

Telemedicine in Chile: the pioneering experience of the Telemedicine and Telehealth Regional Center of Biobío



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Abstract

Chile, with its extensive geography and demographic concentration in the central region, faces the challenge of a shortage of healthcare specialists, especially in remote and isolated areas. In this context, the need arises to bring Telehealth to remote sectors with health needs through the creation of The Telemedicine and Telehealth regional Center of Biobío (CRT Biobío).

Objective: To describe the implementation and results of The Telemedicine and Telehealth Regional Center of Biobío, in a Region in Southern Chile. **Methodology:** An interdisciplinary, collaborative and integrative methodology was used based on guidelines for investment and implementation of digital health interventions WHO/PAHO. In addition, it is complemented by the Model of Public Engagement of University of Concepción UdeC which is characterised by bidirectionality and collaboration between government, academia and health institutions. As a conceptual theoretical basis, the b-Health model was used as a reference framework, putting it into practice through four essential axes of work that coexist to finally offer Telemedicine and Telehealth services. **Results:** CRT Biobío has deployed 12 satellite antennas in territories of the region, contributing to technological enablement and innovating in clinical care processes. In Chile, it has issued more than 6,000 certifications after offering its Training Plan to health professionals and the general population. In addition, 55,800 health services have been provided with CRT Biobío technology, contributing to improving diagnostic and therapeutic resolution, impacting the quality of life of people in the Biobío region, Chile.

Keywords: Telemedicine; Telehealth; Health Services; telemedicine training, Education.

Resumen

Telemedicina en Chile: la experiencia pionera del Centro Regional de Telemedicina y Telesalud del Biobío

Chile, con su geografía extensa y concentración demográfica en la zona central, enfrenta el desafío de escasez de especialistas sanitarios y especialmente en zonas remotas y aisladas. En este contexto surge la necesidad de acercar la Telesalud a sectores alejados y con necesidades sanitarias a través de la creación del Centro Regional de Telemedicina y Telesalud del Biobío (CRT Biobío). **Objetivo:** Describir la implementación y resultados de un Centro Regional de Telemedicina y Telesalud en una Región del Sur de Chile. **Metodología:** Se utilizó una metodología interdisciplinaria, colaborativa e integradora basada en guías de inversión e implementación de intervenciones de salud digital OMS/OPS. Además, se complementa con el Modelo de Vinculación con el Medio de la Universidad de Concepción UdeC, caracterizado por la bidireccionalidad y la colaboración entre gobierno, academia e instituciones sanitarias. Como sustento teórico conceptual el modelo b-Health fue utilizado como marco de referencia, llevándolo a la práctica a través de cuatro ejes esenciales de trabajo que coexisten para finalmente entregar servicios de Telemedicina y Telesalud. **Resultados:** CRT Biobío ha desplegado 12 antenas satelitales en territorios de la región, contribuyendo a la habilitación tecnológica e innovando en los procesos clínicos asistenciales. En Chile, ha emitido más de 6.000 certificaciones tras ofrecer su Plan de Capacitación a funcionarios de salud y a la población en general. Por otra parte, se han realizado 55.800 prestaciones de salud otorgadas con tecnología CRT Biobío, contribuyendo a mejorar la resolutivez y pertinencia diagnóstica y terapéutica, impactando la calidad de vida de las personas de la región del Biobío, Chile. **Conclusión:** CRT Biobío ha demostrado tener un impacto positivo en la calidad de vida de las personas de la Región del Biobío, acercando la atención especializada, capacitando y contribuyendo a mejorar la resolutivez de los equipos de salud, a través de estrategias de telesalud y telemedicina en sitios de difícil acceso.

Palabras-clave: Telemedicina; Telesalud; Servicios de Salud; Capacitación en Telemedicina, Educación.

Resumo

Telemedicina no Chile: a experiência pioneira do Centro Regional de Telemedicina e Telessaúde do Biobío

O Chile, com a sua extensa geografia e concentração demográfica na zona central, enfrenta o desafio da escassez de especialistas em saúde e especialmente em áreas remotas e isoladas. Neste contexto, surge a necessidade de aproximar a Telessaúde de setores remotos com necessidades de saúde através da criação do Centro Regional de Telemedicina e Telessaúde de Biobío (CRT Biobío). **Objetivos:** Descrever a implementação e os resultados de um Centro Regional de Telemedicina e Telessaúde em uma região do sul do Chile. **Métodos:** Foi utilizada uma metodologia interdisciplinar, colaborativa e integradora baseada em guias de inversão e implementação de intervenções de saúde digital OMS/OPS. Além disso, complementa o Modelo de Vinculação com o Público, da Universidade de Concepción UdeC, caracterizado pela bidireccionalidade e pela colaboração entre governo, academia e instituições sanitárias. Como sustentação teórico-conceitual, o modelo b-Health foi utilizado como marco de referência, levando-o à prática através de quatro exemplos essenciais de trabalho que coexistem para finalmente prestar serviços de Telemedicina e Telesalud. **Resultados:** A CRT Biobío implantou 12 antenas parabólicas em territórios da região, contribuindo para a capacitação tecnológica e inovando nos processos de atendimento clínico. No Chile, emitiu mais de 6.000 certificações após oferecer seu Plano de Formação a autoridades de saúde e à população em geral. Por outro lado, foram prestados 55.800 serviços de saúde com tecnologia Biobío CRT, contribuindo para melhorar a resolução e a relevância diagnóstica e terapéutica. **Conclusão:** O CRT Biobío tem comprovado impacto positivo na qualidade de vida das pessoas da Região do Biobío, aproximando o atendimento especializado, capacitando e contribuindo para melhorar a resolutivez das equipes de saúde, por meio de estratégias de telessaúde e telemedicina em locais de difícil acesso.

Palavras-chave: Telemedicina; Telessaúde; Serviços de Saúde; Treinamento em telemedicina, Educação.

INTRODUCTION

Located in southern Latin America, Chile has 17,574,003 inhabitants^{1,2}. Due to its geography, it is divided into 16 regions. The most populated regions are, in descending order, the Metropolitan Region, the Biobío Region, and the Valparaíso Region. Chile is characterized by having 12.2% of the population living in rural areas (1). Concerning the connectivity of the country, this exists through mobile and fixed internet, of which 81% of the highest income quintiles has access to the internet, while for the two lowest income quintiles the averages are 38% and 53%³. This shows the existence of a digital divide among Chilean citizens that exacerbates inequality and inequity⁴.

As in other Latin American countries, the main health system is public⁵, with a private health system that provides health services to Chile. The National Health Fund (FONASA), the ISAPRES, the Armed Forces and the Police, and the Insurance Companies are responsible for health insurance. In this sense, the Chilean health system has challenges in the equity and access, aiming to improve its quality, efficiency, and effectiveness in its health care. Both the public and private systems are directed by the Ministry of Health of Chile, and form the national health network, made up of primary, secondary, and tertiary health

centers, which follow the Ministerial guidelines.

In the context of the health network, Telehealth and Telemedicine in Chile have evolved significantly over the years, as has occurred in Latin America^{6,7} and the world⁸. In the special case of Chile, they have experience in the use of telehealth and telemedicine since 1993, one of the first initiatives being a pilot project executed between a hospital and a university in the capital of Chile.

Telehealth and Telemedicine have been expanding as technology advances. Connecting with remote areas through communication networks has been the first step in developing these strategies. Since 2003, initiatives have been developed to bring specialist care closer to primary health care, ranging from teleradiology to the implementation of specialty initiatives, such as teleradiology, teleophthalmology, and telenephrology. Then, in 2004, these small implementations bore fruit at the national level, with the telecardiology service being one of the first to be implemented by the Chilean Government⁹. Then, in 2018, the National Telehealth Program was launched, based on ministerial guidelines¹⁰ and which aims to generate the technical, technological and financial conditions to improve access, equity and meet health objectives through

telehealth components in health services. The following year, the Public Digital Health Program was created, called 'Digital Hospital', directed by the Ministry of Health and which arose to "expand the offer of specialists in health care coverage for the population"¹⁰. With this program, an additional model to traditional care is installed, which is based on remote care using ICT.

In 2020, the Public Good "Guidelines for the Development of Telemedicine and Telehealth in Chile"¹¹ was developed, framed in the InnovaChile project, Production Development Corporation (CORFO-Corporación de Fomento de la Producción), whose client was the Ministry of Health and was executed by the Universidad del Desarrollo and the Telemedicine Unit of the University of Concepción, together with the UC Davis.

These previous experiences were used as learning when facing the COVID-19 Pandemic. Health services experienced a great challenge by not being able to provide face-to-face care, seeing telemedicine as a complement that allows access to health care for Chilean citizens. In this sense, COVID-19 in Chile, as throughout the world, was a driver of the use of telemedicine and telehealth^{12,15}.

One of the pioneering initiatives when facing the pandemic was the work carried out by the Telemedicine Unit of the University of Concepción. They developed a rapid response technological platform called "TeleCOVID-19 UdeC: Telemedicine System for COVID-19 of the University of Concepción"[®], (University of Concepción, Intellectual Property Registry number 2020-A-6456 Year 2020) which consisted of the evaluation of patients suspected of this disease and the free medical Teleconsultation for guidance, education, and referral of patients¹². The technological platform was accessed from 144 countries, with more than 1,399,562 applications for the evaluation of the risk of infection by SARS-CoV-2.

After these and other experiences, the Telemedicine Unit of the University of Concepción developed and proposed a project called the 'Biobío Regional Telemedicine and Telehealth Center' (CRT Biobío), which was approved for execution with funding from the Biobío Regional Government. This article shares the innovative experience of the CRT Biobío, its methodology, the guidelines for its implementation, current status, and ends with a discussion and conclusion.

METHOD

The methodology adopted was a systemic, bidirectional, and collaborative approach, considering as a reference: The b-Health 2.0 Model¹⁹; The Digital Implementation Investment Guides (DIIG): incorporation of digital interventions in health programs¹⁶; Consolidated Telemedicine Implementation Guide¹⁷ and the Environment Engagement Model (VcM)¹⁸. The selection of some criteria from these references guides health teams, with clear and contextualized guidelines, in the implementation of digital health interventions through a systematic approach that optimizes their benefits and impact^{16,17}.

Also, it focuses on the co-creation of solutions with key actors, such as the government, academia, and health institutions, which allows the integration of telehealth into the face-to-face clinical processes of a health institution. Bidirectionality is essential in this process, as it guarantees that knowledge flows in both directions, allowing mutual learning and adaptation between the university and society¹⁸. The b-Health Model¹⁹ was considered as a theoretical and

conceptual basis to provide a frame of reference for the telemedicine implementations provided by the Center and that contribute to complementing the face-to-face care provided by Primary Care teams in the Biobío Region.

This methodology was carried out by creating four axes of action that not only coexist but are also linked transdisciplinarily to contribute to an effective and sustainable implementation of telemedicine in the region.

Implementation of the Biobío Regional Telemedicine and Telehealth Center

CRT Biobío is a pioneering initiative in Chile, and especially in the Biobío region, implemented by the Telemedicine Unit of the University of Concepción, in collaboration with the Catholic University of the Most Holy Conception and funded by the Biobío Regional Government (GORE). It was conceived and implemented to contribute to improving access, coverage, and opportunity to specialized care for the population, through telemedicine and telehealth strategies.

To this end, the center promotes the integration of telemedicine into the clinical care processes of health centers in the region, complementing traditional in-person care as suggested in the b-Health 2.0 Model^{19,20}. Its ultimate goal is to contribute to reducing inequality, shortening gaps, and favoring promotion, prevention, diagnosis, treatment, rehabilitation, and follow-up. These objectives are articulated with what the World Health Organization proposes: "Digital health should be an integral part of health priorities and benefit people in an ethical, safe, reliable, equitable, and sustainable manner. It should be developed following the principles of transparency, accessibility, scalability, replicability, interoperability, privacy, security, and confidentiality"²¹. To this end, CRT Biobío is based on a collaborative strategy between the Biobío Regional Government, Health Services, Municipal Health Directorates, and Universities. It also seeks to collaboratively integrate the entire digital health ecosystem and strengthen the capacities already installed in the use of technologies.

One of the main characteristics of this center is its transdisciplinary nature, where a diverse team of specialists makes up the center. Giving shape to this idea, four axes of action were considered to achieve the center's objectives. These are the Education Axis, Clinical Care Axis, Research, Development, Innovation and Entrepreneurship Axis (I+D+i+e), and Digital Health Observatory, detailed below.

The Education Axis aims to promote the ongoing training of health professionals and technicians in the Biobío region. To this end, it has decided to develop a Training Plan for professionals and technicians to strengthen their skills in the design, implementation, and evaluation of telemedicine and telehealth. These actions are reflected in courses, workshops, and webinars and are offered free of charge to the community of the Biobío region.

The Clinical Care Axis aims to promote innovation through a support program to provide ongoing support to health providers in the region to incorporate telemedicine and telehealth. This axis planned to achieve its objective by focusing on the design, development, piloting, validation and implementation of

remote clinical care services. Therefore, it focuses on the effective integration of technology in local clinical-care processes, to optimize the provision of health services in the region.

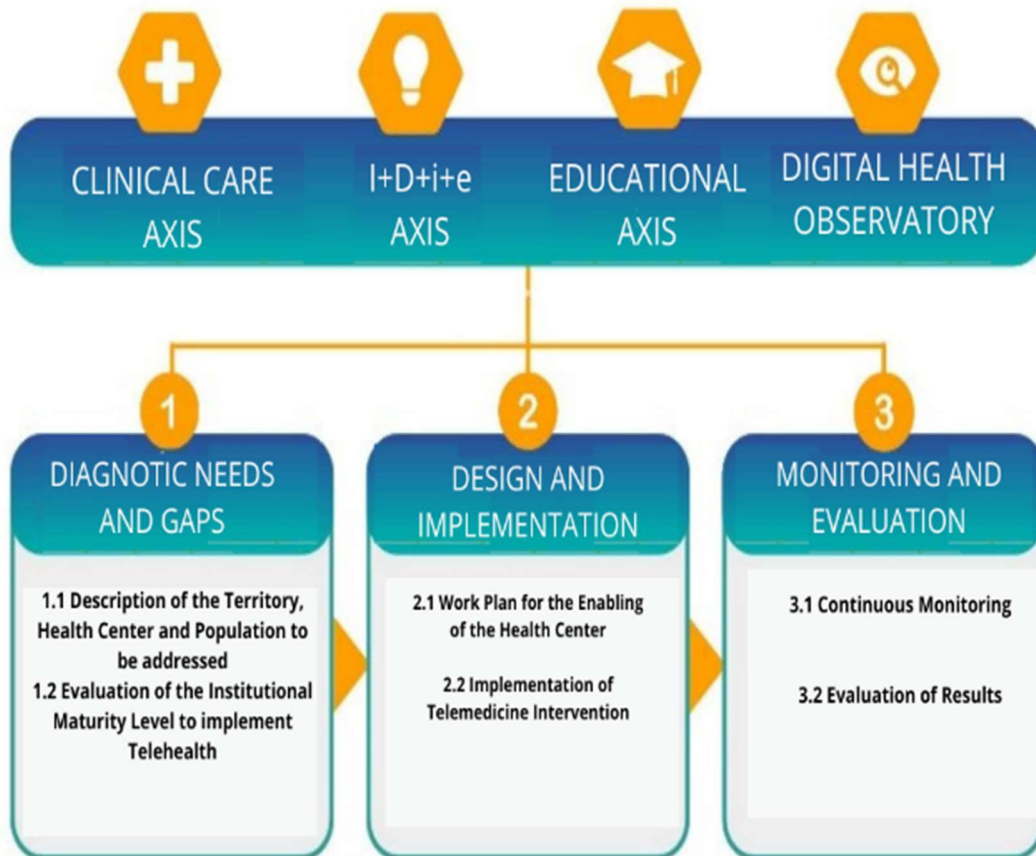
The I+D+i+e Axis seeks to strengthen the innovation capacities and projects of the Biobío region's health ecosystem. This involves the integration of telehealth into clinical-care processes, through the design and evaluation of digital health interventions, Telehealth Laboratory services, support in pilots, technological enablement and connectivity and mentoring aimed at innovators and entrepreneurs in the region.

Moreover, CRT Biobío has a Digital Health Observatory whose role is to collect, analyze, and make available relevant information on digital health, supporting the decision-

making of the axes that make up the center and of health providers at a regional level. In addition, the center aims to digitally educate the population of the Biobío Region through a Communication Plan for Digital Literacy that aims to raise awareness and educate the population on the benefits and use of Telemecine.

The creation of the axes corresponds to the implementation phase of the center (Figure 1). These axes work in a parallel and interrelated way to promote the incorporation of telemecine and telehealth services, improving the quality of life of people and families in the region. Finally, it is about contributing to innovation and change management to gradually configure the bases of a Disruptive Health Model for a new life cycle.

Figure 1 - Lines of action of the Telemecine and Telehealth Regional Center of Biobío.



Source: Own authorship (2024)- Translate

CRT Biobío aims, among other things, to reduce the training and capacity-building gap in the use of enabling tools and technologies, both for healthcare teams and citizens, so that they can become familiar with and accept telemecine and telehealth as a complementary alternative to face-to-face care.

Current status of the Telemedicine and Telehealth Regional Center of Biobío

The CRT Biobío is currently in its third year of implementation. Year after year it has been incorporating professionals from different areas following its transdisciplinary line. To date, thirty-five professionals are part of the center and its different axes of action.

Currently, the Education Axis has a Training Plan that offers academic activities such as courses, workshops, conferences, webinars, and congresses; related to Telemedicine. This plan aims to deliver and strengthen knowledge that helps professionals implement Telemedicine and Telehealth in their respective health centers. The courses currently available are the following:

- Introduction to Telemedicine and Telehealth for health officials.
- Implementation of Digital Health Teleconsultation and Teleinterconsultation.
- Remote Clinical Examination.
- Installation, Configuration, and Maintenance of Satellite Connectivity.

- Digital Literacy: Training and use of platforms in Digital Health.

In the case of workshops and webinars, they have been changing for the contingency and the identified needs. In 2023, the following webinars were held:

- Addressing pediatric respiratory diseases.
- Challenges of Telemedicine. The first consultation: In-person or online?
- Teleconsultation in support of primary care.
- Antibiotic resistance: A threat to global health.
- Experiences in Telerehabilitation: A multidisciplinary perspective.

The academic activities are designed and implemented in a b-learning mode²²⁻²⁴ and have been mostly taught asynchronously. All these academic activities are available free of charge in the Virtual Learning Environment (EVA), located on the Center's website (see Figure 2). The Virtual Learning Environment has various virtual environments that allow interactivity between its members, including the virtual library, interactive glossary, forums and audiovisual capsules.

Figure 2 - CRT Biobío Virtual Learning Environment



Note: Screenshot taken from the Course "Introduction to Telemedicine and Telehealth for Healthcare Workers course."

To date, in Chile, CRT Biobío has offered healthcare workers and the general population the opportunity to participate in one or more stages of its Training Plan, resulting in a total of 6,000 certifications issued. Of these, 2,905 certifications correspond specifically to the Biobío region.

The Clinical Care Axis is currently developing a Support Program to Implement Telemedicine and Telehealth based on investment and implementation guides for digital health interventions^{16,17}. The program aims to be a roadmap for the diagnosis, implementation, and evaluation of telemedicine and telehealth initiatives tailored to local needs, which favor the integration of information and communication technologies into the clinical care and administrative processes of the care network by supporting the health teams in the region. This program sets out the following specific objectives:

- To diagnose the level of organizational maturity of health institutions, through a description of the sociodemographic context and application of the Maturity Assessment Matrix for Telehealth.
- To develop a work plan based on the diagnosis carried out, strengthening the installed capacities of health institutions to implement telemedicine and telehealth.
- To design and implement digital telemedicine and telehealth interventions that respond to the specific needs of the localities addressed, in collaboration with the local health team.
- To monitor and evaluate the process and results of the implemented digital interventions, including all those involved (healthcare workers, patients, authorities), contributing to the continuous improvement of clinical care and administrative processes.

Currently, this program is being implemented in more than 23 health centers and has contributed with specialized medicine in the following areas: Gastroenterology, Endocrinology, Bronchopulmonary, Ophthalmology, Nephrology, Speech Language Pathology Rehabilitation, Family Health, Monitoring, Promotion, and Health Operations.

The incorporation of the specialty of Ophthalmology arises from the experience of this area of knowledge generated in England, where massive screening for diabetic retinopathy was carried out using telemedicine in patients of the Public Health System. This experience was replicated in the city of Concepción, Chile with the advice of Dr. Peter Scanlon of the University of Oxford, reaching a coverage of more than 8,000 patients of the Public Health Network²⁵. In addition, the Clinical Assistance Axis, in partnership with private companies, has clinical portals to the region's health centers to provide remote clinical care. In addition to the above, a platform was designed for the telemonitoring of diabetic patients who benefit from primary care health centers, which is in the final stage of implementation. To carry out this strategy, remote devices were acquired, which have served to remotely monitor the taking of clinical parameters (blood pressure, blood sugar, and oxygen saturation) of patients who benefit from this program.

Improved Internet access, enhanced satellite Internet connectivity, and training of health officials have enabled CRT Biobío to provide 55,800 telehealth services using technology in different health centers in the Biobío region.

The I+D+i+e axis is working on implementing a Telehealth Laboratory that has allowed the testing and validation of hardware/software solutions, the development of initiatives, and connectivity monitoring platforms. To date, twelve satellite internet antennas have been deployed in different health centers in different locations in the Biobío region, preferably in pre-mountain and island territories, which are characterized by being rural areas, with difficult access and low internet connectivity. At the same time, work has been done on the ISO 13.131 standardization project that guarantees the quality of telehealth and telemedicine services through standards that offer guidelines and directives to manage risk and plan quality in telehealth. CRT Biobío, through the contracting of the services of the National Institute for Standardization of Chile, INN, make available the final version of the Chilean Standard 3858 on Health Informatics – Telehealth Services – Guidelines for a quality planning.

The Digital Health Observatory is working on the development of a Competence Framework for Telehealth in Biobío, in which actors involved in the health system have participated. This Competence Framework is in the process of being evaluated by directors and coordinators of the Biobío CRT and will be disseminated at the end of 2024. In addition, concerning the Communication Plan for Digital Literacy, an operational schedule has been implemented that organizes a series of activities to raise awareness and disseminate Telemedicine and Telehealth within the community, both in digital media and in face-to-face sessions held in different rural areas of the Biobío Region. On the other hand, the Observatory has contributed to the collection of information in the region, managing to make it available both in the region and scientific publications at an international level.

DISCUSSION AND CONCLUSIONS

The development of Telehealth in Latin America has advanced considerably in recent years, driven by the need to improve access to health services in rural and urban areas, in addition to the digital transformation accelerated by the past COVID-19 pandemic^{6,20,26,27}.

These experiences show positive aspects that together demonstrate the effectiveness of Telehealth as a complement to in-person care. Both Chilean and Brazilian authors argue that telehealth and telemedicine help improve access to health services and optimize medical resources, especially in rural or remote locations^{19,28}.

Some experiences show that telehealth reduces costs for patients and health systems by minimizing the need for transportation, infrastructure, and waiting times, and optimizing resources^{29–31}. A success story in Latin America is the Telehealth Center linked to the Hospital das Clínicas of the Universidade Federal de Minas Gerais in Brazil³². This center highlights important lessons for the implementation of telemedicine. In Brazil, the expansion of telemedicine services has made it possible to reach numerous remote municipalities and improve care in disadvantaged areas, thanks to a robust infrastructure and a telecare model. This approach has been vital to address logistical and technical challenges in health

coverage.

Like the pioneering initiative in Chile of the Telemedicine and Telehealth Regional Center of Biobío³³, the Brazilian experience offers valuable insights into the integration of technologies and the management of telehealth networks in diverse and difficult-to-reach regions, which can inform and optimize future implementations in similar contexts. In the particular case of Chile, telehealth has demonstrated a positive impact on the quality of people's lives¹⁰, where the care provided by the Digital Hospital Program through Telemedicine³⁴, effectively helped reduce the gap in health care and access to users^{9,20,26,35}. It has meant improved access to health care, with standards of confidentiality, security, and privacy; the reduction of unnecessary transfers; and therefore, the reduction of waiting times, especially in isolated, rural areas or with a lack of specialists, favoring the resolution of less complex centers.

However, there is still a long way to go to achieve successful implementation of Telemedicine in Latin America and Chile^{36,37}. In this sense, the implementation of the Biobío CRT plays an important role in showing the way to enable and implement Telemedicine in remote and isolated areas of Chile, both insular and continental. As a lesson learned from these years of the Biobío CRT, health personnel must be trained in the use of various technologies and strategies to carry out, among others, a telemedicine consultation. To achieve this, it is first necessary to identify clinical competencies in telemedicine and telehealth topics, and thus understand what services can be performed through them and evaluate the possibility of accessing specific training to guarantee a minimum standard of clinical knowledge and skills in the employees.

In addition, it is important to diagnose the conditions of health centers concerning the use of ICT and specifically ensure that they have internet connectivity and adequate technological infrastructure for the provision of telemedical services. Along with reviewing the availability and competence of health personnel, it should also include a detailed analysis of the level of organizational maturity to implement telemedicine and telehealth, to adapt digital interventions accordingly and/or seek improvement alternatives according to the context of each health center.

The experience of the CRT Biobío shows that it is essential to develop these strategies through mutual collaboration between different actors and to maintain an interdisciplinary approach. Within this collaborative approach, the participation of all members is essential. In the case of CRT Biobío, the participation of the national and regional government; the health institutions involved in the care processes; the technology providers; the people who benefit from the health systems; the academia who, makes an important contribution through research in this area, were all essential part of the project.

In conclusion, telemedicine contributes to improving the health of Chilean inhabitants. To achieve this great challenge, the experience of CRT Biobío has demonstrated through its lines of action a comprehensive and multidisciplinary way of developing telemedicine and telehealth, bringing health care closer to the population, especially in isolated areas that suffer from inequity in terms of provision of health services. However, it is important to highlight that in Latin America it is still necessary to continue working to improve inequalities that are still present, such as access to technology and the Internet and the security and confidentiality of data, all to contribute increasingly to the search for solutions that

prefigure the bases of a Disruptive Health that offers the best-personalized options and the application of technology in health according to each particular situation and in harmony with the environment.

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