patient-reported outcomes in palliative care, 12 studies (6 quantitative and 6 qualitative) were evaluated for interventions and outcomes [10]. Technology used included videophones and regular phones for counseling and support, self-monitoring equipment, computer with internet access for communication and smart phones. Most of the studies lacked rigorous methods and the results varied across the studies. Quality of life was not significantly changed among the study group. Overall, the authors noted there was weak support for telehealth interventions in palliative care.

People with Chronic Disease

A systematic review and meta-analysis of 92 studies [11], a meta-analysis of 55 randomized controlled trials (RCT) [12] and a systematic review of secure messaging with electronic health records (EHR) [13] involved people with diabetes. The very large number of people in the USA with diabetes (type 1 or type 2) warrants a great deal more research to find what works to deal with this disease and its complications. More knowledge about successful prevention of diabetes is also needed. The International Diabetes Foundation has estimated that North America and the Caribbean had 44.3 million people with diabetes in 2015 and will have 60.5 million people with diabetes in 2040 [14]. The US Centers for Disease Control and Prevention (CDC) estimated that 22 million people, or 7 percent of the USA population, have diabetes [15].

The systematic review and meta-analysis analyzed whether nutritional counseling in telemedicine improved treatment outcomes in diabetes [11]. The researchers found no difference in outcomes between people who had a nutritional component and those who had not received the nutritional counseling. They also reported that nutritional interventions via short messages such as email or text messages were equally as effective as personal

nutritional counseling with videoconferencing or telephone. The meta-analysis of RCTs found that telemedicine applications during care were favored over conventional care, with more effect among people with type 2 diabetes than those with type 1 diabetes [12]. The systematic review of secure messaging integrated with the patient's EHR pointed out that tools used in managing people with diabetes and in helping them to manage themselves should be assured of security [13]. The researchers reviewed reports of research that included secure messaging. There was significant improvement of patients' glycated hemoglobin (HbA1c) in 7 of the 11 reports, however, secondary outcomes (blood pressure and cholesterol management) had inconsistent findings. All three of these studies add to the body of knowledge about telemedicine in diabetes care and management by grouping previous studies and drawing conclusions. Evidence in support of THTM for people with diabetes can be found in systematic reviews and meta-analysis but the evidence is not overwhelming.

Two systematic reviews and a meta-analysis of telehealth interventions for cardiovascular disease reported mixed support of telehealth applications. Heart disease is a serious problem in the USA [16]. It is the leading cause of death for both men and women. About 610,000 Americans die from heart disease every year (1 in 4 deaths). Coronary heart disease, the most common type of heart disease, killed about 365,000 people in 2014.

A systematic review of 9 studies examining the impact of mHealth-based heart failure management interventions on heart failure outcomes found inconsistent support for the interventions [17]. Typical interventions were the use of blood pressure measuring devices, weighing scales and electrocardiogram recorders. Monitoring processes and intensity varied across the studies. Outcomes measured included all-cause mortality, cardiovascular mortality, heart failure-related hospitalizations, length of stay, functional class, left ventricular ejection fraction, quality of life and self-care. Evidence supporting the relationship between telehealth and outcomes was inconclusive. The authors noted limitations of the studies reviewed to include small sample sizes and use of older mobile phone technology.

A systematic review of 28 studies assessing text messaging and mobile applications (apps) for secondary prevention of cardiovascular disease found that 22 of the 28 studies reported effectiveness in improving outcomes [18]. The studies of text messaging or mobile apps compared with internet or continuous monitoring found that user adherence and satisfaction were higher among the texting and apps group. The authors noted that when text messages are used to enhance adherence, a once-per-day frequency should be considered.

In a meta-analysis of remote hemodynamic-guided care for people with heart failure, 5 studies involving 1296 patients with chronic heart failure were analyzed in detail [19]. Heterogeneity testing failed to show instability of analysis due to differences between the trials. The authors found that patients with an implantable device for measuring cardiac filling pressures had a 38% lower hospitalization rate with this therapy, concluding that this therapy is superior to traditional clinical management.

People with Mental Illness

Telehealth applications are showing positive outcomes when dealing with the problem of mental illness in the US. The National Alliance on Mental Illness has reported that every year 1 in 5 people in America will experience mental illness [20]. One in 25 adults in America (10 million people) live with serious mental illness. And one-half of all chronic mental illness begins by age 14; three-quarters of all chronic illness begins by age 24.

A meta-analysis of 36 randomized controlled trials of computerized cognitive behavioral therapy (cCBT) for anxiety and depression was undertaken to describe a range of indices that impact efficacy and generalizability [21]. The authors noted that the number of RCTs for cCBT has nearly doubled in the last 4 years. They further reported that pooled effect estimates showed about 50 percent of participants, who receive cCBT for anxiety or depression, will experience clinically significant change, a rate about 3 times greater than with conventional therapy. The literature is increasingly showing that computerized psychotherapy is a viable option for people unable or unwilling to engage with traditional face-to-face therapy.

Maternal Health

mHealth is a great step forward for maternal and child health especially in low-income countries, where mobile phones are proliferating. In a systematic review of mHealth interventions in 14 countries, the authors found 19 studies that met their inclusion criteria [22]. In assessing the quality of the studies, 5 were 'high,' 5 'moderate' and 9 'low' quality. Mobile phones were used for decision support, provider to provider communication, appointment reminders, health education and clinical management. Mobile phones are not uncommon in underserved populations but challenges in using them for research include their cost, maintenance and the means for keeping each unit charged. The authors recommended more rigorous testing so that resources can be sought to scale up this technology.

Weight Loss

A meta-analysis of 12 studies using mobile phones to deliver interventions to reduce body weight reported that 4 studies rated 'strong,' 7 studies rated 'moderate,' and 1 study rated 'weak' using the Effective Public Health

Practice Project Quality Assessment Tool for Quantitative Studies [23]. Considering the papers together, the pooled body weight reduction with mobile phone interventions was significant. Associated with weight reduction were personal contact and more frequent, e.g., daily, interactions with the target population.

Remote Monitoring

The ability to monitor people over distances and barriers may be the most important means by which people in the USA see and normalize telehealth and telemedicine as essential to their physical, mental and social well-being. Remote patient monitoring (RPM) is in health providers' and some patients' lexicon but the understanding and application of RPM capability applies beyond patients to all people interested in their health.

A systematic review of 62 papers addressing RPM via non-invasive digital technologies used a patient-centered definition of RPM: "an ambulatory, noninvasive digital technology used to capture patient data in real time and transmit health information for assessment by a health professional or for self-management" [page 4] [24]. Most of the studies (44 of 62) were RCTs. Key trends identified included technology such as smartphones/PDAs, wearable devices, biosensor devices, computerized systems, and multiple component systems. Wearable devices most often transmitted data to study researchers while biosensor devices and multicomponent interventions mostly transmitted data to physicians or nurses. People with respiratory or metabolic conditions were primarily monitored with multicomponent systems while people with cardiovascular diseases were mainly monitored using biosensor devices. The authors noted that most studies reported positive health outcomes.

Reviews of Tele-rehabilitation Literature

Of the 9 author- or journal-declared reviews of literature found with the search for this chapter, 1 concerned tele-rehabilitation with older adults and 8 were from the mental health field. Reviews of literature focused on technology itself will be described in a later section of the chapter.

Tele-rehabilitation

This paper reviewed 9 studies from 4 countries published from 2006 to 2015 [25]. Technology used included real-time video with a remote therapist (6) and text- or web-based messaging and electronic surveys (3). Six studies used dial-up internet service and 3 used broadband connections. The authors noted that the real-time video interventions were feasible and gave evidence of improvements in physical function, self-efficacy and quality of life. There was some evidence for improved exercise adherence and performance of

instrumental and social tasks with the text- or web-based messaging interventions. In-home tele-rehabilitation applications are a positive use of telehealth technology.

Mental Health

The 8 mental health papers all describe literature reviews for telehealth interventions with children or adolescents or both as the care recipient group. Concerns for privacy, confidentiality, provider preparedness and emerging evidence for care models, the goal of positive outcomes and the need for more research are themes throughout the papers. Four papers addressed videoconferencing for children and adolescent mental health therapy. In a review of real-time videoconference evidence in 38 studies, the authors noted positive results, such as increasing evidence for practice, and advantages for the children, such as acceptance by families and treatment available even with the demand for therapy exceeding the supply of specialists [26]. Another paper reviewed the benefits and barriers of using videoconferencing for cognitive behavioral therapy with children [27]. Benefits included cost reduction, family participation (if appropriate) and a more comfortable environment, which could allow the child to reveal more information. Barriers noted were a decreased ability for the provider to assess body language and nonverbal behavior, distractions in the child's environment and a mismatch between the child's chronological age and his or her developmental stage.

A paper on videoconferencing with children and adolescents addressed the development of rapport and therapeutic alliance during telemental health sessions [28]. The authors noted evidence in the literature that therapists can establish therapeutic relationships in telemental health, based on patient feedback. Rapport and therapeutic alliance need an accurate client evaluation, evidence-based care and family support, if effective outcomes are to be achieved. Another paper concerned juvenile offenders who may be helped in their rehabilitation with videoconferencing [29]. The challenges are many with this group, who may have decreased access to technology due to their socioeconomic environment, and decreased mental maturity and emotional connectedness. The authors noted no known negative outcomes from using teleconferencing with juvenile offenders but that more research is needed to validate inferred positive outcomes.

Two reviews of literature for children with psychiatric conditions focused on mobile health interventions. In one, the authors reviewed 8 studies that had outcome data regarding the mHealth intervention for children with mental disorders [30]. Outcome categories included usability, acceptance, feasibility and clinical outcomes. Most of the studies had small sample sizes; only 3 included symptomatic improvement outcomes with 2 of these using a

control group for comparison. The authors noted that mHealth is subjectively useful for mental health interventions with children but that rigorously designed large-scale studies are needed to establish an evidence base.

Another paper assessed barriers to evidence based treatment, potential benefits of mHealth for childhood anxiety disorders, standards for evaluating mHealth interventions and currently available applications [31]. The author identified a key barrier to effective care as being insufficient numbers of therapists using evidence-based treatments. Benefits included the ability to reach more people, given the ubiquity of smart phones, and ICT that supports schedule reminders, individually tailored information, real time assessment and accessible asynchronous communication. Three standards for evaluating apps for child anxiety were: consistence with the treatment literature, design and functionality that maximizes engagement, and empirical evidence that the app is correlated with positive outcomes. The author noted that few apps meeting these standards are available and then went on to describe the Mayo Clinic Anxiety Coach app, which would meet the standards.

The seventh review of literature for mental health addressed the use of telepharmacotherapy with children and adolescent psychiatric patients [32]. The authors noted that there was more literature supporting treatment of adults with psychotropic medications via telepsychiatry than that supporting children receiving this treatment. The authors noted one randomized trial with children and two retrospective chart reviews that provided the beginnings of evidence for care. Then followed a clear recognition of eight challenges for the topic. For example, challenge 3 was selecting a model of care that defines the telepsychiatrist's role in the patient's system of care, coordinates pharmacotherapy with primary care providers, and complements the mental healthcare system in the local community. Each challenge was followed by a substantive solution that should be useful to others involved with telepharmacotherapy for child and adolescent psychiatric patients.

The eighth review of literature for mental health addressed technology-based care for attention deficit hyperactivity disorder (ADHD), the most common childhood neurodevelopmental disorder [33]. The authors reviewed literature for evidence-based technology in ADHD care and then proposed a theoretical model for implementation and evaluation of technological interventions. The model had three major components for developers who design intervention technology for ADHD: schedule setting, difficulty matching (adjusting to person's level of functioning and behavior changes), and immediate feedback (to behavior). The authors distinguished technology by its training or support function and then listed 7 types of ADHD-related technology by their domain of behavioral function construct (e.g., sustain attention, emotion lability) and their training or support characteristic.

Editorials

Nine editorials were found that were fit for purpose for this chapter and they expressed a range of opinions on telehealth telemedicine from absolute support to more-evidence-is-needed (as was often seen in the systematic and literature reviews above), to raising the need for recognition of a digital divide that exists for potential beneficiaries of technology. An editorial from a THTM journal showed optimism for a newer model of health care access [34], two from cardiovascular journals were positive but guarded [35, 36], one from the neurovascular community supplemented by a commentary and clinical trial report showed positive support for telestroke [37, 38, 39], two from the pain literature advocated for more evidence [40, 41], one from the rehabilitation literature stressed the critical patient-provider relationship in rehabilitation [42], and two addressed the digital divide in different populations [43, 44].

Direct Access Telemedicine

Direct access telemedicine, or direct-to-consumer medicine, is an approach that goes directly from the person with healthcare needs to the necessary care provider without having to first go through a primary care gate-keeper [34]. Estimates are that 124 million doctor-patient video consultations will take place in the USA by 2019, compared with 7.2 million in 2015 [34]. Many questions arise from this direct access phenomenon, including quality of care using evidence-based best practices, numbers of people seeking care who would not otherwise seek care, costs of care, processes of referral, management of interventions including devices and prescription drugs, and patient protections such as privacy and confidentiality.

Cardiovascular

In a cautiously supportive editorial, consumer-focused technology was said to be important in cardiovascular disease prevention and treatment [35]. The many types of technology are not yet fully able to meet the needs of providers and patients due to, for example, designs that compromise usability, a lack of evidence for quality, and insufficient safety and security. However, the technology is going to continue to develop and healthcare providers will need to ensure that ethical standards, procedures and evaluation measures are all in place.

Another editorial from the cardiovascular environment, with authors from the USA and Germany, discussed a clinical trial (Optilink) that failed to show benefit for remote telemedicine support [36]. The editorial noted that the disappointing results may have been due to factors in the trial design and workflow. The authors maintained that the trial results do not indicate that remote monitoring is ineffective in heart failure and that implant-based

remote monitoring will continue to be improved so that it is a key technology in heart failure. The trial was presented in a separate article in the journal. The editorial was supportive of the trial researchers and encouraged continued research in this field.

Neurovascular

An editorial [37], comment [38] and report of a systematic review and meta-analysis [39] on the topic of thrombolysis in patients with stroke were published in the same journal. The editors briefly summarized the history of stroke care and noted the substantive research report. They then noted that an “adequate number of studies have demonstrated virtual stroke care as non-inferior to on-site stroke care” (p. 1314) [37]. Clinicians commented that until this review and meta-analysis, no one had compared telestroke with on-site treatment of stroke in such a comprehensive fashion. They wrote that the data suggested that telestroke is at least as good and as safe as being treated for stroke at a medical center [38]. The research itself took place in Germany. The researchers added a caveat to the findings noted in the editorial and comment by writing that thrombolysis is safe and effective in the 3-hour window and more research is needed to further substantiate safety of treatment in longer time frames (3-4.5-hour window) [39].

Pain Care Technology

Pain is a complex phenomenon for people with pain and for providers who care for them. Chronic pain affects about 100 million people in the USA. The costs for healthcare plus disability days and lost wages and productivity due to pain range from \$560billion to \$635billion annually [45]. An editorial advocating the use of digital apps that would serve people with chronic pain described what is needed beyond the apps available for healthcare today [40]. Apps for pain could include information apps and patient-facing apps that would support patient engagement and integrate a biopsychosocial approach to pain. Other types of apps for pain could include diaries and social support and self-management modalities. The apps should be consumer friendly and should contain clinically valid processes and data using evidence-based guidelines.

A second editorial from the pain care community wondered if pain care through telemedicine is future or folly [41]. While recognizing the possible benefits of telehealth pain services, to include improved access to care, opioid discontinuation, reduced pain in cancer patients and improved psychosocial outcomes in patients with fibromyalgia, the author noted that pain services must be economically viable. In the US, this includes compliance with the CMS 2016 Final Rule Medicare Telehealth Services (cms.gov). The Rule stipulates that the telehealth service must be furnished via an interactive

telecommunications system, by an authorized provider, to an eligible individual. The person receiving the service must be in a telehealth-originating site [41]. These concerns raise an important issue in the USA, with its complex insurance and financial structures for healthcare in America.

Rehabilitation

The authors of this editorial about rehabilitation expressed concern over the possibility that the proliferation of technology applications for rehabilitation may threaten the patient-provider relationship and its goodness in the patient's recovery [42]. Given that technology applications have the potential to support and enhance the patient-provider relationship, three aspects of the care process were listed and elaborated. The aspects were: knowing the person and contextual factors, effective information exchange and information and shared goal setting and action planning. The authors also stressed the importance of ensuring privacy, confidentiality and security when more sophisticated technologies are added to the patient's rehabilitation regimen.

Digital Divide

In a discussion of telehealth technology supporting family caregivers (estimated at more than 40 million caregivers in the USA as of 2015), the authors were encouraging about the range of tools and interventions available [43]. Tools described included videos, web-based interactive platforms and telephone-based technology. However, a 2016 survey found that while 71% of caregivers were interested in supportive technology, only 7% were using it to assist with caregiving tasks. The authors emphasized the importance of recognizing a digital divide due to caregivers' lack of technical skills, the lack of infrastructure supporting technology, and the cost of hardware and software.

Another editorial made note of the emerging evidence revealing a digital divide in health technology use, especially among racial or ethnic minority groups or those with limited health literacy [44]. The editor wrote that this issue of the journal aimed to provide evidence about the design, testing and implementation of mobile or fixed technology platforms that would address the diverse nature of care recipients, in this case, people with diabetes. It is critical to consider the patient's family environment, culture, language and capability for interaction with the healthcare system, if the digital divide is to be overcome.

Commentaries

The papers in this section were narrative descriptions of a wide range of telehealth telemedicine care recipient groups. Topics included pediatric

telehealth [46], outpatient and private practice telehealth [47, 48], primary care obesity management in rural older adults [49], lessons learned in telehealth research with underserved populations [50], challenges in using telemedicine with children with special health care needs [51], telemental health with children and adolescents [52, 53], telehealth with people with chronic disease [54, 55, 56], and reducing readmissions in people with heart failure [57] and teleICU [58].

The commentary authors often gave their definitions for telemedicine or telehealth or both, and addressed telehealth benefits, barriers and challenges; most made recommendations for dealing with the latter two. Benefits, or potential benefits, were those generally found in THTM literature and included improved access and outreach; patient, family and provider education; and improved resource utilization [46]. Challenges included the technology itself, provider concerns, financial barriers, provider credentialing and licensing, and legal concerns [46]. More challenges included when to use and when not to use technology, who in primary care is using telehealth in clinical practices, increased risks due to decreased confidentiality, truly informed consent, logistics and patient safety [47, 48]. Still more challenges included lack of the specific service provider required for care, transportation, and uncertainty about reimbursement [49].

Assumptions about the availability of technology also need to be assessed for accuracy. Researchers intending to use mHealth applications (smartphones) for research with underserved populations, in this case American Indian and Alaska Native women, found that the research participants could not be given smartphones due to their cost, maintenance and uncertain post-study use [50].

Families of children with special health care needs face many barriers to the frequent need for routine and urgent care such as access to providers and financial, insurance and geographic barriers to care [51]. Some research has shown telemedicine interventions to be effective with this population but more research is needed. The authors proposed research specifically in the topic of telemedicine applications and effectiveness with a family-centered care model.

In addition to the benefits already described, telemental health with children and adolescents can decrease (1) time away from school and work (parents), (2) worries about unfamiliar care settings, and (3) the stigma by connecting to child friendly settings such as schools [52]. These authors gave a well-organized description of the when, where, who with and how to implement telemental health programs with children and adolescents. Online and virtual therapies for children with mental health needs are being developed and implemented with some success. Key principles for

technology design are usability – can the child effectively use the technology – and user experience – is the child engaged and motivated to use the technology [53]. A further caution with this therapeutic modality was that clinical practitioners need to be continually advancing their skills and abilities with technology.

In an overview of technology in chronic disease care, the point was made that chronic disease in the USA accounts for 86% of healthcare costs and 70% of deaths [54]. Self-care and self-management were commonly used models for working with people with chronic disease to maintain, if not improve, their state of health. These authors noted that tracking disease-associated metrics directly educates and engages patients in self-care toward improved outcomes. A useful description of the components of an integrated practice unit was given and included exercise, diet planning, medication adjustment, education, health apps, and social development network [54].

Authors writing commentaries often described what should be possible (as compared with researchers who are obliged to describe what was possible). A brief discussion of current and future trends in diabetes gave a clear schematic of diabetes care using telemedicine [55]. The steps were these: measure glucose; transmit glucose data and data from other sources; aggregate glucose data with other physiologic data; analyze; use remote cloud storage; present as actionable information and populate a treatment algorithm; patient makes decision; data driven action; improved outcome [55]. Perfection. Barriers and solutions identified in this paper, in addition to those above, included EHR integration (solution: train users, improve workflow and data), perceived low quality care (solution: positive outcomes data), and low consumer trust and acceptance (solution: MD satisfaction).

A commentary on telemedicine and cardiology noted that cardiologists have used telehealth applications for many years, including Holter (home) monitoring and emergency department cardiology consultations over distances [56]. There was some evidence that primary care electronic consultations with cardiologists can reduce emergency room visits. As noted above, barriers included reimbursement and providers who are slow to embrace the technology.

Another commentary from the cardiovascular community noted that telemonitoring has not shown improved outcomes in heart failure [57]. Two large studies were briefly described (Tele-HF and BEAT-HF), both of which had negative findings. The authors considered the emerging concept of ‘treatment burden’ as helpful in understanding low patient adherence to a treatment regime. The authors briefly described two more areas for future researchers’ consideration, those being toxicities of hospitalization and persistence of symptoms after discharge.

A commentary about the evolution of Tele-intensive care unit or electronic intensive care unit (TeleICU or eICU) noted that this style of augmented practice has demonstrated an obvious and logical approach to dealing with the shortage of critical care expertise throughout the country [58]. This is especially true in rural and underserved areas where relatively large numbers of critically ill patients can benefit from centrally located physicians and nurses.

Telehealth Telemedicine Economic Analyses

The economics of THTM are an underlying current of nearly every healthcare delivery service in the USA, be it large or small, urban or rural, new or established. Publications about the THTM economics range from big-picture to more focused analyses to healthcare specialties similar with those described in the sections above. The papers described below are substantive, data-filled and complex. While numbers of beneficiaries served by THTM can be counted objectively, the data for estimating value, benefits, and even outcomes are often subjective and difficult to measure. A further challenge with economic data and results is the rapid proliferation and change of THTM technology and applications. What was true and data-based one year ago may not be true and data-based today.

Big-Picture Economics

The big-picture publications dealt with business models [59], economic value of eHealth [60] and quality improvement methods' efficiency, throughput and outcomes [61]. Business models were shown to help articulate and clarify the complexities of a service, in this case telehealth [59]. After describing 26 business models from the literature, the VISOR approach to business plan development was described; it addressed the service's value proposition, interface, service platform, organizing model and revenue model. Descriptors for each of these concepts were given and examples were then used to further articulate the author's recommendations.

Evidence for the economic value of eHealth in the USA was drawn from a systematic review of related literature leading to 20 papers subjected to qualitative analyses [60]. The authors considered eHealth ranging from single isolated technologies to complete virtual systems of healthcare and divided their findings between single-item cost assessments and full cost assessments. The authors noted that economic studies need great design rigor and that cost assessments were most common in rural areas or in areas lacking clinical specialties.

Another approach to health information technology economic analysis considered quality improvement methodologies' (QIMs) efficiency, throughput and financial outcomes [61]. The study focused on 8 QIMs: Lean

Six Sigma, Lean Management, Six Sigma, Clinical Pathways, Business Process Reengineering, Continuous Improvement, Total Quality Management and Benchmarking. While 99.3% of the sites studied had implemented at least one QIM over the last 10 years, an inverse correlation was found between manual data collection and overall QIM efficiency and throughput outcomes and an insignificant relationship with financial outcomes. The authors noted that it was not clear whether automated data collection could show a positive correction.

Focused Economic Analyses

Somewhat narrower discussions of THTM economics include delivery type [62], within a specified system [63], and within a specified care recipient population [64]. The direct-to-consumer (DTC) telehealth model, where a patient has access to a physician via telephone or videoconferencing, is gaining adherents rapidly [62]. These authors used commercial claims data on over 300,000 patients from 2011 to 2013 to explore patterns of utilization. Their concerns were that DTC could lead to more care episodes, and therefore costs, and it could increase spending on illnesses that would otherwise not have caused a person to seek medical care. Their first concern was not supported by their data analysis but they also estimated 88% of the visits they analyzed represented new, and possibly unnecessary, visits to a provider.

Soon after this study was published, an article in the lay press summarized its findings and included a rebuttal from one of the companies whose data the study had used, specifically that this company's 2016 data showed only 13% of DTC interactions represented new medical use [65].

An analysis of cost was done at one USA Veterans Affairs (VA) hospital in Vermont, to quantify travel expense savings with the use of telemedicine over an 8-year period [63]. The VA is unique in that it pays travel reimbursement for time and money spent traveling to appointments. The authors reported that telemedicine visits, compared with face-to-face visits resulted in average travel savings of 145 miles and 142 minutes per patient. With 47.1% of patients eligible for travel payments, the total amount saved was an average of \$18,555 per year. Although this was a substantial amount, the authors noted that the savings on travel pay were relatively modest, amounting to 3.5% of the total travel budget.

Rural, older people in the USA (those over 65 years or those disabled, and eligible for government-sponsored Medicare) are often seen as an important group who could benefit from telehealth. Using 2004-2013 claims data from a 20% random sample of Medicare beneficiaries, telemedicine visits were categorized by diagnosis, location, and socio-economic demographics [64]. Telemedicine visits in this sample increased from 7015 in 2004 to 107,955 in 2013, a 28% annual growth rate. While these data were impressive, this

represented less than 1% of rural Medicare beneficiaries compared with the VA system, where 12% of beneficiaries received some form of telehealth in a year.

Economics in Specialties and Settings

The third category for THTM publications with an economic focus included examples from mental health, chronic disease and heart failure, telestroke and intensive care. As noted above, mental health disorders often begin during childhood or adolescence. When looking at economic benefits of mobile apps for mental health and telepsychiatry with adolescents, there were direct and indirect benefits for the care recipient, provider and caregivers [66]. The authors qualitatively described the benefits, listing 4 or 5 for each category. With apps, a direct benefit could be savings from preventing higher acuity situations, while an indirect benefit could be increased earnings and economic output from improved performance at work. With telepsychiatry, a direct benefit could be higher earnings for the psychiatrist due to higher service use and fewer missed appointments, and an indirect benefit could be decreased lost wages and increased economic productivity for caregivers. The authors noted there was sparse quantitative research on the return on investment for these types of telehealth interventions.

Researchers in New Mexico compared costs of behavioral health care for rural, Native American people between care via telehealth, physicians traveling to satellite sites to provide care, and patients traveling to the physician at the main site [67]. In addition to travel and per diem cost comparisons, the costs of the telehealth system were modeled using equipment, transmission, administrative and IT costs from an established center. The per-patient travel cost for physicians was \$170 and for patients \$334, while the per-patient cost of providing behavioral care via telehealth was \$138. These findings can help to guide policy about the feasibility of using telehealth with rural populations.

Medical expenditures in people with chronic disease(s) account for a large percentage of healthcare costs in the USA. Using a random effects regression model, researchers compared people who participated in a payer-provided telephone-based chronic disease management program with people who did not participate in the program [68]. Claims data were used with the subjects; 16,224 in the participating group and 13,509 in the non-participating group. Disease management included motivational interviewing and coaching by nurses via telephone. The number of chronic diseases diagnosed participant ranged from 1 (28.4%) to 7 (2.2%), with a sharp drop between 4 (12.7%) and 5 (6.9%). Results of data analyses showed an average annual savings of \$1158 per program participant and savings increased with length of time in

the program. It should be noted that the results did not include medication costs.

Home-based telehealth programs for people with congestive heart failure (CHF) are gaining acceptance and there is some evidence that they reduce readmissions. This study applied Markov methods to examine cost consequences of home-based programs, using re-hospitalization as an indicator of disease progression [69]. The researchers investigated multiple scenarios for cost and clinical performance to demonstrate likely cost-saving capabilities of the CHF telehealth program. The authors noted that, to their knowledge, this was the first study to assess telehealth economic and clinical consequences in CHF. Cost savings from \$2832 to \$5499 per patient over a 1-year period were found. Regions with high costs of inpatient care for CHF and high readmission rates would receive the most benefit from home-based telehealth programs.

A study from the Providence Oregon Telestroke Network used data from 864 patients (98 pre- and 766 post-implementation) to assess cost-effectiveness of telestroke using a decision analytic model [70]. The authors noted that the imbalance in groups was a study limitation. Their system had 2 hubs (Primary and Comprehensive Stroke Centers, respectively) and 17 spoke facilities. The authors noted that this study was the first to examine cost-effectiveness of telestroke by stroke severity as measured by the NIH Stroke Scale. They also noted that cost inputs to their model included encounter-level data derived from their system's cost and reimbursement information (real-world data) and not estimates. Findings were that telestroke was cost-effective for treatment of ischemic stroke patients but the degree of cost-effectiveness depended on stroke severity and the proportion of telestroke implementation costs paid for by spoke or hub hospitals. The analysis used 0%, 50% and 100% paid levels in their analysis. Cost-effectiveness was also demonstrated across medium and high severities of stroke even when the spokes bore all the implementation costs.

A study of ICU telemedicine program financial outcomes represented the evolution of eICU in that it began in 2004 and ended in mid-2013 [71]. The teleICU function began in mid-2006 and the logistic center function was added in early 2010. The logistic center support group reflected the effects of 51 care-standardization and quality improvement projects classified into 4 domains: patient experience, financial sustainability, patient-care redesign and integrated safe high-quality care. The purpose of this study was to test the hypothesis that ICU telemedicine modified to serve as a logistics center and to support quality care standardization projects was associated with increased case volume and improved financial outcomes. The main finding of the study was that implementation of an ICU telemedicine program that

improved clinical outcomes was associated with a significantly larger direct contribution margin (annual case revenue minus annual case direct costs). In an interesting caveat, the authors noted that the study was designed before the 2009 passage of the USA Affordable Care Act and that its findings should be interpreted in the context of subsequent shifts of government and private insurance healthcare finance programs.

Another paper used cost-effectiveness analysis to estimate an economic evaluation of patients in ICUs who either had or did not have telemedicine applications with their care [72]. The decision tree model devised by the authors showed a simulation analysis of care costs related to patients' death or their survival across 5 years. The authors concluded that telemedicine in ICU is cost-effective in most cases and cost-saving in some cases.

Telehealth Telemedicine Practice Improvement

This section will address aspects of THTM that are shaping, pushing, pulling and challenging healthcare delivery throughout the USA. The content represents relevant issues in the USA and provides resources for readers who wish to pursue certain topics in more depth. Policies and guidelines are being promulgated by federal and state governments and by professional organizations. Healthcare funding is complex in the USA and dependent on federal, state and local laws, regulations, policies and programs. Healthcare funding, affordability and availability are also part and parcel of the dynamic political, economic and social milieu of the USA. Ethical and legal issues, closely tied to regulation and provider licensure, are another source of complexity for THTM. Unified THTM programs range from city- to state-wide endeavors and are found in academic medical centers, healthcare systems and stand-alone entities. Care models are emerging; these can provide consistent structures for providers and care recipients.

Policies and Guidelines

The American Telemedicine Association (ATA) (www.americantelemed.org/home) is a non-profit, non-governmental organization with national and international membership of more than 10000 industry leaders and healthcare professionals. The ATA informs members and others about federal and state policies as they evolve from concepts to laws and regulations. ATA supports a learning center, courses, webinars and hosts an annual conference attended by thousands of people. The association has 73 different working groups, among which are 12 Special Interest Groups. A daily online Telehealth Morning Update is available to ATA members. In 2016, an online Open Forum was made available to members;

this is a place where questions about platforms, hardware, software, certification, legal and ethical issues can be discussed.

Nearly 20 practice guidelines are on ATA's web site as of this writing. (hub.americantelemed.org/resources/telemedicine-practice-guidelines). The ATA Core Guidelines for TeleICU Operations were developed for effective and safe care provision [73]. The ATA Practice Guidelines for Teledermatology were first published in 2007 and now have been reissued in 2016 [74]. Guidelines for Telestroke [75] and Teleburn [76] were recently released and the Pediatric Telehealth and Child and Adolescent Telehealth Guidelines are nearing completion. ATA Guideline development and revision are on-going processes, purposefully responding to the THTM community's continued need for expert- and evidence-based guidance.

Recent publications (2016, 1st quarter 2017) in professional journals from many organizations and advocates demonstrate a strong commitment to guidelines for THTM healthcare. The American College of Emergency Physicians released a Policy Statement on Ethical Use of Telemedicine in Emergency Care [77]. The American College of Physicians published a Position Paper for Policy Recommendations to Guide the Use of Telemedicine in Primary Care Settings [78]. A Policy Statement from the American Heart Association (AHA) provided Recommendations for the Implementation of Telehealth in Cardiovascular and Stroke Care [79]. Another Statement from the AHA addressed Telemedicine in Pediatric Cardiology [80]. The Infectious Diseases Society of America provided its members a Position Statement on Telehealth and Telemedicine as Applied to the Practice of Infectious Diseases [81].

There were also calls for new guidelines. Pediatricians and dermatologists collaborated to review direct-to-consumer pediatric teledermatology policies and called for consensus, standards and guidelines in this area [82]. Mental health practitioners recognized the need for clinical guidelines for telemental care of children and adolescents [83]. Perinatal providers have assessed telemedicine policies of states and territories for policy language addressing perinatal risk-appropriate care [84].

National, State and Local Funding for Telehealth Telemedicine

The Department of Health and Human Services (DHHS) is a cabinet-level organization in the USA, with the Secretary of DHHS reporting directly to the President. DHHS's Centers for Medicare & Medicaid Services (CMS) (www.cms.gov/) is the entity where telehealth and telemedicine funding and policy are addressed on a national level. Since the Medicare and Medicaid programs involve about half the USA population, with Medicaid funding generally being further managed at the state level, the regulations and

reimbursement policies covering THTM apply to almost all healthcare systems and stand-alone facilities nationwide.

National organizations have worked diligently to provide current information about telehealth telemedicine in the USA. The Center for Connected Health Policy, sub-labeled ‘The National Telehealth Policy Resource Center’, (www.cchpca.org/) released in April 2017 a document titled ‘State Telehealth Laws and Reimbursement Policies’. The American Telemedicine Association (www.americantelemed.org/home) provides members with by-state information in its State Policy Resource Center and its State Telemedicine Gaps Reports. ATA also provides a national overview of telehealth bills before Congress; the list from May, 2016 comprised more than 45 bills. Almost all state legislatures (including territories and Washington DC) are interfacing to a greater or lesser extent with telehealth advocates and practitioners so that state laws and professional practice acts allow and support telehealth practice fully while also protecting the consumer.

Ethical and Legal Issues, Regulation and Licensure

The privacy, confidentiality and security of healthcare data have become a larger issue as information and communication technologies have changed the world and, therefore, healthcare. All people, patients, providers, and the immense human infrastructure for healthcare play a part in gathering, storing and disseminating data in hopes of generating information and knowledge used for good. Every contact point between a person and the healthcare system has the potential to diminish or destroy privacy, confidentiality and security for people, well or ill, and for the healthcare system. Additional concerns include malpractice liability, provider credentialing and privileging and informed patient consent [85].

The Health Insurance Portability and Accountability Act of 1996 (HIPAA) was enacted in the USA to support data privacy and security of medical information. The law has made the public and patients more aware of their data and the need for privacy but it has not ensured absolute data security. National, state and local entities emphasize the need for privacy and confidentiality in telehealth telemedicine. Professional organizations often have codes of ethics for their constituency that address privacy and confidentiality and these will evolve as telehealth telemedicine becomes more consistently defined and described. The codes will further evolve when THTM becomes so integrated and normalized that it will be considered healthcare (without the need to add the ‘tele’).

In the USA, each state has regulatory authority for healthcare providers and related fields. Physicians, nurses and many other practice specialists are

required to be licensed by their respective state and to work within the scope of practice that the state has established. The Federation of State Medical Boards and the National Council of State Boards of Nursing are examples of national professional organizations working to improve consistency and validity of licensure across state lines for their constituents. THTM is straining the practice-stops-at-the-border attitude about healthcare delivery that has stood the test of time until recently. For example, the staffs for eICUs are a disruptive influence on this attitude in that some eICU central sites serve hundreds of people in ICU beds in many different states simultaneously. There has been continued progress toward interstate compacts for professionals where, for example, one state recognizes the licenses of providers in another state so that practitioners do not have to apply for a new license in the second state and patients could receive care from the most qualified provider and in a timely manner, using telehealth telemedicine.

Unified Telehealth Telemedicine Programs

Unified THTM programs represent a strong commitment to the advancement of healthcare delivery and education. The unified programs are usually intra-state, possibly due to the challenges of cross-border care delivery as described above. In addition to leadership and communication, their success depends on such things as partnerships with telecommunications companies, state government, health professions' licensure boards and private donors [86].

A recent study conducted interviews of the key individuals for 10 selected THTM organizations' business models, and identified five general approaches for sustainment: grants, telehealth network membership fees, income from providing clinical services, per encounter charges and operating as a cost center [87]. Six of the 10 were academic medical centers, 3 were stand-alone programs, and one was a healthcare system.

Unified programs support a wide range of THTM care delivery and education. Other examples in the recent literature showing the usefulness and wide impact of unified programs included fetal urologic care, pain management, ebola education, telemental health training and workforce development, and telepsychiatry on a separate campus [88-92].

Care Models

The DHHS Centers for Medicare and Medicaid (CMS) (www.cms.gov/) works to improve care delivery and control the costs of healthcare. Care models have emerged to shape and guide care systems and delivery. CMS advocates for Accountable Care Organizations (ACO) and Patient-Centered Medical Homes (PCMH), for example, and, since funding for Medicare- and

Medicaid-patient care is part of CMS's portfolio, healthcare entities consider using these or similar models in their practices. ACOs seek to ensure their care systems are coordinated and providing high quality care without medical errors. Coordination means that patients receive the right care from the right provider at the right time without duplication.

PCMH models work toward a holistic approach to the person with health care needs, developing a more personal relationship between providers and care recipients with care coordination, high quality care that is safe and accessible. The principles of PCMHs can be seen in other care models such as care management, connected care and care coordination. CMS includes in Care Management advance care planning, behavioral health integration, chronic care management and transitional care management. Integration of THTM strategies within a PCMH environment holds great promise for sustaining a personal relationship with patients while supporting care quality and safety measures.

Name-brand care models, using THTM technology, have also been described in the literature. The Transitional Care Model was applied with heart failure patients receiving skilled home health services. Patients were monitored for vital signs and oxygenation and received instruction about heart failure symptoms [93]. Results showed a reduction by 14 percent of all-cause 30-day readmission rate over three years. The Health-e-Access model, evidence-based and information-rich, serves children with acute illness [94]. Parent, child and provider engagement was enhanced with videoconference or telephone. Of 13,812 visits using Health-e-Access, 98.2% were completed and 95.2% of primary diagnoses were supported.

Building Telehealth Telemedicine Knowledge through Research

A great deal of THTM literature represents technology research and evaluation, and human subjects research, where the technology-person interface is explored and described. As noted above, the lines between telehealth topics are not clear-cut. Here we have divided research papers into those mostly about the technology and those mostly about technology involving human subjects. The purpose of the two research sections is to provide an overview, not a detailed analysis, of relevant USA publications from 2016 and early 2017. The papers themselves should be consulted for details of methods, results data and research findings.

Telehealth Telemedicine Technology Research

THTM technology research papers often have more than one topic or focus. For example, how does smartphone technology work to support adolescents' adherence to medication for asthma? We have devised a set of tables to show

the cross-topic nature of THTM technology research and evaluation. The tables list the sub-topics that the technology research involved: medical specialties, age groups, chronic diseases, populations, technology itself and targets for apps. Not all papers included information about each sub-topic. With these cross topics tables, readers can see where research that is of interest to them can be found (Tables 1a – Table 1f). Tables 2a – 2d show the research designs and study approaches taken in THTM technology research and evaluation.

Table 1a. Cross-topic Nature of THTM Technology Research and Evaluation-Specialties

Specialties	
	Intensive Care, eICU [95]
	Emergency Medical Systems [96]
	Dermatology [97, 98]
	Mental Health [99, 100, 101]
	Gynecology/Endocrinology [102, 103, 104, 105]

Table 1b. Cross-topic Nature of THTM Technology Research and Evaluation-Age Groups

Age Groups (when specified)	
	Children [99, 106, 107, 108, 109, 110]
	Adolescents [111]
	Adults [103, 112, 113]
	Families [101, 108]

Table 1c. Cross-topic Nature of THTM Technology Research and Evaluation-Chronic Diseases

Chronic Diseases	
	Diabetes [113, 114, 115, 116, 117]
	Neurovascular/Stroke [96, 112]
	Cardiovascular [107, 118, 119, 120, 121, 122]
	Asthma [108, 111]
	Cancer [103]

Table 1d. Cross-topic Nature of THTM Technology Research and Evaluation-Populations

Populations	
	High-need, high-cost [103]
	Underserved [108]
	Disengaged [114]
	Adherence [109, 124]
	Direct-to-Consumer [98]
	Rural [96]

Table 1e. Cross-topic Nature of THTM Technology Research and Evaluation-Technology

Tech	
	Phones [108]
	Smartphones/mobile phones [108, 111, 115, 118, 121, 122]
	Activity trackers [119, 120, 123]
	Wearable devices/Sensors [115, 120]
	Remote monitoring [112]
	Cardiac implantable electronic device [121]
	Portals [106]
	eMobile platform [95]
	Tablet-based [96, 107]
	Video(s)[108]
	Videoconferencing [99, 101, 112]
	Computer – remote access [107]
	Computer on server [107]
	Tele-retinal screening [113]
	Otoscope [110]
	Cystoscope [103]
	mHealth system for diabetics [117]

Table 1f. Cross-topic Nature of THTM Technology Research and Evaluation-Apps

Apps	
	Applications Scoring System [102, 104, 105]
	Gynecology Oncology [102]
	Menstrual cycle [104]
	Reproductive endocrinology & infertility [105]
	Dermatology [98]

	Stress management [100]
	Asthma [111]
	Diabetes [115,116]
	Medication adherence [124]
	Angular movement monitor [125]

Table 2a. THTM Technology Research & Evaluation Designs-
Descriptive/qualitative

Design	Study Approaches
Descriptive/qualitative	
	Considerations for VTC systems in child telemental healthcare [99]
	Considerations for VTC in family-based mental healthcare [101]
	Assess design and functionality of new app for asthma action plan [111]
	Assess quality of otoscope, parents' perceptions, practitioners' attitudes [110]
	Assess quality of telecystoscopy after training [103]
	Useability evaluation of mHealth system for diabetics [117]
	Identify and compare text messaging platforms for mHealth and summarize advantages and disadvantages [126]
	Identify and analyze all direct-to-consumer (DTC) dermatology services available in US [97]

Table 2b. THTM Technology Research and Evaluation Designs-Specified
Descriptive

Case vignette and review	Review evidence for smartphone ECG and cardiac implantable electronic device monitoring [121]
Content analysis	CA of research, definitions and pediatric patient portal use [106]
Prospective cohort study	State of teleretinal screening for diabetic retinopathy [113]
Retrospective review	eMobile care by RRTs [95]

Critique & Reply	Smartphone app for blood pressure measurement [118, 122]
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Table 2c. THTM Technology Research and Evaluation Designs-Reviews

Reviews	Review of physical activity trackers in CVD [119]
	Review of mHealth apps and wearables in CVD [120]
	Review of connected technologies for diabetes self-management (apps, wearables) [115]
	Synthesize reviews of apps for diabetes self-management [116]
	Review of telecom tools for engaging diabetics (portals, videoconference, home monitoring, mHealth) [114]
	Review of apps for reproductive endocrinology and infertility [105]
	Review of apps for teledermatology [98]

Table 2d. THTM Technology Research and Evaluation Designs-Quantitative

Quantitative	Test accuracy and precision of a smartphone app – exercise training [125]
	Test iPad use in pediatric telecardiology [107]
	Evaluate iOS apps for evidence-based stress management strategies [100]
	Rate gyn-onc apps using APPLICATIONS scoring system [102]
	Rate menstrual cycle apps using APPLICATIONS scoring system [104]
	Rate apps for medication adherence [124]
	Rate apps for pediatric medication adherence [109]
Feasibility assessment/evaluation	Test system for remote acquisition of neuropsychological data (RAND) [112]
	Assess videos via mobile phones in pediatric telephone triage [108]
	Test mobile connectivity during transport for telestroke [96]
	Evaluate ‘patient-facing’ mHealth apps [123]

Telehealth Telemedicine Human Subjects Research

The number and variety of THTM human subjects research papers being published represents a widespread commitment to advancing eHealth knowledge and practice in the USA. As was done with the technology research papers above, we have organized the publications into categories. The three largest categories were mental health, heart failure and diabetes. These papers will be characterized in more detail in the tables below (Tables 3, 4 and 5).

Research in the remaining dozen or so categories will be described more briefly. Readers can find their area(s) of interest in the text and references and then go more deeply into the papers that will guide practice, research or education in their specialty or setting.

Mental Health

The mental health papers are categorized below by the identified age group(s), chronic disease, health risks, populations, technology to be studied and research designs. Not all papers included information about each sub-topic. Tables 3a to 3g list the information.

The range of topics covered and the great amount of expertise and commitment to using telehealth technology to advance mental health treatment and care, and cure when possible, shows clearly in this point-in-time slice through the extensive literature.

Table 3a. Mental Health THTM Human Subjects Research-Age Groups

Age Groups (when specified)	
	Children [127, 128, 129, 130, 131, 132]
	Adolescents [127, 130, 131, 132]
	Early adults (college age) [133]
	Adults [134, 135]
	Older adults [136, 137]

Table 3b. Mental Health THTM Human Subjects Research-Chronic Diseases

Chronic Diseases	
	HIV/AIDS [137]
	Chronic tic disorders [131]
	Mental illness [138]
	Bipolar disorder [139]
	Dementia [140, 141]
	Depression [137]

	Anxiety disorder [136]
	Autism [129]

Table 3c. Mental Health THTM Human Subjects Research-Health Risks

Health Risks	
	Smoking [142]
	Emotional distress [133]
	Insomnia [143]
	Eating disorders [127]
	PTSD [135, 144, 145, 146]

Table 3d. Mental Health THTM Human Subjects Research-Populations

Populations	
	People who are deaf [147]
	Veterans [141, 143, 144, 145, 146]
	Caregivers (for dementia) [148]
	Caregivers (for children) [149]
	Rural [136]
	Parents (children with autism) [128, 129]

Table 3e. Mental Health THTM Human Subjects Research-Technology

Tech	
	VoIP for comprehensive behavioral intervention [131]
	Massive open online interventions (MOOIs) [141]
	Videoconferencing for therapy and interventions [130]
	Smartphone ownership [138]
	Videoconferencing for collaborative care of bipolar disorder [139]
	Exposure therapy for PTSD via videoconferencing [135]
	Video-teleconferencing psychotherapy for PTSD [145]
	Centrally assisted collaborative telecare [145]
	Group teletherapy for depression [137]
	Group cognitive-behavioral treatment with clinical video telehealth for insomnia [143]
	Cognitive behavioral therapy with telephone for sleep, QOL, disability [136]
	Home-based telehealth [144]

	MOOCs for psychotherapy of adolescents and parents of children with eating disorders and app development for children not in treatment [127]
	Desktop video-conferencing [129]
	Clinic-based and home-based telehealth [128]
	Mobile-enabled SMS text technology [134]

Table 3f. Mental Health THTM Human Subjects Research-
Descriptive/Qualitative Research Designs

Descriptive Qualitative Designs	Approach
	Proof-of-concept participant- preference smoking-cessation trial [142]
	Case studies illustrating best practices for using videoconferencing for therapy [130]
	Case studies on MOOC methods, platform and development of mobile app [127]
	Survey outpatient psychiatric patients for smartphone usage [138]
	Survey deaf individuals for perspectives on receiving telemental health services [147]
	Survey college students for willingness to use digital delivery mediums for emotional distress [133]
	Survey veterans for interest in use of digital technologies for health [141]
	Program evaluation of videoconferencing for collaborative care [139]
	Evaluation of commercial system supporting engagement in dementia [141]
	Evaluate potential and limits of telemental health in schools with review of literature and focus groups [132]
	Secondary analysis of data from RTC across depressive symptom trajectory groups [137]
	Secondary analysis of data from RCT comparing cognitive behavioral therapy via phone and phone-delivered non-directive supportive therapy [136]
	Compared Insomnia Severity Index and sleep diaries over 6-weeks of therapy [143]

	Evaluated parents' self-reported ability to apply interventions (to autistic children) learned via video-conferencing [129]
	Compared outcomes and costs for parents' use of applied behavior analysis (with autistic children) after learning via in-home therapy, clinic- or home-based telehealth [128]
	Feasibility pilot study to evaluate external validity for treatment outcomes of and satisfaction with text therapy [134]

Table 3g. Mental Health THTM Human Subjects Research-Quantitative Research Designs

Quantitative Designs	Approach
	Randomized, waitlist-controlled pilot trial of CBIT-VoIP [131]
	Random assignment to behavioral intervention (video, workbook, phone coaching) versus education guide and phone support [148]
	Correlated caregiver psychosocial health with eHealth use & eHealth literacy [149]
	Evaluate effects of exposure therapy (for PTSD) with randomization to receive medication (cognitive enhancer) or placebo [135]
	Randomized controlled non-inferiority trial of prolonged exposure (for PTSD) via home-based telehealth or standard-in-person PE [144]
	Randomized controlled equivalence trial comparing videoconferencing with in person delivery of cognitive processing therapy for PTSD [146]
	Randomized clinical trial comparing centrally assisted collaborative telecare for PTSD with usual care for PTSD or depression [145]

Heart Failure

We used 'heart failure' rather than 'cardiovascular disease' after finding that the telehealth telemedicine literature uses 'heart failure' almost exclusively. The heart failure papers are categorized below by the identified age group(s), populations, technology to be studied and research designs. Not all papers included information about each sub-topic. Tables 4a to 4h list the

information. Only one paper included a health risk, that of decreased health literacy [150]. Rather surprisingly, only one app was developed and evaluated in a study, with heart failure information integrated with a mobile app [151]. This same paper described the work as theory-based, using Mayer’s Cognitive Theory of Multimedia Learning, Sweller’s Cognitive Load, Instructional Design Approach, and Problem-based Learning in the development of the mobile app [151]. The authors in this set of papers noted no other theories or models.

Table 4a. Heart Failure THTM Human Subjects Research-Age Groups

Age Groups (when specified)	
	Early adults (college age) [152]
	Adults [152,153]
	Older adults [152, 153, 154, 155]

Table 4b. Heart Failure THTM Human Subjects Research-Populations

Populations	
	Veterans [156]
	People with health disparities [157]

Table 4c. Heart Failure THTM Human Subjects Research-Technology

Tech	
	Mobile platform for interactive education app [151]
	Under mattress piezoelectric sensor to monitor breathing, heart beats and body movement [158]
	Home telehealth [156]
	Wireless wristwatch-based home monitoring device [154]
	Body weight scale, blood pressure device, tablet for subjective states assessment, pulse oximeter, and activity monitor [152]
	Remote patient monitoring [153]
	HIPPA compliant tablet -based platform for remote patient monitoring and videoconferencing with social worker [155]
	Tele (home) monitoring [150, 159]

Table 4h. Heart Failure THTM Human Subjects Research-Research Designs

Descriptive - Qualitative Designs	Approach
	Assess users' confidence in using the mobile app [151]
	Prospective observational study of nocturnal physiological patterns of HF patients at home [158]
	Map home telehealth into existing care pathways [156]
	Usability and adherence study assessing real-time monitoring of temperature and motion data from remote device, weight scale and blood pressure devices, and tablet for responses to survey [154]
	Descriptive observational study of usability of patient-facing devices at-home during the night [152]
	Secondary analysis of data using data mining to detect associations with rehospitalizations with telehome care patients [160]
	Community-based participatory research to adapt a telemonitoring HF intervention to the community (focus groups) [157]
	Assess self-care knowledge after telecoaching and symptom monitoring [155]
	Pretest-posttest treatment only study for effect of telemonitoring plus education by home healthcare nurses [150]
Quantitative Designs	
	Randomized trial to compare adherence with telemonitoring with telephonic support versus passive adherence monitoring [159]
	Randomized clinical trial to compare usual care with Better Effectiveness After Transition-Heart Failure interventions [159]

Diabetes

The diabetes papers are categorized below by health risks, populations, technology, theories/models used and research designs. As we have seen above, not all papers included information about each sub-topic. Most of the papers involved adults without specifying younger or older adults. The

technology and designs sub-sections inform the reader about current research and areas of interest. Tables 5a to 5f list the information.

Table 5a. Diabetes THTM Human Subjects Research-Health Risks

Health Risks	
	Persistent poorly controlled diabetes (PPCD) [161, 162, 163]
	Type 2 diabetes (T2D) [164, 165]

Table 5b. Diabetes THTM Human Subjects Research-Populations

Populations	
	Vulnerable, underserved [166, 167]
	Veterans [161, 162, 163, 168]
	Prisoners [169]
	Nonwhite ethnicity [167, 170, 171]
	American Indian/Alaskan Native heritage [170]
	Rural [165]

Table 5c. Diabetes THTM Human Subjects Research-Technology

Tech	
	Phone intervention [172]
	Telemonitoring, medication management, self-management support, depression management [162]
	Encrypted, compressed secure system for sending eye images [170]
	Four apps related to diabetes self-management [165]
	iPad with videoconferencing capabilities [173]
	Daily education briefs via diabetes telemonitoring system [167]
	Text messaging [171]
	Video-shared medical appointments (video-SMA) [174]
	Home telemedicine interventions for treatment of older adults with diabetes [175]
	Videoconferencing technology for training primary care providers in diabetes care with Specialty Care Access Network-Extension for community Healthcare Outcomes (SCAN-ECHO) [163]
	Telephone calls for clinic visit scheduling and automated call reminding of appointment [176]

Table 5d. Diabetes THTM Human Subjects Research-Theories/Models Used

Theories / Models Used	
	Grounded theory thematic analysis [177]
	Donabedian’s structure- process-outcomes framework [164]

Table 5e. Diabetes THTM Human Subjects Research-Descriptive Qualitative Designs

Descriptive Qualitative Designs	Approach
	Content analysis of semi-structured interviews to evaluate patient perceptions of the intervention (telemonitoring, self-management support, medication management) [161]
	Quality improvement study to evaluate effectiveness of phone calls in improving frequency of glucose monitoring [172]
	Self-administered cross-sectional survey to assess use of and interest in mHealth for diabetes self-care [166]
	Retrospective chart review of prisoners who received televisits for diabetes [169]
	Design phase usability study to characterized provider preferences for integrating externally generated life-style modification data into a primary care EHR workflow [177]
	Retrospective observational study of consecutive graduates on 8-week diabetes behavioral telehealth program to assess depression, anxiety, and stress symptoms (DASS) [178]
	Focus groups used to understand barriers, benefits and facilitators among people with T2D re: use of free mobile apps for diabetes management or behavior monitoring [165]
	Survey of participants to determine satisfaction and usability with communicating with diabetes care team using videoconferencing capabilities [173]

	Post-hoc description of strategies used to augment patient education during 6-month telemonitoring intervention for diabetes [167]
	Focus groups used to understand patients' perceptions of video-SMA [174]
	Survey to identify factors that influence patients' attitudes toward participating in telemedicine [168]
	Review literature for home telemedicine interventions for elders with diabetes [175]
	Retrospective program evaluation based on changes in patients' HbA1c values after treatment by Primary Care Providers who had the SCAN-ECHO training [163]

Table 5f. Diabetes THTM Human Subjects Research-Quantitative Designs

Quantitative Designs	Approach
	Randomized trial comparing usual care with telemedicine intervention (telemonitoring, medication management, self-management support, depression management [162]
	Secondary data analysis of care in a telemonitoring program, using mixed model regression and analysis of variance to correlate patient demographics with clinical characteristics [164]
	Randomized participants to telemedicine or traditional surveillance to detect eye disease using non-mydratic cameras [170]
	Quasi-experimental pilot to measure health goal adherence before and after text messaging intervention [171]
	Compared HbA1c, blood pressure and lipid levels between participants receiving video-SMA with usual care [174]
	Randomized groups comparing education- and phone-based appointment scheduling/reminding with usual care for vision care in patients with diabetes [176]

In mental health, heart failure and diabetes research, descriptive-qualitative research designs are the most commonly used. Randomized controlled trials,

while found in the literature, are notoriously difficult to carry out when human subjects are involved; the extraneous variables are very difficult to control. The constant call for evidence-based practice in THTM needs to be answered with research that is rigorous, with sufficient sample sizes and well-planned interventions so that confidence in the findings can be assured. Coupled with clinicians' well-grounded experience, the replication of descriptive-qualitative studies using consistent and sizeable samples, reliable and valid data collection methods and appropriate data analyses may be the most realistic way to achieve the evidence-base for telehealth telemedicine care delivery.

More Topics for Telehealth Telemedicine Human Subjects Research

This slice of THTM literature (2016 & 1st quarter 2017) shows a great diversity of research involving human participants being pursued in the USA. The variety of papers and presentations at national and international conferences supports this assertion. This section presents a description of research topics with the aim of informing readers about the directions that THTM research has taken. More than 100 papers were divided into four groups: (1) Specialties, (2) People with Healthcare Needs, (3) Health Risks and (4) Diseases. Many, but not all, of the 50 states were represented in this set of papers.

Specialties

Specialties was the largest group with THTM human subjects research papers and included primary care, pulmonary, neurovascular, e-Intensive Care (eICU), emergency medicine, dermatology, pain care, nephrology, oncology, dentistry, ophthalmology, rheumatology and physical therapy. Primary care research papers addressed patient portals [179, 180], other patient-facing devices and apps [181, 182, 183] and assessment of patients' perspectives on using mHealth [184, 185]. Further primary care research concerned e-consults to specialists [186, 187], access to care [188], direct-to-consumer care [189], recruiting patients by phone [190] and mentorship of providers [191].

Pulmonary research papers included asthma [192, 193, 194], measuring oxygen saturation with phone sensors [195], managing Chronic obstructive pulmonary disease (COPD) exacerbation [196, 197], self-monitoring among lung transplant recipients [198] and managing respiratory infections [199]. Neurovascular research papers included the topics of telestroke [200, 201, 202, 203], disparities in access to stroke care [204], treatment of traumatic brain injury [205, 206] and follow-up care of neurology patients [207].

eICU research papers addressed mobile robot telerounding in NICU [208], ICU co-management methods [209], critical care mortality with eICU [210],

the use of teleultrasound in ICUs [211], nursing care in eICUs [212] and family perceptions of eICUs [213].

Emergency medicine research assessed emergency department use when seniors in senior living communities were engaged by high-intensity telemedicine [214] and determining in what clinical situations tele-emergency systems are activated [215]. A retrospective cohort study compared severity of illness and outcomes among children who were transferred from an emergency department (ED) to a pediatric intensive care unit (PICU) where the ED either had access to a pediatric critical care telemedicine program or did not have access to such a program [216]. When children were transferred to the PICU from the ED with telemedicine they were younger and less sick at admission compared with those children transferred from a non-telemedicine ED.

Dermatology has a long-standing history of using telehealth technologies in patient diagnosis and treatment. Research papers describe using store and forward teledermatology for skin readings [217, 218] and consultation [219]. Further research topics include improved access [220, 221] and provider, patient and nurse satisfaction teledermatology methods [222, 223].

The diagnosis and treatment of pain has evolved into its own specialty in the USA. Chronic pain is widespread among the population and methods for its relief are far from perfect. Research papers about telehealth methods for dealing with pain address both the person with chronic pain [224] and the caregivers of children with chronic disease who have pain [225]. Cognitive behavioral therapy via telephone targeted to parents of children with functional abdominal pain was studied for parent and child outcomes including quality of life and other improvements [226]. Telepain was used successfully in people with phantom limb pain after amputation. Patients were instructed in the use of mirror therapy at home [227].

Nephrology research assessed telehealth use in people who have chronic kidney disease for improved access and clinical status. Telenephrology improved blood pressure and stabilized renal function in one study [228]. Another nephrology study comparing usual care with a multidisciplinary team and a mobile device for communication, found no difference on all-cause mortality, hospitalization, emergency department visits or nursing home admission [229].

In oncology, two linked papers addressing adults with cancer described a proof of concept for using short message service (SMS) to promote adherence to oral anticancer medication and, second, recruitment and enrollment of people with cancer in SMS trials. The first study found that people were satisfied with receiving the SMS messages and the second study demonstrated success in recruitment and enrollment in the trial [230, 231].

Teledentistry can improve access to dental care in underserved areas, at least for evaluation, diagnosis and development of a treatment plan. A study assessing rural pediatric patients for compliance with recommendations for dental treatment after a live-video teledentistry consultation were reasonably good [232]. In a study evaluating training results, dental students and oral and other health professionals were surveyed after participating in a teledentistry training program. The participants demonstrated a more positive attitude for their readiness for teledentistry after the training [233].

The success of teleophthalmology over global distances was reported in a research paper describing the use of smartphones to send and receive real-time video during microscopic ocular surgery. The surgery took place in Hangzhou China and the transmission was received in Miami Florida [234]. While diabetic teleretinal screening has been used successfully worldwide, the data from 1774 patients were re-examined for nondiabetic eye diseases. The teleretinal screening data were used to further diagnose cataracts, suspicious (optic) nerve, and macular degeneration [235].

Telerheumatology is rather new but, as with other specialties, its use can improve access for rural populations. A quality improvement study assessed providers, presenters and patients about their care experiences [236]. The most common diagnosis was inflammatory arthritis. In 19% of the cases, the use of telehealth was not appropriate due to an unclear diagnosis or to disease that was too complex.

Physical therapists are using mobile apps more commonly in their work with patients, possibly due to the large numbers of young military veterans requiring physical therapy and probably due to the widespread use of apps in daily life. A survey of 66 therapists found that most did not now nor did they receive encouragement to use apps in their practice [237]. The small sample from one state may have not given a full picture of apps used in the USA in this non-physician, non-nurse cohort of health care providers.

People with Healthcare Needs

The second group, *People with Healthcare Needs*, included THTM research with women, elders, children, postoperative patients, rehabilitation patients and transgender patients. Women's health is a wide-ranging area with many opportunities for telehealth applications such as using telehealth for teaching reproductive health to female rural high school students [238]. With pregnant women, telehealth applications included delivering behavior change interventions via mHealth devices [239], wireless monitoring of vital signs [240] and telephone counseling for smoking cessation [241]. Postpartum women were surveyed to gauge their interest and ability in accessing their personal health records via mobile technologies [242]. Women with postpartum depression were given interpersonal psychotherapy

by nurse-midwives and compared with a control group that had been referred to mental health professionals; while client satisfaction was high in both groups, depression was significantly lower in the intervention group [243].

Cultural disparities in healthcare is a common problem. A study assessed African American women for their willingness to participate in eHealth/mHealth research. A self-report survey completed by 589 women found that most women were willing to receive text messages as part of a research study and that many women have used a health-related application in the past 30 days [244].

Disease prevention is a thread that runs through women's health. A study of a hospital-based telecolposcopy program serving eight spoke sites in the state of Arkansas provided increased access to care, and reduced travel time and costs associated with a face to face visit [245]. In a randomized trial aimed at improving mammography adherence, women were either mailed a tailored interactive DVD or a computer-tailored phone counseling or usual care. Women with incomes below \$75,000 who received the interactive DVD had significantly more mammograms than women in usual care whereas women with incomes above \$75,000 had significantly fewer mammograms than women with income below \$75,000 regardless of the group [246].

Peri- and postmenopausal women with vasomotor symptoms often have insomnia. In a study of telephone-based cognitive behavioral therapy for insomnia in these women, compared with menopause education control group, the women receiving the CBT showed significantly less insomnia and greater sleep quality [247].

Given the increasing numbers of seniors 65 years and older in the USA, THTM research has considered their needs in different ways. A research letter described trends in seniors' use of digital health technology between 2011 and 2014 [248]. Cell phone use was reported at about 80% usage, computers at about 60% and internet at about 45%. Seniors were using digital technology for banking, networking, shopping, obtaining health information, filling prescriptions and contacting clinicians.

Older adults are at high risk for falls in the home and other locations. The feasibility or efficacy of telephone care management of older adults who presented for medical attention due to a fall was supported with no medically attended falls occurring over the 6 months of follow-up [249]. A fall detection device was studied among older adults over a period of 4 months; participants enjoyed the GPS and automatic detection features of the device but they were less pleased with false alarms and device obtrusiveness [250].

The number of seniors living in independent living senior communities and nursing homes is increasing in the USA. The CDC reports that in 2014, there were 15,600 nursing homes with 1.4 million residents in the USA

(www.cdc.gov/nchs/fastats/nursing-home-care.htm). A study of high-intensity telemedicine for acute care needed by senior living community residents used a primary outcome of emergency department use. Among the intervention group, ED use decreased at an annualized rate of 18% while the control group showed no significant change in ED use [251].

Infants and children are benefiting from telehealth telemedicine technology. A study to determine feasibility of using teleaudiology and the rate of loss to follow-up found that parents and providers were very satisfied with the diagnostic evaluation and that there were no patients lost to follow-up compared with 22% loss to follow-up prior to the intervention [252]. Another study evaluated teleaudiology methods for delivering early intervention services to infants and toddlers who were deaf or hard of hearing [253]. Children in the intervention group scored significantly higher than children in the in-person treatment group on the Receptive Language and Total Language scales. There were no differences in family outcomes of support, knowledge or community involvement, however. In a replication study using a hybrid telehealth model for screening the language development of Spanish-speaking children, findings confirmed the original study that this method is a viable screening alternative when face-to-face access to a bilingual provider is not possible [254]. The hybrid telehealth approaches combined the use of video technology and traditional pen and paper surveys.

Studies of children with hemophilia are rare in the THTM literature. A small feasibility study of this population was done using telehealth videoconferencing with the children and their families [255]. The aim was to see if care was enhanced when hemophilia patients experienced a bleed because real-time detailed assessment could be done. Videoconferencing was found effective in 3 of the 12 patients who completed 4 video appointments. Communication and satisfaction were improved.

The Veterans Health Administration (VHA) is a strong proponent of telehealth telemedicine as has been seen in numerous references in the content above. Patients and providers themselves have found uses for telehealth technology. A retrospective study of veterans, who had surgery, were evaluated for patient and operative criteria likely to be telehealth-amenable which was defined as post-operative care accomplished in a single clinic visit with no invasive procedure or new complication [256]. 47% of patients (n=251) were found to be telehealth-amenable for follow-up. Clinicians providing rehabilitation for rural veterans using the TeleHOME program were surveyed for their perceptions of the interdisciplinary care processes and goals attainment [257]. Results showed the participants were

positive about the program; they also made recommendations made for overcoming the challenges of the TeleHOME services.

The VHA has recognized its responsibility for quality transgender care for those veterans using VHA services. A 3-year feasibility program for nationwide interdisciplinary e-consultation offers veteran-specific consultation to providers who treat transgender patients [258]. In the first 17 months of the program, there were 303 e-consults with consultation provided on the care of 230 unique veterans. The program was found to be feasible and complementary to other training within the VHA.

Health Risks

The third group, *Health Risks*, included THTM research on obesity, sleep apnea, substance abuse, osteoporosis and genetic counseling.

Obesity in the USA is a serious health risk. For children and youth, estimates are that 17.2% are obese (stateofobesity.org/obesity-rates-trends-overview/). For adults, obesity rates now exceed 35% in four states, 30% in 25 states and are above 20% in all states (stateofobesity.org/rates/). In just the USA Military Health System, annual costs for morbidities associated with being overweight exceeds \$1billion [259]. A survey to assess the current level of technology usage by military service member families and to assess their needs and interests in health/nutrition information found that technology found military families used devices and the internet in similar numbers to the civilian population and 57.2% of respondents were interested in learning more about health and nutrition [259].

A cluster randomized trial examined the feasibility of speaker phone versus interactive synchronous videoconferencing for the delivery of multidisciplinary weekly family-based behavioral group interventions to treat pediatric obesity in rural residents [260]. Participants were highly satisfied with both types of interventions. In another feasibility study, multidisciplinary pediatric obesity care was given in an urban setting via teleconferencing between providers in their clinics and the pediatric patients in a school clinic or a family clinic [261]. 93% of responding patients and 88.3% of referring providers were satisfied with the appointment.

Sleep apnea is a risk for children and adults. Children who undergo adenotonsillectomy (T&A) for obstructive sleep apnea (OSA) often have persistent symptoms. A descriptive pilot study used telephone screening with the Pediatric Sleep Questionnaire Sleep-Disordered Breathing Questionnaire to identify children with residual symptoms of OSA after T&A [262]. One-third of the children (or their parents) surveyed have symptoms of sleep disordered breathing after T&A, suggesting a high risk for OSA. Telephone screening was used as the first-level intervention prior to referral for further sleep studies. In a retrospective efficiency study, chart review was followed

by e-consultation with sleep specialists to determine eligibility for portable versus in-person sleep study, prescription for positive airway pressure for sleep apnea and need for in-person evaluation in the sleep clinic [263] The e-consultation decreased the time between the sleep consult and receipt of the positive airway prescription.

Substance abuse is a well-known health risk in the USA and opioid overdoses are considered an epidemic today. Opioids (including prescription opioids and heroin) killed more than 33,000 people in 2015, more than any year on record. Nearly half of all opioid overdose deaths involve a prescription opioid (www.cdc.gov/drugoverdose/). After interviews, meetings and focus groups with more than 50 clinicians, an mHealth system – Seva, a smart-phone app – was implemented in three Federally Qualified Health centers that provide primary care to underserved populations [264]. A mixed methods study of clinicians found that behavioral health care providers, rather than physicians, had incorporated Seva into patient care, primarily by discussing it during appointments. Patients showed a sustained, mutually supportive use of Seva, with few instances of misuse. The development and initial testing of a tailored telephone intervention delivered by peers to prevent recurring opioid overdoses (TTIP-PRO) found peer interventionists highly satisfied with the product [265]. The 2 peer interventionists and 8 recruited patients all found the TTIP-PRO very helpful. Opioid overdose knowledge increased significantly.

Two more health risks, for which THTM research is being applied, are osteoporosis and genetics. Project ECHO (Extension for Community Healthcare Outcomes) has been used for telementoring providers and has established Bone Health ECHO telementors to assist healthcare professionals in developing the clinical skills needed to provide advanced care to patients with skeletal disorders [266]. Outcomes of Bone Health Echo teaching clinics during this first year were assessed with learners being asked qualitative questions about self-efficacy. Of the 50 providers surveyed, outcomes included increased ability to evaluate risk factors and secondary causes of osteoporosis, improved dual-energy X-ray absorptiometry screening (DEXA screening) methods and the ability to educate colleagues with new information.

The concept of personalized medicine has changed drastically from the old ‘good bedside manner’ to the new approach of genetic testing to determine the optimal diagnosis and treatment plans for individual patients. Genetic counselors serve at the interface between providers and patients or other people with healthcare needs. Limited geographic access to genetic counseling has been identified as a problem. An anonymous online survey of genetic counselors aimed to assess whether those using telephone genetic

counseling (TGC) completed the tasks identified in the American Board of Genetic Counseling Practice Analysis similarly or differently from those using in-person counseling [267]. The 88 respondents with experience in TGC identified differences in 13 of the 88 tasks studied with the most different task being ‘establishing rapport through verbal and nonverbal interactions.’ The authors of the paper recommended more training in TGC for genetic counselors.

Diseases

The fourth group, *Diseases*, included THTM research for Parkinson’s disease, multiple sclerosis, hepatitis C and human immunodeficiency virus (HIV). The discussion in a recent paper of interest in, feasibility for, and barriers to participation in a national randomized controlled trial of virtual house calls for people with Parkinson’s disease provided substantial knowledge about large, multi-institutional studies, which are considered to be the best source of evidence-based healthcare [268]. There was great interest, as evidenced by over 10,000 people worldwide visiting the 1-page study site and 1000 people with Parkinson’s disease interested in being study participants. The numbers showed the feasibility of entirely remote participation in research but it also showed that the people with Parkinson’s disease with the least access to care – older, rural and women – were also those with the least access to the internet and broadband. More barriers slowing enrollment were the need to obtain Institutional Review Board approval from each participating institution and the requirement for hand-signed consent forms. Policy barriers, provider licensure and reimbursement for care, were also significant issues. Further reports from this study will demonstrate healthcare for people with Parkinson’s disease but they will also exemplify the challenges with THTM today.

An exploratory retrospective chart review of nursing home (NH) residents diagnoses with Parkinson’s disease aimed to examine the medical recommendations made for those residents during videoconferencing encounters with a movement disorder specialist [269]. The author noted that 20% of Parkinson’s diagnoses for NH residents are incorrect. Of the 69 eligible individuals whose charts were reviewed, 93% warranted a change in medical care and the average number of changes recommended was 1.9. The changes included medication addition, medication discontinuation, medication dosage change, diagnostic study and rehabilitative therapy change.

A randomized controlled study of people with Parkinson’s disease compared in home or in-clinic videoconferencing for follow-up care with specialty providers with in-home or in-clinic control groups receiving usual care [270]. Satisfaction was high in all groups. Greater satisfaction for the

telehealth modality was found in assessments of convenience and accessibility/distance. Travel burden was also decreased with the telehealth group.

Multiple sclerosis affects more than 2.3 million people worldwide and more than 450,000 in the USA (www.nationalmssociety.org/). Non-adherence to medication regimes is common and costly. In a pilot study of medication adherence among people with multiple sclerosis, a web-based tool was used to monitor and potentially modify medication adherence [271]. Thirty participants were randomized to either usual care (chart reviews and phone calls) or to the MS Home Automated Telehealth (MS HAT) system. Medications were tracked using multiple modalities. Weekly interferon adherence was highly correlated across all modalities, while vitamin D adherence was not as consistent. The authors noted that the MS HAT was a promising tool for monitoring medication adherence. In a feasibility pilot study, participants with multiple sclerosis attending a community neurology clinic had an initial face-to-face meeting with an MS-certified nurse who then used motivational interviewing techniques during 5 scheduled phone calls during the a 12-week period [272]. Ten of the 12 participants showed progress toward their goals by the end of the 12 weeks, targeting either fatigue reduction or stress management.

Hepatitis C infection is a serious problem in the USA and often undiagnosed. The Department of Veterans Affairs (DVA) is the largest provider of hepatitis C in the USA [273]. The DVA launched its VA Extension for Community Health Outcomes (VA-ECHO) to support primary care providers dealing with hepatitis C patients [273]. The program uses videoconferencing specialist support. Patients treated by a provider who had participated in the VA-ECHO process provided significantly higher rates of antiviral treatment to patients when compared with providers who had not participated in the VA-ECHO specialist support. However, there was not a significant difference in sustained virologic response between the two groups of patients.

THTM applications are being used with people living with HIV. A community message board (CMB) was supported by a smartphone app Positive Links (PL) for HIV clients. 38 people received cell phones that supported the app and the CMB [274]. The characteristics of posters and non-posters to the CMB and the content posted to the CMB were evaluated. 24 participants posted to the CMB. Those who were white and had private insurance were less likely to post. Those who had unsuppressed viral loads were more likely to post. Most of the messages (62%) had psychosocial content, 29% had community chat and 10% had biomedical content. The

authors noted that the CMB reached vulnerable populations and provided psychosocial support to people living with HIV.

People with HIV in rural, underserved counties were assessed to determine rate of computer, tablet and smart phone usage and internet access to inform the delivery of an internet- and mobile technology-based intervention [275]. Of the 150 people surveyed, 111 had access to a computer, 101 had a smartphone and 41 had a digital tablet. Younger people had smartphones more often than older people but racial differences were not significant. The authors indicated the positive findings would support their mobile device intervention development.

Medication adherence among people living with HIV continues to be a challenge. A qualitative pilot study aimed to describe the experience of HIV medication adherence using a mobile phone application [276]. Nine focus group discussions were held (3 groups of 10; one session per month) to discuss the participants' experiences with the mobile phone application, Care4Today™ Mobile Health Manager. The conversation data were analyzed with thematic analysis. Ease of use, chaos to order, and someone cared were the themes drawn for the qualitative data collected. A 6-month pilot study investigated the use of a clinic-based bi-directional texting intervention to enhance engagement in HIV care [277]. Participants were asked to identify barriers and facilitators for their own care and to choose text messages they had developed or that were pre-developed for remembering appointments, medication adherence and overcoming barriers to care (e.g., don't forget your meeting). Participants were phoned each month to see if they wanted to change the content or frequency of their text messages. The findings supported use of clinic-based, bi-directional text messages for adherence and improvement in self-care.

The Future of Telehealth Telemedicine

What we know. Ideas and prototypes for THTM that we laugh at today will be what we are dealing with tomorrow. The possibilities for THTM applications that will meet most healthcare needs are endless. 'Tele' will fade from use. People are willing and able to use digital devices for their health, whether young, old, rich, poor, urban, rural, any ethnicity, or any gender preference.

Developers are creating new devices and methods faster than their safety and efficacy can be assessed. Clinicians will use technology when they see the value and usefulness in their specialty or setting. Lawmakers and policy makers are seeing the value of THTM and moving forward with supporting legislation and regulation. Insurers are moving toward reimbursing THTM-driven healthcare.

A great deal of research is taking place that should advance THTM. As we have seen in this chapter, however, research needs to get bigger and better: we need programs of research instead of pilot studies and focus groups; systematic reviews of the work already done on the topic to identify what needs doing before embarking on another one-off study; and synthesis of findings based on large samples, consistent data collection and data analyses. The THTM and informatics communities could be considered siblings or, perhaps, cousins in the eHealth/ICT environment. However, the two groups have organizations, journals and academies of Fellows that do not often overlap. An interesting cross-over paper describes the preparation of an ontology for mHealth [278], developed by deconstructing the domain into primary dimensions and elements. The researchers report that the emphases of mHealth research in 2014 were uneven with “a few bright spots and many light spots” (p. 16). Perhaps bigger and better THTM research, including mHealth, will support the generation of a more complete ontology as time goes on.

We also know that attitudes about healthcare education and delivery must change. An interviewer with Dr S.K. Klasko, President of Thomas Jefferson University and CEO, Jefferson Health, noted that he was “wildly optimistic that the disruptive trends we see in healthcare today will actually help us create a rewarding and transformed future” (p. 337) [279]. Dr Klasko talked about doing things completely differently such as educating providers to be skilled in communication and observation since all the data and facts they need will be available from augmented intelligence beings by their side. He also talked about where healthcare will be delivered; except for the very sick, it won't be in brick and mortar buildings. His hope is that every person will take more personal responsibility for health in the age of digitally supported healthcare.

Professionals looking at the future know that there is more to be done to fully integrate THTM with the healthcare system. A CEO of a USA privately health telehealth company, Dr R. Schoenberg, recently published his predictions for THTM. They include the coming of reimbursement, return on investment mainly from follow-up care, progress toward seamless integration of provider workflows and electronic records, expansion of consumer healthcare beyond basic primary care and greater provider-to-provider telehealth that facilitates communications between systems [280].

Dr R. C. Merrell and Mr. C. R. Doarn, Editors-in-Chief of the journal *Telemedicine and eHealth*, reflected on the unsettled mood and great uncertainty in the USA around the recent elections for President and members of Congress. While new legislation and policy development are as yet unknowns, these editors emphasized the THTM “is a tool of medicine

dedicated to human health through use of information and telecommunications” (p. 73) [281]. They encouraged all interested professionals to be neither complacent nor despairing but rather to refresh our determinations and convictions (p. 74).

Several more papers that consider the future of THTM reflect the contents of this chapter to some degree with topics of telemental health, heart failure, diabetes, and specialties. Telemental health applications for children’s health services should be used carefully and with thought for mediators and moderators of telemental health treatment response [282]. No one method is right for every situation but pursuing quality and improved accessibility to children with mental healthcare needs is essential for our society.

Many challenges exist in the use of telehealth for heart failure, including inconsistent research evidence, logistics, reimbursement and policy issues [283]. However, the number of people in the USA with heart failure, the cost of their care and the constant risk of readmission following care make continued pursuit of THTM interventions worthwhile and essential. People with heart disease or failure who can maintain their health status and control costs to themselves and the healthcare system are great motivators for cardiovascular providers and researchers committed to THTM.

People with diabetes, another chronic, non-communicable disease, could, theoretically benefit from THTM technology and applications. There is plenty of research on the topic. Looking toward the future, the concept of person-centered care is raised as an underlying strategy for diabetes care. Rather than the person receiving intermittent care when needed, could there be a “more comprehensive partnership with patients, providers, and payers” (p. 42) [284] along a continuum of care. The idea of a care continuum makes intuitive sense but its reality has not yet infused or been fully integrated with healthcare overall.

Finally, the challenges of THTM integrated care continue to be noted in papers considering what could be done or what we could have: reimbursement, licensing, fear of litigation, ensuring quality, the technology itself [285, 286]. However, an optimism is also palpable, for higher-value care, convenience, efficiency, expanded reach, decreased costs and improved population health [285, 286].

We can look at past leaders to encourage us for the future.

- So what if it’s the hard road? There’s always less traffic (Bob Swanson, Chair and CEO of Linear Technology Corporation, 2002).
- Accomplishment is moving yourself forward. Progress is bringing the world with you (Dr I. M. Jacobs, CEO Qualcomm Inc., 2002).

- This is not the end. It is not even the beginning of the end. But it is, perhaps, the end of the beginning (Sir Winston Churchill).

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The Digital Library - What and Where at ISfTeH Web

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This chapter presents in brief the two new sections on the website of the International Society for Telemedicine and eHealth (ISfTeH), created in 2018. These are the sections “Knowledge Resources” and “Telemedicine/eHealth History”. Both are accessible from the Media Section of the web <https://www.isfteh.org/media> (Fig. 1).

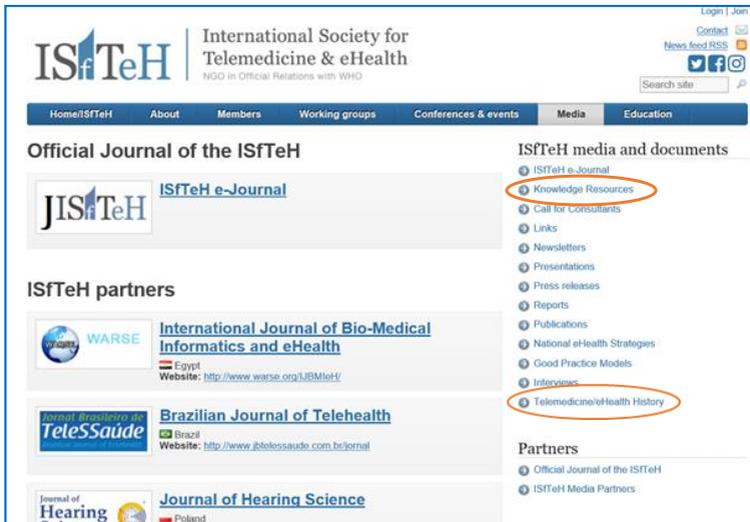


Fig. 1

Why These Sections Were Created?

The creation of both sections is in response to the ISfTeH mission to “*Facilitate the international dissemination of knowledge and experience in Telemedicine and eHealth and providing access to recognized experts in the field worldwide*”. It is also line with the constant efforts of the ISfTeH to share knowledge and expertise not only between its members but also with all interested parties.

In addition, this is a step further to the launch of a free of charge digital library, focused on Telemedicine and eHealth. At present, the sections “Knowledge Resources” and “Telemedicine/eHealth History” are the core of the digital library. As Technopedia [1] defines, a digital library is:

“... a collection of digital resources that may have existed only in digital form, or have been converted from another form to digital. These resources are generally stored in a broad range of formats and can be accessed by users over a computer network. Such libraries have many advantages in that they can be updated on a daily basis and can be accessed instantly by users. Additionally, they do not have a physical boundary, can store more information, and offer access to multiple resources simultaneously. Digital libraries can largely differ in terms of size, scope and purpose. They may be maintained by institutions, organizations or even individuals.”

The sections ISfTeH Journal, Reports, Publications, National eHealth Strategies and Good Practice Models are also part of the ISfTeH Digital library (Fig. 1).

The Significance of ISfTeH Digital Library

The importance of the ISfTeH digital library is enormous. It is a blessing for many people and organizations. Users can both read the contents and download it, when required, if they have a decent internet connection and a computer or a mobile device. What is more, the library is becoming a portal, where organizations, groups and/or individuals may publish their researches, share their expertise and gain information to enhance their work. It gives a great amount of choices and with a huge quantity of selections, it boost users to expand their horizons.

The library is enhancing the knowledge sharing by giving users access to multiple contents. Knowledge is a strategic resource. It is a significant source increasing the competitive advantage of organizations and individuals. Often is underlined that in a complex and dynamic environment, as Telemedicine / eHealth, knowledge has a pivotal role both as a resource in itself and as an integrating factor that makes other resources and capabilities effective [2].

What These Sections Include

Both sub-sections summarize the results of or are inspired from (as is the case of the “Telemedicine/eHealth History”) Med-e-Tel, the International eHealth, Telemedicine and Health ICT Forum for Education, Networking and Business. Med-e-Tel was an official annual event of ISfTeH from 2002 until 2017. It was a eHealth science, practice and market meeting place by excellence. The name Med-e-Tel summarizes what the event was about, i.e.:

- The "Med" in Med-e-Tel stood for healthcare services (institutional and home based care, prevention and education) and for medical products and equipment (medical imaging equipment, monitoring devices, electronic health records, etc.).
- The "e" stood for the electronic and IT industry and services (hard- & software, internet, e-mail, etc.), while
- The "Tel" stood for telecommunications (whether it is POTS, mobile, satellite, videoconferencing, VoIP, or other).

Med-e-Tel was the meeting place with a proven potential for Education, Networking and Business among a global audience with diverse professional backgrounds. It brought suppliers of specific equipment and service providers together with buyers, healthcare professionals, scientists, decision makers and policy makers from many countries around the globe and provided them with hands-on experience and knowledge about currently available products, technologies and applications. This was the forum where state-of-the-art products, ideas, projects, etc. were presented and discussed. Year after year Med-e-Tel was the nesting place for new co-operations and partnerships between scientific groups and institutions, small, medium and large size enterprises, from all over the world.

Med-e-Tel was publishing Electronic Proceedings since 2006 and the series “Global Telemedicine/eHealth Updates: Knowledge Resources” since 2008. Both publications presented a collective experience of experts from different continents all over the world. Papers revealed various national and cultural points of view on how to develop and implement Telemedicine/eHealth solutions for the treatment of patients and wellbeing of citizens. Year after year the series “Global Telemedicine and eHealth Updates: Knowledge Resources” provided a glimpse and summarized the most recent practical achievements, existing solutions and experiences in the area of Telemedicine/eHealth.

Both publications offered ideas and valuable knowledge to those who were and still are preparing to update or start introducing Telemedicine/eHealth in their regions or countries. They allowed readers to rely on the experience of others, make them aware of the benefits and problems that encountered during or after implementation of systems or

services, and as such help them to avoid mistakes and reduce potential problems.

One of the most important initiatives of Med-e-Tel was the creation of the Knowledge Resource section on its website. This database, available for free, provided copies of all abstracts, papers and presentations that were made at Med-e-Tel throughout the years (2002-2017). It was a comprehensive listing, providing an overview of Telemedicine and eHealth research, technology, practical experiences and information from around the world, updated year after year with new titles and links.

After the official end of Med-e-Tel, the huge information database was lost. The creation of the sections “Knowledge Resources” and “Telemedicine/eHealth History” partially compensate this loss.

The screenshot shows the ISITeH website interface. At the top, the logo 'ISITeH' is displayed next to the text 'International Society for Telemedicine & eHealth' and 'NGO in Official Relations with WHO'. There are navigation links for 'Home/ISITeH', 'About', 'Members', 'Working groups', 'Conferences & events', 'Media', and 'Education'. A search bar and social media icons (Twitter, Facebook, YouTube) are also present.

The main content area is titled 'Knowledge Resources' and lists three entries:

- Global Telemedicine and eHealth Updates: Knowledge Resources Vol.10 2017**
 - Published in the Journal of ISITeH
 - Link: <http://journals.ukzn.ac.za/index.php/ISITeH/>
 - Download (pdf) [Global Telemedicine and eHealth Updates 2016](#) (Global_Telemedicine_and_eHealth_Updates_2016.pdf.pdf (9,899,125kb))
- Global Telemedicine and eHealth Updates: Knowledge Resources Vol. 9 2016**
 - Editors: Malina Jordanova and Frank Lievens
 - Download (pdf) [Med-e-Tel 2016 Electronic Proceedings](#) (Electronic_Proceedings_of_Med-e-Tel_2016.pdf.pdf (11,185,710kb))
- Global Telemedicine and eHealth Updates: Knowledge Resources Vol. 8 2015**
 - Editors: Malina Jordanova and Frank Lievens
 - Download (pdf) [Med-e-Tel 2015 Electronic Proceedings](#) (Electronic_Proceedings_of_Med-e-Tel_2015.pdf.pdf (10,104,146kb))

On the right side, there is a 'Partners' section with links to 'Official Journal of the ISITeH' and 'ISITeH Media Partners'. A 'Knowledge Resources' sidebar menu is also visible, listing various categories like 'ISITeH e-Journal', 'Call for Consultants', 'Newsletters', etc.

Fig. 2

The “Knowledge Resources” page (Fig. 2, https://www.isfteh.org/media/category/knowledge_resources) includes all ten volumes of the series “Global Telemedicine and eHealth Updates: Knowledge Resources” as well as the Electronic Proceedings of Med-e-Tel from 2008 till 2016, listed per year. The content of the books and proceedings is free to read and download.

In the proceedings the papers and abstracts are arranged in sessions. The sessions are listed in the order of their scheduling in the Med-e-Tel programs. The papers within the sessions are arranged in an alphabetical order of their titles.

The content of the books is divided in chapters covering various areas of Telemedicine/eHealth. The chapters, and papers in each chapter, are listed alphabetically and the original style of the authors is respected as much as possible. “How”, “Where”, “When” and especially “How Much” – are only part of the questions that authors were trying to answer. With almost 1200 papers published only in the books, it is definitely worth paying special attention to this section of ISfTeH digital library. The latter is offering an extraordinary virtual tool for all engaged in the field of Telemedicine/eHealth.

The foundation of the “Telemedicine/eHealth History” section (Fig. 3, https://www.isfteh.org/media/category/telemedicine_ehealth_history) was laid with the publication of the "Atlas of the Telemedicine History" by Yu. V. Dumansky, A. Vladzomyrsky, V. M. Lobas, and F. Lievens in 2013. The Atlas illustrates the main historical stages of the telemedicine development.

The history section, to name it shortly, is an important part of the digital library. There are many reasons why to study history. No doubt, history provides us with valuable information, solutions and ideas. Everything that happened a second ago is already a history. Yet, at present, the history of telemedicine /eHealth is difficult to find at one place. There are many publications on the topic. The difference of the “Telemedicine/eHealth History” sub-section is that it is aimed at giving a platform to different countries to present and share the history of their Telemedicine/eHealth implementation, describing all successes and failures.

At present, the section includes the above-mentioned “Atlas of the Telemedicine History”, “The History of Telehealth in Rio Janeiro State Brazil” by Alexandra Monteiro and João Neves, published in 2015 and “Lessons Learned from 25 Years with Telemedicine in Northern Norway” by Gunnar Hartvigsen, Steinar Pedersen, printed in 2015.

It also presents the first two books of the series “A Century of Telemedicine. Curatio Sine Distantia et Tempora”, dedicated to a more

The screenshot shows the ISfTeH website interface. At the top, there is a navigation bar with links for Home/ISfTeH, About, Members, Working groups, Conferences & events, Media, and Education. A search box is located on the right. The main content area is titled 'Telemicine/eHealth History' and contains three book entries. Each entry includes a book cover image, a title, authors, and a brief description. Below each description is a 'Files' section with a 'Download (pdf)' button and a 'File' link. The right sidebar contains 'ISfTeH media and documents' and 'Partners' sections.

Fig. 3

detailed history of Telemedicine and eHealth in various countries. This new series was inspired by an original monograph dedicated to deep scientific

analysis of the history of telemedicine technology worldwide, i.e. the book "A Century of Telemedicine: Curatio Sine Distantia et Tempora" by A. Vladzimirskyy, M. Jordanova and F. Lievens, 2016. The latter is an overview of telemedicine implementation until the beginning of 1980s. It is an enriched and adapted version of two previous publications [3, 4], that already clearly revealed the range and complexity of Telemedicine development over the past 100 years. Yet, the book is not just a duplication of the previous publications. Researchers of telemedicine history will not be disappointed. New facts, theories, and amazing stories from different parts of the world are included.

The book "A Century of Telemedicine - A World Wide Overview (Part I)" is the first one, dedicated to a detailed presentation of Telemedicine and eHealth history in different countries. Each chapter is dedicated to one country. The chapters provides a glimpse and summarizes the practical achievements, existing solutions and experiences in Australia, Brazil, Czech Republic, India, Nigeria and Russia. The goal of the authors was to share these experiences with international, national and regional institutions and policy makers as well as with all groups or individuals involved in healthcare. The book was launched during the international Med-e-Tel conference (April 2017, Luxembourg).

The next book from the series, "A Century of Telemedicine - A World Wide Overview (Part II)", which is in your hands, will be on the web shortly. It reveals long way and enormous efforts of Chile, Finland, Georgia, Japan, Peru and USA in wide implementation of Telemedicine/eHealth. It is worth underlining that the countries presented in each volume are chosen on basis of a random selection method.

The information included in these volumes 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 purposes of healthcare delivery.

Telemedicine/eHealth technological solutions are available and ready for implementation. If carefully realized, taking into account the needs of the community, cultural frames and economic development, Telemedicine/eHealth is able to improve both access to and the standard of healthcare, and thus to close the gap between the demand and supply of affordable, high quality healthcare to everyone, at any time, everywhere.

The books provide useful information to those who are preparing to introduce or expand Telemedicine/eHealth in their regions or countries. They give readers the chance to rely on the experience of others, make them aware of the benefits and problems that were encountered during and after implementation of systems or services, and as such, help to avoid mistakes and reduce potential problems.

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