

Telehealth in Espírito Santo: An experience of technological innovation and integration in the state's public health system

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Abstract

Introduction:The Telehealth Espírito Santo program emerged as an extension initiative stemming from a collaboration between the Ministry of Health (MS) and the Federal Institute of Espírito Santo (IFES), along with local partners such as the State Department of Health (SESA), the Federal University of Espírito Santo (UFES), and various municipal health departments. The initial agreement between MS and IFES was established in 2011. **Objective:** enhancing the quality of primary care services and reducing healthcare costs. This was to be achieved through professional training, minimizing unnecessary patient travel, and increasing disease prevention efforts. **Conclusion:** The results have been noteworthy, highlighting the project's significant influence on Espírito Santo in terms of scientific knowledge production, technology development and transfer, as well as the training and support of health professionals via tele-education, teleconsultation, and telecardiology services.

Key-words: Telehealth;Telemedicine;Primary Health Care;Health Information Systems

Telesalud en Espírito Santo: Una experiencia de innovación e integración tecnológica en la salud pública de Espírito Santo

Introducción: El programa de Telesalud de Espírito Santo se convirtió en un proyecto de extensión a partir de un convenio entre el Ministerio de Salud (MS) y el Instituto Federal de Espírito Santo (IFES), junto con la Secretaría de Salud del Estado (SESA), la Universidad Federal de Espírito Santo (UFES) y las Secretarías de Salud Municipales como socios locales. El primer convenio entre el MS y el IFES se firmó en 2011. **Objetivo:** con el objetivo de mejorar la calidad de los servicios de atención primaria, disminuir los costos de salud mediante la cualificación profesional, reducir el número de traslados innecesarios de pacientes e incrementar las actividades de prevención de enfermedades. **Conclusión:** Los resultados fueron significativos y demuestran el impacto del proyecto en el estado de Espírito Santo en términos de producción de conocimiento científico, desarrollo y transferencia de tecnología, y capacitación y apoyo a profesionales de la salud por medio de la prestación de servicios de teleeducación, teleconsulta y telecardiología.

Palabras clave: Telesalud;Telemedicina;Atención Primaria de Salud;Sistemas de Información en Salud

Telessaúde no Espírito Santo: Uma experiência de inovação tecnológica e integração na saúde pública capixaba

Introdução: O programa Telessaúde Espírito Santo tornou-se um projeto de extensão resultante de um convênio entre o Ministério da Saúde (MS) e o Instituto Federal do Espírito Santo (IFES), tendo como parceiros locais a Secretaria de Estado da Saúde (SESA), a Universidade Federal do Espírito Santo (UFES) e as Secretarias Municipais de Saúde. O primeiro convênio entre MS e o IFES foi celebrado em 2011. **Objetivo:** com objetivo de melhorar a qualidade dos serviços prestados em atenção primária, diminuindo o custo de saúde através da qualificação profissional, redução da quantidade de deslocamentos desnecessários de pacientes e por meio do aumento de atividades de prevenção de doenças. **Conclusão:** Os resultados foram expressivos e demonstram o impacto do projeto no Estado do Espírito Santo em termos da produção do conhecimento científico, do desenvolvimento e da transferência de tecnologia, e da capacitação e do apoio aos profissionais de saúde por meio da oferta de serviços de tele-educação, teleconsultoria e telecardiologia.

Palavras-chave: Telessaúde;Telemedicina;Atenção Primária à Saúde;Sistemas de Informação em Saúde

INTRODUCTION

Telemedicine is a model of therapeutic follow-up in which healthcare professionals provide clinical assistance to their patients, whether via video call, telephone call, or text message, using Information and Communication Technology (ICT) tools. These technological tools enable the expansion of healthcare access and service coverage while prioritizing the quality of care provided (SILVA, 2017; CELES et al., 2018; BRASIL, 2020). Meanwhile, the telehealth strategy known as mHealth (or mobile health) is defined by the World Health Organization (WHO) as the provision of health services supported by mobile devices, involving the establishment of connections between patients and professionals (World Health Organization, 2022).

The introduction of ICTs, through the creation of the Telehealth Brazil Program (Programa Telessaúde Brasil), allowed the insertion of Telehealth to support the Family Health Strategy in the SUS. Its expansion gave rise to the National Telehealth Brazil Networks Program (PNTBR - Programa Nacional Telessaúde Brasil Redes), established in January 2007, through Ordinance number 35. Then, there was a redefinition and expansion of the program through Ordinance number 2,546 of October 27, 2011, which offered conditions for interaction between users of the Unified Health System and professionals (BRASIL, 2007; 2011).

Key modalities and services highlighted are: Teleconsultation (a remote consultation between doctor and patient); Teleconsultancy (a consultation between healthcare professionals, such as a primary care physician consulting a specialist); Telediagnosis (issuing reports remotely by transmitting test results via the internet); Telemonitoring (remote symptom tracking); Triage (remote symptom assessment to guide patient care); and Tele-education (the provision of remote educational activities such as web conferences, classes, and courses) (World Health Organization, 2022).

The use of ICTs in healthcare is growing, and researchers argue that these tools can offer users options for self-managing their health conditions, such as in oncology (Grossi, 2014); diabetes, nutritional guidance, and hypertension (Gasch, 2016; Shannon et al., 2019); physical activity (Fiedler, 2020); and cardiovascular diseases (Akinosun, 2021). Telehealth is also viewed as a tool for the continuing education of healthcare professionals, providing support, work-integrated training, and the sharing of experiences (WHO, 1997; Araújo, dos Santos, Alencar, 2023).

In this context, the development of systems designed to manage health through the monitoring of user behavior and vital signs is anticipated. The processes of data collection, analysis, and interpretation, combined with scheduled notifications and feedback delivery, facilitate the planning of actions and care plans, as well as

promote effective communication and support for users (CHEN, 2017; LEE, 2018).

In Brazil, the use of modern information and communication technologies for remote health-related activities across various levels of care began in 2007 with the Telehealth Brazil Pilot Project. Initially, the project included the states of Amazonas, Ceará, Goiás, Minas Gerais, Pernambuco, Rio de Janeiro, São Paulo, Santa Catarina, and Rio Grande do Sul.

This experience report aims to summarize the development and implementation of the Telehealth Center in the state of Espírito Santo from 2008 to 2019. It will also discuss the challenges encountered and the prospects, given the increasing use of strategies and the expansion of telehealth services.

METHODOLOGY

This is a descriptive, retrospective study of the conception, implementation, consolidation, and structuring of the Espírito Santo Telehealth Center (Telessaúde-ES). The analysis covers the period from 2009, the year the telecardiology pilot project began, to 2019, providing a longitudinal view of the network's strategic and operational evolution within the state.

The investigation focused on analyzing the implementation of health technologies within the Unified Health System (SUS). It regarded Telehealth as an organizational and technological strategy designed to enhance Primary Health Care (PHC), improve the quality of health services, and foster the integration of care networks.

Setting and Object of Study

The setting for this initiative is the Telehealth Center of Espírito Santo (Núcleo de Telessaúde-ES), based at the Federal Institute of Espírito Santo (IFES) in partnership with the State Department of Health (SESA), the Federal University of Espírito Santo (UFES), and the Ministry of Health. The analysis focuses on the conception, implementation, consolidation, and structuring of the Telehealth Program in Espírito Santo as a support tool for Primary Health Care (PHC), to enhance professional qualifications and improve the problem-solving capacity of the Unified Health System (SUS) within the state.

The process analyzed includes different implementation phases: (i) initial inter-institutional coordination and pilot project (2008–2009); (ii)

formal establishment of the unit with federal funding (starting in 2010); (iii) consolidation, maintenance, and expansion of services (2012–2019); and quantitative results.

Data sources and collection procedures

The data were compiled from multiple institutional secondary sources, enabling information triangulation and greater analytical consistency. The following were used:

- administrative records of agreements established with the Ministry of Health (Decentralized Execution Agreements – TED-Termos de Execução Descentralizada);
- technical and operational reports from the ES Telehealth Unit (Núcleo de Telessaúde ES);
- data extracted from the Salus digital platform, including records of teleconsultations, tele-education, and telediagnosis;
- service output and coverage indicators (number of teleconsultations, professionals served, web-lectures, and online/offline access);
- results of system user satisfaction surveys;
- institutional documents regarding program governance (minutes, resolutions, and the Steering Committee structure);
- technical-scientific output linked to the project (articles, dissertations, software registrations, and academic reports).

Ethical aspects

As this study was based on aggregated secondary data and institutional information, without the individual identification of users or healthcare professionals, submission to the Research Ethics Committee was not required under current regulations. Nevertheless, the ethical principles of health research were upheld, particularly regarding information confidentiality and the responsible use of data.

RESULTS

An analysis of the implementation of the Espírito Santo Telehealth Center (Telessaúde-ES) between 2008 and 2019 reveals a progressive process of institutionalization, operational expansion, and diversification of strategies to support Primary Health Care (PHC), with measurable impacts on coverage, service utilization, and the quality of health work.

Initial inter-institutional coordination and pilot project (2008–2009)

Discussions regarding telehealth in Espírito Santo originated from research projects coordinated by researchers from the state (Dr. Luiz Ary Messina, Dr. José Gonçalves Pereira Filho, Dr. Saulo Bortolon, and Dr. Rodrigo Varejão Andreão). In 2008, during the 2nd International Telehealth Workshop [1], coordinated by Professor Rodrigo Varejão Andreão and held in Vitória, researchers from IFES and UFES established contact with the State Department of Health, initiating discussions on a telehealth project for Espírito Santo.

In 2009, Espírito Santo carried out an initial telecardiology pilot project through a partnership between IFES and the Telehealth Center at the UFMG University Hospital. This experience was fundamental to the dissemination of this new service and laid the foundation for the project that would eventually become the Espírito Santo Telehealth Program.

The Espírito Santo Telehealth program became an outreach project resulting from an agreement between the Ministry of Health (MS) and the Federal Institute of Espírito Santo (IFES), with the State Department of Health (SESA), the Federal University of Espírito Santo (Ufes), and municipal health departments as local partners. As an outreach project, Espírito Santo Telehealth serves as a tool for achieving comprehensive care within the health system. This initiative aligned with public policies developed by the Espírito Santo State Department of Health, particularly those focused on strengthening primary care and the Effective Health Networks Project.

Formal establishment of the center with federal funding (starting in 2010)

Strengthening primary care has been a key priority for the government of Espírito Santo, involving significant investments in professional training through the state's Continuing Health Education Policy. This initiative includes the construction of basic health units and the provision of equipment to enhance care organization and improve service delivery. As a result, Espírito Santo has become an ideal environment for the implementation of telehealth.

The State Coordination Committee for Telehealth Brazil in Espírito Santo (Comitê Estadual de Coordenação do Telessaúde Brasil no Espírito Santo) was subsequently established by CIB Resolution 1005/2010, serving as a key forum for coordination among various health,

educational, and public administration institutions. The committee was responsible for conducting the workshops that led to the development of the implementation plan for telehealth services in Espírito Santo. At that stage, IFES was designated as the implementing institution, in collaboration with UFES and SESA, and Professor Rodrigo Varejão Andreão was appointed as the project coordinator.

The State Coordination Committee for Telehealth Brazil in Espírito Santo was composed of five representatives from the Espírito Santo State Department of Health (SESA), specifically from the Planning Management, Primary Care Coordination, CIES, Human Resources Development Unit, and Information Technology Management divisions, and one representative each from the Espírito Santo Research and Innovation Support Foundation (FAPES), the Council of Municipal Health Secretaries of Espírito Santo (COSEMS/ES), the Telehealth Unit of the Federal University of Espírito Santo, the Federal Institute of Espírito Santo, the State Health Council, the Bipartite Inter-managerial Commission, the Capixaba Society of Family Medicine and Health, the Regional Council of Medicine of Espírito Santo, and the Forum of Higher Education Institutions.

The committee strengthened the governance of the Telehealth ES program, ensuring that the actions undertaken were aligned with the needs of the state's health regions. The diverse representation of sectors will ensure decisions that are participatory, integrated, and focused on enhancing the quality of Primary Care.

IFES was tasked with submitting the work plan to the Ministry of Health for evaluation and approval, and subsequently coordinating the transfer of funds from the Telehealth Brazil Program to IFES. The initial agreement between the Ministry of Health and IFES was formalized through a Decentralized Execution Agreement (TED), specifically TC16/2011, entitled "Implementation of the Telehealth Network in the State of Espírito Santo." This agreement initiated telehealth initiatives in Espírito Santo, connecting municipal family health teams with the reference university center, Cassiano Antônio Moraes University Hospital (HUCAM/Ufes). The project's objectives included enhancing the quality of primary care services, reducing healthcare costs through professional training, minimizing unnecessary patient travel, and increasing activities aimed at disease prevention.

The ES Telehealth Center began its activities in 2012^{2,3} and carried out teleconsultation, telediagnosis, and tele-education initiatives to support health professionals and administrators, health professionals, and educational institutions, fostering information sharing, clarifying questions, and encouraging participation in the program.

The Telehealth-ES coordination team, led by the Federal Institute of Espírito Santo (IFES), has reinforced the role of education and technological innovation in strengthening the Unified Health System (SUS). The involvement of IFES and Ufes ensured a high-quality pedagogical approach to initiatives supporting clinical practice and the training of health professionals. Thus, the Steering Committee and regional seminars

Regional seminars were held during 2013 and 2014 to expand the reach and understanding of the role of Telehealth-ES in primary care. These events served as forums for dialogue among complement each other as key strategies to consolidate Telehealth-ES as an efficient tool for supporting primary care, particularly in regions with limited access to specialists and continuing education.

To support the activities of the ES Telehealth Center, the Salus platform was developed, offering dedicated modules for teleconsultation, telediagnosis, and tele-education. The development of this platform began in October 2011, and it remained operational throughout the project's execution. In addition to modules supporting telemedicine practices, Salus incorporates a Virtual Health Library (VHL), a knowledge base built from information derived from teleconsultations to provide insights for similar clinical cases. Figure 1 shows the home page of the Salus graphical interface.


SALUS


Telessaúde ES

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Bem-vindo(a), Profissional

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Ambiente de Teleconsultoria do Telessaúde Espírito Santo

Seja bem-vindo ao ambiente de Teleconsultoria do Telessaúde Espírito Santo.

Nosso objetivo é utilizar as Tecnologias de Informação e Comunicação para desenvolver ações de apoio à assistência à saúde.

Iremos direcionar nossos esforços na teleconsultoria, ampliando a resolubilidade da atenção primária nos municípios, e na formação continuada dos profissionais de saúde no Espírito Santo.

Este ambiente consiste em uma ferramenta computacional voltada para a realização dos serviços de Teleconsultoria, que poderá ser uma Discussão de Caso Clínico ou Segunda Opinião Formativa, dando suporte ao trabalho realizado pelos profissionais da ESF cadastrados pelos municípios no Telessaúde-ES.

O profissional cadastrado poderá acessar esse serviço de qualquer computador que tenha acesso a Internet.

Nessa primeira fase não haverá Teleconsultoria On-line, ou seja, não teremos especialistas de plantão conectados ao sistema. As dúvidas aqui colocadas serão respondidas em um prazo máximo de 72h.

Será possível anexar arquivos como fotos ou imagens (em formato PDF) de exames para suporte a análise do caso clínico.

Visando a segurança de nossa base de dados, possuímos uma política de backup e nosso sistema de teleconsultoria possui controle de autenticação e ações dos usuários.

Cada usuário possui Login e Senha exclusivo, individual e intransferível. Não divulgue.

Eventuais dúvidas quanto ao uso do sistema podem ser tiradas através do serviço de suporte do Telessaúde-ES [neste link](#).

AÇÕES RECENTES

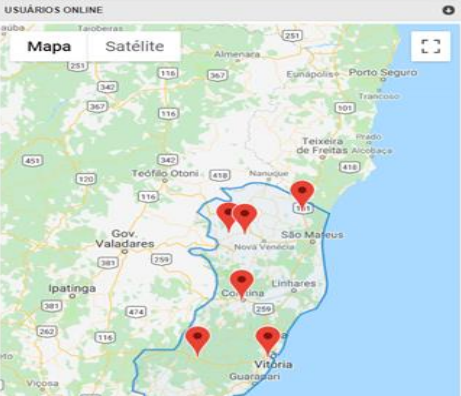
- + 28 de Agosto de 2019 às 09:31**
Login efetuado
- + 26 de Agosto de 2019 às 09:21**
Requisição 22874 finalizada
- + 26 de Agosto de 2019 às 09:20**
Login efetuado
- + 22 de Agosto de 2019 às 12:34**
Logout efetuado
- + 22 de Agosto de 2019 às 12:34**
Login efetuado
- + 22 de Agosto de 2019 às 07:23**
Logout efetuado
- + 22 de Agosto de 2019 às 07:23**
Requisição 22769 finalizada
- + 22 de Agosto de 2019 às 07:13**
Login efetuado
- + 21 de Agosto de 2019 às 15:00**
Requisição 23003 aberta
- + 21 de Agosto de 2019 às 14:59**
Requisição 23002 aberta
- + 21 de Agosto de 2019 às 14:56**
Requisição 22950 finalizada

Visão geral

USUÁRIOS ONLINE

Mapa

Satélite



CERTIFICADOS

Tipo Certificado	Total de Horas
 Teleconsultoria	54,0
 Web Curso	0,0

SUMÁRIO

	Aguardando Triagem	0
	Aguardando Ação	1
	Em Tramitação	0
	Finalizada	42

ÚLTIMAS TELECONSULTÓRIAS

	Assunto	Tramitação
	Antibióticos e Gravidez	

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In 2013, IFES entered into the TED TC366/2013 agreement, titled “Expansion of the Telehealth Network in the State of Espírito Santo,” to serve all municipalities and their respective health units participating in the Mais Médicos (More Doctors) and PROVAB (Primary Care Professional Valorization Program) initiatives. Web-based telemedicine services, such as tele-education, teleconsultation, and teleradiology, were expanded to improve the quality of primary healthcare services, enhance the quality of specialist referrals, and reduce unnecessary patient travel.

Four years later, IFES entered into a third agreement, designated TED 22/2017 and titled “Maintenance of the Telehealth Program in Espírito Santo”, which concluded on December 31, 2019. This agreement between IFES and the Ministry of Health aimed to integrate the Telessaúde Brasil Redes (National Telehealth Program) by maintaining the state-level Telehealth Center and 140 municipal telehealth points, improving the quality of primary care within the Unified Health System (SUS).

QUANTITATIVE RESULTS AND TECHNICAL-SCIENTIFIC OUTPUT

The results of the Telehealth Program in Espírito Santo are significant and demonstrate the project's impact on scientific knowledge production, technology development and transfer, and the training and support of health professionals through the provision of tele-education, teleconsultation, and telecardiology services. Regarding Telehealth coverage, by 2018, all municipalities had at least one unit registered on the Salus Telehealth platform. Due to the service expansion achieved in 2018 and 2019, Telehealth ES handled a teleconsultation volume averaging over 150 requests per month, surpassing the target set for the period, and involved more than 900

health professionals. The user satisfaction survey for the teleconsultation system indicated that:

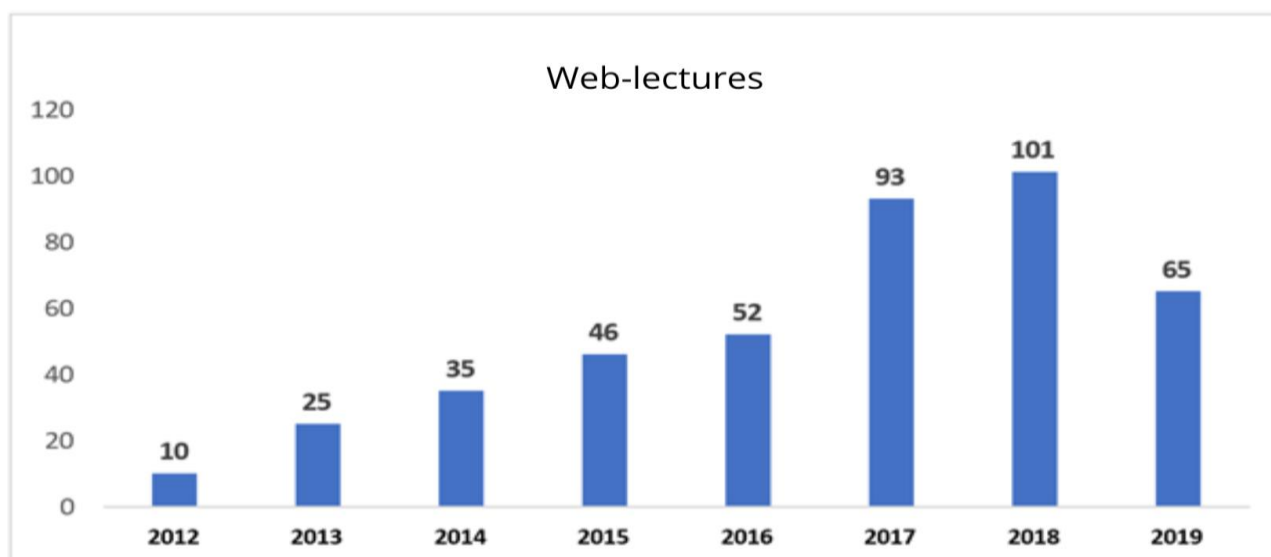
- the response provided by the teleconsultation service met or fully met needs in 99% of cases;
- using the Telehealth ES platform was considered easy or very easy by 96% of users;
- the response provided by the teleconsultation service contributed or contributed significantly in 91% of cases;
- in 81% of cases, patient referral was avoided.

The following figures are a summary of the final years during which Telehealth was active, given that the last agreement with the Ministry of Health ended in December 2019:

- Tele-education and web-lectures

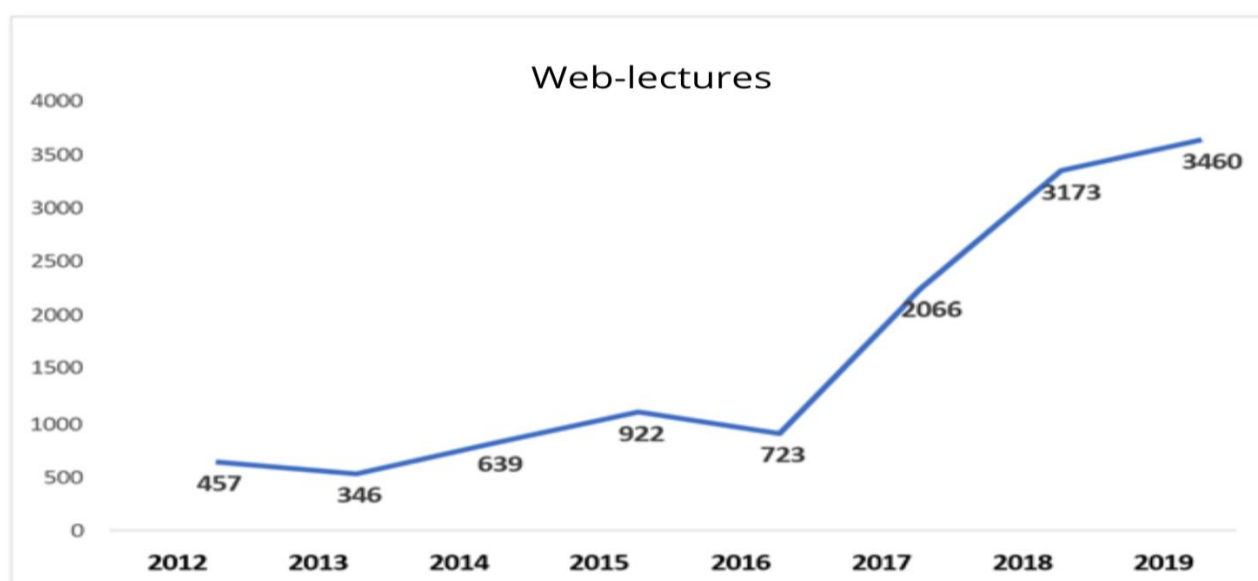
The tele-education service provided by the ES Telehealth Center (Núcleo de Telessaúde ES) offered an average of six web-lectures per month in 2019, reaching 3,460 online participants that year and generating over 400,000 offline views across 23 Brazilian states, as shown in the graphs in Figures 02 through 04. As observed in Figure 03, the number of online participants rose from 457 in 2012 to 3,173 in 2018, a more than sixfold increase (657%). The ES Telehealth Center's role in knowledge dissemination was so well-established that, even with a reduction in the number of web-lectures in 2019 compared to 2018, there was still a 9% increase in the total number of online participants. Offline views also saw significant growth, rising from 2,732 in 2014 to 353,534 in 2018, an increase of more than 128-fold over the period, as shown in Figure 04. Despite the decrease in web-lectures from 2018 to 2019, there was an increase of over 50,000 views, representing a growth of 14%.

Figure 02 – Comparison of web-lectures offered from 2012 to 2019 (2019 data calculated up to November 2019).

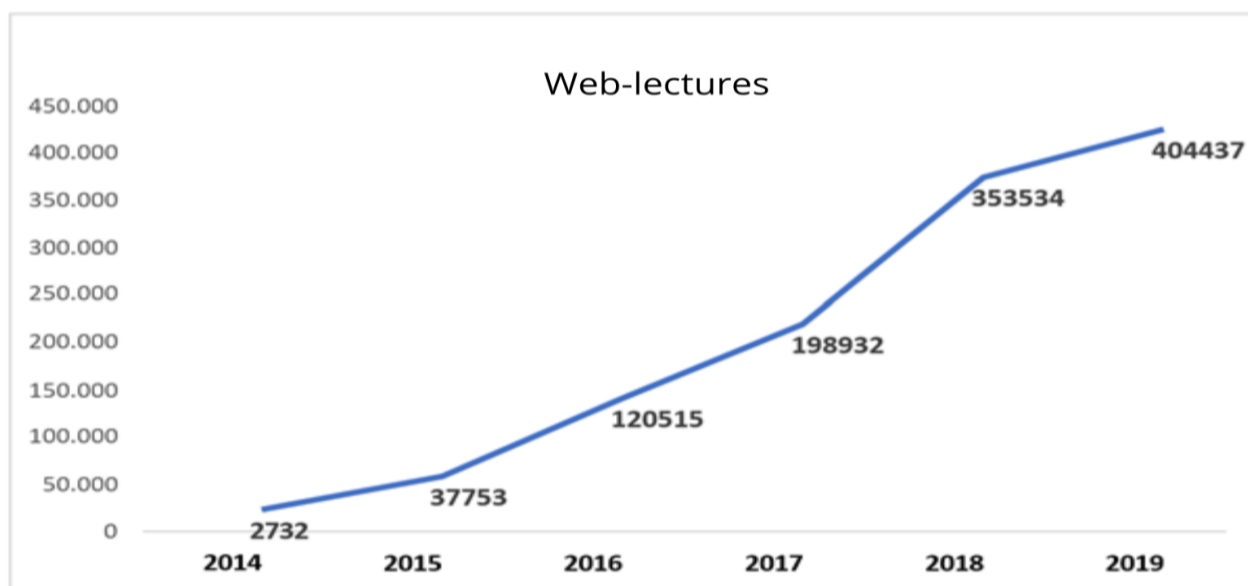


Source: <https://telessaude.ifes.edu.br/>.

Figure 03 – Comparison of online participation in web-lectures from 2012 to 2019.



Source: <https://telessaude.ifes.edu.br/>.

Figure 04 - Comparison of offline accesses from 2014 to 2019 (no data before 2014).

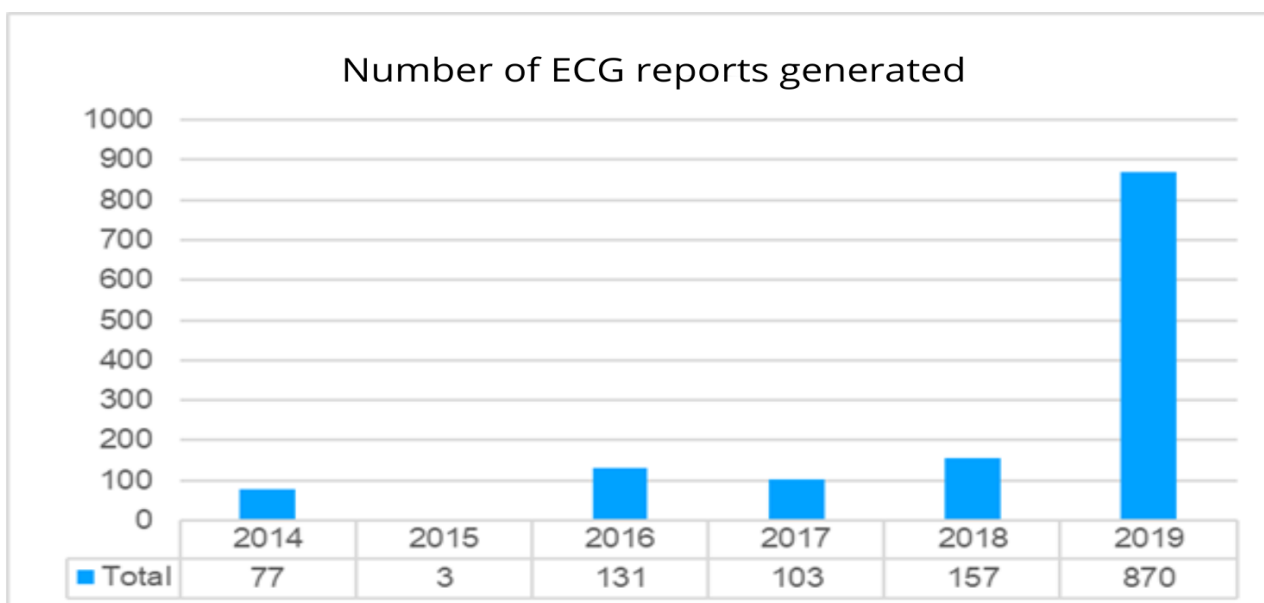
Source: <https://telessaude.ifes.edu.br/>.

Distance learning courses such as “Oral Health Promotion” and “Prenatal Care” recorded pass rates exceeding 45% and satisfaction levels above 95%.

- Telecardiology

Although the telecardiology service was not originally included as a target for the Espírito

Santo Center, it was implemented using funds secured by the responsible team from other projects. However, its impact was limited due to a lack of electrocardiogram equipment in the municipalities. This situation began to be resolved in 2019, when 23 municipalities were served, resulting in a sharp increase in the number of reports generated, as shown in Figure 5.

Figure 05 - Evolution of reports issued by the telecardiology service from 2014 to 2019.

Source: <https://telessaude.ifes.edu.br/>.

- **Formative Second Opinion (SOF-Segunda Opinião Formativa)**

A meticulous technical-scientific initiative undertaken by the Telehealth Center involved the production and registration of “formative second opinions” with the Virtual Health Library (VHL). This work entailed selecting the most relevant teleconsultations and transforming them into training and professional development materials for healthcare professionals across Brazil.

Eighty-eight SOFs from the Espírito Center were registered between 2016 and 2019, addressing topics such as oral health and pregnancy (including care for pregnant women), among others, with the greatest engagement coming from dentistry teams.

- **Integration with Teaching and Research**

The ES Telehealth Center demonstrated strong integration with teaching and research activities, established as a center for professional training and scientific production.

In terms of education, the project engaged interns from technical, undergraduate, and graduate programs, who actively participated in audiovisual material production and technological development activities. Statements from students in fields such as electrical engineering and design highlight the experience's importance in shaping their academic and professional paths, even influencing their choice of topics for final course projects. The distance learning courses and web-based lectures offered by the program are tools for continuing health education, enhancing the skills of SUS professionals at various levels, with satisfaction rates exceeding 90%.

During the research, the Telehealth Center was the subject of scientific articles, undergraduate capstone projects, and dissertations, in addition to generating software registrations related to the practices and technologies developed within the program. Academic materials, such as manuals, videos, technical articles, and presentations, were produced, many of which were available in the Virtual Library – Formative Second Opinion (SOF).

In the technological area, the Telehealth project became a significant achievement for IFES. In addition to the software developed during the project (the Salus Platform, the Salus App, and teleconsultation and telecardiology services), on March 10, 2020, the institution received a Certificate of Registration for a Technology Transfer Agreement from the National Institute of

Industrial Property (INPI-Instituição recebeu do Instituto Nacional da Propriedade Industrial). This certificate formally recognized the licensing of the Salus platform to the Professor Fernando Figueira Institute of Integral Medicine (IMIP-Instituto de Medicina Integral Professor Fernando Figueira) in Recife. This licensing marked the first technology transfer carried out by IFES, demonstrating the institution's ability to transform academic and outreach initiatives into technological solutions with the potential for adoption by other public health institutions.

Technical-Scientific Output

In terms of scientific output, the Telehealth Center ES has produced various references, which are listed below by topic:

a) Salus Platform

Salus Teleconsulting Platform. 2018. Patent: Computer Program. Registration number: 512018051581-9, registration date: September 5, 2018, title: "Salus Teleconsulting Platform", Registration institution: INPI – National Institute of Industrial Property.

Celestrini, J.; SILVA, W. P.; ANDREÃO, R. V.; Komati, K; Corradi, S. M. L.; SYLVAN, A. C. L.; FERNANDES, F. X.; Schimidt, M. Q.; Sarti, T. The Salus Platform: a Tele-health solution to support teleconsulting for the Brazilian Primary Health Care Network (4 pages, n. 193). In: IEEE-EMBS International Conferences on Biomedical and Health Informatics, 2014, Valencia. Proceedings of the IEEE-EMBS International Conferences on Biomedical and Health Informatics, 2014.

Celestrini, J.; ANDREÃO, R. V.; Sarti, T.; Schimidt, M. Q.; SYLVAN, A. C. L. Asynchronous Teleconsultation Platform Based on Django Technology (6 pages). In: XIII Brazilian Congress on Health Informatics, 2012, Curitiba. Proceedings of the XIII Brazilian Congress on Health Informatics, 2012.

b) VoIP Call Center for Telehealth Services

RODRIGUES, C. L.; ANDREÃO, R. V.; SILVA, D. C. A.; Zago, G. T. Impact of adaptive noise cancellation and speech quality assessment during a VoIP call in a telehealth environment. In: 8th Brazilian Congress of Telemedicine and Telehealth - CBTms 2017, 2017, Gramado. Proceedings of the 8th Brazilian Congress of Telemedicine and Telehealth - CBTms 2017, 2017.

RODRIGUES, C. L.; ANDREÃO, R. V.; CABELINO, R. B.; Zago, G. T.; Schmidt, M. Q.; CELESTRINI, J. R. Implementation of synchronous teleconsultation in the ES Telehealth service via a call center based on an open-source VoIP platform. In: 8th Brazilian Congress of Telemedicine and Telehealth (CBTms 2017), 2017, Gramado. Proceedings of the 8th Brazilian Congress of Telemedicine and Telehealth – CBTms 2017, 2017.

c) AI for Automated Medical Exam Triage

ANDREÃO, R. V.; Sarti, T.; Celestrini, J.; Schmidt, M. Q. Automatic Triage of Electrocardiograms. In: Med-e-Tel, 2013, Luxembourg. Global Telemedicine and eHealth Updates: Knowledge Resources, 2013. v. 6. p. 143-147.

PEREIRA, R.; ANDREÃO, R. V.; Zago, G. T.; CELESTRINI, J. R. Proposal for an Automatic Retinal Image Screening System for Teleophthalmology Services (No. 102629, 14 pages). In: Brazilian Congress on Health Informatics, 2018, Búzios. Proceedings of the XVI Brazilian Congress on Health Informatics, 2018. Vol. 1, pp. 1-14.

d) Virtual Reality to Aid the Training of Health Professionals

COSER, A. A.; MESTRIA, M.; Varejão, Rodrigo Andreão. Virtual Urgency and Emergency Room for the Development of Virtual Reality Training Applications (6 pages). In: XXVII Brazilian Congress of Biomedical Engineering (CBEB 2020), 2020, Vitória. Proceedings of the XXVII CBEB, 2020. Vol. 1, p. 1.

Evaluation of Telehealth Services

Cibelle Barroso de Sousa. Analysis of the Implementation of Information Technologies Developed by the Espírito Santo Telehealth Program in the Municipality of Vitória, ES. 2018. Dissertation (Professional Master's Program in Sustainable Technologies) – Federal Institute of Education, Science and Technology of Espírito Santo. Advisor: Rodrigo Varejão Andreão.

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DISCUSSION

The creation and implementation of digital health centers in Brazil dates back to 2007 with the establishment of the Telehealth Brazil Pilot Project, which aimed to integrate information technology into the Family Health Strategy (ESF-Estratégia de Saúde da Família). Unlike the model observed in Espírito Santo, where management is tripartite, involving the Federal Institute of Espírito Santo (IFES), the Federal University of Espírito Santo (UFES), and the State Department of Health (SESA), most of the country's pioneering centers emerged with strict ties to university medical centers [18, 18–21] and the military, as seen in the Indigenous Health Subsystem and among border populations in the state of Amazonas²².

Institutional support and partnerships with technological education institutions, such as IFES, give Espírito Santo a unique profile regarding technological development. While most telehealth services in Brazil and worldwide rely on commercial software, the Capixaba model focuses on the in-house development of solutions, drawing parallels with Canadian and Australian experiences^{24, 23}. In those countries, the involvement of applied technology centers is crucial for creating point-of-care devices and remote patient monitoring systems, ensuring that innovation is shaped by specific national needs^{2, 24}.

The expansion of the National Telehealth Brazil Networks Program (PNTBR) showcases its extensive reach, encompassing participation from all 26 Brazilian states and the Federal District. Data from the Ministry of Health and monitoring studies reveal that between 2024 and 2025, telehealth services within the Unified Health System (SUS) enabled over 5.7 million consultations across 2,929 municipalities in Brazil. This highlights the significant expansion and impact of the strategy throughout the country, indicating that the Brazilian Telehealth Network is integrated into a comprehensive state-level initiative rather than functioning as an isolated project.

The distribution of these centers is uneven, predominantly concentrated in the Northeast and Southeast regions²⁵. In this context, the state of Espírito Santo stands out for its impressive teleconsultation resolution rate, which exceeds 80%. This figure not only surpasses national averages but also positions the state as a reference center for digital health².

The importance of telehealth for the primary care professionals' training is also highlighted, as it serves as a tool for continuing health education. The "Formative Second Opinion" interface enables primary care professionals to learn while addressing specific clinical cases, reducing the need for referrals. In Espírito Santo, the more than 400,000 views of offline educational content underscore how the digital center integrates technology-mediated continuing education into the workforce^{26,27}.

Despite advancements, there are barriers to sustaining Information and Communication Technologies (ICTs) in healthcare. The primary criticism centers on the lack of dedicated funds and specific financing. Historically, funding allocations for telehealth in Brazil have relied on episodic projects and temporary calls for proposals, such as Decentralized Execution Agreements (TEDs), which create administrative instability and hinder widespread adoption. The absence of a permanent budget line prevents managers from investing in hardware upgrades, data security, and stable staffing. Without structural funding, mobile health (mHealth) and teleconsultation solutions risk becoming obsolete or being discontinued due to a lack of basic technical support²⁴⁻²⁷.

CONCLUSION

The Espírito Santo Telehealth Program showed significant growth in reach and engagement between 2018 and 2020, established as a strategic tool for continuing education and support for Primary Health Care (PHC). The substantial increase in offline access highlights the importance of asynchronous content in overcoming geographical and scheduling barriers. Despite limitations in telecardiology due to infrastructure constraints, other areas met or exceeded targets, achieving high satisfaction rates. Integration with education and research reinforces the program's role as a catalyst for innovation and professional development within the Unified Health System (SUS).

IFES has recently entered into its fourth TED 38/2024 with the Ministry of Health. The general

objective is to restructure the Capixaba Telehealth Network through the implementation, standardization, and management of tele-education, teleconsultation, and teliagnosis services, focusing on cardiovascular diseases and stroke.

The restructuring of the Telehealth system in Espírito Santo, in addition to previously offered services, will facilitate specialized care for patients residing in remote areas, thereby enhancing the speed and effectiveness of the process. The proposed telemedicine services aim to establish connections between specialist teams at a central hub and those in outlying regions. As a result, patients experiencing acute ischemic stroke will benefit from rapid care within the crucial treatment window of up to 4.5 hours. Utilizing telemedicine for neurological assessment is a strategic approach that enables consultations with experienced neurologists, even in remote emergencies. This method has been implemented for approximately two decades, and its cost-effectiveness has been assessed in various countries. There is substantial evidence indicating that remote evaluations by neurologists lead to improved triage, an increase in reperfusion treatments, reduced time to thrombolytic administration, a higher number of endovascular treatments, optimized referrals to advanced hospitals, and better prognoses when compared to standard care administered by emergency physicians.

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