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PhD in Tropical Knowledge and Management

PhD Thesis

STRATEGIC MANAGEMENT FOR DIGITAL TECHNOLOGIES SHAPING THE FUTURE OF GLOBAL HEALTH IN SAO TOME AND PRINCIPE

CÁTIA MARISA ROCHA GONÇALVES

Supervisor: Prof. Doutor Luís Velez Lapão

Co-supervisor: Prof. Doutor Luís Lages

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PREFACE

This thesis presents data obtained as a result of a set of three studies included in my Ph.D. research.

This thesis is structured in five chapters. The first chapter provides insight into previous knowledge regarding the role of digital health in the global health topic. It also includes the objectives and aims of this thesis.

The second chapter presents the results of the first study, a systematic review performed on the National Telemedicine Programs in the African SIDS (Cabo Verde, Comoros, Guinea-Bissau, Mauritius, Sao Tome and Principe, and Seychelles).

The third chapter comprises the second study, where a case study approach is used to better understand the implementation and deployment of telemedicine in Sao Tome and Principe. This work was published in an international journal (i).

The fourth chapter, addresses the third study, where it exploits a case study approach combined with the AAAQ (availability, accessibility, acceptability, and quality) health workforce framework for assessing the STP telemedicine program.

Chapter five encloses an overall discussion and conclusions of the studies performed, together with the limitations, recommendations and future perspectives of the work developed.

(i) Gonçalves, C., da Mata, A., & Lapão, L. V. (2021). Leveraging technology to reach global health: the case of telemedicine in Sao Tome and Principe health system. *Health Policy and Technology*, *10*(3), [100548].https://doi.org/10.1016/j.hlpt.2021.100548

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ABBREVIATIONS AND ACRONYMS

AAAQ - Availability, Accessibility, Acceptability, and Quality

CPLP - Community of Portuguese Speaking Countries

ICT - Information and Communications Technology

INPS - National Institute of Social Security

IMVF – Instituto Marquês de Valle Flor

IVeH - International Virtual e-Hospital Foundation

HAM – Hospital Dr. Aires de Menezes

HAN – Hospital Dr. Agostinho Neto

HBS – Hospital Batista de Sousa

HRH – Human Resources for Health

NHS- National Health Service

PALOP - Portuguese-speaking countries in Africa

SDG - Sustainable Development Goals

SIDS – Small Islands in the Developing States

STP – Sao Tome and Principe

TC – Teleconsultation

UHC- Universal health coverage

WHO – World Health Organization

CHAPTER 1. INTRODUCTION

CHAPTER I: INTRODUCTION

1.1 GLOBAL HEALTH

1.1.1 EQUITABLE, AFFORDABLE AND UNIVERSAL ACCESS TO HEALTHCARE

Universal health coverage (UHC) is often explained as that "all people and communities have access to needed quality health services without the risk of financial hardship, cuts across the health targets, and contributes to promoting health security and equity" (UHC 2030 2017). Although, despite some recent improvements, still about "half of the world's population still lacks access to health care", meaning that the health systems are failing in covering all the population" (WHO 2021).

Equitable access to health care is achieved only through a strong link between UHC and quality of service. In other words, even with a supposedly good UHC, justice cannot be achieved if the quality of service is compromised. Often, one needs quality of workforce to reach quality of service. The problems that hamper the use of medical services, i.e., equality of opportunity to access care, should be identified by each country's health institutions. Strategic planning plays an important role in improving access to care towards a UHC. In Africa, countries such as Ghana and Rwanda have embrace strategies very much aligned with the WHO standards and are considered good examples of adequate health governance (Sanogo, Fantaye, and Yaya 2019).

United Nations (2022) in the "Sustainable Development Goals Report - 2022", outlines the expected evolution of the process to achieve the 17 SDGs. Therefore, the report´s data indicate that the 2030 Agenda for Sustainable Development is at risk due to multiple crises we are experiencing, including climate change, COVID-19 and conflicts, which harm all the Goals. The report points out the impact (negative and positive) of COVID-19. On one hand, the analysis shows that the pandemic has infected more than 500 million people worldwide, caused

millions of deaths, disrupted essential health services, altered the progress of UHC, reduced global life expectancy, increased the prevalence of mental illness, and increased deaths from most common infectious diseases as illustrates in Figure 1.

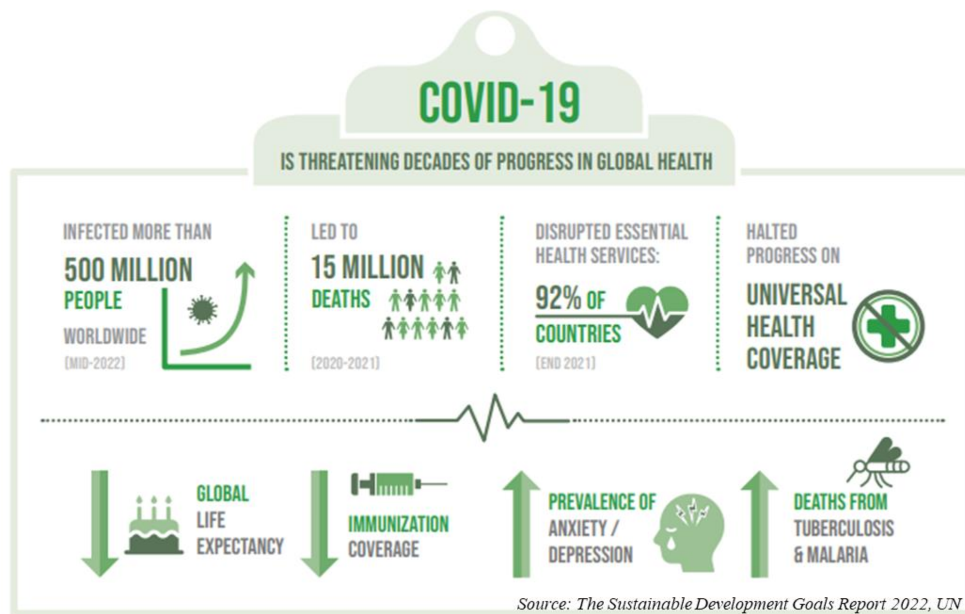


Figure 1. Covid-19 threats to the Global Health

(source: United Nations (2022)

However, the lessons learned during the pandemic should help to improve management mechanisms, particularly data and information mechanisms, so that faster responses can be made in the event of a crisis. Positively, the Covid-19 crisis is an opportunity to improve processes and promote innovation. Globally, all efforts must be brought to achieve the 2030 Agenda for Sustainable Development (United Nations 2022).

1.1.2 HUMAN RESOURCES FOR HEALTH (HRH)

WHO (2016b) defines broadly health workers as “all people engaged in actions whose primary intent is to enhance health”. Hence, these workers have a structuring function for health systems and are considered a very valuable asset for the organisation of health care. From this perspective, the strategic management planning of these human resources is relevant, whether

in the public or private sector. WHO (2018), in line with this idea of the importance of health workers, highlights the Sustainable Development Goals 3 (SDG 3) describes as “Ensure healthy lives and promote well-being for all at all ages”, target 3. C, the importance of aspects like "recruitment, development, training and retention of the health workforce in developing countries, particularly in the Least Developed Countries and Small Island Developing States",

In this sense, to identify the availability of these health workers it is essential to analyse some key concepts, such as demand, need, needs-based shortage and supply. The WHO (2016b) presents the definition of the concepts as described below:

- Demand for health workers is understood as "the number of health workers that the health system (both public and private) can support in terms of funded positions or economic demand for services"
- Need of health workers is the “number of health professionals required to achieve health system goals”
- Needs-based shortage is” the situation in which the number of health workers needed to meet population health needs transcend the available supply of health workers”
- Supply is “the number of health workers that are available in a country”

The planning and monitoring of these workers' stock variables are crucial in workforce management to ensure sufficient proportion and expertise to meet health systems' goals (WHO 2016b; Cometto, Buchan, and Dussault 2020).

Globally, by 2030 the health workforce is estimated to be about 67.3 million, based on the 2013 statistic which indicates that the number of health workers was then over 43 million. Regarding the shortage of health workers (physicians, nurses, midwives and other cadres of health workers), in 2013 it was estimated at 17.4 million. and by 2030, it is projected to be even higher

than 14.5 million. These data may indicate that there will have to be a significant strengthening in the next years to reverse this trend (WHO 2016b).

According to the WHO observatory data realized in 2016, in Africa, the shortage of health workers has reached 4.2 million and is projected (based on needs) to worsen to over 14.5 million by 2030, which poses a considerable challenge to the annual increase in health worker stock in health systems in this region (WHO 2016b). However, the latest data published (in 2020) by WHO estimates that the shortage of health workers in Africa based on needs will reach 6.1 million by 2030, out of a total of 14.5 (WHO 2020).

Human resources for health (HRH) directly influence the performance of health systems and, consequently, the quality of service delivery (WHO 2010a). Thus, taking into account the limited human resources available also in African countries, it is fundamental that health systems be organised and governed with a strong focus on building the capacity of the workforce and distributing these professionals according to the needs of the population (Sanogo, Fantaye, and Yaya 2019).

In Africa in general, and in Portuguese-speaking countries in Africa (PALOP) in particular, the availability of accurate data on health workers is limited. The capacity to collect, analyse and utilize HRH information is weak in the Region. Moreover, research and dissemination of HRH best practices have been limited. The lack of HRH research has hampered the diagnosis of health workforce challenges and the progress of appropriate evidence-based to feed the design of new policy (WHO 2010a, 2020).

1.2 DIGITAL HEALTH

1.2.1 DEFINITION AND SCOPE

Over the years, the technological and digital revolution has promoted greater access to and use of ICT, such as mobile phones and the internet, which have led to changing perspectives on

new business models and even altered human behavior. These technologies have been seen as a potential solution to help address global health problems (WHO 2010b).

Technological innovations and the need to provide quality healthcare that reaches everyone have led us to find ways to expand these services to inaccessible areas, which has had a positive impact on the health of more remote communities, travellers, and even soldiers in war zones (Coiera 2002).

When we describe the history of digital health, we realize that essential concepts such as telematic, telemedicine, telehealth, eHealth, and mHealth are now, after some years, integrated into this digital umbrella. These concepts have had a figurative meaning over the decades until more recent times (Meister, Deiters, and Becker 2016).

In this context, telematics is considered the first concept to emerge in the 1970s, which defines the use of ICT to support the exchange of data between different information systems (Meister, Deiters, and Becker 2016).

According to WHO (2010b) "Telemedicine is the provision of health services where distance is a critical factor" It can be subdivided into a few branches, in which health professionals use ICT for the transfer of valid information for diagnosis, treatment, prevention, and disease monitoring, research and evaluation, and continuing education (WHO 2010b).

Coiera (2002) illustrates that from the beginning to the present time, the development of telemedicine had four different phases, which are presented in Figure 2.

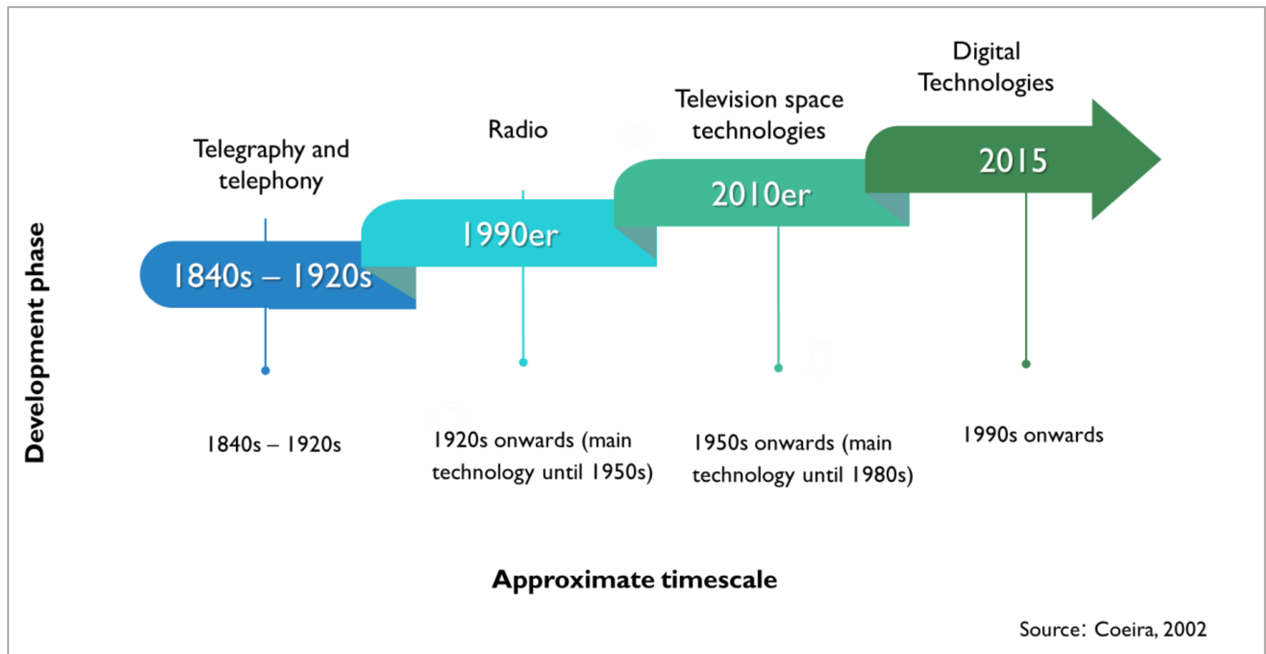


Figure 2. Phases of Telemedicine development

Often the concepts of telemedicine and telehealth are considered synonymous and used interchangeably (WHO 2010b).

The World Health Assembly resolution, WHA58.28, for the first time defined the concept as "eHealth is the cost-effective and secure use of ICT in support of health and health-related fields, including health-care services, health surveillance, and health education, knowledge and research" in 2005 (World Health Assembly 2017). Since then, eHealth has become considered crucial for the World Health Organization (WHO) impacting its growth. In 2015, the mHealth (mobile health) concept emerged as the use of mobile devices for medical and public health practice (WHO 2016a).

Digital health is known as the mean of the "field of knowledge and practice associated with the development and use of digital technologies to improve health"(Dhingra & Dabas 2020). It is an umbrella term that encompasses eHealth, and the use of advanced computer science, which includes smart and connected devices (Dhingra & Dabas 2020).

Nowadays, we can consider that digital health, as a broader term, represents the evolution of telemedicine. Teleconsultation is therefore a service included in digital health.

1.2.2 APPLICATIONS

According to the type of interaction between the individuals (health professionals or health professionals and patients) involved, telemedicine applications can be classified into real-time and asynchronous. Real-time telemedicine (eg. videoconferencing) consists of an exchange of data. On the other hand, asynchronous telemedicine consists of the discussion of copied data between individuals ("Telemedicine Market Size : Global Industry Demand, Growth, Share & Forecast 2024" n.d.). The examination of patients can be performed anytime and reported by any specialist connected to the internet with a good link (Coiera 2002).

Currently, as illustrated in Table 1, telemedicine can be classified into several types: telediagnosis, teleconsultation, Tele-education, telemonitoring, and telesurgery (Coiera 2002; Christiansen et al 2014a ; Xia and Lu 2021).

Table 1. Types of Telemedicine

TYPE	DESCRIPTION
Telediagnosis	Diagnostic examinations (e.g. x-ray, magnetic resonance imaging, electrocardiogram, etc) where interpretation is done remotely (Christiansen et al 2014a).
Telemonitoring	Monitoring of the patient's condition through devices that continuously measure the patient's vital signs, where a response or alert is given to guide the clinical case. The health professional provides remote assistance (Christiansen et al 2014a).
Teleconsultation	Consultation and exchange of information between physicians and patients or between physicians. It could be used for: "establishments, information on laboratory and imaging exam results, discussion of clinical cases, and robotic surgery situations" ("Telemedicina, Relação Médico-Doente e Aspectos Deontológicos – Ordem Dos Médicos" n.d. ; Christiansen et al 2014a).
Tele-training	Training of health professionals at a distance ("Telemedicina, Relação Médico-Doente e Aspectos Deontológicos – Ordem Dos Médicos" n.d.).
Telesurgery	Remote surgical treatment uses wireless networking and robotic technology that allow surgeons to operate on patients who are distantly located (Xia and Lu 2021).

The latest advances in robotics and wireless communication technology have enabled the emergence of telesurgery as a new field, revolutionizing the traditional medical way as it allows surgical treatment at a distance (Xia and Lu 2021). There are already very interesting examples.

According to Choi, Oskouian, and Tubbs (2018), the first telesurgery occurred in 2001, which was conducted by a surgical team in New York, USA, using a robotic system. Since then, advances have been numerous. For example, the possibility of integrating a 3D visual feedback system has been studied, the most significant benefit being the improvement of observation through a floating holographic image of the surgical field, improving the detail of the shared visual exposure, and the collaboration between distant physicians A significant challenge is the "latency time, which is defined as the time delay in transferring feedback between the two distant locations" (Choi, Oskouian, and Tubbs 2018).

1.2.3 CONTRIBUTIONS TO GLOBAL HEALTH

Worldwide, the potential of health technologies to contribute to progress on the 17 Sustainable Development Goals is recognized (WHO 2020a). In this context, new solutions such as Telemedicine and other Information and Communication Technology in health play a significant role in improving medical diagnosis, therapy, clinical trials, self-management of care, and person-centered care, as well as building more knowledge, skills and evidence-based competencies for professionals to support healthcare (WHO 2010b; WHO 2020a).

WHO argues that these technologies have the potential to assist the "triple billion" goals by ensuring that "an additional billion people enjoy universal health coverage, that an additional billion people are better protected from health emergencies, and that an additional billion people enjoy better health and well-being" (Figure 3) addressed in the WHO's Thirteenth General Programme of Work, 2019-2023 (WHO 2020a; WHO 2018).

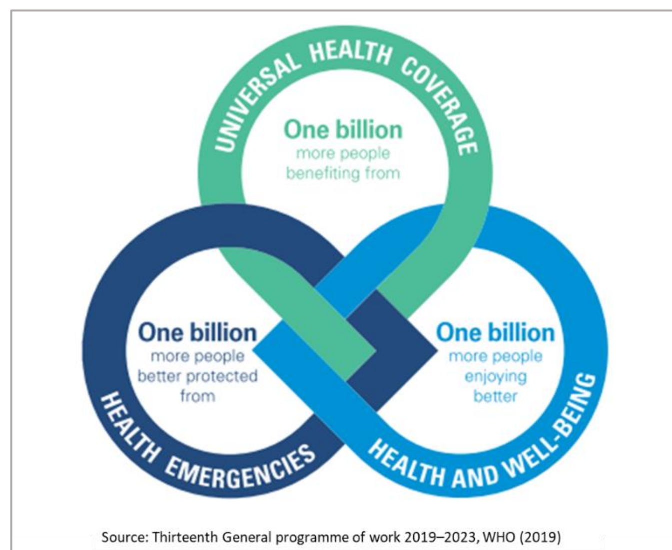


Figure 3. Strategic priorities interconnected

In this context, WHO presented in 2020 the "Global Strategy on Digital Health 2020-2025" aiming at strengthen digital interventions in health systems and institutional support for countries to implement action plans to consolidate their national strategies for digital health.

To accomplished this there will be the need to strengthen investments in governance, institutional capacity and the workforce (WHO 2020a).

In sub-Saharan Africa and the Community of Portuguese Speaking Countries (CPLP), telemedicine has already brought together some successful health programs, which have been continued (Lapão et al. 2016). In this way, telemedicine solutions are expected to bring more efficiency and provide quality to health service delivery for the benefit of citizens and health professionals (WHO 2010b).

The implementation of telemedicine in low-income countries has had positive impacts on the access to clinical assessment, diagnosis, treatment and follow-up consultations. The challenge is the organization of consultations and the training of professionals, among others, for their integration into health services (Maia, Correia, and Lapão 2015).

1.3. THE EVOLUTION OF TELEMEDICINE ROLE IN CPLP

Nowadays, the impact of globalization is conducting the easy dissemination of medical technologies. But on the other hand, the speed of global communication also increases the risk of pandemics. Thus, global health priorities are more complex than they were two or three decades ago, which makes "sustainable development" an even more significant challenge. Because of these threats, there is a need to strengthen external health assistance to some countries, especially the PALOP/CPLP countries (IPAD 2011; Huynen, Martens, and Hilderink 2005).

In this context, in 2008, the commitment to strategic cooperation between the CPLP member states in the health sector led to the development of the Strategic Health Cooperation Plan (PECS/CPLP). Therefore, the main goal of the PECS is to contribute toward strengthening the health systems of the CPLP member states, with priority on the capacity building of human

resources and institutional development to guarantee universal access to quality health care (CPLP 2009).

One of the priorities of the PECS/CPLP is to “promote the use of ICTs to guarantee universal access to quality health care among member countries and identify opportunities for cooperation as a way of leveraging their use” (Lapão et al. 2016). Some of these countries have experience in using ICTs for telehealth; for example, within the CPLP, two countries classified as Small Island Developing States (SIDS) can be highlighted, namely Cape Verde and Sao Tome and Principe (Lapão et al. 2016; WHO 2017).)

1.3.1 SAO TOME AND PRINCIPE

The Republic of Sao Tome and Principe (STP) is a volcanic archipelago with two islands, divided into seven sanitary districts: Água Grande, Mé-Zochi, Lembá, Lobata, Cantagalo, Caué, and the Autonomous Region of Príncipe (RAP) (Figure 4), is located in the Gulf of Guinea, 350 km off the west coast of Africa, with an area of 1,001 km^2. The official language is Portuguese and has a population of over 215,000 inhabitants. STP has young people, with an average age of 17.9 to 19 years, 17.5 for men, and 18.4 for women. About 61% of the population is under 25 years of age, and the average age of the population is 18.6 years (World Bank 2020; WHO 2021; Lima 2018; Nações Unidas 2021).

Figure 4. Map of Sao Tome and Principe´s
(source: https://www.scandalouscandice.com/)

STP has a tropical climate, with a rainy season from October to May. Agriculture (particularly cocoa) constitutes a significant part of the country's economy. The country had a Gross National Product (GNP) per capita of US$1,960 in 2019. It is considered to be a particularly vulnerable country to climate change due to low economic growth and high poverty rates of the population (WHO 2021; Lima 2018).

According to the Basic Law on Health (Law no. 09/2018), in STP, in terms of health care levels, the health system is based on primary, secondary and tertiary care, which should be articulated to ensure a permanent service to the population for "promotion, prevention, treatment and rehabilitation care related to health". This National Healthcare Network includes public, private or mixed facilities. Thus, the Public Health System (PHS) includes all public establishments under the tutelage of the government department responsible for health: Central Hospitals, Regional Hospitals, Health Centres and Health Posts. Private health facilities include clinics, health posts, pharmacies, private organizations, general or specialized health houses, as well as other private health facilities (Assembleia Nacional 2018).

The Health Policy in STP is mirrored in the National Health Development Plan (PNDS) 2017-2021. The Plan is intended to be a driving force for the continuous improvement of the population's health at both community and hospital levels. The Plan aims to strengthen the programs, the health support system and good health practices to achieve greater effectiveness and efficiency in the management of the health system (MSSTP 2021).

In the "United Nations Development Assistance Framework Plan for equitable, inclusive and sustainable development in Sao Tome and Principe - UNDAF 2017 – 2021", some of the medium-term development challenges that the country must face are presented. In the area of health, inadequate training is highlighted, aggravated by the brain drain in Angola, Mozambique and Portugal, limiting the number of doctors, nurses, midwives and specialists (UNDAF 2017).

In international relations of the STP, within the scope of health, bilateral and multilateral cooperation with other countries, bodies and cooperation agencies, in particular with Portuguese-speaking countries, is encouraged (Assembleia Nacional 2018). In this context, we highlight an NGO for Development, Instituto Marquês de Valle Flôr (IMVF) founded in 1951. It has been operating in São Tomé and Príncipe (STP) since 1988, initially in the districts of Mé-Zoxi Mé-Zoxi and Cantagalo, reaching the entire territory in 2008 (Barrocas and Freitas 2014a).

The IMVF developed the "Health for All" project, which represents an "innovative health development practice" from which crucial lessons can be drawn, even for the most developed countries, in the area of management and differentiated offer of services at the level of primary health units (Barrocas and Freitas 2014a; Freitas et al., 2014) in a case study, emphasize that the Project's results confirmed that the contracting of healthcare services "is a solution that makes it possible to ensure the efficiency and effectiveness of care provision and the rapid achievement of good health outcomes for the populations covered, without jeopardizing the

coverage and equity of care", especially in the primary health care context (Barrocas and Freitas 2014a).

Lapão et al. (2016) summarise the main evidence regarding the telemedicine programme in STP and recount that since 2012, the country has been experiencing a phase of strengthening specialised care ("Projecto "Saúde para Todos"-"Specialised Care and Telehealth") through the use of a platform. This project is in partnership with Camões - Instituto da Cooperação e da Língua, I.P. and the Calouste Gulbenkian Foundation, with the direct support of the Hospital Professor Doutor Fernando Fonseca. Also, STP, since 2008, has had significant support in access to child health through bilateral cooperation between the paediatric service of this country and Portugal, which uses telemedicine for clinical discussion of cases and support in the evacuation of children.

1.3.2 CABO VERDE

Cabo Verde is an archipelago located 500 km off the west coast of Africa, consisting of 10 islands (Figure 5), nine of which are inhabited by about 538,000 inhabitants [2017]. According to INE projections for 2030, a significant increase in population aging is expected. Cabo Verde's population aged 24 or under will reduce substantially, from the current 47% to 38% in 2030, while the population aged 65 or over will increase from 6% to 8% of the total (World Bank n.d.; Perrault, Litse, and Bakoup 2014Ministério da Saúde de Cabo Verde 2021;).

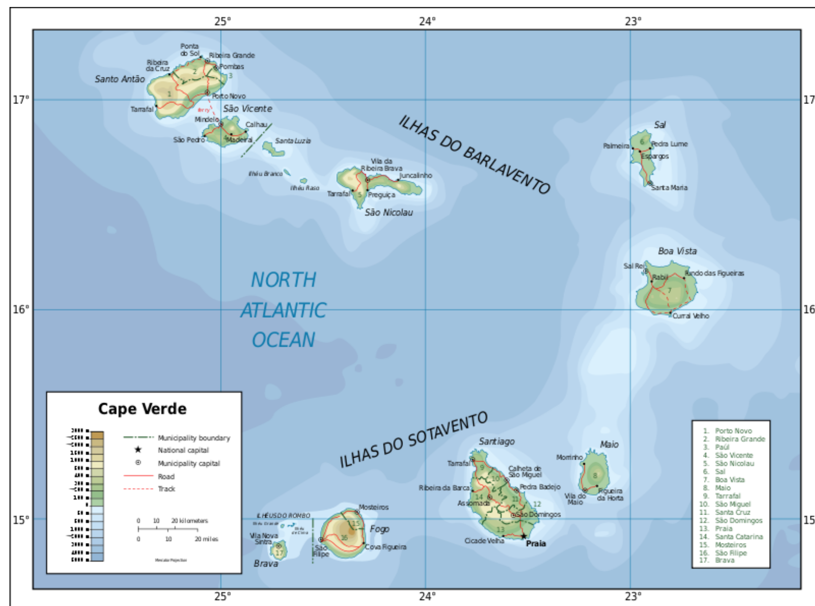


Figure 5. Map of Cabo Verde

(source: http://www.mappery.com)

The country has seen remarkable economic progress since 1990, and this development is mainly due to tourism and social policy developments since the 1970s. The Cape Verdean economy is supported by tourism - which accounts for 25 percent of GDP and drives about 40 percent of overall economic activity - with a temperate climate all year round. Tourism growth in recent years has been significant, showing an increase in 2017 (Governo de Cabo Verde n.d.; World Bank n.d.; MSSSCV 2021).

Cape Verde's performance was highlighted in 2012 for its good governance. Cape Verde's potential to develop into a logistics, digital, innovation, or financial center is posted. However, it would require creating and maintaining international competitiveness, which is not possible due to the characteristics of the ICT sector (relatively low bandwidth per internet user and weak enforcement of the regulatory regime) that place it below the global average. However, likely, the technologies sector will likely support the modernization of the delivery of education and health services across the archipelago and the development of logistics and tourism (World Bank Group 2018; Perrault, Litse, and Bakoup 2014).

In Cabo Verde, the National Health System has a public and a private component. The public offer of health care focuses on primary, secondary and tertiary care levels. On the other hand, for the private sector the most significant representation of the available supply is at the level of clinics/physician practices with consultations in different specialties, characterized by a substantial number of small offices of individual physicians (MSSSCV 2021).

Since 2012, the Cabo Verde Telemedicine program (CVTP) managed Ministry of Health of Cape Verde has emerged as a specialized care offer, covering all islands. The geographical dispersion of the country leads to the need for patient evacuation, internally and externally, depending on the clinical needs of the patients and the existing response capacity of the two central hospitals. These patient evacuations may be conditioned due to irregular inter-island connections (sea and air). In this context, telemedicine has been a resource of great interest in an archipelagic country where specialized resources are still scarce and concentrated in the hospital units with the highest level of differentiation, avoiding unnecessary and expensive transfer (Azevedo et al 2020; MSSSCV 2021).

Its implementation had international support, having been built by the International Virtual e-Hospital Foundation (IVeH), and funded by the Slovenian Ministry of Foreign Affairs. Nowadays, it continues to increase access to specialized care. Azevedo et al (2020) reported that the CVTP between 2014 and 2018 had a total of 2,442 telemedicine requests. Therefore, is considered a successful telemedicine program in Africa.

1.4 AIMS

1.4.1 MAIN AIMS

The main goal of this thesis is to study the role of telemedicine in Sao Tome and Principe to increase access to healthcare and to help make decisions and define policies.

1.4.2 SPECIFIC OBJECTIVES

The objectives will be divided into specific goals that will require the performance of some analysis, all listed below:

1. Exploratory study to analyze in a global way what is published about the telemedicine service in African SIDS (they are in the same group as the country under study, STP)
2. Characterization of Telemedicine in STP: study the origins and evolution of Telemedicine, through the description and analysis of the main initiatives and experiences in the teleconsultation branch that have contributed to the improvement of service conditions in the provision of care to citizens.
3. To discuss the contribution of Telemedicine to the health workers' performance in the STP system.

1.4.3 STUDY DESIGN

Three studies were performed to accomplish the previously defined specific objectives.

Study I:

"Telemedicine in African Small Island Developing States: a systematic literature review"

There were 38 SIDS on the United Nations list (United Nations n.d.), and for this study, we decided to select Africans. Brief geographic and demographic information is provided for each country, followed by a historical review of the national strategies for telemedicine development.

Study II:

"Leveraging technology to reach global health: the case of telemedicine in STP health system"

A case study approach was used and combined with Momentum's critical success factors to successfully launch telemedicine services analysis to help understand the implementation and scale-up processes, as well as the role of strategic partnership in leveraging healthcare services with technology.

Study III

"How is telemedicine improving the performance of the health system in a low- and middle-income country?"

A case study approach was used and combined with the AAAQ (availability, accessibility, acceptability, and quality) health workforce framework for assessing the STP telemedicine program.

This thesis consisted of a sequential explanatory design. Therefore, this type of study has the first phase of an exploratory study that influences and provides information for the second and third phases of data collection and analysis, as described in Figure 6.

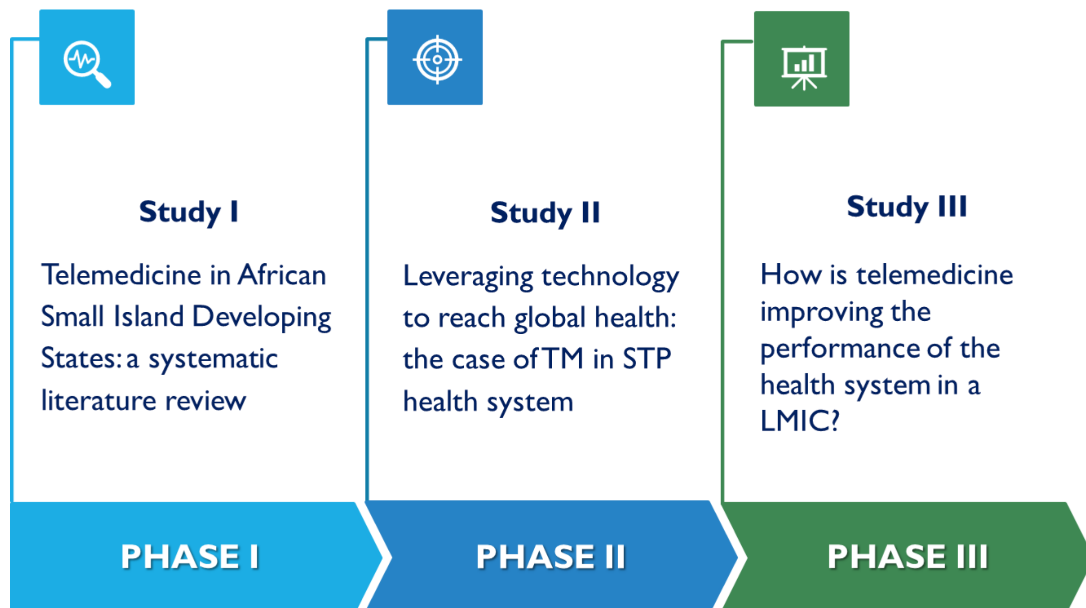
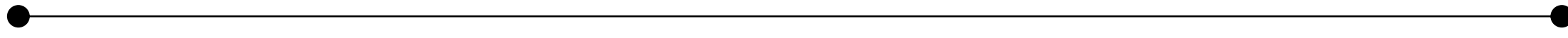


Figure 6. Ph.D. study design

CHAPTER 2: «Telemedicine in African Small Island Developing States: a Systematic Review »



Telemedicine in African Small Island Developing States: A systematic literature review

This paper will be submitted to the International Journal of Healthcare Technology and Management.

Cátia Gonçalves[1] , Luís Velez Lapão[2]

[1] Nova School of Business and Economics, Nova University of Lisbon, Campus de Carcavelos, Rua da Holanda, n.1, 2775-405 Carcavelos, Lisbon, Portugal.

[2] Global Health and Tropical Medicine, Institute of Hygiene and Tropical Medicine, Nova University of Lisbon, Rua da Junqueira 100, 1349-008, Lisbon, Portugal.

Abstract

Background: African Small Island Developing States (SIDS) have much to gain from using telemedicine to improve population health, increase access to care, and reduce costs.
As a systematic review, this paper aims to be comprehensive to assess the current state of knowledge on SIDS and digital health.

Objective: This work aims to determine the state of Telemedicine services/projects/programs in African SIDS (Cabo Verde, Comoros, Guinea-Bissau, Mauritius, Sao Tome and Principe, and Seychelles) by critically reviewing the work published about these healthcare services in these countries.

Methodology: We applied a systematic literature review (SLR) process to research articles retrieved from Pub Med, BVC and Google Scholar databases. Using the keywords that included telemedicine in African SIDS countries, we searched for articles from these databases.

Results: We analysed 15 papers selected from 32 papers initially retrieved to answer the research questions. The findings revealed that about 80% of research on telemedicine in African SIDS countries was undertaken in three countries: Cabo Verde, Sao Tome and Principe, Mauritius and Seychelles. The review of the selected articles revealed a lack of

research in some countries. The SLR points out that most countries in the region do not have a National Telemedicine Centre. This study can contribute knowledge to policy makers, and offer opportunities for future research.

Conclusions:

We highlight the differences in maturity among the National telemedicine Programs. Finally, the study also identifies the need for building new knowledge and new skills to help develop better-suited National telemedicine Programs, and address inadequate technical support, that can be mitigated with a proper strategy for telemedicine adoption and expansion.

Keywords

National Telemedicine Program, African SIDS, Global Health

INTRODUCTION

Small Island Developing States (SIDS) as the name implies, are small territories. Due to their dispersed geography, these countries are relatively more vulnerable to climate change. Their geography makes them more isolated, which is reflected in terms of economic development (WHO 2017; Robinson 2020). Table 2 lists the recognized group of 58 island nations divided into 3 geographic divisions - the Caribbean, Pacific and Atlantic, Indian Ocean, Mediterranean, and South China Sea (AIMS) (WHO 2017).

Table 2. SIDS: States, territories, and areas in each division

Region	Countries	Total
AIMS	Bahrain, Cabo Verde, Comoros, Guinea-Bissau, Maldives, Mauritius, Sao Tome and Principe, Seychelles, and Singapore	9
Caribbean	Anguilla*, Antigua and Barbuda, Aruba*, Bahamas, Barbados, Belize, Bermuda*, British Virgin Islands*, Cayman Islands*, Cuba, Curacao*, Dominica, Dominican Republic, Grenada, Guadeloupe*, Guyana, Haiti, Jamaica, Martinique*, Montserrat*, Puerto Rico*, Sint Maarten*, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago, Turks and Caicos Islands*, and United States Virgin Islands*	28
Pacific	American Samoa*, Cook Islands*, Federated States of Micronesia, Fiji, French Polynesia*, Guam*, Kiribati, Marshall Islands, Nauru, New Caledonia*, Niue*, Northern Marianas Islands*, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu, and Vanuatu	21

Source: (WHO 2017).

Although they have similar challenges, economic and health statistics vary across SIDS. Political, social, and environmental issues can pose a threat to the health of populations with SIDS (WHO 2017).

In these countries, some health systems face difficulties in terms of the low number of specialized physicians and depend on other countries for training specialists, which increases

the vulnerability of the necessary health services. Therefore, some more demanding procedures, such as surgeries, are done abroad (WHO 2017; Latifi et al. 2014a). In this context, telemedicine/digital health can benefit health systems regardless of a country's level of development (Gupta et al. 2019). Despite the many benefits offered by telemedicine, it has not been fully utilized to serve humanity and is underutilized (Edworthy 2001).

This study aims at determining the state of Telemedicine services, projects, or programs in African SIDS (Cabo Verde, Comoros, Guinea-Bissau, Mauritius, Sao Tome and Principe, and Seychelles) by systematically reviewing the work published about these healthcare services in these countries.

METHODOLOGY

For this study, we analyze the 6 African SIDS. Table 3 provides brief geographic, demographic, and economic information for each country under analysis.

Table 3. African SIDS characteristics

Country	National Language	Geography	Total Population *(millions)*	GDP *(per capita)*	Human development index *(HDI)*	Life expectancy *(years)*
Cabo Verde	Portuguese	10 main islands (9 inhabited)	0.5	1,704 billion	0.651 Medium	72,98
Comoros	Comorian, French, and Arabic	4 islands	0.8	1,22 billion	0.538 Low	64,32
Guinea-Bissau	Portuguese	The Bissagos Islands: 88 islands and islets	1.9	1,432 billion	0,461 Low	58,32
Mauritius	English and French	4 islands	1.3	10,91 billion	0.796 High	74,24
Sao Tomé and Principe	Portuguese	2 islands	0.2	472, million	0.609 Medium	70,38
Seychelles	French English Seychellois Creole	115 islands	0.1	1,125 billion	0.801 High	73,94

1) 2019 data

2) USD; 2020 data

Source: UNDP data, 2018 ("Human Development Indices and Indicators: 2018 Statistical Update" n.d.).

Search strategy

To identify relevant documents focusing on the use of Telemedicine in African SIDS two electronic databases (PubMed and Biblioteca Virtual da Saúde - BVS) were searched using combinations of MeSH terms and free-text words such as MeSH: "telemedicine" (MESH), "national telemedicine centre", "national telemedicine programme", "national telemedicine system", "national telemedicine network" regional PALOP, CPLP. The search results were then combined with the name of each SIDS African country: Cape Verde, Comoros, Guinea Bissau, Mauritius, Sao Tome and Principe and Seychelles. An efficient and complete approach was adopted using combinations of different search strings in each electronic database chosen

for this study. The main source of the data for our study was a systematic search in PubMed and BVS. The Google Scholar search was considered as an additional source only (Giustini Dean and Kamel Boulos 2013; Piasecki, Waligora, and Dranseika 2018). Google Scholar is considered an important source of grey literature, and government and institutional reports (Piasecki, Waligora, and Dranseika 2018). As we already expected a small total number of documents, this database was used to increase the scope of our research, given the qualitative rather than statistical nature of the study.

The results of all searches were downloaded to the *Mendeley* program (Elsevier); duplicates were automatically removed using *Mendeley* and manually checked, followed by the implementation of the inclusion process.

Study selection

Publications were included in the study when all of the following selection criteria were met:

1) Research articles, i.e., publications structured as Introduction, Material, and Methods, and Results/ Discussion, or similar;
2) Grey literature;
3) Available as Free Full-Text;
4) Written in English, French or Portuguese;
5) Published until the date of the search (31st March 2020);

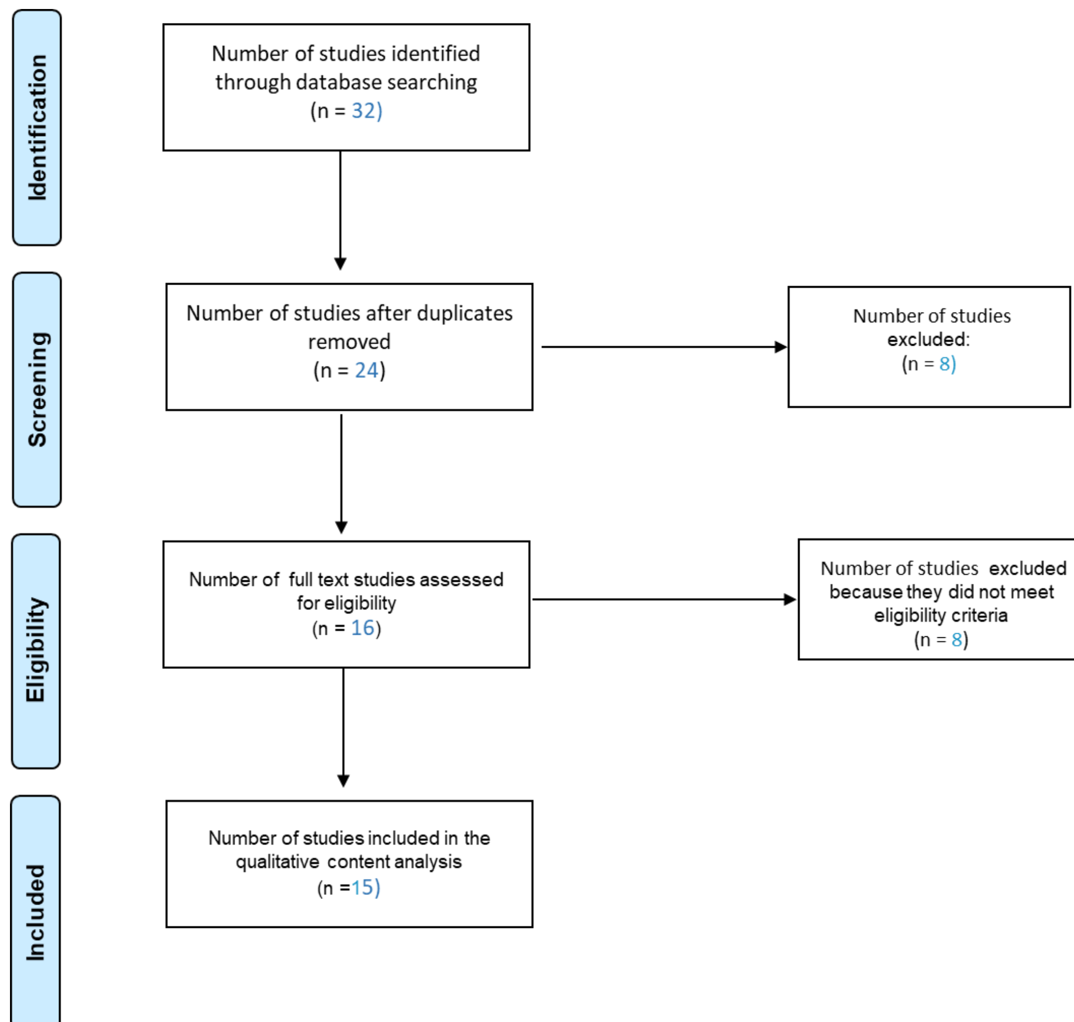
Data synthesis and analysis

According to the analysis, publications were classified into as many categories as possible to reduce the likelihood of missing key points in the data.

RESULTS

Database searches resulted in a total of 19 publications and 13 complimentary publications. Google Scholar was used as the database because it includes relevant grey literature in the field. After the removal of duplicates, 24 references were selected. After the two-stage selection process, 16 articles were included in the study, and 15 publications were analyzed as described in the Figure below. Additionally, Tables 7, 8, and 9 are available in the appendix A.2, and display the publications selected in each phase of the process.

Figure 7. PRISMA Flowchart reporting the publications in each phase of the review



The research used gave a comprehensive status of telemedicine in African SIDS. The search targeted the title and abstract used in the article. In the first phase, we applied the refined search string using the search string ("telemedicine") AND ("each country") OR "PALOP OR CPLP", the selected databases yielded 32 research articles as shown in Figure 7.

In the second phase, we examined the entire research article by title, yielding 24 articles. In the next phase, we retained 15 research articles (Table 4) after examining each publication title to make sure it was specifically related to telemedicine in African SIDS. The references of the publications analyzed were ordered from 1 to 15 and cited in italics for differentiation from the manuscript references listed at the end of the manuscript.

Table 4. Studies included in the qualitative content analysis

No	Author	Title	Year	Type	Country
1	G. Ramalanjaona & G.X. Brogan /	EMS in Mauritius.	2009	Research article	Mauritius
2	R. Latifi *et al.*	Beyond 'initiate-build-operate-transfer' strategy for creating sustainable telemedicine programs: Lesson from the first decade	2012	Brief communications	CV
3	Syed-Abdul *et al*	Telemedicine utilization to support the management of the burns treatment involving patient pathways in both developed and developing countries: a case study.	2012	Research article	STP
4	IMVF	"Saúde para todos": cooperação em saúde com São Tomé e Príncipe	2013	Report	STP
5	R. Latifi *et al.*	"Cabo Verde telemedicine program: initial results of nationwide implementation.,"	2014	Research article	CV
6	Lapão *et al*	Improving Access to Pediatric Cardiology in Cape Verde via a Collaborative e International Telemedicine Service.	2015	Research article	CV
7	Maia *et al*	Telemedicina - Um meio para a saúde global. Um caminho para o acesso universal à saúde.	2015	Research article	CPLP
8	Loureiro *et al*	Saúde Para Todos – Especialidades: Cooperação Portuguesa Com São Tomé E Príncipe Na Área Da Cardiologia	2015	Research article	STP
9	Lapão et al	"Roteiro estratégico para a telessaúde na CPLP : diagnóstico e prioridades para o desenvolvimento da telessaúde,"	2016	Research article	CPLP
10	E. Castela	Coimbra telemedicine service improves access to pediatric cardiology in Cape Verde	2017	Acta med	CV

11	Correia A, et al.	Implementation of Telemedicine in Cape Verde: Influencing Factors	2017	Research article	CV
12	Correia, A	A telemedicina em Cabo Verde : Desafio de integração na rotina de prestação	2017	Phd thesis	CV
13	Ferreira, R	Que serviço de imagiologia para Cabo Verde, um país arquipelágico?	2018	Internship report	CV
14	Maia et al,	How to develop a sustainable telemedicine service? A Pediatric Telecardiology Service 20 years on-An exploratory study	2019	Research article	CPLP
15	Beja et al	Trends and contexts of implementation of information and communication technologies for health systems strengthening in low and middle income CPLP countries: the cases of Cabo Verde, Moçambique and Guiné-Bissau	2019	Research article	CPLP

Of the 15 publications selected for review, the majority were research papers. The research yielded a total of 2 national telemedicine programmes from six countries: Cape Verde, Sao Tome and Principe.

Content analysis was conducted to extract emerging themes from the selected papers. The extracted data were then classified to address the research questions. The papers provided information on the country, the focus of the study and how the data was analysed. The main variables are discussed as the emerging themes show the state of telemedicine in African SIDS. We used the emerging themes to identify trends and gaps in telemedicine research in the region. The data were then qualitatively analysed to interpret the underlying terms and arguments which are described in detail in the appendix A.2.1).

The results of our study, answer our research question and discuss the results of the extracted data. To analyse the data, we used qualitative methods to explain the themes emerging from the selected articles.

The state of telemedicine programs/services/projects in African SIDS

Distribution of papers by country

The analysis of the selected 15 papers showed that 11 specifically focused on four African SIDS countries (Cape Verde, Mauritius, Sao Tome and Principe), while four covered the group CPLP in general. Figure 8 highlights the distribution of the articles by country. A total of seven papers (47%) focused on Cape Verde while Sao Tome and Principe followed with three papers (20%), Mauritius with one paper (7%), with the remaining four (27%) focusing on the group CPLP.

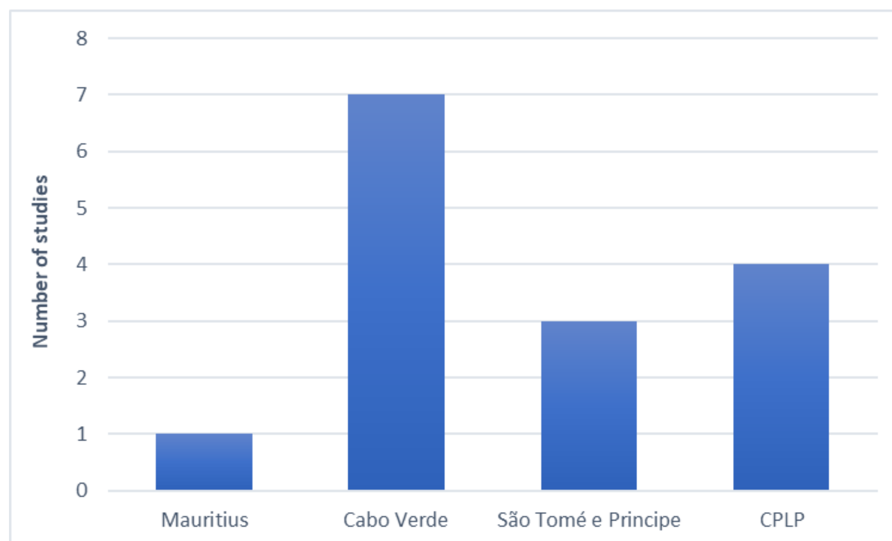


Figure 8. Number of studies included in the qualitative content analysis

The two most researched countries account for 60% of the articles in the final inclusion.

Distribution of papers by category

Of the selected 15 articles, one points out the use of telemedicine to assist the Emergency System, the IBOT implementation technique, and the way to improve the implementation of National Telemedicine Centres: eight critical factors; one about case-study (burns), one about cooperation, one about cooperation in cardiology.

Analysis of Content

Our analysis shows that of the selected countries, Cape Verde and STP in particular are in a more advanced state in terms of telemedicine implementation. Table 5 summarizes the results of the content analysis.

Table 5. Findings from the analysis of content

	Cabo Verde	Mauritius	Sáo Tome and Principe	Guinea Bissau
National telemedicine Program	Since 2012		Since 2011	
Leadership	Government	Government	NGO and government	
Support internal and external evacuations	- Internal - External (to Portugal) - Post-evacuation		-External (to Portugal) -Post- evacuation	
Use telemedicine to support EMS		Coordinate EMS response		
Teletraining	yes	yes	yes	Teleconference seminars

3.1.2 Cabo Verde

In 2000, an international collaboration project between Cape Verde (Brava Island) and the USA arose whose objective was to make diagnosis and communication between doctors through an ISDN line platform and used Net Meeting for communication with the X-ray transmission image *(Lapão and Correia 2015).*

Since 2009 Cape Verde has had a collaboration with the Paediatrics Department of the Coimbra Hospital Centre, in paediatric cardiology, allowing teleconsultations for discussing cases, second opinions, diagnosis and scheduling of evacuations *(Lapão et al. 2016),* using the Medigraf platform developed by PT-Inovação. The performance of this service has already been recognised nationally and internationally for its benefits through telemedicine, saving financial resources with unnecessary travel. Without this resource, some of these children would not have been diagnosed and many of them would have come to Portugal unnecessarily and with significant socio-economic costs *(Castela n.d.; Maia et al. 2019; Beja et al. 2019).*

The study from Latifi et al. (2014a) reviewed show that an integrated telemedicine and e-health programme for Cape Verde (ITeHP-CV), was implemented in 2012, using the NGO IVeH strategic approach known as IBOT -" Initiate-Build-Operate-Transfer" for 26 months (November 2011-December 2013) .

Latifi et al. (2012), suggest that the strategy should be complemented by eight other components for successful telemedicine programmes in developing countries. Policy instruments and conditional and facilitating factors of the programme were also identified *(Correia, Azevedo, and Lapão 2017).*

The programme had training and fostering local champions, and was established and supported by the Ministry of Health. This support was established from the beginning of the implementation as the sustainability of the programme has always been a priority (Latifi et al. 2014a; Latifi et al. 2012; Correia 2017). Thus, the political priority (e.g. legislation to use telemedicine in patient evacuation) and international partnerships established (e.g. with Portugal), are pointed out as fundamental for the success of the implementation process of the National Telemedicine Programme in Cape Verde *(Correia, Azevedo, and Lapão 2017; Correia 2017).*

Correia, Azevedo, and Lapão (2017) show us that the National Telemedicine Programme (NTP) was implemented in Cape Verde, at national and regional levels, and in addition to the acquisition and installation of the equipment, it was necessary to build capacity on the various islands, it was also necessary to create a leadership team at the level of the Telemedicine Programme directorate, and members of the Telemedicine Centres were appointed.

In early 2014, the NTP was made official through Order No. 2 of 17 January from the Minister of Health, and the priority axes and objectives were defined. In the same year, the NTP coordinator was appointed and a set of organizational and functional standards were approved *(Correia, Azevedo, and Lapão 2017).*

However, the analysis of the Cape Verde context concluded that there are opportunities and threats that influence the integration of telemedicine in the care delivery system *(Correia 2017).*

In Cabo Verde, more demanding procedures, such as neurosurgery and cardiac surgery, are done in Portugal *(Latifi et al. 2014a)* because the health system lacks many specialists *(Lapão and Lopes 2013).*

In this sense, the use of telemedicine to support the management of the evacuation from Cape Verde to Portugal, and evacuations between islands, and monitoring of patients in post-evacuation, allows for cost reductions in the management of the health system *(Lapão and Lopes 2013; Maia, Correia, and Lapão 2015; Lapão et al. 2016).*

3.1.4 Guinea Bissau

A study highlights the implementation of two telemedicine projects in Guinea-Bissau to train health professionals through tele-training and teleconference seminars: the Telehealth UERJ11 project, of the UERJ Telehealth Centre of the State University of Rio de Janeiro, Brazil, which integrates two national programmes (the university telehealth network - RUTE - and the Brazil

telehealth network); and the Pan African e-Network10 developed by the Indian Government and African Union which also provides telehealth services by speciality consultations. Both projects are part of a network with other African countries *(Lapão et al. 2016).*

The use of ICTs in digital health is pointed out as an opportunity and a means of contributing to universal coverage in Guinea-Bissau. They represent a major challenge, due to the investment costs and resources required (infrastructure, IT resources, quality internet network), and the need to train adequate HR and involve them in the implementation of these projects *(Beja et al. 2019).*

3.1.5 Mauritius

Mauritius is an island, part of a group of islands (Mascarene Islands), with about 59% of the population living in rural areas, and is beset by frequent natural disasters such as cyclones and hurricanes. Thus, it has characteristics that make it privileged to use telemedicine to support EMS, because it has increased access and communication to rural and isolated areas. In addition, the technology has enabled "tele-education, teleconsultation with specialists and telecommunication for EMS workers to help coordinate emergency response in disaster management*"(Ramalanjaona and Brogan 2009).*

Mauritius' EMS systems are a reference in Africa, a breakthrough that has been achieved due to economic growth and good governance. By government decision, telemedicine was introduced into the EMS system as a way to decentralize and develop the healthcare system. *Ramalanjaona and Brogan (2009)* recognise that to make progress the country must continue to invest in telemedicine and other technologies.

3.1.6 Sao Tome and Principe

Since 2008, a collaboration between the Paediatrics Department of the Hospital Professor Doutor Fernando Fonseca (HFF) and the Instituto Marquês de Valle-Flor (IMVF), Portugal has contributed to the communication and exchange of information and support in child evacuations *(Lapão et al. 2016).* And in this collaboration telemedicine has always been seen as a support for diagnosis, therapeutic guidance and decisions to evacuate patients to Portugal for surgical or percutaneous treatment at the right time in the evolution of the disease and as a support for continuous and distance training of human resources *(Loureiro et al 2015).*

In 2012, it was shown through a case study "Telemedicine Utilization to Support the Management of the Burns Treatment Involving Patient Pathways in Both Developed and Developing Countries: A Case Study"*(Syed-Abdul et al. 2012)* how the burn emergency support service works with the Taipei Hospital, exclusively to attend STP patients who need greater care, simultaneously, the training of Taiwanese doctors who are attending locally in the central hospital of STP is done. They mentions that the service started in 2009. It shows that the existence of this service provided a closer relationship between the government of STP and Taiwan (including some consultations VC were performed at the embassy of this country).

Since 2009, Taipei Medical University has been providing medical services in STP with a medical team that is physically present on the islands. Taking into account the limited access to internet, to make the service sustainable they point out some improvements to implement, namely the use of storage and anticipation for teleconsultations and teletraining (eg. Educational videos on Youtube), they suggest a system to educate the clinical staff on how to take digital photographs to help in the diagnostic process *(Syed-Abdul et al. 2012).*

Since 2012, the Health for All - Specialised Care and Telehealth Project, a programme integrated in the "Saude para todos" project operating in the country since 1988, has been strengthening the provision of specialised healthcare for an effective improvement of health

indicators, through the use of a telehealth platform to make the missions of specialities. The project is managed by the NGO IMVF and supported by the Instituto da Cooperação e da Língua, I.P. and the Calouste Gulbenkian Foundation, with the direct collaboration of the Hospital Professor Doutor Fernando Fonseca *(Lapão et al. 2016 ; Para et al. 2013; Lapão et al. 2016).*

A telemedicine platform was installed in order to monetize the missions of the specialties. Thus the transmission of live ultrasound, Rx images by remote, and the discussion of clinical cases became a reality, The first year of activity points to 13369 telediagnosis, 11958 digital radiography, 361 ultrasound and 166 teleconsultations *(Para et al. 2013).*

In 2013 version 3.0 of the Medigraf platform used in telemedicine with São Tomé was developed in conjunction with a Portuguese company, PT Inovação, which allows live, real-time transmission of moving images of an examination being performed by a doctor or technician in São Tome and Príncipe. This platform was awarded at the end of 2013 with two prizes: Changing Lives category of the AfricaCom 2013, and Broadband Infovision awards. This technology, initially available only from a computer installed at the IMVF headquarters in Lisbon, can now be accessed from any laptop and will also become available to other organisations *(Loureiro et al 2015).*

CPLP

In the context of the CPLP, collaboration with the West African Health Organisation and other international partners is seen as strategic for building a platform that aggregates various resources, guaranteeing interoperability of systems and helping to avoid dependence and pressure from the software market, compensating for the small scale of some of the countries in the group *(Beja et al. 2019).*

DISCUSSION

Successful implementation of telemedicine services

The present study analyses countries at various development stages/income levels, with Guinea-Bissau and Comoros being the least developing countries and Cabo Verde and STP a medium-income countries. These characteristics should be taken into account when analysing the evolution of their national telemedicine systems, in terms of scale. Countries like Cape Verde are an archipelago consisting of several islands have a greater need for telemedicine infrastructure to support the various islands the Telemedicine National Network provides inhabitants of the islands with specialised and high-level health services, without requiring them to travel, o que tem sido um sucesso.

Despite the recognised role of telemedicine in countries with a wide geographical dispersion, it is not always possible to implement it in these countries due to several barriers. (Nazviya and Kodukula 2011), examines o caso das Maldives, an island nation consisting of 1190 islands with a population of about 300,000 people. Thus, due to the geographical distribution of the islands and population distribution, challenges related to transportation costs arise when seeking access to medical care by rural island populations, making it a suitable country to implement telemedicine. Nevertheless, a number of constraints have been identified, from technological to political, that have prevented a national-level programme from being successful.

We also recognized that the AIMS region also provided opportunities for action at a sub-regional level to address issues related to the geographical position of certain AIMS countries, language commonalities and similarities of the challenges faced. For example, it is the case of Cape Verde and STP.

Our research found a successful implementation of telemedicine services in the healthcare setting of some African SIDS, i.e. systems that have remained active and are adopted into the daily routine. However, we understand that to infer the sustainability of a telemedicine service, cost-effectiveness analysis should also be taken into account. Also, it is important to note the critical role played by the private sector in the success of telemedicine. For example, when comparing LMIC SIDS with countries like Singapore with business-friendly policies, a strong information technology capability realizes the importance the private sector can have for development and can play a significant role in the regional and global telemedicine network.

The maturity and sophistication of each program

According to Kidholm *et al.(*2012), the maturity of telemedicine systems may correspond to their degree of development taking into account the implementation time. Even though the maturity and sophistication of each program found that no African SIDS studied varied greatly, they all shared the vision of improved access to health care for the population and training for the capacity-building workforce.

In our research we analyse the maturity of telemedicine solutions in terms of development times. Thus, we concluded that they are at different levels of maturity, and that most solutions have been in operation for more than five years. From our results we also noticed that most of the publications spoke about specialties in general and did not focus on just one, with the exception of some papers from Sao Tome and Principe that spoke about telecardiology-

A review was performed by Marcelo et al. (2015) about the state of governance and management of National Telehealth Programs in seven countries (Bangladesh, India, Indonesia, Malaysia, Maldives, Philippines, and Sri Lanka) in Asia. Results suggest that each of these programs has been established and/or is supported by Ministries of Health and/or organizations that play key roles in their regions in both healthcare and education and is funded

by different organizations. The authors argue that alignment of management and governance is critical to realize benefits for stakeholders and ensure the sustainability of programs.

(Weber et al. 2017) refers to the positive impact dos remarkable investments in telecommunications and electronic health infrastructure in countries such as Bahrain, a high-income SIDS. Such advances in technology instituted by the government in Bahrain are reinforced by Alawi and Ahmed (2012), which suggests that in the country the IT infrastructure at the Ministry of Heath where all the primary and secondary care center systems are connected by the Internet, which facilitates the development of a program that promotes the integration of telemedicine in various medical specialties in the country. Similar results are achieved by (Rana and Fadel 2020) which analyses the experience of a Bahraini oncology centre, where telemedicine emerged as an important tool for patients, providing state-of-the-art cancer palliative care and support services during the COVID-19 pandemic when it had limited access to health services.

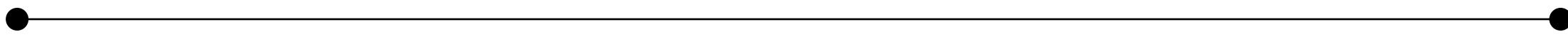
CONCLUSION

SIDS are countries with small, geographically distinct populations and/or sparse workforces, on health issues are particularly vulnerable burdens. The health services available in these countries are considered to have a vital role to play in the sustainable development of the country. Thus, the importance of national telemedicine programmes in these complex and vulnerable countries should be reflected in the scale of effort they put into implementing telemedicine programmes. The benefits are enormous, with even greater importance in archipelagos made up of several islands where there is no difficulty in having specialised human resources on all the islands.

This paper reviewed 15 published studies that found that in the countries analysed the Cabo Verde was the main source of knowledge, this helps to show the importance of this health

service in archipelagic countries. The review reports that each country has its own digital health action plan built on the strategy, within its national context. The importance of telemedicine for triage and evacuation is highlighted in some of these countries.

CHAPTER 3. « "Leveraging technology to reach global health: the case of telemedicine in Sao Tome and Príncipe Health System"»



Leveraging technology to reach Global Health: The case of Telemedicine in Sao Tome and Príncipe Health System

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Cátia Gonçalves[1] , Anicolette da Mata[2], Pascoal d ´Apresentação[2], Luís Velez Lapão[3],

[1] Nova School of Business and Economics, Nova University of Lisbon, Campus de Carcavelos, Rua da Holanda, n.1, 2775-405 Carcavelos, Lisbon, Portugal.

[2] Hospital Ayres de Menezes, Ministry of Health, Rua Patrice Lumumba 23; São Tomé e Principe

[3] Instituto de Higiene e Medicinal Tropical, and UNIDEMI-Research and development unit for mechanical and industrial engineering, Nova University of Lisbon, Rua da Junqueira 100, 1349-008, Lisbon, Portugal.

ABSTRACT

Background: Many African Healthcare systems are seeking innovative solutions to improve access to specialized care while leveraging new technologies. Sao Tome e Principe (STP) has adopted telemedicine to overcome geographic barriers and the shortage of healthcare professionals, since 2011, which has been daily connecting with Portuguese specialists, through a teleconsultation platform. This study presents a comprehensive assessment of the telemedicine service development, evolution, and impact in global health in the context of a low and middle-income country (LMIC).

Methods: A case study approach was used and combined with the Momentum's critical success factors to successfully launch telemedicine services analysis to help understand the implementation and scale-up processes, as well as the role of strategic partnership in leveraging healthcare services with technology.

Results: Growing steadily from 2011 to 2019, the telemedicine service in STP performed a total of 4 966, real-time teleconsultations, 137 976 exams, and clinical files introduced in the

telemedicine platform. Fourteen medical specialities are providing remote access to care from Portugal. The most frequent consulting clinical programs were teleradiology (72.0%), teleophthalmology (13.0%), teleotorhinolaryngology (9.0%), and telepediatric (4.0%). Behind this platform to adapt to the country context, there were local human resources trained to perform teleconsultations with autonomy. Additionally, the Valle Flor Marques institute's leadership has been a successful factor.

Conclusion: These results suggest a consistent evolution of the service benefitted from the system's integration with the daily routine and with the Portuguese health service. This telemedicine service is an excellent example of the contribution that information technologies can have to LMIC, especially in a perspective of universal healthcare coverage.

Key-words: Telemedicine, Sao Tome and Principe, Universal Health Coverage, Global health, Implementation science

INTRODUCTION

Information and communication technologies (ICT) have been used in recent years to support healthcare systems innovation, especially in low and middle-income countries (LMIC), often as a significant contribution towards attaining Universal Health Coverage (UHC) (WHO 2020b). According to the (WHO 2020b) telemedicine is "the provision of health services, where distance is a critical factor, using ICT to exchange valid information for the diagnosis, treatment, and prevention of diseases and injuries, research and evaluation, and for the continuing education of health professionals"

Regardless of the promising potential of telemedicine to address healthcare problems, especially in lower-middle-income countries, its scale-up has been unsatisfactory, and many telemedicine services fail to sustain their implementation shortly after initial funding or after a pilot phase. Therefore, it is essential to document existing models of telemedicine implementation in these countries to identify commonalities and extract experiences that would be useful for implementers, policymakers, and future researchers (Luis et al. 2016).

In sub-Saharan Africa, such as in Portuguese-speaking Countries (CPLP), telemedicine already has some successful programs (Lapão et al. 2016). The Republic of Sao Tome and Principe (STP) is a lower middle income, developing, small island state with a fragile economy. STP is an archipelago made up of two islands, located in the Gulf of Guinea with 204,000 inhabitants and a Gross National Income (GNI) per capita of $1,890 as of 2018 (World Bank 2020).

STP's National health system (NHS) is very fragile and lacks basic infrastructure, technology, and human resources to deal with the fundamental population health demands. Medical evacuations play an essential role as the ultimate level of the NHS and also constitute a significant challenge, involving financial and social problems, for evacuated patients (Lapão

and Correia 2015). Portugal is the main destination for patients from STP, with about 200 evacuations per year, as agreed in a treaty (IMVF 2012).

In LMIC countries, telemedicine can be used to reduce healthcare costs, improve access, and advance health outcomes. It is, therefore, essential to recognize telemedicine as a crucial tool contributing to the quality of health services from a global health perspective (Kim and Zuckerman 2019)(Afzal 2016). In this paper, we discuss the potential for leveraging telemedicine to deliver essential healthcare services in LMIC supported by the international community. Thus, the objective of this study was to present the results of almost ten years of Telemedicine Program for STP, with an emphasis on policy and implementation.

METHODS

This study used mixed methods, integrating qualitative and quantitative research for a broader understanding of telemedicine as a complex intervention in STP (Caffery, Martin-Khan, and Wade 2017). The methodology was as follows (Figure 9):

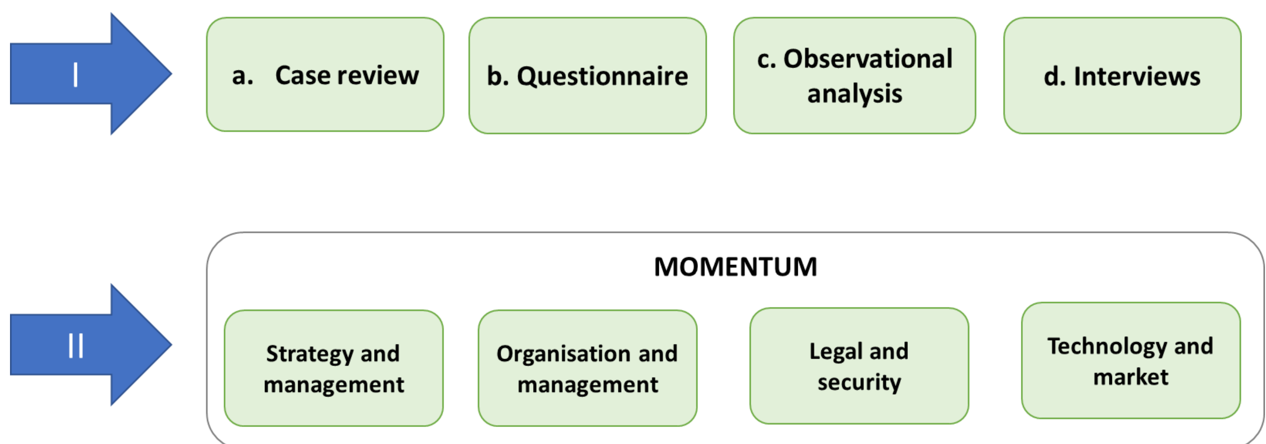

Figure 9. The case-study framework

I. A case study was built using two sets of data: a case-review, that includes a questionnaire, observational analysis and interviews with STP's telemedicine service coordination, management, health professionals and Portuguese specialists; (Appendix A.3.1 to A.3.5)

II. All collected data were analysed according to the Momentum framework's 18 critical success factors (CSF) criteria (Christiansen et al 2014c) to understand the process of telemedicine implementation and development, identify main actors and relevant factors to improve access, assure sustainability, and reshape organizational models.

Study design and data collection

Case-review

The institutional data (on-site observations, official data and "Health for All" reports) and data from the telemedicine platform and regulatory instruments (procedures related to the implementation of telemedicine in the country) were collected to perform the case-review. To demonstrate the benefits of the telemedicine services, ten evaluation indicators were used (e.g., demographic, performance, effectiveness, impact, and quality), based in the report "Defining Evaluation Indicators for Telemedicine Projects," convened by the Pan American Health Organization (Pan American Health Organization and World Health Organization 2016). Details on the evaluation indicators can be found in the appendix A.3.7).

An S-shape logistic curve representing the telemedicine services adoption was fitted with the actual evolution data, tracing the teleconsultations (TC) trend from 2011 to 2019 (Zanaboni and Wootton 2012). Results will be analysed following the order of importance, not chronological order.

Questionnaire, observational analysis, and interviews with key-members of the organization

In this study an exploratory approach was used, and the key-members were chosen because they were and some still are actors in the telemedicine system.

The questionnaire was designed by the Momentum European Project, where it was validated while applying it to several telemedicine cases around Europe. Furthermore, the questionnaire was applied (and published) using cases from Cape Verde and Portugal. This questionnaire is a combination of open and closed (closed-ended questions dichotomous, multiple-choice or was a Likert scale used) questions to balance the content received and to allow for individual views and assessments. Applying the Momentum Survey, each question was analysed whether does it fulfilled or not the criteria. The data were entered on an Microsoft Excel (version 2016) sheet for better treatment and analysis of the variables under study.

In the questionnaire (to be answered only once for the overall national healthcare system that relates to telemedicine initiative) a total of three professionals were daily working with the telemedicine service engaged directly in the telemedicine initiative (n=3) answered the questionnaire adapted from the Momentum project (Christiansen et al 2014a).

The questionnaire´s purpose is to gather information to have a basis of knowledge and is structured in four main parts: (i) Telemedicine strategy and management, (ii) Organizational implementation and change management, (iii) Legal, regulatory, and security issues, and (iv) Technical infrastructure and market relations (Appendix A.3.6)

Observational analysis

Regarding the observational analysis a set of physicians were observed during a set of scheduled TC to understand the process.

The interviews with key-members involved in the implementation of telemedicine service were the main data source. These allowed the direct collection of the information needed to answer the research question. The key-members selected encompassed Portuguese and STP. A 30-minute semi-structured interview was conducted with each key-member, to obtain opinions, historical context, including the reasons for strategic and operational decisions, and identification of the role of stakeholders in the telemedicine agenda setting. The Central Hospital's director was included due to their engagement in managing the telemedicine service. The participating key-members included telemedicine players (n=24), consisting of fourteen general practitioners, two specialists, one nurse, two radiology technicians, the technician responsible for maintaining system technology, and the country’s telemedicine managers: the current service coordinator in Hospital Aires de Menezes (HAM), and three coordinators from Instituto Marquês de Valle Flôr (IMVF). Interviews were audio-recorded and transcribed; following this, they were open and axial coded. Thematic analysis was then performed by the authors (full details are available in appendix A 3.8).

This study was approved for the Ethical Commission of Sao Tome and Principe. The interviews and the questionnaire were carried out with the participants' free and informed consent properly signed, with the guarantee of confidentiality and anonymity, as well as the protection and non-dissemination of the records.

Identification of critical success factors (CSF)

The sustainability of the telemedicine service was studied by considering strategy, organization, management, legality and safety issues, technology innovation and constraints, market evolution, and demand (details are available in appendix A 3.9).

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RESULTS

The results were analysed by following two approaches: (I) case-study review and (II) telemedicine service assessment based on the Momentum framework.

Case-Study review

The integration of telemedicine into STP's healthcare system

The delivery of telemedicine services is dependent on collaboration with international institutions. Three maturing phases were found in the development of the TC over ten years:

Phase I (2011–2012): The first TC was held in 2011 with the 1st generation Medigraf platform, under an institutional protocol signed between Marquês de Valle Flor Institute (MVFI) and PT Inovação (today's Altice Labs) (Barrocas and Freitas 2014b). In January 2012, the program "Health for All: Specialized Care and Telemedicine" started and it was integrated with the Portuguese Health Information Network (HIN) (Instituto Marquês de Valle Flôr (IMVF) 2012).

Phase II (2013–2016): From the launch of the new telemedicine platform (Medigraf NG) on the 17th of June 2013, until the creation of new coordination for telemedicine service at HAM (Barrocas and Freitas 2014b)(Instituto Marquês de Valle Flôr (IMVF) 2013a). The new system is wireless, so no longer needs to be integrated with HIN (Barrocas and Freitas 2014b).

Phase III (2017–2020): The New "Health for All - Towards Sustainability" program started to consolidate healthcare in the country with the support of telemedicine (Instituto Marquês de Valle Flôr (IMVF) 2017). At present, regarding the system of telemedicine service in STP, as shown in Figure 10, two main components can be identified, the follow-up and referral of clinical cases and professional training and counselling.

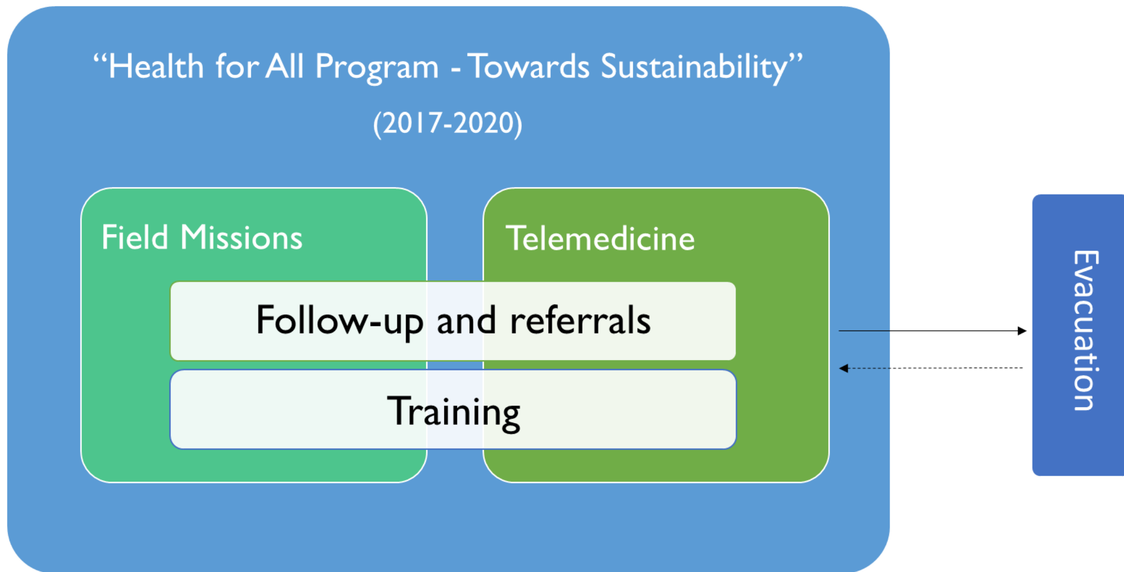

Figure 10. Compounds of Telemedicine project

The follow-up and referral of clinical cases include teleconsultations (TC), either real-time or store & forward (e.g., diagnostic exams uploaded in the telemedicine platform), between the attending physician at HAM and a specialist at a hospital in Portugal. Additionally, it supports regular medical short-term missions to STP, about three times per year in each speciality to ensure the coverage of specialized care, professional training and counselling, and the installation and maintenance of technical infrastructure.

Evaluation indicators

Program Coverage

All of the population would potentially benefit from the program through the HAM physician's referral.

Number of real-time and store-and-forward teleconsultations in each period.

A total of 4,966 real-time TCs and 137,976 clinical files and exams were uploaded in the platform (by November 2019) and are available for remote consultation in the different medical specialities (Figure 11).

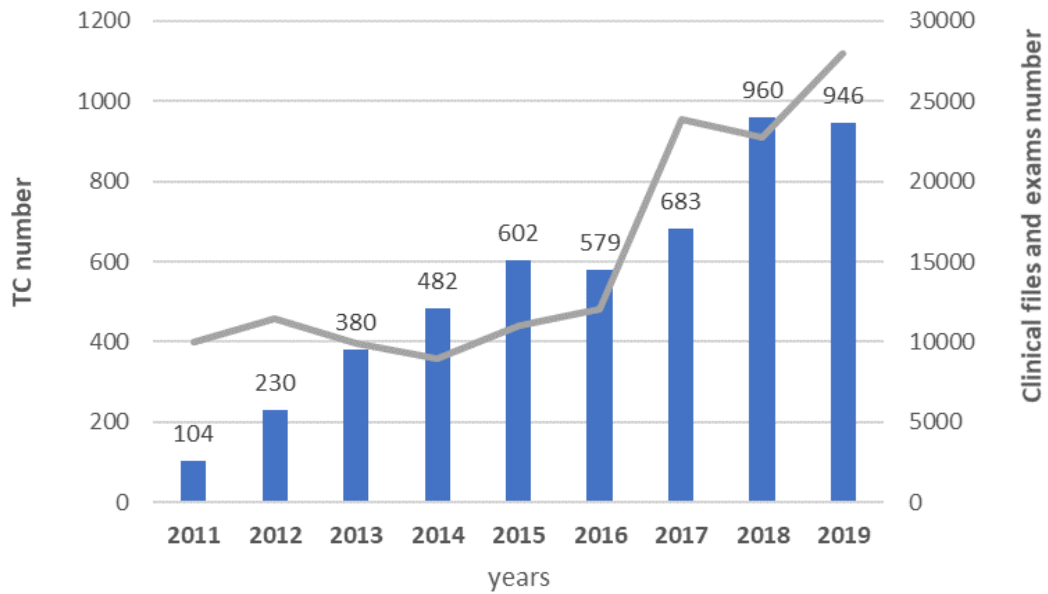

Figure 11. Teleconsultations evolution in São Tomé and Príncipe´s service

Between 2011 and 2013 the telemedicine in STP was taken as an experimental period, and it was possible to notice that the focus was more on uploading the clinical files and exams in the platform.

Teleconsultations held

To measure progress, the increase in TC held over previous years was measured and fitted with an S-shape logistic growth pattern (Figure 12), showing a good fit (r =0.9997).

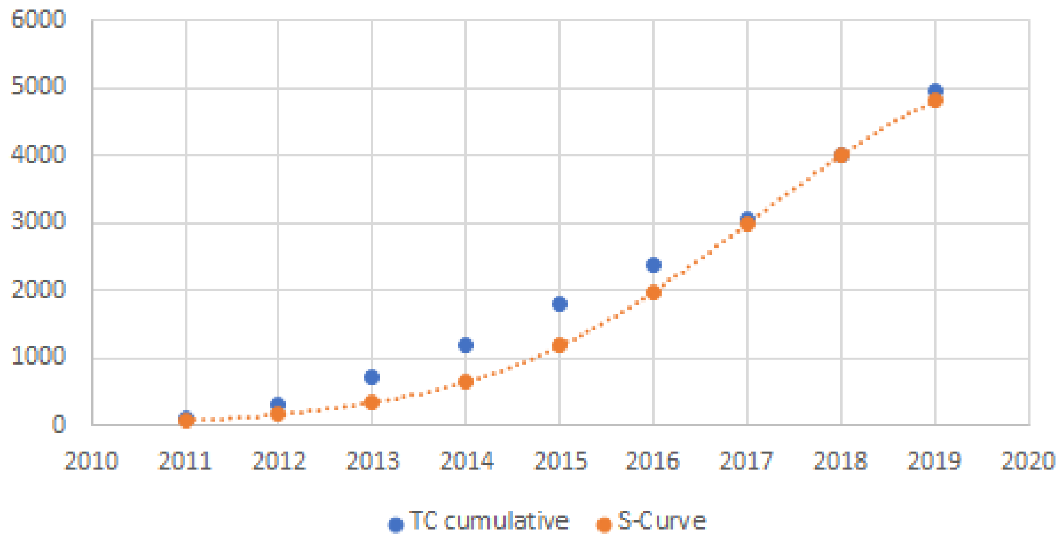

Figure 12. Telemedicine service logistic growth curve, 2011- 2019

Specialty consultations by telemedicine

It was observed that 13 specialties benefited from telemedicine since the beginning of the program. The specialties with the most access were teleradiology (72%), teleotorhinolaryngology (13%) and teleophthalmology (9%) (Figure 13).

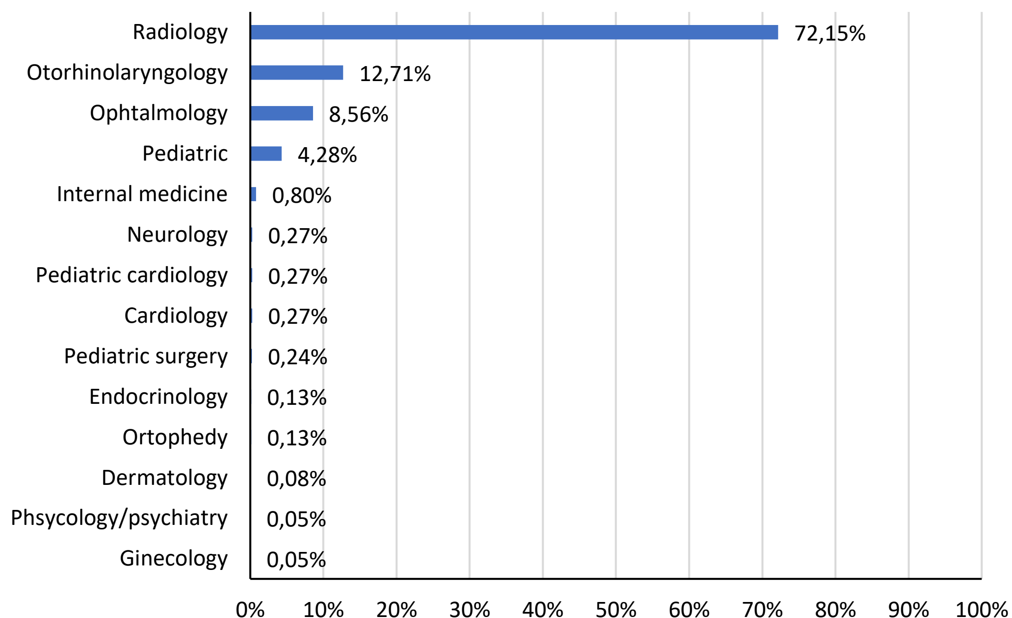

Figure 13. Teleconsultations provided in each specialty from 2015-2019

Hours available for teleconsultations with specialists and wait time for teleconsultation

Teleradiology

Since 2011, this service has consisted of one radiologist located in Portugal, who communicated with physicians and radiology technicians in STP via the internet. It was observed that HAM's complementary means of diagnosis is today entirely digitized with ultrasound, mammography, and radiology (Instituto Marquês de Valle Flôr (IMVF) 2014). Thus, teleradiology has become part of the HAM's regular workflow to help balance workload, and it was the most accessed specialty.

Teleotorhinolaryngology

In 2016 teleotorhinolaryngology (TeleORL) was introduced, using digital endoscopes, otoscopes, and laryngoscopes. In 2019, this service included one otorhinolaryngologic located in Portugal available for TC, twice a week. As there is no otorhinolaryngology specialist in STP, the TC has been facilitated by two local physicians and also worked as a regular online medical education program. The waiting-time between the scheduled and the actual TC was about one day.

Teleophthalmology

In 2014, the TELEYE® solution (a Slit Lamp, a Retinograph, an Auto-Refractometer/Keratometer, a Tonometer, and a High Definition Camera) was installed, allowing complete ophthalmological examinations to be performed at a distance, in real and deferred time. In 2015, the teleophthalmology (TeleOph) service included a high-quality image of the patient's eyes, for remote clinical diagnosis (IMVF 2015b).

In 2019, the teleophthalmology program was not operating because of technical issues. The patient (supported by a local technician) is consulted by one ophthalmologist located in Portugal, available for TC once a week, receiving the images captured by the referred equipment through the telemedicine platform. The waiting time between the scheduled and the actual TC was about 2.5 days.

Portuguese specialists taking part in telemedicine

Since 2012, 18 Portuguese hospitals (full details in appendix A.3.10) supported STP**.** There is a list of focal points of the various medical specialties which, following the definitive endorsement by the Portuguese Ministry of Health (MoH), currently serve as a reference for the STP GDoH for treatment in the Portuguese NHS (IMVF 2012).

Transfers generated through telemedicine

The number of evacuations carried out in 2012 compared to 2009 decreased by 61%. This was due to the increased access to complementary means of diagnosis in the various specialities, either on-site or via telemedicine. It favours a better resolution of the patient's clinical situation, thus avoiding, in many cases, a need for evacuation from STP to Portugal However, with better diagnosis, more complex situations were also diagnosed, increasing the need to evacuate patients in the following years (IMVF 2015a).

In the last three years, it was observed that pediatry as the speciality with the highest percentage of patients referred for evacuation supported by the telemedicine system. It works both sides, first telemedicine allows for consultations that work as a triage process (that solves most cases) and only if necessary, the evacuation process is initiated, having as reference this consultation.

A tele-training as part of an online medical education program

An indicator of appropriateness required evaluating knowledge, using the different modalities before and after having implemented the training. Thus, it is difficult to make the association between the training (remote or not) and its direct impact on service delivery (Pan American Health Organization and World Health Organization 2016).

STP physicians use telemedicine

According to the service database, over the last three years (2017, 2018 and 2019), around 52%, 87%, and 63% of STP physicians, respectively, have used telemedicine to interact with other healthcare professionals (Figure 14).

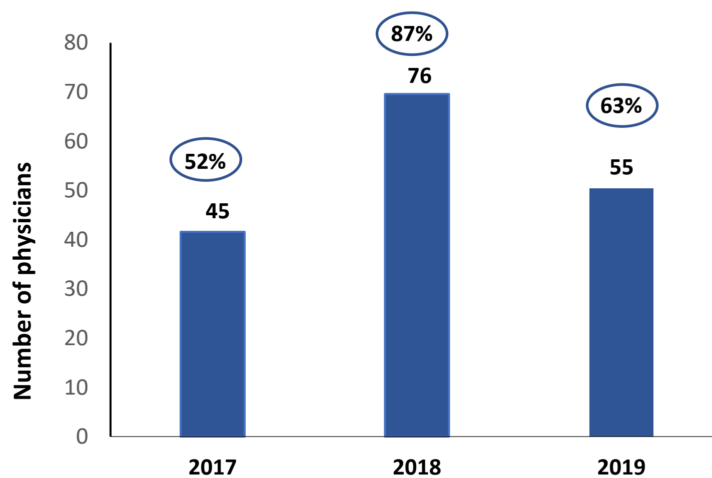

Figure 14 - Number of Physicians that used telemedicine

(considering that there are 87 doctors currently working in STP (Ministério da Saúde de São Tomé e Principe n.d.).

The recent observed decrease of TC (from 2018 to 2019; fig. 6) could be related to a new tendency to practice more informal telemedicine by using social digital applications (e.g. WhatsApp).

I) Interviews with key-elements and observational analysis

The Central Hospital's director was included due to their engagement in managing the telemedicine service. The participating key-members included telemedicine players (n=24), consisting of fourteen general practitioners, two specialists, one nurse, two radiology technicians, the technician responsible for maintaining system technology, and the country's telemedicine managers: the current service coordinator in Hospital Aires de Menezes (HAM), and three coordinators from Instituto Marquês de Valle Flôr (IMVF). Interviews were audio-recorded and transcribed; following this, they were open and axial coded. Thematic analysis was then performed by the authors.

The observation of real-life procedures was relevant to understand how the organization works. Physicians were observed in their different tasks, specifically during a set of scheduled TC. The Medigraf's TC platform was adapted to the STP's context. It enables real-time visualization and a record of exams, while oral communication and data file exchanges are taking place between the specialist physician, Physician A, and the other site's physician, Physician B.

The observation of a TC ophthalmology specialty focused on Physician A's procedures and interaction with the equipment, providing an understanding of how telemedicine allows the optimization of Physician A's schedule and better management of his functions. The TC schedule is managed by assigning the platform, considering the hospital of origin (site A–STP) to a designated consultation day and specialist (site B-Portugal). The telemedicine session was made up of three main elements: (i) consultation with real-time exams acquisition and transmission, (ii) discussion between physicians (e.g., second opinion), and (iii) discussion

with the patient and family. The observed telemedicine session was transmitted from HAM to Portugal, in a total of 70 minutes for three TCs, 20 minutes on average for each TC.

II) CSF identification

The Momentum framework for telemedicine implementation presents three main scopes (represented by each of the “shamrock leaves”): “People”, “Plan” and “Run” process. The shamrock stem lies in the context of the telemedicine service, where one should find both a cultural readiness and a compelling need consensus (see appendix A.3.9). The 18 CSF analysis required the collection of evidence from documents, questionnaires, and interviews. STP's telemedicine service was found to comply with most CSF (full details in appendix A.3.9), with strong strategy and management, despite some vulnerability related to legal and security issues.

a) Strategy and management

The health policy influenced the strategy for implementing the STP telemedicine service. In 2012, the increasing use of telemedicine became an integral part of the "Health for All" Program. In the same year, a Cooperation Protocol was signed for the medical evacuation process between STP and Portugal, reinforcing the use of telemedicine (Ministério da Saúde de São Tomé e Príncipe, Ministério da Saúde Portugal 2012). In 2019, a hospital in China pledged to establish a telemedicine service to connect the hospital's doctors available to patients on STP, although since the service provided will be in English, some communication difficulties are expected (Xinhua n.d.).

STP's telemedicine strategy is to provide care at any time patients need to access the service (Instituto Marquês de Valle Flôr (IMVF) 2015a). It is also viewed positively as a means of support field missions. The stakeholders managed to obtain the resources to implement the

service at each stage of development: financial, human and technology (Christiansen et al 2014c).

The STP's telemedicine service combined a set of skills and knowledge from clinicians, managers, and IT staff. There were several champions at different levels. The person who championed the service came from IMVF. However, the champion had relevant knowledge, and created the conditions for continuity and ensured good management at the various critical stages. Health professionals and technicians were trained at STP and abroad (IMVF 2015b).

The funding for the Telemedicine Project was obtained from the Portuguese cooperation agency (through Camões, I.P.), the General Directorate of Health (GDoH) of Portugal, and the Calouste Gulbenkian Foundation. The program design was based on population needs, necessary equipment, and the availability of proper infrastructure (IMVF 2012).

b) Organizational implementation and change management

The main actors directly involved in the planning and development of the project of telemedicine service were the IMVF team, the HAM team, and the medical specialists in Portugal (Figure 15).

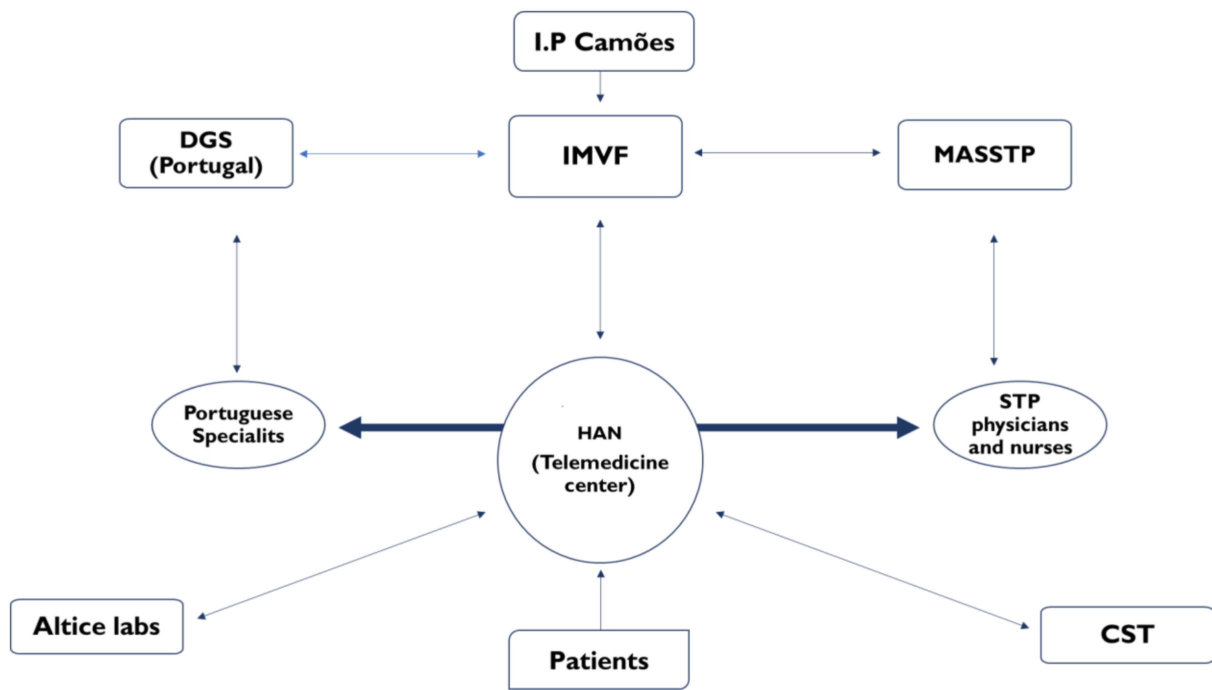

Figure 15 . . Representation of the functional relationships between the Telemedicine center and stakeholders

The Ministry of health of STP (MSASSTP) ensured the necessary support for the activities and co-financing them (Ministério da Saúde de São Tomé e Príncipe, Ministério da Saúde Portugal 2012).

The IMVF has been leading the missions of specialities, telemedicine and to articulate with the other parties (Instituto Marquês de Valle Flôr (IMVF) 2013a). They provide the procedures, equipment, and training, plus clinical and technical support. They also implemented a business and a change management plan. The IMVF's management team consisted of two full-time physicians, one manager, one administrative, and also a local coordinator in STP. At the HAM, there was a telemedicine service coordinator, one electromedicine technician, 87 physicians, and one nurse.

In 2013, the STP Telecommunications Company (CST) and IMVF officially became partners. CST has installed fibre-optic Internet access at a 50% cost reduction (Instituto Marquês de

Valle Flôr (IMVF) 2013a). The TC process started at the hospital, where patients access specialist via TC (Figure 16).

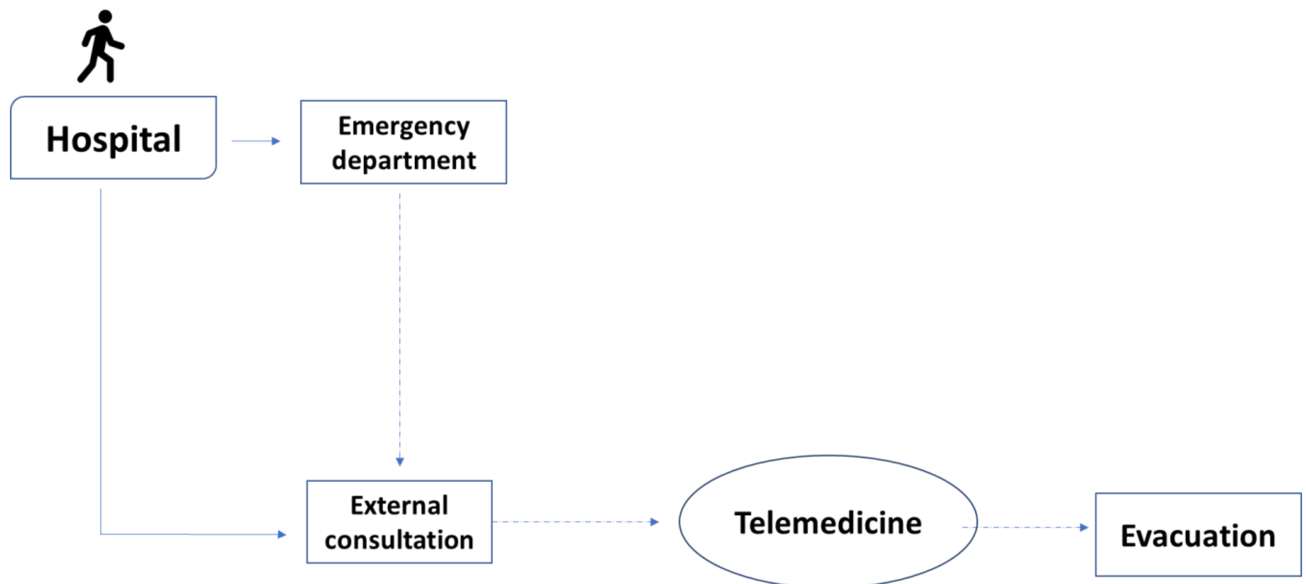

Figure 16 - Patient flow from access to care, to diagnosis and evacuation

On the other hand, in the event of an evacuation, the system allows for the remote identification of the patient's clinical situation, permitting to identify the hospital that will receive the patient, thus improving travel efficiency (Instituto Marquês de Valle Flôr (IMVF) 2015b)

c) **Legal and security (legal, regulatory and security issues)**

No specific telemedicine legislation has yet been issued in STP. There is one person responsible for the security, legal standards and data management. Changes were made to normalize data management procedures and promoting appropriate follow-up for patients assisted via telemedicine, and a new model for identifying and recording clinical sessions was also devised (IMVF 2017). These conditions present lower risks to confidentiality, the integrity of information, or the availability of telemedicine services. Methods of authentication are used to obtain access to the telemedicine service, including the patients' health information. To sign

into the platform, one has a user name and password, and uses a Virtual Private Network (VPN) connection.

d) Technology

The technologies used to run TC are integrated. The system has three main technological elements: (i) videoconferencing system over internet protocol; (ii) Medical equipment capable of being used with the assistance of a local physician assistant, and (iii) a platform to store and access patient data. Proper vendor relations were secured through contracts and agreements among partners (IMVF, Meo Altice, and HAM). The platform is compatible with most medical diagnostic equipment available, connected to the internet with a bandwidth of 1MB (IMVF 2013a). The combination of a Picture Archiving and Communication System (PACS) has facilitated the transmission of medical images between the two countries (using DICOM standards). According to Maia et al. (2019), this platform has been used in other countries. In the case of STP there was a strategic choice of using less complex technologies.

DISCUSSION

The discussion is divided in three parts.

I) The genesis of STP's telemedicine service

The TC's clearly benefited the country's health system, with about 5000 real-time TCs performed, involving 14 medical specialities, and more than 138 thousand exams and files uploaded in the platform. Almost 10 years after it started, the increasing numbers of TCs shows that this telemedicine service is vital in providing specialized healthcare access to STP’s population (Kim and Zuckerman 2019). This service amplified the emergency department and the external consultations. Its implementation has changed work habits and care pathways (Christiansen et al 2014c) and lead to a S-shape logistic growth curve (fig. 3) (Maia et al. 2019).

International cooperation often provides important resources for LMIC (Syed et al. 2012), as well as strategic public-private partnerships (Instituto Marquês de Valle Flôr (IMVF) 2018). Cultural affinities between STP and Portuguese partners helped (Chand, Informatics, and Mishra 2016). In 2010, a project supported by Indian cooperation failed due to languages differences (Chand, Informatics, and Mishra 2016).

The STP Telemedicine is now scaling-up and forming an extensive network of medical specialists collaborating both via telemedicine and through humanitarian missions (Instituto Marquês de Valle Flôr (IMVF) 2015b).

Portugal, as a development partner, was a worthy example to be followed, moreover having recently reached an important milestone in the field of telehealth with the elaboration of the National Strategic Plan for Telehealth (2019-2022) (Ministério da Saúde de São Tomé e Príncipe 2021).

II) Integration of technology, people, and process: What value for the health system?

The STP's healthcare system is deeply dependent on external support. The sustainability of telemedicine services within LMIC benefits from local people´s leadership once "the foreign developer has moved on" and from the institutionalization of telemedicine (Latifi et al. 2014a). Thus, the challenge is to improve regional healthcare by providing resources that will remain available at the location and within the culture. Education is the most effective means of providing a sustainable solution to the health problems of the developing countries (Shonubi et al. 2005).

We have identified several sustentability driving forces. Among them, clinical telemedicine activities supported by clinical protocols, the development of specific software, scheduling, and a proper coordination of clinical activities, as telemedicine implementation is not a linear

process (Maia et al. 2019). Therefore, as uncertainty often increases with the number of partners, a clear definition of roles and responsibilities was specified (Christiansen et al 2014c).

In STP, the national policy and the satellite-based and internet infrastructure favour the adoption of telemedicine (“Sao Tome and Principe Internet Speed | 2007-2017 Data | 2019-2020 Forecast | Calendar” n.d.). There is also a plan to extend the telemedicine service to the island of Principe. The main barrier are still the lack of qualified professionals, and the fact that in STP, telemedicine service will keep being dependent on international technical assistance.

III) Potentialities of telemedicine in addressing the global health challenge

Given the growing challenges of both global health and sustainable development goals, it is urgent to strengthen the health systems with innovative solutions, and STP is no exception (Ministério da Saúde de São Tomé e Principe n.d.).

This case study illustrates how telemedicine leveraged access to care. From a universal access perspective, external medical evacuations make a valuable contribution to minimizing inequalities in the STP health system. The telemedicine service significantly improved the effectiveness of medical travel, as it led to a reduction of more than 50% in the number of patient transfer requests to Portugal between 2011 and 2013. This drastic decrease generated a savings of about 20% in the STP’s Health budget and nearly one million euros to the Portuguese MoH (IMVF 2013b). The quota established by the Portuguese State for STP evacuations for treatment in Portugal of 200 patients annually is now better used for more complex patients (IMVF 2013a). It was clear that with the implementation of telemedicine, the evacuation procedures were revised and improved.

This tool has revolutionized the way healthcare is provided in the field of radiology, otorhinolaryngology, ophthalmology, and has further enhanced accessibility, equity, and quality in healthcare. Moreover in a country without a single local specialist in these areas

(IMVF 2018). Globally, teleradiology is currently the most developed telemedicine field ((WHO 2010b) and STP follows a similar pattern, and an essential component in the telemedicine service (Abdullah, Ng, and Pathmanathan 1999). Telemedicine enables access to paediatrics consultations for children and those younger than 14 years of age, constituting 40% of the population ("Africa :: Sao Tome and Principe — The World Factbook - Central Intelligence Agency" n.d.). The "Tele-eye" program was also well implemented (Caffery et al. 2019), but is still reliant on having a skilled local care provider.

Telemedicine can have a profound impact in countries such as STP. Lapão *et al.* (2016) advocated the creation of a "telehealth network" in CPLP countries, and that each country should establish national telemedicine centers. It is important to identify opportunities for collaboration between these countries as a way of leveraging the use of telemedicine (1). Thus, it is crucial to establish a permanent working group to develop the network's activities. For example, Cape Verde has all the potential to consolidate a technical exchange with the STP, which would facilitate the population's access to new medical specialties and health professionals to exchange experiences and continuous training. A triangular cooperation (STP – Portugal – Cabo Verde) could be thought as way to leverage the systems implemented in each country. The barriers to this network can be overcome through well-defined regional guidelines for the management and governance of the respective services.

LIMITATIONS OF THE STUDY

There are two principal limitations to this study. First, the case study approach has several limits. It is not possible to generalize the findings (Crowe et al 2011). The results obtained were specific to the STP telemedicine service, although many can be transferable to similar countries and other settings. The second limitation is that the information on the statistics on services

provided by HAM was not made available; this limits the accuracy of some assessments about the representativeness of the telemedicine service concerning other services at the central level.

CONCLUSION

This study has demonstrated that telemedicine is feasible for consulting, screening, triage, and remote supervision applications across a broad range of several diseases' conditions, in STP. Collaboration between physicians and specialists and other local care providers is an important consideration when implementing a telemedicine service. Similarly, the infrastructure for telemedicine needs to be seriously considered. The STP´s telemedicine was found to be in compliance with most the critical success factors, with strong strategy and organization. Thus, the results found concrete evidence that the critical success factors had a direct influence on an effective telemedicine strategy development.

The telemedicine service implementation in STP used a suitable phasing and has moved from the pilot stage to routine delivery, although more should be done in the future to enhance telemedicine services. It should be highlighted, as the main challenges identified, to guarantee the necessary technological infrastructures (technical and operational) and the continuous and efficient management of human resources.

In the context of LMIC, STP is an example of using information systems to improve healthcare, especially in a perspective of universal access and efficient use of resources. STP is also an example of collaboration between health systems within the global health paradigm and truly aligned with the sustainable development goals.

Acknowledgments

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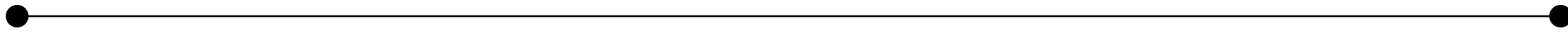
CHAPTER 4. « "How is telemedicine improving the performance of the Health System in a Low- and Middle-Income Country? »



How is Telemedicine improving the performance of the health system in a Low and Middle Income Country? A case study from the Island of Sao Tome and Principe

This paper was submitted to the Telemedicine Reports Journal

Authors (Name and academic degrees):

Cátia Gonçalves[1] – MSc, Anicolette da Mata[2] - MSc, Luís Velez Lapão[3] – MSc, PhD

Affiliations:

[1] Nova School of Business and Economics, Nova University of Lisbon, Campus de Carcavelos, Rua da Holanda, n.1, 2775-405 Carcavelos, Lisbon, Portugal.

[2] Hospital Ayres de Menezes, Ministry of Health, Rua Patrice Lumumba 23; Sao Tome and Principe

[3] Institute of Hygiene and Tropical Medicine, Nova University of Lisbon, Rua da Junqueira 100, 1349-008, Lisbon, Portugal.

*Corresponding author:**

Campus de Carcavelos, Rua da Holanda, n.1, 2775-405 Carcavelos, Cascais, Portugal.

Email: catia.goncalves@novasbe.pt

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ABSTRACT

Background: Health systems are complex and diverse. African healthcare systems are making an effort to strengthen the capacities needed by health professionals to respond to current and emerging issues in the public sector. The Sao Tome and Principe (STP) telemedicine program has been active since 2011, reaching about 204 000 people, allowing to overcome geographic barriers and the shortage of healthcare professionals who have been daily connecting with Portuguese specialists, through a teleconsultation platform. The overall aim of this study is to examine the impact of telemedicine on the health workforce's performance.

Methods: A case study approach was used and combined with the AAAQ (availability, accessibility, acceptability, and quality) health workforce framework for assessing the STP telemedicine program.

Results: The study found that the implementation of telemedicine had many positive impacts on the healthcare workflow, in terms of planning and decision making. After some time, a coordinator for the telemedicine service was appointed, with the responsibility for all telemedicine systems. A capacity-building process helped to provide new digital skills to local human resources for health (HRH), allowing them to perform teleconsultations with autonomy. This had implications for both the HRH organization and the management of healthcare services.

Conclusion: These results illustrate how telemedicine can improve the delivery of services by capacitating the health workforce in low and middle-income countries (LMIC). The lessons learned from this case could help other health organizations recognize leadership, organization, and training as critical success factors to implement a model where capacity building, leveraged by technology, can improve healthcare systems in an LMIC country.

INTRODUCTION

The digital transformation has, over the years, contributed to the development of what we now know as digital health. From a global perspective, a significant milestone has been the covid-19 pandemic experienced since 2020 around the world, which has generally increased the use of technologies. During the lockdown, the use of telemedicine became imperative in healthcare systems to provide continuity of care and, at the same time, as a way to prevent the contamination and spread of the virus. Consequently, using the PubMed database is notable that the interest in telemedicine research has increased, and the number of publications on this subject increased by 99% in 2020 and 2021

In this study we refer to telemedicine as the "delivery of health care services, where distance is a critical factor, by all health care professionals using ICT for the exchange of valid information for the diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities" (WHO 2010b).

The WHO perspective is very clear in the Global Strategy for Digital Health, where the role of systems such as telemedicine for the development of health-related SDGs is encouraged (WHO 2020a).

New digital skills can significantly strengthen the health system (Lapão and Dussault 2017). The performance of the health workforce is fundamental, as it has an immediate impact on the provision of health services and, finally, on the health of the population. According to WHO (2006) "performance is a combination of staff being available, competent, productive and responsive" (WHO 2006). A well-performing workforce works responsibly, reasonably, and efficiently to achieve the best possible health outcomes, given the resources and circumstances available (Thomas Bossert et al. 2007).

In this context, in response to the digital transformation in the health sector, it will be important to build digital skills in health professionals to leverage the use of available technologies and improve their productivity. This idea is advocated by Lapão and Dussault (2017) in their study to assess how the new digital skills are significantly strengthening the performance of health systems, giving the example of countries like Portugal and Norway.

According to Pote et al. (2021) the integration of digital skills may still be an issue and illustrates the example of how the integration of these skills has been in clinical psychology in the UK. Their analysis highlighted that the majority of respondents considered the development of digital mental health skills important, but were not integrating this into their work routine.

We approached the acquisition of digital skills, but beyond this concept, it is important to talk about digital literacy, which we understand as the ability to use this digital knowledge, in the specific case of health care.

A recent review by Matthews (2021) identifies areas of good practice and areas that need to be considered in higher education programs and by academics to ensure digital literacy of the future healthcare workforce, and to improve both capacity and motivation for improved performance.

Competencies are a component of performance. According to (WHO) 2006) “performance is a combination of available, competent, productive and accountable personnel". The explanation of Thomas Bossert et al. (2007) is in line with the WHO definition, stating that to achieve good results the labour force should work responsibly and make efficient use of available resources.

The focus of our work is on sub-Saharan Africa, due to the economic, social and environmental challenges it faces, which are naturally reflected in the health care of the population. Wamala and Augustine (2013) state that sub-Saharan Africa should encourage a strong policy focus on

ICT as a way to overcome the problems in health systems (eg. scarce human resources.). It was highlighted that political support has been crucial for the significant development of telemedicine in countries like Ethiopia and South Africa, on the other hand, the lack of this support is reflected in countries like Burkina Faso and Nigeria where progress in telemedicine is slow.

In PALOP, telemedicine already has some significant programmes (Lapão et al. 2016). For example, the STP telemedicine programme has been active since 2011, reaching about 204 000 people, which bridges geographical barriers and the shortage of health professionals through a teleconsultation platform that has political support, so it has been developed.

In STP, the ratio of health professionals per inhabitant is relatively satisfactory, as there were approximately 87 doctors per 100,000 inhabitants by the first half of 2017, while the global average is about 146 doctors per 100,000 inhabitants, and concerning nurses, the nurse/inhabitant ratio is about 413/100,000 inhabitants while the global average is 334/100,000 inhabitants. However, it is not equally distributed throughout the country (Ministério da Saúde de São Tomé e Principe 2018).

Literature/empirical evidence about how these new services affect the health workforce is scarce (Lapão and Dussault 2017). Hence, this research aims to contribute to the telemedicine research gap in sub-Saharan countries. In this study, we discuss the contribution of telemedicine services to improve the performance of health systems in LMICs supported by the international community in more than ten years of establishing a program and characterize them concerning availability, accessibility, acceptability, and quality. And thus "help improve the lives of the citizens of STP, both patients and health professionals, while addressing the challenges for the health system, such as improving access to care, improving referrals, and avoiding unnecessary evacuations to Portugal.

METHODS

Study design and data collection methods

The structure of this study aims to explore the answer to the research question, "What is the effect of telemedicine on human resource performance development? Therefore, the study seeks to explore the current status of using telemedicine at the study organization.

The approach used in this study incorporated mixed methods. In health-related research, these methods have been widely used in various areas from cardiology to mental health services (Meissner et al. 2011). This includes analysing and integrating quantitative and qualitative methods to provide different perspectives and consequently a better understanding of the topic under study in the telemedicine service (Caffery, Martin-Khan, and Wade 2017). The methodology was as follows (Figure 17).

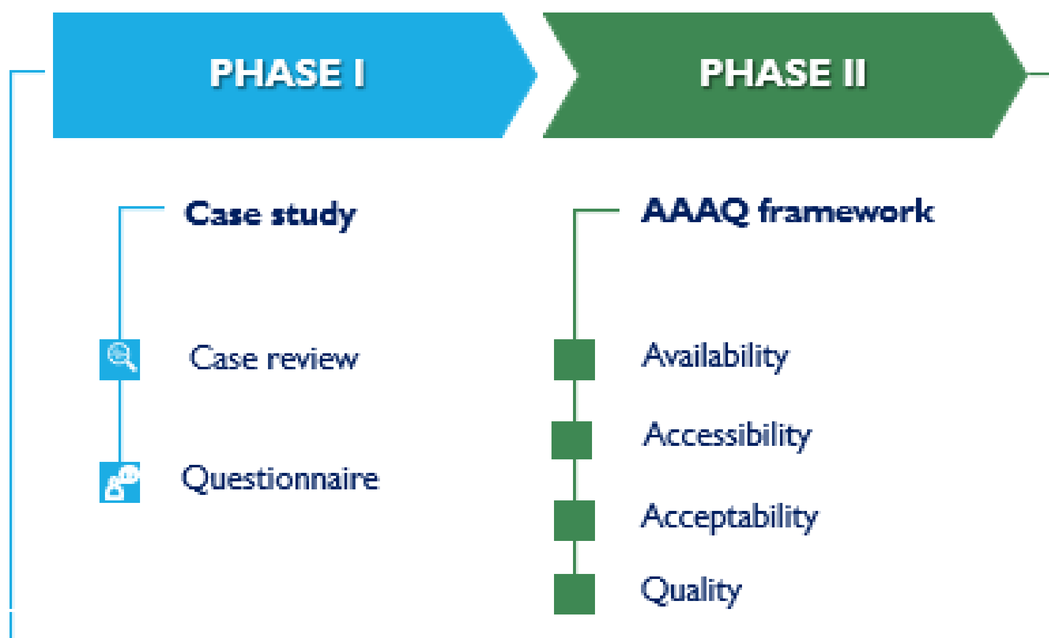

Figure 17 - The case-study framework

Phase I

A case study was built using sets of data: a case review, that includes a documental analysis (institutional reports) and a questionnaire (qualitative and quantitative data) on STP's telemedicine service health professionals (details in Appendix A.4.1 and A.4.2).

Case-review

A scoping review of the institutional data and data from the telemedicine platform was conducted with particular attention to regulatory instruments and procedures related to the implementation of telemedicine in the country, which was collected to write the case review.

Questionnaires with members of the organization

In both qualitative and quantitative components, the sampling methodology adopted for this research was purposive sampling, aiming at obtaining qualitative and quantitative information and an in-depth understanding of given situations. To collect information from participants who are easily accessible to the researcher This involves identifying and selecting individuals or groups of individuals that are especially knowledgeable about or experienced with a phenomenon of interest. In addition to knowledge and experience, note the importance of availability and willingness to participate (Palinkas et al. 2015). The data were collected from August 2019 to November 2019.

The questionnaire with the telemedicine service professionals was one of the data sources, as it allowed to collect directly the information needed to answer the research question (Britten 1995) concerning the criteria of workforce performance as well as the individual characteristics of the health professionals. Thus, 13 general practitioners plus one specialist (from Cuba cooperation), one nurse, and two technicians were specifically selected for the study. The authors selected the criteria that collaborated directly in the telemedicine service. A

questionnaire was conducted with each member to examine their perception of using the telemedicine service daily.

The questionnaire was adapted from *Momentum Project.* The questionnaire is a mixture of open and closed (closed-ended questions dichotomous, multiple-choice or was a Likert scale used) questions to balance the content received and to allow for individual views and assessments (Christiansen et al 2014a). One question about a professional's experience (time of practice, type of experience, etc) with telemedicine in general. Two questions about the organizational implementation of the service, specifically the knowledge of the existence of the service integrated into the hospital, and that they can describe the current status of telemedicine service namely type of services provided, equipment, partners involved; and about the training and education of professionals. One question about the healthcare professionals' use of the service, specifically, how often they use telemedicine services to share experiences or seek support from other colleagues, and one question about the technical infrastructure. Three questions about the perceptions of the professionals about the telemedicine service: what are the advantages of using telemedicine in the routine provision of health services in the hospital where they work; how do they see the need for telemedicine in the country, and which factors they think will most influence the future of Telemedicine in STP. The questionnaires were in Portuguese, which is the official working language in STP.

Respondents are also characterized by gender, age, role, time in the program and clinical specialty. Proportions were calculated for the different variables, to allow a better understanding of their respective weight.

This study was approved by the Ethical Commission of Sao Tome and Principe. The interviews and the questionnaire were carried out with the participants' free and informed consent, with the guarantee of confidentiality and anonymity, as well as the protection and non-dissemination of the records.

Phase II

Availability, Accessibility, Acceptability, and Quality (AAAQ framework)

All the data collected in the 1st Phase were analysed according to the HRH's AAAQ framework. Therefore (this framework that helps to identify strengths and potentials) to understand how this service affects the performance of health professionals in STP, we examined how it impacts on four dimensions, according to the so-called AAAQ (Lapão and Dussault 2017) which considers the four aspects of human resources for health: availability, accessibility, acceptability and quality of health services (Figure 18) that strengthen universal health coverage (Campbell et al. 2013).

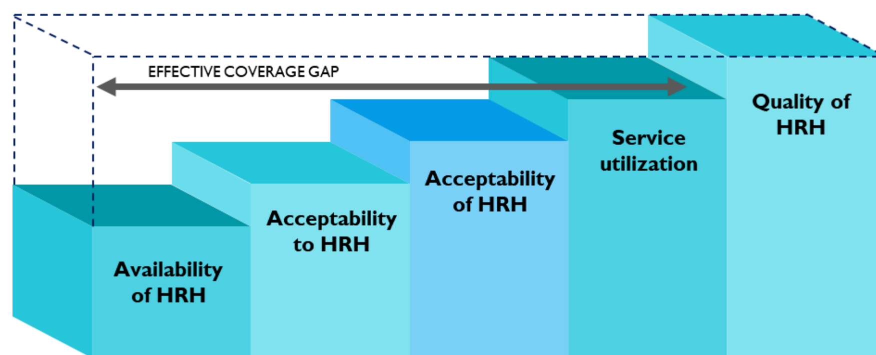

Figure 18. HRH dimensions for effective coverage (source: (Campbell et al. 2013)

In this context, according to Campbell et al. (2013), the four dimensions mentioned can be described as follows:

- **Availability**: the sufficient supply and stock of health workers, with the relevant competencies and skill mix that correspond to the health needs of the population;

- **Accessibility**: the equitable access to health workers, including in terms of travel time and transport, opening hours and corresponding workforce attendance, whether the infrastructure is disability-friendly, referral mechanisms and the direct and indirect cost of services, both formal and informal;

- **Acceptability**: the characteristics and ability of the workforce to treat everyone with dignity, create trust and enable or promote demand for services;
- **Quality**: the competencies, skills, knowledge and behaviour of the health worker as assessed according to professional norms and as perceived by users.

Based on the criteria presented in Fig. 1, the WHO AAAQ framework was developed for the concept of "effective coverage”. We selected this framework for this study because it has also been used as a reference in studies for the health workforce (Campbell et al. 2013; OASES 2021; Lapão and Dussault 2017).

RESULTS

The results were presented in two phases: (I) the case-study review, and (II) the telemedicine health workforce assessment based on the AAAQ dimensions.

I) Case Review

The result showed that the system of in telemedicine service in STP ~~since 2011 has ensured the coverage of specialized care. Through **(i)** the follow-up and referral of clinical cases which include teleconsultations (TC), either real-time or store-&-forward (e.g., exams uploaded on the telemedicine platform) between the attending physician at the Aires de Menezes Hospital (HAM) and a specialist in Portugal. and **(ii)** the professional training and counseling include international and real-time teletraining and the installation and maintenance of technical infrastructure (details in Appendix A.4.3). Furthermore, the telemedicine service supports the short-term medical missions to STP three times per year in each specialty.~~

At the beginning of the implementation of the service, in 2010, two intensive cytology internships were carried out by a doctor and an imaging technician, who would be responsible for the service. In 2011, two training courses were carried out by two STP health technicians

living in Portugal, in the areas of cardiopneumology and radiology. After training, both techniques were part of the STP National Health System, within the scope of the project. It was identified a responsible for both the security and legal standards of the telemedicine service as well as a data controller. They have made changes to routine data management procedures to implement the service and promoted appropriate follow-up for patients via telemedicine (IMVF 2017).

Since 2012, 18 Portuguese hospitals have been supporting the STP health system (IMVF 2012).

In this study participated a total of 17 health professionals working in the HAM, 5 from pediatrics (9.8%), 3 ORL, five from intern medicine, three from ophthalmology and one from radiology participated in this study. The results showed that (11/17) 65.0% of the respondents were female, and (6/17) 35.0% were male. More than half (58.8%) of the respondents within 25-35 years of age. However, the average age was 49.9 years (SD=19.04 years, min=18 years and max=91 years). The level of experience with telemedicine services, was, on average, between 1 (23,5%) and 3 years (23,5%) (Figure 19).

Level of experience by using telemedicine service in STP (n=17)

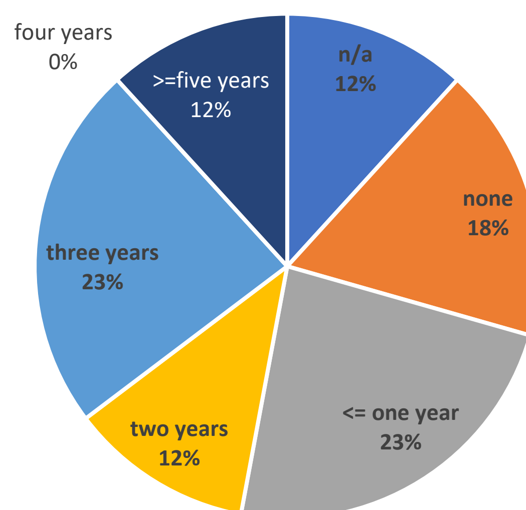

Figure 19 - The level of experience by using telemedicine service in STP

The frequency of telemedicine service consultations was about 3-to-4 times per-month for 52.9% of the respondents (Figure 20).

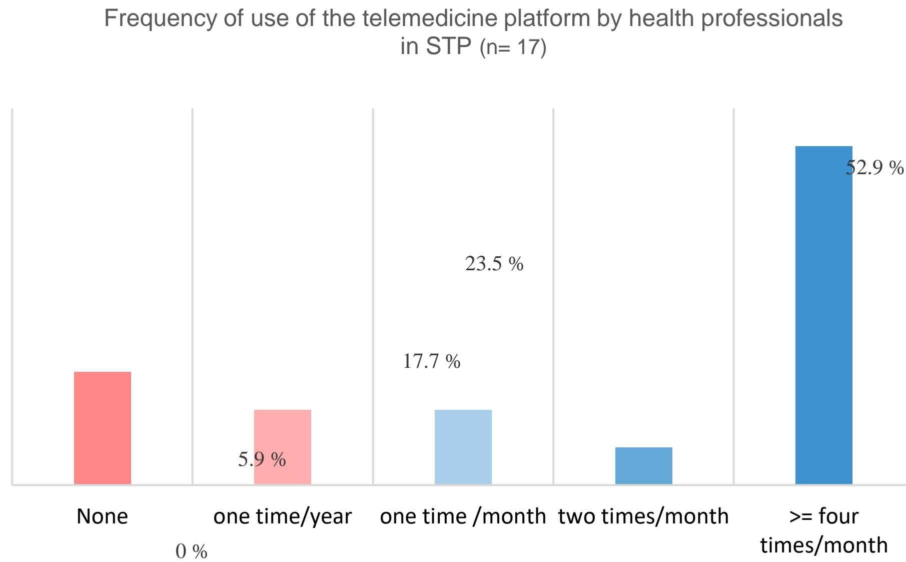

Figure 20 - Frequency of use of the telemedicine platform by health professionals in STP

The perceptions of need were obtained using a five-point Likert scale ranging from 1 to 5, where (1= Very low, 2= Low, 3= Average, 4= High, 5= Very high) and about 5.9% of respondents rated it as low and 52.9% as very high (Figure 21).

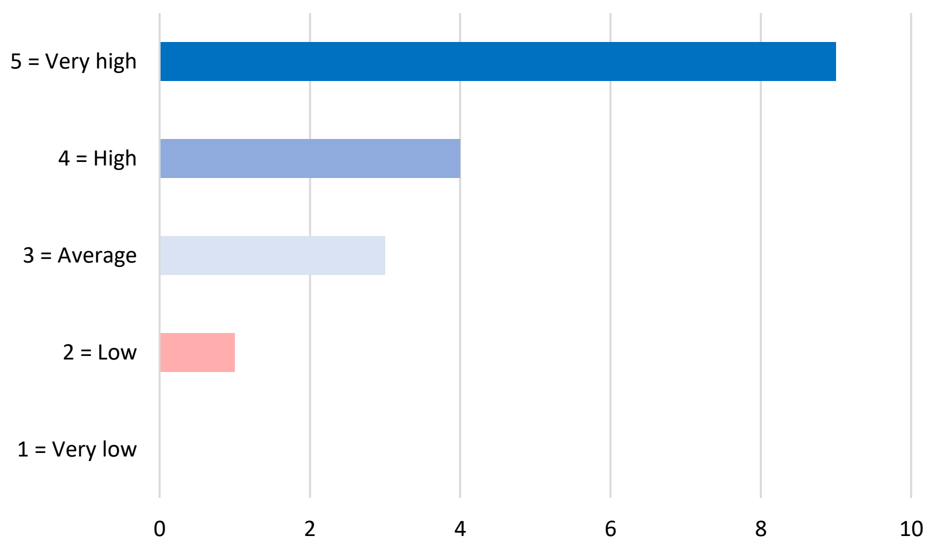

Figure 21 - Physicians' perceptions of the necessity of telemedicine technology

The advantages of using telemedicine were highlighted during the questionnaire. The content analysis allowed us to highlight the following domains (Full results are available in Appendix A.4.3).

- **Provision of care:** "Improvements in access to specialized care, promotes the improvement of diagnosis, guidance and validation of therapeutics (second opinions), discussion of cases."
- **Logistics/Articulation:** "Assistance in referring patients for evacuation; it allows us to reduce the number of evacuations".
- **Training:** "Allows an effective learning process".

II) AAAQ dimensions

I. Availability

The STP has a central hospital where telemedicine is provided, with free access to the entire population. The main actors involved in the development of telemedicine service were the Instituto Marquês de Valle Flôr (IMVF), the HAM team, and the medical specialists in Portugal. It was found that radiology technicians, electromedical technicians, and physicians were the most affected by these changes. There was no significant change in the distribution of HRH, and their numbers remained constant. The protocol established with Portugal, in the case of a sanitary evacuation, provides for the prior remote identification of the patient's clinical situation, allowing both the identification of the hospital and who will be available to receive the patient in Portugal.

II. Accessibility

STP's telemedicine strategy aims at providing care to its population at any time they need it (IMVF 2015a). The decision to promote close collaboration between physicians and specialists was vital. Therefore, no patient could be admitted to the program without the recommendation or consent of his/her general practitioner. The patient flow was directly affected as patients were only evacuated after undergoing a TC with a specialist. The information exchange via e-mail, WhatsApp, or through the telemedicine Platform constituted a reliable communication tool between STP and Portugal, with benefits for both countries with less paperwork and fast information access.

III. Acceptability

The provision of these services by highly qualified professionals is improving the level of trust that would strengthen the health professionals' confidence in the quality of services. Physicians

are satisfied with Telemedicine and integrate it into the daily routine, for both evacuated patients and medical decision-making. STP's telemedicine service promotes a solid personal relationship between technicians and patients, including face-to-face physical visits. About 18% of physicians during the interviews said they have known about the service from other colleagues and were encouraged to use it.

IV. Quality

The work related to the short-term medical field mission was improved with telemedicine, allowing for better mission planning (e.g., list of cases to be intervened), and monitoring of patients after the intervention. The distribution of HRH suffered no fundamental change. The service reports show that the health workforce was trained in STP and Portugal, leveraging the telemedicine resources (IMVF 2015b). Capacity building of HRH is a priority of the 'Health for all' program (IMVF 2014). The training was given to empower the technicians in using and maintaining the equipment (IMVF 2012). For example, in teleophthalmology relevant training on diagnostic instruments has been identified as a success factor. Moreover, the success largely depends on the availability and motivation of HRH to actively participate in clinical and on-site training sessions, as well as the availability to leave the country for capacity building in Portugal.

II) AAAQ dimensions

Availability

The result showed that regarding the availability dimension, we highlight that this telemedicine service offered at the country's central hospital (HAM) is available to the entire population.

Since 2011 has ensured the coverage of specialized care. Through **(i)** the follow-up and referral of clinical cases which include teleconsultations (TC), either real-time or store-&-forward (e.g., exams uploaded on the telemedicine platform) between the attending physician at the Aires de Menezes Hospital (HAM) and a specialist in Portugal. and **(ii)** the professional training and counseling include international and real-time teletraining and the installation and maintenance of technical infrastructure (details in Appendix A.4.3). Furthermore, the telemedicine service supports the short-term medical missions to STP three times per year in each specialty (IMVF 2018).

The use of telemedicine for the two above-mentioned components resulted in an improvement in the availability of consultations. It allowed time savings through faster access to consultations that would only be possible during the short-term medical missions of Portuguese medical specialists three times per year in each specialty, ensuring the coverage of specialized care.

The data contained in the reports of the Program "Health for All" refer that throughout the nearly 10 years of the program the number of Portuguese partner medical institutions has grown, and currently there are about 50 partner health institutions in Portugal, which constitutes a network of medical specialists that have been supporting the STP health system (IMVF) 2018).

The main actors involved in the development of telemedicine service were the Instituto Marquês de Valle Flôr (IMVF), the HAM team, and the medical specialists in Portugal. It was found that radiology technicians, electromedical technicians, and physicians were the most affected by these changes. According to the interviews, there was no significant change in the distribution of HRH, and their numbers remained constant. However, they have made changes to routine data management procedures to implement the service and promoted appropriate follow-up for patients via telemedicine (IMVF 2017).

The telemedicine service in STP opened a “window of opportunity” for professionals to be trained through the telemedicine system and trained to use the service with autonomy and confidence. At the beginning of the implementation of the service, in 2010, two intensive cytology internships were carried out by a doctor and an imaging technician, who would be responsible for the service. In 2011, two training courses were carried out by two STP health technicians residing in Portugal, in the areas of cardiopneumology and radiology. After training, both techniques were part of the STP´s National Health System, within the scope of the project. They have made changes to routine data management procedures to implement the service and promoted appropriate follow-up for patients via telemedicine (IMVF 2017).

Accessibility

STP's telemedicine strategy aims at providing care to its population with free access to the entire population, and the facilities are open at convenient hours (IMVF 2015a).

According to the service database in 2019 around 63% of STP physicians, have used telemedicine to interact with other healthcare professionals. . Improve access to healthcare with less paperwork and faster access to information. The information exchange via e-mail, WhatsApp, or through the telemedicine Platform constituted a reliable communication tool between STP and Portugal, with benefits for both countries with less paperwork and fast information access. Thus, the decision to promote close collaboration between physicians and specialists was vital. Therefore, no patient could be admitted to the program without the recommendation or consent of his/her general practitioner.

The patient flow was directly affected as patients were only evacuated after undergoing a TC with a specialist.

The information exchange via e-mail, WhatsApp, or through the telemedicine Platform constituted a reliable communication tool between STP and Portugal, with benefits for both countries with less paperwork and fast information access.

The frequency of telemedicine service consultations was about 3-to-4 times per-month for 52.9% of the respondents (Figure 22).

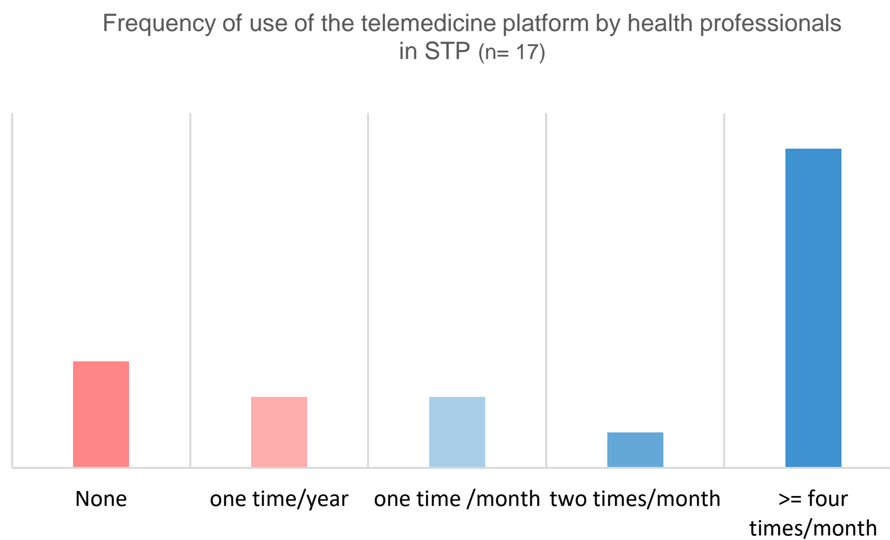

Figure 22 - Frequency of use of the telemedicine platform by health professionals in STP

Acceptability

A total of 17 health professionals working in the HAM, 5 from pediatrics (9.8%), 3 ORL, five from intern medicine, three from ophthalmology, and one from radiology participated in this study.

Related to the demographic data on the age and gender of the health professionals in this study the results showed that (11/17) 65.0% of the respondents were female, and (6/17) 35.0% were male. More than half (58.8%) of the respondents within 25-35 years of age.

The acceptance of telemedicine technology among physicians was assessed through two factors: “perceived ease of use of telemedicine platform” and “perceived usefulness of telemedicine in STP”

From the health professional's perspective, the majority considered that the technology used in telemedicine service is “user-friendly” (Figure 23). This perspective may correlate with the young age group of professional respondents who are more familiar with the "virtual world" through the use of digital technologies.

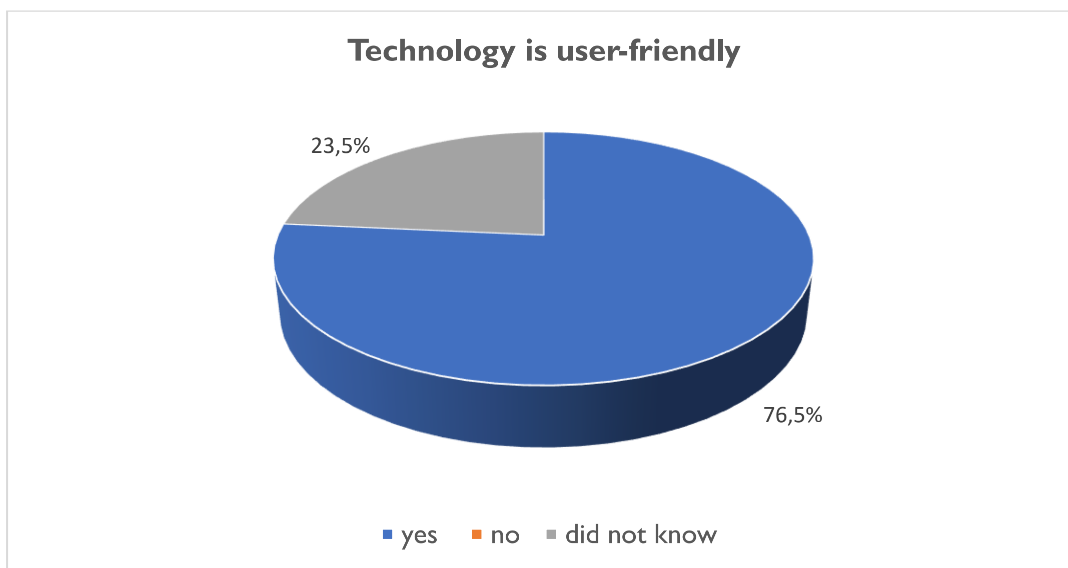

Figure 23. Technology's “user-friendly” perception

STP's telemedicine service promotes a solid personal relationship between technicians and patients, including face-to-face physical visits. We observed that the patient's personal information is treated confidentially, and only the physicians and the technician coordinating the service have access to the data on the telemedicine platform. About 18% of physicians during the interviews said they have known about the service from other colleagues and were encouraged to use it.

The provision of these services by highly qualified professionals is improving the level of trust that would strengthen the health professionals' confidence in the quality of services. Physicians

are satisfied with Telemedicine and integrate it into the daily routine, for both evacuated patients and medical decision-making.

Respondents' perceptions of the necessity of telemedicine technology in Figure 24, were obtained using a five-point Likert scale ranging from 1 to 5, where (1= Very low, 2= Low, 3= Average, 4= High, 5= Very high). Only 5.9% of respondents rated it as low and 52.9% as very high.

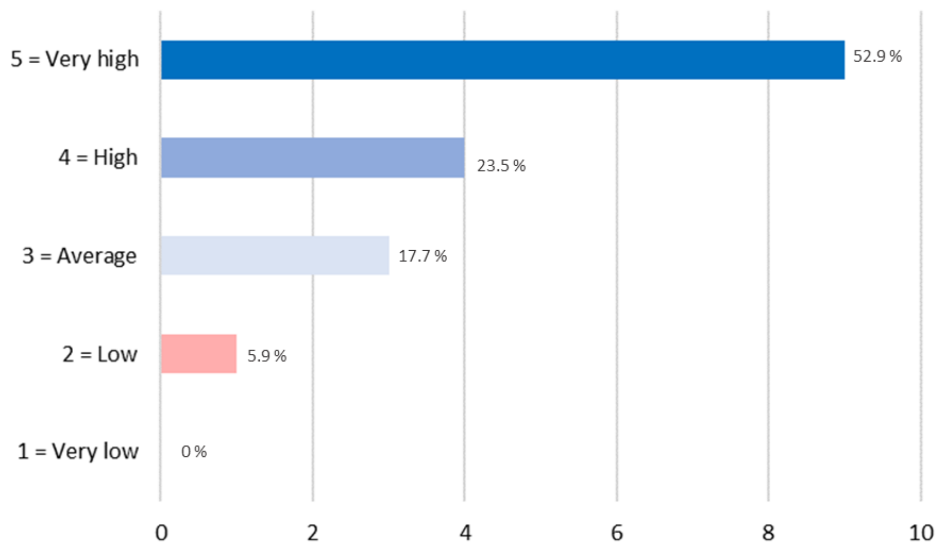

Figure 24 - Physicians' perceptions of the necessity of telemedicine technology

During the interviews, the specialists' idea that telemedicine is essential in STP became clear, as it is an important tool for specialists to maintain contact with the HAM service between short field missions. Therefore, the telemedicine system made communication between health professionals in different countries (STP and Portugal) easier.

Quality

The IMVF, the HAM team, and medical specialists in Portugal are the main actors involved in the development of the telemedicine service, thus a team with relevant skills and a mix of skills corresponding to the health needs of the population.

A total of 17 health professionals participated in the study. The level of experience with telemedicine services, were, on average, between 1 (23,5%) and 3 years (23,5%) (Figure 25).

Level of experience by using telemedicine service in STP (n=17)

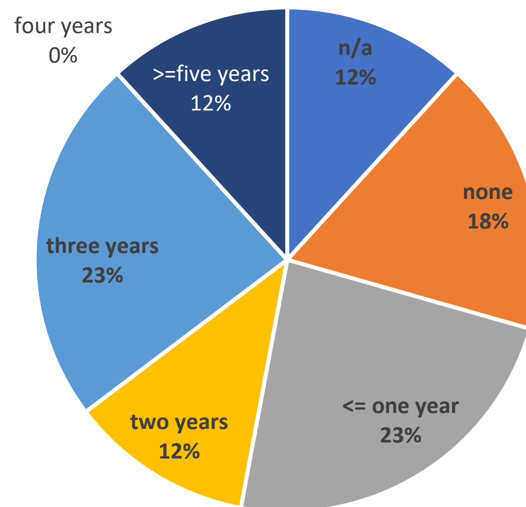

Figure 25 - The level of experience in using telemedicine service in STP

The protocol established with Portugal, in the case of a sanitary evacuation (Ministério da Saúde de São Tomé e Príncipe, Ministério da Saúde Portugal 2012), provides for the prior remote identification of the patient's clinical situation, allowing both the identification of the hospital and who will be available to receive the patient in Portugal which improves the service effectiveness.

The work related to the short-term medical field mission was improved with telemedicine, allowing for better mission planning (e.g., list of cases to be intervened), and monitoring of patients after the intervention which improves the patient's safety.

The distribution of HRH suffered no fundamental change. The service reports shown that health professionals and technicians were trained in STP and abroad, leveraging the telemedicine resources (IMVF 2015b). The success largely depends on the availability and

motivation of HRH to actively participate in clinical and on-site training sessions, as well as the availability to leave the country for capacity building in Portugal.

Capacity building of HRH is a priority of the 'Health for all' program (IMVF 2014). The training was given to empower the technicians in using and maintaining the equipment which allows for scaling up the skills and autonomy with professional standards (IMVF 2012).

DISCUSSION

The outcomes of this research have provided insight into the effectiveness of the telemedicine service in improving workforce performance in STP/PT. However, the results should be interpreted with attention due to the small sample size which could limit the generalizability of the results.

Regarding the adopted AAAQ framework (availability, accessibility, acceptability, quality) this can give the following contribution:

Availability

Regarding the health workforce (HWF) availability dimension, the telemedicine service in STP increases the number of health professionals who can attend the entire population of the country, since the HAM now has the HWF "active" stock that attends in person at the HAM and the stock of doctors who provide the service remotely from Portugal, especially in the health sectors secondary care, tertiary care. These are more doctors to meet the demand of the country, especially in specialties that would not have any coverage if it were not for the telemedicine system. There is therefore a greater density of doctors in the central hospital.

In the specific case of telemedicine in STP, we found that with the introduction of telemedicine in STP there was an absolute increase in the number of doctors available to provide services to the HAM, which increased the availability and capacity to provide services to more users. On

the other hand, (Lapão and Dussault 2017) concluded that paradoxically even within the same numbers of health professionals the technologies applied to health as with eHealth/mHealth, and similarly to telemedicine have the potential for increased availability due to faster practices.

In STP we noted this in the case of physicians, but it could be something to achieve with time for nurses, for example. STP has a reasonable ratio of doctors to patients, but the numbers are concentrated in the capital. Telemedicine can solve the problem of the availability of specialists, but the problem of the concentration of specialists available in the capital of the country remains, and this problem of concentration is even more striking if we think about the situation of patients from the island of Principe who are more disadvantaged because they must travel to the island of Sao Tome to benefit from telemedicine consultation.

The study highlighted that in addition to teleconsultations the system also promotes teletraining (IMVF 2018). In this regard, during the installation of the equipment, local teams were exposed to the technology, so the HRH behind STP's telemedicine service was based on the needs of the country. The creation of training programs, in specialties such as ophthalmology and ORL, had a significant impact. All educational programs were conducted in Portuguese. The use of telemedicine has been more plausible when the ICT sector gained maturity and the hardware and telecommunication cost declined.

Lapão et al. (2006) illustrated the importance of training in the case of a pediatric cardiology department, where workshops were held to inform and sensitize physicians to the use of telemedicine services. These sessions were attended by a multidisciplinary team, including pediatricians and obstetricians, and technology partners. The training sessions promoted knowledge recycling with updated information. Thus, we clearly understand that the training of health professionals is directly related to the availability of the health workforce.

Organization and leadership are crucial issues for the success of the service (Lapão et al. 2006). Articulation mechanisms were established, and a service coordinator was identified at HAM who liaises between physicians and specialists, as well as between patients and specialists. Thus, the management of the relationship between the stakeholders involved in the implementation and development of the telemedicine service in STP is highlighted in this work.

In the case of STP, the issue of leadership goes beyond the appointment of a service manager. We must highlight the importance of the IHMVF team, the pioneer of the "Health for all" project, where the telemedicine service is integrated. Similarly, the *Momentum project* highlights the importance of leadership as a success factor for the implementation and development of services, giving an example of the Norwegian dialysis service at the nephrology department in a hospital in the country. A conclusion is reached by Christiansen et al (2014b) when analyzing the dynamics of the department, that there were several "champions" at different levels of the unit, from the physician head of the hospital's medical department, the head nurse of the hospital's renal unit, and the technologist project manager at the unit, each contributing different visions to the implementation and development of the service.

Moreover, leadership is a very important aspect to consider when implementing a telemedicine service, and in the case of the telemedicine service in Sao Tome, we consider two types of leadership the leadership of the system and operational leaders.

We noticed through analysis of the system that some organizational changes have occurred, namely in the redistribution of functions or changes in procedures, and some categories of health professionals who are more directly linked to the telemedicine system implemented in the hospital.

According to the study carried out by Aas (2014) the changes that happen in organizations when telemedicine was implemented, are mainly at the level of work processes, organizational restructuring, creation of new units, new internal coordination mechanisms, exchange of experiences, and a different patient flow in the health system.

By the same token, it can be noticed that the changes when they are implemented should be part of a change management plan, so that they are an incentive and not a reason for overload and consequent dissatisfaction for the health professional, who sees his work doubled and in financial terms remains the same.

In STP´s service training in different specialties has been implemented since the implementation of telemedicine and periodically as a form of recycling.

In the review of (Kho, Gillespie, and Martin-khan 2020) initial and continuing, training and education were identified as being useful in helping to troubleshoot equipment and carry out teleconsultations.

The telemedicine service in STP opened a “window of opportunity” for professionals to be trained through the telemedicine system and trained to use the service with autonomy and confidence.

Accessibility

The model adopted in STP is for free teleconsultations. India is also an example of a country whose National Teleconsultation Service (eSanjeevani) has been offered to the population free of charge in each State. Users must have a laptop or a personal computer with a web camera connected to Internet (1Mbps) and have a registration number to log in (National TeleConsultation Service Ministry of Health and Family Welfare 2020). Thus, in LMICs such

as STP and India, the use of this option can make healthcare more affordable and equitable for all.

Telemedicine has been used to facilitate evacuations in STP. Countries with the same SIDS characteristics, such as Cape Verde, have used teleconsultation as a triage for both internal and external evacuations (Latifi et al. 2014b). Telemedicine helps physicians by giving them easy access to specialists and helping them with the diagnosis.

From the results obtained, we conclude that about half of the respondents access the service between 3 and 4 times a month. In this case, physicians' access to the platform should be encouraged to have a higher frequency of weekly teleconsultations.

Acceptability

In this study, we noticed that the respondents have a positive acceptance of the technology and consequently with the perspective of ease of the telemedicine platform. In parallel, it was found that the respondents understand its advantages. A similar result has been shown in a study performed in Pakistan (Ashfaq et al. 2020). According to Lapão and Dussault (2017) the correlation between age and technology acceptance may be explained by the fact that the younger HRH born in a more digitalized environment were less likely to resist adopting these tools. Thus, this positive perspective may correlate with the young age group of the professionals surveyed who are more familiar with the "virtual world" through the use of digital technologies.

The STP´s telemedicine service includes face-to-face physical visits both during consultations, where patients are accompanied by a local physician, and during field missions, where patients are personally consulted by the same medical specialists who give teleconsultations. From this characteristic of the implemented system, we can infer that it is very similar to "traditional"

consultations, and therefore promotes a solid personal relationship between physicians and patients.

Quality

We conclude that the quality dimension is interdependent on the aforementioned dimensions - availability, accessibility, and acceptability. Hence, both the individual skills and characteristics, the mechanisms to improve access to the service, and the planning of field missions supported by the telemedicine service are aspects that are aligned with the improvement of service quality over the years. This analysis supports the theory that the adoption of this digital modality has to take into account the "people" factor, the Telemedicine implementation seems to not depend only on technological factors, but also on HRH capacity-building investments (Shiferaw and Zolfo 2012;Luis et al. 2016). In LMIC to provide a sustainable healthcare solution, education is imperative (Shonubi et al. 2005).

According to Laukka et al (2021) there is a clear need to have a coherent concept of leadership in digital services. Defining and clarifying the concept of leadership in digital health services could be an enabler for service quality, as well as clarifying responsibilities, and providing better education and training for healthcare leaders in ICT.

The STP program includes compensation to the responsible for the service, aligned with the literature recommendation. Staff motivation also grows with vision sharing and encouragement (Barreiro et al. 2020). According to the definition of the *Momentum* framework, this is considered a critical success factor, a champion "is a person committed to the telemedicine idea or initiative or service. The person may have a considerable range of qualities and skills that are described here. The person is willing to put themselves 'on the line', i.e. be open to considerable risk to make the service happen; can enlist others in the cause; can secure a

commitment from the leadership of the organization or system, and can mobilize resources to make the initiative happen" (Christiansen et al n.d.).

Interestingly, we illustrate the example of the Cape Verde National Telemedicine Programme (NTP), which describes the issues related to ensuring leadership through a champion. As described in (Latifi et al. 2014a) the process of capacity-building focuses on creating telemedicine experts, ambassadors, and champions. Therefore, during the evaluation of the initial results of the implementation at the national level were visible the prominence of two dermatologists and the trauma surgeon who performed the highest number of teleconsultations (57.3% of the total) during the initial 7 months (in 2014).

Therefore, Cape Verde, in 2021, in a follow-up study based on data collected from 2014 to 2018, from the NTP, highlighted champions were defined "as those most frequently using telemedicine program (>100 consultations) to deliver care. Transfer status as an indicator of success in treating patients locally with telemedicine capabilities was compared across Champion programs overall, and in each year" (Azevedo et al 2020).

Accessibility benefited from the existing organizational and technical infrastructure, moreover regarding third-level care (Ministerio da Saude da República de Angola 2017). The Island of Príncipe presented the biggest challenge as the population had less access to care and an opportunity for telemedicine supporting primary care (Ministério da Saúde e dos Assuntos Sociais 2012). Telemedicine could have a positive impact on HRH retention in underserved areas, by reducing stress and professional isolation and improving communication with other colleagues, facilitating distance education, for colleagues working in Senegal's cities (Ly et al. 2017).

Furthermore, to meet increased demand from a population of patients with chronic diseases and the need for specialty consultations and disease monitoring, the telemedicine service in

STP may require more categories of professionals to meet the needs of the country's population. WHO recognizes interprofessional collaboration in education and practice as a strategy to mitigate the global health crisis (Gilbert, Yan, and Hoffman 2010). For instance, in 2014, the local STP's physicians, technicians, and one nurse assistant were empowered through training using telemedicine (IMVF 2014). Additional conferences and workshops are needed to increase telemedicine expertise in STP.

The AAAQ methodology adopted for this study has been successfully used in other studies on healthcare workforce performance. However, other interesting methodologies have emerged. In this sense, for example, in the literature on job performance some authors consider an adaptive performance dimension, which is of great importance in constantly changing environments (Krijgsheld 2022) , we consider that this dimension could be used for further research in a follow-up study on workforce performance in the STP system.

Limitations

There were three main limitations to this study. First, limited data is available about the small number of HRH available in the HAM to respond to the questionnaire. Which conducted to a potential bias in those interviewed and a potential lack of generalizability.

Second, it was not possible to include telemedicine patients' satisfaction data to deduce the patient acceptability of the service. Third, since this is a case study, it is difficult to generalize the results obtained, as it is an in-depth study of a specific reality. Finally, the results will be specific to the case "Telemedicine in STP" and, therefore, they cannot be extrapolated to other contexts. However, the study will add knowledge for a better understanding of the implementation of telemedicine in similar contexts.

Conclusion

This study has demonstrated that STP's telemedicine program has been promoting and facilitating access to healthcare and that some countries are becoming good models for the integration of telemedicine in their health systems. Knowledge transfer between physicians and specialists has been an essential factor when deploying a telemedicine service resulting in an improvement in access to care, improving referrals, and avoiding non-necessary evacuations to Portugal.

When looking at the STP telemedicine system, we found evidence of strength, such as working conditions and satisfaction of health professionals, as they are better prepared to carry out their work. These results illustrate how telemedicine can improve the delivery of services by capacitating the health workforce in low and middle-income countries. The lessons learned from this case could help other health organizations recognize leadership, organization, and training as critical success factors to implement a model where capacity building, leveraged by technology, can improve healthcare systems in an LMIC country.

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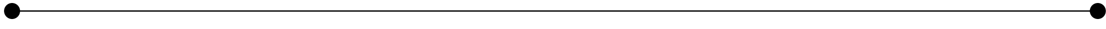
CHAPTER 5.



5.1 DISCUSSION

The outcomes of this research provided a comprehensive description of telemedicine in STP to increase knowledge of this initiative. It explores how this national program has been contributing to the improvement of health services conditions in the provision of care to citizens through teleconsultations; and enhances the contribution of tele-training in the transfer of knowledge for professionals. The results obtained achieved the objectives defined in this thesis study regarding the genesis and evolution of the Telemedicine system and the action in health workforce management to help decision and policy making.

The differences between similar countries such as CV and STP

The telemedicine program in STP is well integrated into the health system at the national level through international cooperation and governance mechanisms, which operate at the country's central hospital. On the one hand, in the Cape Verde example, the telemedicine service is a link between central and regional hospitals and reference centers in all the islands. It should be noted that Cape Verde's health system also discusses and sends patients to other countries (e.g., Portugal) using a telemedicine platform, as does STP (Correia 2017).

STP's telemedicine program is part of a national health program implemented over 25 years ago, which has had a significant impact on improving the country's health indicators. STP link between the central hospital and doctors in Portugal. Implemented and managed by IMVF, a non-governmental organization with an approach that combines technological and human resources, leadership, and financial and organizational tools, in an action plan which enables articulation among all the stakeholders (IMVF 2018).

It is interesting to make a comparative analysis of the development process of the National Telemedicine Programme in STP with the integrated Cape Verde Programme, implemented by the International Virtual e-Hospital Foundation (IVeH), a non-governmental organization with

funding from the Government of Slovenia. When the CV was fully mature then the program is transferred to the Ministry of Health of Cape Verde.

(Latifi et al. 2012) stress that the unequivocal importance of the methodology implemented ('Initiate-Build-Operate-Transfer (IBOT)) to ensure sustainability and ownership of the programs that have successfully established in Kosovo and Albania and other countries around the world Therefore, in both countries, there is a commitment from politicians and other stakeholders, which is reflected in the existing health sector policies. This support is considered one of the Critical Success Factors for telemedicine implementation (Nazviya and Kodukula 2011).

Fostering Collaborations and Strategic Partnerships: Triangular Cooperation

This work allowed us to analyze the maturity of the national telemedicine program in this middle-income country and to understand the potential for collaborative strategic partnerships. For example, in Cape Verde, internationalization was presented by Correia (2017) as one of the potentialities for the consolidation of the national telemedicine program. Both by receiving technical support, for the early diagnosis of patients in Portugal, in various specialties such as oncology, pathological anatomy, neurosurgery, and neuroradiology, and by providing support, through teleconsultations, either in the context of public network provision or through the involvement of national individuals, in the provision of teleconsultations. Through tele-training assistance, clinical sessions, congresses, case discussions, and teleconsultations to other CPLP countries, namely STP (Correia 2017).

In this context, and taking into account the experience of international cooperation in health that exists between these Portuguese-speaking countries, Portugal and Brasil, thus, it is expected that Portugal and Brasil will be identified as suitable countries for strategic partnerships between Cape Verde and São Tomé and Príncipe, to identify best practices that

have enabled the major challenges identified by each country to be met. In fact, the creation of a "telehealth network," a platform for collaboration, sharing information, and capacity building in human resources for health among Portuguese-speaking countries is also advocated. It is important to note that these partnerships provide mutual benefits for both developing and developed countries (Lapão et al. 2016).

However, the security of data transfer, interoperability between different telemedicine applications, and the organization of healthcare delivery are challenges to the integration of these cross-border telemedicine services (Bensemmane, Baeten, and Observatory 2020). We agree that these are pertinent issues to be discussed and resolved but that they cannot jeopardize this significant potential that telemedicine offers us for the construction of technical exchange networks between countries, facilitating the access of populations to new medical specialties and health professionals to the exchange of experiences and continuous training (Correia 2017).

Digital health services as a strategy to overcome the health coverage barriers

Nowadays, healthcare is undergoing a digital revolution. Thus, WHO has been motivating stakeholders to create a robust digital health strategy in line with each country's health priorities and resources, developing an action plan, and creating a methodology for monitoring and evaluating digital health implementation and progress. In this regard, more than 120 countries - including LMIC - have developed such strategies and policies (WHO 2020a).

This study highlights the relevance of developing telemedicine strategies and policies in LMICs. For these countries, telemedicine has been one solution to supply specific needs, such as the distance between cooperating health care providers being too large, shortage of qualified health care professionals, or specialized health care needed in remote areas. The great challenge is its integration into health services, which implies the organization of consultations and the training of professionals, among others (Maia, Correia, and Lapão 2015).

It should be noted that the case of telemedicine programs in STP, due to their archipelagic nature and relatively small population, and few resources is very relevant in terms of global health.

Technological and human resources for health challenges

Demographic e economic growth, combined with epidemiological transitions, could be reflected in greater overall demand in the health sector and the need for the workforce will increase substantially in the coming decades. However, significant disparities in health worker needs, demand, and supply exist at national, regional, and global levels, leading to inequitable distribution and allocation of health workers (World Organization Health 2016).

We argue that besides ensuring the technological innovations for the implementation and development of telemedicine, there must be continuous social innovations. In Portugal, the National Strategic Plan for Telehealth (PENTS) recognises that, to implement a digital transformation process, and for it to be successful, it is necessary to monitor human resources during the change process, promote the development of "eSkills" of health professionals and the digital literacy of citizens, and invest in a viable, simple and user-friendly technological solution (SPMS - Serviços Partilhados do Ministério da 2119).

For example, in the Philippines, Luis et al. (2016) examined the effects of educational programs on the perception of use usefulness of ICTs in health services. Results suggest that positive awareness effects occur in initiatives that seek to expose health workers to the practice of telehealth and consequently allow for the optimization of available human resources. The authors claim that should be reinforced investment in health human resources through the development of training programs for telemedicine for health workers, particularly among non-medical personnel.

Strategic planning

The evolution of technologies applied to the healthcare sector has allowed the development of systems that lead to improved quality, safety and efficiency of processes. In this context, despite the great possibilities and applications of telemedicine, rigorous evaluations of telemedicine projects are necessary, it is required to determine the limitations of the project, adopt strategies to overcome them, and establish a comparative framework. Thus the development of evaluation indicators (indicators of timeliness, effectiveness, quality, and efficiency, should be an integral part of the planning and organization (Pan American Health Organization and World Health Organization 2016).

The *Momentum* framework as described before enumerates the strategic drivers that allow the transition from the pilot phase to large-scale deployment (Christiansen n.d.)**.** The telemedicine service in STP illustrates several critical success factors and can be used as examples of the successful integration of telemedicine solutions into routine care. The same assessment was made of the National Telemedicine Programme in Cape Verde, a medium-income country (Correia 2017), and a Pediatric Telecardiology Service in Portugal, allowing an understanding of how barriers were overcome and what improvements to implement for the establishment of a sustainable telemedicine service (Maia et al. 2019).

Similarly, the MAST framework has also been widely used to evaluate telemedicine systems, analyzing several domains: health problem and application description, safety, clinical effectiveness, patient perspectives, economic aspects, organizational aspects, socio-cultural, ethical, and legal aspects. Considered crucial to realize the benefits for patients and health institutions (Kidholm et al. 2012).

The value of telemedicine

According to (Lages 2016) the value of a service can be defined as "the benefit derived by stakeholders, being generated through collaboration, innovation, and management processes that aim to leverage a service's competitive position in the system".

In this sense, to reflect on the value of telemedicine in health systems, we have to think about the size of the problem that telemedicine enables to overcome, the opportunity, the value of the solution, and the benefits for each of the stakeholders (Figure 26). Furthermore, it is crucial to understand the role telemedicine plays in the different elements of the healthcare system.

Figure 26. A conceptual framework to reflect on the value of telemedicine

Source: adapted from Lages (2016)

To further clarify the value of telemedicine in the case of STP, we can try to answer the following question: "If the goal of telemedicine is met, what are the desired outcomes for multiple stakeholders?" In the table below (Table 6) we schematically illustrate the answer to this question.

Table 6. Value of Telemedicine in the healthcare system

		STAKEHOLDER					
BENEFITS		**Patients**	**Physicians**	**Other Health professionals**	**Hospital (Govern ment)**	**IT provider**	**Researcher**
	Access to a quality care	●	●	●	●		
	Efficiencies	●	●	●	●		

	Timeless	●			●		
	Comfort	●			●		
	Follow-up	●	●	●	●		
	Avoiding unnecessary transfer of patients	●			●		
	Improved outcomes	●	●	●	●		
	Advancement in the medical field					●	●
	Technology advancement					●	●

Therefore, from our analysis, although all stakeholders benefit from the implementation of telemedicine, we observed that some have more benefits. For example, for patients, telemedicine can provide access to high-quality healthcare services, allow patients to reduce waiting times, enable patients to receive care in their community without having to travel and improve their comfort level. Avoiding the unnecessary transfer of patients has benefits for both patients and hospitals by reducing the resources generally used in face-to-face care. On the other hand, the hospital, telemedicine helps hospitals perform better and improve their scores, for example, telemedicine helps reduce the spread of certain diseases such as COVID-19.

Also, it is crucial to draw a parallel with the situation of the telemedicine market worldwide, which has grown in recent years mainly due to demand during the pandemic. In ("• Telemedicine Market Size Worldwide 2019-2030 | Statista" n.d.)Stata Platform, a recent analysis of the overall market for telemedicine services worldwide is presented. They state that the driving forces behind the growth of the telemedicine market are the increasing demand for home care monitoring, reduction in healthcare costs, filling the shortage of skilled human

resources, technological advances, and the growth of the elderly population and that these same factors will be the driving forces for the development of telemedicine services in the future.

Thus, it was observed that in 2019 the market reached a value of nearly $49,898.9 million is expected to grow to $194,054.4 million in 2023 at a rate of 40.4% to $277,930.9 million in 2025 at a CAGR of 19.7%. The market is projected to grow and reach $459,804.5 million by 2030 at a CAGR of 10.6% (Figure 27).

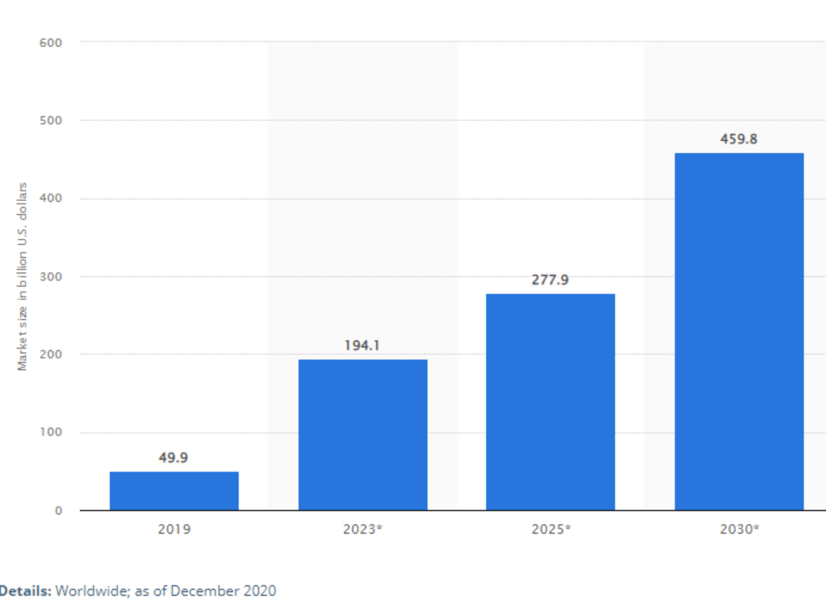


Figure 27. Telemedicine Global Market

Source: https://www.statista.com/

The weakness in growth was due to regulatory challenges and data breaches. these are important factors to watch out for in the future as they may hamper the growth of the telemedicine services market in the future.

We stress the value of telemedicine for physicians and other health professionals, the use of telemedicine for continuing education and training through the collaboration of health professionals improves job performance; telemedicine stimulates collaboration between staff,

which improves the quality of care patients receive, this issue is more relevant in countries such as STP with particular healthcare-context characteristics.

For the government, an important benefit of telemedicine is the management of evacuations through telemedicine and consequently p the cost reduction of healthcare and saving time which increased efficiency. ,

Today's technology market is ever-changing and healthcare practices have evolved at a galloping pace, so ongoing research is needed to keep up. Technology company strengthens with the advance in telemedicine in the country. For IT (telecommunications companies) and research companies, R&D activities in the digital topic have increased in the last decade, and advances in the medical field have further boosted market growth. We predicted a Telemedicine technology is expanding rapidly expansion on the adoption rate of telemedicine.

This knowledge can then be applied to the production process, such as the integration of telemedicine services and innovative solutions like Artificial Intelligence, Big Data, or robotic surgery, etc. to provide quality improvements to patient care.

5.2 CONCLUSIONS

In SIDS health issues are particularly sensitive as countries with small and geographically distinct populations and/or labor shortages make them vulnerable. The health services available in these countries are considered to have a vital role to play in the sustainable development of the country and, in terms of global health, are very relevant. Thus, the importance of national telemedicine programs in these complex and vulnerable countries should be reflected in the scale of effort they put into implementing telemedicine programs. The benefits are enormous, with even greater importance in archipelagos where there is difficulty in having specialized human resources on all the islands. Therefore, the role of telemedicine for triage and internal or external evacuations is highlighted in some of these countries formed by archipelagos.

This study has shown that STP's telemedicine program has promoted and facilitated access to healthcare and that, like some developed countries, it is becoming a good model of telemedicine integration in healthcare systems. We highlight the transfer of knowledge between doctors and specialists as a crucial factor in the implementation of the telemedicine service, resulting in improved access to healthcare, enhanced referrals, and avoiding unnecessary evacuations to Portugal.

In this work, we illustrate how telemedicine can improve service delivery through health workforce capacity building in LMIC. The lessons learned from this case could help other health organizations to recognize leadership, and training as critical success factors to implement a model where capacity building, leveraged by technology, can improve health systems in an LMIC.

This study demonstrated that telemedicine is feasible for remote consultation, screening, triage, and supervision applications in a wide range of conditions of various diseases STP telemedicine was found to meet most of the critical success factors, firm strategy, and organization. Thus, the results found concrete evidence that the critical success factors had a direct influence on the development of an effective telemedicine strategy. Thus, from the analysis, in STP, they are more opportunities than threats that bode well for the future service to support better working conditions and higher satisfaction of health professionals, with more skills to do their work.

This work suggests that the implementation of the telemedicine service in STP used appropriate phasing and moved from the pilot phase to routine delivery, although more should be done in the future to improve telemedicine services. Ensuring the necessary technological infrastructure (technical and operational) and continuous and efficient management of human

resources should be highlighted as the main challenges identified when we talk about system sustainability.

This thesis aims to provide an example in the context of LMIC, of the use of information systems to improve health care, especially from a perspective of universal access and efficient use of resources. The STP is also an example of collaboration between health systems within the global health paradigm and is truly aligned with the goals of sustainable development.

5.3 LIMITATIONS

Methodological insufficiencies were common; thus, findings must be inferred with prudence. In this sense, there are limitations to this study. First, this thesis described and summarised the data, which allowed the description of a case study in the implementation of telemedicine in STP. Thus, the case study approach has several limits. It is not possible to generalize the findings (Crowe et al 2011). The results obtained were specific to the STP telemedicine service, and, therefore, they cannot be extrapolated to other contexts.

The second limitation is that the information on the statistics on services provided by HAM was not made available; this limits the accuracy of some assessments about the representativeness of the telemedicine service concerning other services at the central level.

However, the three studies performed will add knowledge for a better understanding of the implementation of telemedicine in similar contexts.

5.4 RECOMMENDATIONS AND FUTURE PERSPECTIVES

We highlight some recommendations and future perspectives to be considered in the telemedicine systems in the study:

- Research is still required to identify incentives for potential telemedicine users and understand their importance for widespread adoption; moreover the use of the “Momentum” framework;
- Fostering Collaborations and Partnerships: Involve scientific institutions, to help lead workshops and sessions, along with key national political and scientific actors and promote alignment between the stakeholders;
- To continue to promote global collaboration and advance the transfer of knowledge on digital health, taking into account areas where, for example, Portugal and Cape Verde have the greatest advances;
- Invest in education and training, recruitment, deployment and retention of health workers to meet national and sub-national needs through a training plan that in addition to doctors also includes nurses;
- Creating more evidence-based knowledge, skills, and competence for professionals to support health care: an adaptable health workforce.
- When drafting the update of the health human resource plan of the Ministry of Health, we recommend the inclusion of Telemedicine as part of the HR Policy Framework for the benefit of health professionals and hospitals.
- Cost-effectiveness of some specialties that have greater representativeness in the country, allowing new business models in service provision.
- Establish a knowledge management approach to identify and share good practices, knowledge about the implementation of new methods and techniques, evidence and lessons learned

Research regarding this subject is a continuous and never-ending work in progress. The valuable next steps are:

- To further develop the role of the National Telemedicine Center;
- For adaptive and flexible policy-making processes scenario planning can be an appropriate tool to help make better decisions under conditions of profound uncertainty (Volkery and Ribeiro 2009);
- Apply Value Creation Wheel (VCW) methodology helps to identify, analyze, and solve problems by providing a step-by-step dynamic process for creating value for society and all the stakeholders involved in the value chain (Lages 2016);
- To explore the cost-effectiveness of telemedicine.
- To assess the environmental impact despite the increasing threat of the climate emergency: evidence on the carbon footprint of telemedicine.
- To develop an explicit relationship of quantitative modeling with qualitative approaches for building long-term scenarios.

- Enhancing cybersecurity through recommendations to be disseminated by healthcare professionals to protect the privacy, confidentiality, and availability of data and the processing of personal health data.

REFERENCES

"• Telemedicine Market Size Worldwide 2019-2030 | Statista." n.d. Accessed July 18, 2021. https://www.statista.com/statistics/671374/global-telemedicine-market-size/.

Aas, Monrad I H. 2014. "A Qualitative Study of the Organizational Consequences of Telemedicine," no. November. https://doi.org/10.1258/1357633011936093.

Abdullah, B. J., K. H. Ng, and R. Pathmanathan. 1999. "The Impact of Teleradiology in Clinical Practice--a Malaysian Perspective." *The Medical Journal of Malaysia* 54 (2): 169–74.

"Africa :: Sao Tome and Principe — The World Factbook - Central Intelligence Agency." n.d. Accessed June 28, 2020. https://www.cia.gov/library/publications/the-world-factbook/geos/print_tp.html.

Afzal, Dr. Saira. 2016. "Telemedicine: Underutilized Tool of Global Health." *Annals of King Edward Medical University* 22 (1): 1. https://doi.org/10.21649/akemu.v22i1.786.

Alawi and Ahmed. 2012. "Screening for Diabetic Retinopathy: The First Telemedicine Approach in a Primary Care Setting in Bahrain." *Middle East African Journal of Ophthalmology* 19 (3): 295. https://doi.org/10.4103/0974-9233.97928.

Ashfaq, Ahsan, Shehzeen Fatima Memon, Ayesha Zehra, Samrana Barry, Huzema Jawed, Maryam Akhtar, Wajeeha Kirmani, et al. 2020. "Knowledge and Attitude Regarding Telemedicine Among Doctors in Karachi." *Cureus* 12 (2). https://doi.org/10.7759/cureus.6927.

Assembleia Nacional. 2018. "Lei n.º 09/2018 Lei Base de Saúde."

Azevedo et al. 2020. "Cabo Verde Telemedicine Program: An Update Report and Analysis of 2,442 Teleconsultations" 00 (00): 2–4. https://doi.org/10.1089/tmj.2020.0001.

Barreiro, Mariana, Ashley Coles, Caris Conradt, Emma Hales, and Elizabeth Zellmer. 2020. “Barriers to the Implementation of Telehealth in Rural Communities and Potential Solutions.” https://digitalshowcase.oru.edu/nurs_undergrad_work.

Barrocas, Sofia, and Paulo Freitas. 2014a. *Saúde Para Todos, 25 Anos Ao Serviço de São Tomé e Príncipe*. Edited by Instituto Marquês de Valle Flôr (IMVF). Lisbon.

———. 2014b. *Saúde Para Todos, 25 Anos Ao Serviço de São Tomé e Príncipe*. Edited by Instituto Marquês de Valle Flôr (IMVF).

Beja, André, Artur Correia, Bernardina de Sousa Gonçalves, Plácido Cardoso, and L Lapão. 2019. “Tendências e Contextos de Implantação de Tecnologias de Informação e Comunicação Para o Reforço Dos Sistemas de Saúde Em Países de Baixo Rendimento Da CPLP.” *Anais Do Instituto de Higiene e Medicina Tropical* 18: 52–57. https://doi.org/doi.org/10.25761/anaisihmt.338.

Bensemmane, Sherihane, Rita Baeten, and European Social Observatory. 2020. “Cross-Border Telemedicine : Practices and Challenges,” no. October 2019.

Britten, Nicky. 1995. “Qualitative Research: Qualitative Interviews in Medical Research.” *Bmj* 311 (6999): 251. https://doi.org/10.1136/bmj.311.6999.251.

Caffery, Liam J., Monica Taylor, Glen Gole, and Anthony C. Smith. 2019. “Models of Care in Tele-Ophthalmology: A Scoping Review.” *Journal of Telemedicine and Telecare* 25 (2): 106–22. https://doi.org/10.1177/1357633X17742182.

Caffery, Liam J, Melinda Martin-Khan, and Victoria Wade. 2017. “Mixed Methods for Telehealth Research.” *Journal of Telemedicine and Telecare* 23 (9): 764–69. https://doi.org/10.1177/1357633X16665684.

Campbell, James, G Dussault, J Buchan, F Pozo-Martin, M Guerra Arias, C Leone, A Siyam,

and A Cornetto. 2013. “A Universal Truth: No Health without a Workforce.” *World Health Organization*. http://www.who.int/workforcealliance/knowledge/resources/hrhreport2013/en/.

Castela□, Eduardo. n.d. “Coimbra Telemedicine Service Improves Access to Pediatric Cardiology in Cape Verde.” *Actamedicaportuguesa.Com*. Accessed March 3, 2020. https://doi.org/10.20344/amp.9034.

CChristiansen EK, Henriksen E, Jensen LK, Lange M, Lapão L, Kaye R et al. n.d. “European Momentum for Mainstreaming Telemedicine Deployment in Daily Practice (Grant Agreement No 297320). Deliv D4.2, Report on SIG1 - ‘Strategy and Management.’” Accessed April 3, 2019. http://telemedicine-momentum.eu/europe/.

———. 2014a. “"European Momentum for Mainstreaming Telemedicine Deployment in Daily Practice (Grant Agreement No 297320) Knowledge Gathering Questionnaire.” http://www.telemedicine-momentum.eu/wp-content/uploads/2012/09/MOMENTUM-WP3-Questionnaire-2_v2-Summary.pdf.

———. 2014b. “European Momentum for Mainstreaming Telemedicine Deployment in Daily Practice (Grant Agreement No 297320). In: Deliverable 3.2. Towards a Personalised Blueprint - for Doers, by Doers: Consolidated Version.” http://telemedicine-momentum.eu/europe/.

———. 2014c. “European Momentum for Mainstreaming Telemedicine Deployment in Daily Practice (Grant Agreement No 297320).” *Deliverable 3.2. Towards a Personalised Blueprint - for Doers, by Doers: Consolidated Version*. http://www.telemedicine-momentum.eu/wp-content/uploads/2015/02/D3.4_v1.0_ValidatedBlueprint.pdf.

Chand, Repu Daman, Biomedical Informatics, and Saroj Mishra. 2016. “Telemedicine- A

Tool for International Cooperation : A A SGPGI Experience,” no. November.

Choi, Paul J, Rod J Oskouian, and R Shane Tubbs. 2018. “Telesurgery : Past , Present , and Future” 10 (5): 1–5. https://doi.org/10.7759/cureus.2716.

Coiera, Enrico. 2002. *Essentials of Telemedicine and Telecare*. *BMJ*. Vol. 324. https://doi.org/10.1136/bmj.324.7345.1104.

Cometto, Giorgio, James Buchan, and Gilles Dussault. 2020. “Developing the Health Workforce for Universal Health Coverage.” *Bulletin of the World Health Organization* 98 (2): 109–16. https://doi.org/10.2471/BLT.19.234138.

Comunidade dos Países de Língua Portuguesa (CPLP). 2009. “Plano Estratégico de Cooperação Em Saúde Da CPLP (PECS/CPLP) 2009-2012.” http://www.cplp.org/Files/Filer/Documentos Essenciais/Estatutos_CPLP_REVLIS07.pdf.

Correia, Artur. 2017. “A Telemedicina Em Cabo Verde : Desafio de Integração Na Rotina de Prestação de Cuidados e Perspetivas de Desenvolvimento.” Universidade Nova de Lisboa.

Correia, Artur, Vanda Azevedo, and Luís Velez Lapão. 2017. “Implementation of Telemedicine in Cape Verde: Influencing Factors.” *Acta Medica Portuguesa* 30 (4): 255–62. https://doi.org/10.20344/amp.7578.

Crowe et al. 2011. “The Case Study Approach.” *BMC Medical Research Methodology* 11 (100). https://doi.org/10.1177/108056999305600409.

Dhingra, Dhulika, and Aashima Dabas. 2020. *Global Strategy on Digital Health*. *Indian Pediatrics*. Vol. 57. https://doi.org/10.1007/s13312-020-1789-7.

Edworthy, S. M. 2001. “Telemedicine in Developing Countries.” *Bmj* 323 (7312): 524–25.

https://doi.org/10.1136/bmj.323.7312.524.

Gilbert, John H.V., Jean Yan, and Steven J. Hoffman. 2010. “A WHO Report: Framework for Action on Interprofessional Education and Collaborative Practice.” *Journal of Allied Health* 39 (SUPPL. 1): 196–97.

Giustini Dean, and Maged N. Kamel Boulos. 2013. “Googlr Scholar.” *Online Journal of Public Health Informatics* 5 (2): 1–10. https://doi.org/10.5210/ojphi.v5i2.4623.

Governo de Cabo Verde. n.d. “Geografia.” Accessed July 23, 2022. https://www.governo.cv/o-arquipelago/geografia/.

Gupta, Amar, Mariam E. Dogar, Emily Sijin Zhai, Pooja Singla, Tooba Shahid, Hilal Nuriye Yildirim, and Sabrina Singh. 2019. “Innovative Telemedicine Approaches in Different Countries: Opportunity for Adoption, Leveraging, and Scaling-Up.” *Telehealth and Medicine Today*. https://doi.org/10.30953/tmt.v5.160.

“Human Development Indices and Indicators: 2018 Statistical Update.” n.d. Accessed November 6, 2018. http://hdr.undp.org/en/data.

Huynen, Maud M.T.E., Pim Martens, and Henk B.M. Hilderink. 2005. “The Health Impacts of Globalization: A Conceptual Framework.” *Globalization and Health* 1: 1–12. https://doi.org/10.1186/1744-8603-1-14.

Instituto Marquês de Valle Flôr (IMVF). 2012. “Global Report ‘Health For All’ Program.” Sao Tome and Principe.

———. 2013a. “Global Report ‘Health for All’ Program.” Sao Tome and Principe.

———. 2013b. “Primeira Consulta Com a Nova Plataforma de Telemedicina Entre São Tomé e Principe e Portugal, Comunicado de Imprensa.” Lisbon. https://www.imvf.org/wp-content/uploads/2018/04/PRNovaMedigraf.pdf.

———. 2014. “Global Report ‘Health For All’ Program.” Sao Tome and Principe.

———. 2015a. “Global Report ‘Health For All.’” Sao Tome and Principe.

———. 2015b. “‘Saúde Para Todos’, São Tomé e Príncipe - Documento Informativo 1988-2015.”

———. 2017. “Global Report ‘Health for All’ Program.” Sao Tome and Principe.

———. 2018. “Program Health for All, Sao Tome and Principe, Project Highlights, 1998-2018.”

Instituto Português de Apoio ao Desenvolvimento (IPAD). 2011. “Estratégia Da Cooperação Portuguesa Para a Saúde.” https://www.instituto-camoes.pt/images/cooperacao/estrategia_cooperacao_saude.pdf.

Kho, Joanna, Nicole Gillespie, and Melinda Martin-khan. 2020. “A Systematic Scoping Review of Change Management Practices Used for Telemedicine Service Implementations,” 1–16.

Kidholm, Kristian, Anne Granstrøm Ekeland, Lise Kvistgaard Jensen, Janne Rasmussen, Claus Duedal Pedersen, Alison Bowes, Signe Agnes Flottorp, and Mickael Bech. 2012. “A Model for Assessment of Telemedicine Applications: Mast.” *International Journal of Technology Assessment in Health Care* 28 (1): 44–51. https://doi.org/10.1017/S0266462311000638.

Kim, Taehoon, and James E Zuckerman. 2019. “Realizing the Potential of Telemedicine in Global Health.” *Journal of Global Health* 9 (2). https://doi.org/10.7189/jogh.09.020307.

Krijgsheld. 2022. “Job Performance in Healthcare: A Systematic Review.” *BMC Health Services Research* 22 (1): 149. https://doi.org/10.1186/s12913-021-07357-5.

Lages, Luis Filipe. 2016. “VCW—Value Creation Wheel: Innovation, Technology, Business, and Society.” *Journal of Business Research* 69 (11): 4849–55. https://doi.org/10.1016/j.jbusres.2016.04.042.

Lapão, L V, L V Tavares, J B Mendes, and E Castela. 2006. “HPC Telemedicine’s Service Improves Access to Pediatric Cardiology in Central Portugal: Leadership, Organization and Training as Critical Success Factors – People Really Matter!” *Radiology* 524 (375): 149.

Lapão, Luís Velez, and Artur Correia. 2015. “Improving Access to Pediatric Cardiology in Cape Verde via a Collaborative International Telemedicine Service.” *Studies in Health Technology and Informatics* 209 (January): 51–57. https://doi.org/10.3233/978-1-61499-505-0-51.

Lapão, Luís Velez, and Gilles Dussault. 2017. “The Contribution of EHealth and MHealth to Improving the Performance of the Health Workforce : A Review.” *Policy and Practice*, no. 2: 463–71.

Lapão, Luís Velez, Luiz Ary Messina, Regina Ungerer, and Francisco Campos. 2016. “Roteiro Estratégico Para a Telessaúde Na CPLP: Diagnóstico e Prioridades Para o Desenvolvimento Da Telessaúde.” *Anais Do Instituto de Higiene e Medicina Tropical* 15 (Suplemento 1). http://ihmtweb.ihmt.unl.pt/PublicacoesFB/Anais/Anais2016-suplemento/index.html#67/z.

Latifi, Rifat, Erion Dasho, Ismet Lecaj, Kalterina Latifi, Flamur Bekteshi, Molly Hadeed, Charles R. Doarn, and Ronald C. Merrell. 2012. “Beyond ‘Initiate-Build-Operate-Transfer’ Strategy for Creating Sustainable Telemedicine Programs: Lesson from the First Decade.” *Telemedicine and E-Health* 18 (5): 388–90. https://doi.org/10.1089/tmj.2011.0263.

Latifi, Rifat, Erion Dasho, Ronald C Merrell, Miguel Lopes, Vanda Azevedo, Flamur Bekteshi, Kalterina L Osmani, Orland Qesteri, Julian Kucani, and Ismet Lecaj. 2014a. "Cabo Verde Telemedicine Program: Initial Results of Nationwide Implementation." *Telemedicine Journal and E-Health : The Official Journal of the American Telemedicine Association* 20 (11): 1027–34. https://doi.org/10.1089/tmj.2014.0026.

———. 2014b. "Cabo Verde Telemedicine Program: Initial Results of Nationwide Implementation." *Liebertpub.Com* 20 (11): 1027–34. https://doi.org/10.1089/tmj.2014.0026.

Laukka et al. 2021. "Leadership in Digital Health Services: Protocol for a Concept Analysis." *JMIR Research Protocols* 10 (2): 1–9. https://doi.org/10.2196/25495.

Lima, Helena. 2018. "Diagnóstico Situacional Sobre a Implementação Da Recomendação Opção B +, Da Transmissão Do VIH e Da Sífilis Congênita, No Âmbito Da Comunidade de Paíse de Língua Portuguesa - CPLP."

Loureiro et al. 2015. "Saúde Para Todos – Especialidades : Cooperação Portuguesa Com São Tomé e Príncipe Na Área Da Cardiologia." *Rev Clin Hosp Prof Dr Fernando Fonseca*, 2015.

Luis, Romeo, A Macabasag Rn, Kristine Mae P Magtubo, and Portia Grace H Fernandez-. 2016. "Implementation of Telemedicine Services in Lower-Middle Income Countries: Lessons for the Philippines." *Journal of the International Society for Telemedicine and EHealth*, no. December: 0–11.

Ly, Birama Apho, Ivy Lynn Bourgeault, Ronald Labonté, and Mbayang Ndiaye Niang. 2017. "Physicians' Perceptions on the Impact of Telemedicine on Recruitment and Retention in Underserved Areas: A Descriptive Study in Senegal." *Human Resources for Health* 15 (1): 1–8. https://doi.org/10.1186/s12960-017-0242-z.

Maia, Mélanie Raimundo, Eduardo Castela, António Pires, and Luís Velez Lapão. 2019. "How to Develop a Sustainable Telemedicine Service? A Pediatric Telecardiology Service 20 Years on - an Exploratory Study." *BMC Health Services Research* 19 (1): 681. https://doi.org/10.1186/s12913-019-4511-5.

Maia, Mélanie Raimundo, Artur Jorge Correia, and Luís Velez Lapão. 2015. "Telemedicina - Um Meio Para a Saúde Global . Um Caminho Para o Acesso Universal à Saúde ." https://doi.org/10.13140/RG.2.1.4616.9047.

Marcelo, Alvin, Jai Ganesh, Jai Mohan, D. B. Kadam, B. S. Ratta, Gumindu Kulatunga, Sheila John, et al. 2015. "Governance and Management of National Telehealth Programs in Asia." *Studies in Health Technology and Informatics* 209 (January): 95–101. https://doi.org/10.3233/978-1-61499-505-0-95.

Matthews, Barry. 2021. "Digital Literacy in UK Health Education : What Can Be Learnt from International Research ?" 0694: 0–1. https://doi.org/10.30935/cedtech/11072.

Meissner, Helen, John Creswell, Ann Carroll Klassen, Vicki Plano, and Katherine Clegg Smith. 2011. "Best Practices for Mixed Methods Research in the Health Sciences." *Methods* 29: 1–39. https://doi.org/10.1002/cdq.12009.

Meister, S, W Deiters, and S Becker. 2016. "Digital Health and Digital Biomarkers – Enabling Value Chains on Health Data." *Current Directions in Biomedical Engineering* 2 (1): 577–81. https://doi.org/10.1515/cdbme-2016-0128.

Ministerio da Saude da República de Angola. 2017. "Plano Nacional de Desenvolvimento Sanitario 2017-2021" 2: 402.

Ministério da Saúde de Cabo Verde. 2021. "Plano Nacional de Desenvolvimento Sanitário (2017-2021)." Vol. I.

Ministério da Saúde de São Tomé e Príncipe, Ministério da Saúde Portugal, Instituto Marquês de Vale Flor. 2012. “Protocolo de Cooperação Relativo Ao Processo de Evacuações Sanitárias Entre S. Tomé e Príncipe e Portugal.” https://www.dgs.pt/relacoes-internacionais1/acordos/protocolo-de-cooperacao-relativo-ao-processo-de-evacuacoes-sanitarias-entre-s-tome-e-principe-e-portugal-pdf.aspx.

Ministério da Saúde de São Tomé e Principe. n.d. “Plano Nacional Do Desenvolvimento Da Saúde (2017 - 2021).” Accessed January 28, 2019. http://ms.gov.st/wp-content/uploads/2018/05/PNDS-2018.pdf.

———. 2018. “Política Nacional de Recursos Humanos.” República Democrática de São Tomé e Príncipe.

Ministério da Saúde de São Tomé e Príncipe. 2021. “Plano Nacional de Desenvolvimento Sanitário (2017 - 2021).” http://ms.gov.st/wp-content/uploads/2019/01/PNDS-2017-2021-actualizado.pdf.

Ministério da Saúde e dos Assuntos Sociais. 2012. “Carta Sanitária de São Tomé e Príncipe.”

Nações Unidas. 2021. “Relatório Anual de Resultados Das Nações Unidas - São Tomé e Principe.” 2021. https://saotomeeprincipe.un.org/sites/default/files/2022-04/ANNUAL REPORT 2021 - SAO TOME AND PRINCIPE_compressed.pdf.

National TeleConsultation Service Ministry of Health and Family Welfare. 2020. “ESanjeevaniOPD -SAFE HOME OPD National Teleconsultation Service-MoHFW.” MoHFW. 2020. https://esanjeevaniopd.in/Home.

Nazviya, Mariyam, and Subrahmanyam Kodukula. 2011. “Evaluation of Critical Success Factors for Telemedicine Implementation.” *International Journal of Computer Applications* 12 (10): 975–8887.

OASES. 2021. "D5 . 1 Framework for the Data Collection," 1–20.

Palinkas, Lawrence A., Sarah M. Horwitz, Carla A. Green, Jennifer P. Wisdom, Naihua Duan, and Kimberly Hoagwood. 2015. "Purposeful Sampling for Qualitative Data Collection and Analysis in Mixed Method Implementation Research." *Administration and Policy in Mental Health and Mental Health Services Research* 42 (5): 533–44. https://doi.org/10.1007/s10488-013-0528-y.

Pan American Health Organization, and World Health Organization. 2016. "Defining Evaluation Indicators for Telemedicine as a Tool for Reducing Health Inequities: Study and Results of a Community of Practice." www.paho.org/permissions.

Para, Saúde, Todos Cooperação, E M Saúde, and C O M São. 2013. "'Saúde Para Todos': Cooperação Em Saúde Com São Tomé e Príncipe" 1 (1): 8–10.

Perrault, M Franck, M Janvier Litse, and M Ferdinand Bakoup. 2014. "Cabo Verde : Country Strategy Paper 2014-2018," no. March: 50. http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/2014-2018_-_Cape_Verde_Country_Strategy_Paper.pdf.

Piasecki, Jan, Marcin Waligora, and Vilius Dranseika. 2018. "Google Search as an Additional Source in Systematic Reviews." *Science and Engineering Ethics* 24 (2): 809–10. https://doi.org/10.1007/s11948-017-0010-4.

Pote, Helen, Annabel Rees, Charley Holloway-Biddle, and Emma Griffith. 2021. "Workforce Challenges in Digital Health Implementation: How Are Clinical Psychology Training Programmes Developing Digital Competences?" *Digital Health* 7: 1–11. https://doi.org/10.1177/2055207620985396.

Ramalanjaona, Georges, and Gerald X. Brogan. 2009. "EMS in Mauritius." *Resuscitation* 80

(2): 163–64. https://doi.org/10.1016/j.resuscitation.2008.10.006.

Rana, ShivPratap Singh, and Elias Fadel. 2020. *Telemedicine during the COVID-19 Pandemic: Experience at Bahrain Oncology Centre, Bahrain*. *Indian Journal of Palliative Care*. Vol. 26. Medknow Publications and Media Pvt. Ltd. https://doi.org/10.4103/IJPC.IJPC_181_20.

Robinson, Stacy ann. 2020. "Climate Change Adaptation in SIDS: A Systematic Review of the Literature Pre and Post the IPCC Fifth Assessment Report." *Wiley Interdisciplinary Reviews: Climate Change* 11 (4): 1–21. https://doi.org/10.1002/wcc.653.

Sanogo, NA, AW Fantaye, and S Yaya. 2019. "Universal Health Coverage and Facilitation of Equitable Access to Care in Africa: A Systematic Review." *Frontiers in Public Health* 7 (APR). https://doi.org/10.3389/fpubh.2019.00102.

"Sao Tome and Principe Internet Speed | 2007-2017 Data | 2019-2020 Forecast | Calendar." n.d. Accessed February 14, 2020. https://tradingeconomics.com/sao-tome-and-principe/internet-speed.

Shiferaw, Fassil, and Maria Zolfo. 2012. "The Role of Information Communication Technology (ICT) towards Universal Health Coverage: The First Steps of a Telemedicine Project in Ethiopia." *Global Health Action* 5 (1): 15. https://doi.org/10.3402/gha.v5i0.15638.

Shonubi, Aderibigbe M.O., Olatunde Odusan, David O. Oloruntoba, Solomon A. Agbahowe, and M. A. Siddique. 2005. "'Health for All' in a Least-Developed Country." *Journal of the National Medical Association* 97 (7): 1020–26.

SPMS - Serviços Partilhados do Ministério da. 2119. "Plano Estratégico Nacional Para a Telessáude 2019 -2022." *Centro Nacional de TeleSaúde*.

Stuckey, Heather. 2015. “The Second Step in Data Analysis: Coding Qualitative Research Data.” *Journal of Social Health and Diabetes* 03 (01): 007–010. https://doi.org/10.4103/2321-0656.140875.

Syed-Abdul, Shabbir, Jeremiah Scholl, Chiehfeng Cliff Chen, Martinho D.P.S. Santos, Wen Shan Jian, Der Ming Liou, and Yu Chuan Li. 2012. “Telemedicine Utilization to Support the Management of the Burns Treatment Involving Patient Pathways in Both Developed and Developing Countries: A Case Study.” *Journal of Burn Care and Research* 33 (4). https://doi.org/10.1097/BCR.0b013e318241b6b7.

Syed, Shamsuzzoha B., Viva Dadwal, Paul Rutter, Julie Storr, Joyce D. Hightower, Rachel Gooden, Jean Carlet, et al. 2012. “Developed-Developing Country Partnerships: Benefits to Developed Countries?” *Globalization and Health* 8 (1): 17. https://doi.org/10.1186/1744-8603-8-17.

“Telemedicine Market Size : Global Industry Demand, Growth, Share & Forecast 2024.” n.d. Accessed November 20, 2018. https://www.researchnester.com/reports/global-telemedicine-market-analysis-opportunity-outlook-2024/84.

Thomas Bossert et al. 2007. “Assessing Financing , Education , Management and Policy Context for Strategic Planning of Human Resources for Health.” https://apps.who.int/iris/handle/10665/43780.

UHC 2030. 2017. “International Health Partnership - Global Compact for Progress towards Universal Health Coverage.” https://www.uhc2030.org/fileadmin/uploads/uhc2030/Documents/About_UHC2030/mgt_arrangemts___docs/UHC2030_Official_documents/UHC2030_Global_Compact_WEB.pdf.

UNDAF de São Tomé e Príncipe. 2017. “Plano-Quadro Das Nações Unidas Para a

Assistência Ao Desenvolvimento Na Ótica de Um Desenvolvimento Equitativo, Inclusivo e Sustentável Em São Tomé e Príncipe – UNDAF 2017 -2021," 48.

United Nations. n.d. "List of SIDS - Sustainable Development Knowledge Platform." Accessed September 20, 2019. https://sustainabledevelopment.un.org/topics/sids/list.

———. 2022. "The Sustainable Development Goals Report 2022." *Department of Economic and Social Affairs*. https://unstats.un.org/sdgs/report/2022/The-Sustainable-Development-Goals-Report-2022.pdf.

Velez Lapão, Luis, Luís Velez LAPÃO, and Miguel Lopes. 2013. *Managing Health Systems in a Globalized World: Telemedicine Service Improves Access to Pediatric Cardiology in Cape Verde*. *Ieeexplore.Ieee.Org*. https://www.researchgate.net/publication/261054740.

Volkery, Axel, and Teresa Ribeiro. 2009. "Scenario Planning in Public Policy: Understanding Use, Impacts and the Role of Institutional Context Factors." *Technological Forecasting and Social Change* 76 (9): 1198–1207. https://doi.org/10.1016/j.techfore.2009.07.009.

Wamala, Dan S., and Kaddu Augustine. 2013. "A Meta-Analysis of Telemedicine Success in Africa." *Journal of Pathology Informatics* 4 (1): 6. https://doi.org/10.4103/2153-3539.112686.

Weber, Alan S., Rebal Turjoman, Yanal Shaheen, Farah Al Sayyed, Mu Ji Hwang, and Faryal Malick. 2017. "Systematic Thematic Review of E-Health Research in the Gulf Cooperation Council (Arabian Gulf): Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates." *Journal of Telemedicine and Telecare* 23 (4): 452–59. https://doi.org/10.1177/1357633X16647894.

WHO. 2018. "Thirteenth General Programme of Work 2019–2023." *WHO Press*, no. April 2018: 50.

———. 2020. "The African Regional Framework for the Implementation of the Global Strategy on Human Resources for Health: Workforce 2030." http://apps.who.int/bookorders.

Wolrd Health Organization. 2021. "Health & Climate Change Country Profile 2021," 3–5. https://apps.who.int/iris/handle/10665/339961.

World Bank. n.d. "Cabo Verde Aspectos Gerais." Accessed July 23, 2022. https://www.worldbank.org/pt/country/caboverde/overview.

———. 2020. "Sao Tome and Principe." 2020. https://doi.org/10.4135/9781412963855.n1066.

World Bank Group. 2018. "República de Cabo Verde Ajustando o Modelo de Desenvolvimento Para Revitalizar o Crescimento e Fortalecer a Inclusão Social," 123. http://documents1.worldbank.org/curated/pt/320521541698395488/pdf/130289-SCD-REVISED-PORTUGUESE-P159323-PUBLIC.pdf.

World Health Assembly. 2017. "EHealth." *WHA58.28 EHealth - RESOLUTIONS AND DECISIONS*. https://doi.org/10.1002/9783527800728.ch19.

World Health Organization (WHO). 2006. "Improving Health Worker Performance: In Search of Promising Practices." *Evidence and Information for Policy, Department of Human Resources for Health*. Vol. 27. Geneva. https://doi.org/10.3969/j.issn.1008-794X.2018.04.019.

———. 2010a. *Análise Dos Recursos Humanos Da Saúde (RHS) Nos Países Africanos de Língua Oficial Portuguesa (PALOP)*. https://doi.org/ISBN 978 92 4 859907 1.

———. 2010b. “Telemedicine: Opportunities and Developments in Member States: Report on the Second Global Survey on EHealth 2009 (Global Observatory for EHealth Series, Volume 2).” https://www.who.int/goe/publications/goe_telemedicine_2010.pdf.

———. 2016a. “Global Diffusion of EHealth: Making UHC Achievable.” http://www.who.int/goe/publications/global_diffusion/en/.

———. 2016b. “Health Workforce Requirements for Universal Health Coverage and the Sustainable Development Goals.” https://apps.who.int/iris/bitstream/handle/10665/250330/9789241511407-eng.pdf.

———. 2017. “Small Island Developing States Health and WHO - Country Presence Profile Background.” WHO/CCU/17.08. 2017. https://apps.who.int/iris/bitstream/handle/10665/255804/WHO-CCU-17.08-eng.pdf?sequence=1.

———. 2020a. “Global Strategy on Digital Health.” https://doi.org/10.1007/s13312-020-1789-7.

———. 2020b. “Global Strategy on Digital Health 2020-2024 (Draft).” https://www.who.int/docs/default-source/documents/gs4dh0c510c483a9a42b1834a8f4d276c6352.pdf.

———. 2021. “Universal Health Coverage (UHC).” 2021. https://www.who.int/news-room/fact-sheets/detail/universal-health-coverage-(uhc).

World Organization Health. 2016. “Global Strategy on Human Resources for Health: Workforce 2030.” *Who*, 64. https://www.who.int/hrh/resources/global_strategy_workforce2030_14_print.pdf?ua=1.

Xia, Shi Bo, and Qing Sheng Lu. 2021. “Development Status of Telesurgery Robotic

System." *Chinese Journal of Traumatology - English Edition* 24 (3): 144–47. https://doi.org/10.1016/j.cjtee.2021.03.001.

Xinhua. n.d. "Chinese Hospital Opens Telemedicine Platform to Serve Sao Tome and Principe Patients." Accessed September 16, 2019. http://www.xinhuanet.com/english/2019-06/07/c_138123713.htm.

Zanaboni, P., and R Wootton. 2012. "Adoption of Telemedicine: From Pilot Stage to Routine Delivery. BMC Medical Informatics and Decision Making," 1–9.

APPENDIX

A.2 Appendix Chapter 2

A.2.1. Database searches results

Table 7. Database searches resulted in 19 publications and 13 complimentary publications.

No	Title	Country
1	Beyond 'initiate-build-operate-transfer' strategy for creating sustainable telemedicine programs: Lesson from the first decade	Cabo Verde
2	Cabo Verde telemedicine program: initial results of nationwide implementation	Cabo Verde
3	Coimbra telemedicine service improves access to pediatric cardiology in Cape Verde	Cabo Verde
4	EMS in Mauritius	Mauritius
5	What is telemedicine? A collection of 104 peer-reviewed perspectives and theoretical underpinnings.	Mauritius
6	Differences in public and private sector adoption of telemedicine: Indian case study for sectoral adoption.	Mauritius
7	Development of telemedicine technology in India: "Sanjeevani"--an integrated telemedicine application.	Mauritius
8	Implementing telemedicine technology: lessons from India.	Mauritius
9	Potential Reach of mHealth Versus Traditional Mass Media for Prevention of Chronic Diseases: Evidence From a Nationally Representative Survey in a Middle-Income Country in Africa.	Seychelles
10	Telemedicine utilization to support the management of the burns treatment involving patient pathways in both developed and developing countries: a case study.	STP
11	Coimbra Telemedicine Service Improves Access to Pediatric Cardiology in Cape Verde	Cabo Verde
12	Implementation of Telemedicine in Cape Verde: Influencing Factors	Cabo Verde
13	Cabo Verde telemedicine program: initial results of nationwide implementation.,	Cabo Verde
14	Cycle assessment dialogues Brazil - Cape Verde with the use of audiovisual conference in limited internet connection,	Cabo Verde
15	Improving Access to Pediatric Cardiology in Cape Verde via a Collaborative e International Telemedicine Service.	Cabo Verde
16	Telerheumatology - breaking barriers to access care in Rheumatology	PALOP

Table 8. Database searches resulted in 19 publications and 13 complimentary publications (cont.)

No	Title	Country
17	Telemedicine utilization to support the management of the burns treatment involving patient pathways in both developed and developing countries: a case study.	STP
18	Potential Reach of mHealth Versus Traditional Mass Media for Prevention of Chronic Diseases: Evidence From a Nationally Representative Survey in a Middle-Income Country in Africa.	Seychelles
19	EMS in Mauritius.	Mauritius
20	Beyond 'initiate-build-operate-transfer' strategy for creating sustainable telemedicine programs: Lesson from the first decade,	Cabo Verde
21	Roteiro estratégico para a telessaúde na CPLP : diagnóstico e prioridades para o desenvolvimento da telessaúde	CPLP
22	A telemedicina em Cabo Verde : Desafio de integração na rotina de prestação	Cabo Verde
23	How to develop a sustainable telemedicine service? A Pediatric Telecardiology Service 20 years on-An exploratory study	Cabo Verde
24	Potential Reach of mHealth Versus Traditional Mass Media for Prevention of Chronic Diseases: Evidence From a Nationally Representative Survey in a Middle-Income Country in Africa	Seychelles
25	EMS in Mauritius	Mauritius
26	A Telemedicina como um vector de profunda transformação no espaço da saúde e do bem estar	Cabo Verde
27	Telemedicina - Um meio para a saúde global. Um caminho para o acesso universal à saúde.	CPLP
28	Incorporation of telemedicine in disaster management	Cabo Verde
29	Tendências e contextos de implementação de tecnologias de informação e comunicação para o reforço dos Sistemas de saúde em países de baixo e médio rendimento da CPLP: os casos de Cabo Verde, Moçambique e Guiné-Bissau	CPLP
30	Que serviço de imagiologia para Cabo Verde, um país arquipelágico?	Cabo Verde
31	"Saúde para todos": cooperação em saúde com São Tomé e Príncipe	STP
32	Saúde para Todos - Especialidades: Cooperação Portuguesa com São Tomé e Principe na área da cardiologia	STP

Table 9. After the removal of duplicates, 24 references were selected.

No.	Title	Country
1	Beyond 'initiate-build-operate-transfer' strategy for creating sustainable telemedicine programs: Lesson from the first decade,	Cabo Verde
2	"Cabo Verde telemedicine program: initial results of nationwide implementation.,"	Cabo Verde
3	Coimbra telemedicine service improves access to pediatric cardiology in Cape Verde	Cabo Verde
4	EMS in Mauritius.	Mauritius
5	What is telemedicine? A collection of 104 peer-reviewed perspectives and theoretical underpinnings.	Mauritius
6	Differences in public and private sector adoption of telemedicine: Indian case study for sectoral adoption.	Mauritius
7	Development of telemedicine technology in India: "Sanjeevani"--an integrated telemedicine application.	Mauritius
8	Implementing telemedicine technology: lessons from India.	Mauritius
9	Potential Reach of mHealth Versus Traditional Mass Media for Prevention of Chronic Diseases: Evidence From a Nationally Representative Survey in a Middle-Income Country in Africa.	Seychelles
10	Telemedicine utilization to support the management of the burns treatment involving patient pathways in both developed and developing countries: a case study.	STP
11	Implementation of Telemedicine in Cape Verde: Influencing Factors	Cabo Verde
12	Cycle assessment dialogues Brazil - Cape Verde with the use of audiovisual conference in limited internet connection	Cabo Verde

Table 10. After the removal of duplicates, 24 references were selected.

No.	Title	Country
13	Improving Access to Pediatric Cardiology in Cape Verde via a Collaborative e International Telemedicine Service.	Cabo Verde
14	Telerheumatology - breaking barriers to access care in Rheumatology.	PALOP
15	"Roteiro estratégico para a telessaúde na CPLP : diagnóstico e prioridades para o desenvolvimento da telessaúde	CPLP
16	A telemedicina em Cabo Verde : Desafio de integração na rotina de prestação	Cabo Verde
17	How to develop a sustainable telemedicine service? A Pediatric Telecardiology Service 20 years on-An exploratory study	Cabo Verde
18	A Telemedicina como um vector de profunda transformação no espaço da saúde e do bem estar	Cabo Verde
19	Telemedicina - Um meio para a saúde global. Um caminho para o acesso universal à saúde.	CPLP
20	Incorporation of telemedicine in disaster management	Cabo Verde
21	Tendências e contextos de implementação de tecnologias de informação e comunicação para o reforço dos Sistemas de saúde em países de baixo e médio rendimento da CPLP: os casos de Cabo Verde, Moçambique e Guiné-Bissau	CPLP
22	Que serviço de imagiologia para Cabo Verde, um país arquipelágico?	Cabo Verde
23	Saúde para todos": cooperação em saúde com São Tomé e Príncipe	STP
24	Saúde para Todos - Especialidades: Cooperação Portuguesa com São Tomé e Principe na área da cardiologia	STP

Table 11. Publications analyzed (n=15)

No.	Title	Country
1	EMS in Mauritius.	Mauritius
2	Beyond 'initiate-build-operate-transfer' strategy for creating sustainable telemedicine programs: Lesson from the first decade,	Cabo Verde
3	Telemedicine utilization to support the management of the burns treatment involving patient pathways in both developed and developing countries: a case study.	STP
4	Saúde para todos": cooperação em saúde com São Tomé e Príncipe	STP
5	Cabo Verde telemedicine program: initial results of nationwide implementation.,"	Cabo Verde
6	Improving Access to Pediatric Cardiology in Cape Verde via a Collaborative e International Telemedicine Service.	Cabo Verde
7	Telemedicina - Um meio para a saúde global. Um caminho para o acesso universal à saúde.	CPLP
8	Saúde para todos – especialidades: cooperação portuguesa com são tomé e príncipe na área da cardiologia	STP
9	Roteiro estratégico para a telessaúde na CPLP : diagnóstico e prioridades para o desenvolvimento da telessaúde,"	CPLP
10	Coimbra telemedicine service improves access to pediatric cardiology in Cape Verde	Cabo Verde
11	Implementation of Telemedicine in Cape Verde: Influencing Factors	Cabo Verde
12	A telemedicina em Cabo Verde : Desafio de integração na rotina de prestação	Cabo Verde
13	Que serviço de imagiologia para Cabo Verde, um país arquipelágico?	Cabo Verde
14	How to develop a sustainable telemedicine service? A Pediatric Telecardiology Service 20 years on-An exploratory study	CPLP
15	Tendências e contextos de implementação de tecnologias de informação e comunicação para o reforço dos Sistemas de saúde em países de baixo e médio rendimento da CPLP: os casos de Cabo Verde, Moçambique e Guiné-Bissau	CPLP

A.2 Appendix Chapter 2

A.2.2 Literature content analysis

Qualitative analysis of publication selected

A.2.2.1 Cabo Verde´s publicaction analysis

CABO VERDE					
NO	AUTHOR	TITLE	YEAR	TYPE	COUNTRY
1	Latifi *et al.*	Beyond 'initiate-build-operate-transfer' strategy for creating sustainable telemedicine programs: Lesson from the first decade,	2012	Brief Communications	Cabo Verde
2	Latifi *et al.*	"Cabo Verde telemedicine program: initial results of nationwide implementation.,"	2014	Research article	Cabo Verde
3	Lapão & Correia	Improving Access to Pediatric Cardiology in Cape Verde via a Collaborative e International Telemedicine Service.	2015	Research article	Cabo Verde
4	Castela, E	Coimbra telemedicine service improves access to pediatric cardiology in Cape Verde	2017	Acta Med	Cabo Verde
5	Correia, Azevedo & Lapão	Implementation of Telemedicine in Cape Verde: Influencing Factors	2017	Acta Med	Cabo Verde
6	Correia, A	A telemedicina em Cabo Verde : Desafio de integração na rotina de prestação	2017	PhD thesis	Cabo Verde
7	Ferreira, R.	Que serviço de imagiologia para Cabo Verde, um país arquipelágico?	2018	Report	Cabo Verde

P1. Beyond 'initiate-build-operate-transfer' strategy for creating sustainable telemedicine programs: Lesson from the first decade
Latif et al (2012)

ABSTRACT/RESULTS	THEMES
IveH experience with IBOT: Using the IBOT concept, IVeH has established telemedicine in Kosova (2002–2007) and in Albania (2008–2011). Using the same strategy in Cabo Verde	**Methodology of telemedicine national center implementation**
Purpose of the telemedicine application: Each center provides clinical services, virtual educational programs, an electronic library, and technical support services. Since inception of these programs, 16	**Clinical services** **Educational programs**
Established local leadership to operate and manage national telemedicine programs in the countries	**Goverment Leadership**
8 critical success factors IBOT – lessons learned 1. Flexibility of architectural design of the network and infra- structure 2. Multidisciplinary and functional interoperability of well- trained, actively participating individuals and teams from various clinical and technical disciplines 3. Delivery of effective consultative clinical services 4. Locally relevant, structured educational content through discipline-specific seminars and leadership courses 5. Professional dedication of healthcare providers to telemedicine 6. Strategic flexibility in program implementation 7. Continuous advocacy 8. Development of specific indicators that go beyond creating the program and or a center	**Management** **(Critical success factors)**

P2. Cabo Verde telemedicine program: initial results of nationwide implementation

(Latif et al 2012)

ABSTRACT/RESULTS	THEMES
Preliminary results of our efforts in building the Integrated Telemedicine and e-Health Program for Cabo Verde (ITeHP- CV), with an emphasis on initial utilization and results.	**Results of telemedicine national center implementation** **National telemedicine network and virtual education network**
Strategic approach known as "initiate–build–operate–transfer" over a 26-month period (November 2011–December 2013).	**Methodology of telemedicine national center implementation**
Pillars of process implemented: (1) capacity building; (2) network development and deployment of equipment; (3) implementation of clinical telemedicine; (4) implementation of activities related to continuing medical education, delivered from within the country and from abroad; and (5) establishment and use of the electronic virtual library.	

P3. Improving Access to Pediatric Cardiology in Cape Verde via a Collaborative e International Telemedicine Service.

(Lapão & Correia 2015)

ABSTRACT/RESULTS	THEMES
The role of international telemedicine services in supporting the evacuation procedures from Cape Verde to Portugal, enabling better quality and cost reductions in the management of the global health system.	**Support internal and external evacuations**
The Cape Verde, as other African countries, health system lacks many medical specialists, like pediatric cardiologists, neurosurgery, etc. In this study, telecardiology shows good results as diagnostic support to the evacuation decision.	
Telemedicine services show benefits while monitoring patients in post-evacuation, helping to address the lack of responsive care in some specialties whose actual use will help save resources both in provision and in management of the evacuation procedures.	**Post-evacuation support**
Additionally, with telecardiology. collaborative service many evacuations can be avoided whereas many cases will be treated and followed locally in Cape Verde with remote technical support from Portugal. This international telemedicine service enabled more efficient evacuations, by reducing expenses in travel and housing, and therefore contributed to the health system's improvement.	**International cooperation**
Telemedicine service is based on Medigraf equipment, enabling the distance visualization of an eco-cardiogram. All the images and sounds can be recorded in the system database (~1 Mbps per session). The data can be recorded at both places. The system simply requires a 512 Kbps link, or alternatively a VPN integrated in the RIS (Portuguese Healthcare Network). The network now joins the Portugal, Cape Verde, Angola and São-Tomé-e-Príncipe.	
Addressed beneficial and cost issues. There is a general opinion that communication costs are still high: on average € 5,000/month for two sessions per week, lasting between 1-to-2 hours, with an average of 3-4 patients. It was recognized that telemedicine services have avoided numerous evacuations, reducing the financial and social consequences.	**Financial and Social benefits**

P4. **Coimbra telemedicine service improves access to pediatric cardiology in Cape Verde**

(Castela, E. 2017)

ABSTRACT/RESULTS	THEMES
No Serviço de Cardiologia Pediátrica (SCP) do Centro Hospitalar e Universitário de Coimbra (CHUC), esta atividade iniciou-se em 1998 evidenciando-se, comprovado pelo número crescente de teleconsultas e pelas parcerias que atualmente existem, tanto a nível nacional como também com os PALOP.	**International cooperation**
Fora da região Centro salienta-se o Hospital de Vila Real. Relativamente aos PALOP, destacam-se Angola e Cabo Verde, São Tomé e Príncipe e, muito proximamente, Guiné.	
O intercâmbio possibilita o acesso a tratamentos mais diferenciados, consoante o quadro clínico. Permite também o contato com doenças de menor prevalência no nosso âmbito, estabelecendo um processo de aprendizagem recíproca e saudável	**Teleconsultations** **Teletraining**
Face à inexistência de cardiologistas pediátricos em hospitais dos PALOP, os médicos desses países realizam um período de formação no nosso serviço, iniciando posteriormente esta atividade no seu local de trabalho habitual	**Training**

P4. **Coimbra telemedicine service improves access to pediatric cardiology in Cape Verde** (cont.)

(Castela, E. 2017)

ABSTRACT/RESULTS	THEMES
Salientam-se três aspetos importantes: a plataforma, o ecógrafo e, para a transmissão adequada de dados, a largura da banda nos respetivos hospitais.	**Important tools**
Um dos melhores exemplos de sucesso em telemedicina é a parceria com Cabo Verde que tem demonstrado quanto tem sido útil para todos os intervenientes. as diligências para implementação da telemedicina com este país em 2006, com reuniões para discutir a sua implementação e com estágios de colegas de Cabo Verde no nosso Serviço de Cardiologia Pediátrica - CHUC. Iniciamos a telemedicina semanalmente em Maio de 2009, e de então para cá efectuámos com este país 477 teleconsultas.	**Maturity**
Foram evacuados para tratamento cerca de 90 crianças com patologia cardíaca. A telemedicina é eficaz no diagnóstico e seguimento de crianças com suspeita de cardiopatia, mas igualmente um instrumento de complementaridade entre um centro de referência e os respetivos colaboradores.	**Evacuation support international evacuation**

P5. A Implementação da Telemedicina em Cabo Verde: Fatores Influenciadores

(Correia, Azevedo & Lapão 2017)

ABSTRACT/RESULTS	THEMES
The priorities of the National Telemedicine Program are set, the cores and reference centers are operational, with trained personnel and equipment installed.	**Cores and reference centers Accessibility**
Several other policy instruments and conditioning factors and facilitators of the program have been identified.	**Policy instruments**
Aquisição e instalação dos equipamentos, foi necessário formar uma equipa sobre a operacionalização dos equipamentos e sobre a temática 'Telemedicina', nos diferentes núcleos de telemedicina criados, nas várias ilhas, ao nível das delegacias de saúde e dos hospitais regionais, e, também, ao nível dos centros de telemedicina nos dois hospitais centrais. Foi, ainda, necessário criar uma equipa dinamizadora ao nível da direção do Programa de Telemedicina.	**Organization**

P5. A Implementação da Telemedicina em Cabo Verde: Fatores Influenciadores (cont.)

(Correia, Azevedo & Lapão 2017)

ABSTRACT/RESULTS	THEMES
Despacho de 25 de março de 2013 da Ministra Adjunta e da Saúde, foram nomeados os membros dos Núcleos de Telemedicina. Nesse mesmo ano, foi criada, pela direção do Programa Nacional de Telemedicina, uma página no Fa- cebook para a partilha de informações e documentação, e motivação de profissionais de saúde. Em 2014, através do despacho Nº 2 da Ministra Adjunta e da Saúde, de 17 de ja- neiro, oficializou-se o Programa Nacional de Telemedicina e definiram-se os respectivos eixos prioritários e objectivos. No mesmo ano, foi nomeado o coordenador do PNT e aprovado um conjunto de normas organizativas e funcionais.	**Governemant support**
Fatores críticos de sucesso para a implementação da telemedicina. Em Cabo Verde, três desses dez factores apresentam algumas dificuldades na sua observância, nomeadamente os relativos a 'ter disponibilidade de fundos de forma sus-tentável', 'ter recursos humanos adequados e capacita- dos' e 'garantir comunicação e articulação entre as partes interessadas'.	**Critical Sucess Factors**

P6. A telemedicina em Cabo Verde : Desafio de integração na rotina de prestação

(Correia, a. 2017)

ABSTRACT/RESULTS	THEMES
In Cape Verde, by decision of the government, the implementation of this intervention is under way, being the subject very relevant and priority in the public agenda. Thus, it is crucial to understand the factors that determine its implementation, in order to obtain strategic responses more adapted to the context, for the development of the National Telemedicine Program. The research results show that the PNT is implemented in Cape Verde, in the national and regional levels.	**Governmental support** **National Telemedicine Program**
Certain resistance to change, deficiencies in the articulation between services, the mobility of professionals, some risk of privacy breach and occasional malfunctions in the communication systems.	**Limitations**
Among the facilitators are: the existence of a fiber optic network linking the islands, the existence of a high rate of Internet and mobile network coverage, the existence of telemedicine technical infrastructure, improved communication among professionals.	**Infrasturcture**
Potential for the follow-up of chronically ill patients and remotely evacuated patients, the possibility of carrying out national and international teletraining, the potential for cost reduction and the high rate of satisfaction of professionals and users.	**Teleconsultations** **Support evacuations** **Teletrainig**

P7. Que serviço de imagiologia para Cabo Verde, um país arquipelágico

(Ferreira, R. 2017)

ABSTRACT/RESULTS	THEMES
Tendo em vista a importância que esta área vem tendo no que diz respeito ao diagnóstico e tratamento de doenças, este estudo incidiu sobre o Serviço de Imagiologia existente em Cabo Verde.	**Speciality service**
Tem como principais objetivos entender melhor o funcionamento do serviço público, apresentou-se uma proposta de intervenção, indicando medidas que deverão ser aplicadas para melhoria do serviço atual tanto a nível da distribuição dos equipamentos, padronização da marca dos mesmos, apontar a necessidade da criação de um plano de manutenção preventiva e ainda medidas para melhorar os défices de pessoal existente, e repensar o conceito de telemedicina para redução da necessidade de evacuações tanto internas como externas. Foi utilizado como metodologia a recolha de dados quantitativos referente aos recursos humanos e à sua distribuição, pesquisas bibliográficas baseando-se em relatórios estatísticos. Uma das motivações para o tema escolhido, foi fazer um estudo que poderá servir de auxílio no desenvolvimento de planos para melhoria deste serviço a nível prático. Concluiu-se que há medidas práticas que se poderão adotar para melhoria do serviço de imagiologia atual, focando primeiramente na criação de um Serviço de Instalação de Equipamentos e na criação de planos para descentralizar a distribuição de recursos humanos	**Integration with Telemedicine Program**

A.2.2.2 Mauritius publication analyisis

MAURITIUS					
No	Author	Title	Year	Type	Country
8	Ramalanjaona & Brogan	EMS in Mauritius.	2009	research article	Mauritius

P8. Emergency Medical Services in Mauritius

(Ramalanjaona & Brogan 20009)

ABSTRACT/RESULTS	THEMES
Mauritius is an island, part of a group of islands (Mascarene Islands), with about 59% of the population living in rural areas, and is beset by frequent natural disasters such as cyclones and hurricanes. Thus, it has characteristics that make it privileged to use telemedicine to support EMS, because it has increased access and communication to rural and isolated areas. In addition, the technology has enabled "tele-education, teleconsultation with specialists and telecommunication for EMS workers to help coordinate emergency response in disaster management".	**Telemedicine to support EMS** **Tele-education** **Teleconsultation with specialists**
Mauritius' EMS systems are a reference in Africa, a breakthrough that has been achieved due to economic growth and good governance. By government decision, telemedicine was introduced in the EMS system as a way to decentralise and develop the healthcare system. Ramalanjaona & Brogan (2009) recognise that to make progress the country must continue to invest in telemedicine and other technologies.	**Government support**

A.2.2.3 Sao Tome and Principe publication analysis

SAO TOME AND PRINICPE					
No	Author	Title	Year	Type	Country
9	Syed-Abdul et al	Telemedicine utilization to support the management of the burns treatment involving patient pathways in both developed and developing countries: a case study.	2012	Case report	São Tomé e Principe
10	Freitas, 2013	"Saúde para todos": cooperação em saúde com São Tomé e Príncipe	2013	Report	São Tomé e Principe
11	Loureiro,Freitas , & Antunes	Saúde Para Todos – Especialidades: Cooperação Portuguesa Com São Tomé e Príncipe na Área da Cardiologia	2015	Research article	São Tomé e Principe

P9. Telemedicine Utilization to Support the Management of the Burns Treatment Involving Patient Pathways in Both Developed and Developing Countries: A Case Study

(Syed-Abdul et al 2012)

ABSTRACT/RESULTS	THEMES
Este estudo de caso relata a utilização de telemedicine para apoiar a gestão de cuidados para o tratamento de queimaduras de cidadãos das ilhas de São Tomé e Príncipe Cipe (STP). O processo de cuidados utiliza percursos de doentes que incluem a transferência de e para Taiwan para cuidados cirúrgicos	**International cooperation**
Transferencia para outro pais , para tratamento extensivo, incluindo a cirurgia reconstrutiva **-** assistência a um país de baixo rendimento por parte de um maior número de developed country	
A Universidade de Medicina de Taipé tem prestado serviço médico desde 2009 em STP com uma equipa médica que está fisicamente presente nas ilhas. Esta equipa médica presta cuidados à população local e também recebe aconselhamento especializado de tempos a tempos utilizando a telemedicina através de videoconferência (VC) e o correio electrónico com os especialistas	**Teletraining**
Videoconferência (VC) e o correio electrónico com os especialistas (real time and differred)	**Teleconsultation**
Since 2009 a 2012	**Maturity**

P9. Telemedicine Utilization to Support the Management of the Burns Treatment Involving Patient Pathways in Both Developed and Developing Countries: A Case Study (cont.)

(Syed-Abdul et al 2012)

ABSTRACT/RESULTS	THEMES
Good doctor-patient relationship, - patients in contact with their families	**Patient centred**
Medical mission to get better government support for prevention programmes to reduce burn injuries on the islands of STP.	**Government support**
Lessons Learned to Improve the Telemedicine Process storage and anticipation. system to educate clinical staff on how to take digital photographs to aid in the diagnostic process, instructional videos and post them on YouTube, eLearning in situations where VC cannot otherwise be used, - contexts with very limited internet access	**Organization/Management**

P11. Saúde Para Todos – Especialidades: Cooperação Portuguesa com São ToméePríncipe na Área Da Cardiologia

(Loureiro, Freitas & Antunes 2015)

ABSTRACT/RESULTS	THEMES
Plano de formação de profissionais e criação de condições para a sua fixação no país, uma vez completada essa formação. - telemedicina como apoio ao diagnóstico, orientação te- rapêutica e decisão de evacuação de doentes para Portugal para tratamento cirúrgico ou percutâneo na altura certa da evolução da doença e como apoio à formação contínua e à distância de recursos humanos. Oa orientação da realização do próprio exame e a conferência e discussão dos resultados entre os profissionais dos dois países. Pode ser assim também uma ferramenta de utilidade extrema num processo de formação de recursos humanos, contínua e à distância. Esta tecnologia inicialmen- te disponível só a partir de um computador instalado na sede do IMVF, em Lisboa, pode agora ser acessível a partir de qualquer computador portátil e tornar-se-á disponível também a outras organizações, num espírito de colaboração para um objectivo comum	**Teleconsutations** **-Support of external evacuations** **Teletraining**

P11. Saúde Para Todos – Especialidades: Cooperação Portuguesa com São ToméePríncipe na Área Da Cardiologia (cont.)

(Loureiro, Freitas & Antunes 2015)

ABSTRACT/RESULTS	THEMES
Interesse da implementação de um modelo de telemedicina. Pareceu-nos que a cardiologia, beneficiaria de forma decisiva de uma plataforma de telenedicina como apoio para o estabelecimento de diagnósticos e propostas terapêuticas correctas, incluindo a identificação da necessidade e do momento certo para uma evacuação santária para Portugal, por exemplo para um tratamento cirúrgico ou de intervenção percutânea	**Speciality consultation**
Projecto de desenvolvimento des- sa pataforma, em conjunto com uma empresa portuguesa a PT Inovação, sedeada em Aveiro. A plataforma, de nome Medigraf, entre outros recursos, permite a transmissão em directo e em tempo real de imagens em movimento de um exame que esteja a ser realizado por um médico ou técnico em São Tomé e Príncipe. Esta plataforma foi inaugurada em Junho de 2013. A versão 3.0 da plataforma Medigraf utilizada na telemedicina com São Tomé foi galardoada no final de 2013 com dois prémios na categoria Changing Lives dos prémios AfricaCom 2013, e Broadband Infovision.	**Infrastructure**

A.2.2.4. CPLP publications analysis

No	Author	Title	Year	Type	Country
12	Maia, Correia & Lapão	Telemedicina - Um meio para a saúde global. Um caminho para o acesso universal à saúde.	2015	Technical Report	CPLP
13	Lapão et al	"Roteiro estratégico para a telessaúde na CPLP : diagnóstico e prioridades para o desenvolvimento da telessaúde,"	2016	Research article	CPLP
14	Maia et al	How to develop a sustainable telemedicine service? A Pediatric Telecardiology Service 20 years on-An exploratory study	2019	Research article	CPLP
15	Beja et al	Tendências e contextos de implementação de tecnologias de informação e comunicação para o reforço dos Sistemas de saúde em países de baixo e médio rendimento da CPLP: os casos de Cabo Verde, Moçambique e Guiné-Bissau	2019	Research article	CPLP

P12. Telemedicina - Um meio para a saúde global. Um caminho para o acesso universal à saúde

(Maia, Correia & Lapão 2015)

ABSTRACT/RESULTS	THEMES
Oportunidade no contexto da CPLP: A telemedicina é uma grande oportunidade de servir quer os países de baixa e média renda, quer os países indus- trializados, ao nível das regiões mais carentes dos serviços de saúde e de profissionais especializados, permitindo o acesso otimizado e de maior qualidade aos cuidados de saúde essenciais e a partilha de recursos.	**Opportunity in LMIC**
Cabo Verde, desde 2009 tem uma experiência de parceria com o Serviço de Pediatria do Centro Hospitalar de Coimbra, em cardiologia pediátrica que permite teleconsultas para discussão de casos, segunda opinião, diagnóstico e agendamento de evacuações. Além disso, desde 2012, existe uma experiência de telemedicina interna, que culminou com a criação do Programa Nacional de Telemedicina, em 2014, tendo já realizado cerca de 1000 teleconsultas, várias teleformações e assistência a ses- sões clínicas, nacionais e internacionais	**Pediatric cardiology in Cabo Verde** **International cooperation**
Cabo Verde, inaugurou no passado dia 23 de julho o seu Centro Nacional de Telemedicina para apoiar uma equipa de utilização da mesma nos serviços de saú- de, sobretudo no apoio às evacuações internas e externas. Desde há três anos em funcionamento, já permitiu realizar mais de 1000 consultas à distância, com uma consequen- te redução das evacuações interilhas. No entanto existem recomendações no sentido de ser necessário melhorar a eficácia da coordenação do processo de evacuação.	**Support evacuations**

P12. Telemedicina - Um meio para a saúde global. Um caminho para o acesso universal à saúde (cont.)

(Maia, Correia & Lapão 2015)

ABSTRACT/RESULTS	THEMES
Ao nível da Comunidade dos Países de Língua Portuguesa (CPLP), a telemedicina já tem reunidos alguns programas com bons resultados em saúde, a que tem sido dada continuidade: **CPLP - Projetos específicos:** Plataforma de Teleconsulta Medigraf nos países Angola, Cabo Verde e São Tomé e Príncipe, com o objetivo de contribuir para a redução da mortalidade infantil. Em São Tomé e Príncipe, colaboração entre o Departamento de Pediatria do Hospital Prof. Doutor Fernando Fonseca (HFF) e o Instituto Marquês de Valle-Flôr (IMVF), Portugal, desde 2008, para evacuações de crianças. Drug Resource Enhancement against AIDS and Malnutrition Programme (DREAM), presente em Angola, **Guiné-Bissau** e Moçambique, para concretizar teleconsultas e apoio em saúde	**Sustainable Projects**

P13. Roteiro estratégico para a telessaúde na CPLP: diagnóstico e prioridades para o desenvolvimento da telessaúde

(Lapão et al 2016)

ABSTRACT/RESULTS	THEMES
Guiné-Bissau Projeto Telehealth UERJ11 , sediado no Centro de Telessaúde UERJ da Universidade do Estado do Rio de Janeiro, Brasil, que integra dois programas nacionais (a rede universitária de telessaúde - RUTE - e a rede de telessaúde do Brasil), encontra-se a realizar trabalho com 26 países incluindo a Guiné-Bissau, Angola, Cabo Verde e Moçambique, dedicando-se exclusivamente à reciclagem e re-certificação de com petências dos profissionais de saúde através da realização de teleformação e seminários por teleconferência	**International cooperation** **Teletraining**
Pan African e-Network, presente na Guiné-Bissau, SãoTomé e Príncipe, Cabo Verde e Moçambique, entre outros 42 países do continente africano. Projeto pelo qual a Indian Government and African Union procede à capacitação de profissionais de saúde de África e presta serviços de telessaúde por consultas de especialidade	**Teletraining**
Em 2009, com apoio do Serviço de Cardiologia, do Centro Hospitalar de Coimbra, teve início a primeira ligação entre aquele Serviço e o Serviço de Cardiologia do Hospital Dr. Agostinho Neto, na Praia. Seguiu-se a ligação ao segundo Hospital Central, no Mindelo. Esta iniciativa, no domínio da cardiologia pediátrica, perdura até hoje, através de teleconsultas, discussão de casos e programação de evacuações de Cabo Verde para Portugal. Vários doentes têm vindo a beneficiar desta ligação.	**Teletraining** **Teleconsultations**

P13. Roteiro estratégico para a telessaúde na CPLP: diagnóstico e prioridades para o desenvolvimento da telessaúde (cont.) *(Lapão et al 2016)*

ABSTRACT/RESULTS	THEMES
Em 2012, a implementação do projeto de telemedicina, que permitiu a ligação entre os hospitais centrais, regionais e as delegacias de saúde, em todas as ilhas, sendo os primeiros considerados centros de referência. ITeHP-CV em Cabo Verde que deu lugar ao Programa Nacional de Telessaúde - PNT a realização de teleconsultas, formação à distância, teleconferência e disponibilização de uma biblioteca virtual. Tem-se desenvolvido investigação sobre o impacto da telessaúde na rede de referenciação e evacuações, cujos resultados mostram a sua relevância parra as populações mais distantes e para a eficiência do sistema de saúde (Lapão & Correia, 2014). Note-se que só recentemente em 2014, Cabo Verde deu início a este programa nacional (Azevedo, 2015), tendo inaugurado o centro de telemedicina a 23 de Julho de 2015	**Telehealth National Program** **Support of evacuations**
Programa Saúde para Todos - Projeto de Cuidados Especializados e Telessaúde, que desde 2012 reforça a prestação de cuidados especializados de saúde para uma efetiva melhoria dos indicadores de saúde, através da utilização de uma plataforma de telessaúde, de forma a rentabilizar as missões de especialidades como radiologia, psiquiatria, pediatria, anatomia patológica, cirurgia geral, cardiologia, imagiologia e oftalmologia. Este projeto recebe o apoio de Camões – Instituto da Cooperação e da Língua, I.P. e Fundação Calouste Gulbenkian, com a colaboração direta do Hospital Professor Doutor Fernando Fonseca (Freitas, 2013).	**National Project**

P13. Roteiro estratégico para a telessaúde na CPLP: diagnóstico e prioridades para o desenvolvimento da telessaúde (cont.) *(Lapão et al 2016)*

ABSTRACT/RESULTS	THEMES
São Tomé e Príncipe Colaboração entre o Departamento de Pediatria do Hospital Professor Doutor Fernando Fonseca (HFF) e o Instituto Marquês de Valle-Flor (IMVF), Portugal, que desde 2008 contribuiu para a comunicação e o intercâmbio de informação e suporte nas evacuações de crianças. São Tomé e Príncipe é um país onde 46% da população são crianças e jovens, e só existem duas médicas pediatras, pelo que a Telessaúde repre- senta um suporte significativo no acesso à saúde. Foi criada uma cooperação bilateral entre o serviço de pediatria deste país e Portugal.	**Support evacuation** **International** **Cooperation**

P14. How to develop a sustainable telemedicine service? A Pediatric Telecardiology Service 20 years on: An exploratory study *(Maia et al 2019)*

ABSTRACT/RESULTS	THEMES
Telemedicine services are promoting more access to healthcare. Portugal was an early adopter of telemedicine to overcome both its geological barriers and the shortage of healthcare professionals. The Pediatric Cardiology Service (PCS) at Coimbra University Hospital Centre (CHUC) has been using telemedicine to increase access and coverage since 1998. Their Pediatric Telecardiology Service has been daily connecting CHUC with 13 other Portuguese national hospitals, and regularly connecting with Portuguese-speaking African countries, through a teleconsultation platform.	**International Cooperation**
From 2007 to 2016, a total of 1647 TC were per- formed with Angola (linking to both Luanda and Benguela hospitals), 477 TC with Cape Verde (linking to both Praia and Mindelo hospitals) and 82 TC with São Tomé and Príncipe's central hospital. The PCS continues to perform telemedicine on a weekly base. Soon, it is expected to include Guinea-Bissau in the network.	

P14. How to develop a sustainable telemedicine service? A Pediatric Telecardiology Service 20 years on: An exploratory study (cont.) *(Maia et al 2019)*

ABSTRACT/RESULTS	THEMES
With the total of 32,685 out-patient teleconsultations, growing steadily from 1998 to 2016, the Pediatric Telecardiology Service has reached national and international recognition, being a pioneer and an active promotor of telemedicine.. Conclusion: The Pediatric Telecardiology Service enables real-time communication and the sharing of clinical information, overcoming many barriers (from geographical ones to shortage of healthcare professionals), improving access to specialized care both in Portugal and Africa. Motivation and teamwork, and perseverance, were key for the Pediatric Telecardiology Service to tackle the window of opportunity which created conditions for sustainability. Keywords: Case-study, Implementation research, Process evaluation, Telemedicine service, Telecardiology, Pediatric care, Sustainability, Universal access, Global health	**Maturity**
This telemedicine service has saved significant resources, about 1.1 million euros for the health system (e.g. in administrative and logistic costs) and approximately 419 euros per patient (considering an average of 1777 patients per year).	**Cost-benefit analysis** (general not specific for PALOP**)**

P15. **Tendências e contextos de implementação de tecnologias de informação e comunicação para o reforço dos Sistemas de saúde em países de baixo e médio rendimento da CPLP: os casos de Cabo Verde, Moçambique e Guiné-Bissau**

(Beja et al 2019)

ABSTRACT/RESULTS	THEMES
Cabo Verde: as orientações relativas aos serviços de saúde sido estabelecidas no Programa Nacional de Telessaúde de 2015	**National Telehealth Program** **Maturity** **Support evacuations**
O país enfrentou uma evolução positiva e reconhecida neste campo, com benefícios na organização e na ca-pacidade de resposta dos serviços, nomeadamente ao nível da telemedicina (e.g. evacuações). Sendo Cabo Verde um país insular, o seu modelo é apontado como bom exemplo para o desenvolvimento de serviços de telemedicina noutros países lusófonos ou de caracte-rísticas semelhantes, em virtude dos ganhos de eficá-cia e a eficiência e na mitigação das desigualdades no acesso a cuidados.	
O empenho de profissionais e gestores foi, a par da aposta na capacitação de recursos humanos, do assumir deste tema como prioridade política (e.g. legislação para usar telemedicina na evacuação de doentes) e das parcerias internacionais estabelecidas (e.g. com Portugal), apontado como fundamental para o sucesso do processo de implementação, no alcançar de resultados e no perspetivar do desenvolvimento das TIC no país.	**Capacity- Building** **Government Support** **International Cooperation**

P15. **Tendências e contextos de implementação de tecnologias de informação e comunicação para o reforço dos Sistemas de saúde em países de baixo e médio rendimento da CPLP: os casos de Cabo Verde, Moçambique e Guiné-Bissau** (cont.)

(Beja et al 2019)

ABSTRACT/RESULTS	THEMES
Os benefícios para o sistema de saúde são conside- rados elevados, pois englobam ganhos imateriais, de conforto, de saúde, de confiança no sistema e ecológi- cos, ao evitar viagens desnecessárias. De uma perspe- tiva de poupança de recursos financeiros com deslocações desnecessárias, sabe-se que, entre 2009 e 2017, foram feitas 499 teleconsultas de cardiologia pediátri- ca entre Cabo Verde e os Hospitais da Universidade de Coimbra, resultando em 90 evacuações validadas (18%).	**Social and Economic benefits**
Guiné-Bissau, vários exemplos de utilização de TIC na saúde, nomeadamente para facilitar comunicação entre serviços, para recolha, tratamento e disponibilização de dados em tempo real e tomada de decisão, tanto em situações de rotina como em de emergência, estando por definir uma estratégia nacional para a telessaúde que enquadre e coordene estas experiências.	**Potential of Telemedicine**
Guiné-Bissau. Representam um desafio importante, devido aos custos de investimento e de recursos necessários (infraestrutura, meios informáticos, rede de internet de qualidade), e à necessidade de formar RH adequados e de envolvê-los na implementação destes projetos	**Challenges to overcome**

A.3 Appendix Chapter 3

A.3.1. Interview (I1) guide

Period of application: May to November 2019

Legitimation of the interview

First, I would like to thank you for agreeing to participate in this study.

We clarify that the data collected will be subject to content analysis, for purely academic purposes (Doctoral Thesis in Knowledge and Tropical Management, Specialty in Health Sciences), guaranteeing their confidentiality.

In compliance with ethical aspects, I present you the "informed consent form", for signature.

1. Background to the interview

Study Title	Telemedicine in Sao Tome and Principe: "Strategic management and innovation in the health sector".
Overall aim of the study	To analyse the evolution of telemedicine in Sao Tome and Principe's health system, identifying how the service was implemented and the driving forces that will influence the future of the service.

2. Interviewees

For the convenience of the research, by means of prior invitations and the signing of a "free and informed consent form".

3. Interviewer

The interviews will be conducted by the researcher and will be recorded.

4. Questions

Question 1 (Q_1)	How was the telemedicine service implemented in STP?
Question 2 (Q_2):	What do you expect in terms of the future development of the service?

A.3.2. Interview (I_2) guide

Period of application: May to November 2019

Legitimation of the interview

First, I would like to thank you for agreeing to participate in this study.

We clarify that the data collected will be subject to content analysis, for purely academic purposes (Doctoral Thesis in Knowledge and Tropical Management, Specialty in Health Sciences), guaranteeing their confidentiality.

In compliance with ethical aspects, I present you the “informed consent form”, for signature.

1. Background to the interview

Study Title	Telemedicine in Sao Tome and Principe: “Strategic management and innovation in the health sector".
Overall aim of the study	To analyse the evolution of telemedicine in Sao Tome and Principe's health system, identifying how the service was implemented and the driving forces that will influence the future of the service..

2. Interviewees

For the convenience of the research, by means of prior invitations and the signing of a "free and informed consent form".

3. Interviewer

The interviews will be conducted by the researcher and will be recorded.

4. Questions

Question 1 (Q_1)	How are the telemedicine service activities (daily clinical and technical routine)?
Question 2 (Q_2):	How are the telemedicine service specialties?
Question 3 (Q_3)	How are the legal and security issues of the service?

INFORMED CONSENT FORM

I hereby declare that I have been sufficiently informed about the evaluative research of telemedicine services, in São Tomé and Príncipe, in which I will participate as an interviewee.

I also declare that I have been informed that personal information will not be disclosed and that the results of the study will be published in articles and reports, in an anonymous form. I hereby also expressly state my agreement and consent to participate in the above study.

Name and contact details of the researcher:
Name: Cátia Gonçalves
Email: catia.goncalves@novasbe.pt
Telephone: 00239 90 27 445

Place and date.

Name

/ /

Signature

A.3.3. Knowledge gathering Questionnaire (adapted from *Momentum´s* model)

(Adapted from MOMENTUM´s framework)

I) I. Introductory questions – general questions # 1 – 5] To be answered only once for the overall national healthcare system that relates to your telemedicine initiative	
1. Respondents	
1.1 What level of experience does your organization and yourself have with telemedicine?	
2. Description of service and main beneficiary	
2.1. Please describe the overall aim of the service and the outcomes/results that you expected as a result of the introduction of the intervention (e.g. cost-savings; clinical effectiveness; quality of life)?	
3. Current status of telemedicine service	
3.1. Is the telemedicine service that you describe in operation and running as part of mainstream service delivery?	
4.Targeted population and condition	
4.1. Please describe in your own words and more detail the targeted population of the service (e.g., who is the telemedicine service intended for?; what is their condition or problem)	
4.2. Please indicate the number of patients who received it on a monthly basis.	
5.Characteristics of the service	
5.1. Overall, what is the relationship between the key actors in your telemedicine service?	
5.2. Please describe the telemedicine service in terms of e.g., its type of treatment, technology (telecommunications, service platform), set-up, and parties involved.	

II. Strategy and Management [Questions # 6 -9]			
6. Policy context and support and role of political environment			
6.1. Has the decision to implement the telemedicine service been influenced by a particular policy or the entry into force of some new legislation? (1) If Yes, please state which policy or which legislation			
7. Decision-makers and stakeholders			
7.1. At which institutional level has it been generally decided which telemedicine services are to be implemented?	Central		
	Local		
	Regional		
	I don´t know		
7.2. For the institution that you think was the most influential in the decision to implement the service, who generally makes the final decision on whether to implement/not to implement telemedicine services?			
8. Financing			
8.1. Is the financing of the telemedicine service different from the financing of the health or care sector in your country that is not using telemedicine services?	**Yes**	**No**	**I don´t know**
8.2. Please describe the payment structure of the service; i.e. who pays and how?			
8.3. Does the principle of a direct user fee apply to the delivery of the telemedicine service?			

9. Assessment of outcomes	
9.1. How were the effects and consequences of the implementation of the telemedicine service measured/evaluated?	
9.2. What methods were used to collect evidence/documentation of the effects of the telemedicine service?	
9.3. Which topics were included in the evaluation/assessment you performed?:	

III. Organisational Implementation and Change Management [Questions # 10 – 13]					
10. Involvement in process					
10.1. On a scale from 1-5, how involved was the department management team in the development and planning of the telemedicine service? [5 being the highest score]	**1**	**2**	**3**	**4**	**5**
10.2. On a scale from 1-5 how involved was the department management team in the actual carrying out of the telemedicine service? [5 being the highest score]	**1**	**2**	**3**	**4**	**5**
11. Patient flow and work processes					
11.1. Was the patient flow directly affected by the telemedicine service, e.g. physical vs. virtual consultations, passive measurement vs. own measurement, and/or entry of health data?	**Yes**		**No**	**I don´t know**	
11.2. How did the service affect the work processes?					
11.3. Which personnel groups were affected by these shifts in tasks?	.				

12. Collaboration with external institutions/organizations			
12.1. Was delivery of the telemedicine service dependent on collaboration with healthcare and/or care institutions and organizations outside your own?	**Yes**	**No**	**I don't know**
13. Ethical issues relating to patients			
13.1 Is there an alternative service available for patients who refuse or are not able to manage the telemedicine treatment?			
IV. Legal, regulatory and security issues [Questions # 14 – 20]			
14. Telemedicine legislation			
14.1. There are any changes to legislation or other legal rules been made as a result of your particular telemedicine service?			
If there is specific telemedicine legislation as a result of your telemedicine initiative, please outline its core elements and provide a reference to it.? **14.2**. Is it your opinion that further changes in legislation in your country are necessary for wider and easier implementation of sustainable telemedicine services? If yes, please describe in what way.?			

15. National guidelines for clinical responsibility and liability	
15.1. Are there any national guidelines or recommendations regarding distribution of legal liability between institutions involved in telemedicine services? If Yes, which institution is responsible for the guidelines	
16. Consent, ethical approval and concerns	
16.1. Do patients need to give their explicit and informed consent in order to receive the telemedicine service? (1) If patients have to give their informed consent, how do they do it? (2) How is information about the telemedicine service provided to the patients?	
17. Data management procedures	
17.1. Is it obvious to you which organization or individual is responsible for the security and legal standards of your telemedicine service?	
17.2 Has a data controller been identified	
17.3. Did you have to make any changes to your normal data management procedures to implement your telemedicine service? If you had to change a data management procedure, please describe the changes:	

18. Security issues			
18.1. Does the telemedicine service gives a healthcare professional or other health service employees access to patients' health information? If Yes, which methods of authentication are used to obtain access to the telemedicine service, including the patients' health information?			
19. Privacy training for personnel			
19.1. Have all personnel had privacy training? If Yes, how often is this training repeated			
20 General strategy and legislation on telemedicine	**Yes**	**No**	**I don´t know**
201.1 Does the regional / national authority have a written telemedicine strategy?			
20.2 . Does the regional / national authority have an IT strategy or domains in itself that includes telemedicine?			
20.3. Does the country have legislation that specifically deals with telemedicine? The issue of liability (medical, legal) is addressed in telemedicine legislation?			

20.4. Is there any legislation that in any way hinders or prevents the implementation of telemedicine services?			

V. Technology [Questions # 21 – 23]			
21. Technical Infrastructure and Market Relations			
21.1. Please indicate the specific infrastructure used to run the telemedicine service			
22. Connections and networks			
22.1. Please describe the connections and networks and the locations on which your service is dependent. i.e. what you need for the devices and systems to function and where (e.g. wireless network for mobile devices; telephone line, broadband, ADSL, Videoconferencing or satellite in the home)			
23. Integration, standards and interoperability	**Yes**	**No**	**I don´t know**
23.1. Please indicate if the technology used to run the telemedicine service (devices and/or systems) and basic IT-system are integrated .			
23.2. Is the integration of your telemedicine system achieved using standards?			

23.3. Were relevant identity (ID) verifications technically and legally interoperable (i.e., were the IDs valid across organisations borders)?			
23.4. Did all the necessary sensor devices used in the telemedicine service automatically interact with the controlling devices?			
23.5 Could the data be seamlessly transferred between home or other location for monitoring and the receiving part, e.g. telemedicine service center, hospital?			
23.6. Could the data be seamlessly transferred between the receiving part (e.g. the telemedicine service center) and other actors in health and social care?			

V. Technology [Questions # 24 – 25]	
24. Risk management	
24.1. Do you have methods in place for the risk management of the devices and/or systems of the telemedicine service (e.g. to ensure effectiveness, security and safety)? If yes, which one(s)?	
25. Integration and documentation of the telemedicine treatment	
25.1. Are the telemedicine service events integrated with an Electronic Health Record? If no, is there a separate documentation system for medical treatment including clinical data delivered and collected via the telemedicine solution?	

A.3.4. Momentum framework: Critical Success Factors

Table 12. 18 Critical Success Factors and its observance in STP.

Group	Level of organization	Factors of success	Observed in STP
Context	Strategy and management	1) Ensure that there is cultural readiness for the telemedicine service.	yes
Context	Strategy and management	2) Come to a consensus on the advantages of telemedicine in meeting compelling need(s).	yes
People	Strategy and management	3) Ensure leadership through a champion.	yes
People	Organization and management	4) Involve healthcare professionals and decision-makers.	yes
People	Organization and management	5) Put the patient at the centre of the service	yes
People	Technology and market	6) Ensure that the technology is user-friendly.	yes
Plan	Strategy and management	7) Pull together the resources needed for deployment.	PA
Plan	Organization and management	8) Address the needs of the primary client(s).	yes
Plan	Organization and management	9) Prepare and implement a business plan.	yes
Plan	Organization and management	10) Prepare and implement a change management plan.	yes
Plan	Legal and security	11) Assess the conditions under which the service is legal	PA
Plan	Technology and market	12) Guarantee that the technology has the potential for scale-up.	yes
Run	Legal and security	13) Identify and apply relevant legal and security guidelines.	PA
Run	Legal and security	14) Involve legal and security experts.	PA
Run	Legal and security	15) Ensure that telemedicine doers and users are privacy aware.	yes
Run	Technology and market	16) Ensure that the appropriate information technology infrastructure and eHealth infrastructure are available.	yes
Run	Technology and market	17) Put in place the technology and processes needed to monitor the service.	yes
Run	Technology and market	18) Establish and maintain good procurement processes.	yes

PA – Partially acomplished

A.3.5. Evaluation indicators

Table 13. Evaluation indicators (1-9)

Indicator 1	Program Coverage	Type of Indicator	Demographic
Description	Percentage of localities that have telemedicine service, in the program.		
Formula	The number of localities served by telemedicine x 100/Number of localities that make up the program's target population.		
The primary source of data	Instituto Marques de Valle Flor´s report		
Data Collection Techniques	Documental analysis; informal conversation		
Indicator 2	Hours available for teleconsultations with specialists	Type of Indicator	Performance
Description	Establishes the supply of telemedicine consultations available in the program		
The primary source of data	Instituto Marques de Valle Flor´s report		
Formula	Sum of total hours available for teleconsultation by specialists x 100/total available hours by the specialists		
Data Collection Techniques	Documental analysis; interviews		
Indicator 3	Portuguese specialists taking part in telemedicine	Type of Indicator	Performance
Description	Available for the telemedicine		
Formula	Sum of total hours available for teleconsultation by specialists x 100/total available hours by the specialists		
The primary source of data	Instituto Marques de Valle Flor´s report, and interviews		
Data Collection Techniques	Documental analysis		
Indicator 4	Teleconsultations held	Type of Indicator	Effectiveness
Description	Successful real-time consultations using telemedicine to see patients		
Formula	Number of teleconsultations held x 100/Number of teleconsultations scheduled		
The primary source of data	Instituto Marques de Valle Flor´s report		
Data Collection Techniques	Documental analysis		
Indicator 5	Transfers generated through telemedicine	Type of Indicator	Impact
Description	Addressed the role of telemedicine services in supporting the evacuation procedures from STP to Portugal.		
Formula	Number of transfers of patients seen by teleconsultation x 100/Number of patients seen by teleconsultation		
The primary source of data	Instituto Marques de Valle Flor´s report		
Data Collection Techniques	Documental and statistical analysis		

Table 14. Evaluation indicators (6-10)

Indicator 6	Wait time for teleconsultation	Type of Indicator	Quality
Description	Refers to the time that elapses between when an appointment is scheduled and when it is held		
Formula	(Sum total of hours elapsed between when the appointment is scheduled and when it is held + Duration of the appointment in hours)/Number of teleconsultations held.		
The primary source of data	Telemedicine service database		
Data Collection Techniques	statistic analysis		
Indicator 7	Specialty consultations by telemedicine	Type of Indicator	Performance
Description	Measures the number of consultations by specialty		
Formula	Sum of consultations per specialty using telemedicine x 100/Total number of consultations using telemedicine.		
The primary source of data	Instituto Marques de Valle Flor´s report		
Data Collection Techniques	Documental analysis		
Indicator 8	Tele - training	Type of Indicator	Effectiveness
Description	Frequency of training as part of an online medical education program		
Formula	Total number of training		
The primary source of data	Instituto Marques de Valle Flor´s report		
Data Collection Techniques	Documental analysis		
Indicator 9	STP physicians using Telemedicine	Type of Indicator	Effectiveness
Description	Number of physicians available to performed a teleconsultation		
Formula	Sum of physicians using telemedicine in each year		
The primary source of data	Telemedicine service database		
Data Collection Techniques	Statistic analysis		
Indicator 10	Diagnostic exams introduced in the telemedicine platform	Type of Indicator	Effectiveness
Description	Number of store-and-forward teleconsultations in each period		
Formula	Number of teleconsultations held x 100/Number of teleconsultations scheduled		
The primary source of data	Telemedicine service database		
Data Collection Techniques	Statistic analysis		

A.3.6. Interviews and questionnaire matrix

An iterative process was undertaken to develop the schedule of interviews with semistructured questions, to compile a series of relevant, open questions relating to the key topics: Telemedicine strategy and management; organizational implementation and change management; legal, regulatory, and security issues, and technical infrastructure and market relations. Deductive coding was used, meaning that one starts with a predefined set of codes, then assigns those codes to the new qualitative data (Stuckey 2015).

	Guide	Inclusion criteria	The participating key-members	Results
Interview 1 (I_1)	**Additional file 6**	Be a coordinator of the service or program, or Be a Portuguese specialist	Three coordinators from Instituto Marquês de Valle Flôr (IMVF), and two Portuguese specialists	**Table 1**
Interview 2 (I_2)	**Additional file 7**	Be a member of the telemedicine team at Hospital Aires de Menezes (HAM).	Two radiology technicians, the technician responsible for maintaining the telemedicine platform, and the current service coordinator at Hospital Aires de Menezes (HAM).	**Table 2**
Questionnaire (Q_1)	**Additional file 9**	Be a member of the telemedicine team at Hospital Aires de Menezes (HAM).	The technician responsible for maintaining the telemedicine platform, the current service coordinator at Hospital Aires de Menezes (HAM), and Portuguese specialist	**Table 4**

A.3.7. Interviews and questionnaire results

Table 15. Interview 1 (I_1) results

Interview Question (Q1): How was the telemedicine service implemented in STP?		
Open Coding		Axial code
Participants´answer	Code	Category
P1: The Marquês de Valle Flôr Institute (IMVF) is an Organization for Development, whose mission is to promote socio-economic and cultural development in Portuguese-speaking countries.	The Marquês de Valle Flôr Institute (IMVF) leadership	**Intervention strategy**
P2: The Marquês de Valle Flôr initiated, in São Tomé and Príncipe, the "Mé-Zoxi Health Project", at the Hospital and in seven Health Posts. Despite the remarkable success and the great impact it had on the population, the sustainability of it was not guaranteed, there was a need to seek financing to continue the program.	The Marquês de Valle Flôr Institute (IMVF) great impact into the health system	**Evolution of the intervention**
P1: …" the "Program Health for All" has had an important role to improve the health indicators in STP. We have this data well documented, in the IMVF reports"	The integration of "Program Health for All" into STP's healthcare system	**Initial stage of transformation of the health system**
P2: "I recommend Dra x and Dr y, as the people who could best explain in detail the telemedicine service´s implementation"		

Interview Question (Q1): How was the telemedicine service implemented in STP?		
Open Coding		**Axial code**
Participants´answer	**Code**	**Category**
P4: IMVF has the support of the European Union, the Portuguese Cooperation, the Calouste Gulbenkian Foundation, the Directorate-General for Health and the Government of the island	Organisational support	**Partnerships for development**
P2: In the beginning, specialists accessed a room at the IMVF headquarters, called the "telemedicine room". Today, the specialist doctor can access the clinical files of patients, in Portugal or anywhere in the world, thus being able to provide assistance and send the clinical reports through any portable computer."	Specialist provide assistance from Portugal	
P1: "We have established relations with the current PT Meo altice, The platform was already being used in Portugal."	The choice of The Platform	**Choose technology resources to implement the service**
P2: "Contact with PT was made by Dr. y, who had already heard about the Medigraf Platform."		
P3: We started with a the first generation of the Platform. We are now in the third generation, it has always been improving, adapting to our needs.	The program has well-defined maturity phases	

Interview Question (Q1): How was the telemedicine service implemented in STP?		
Open Coding		Axial code
Participants´answer	Code	Category
P1: “Funding for the Telemedicine Project was obtained from Portuguese cooperation, through Camões, I.P..” and network of medical specialists collaborating both via telemedicine and through humanitarian missions.”	Collaboration with international institutions.	**International Collaboration**
P1: “We selected one doctor from the hospital, as well as nine physicians of different specialties. The participants were trained on the usage of the equipment, in the areas of teleradiology.	IMVF and local partners (Hospital Central Aires de Menezes) conducted the Telemedicine Leadership selection process.	**Training phase for the operational phase**
P2:” The “Program Health for All” implemented in Sao Tome and Principe started in 1988, and since 2011 the telemedicine service is offered. The success of the program is based on its consistency.”	Development of the health for all program, already 25 years old	**Initial stage of transformation of the health system**

Interview Question (Q1): How was the telemedicine service implemented in STP?		
Open Coding		**Axial code**
Participants´answer	**Code**	**Category**
P3 – “The country needs assessment was carried out...”	Provision of health care appropriate to the reality of the country	**The value of telemedicine to the health system**
P4: “Telemedicine has opened up many possibilities in terms of diagnosis and treatment.”		
P4: “...allowed the transition from dysfunctional health service to a decentralized health service of national coverage “. We tried by strengthening health centers to get closer to the population.		
P1: “We went looking for a Sao Tome’s technician that was working in Portugal, and she accepted the challenge of coordinating the service. The current telemedicine service´s coordinator at the hospital is very competent.”	IMVF and local partners (Hospital Central Aires de Menezes) conducted the Telemedicine Leadership selection process.	**Ensure leadership through a champion**
P4: “The program has an intention to extend the telemedicine service to the island of Principe, with an infrastructure that works similarly to the one at the HAM, but the big challenge is the lack of human resources.	Scale up the telemedicine service to the Principe Island	**The value of telemedicine to the health system**

Interview Question (Q1): How was the telemedicine service implemented in STP?		
Open Coding		**Axial code**
Participants´answer	**Code**	**Category**
P2 - Satellite-based and internet infrastructure favour the adoption of telemedicine	Pull together the resources needed for deployment	**Choose technology resources to implement the service**
P4: "…we needed a remote assessment for the patients."	Fill the gap between mission: 3 times per year ich speciality	**The value of telemedicine to the health system**
P5: "Telemedicine allows improvements in access to specialized care, promotes the improvement of diagnosis, guidance and validation of therapeutics (i.e., second opinions), and discussion of cases".	Provision of care	
P4: "Telemedicine promote assistance in referring patients for evacuation; it allows us to reduce the number of evacuations. The number of evacuations carried out in 2012 compared to 2009 decreased by 60%, but we saw an increase in the subsequent years because the diagnose is now more accurate.	Improve the logistics/Articulation	**Improve the evacuation process**
P2:".. Telemedicine came to assist the evacuation process, improvements can be seen as it is still a lengthy process, with several entities involved.	Improve the evacuation process	

<table>
<tr><th colspan="3">Interview Question (Q1): How was the telemedicine service implemented in STP?</th></tr>
<tr><th colspan="2">Open Coding</th><th>Axial code</th></tr>
<tr><th>Participants´answer</th><th>Code</th><th>Category</th></tr>
<tr><td>P1: “The Telemedicine service is dependent on collaboration with specialist doctors, professionals adhere to this collaboration voluntarily.</td><td>Collaboration with Portuguese specialist doctors</td><td>International Collaboration</td></tr>
<tr><td>P5: It allows the training of health professionals. We have the possibility of continuing training through frequent classes with students from a Portuguese university ”</td><td>Allows an effective learning process</td><td rowspan="3">Capacity building</td></tr>
<tr><td>P4: “Therefore, training is needed to make better use of the equipment</td><td>Necessity of training</td></tr>
<tr><td>P3: “We notice that technicians are increasingly familiar with the use of equipment, in all missions we keep providing training in various areas.”</td><td>Allows an effective learning process</td></tr>
<tr><td>P1: “We are looking for European Union tenders to raise funds.”</td><td>Search for financial resources</td><td>Obtain financial resources to implement the service</td></tr>
</table>

Interview Question (Q1): How was the telemedicine service implemented in STP?		
Open Coding		**Axial code**
Participants´answer	**Code**	**Category**
P2: " We were undecided between a Portuguese and an American platform, the latter being much more expensive. The IMVF signs with PT innovation a project support protocol for the design of telemedicine software (Medigraf)."	Technology platform choice	**Choose technology resources to implement the service**
P1: There has been a great evolution in terms of technology in the country, the speed and costs of communication have improved "	Technological developments in the country	
P3: "The combination of a Picture Archiving and Communication System (PACS) has facilitated the transmission of medical images between the two countries."	The technologies used to run TC are integrated.	**System´s interoperability**
P3: "The platform is compatible with most medical diagnostic equipment available, connected to the internet with a bandwidth of 1MB."	Possibility of equipment´s integration	**Equipment´s Integration**

Interview Question (Q1): How was the telemedicine service implemented in STP?		
Open Coding		Axial code
Participants´answer	Code	Category
P5: “ A simple and robust equiment was chosen for easier maintenance and repair”.	There was a strategic choice of using less complex technologies.	**Choose technology resources to implement the service**
P3: “Initially the system worked slowly and costly, sometimes it took a long time to arrive for an exam and came in parts, with the integration it made the process much easier.”	Technological developments	
P5: “Patients are monitored by the attending physician, and the service provider establishes contact and introduces the case. We have two doctors who do ENT consultations. Initially we started with one doctor, and more recently another physician joined.	Strong personal relationship between the technician in the telemedicine center and the patient	**Patient at the centre of the service**
P5: In Sao Tome we realized that more than half of children observed have hearing loss in one or both ears, there was clearly a need for more medical care.	Provision of health care appropriate to the reality of the country.	

<table>
<tr><th colspan="3">Interview Question (Q2): What do you expect in terms of the future development of the service?</th></tr>
<tr><th colspan="2">Open Coding</th><th>Axial code</th></tr>
<tr><th>Participants´answer</th><th>Code</th><th>Category</th></tr>
<tr><td>P2: “We are preparing to sign the next phase of the “Health for All Program” for another 4 years.”</td><td>Program continuity</td><td rowspan="2">Consistency of the Program</td></tr>
<tr><td>P1: “The program has already given rise to scientific publications, doctoral thesis studies, we hope it will continue to produce quality scientific material.”</td><td>Produce quality scientific material</td></tr>
<tr><td>P4: “At this moment in Sao Tome and Principe, almost the majority of the population already uses a mobile phone with internet, and so it will make the future for sure.”</td><td>Mobile phone with internet</td><td rowspan="2">The country context will facilitate the development</td></tr>
<tr><td>P1: “The current minister of health was one of the pioneers of the SPT program, thus exists a context that facilitates and stimulates a good development of the telemedicine.”</td><td>The political context that facilitates the telemedicine development</td></tr>
</table>

<table>
<tr><th colspan="3">Interview Question (Q2): What do you expect in terms of the future development of the service?</th></tr>
<tr><th colspan="2">Open Coding</th><th>Axial code</th></tr>
<tr><th>Participants´answer</th><th>Code</th><th>Category</th></tr>
<tr><td>P3: “We understand that there are still constraints in terms of ownership and sustainability of the actions developed in the country, and it is necessary to progressively conduct the partnership between both countries for the real autonomy and accountability of the Sao Tome State. It is, however, a lengthy process given the complexity and size of the Health sector in STP.”</td><td>Guarantee the program sustainability</td><td rowspan="2">Promote Autonomy</td></tr>
<tr><td>P2:”... it is necessary to work on the effective consolidation of the System, in terms of financial autonomy and human resources management.”</td><td>Promote financial autonomy and good human resources management</td></tr>
<tr><td>P1: “...It has potential to reduce costs, we have a study done in ophthalmology, which shows us these savings.”</td><td>Potential to reduce costs, throw the decrease of evacuations</td><td>Promote Autonomy</td></tr>
<tr><td>P4: “The entire population can have access, but for those who are in the Principe Island access becomes more complicated.”</td><td>Program Coverage</td><td>Increase the healthcare access</td></tr>
</table>

Interview Question (Q2): What do you expect in terms of the future development of the service?		
Open Coding		**Axial code**
Participants´answer	**Code**	**Category**
P3: "…the professionals who are doing training in Portugal return to STP, to continue and improve the telemedicine service.	Training technicians to work in telemedicine	**Capacity building**
P4: "In Principe, prospecting is already done to develop the service, however, the lack of health professionals may be an obstacle. One of the main problems is the lack of qualified professionals to manage the implementation of telemedicine services."	Development of new telemedicine services within the health system	**New services**
P3: "When we think about the evolution of technology and telemedicine in STP, we have to take into account that there may be a scale problem."	Scale problem	**Technology scale-up**
P2: "We have the perspective of developing both dermatology and gastroenterology specialties."	Scale up the service	
P4: "Everything will depend on the relationships and established protocols."	Relationships and established protocols	**Build good partnerships**
P1: "We will continue to build good relations among partners"		

Table 16 -Interview 2 (I2) results

Interview Question (Q1): How are the telemedicine service activities (daily clinical and technical routine)?		
Open Coding		Axial code
Participants´answer	Code	Category
P1: "The most popular specialties nowadays are teleradiology, otorhinolaryngology, ophthalmology, and pediatrics. In pediatrics we have young doctors who easily resort to telemedicine service."	Roles and responsibilities were specified	**Data management procedures**
P1: "São Tomé and Príncipe, does not yet have a single resident ophthalmologist, we have a specialist in cooperation with vats. It would be interesting to talk to the nurse who monitors patients, is replacing the doctor who is training in Portugal."	A nurse monitors patients	**Interprofissionalism**
P1: "The patient flow was directly affected by the telemedicine service, e.g. the evacuation system has been changed and patients only evacuate after undergoing a TC with the specialist."	Telemedicine affect the work flow	**Modified Patient flow and work processes**
P1: "The process starts at the hospital, where patients have access to specialist appointments in the hospital."	Telemedicine access	

Interview Question (Q1): How are the telemedicine service activities (daily clinical and technical routine)?		
Open Coding		Axial code
Participants´answer	Code	Category
P1: "The telemedicine is integrated into the imageology hall, at the HAM, in a room with a computer and the ophthalmological and otorhinolaryngology equipment."	Telemedicine service integrated into the HAM´s	**Infrastructure**
P1: "In the sanitary evacuation, the system foresees the remote identification of the patient's clinical situation, allowing to prepare and identify the hospital and doctor(s) that will be available to receive the patient in Portugal."	Face-to-face physical visits within the field missions.	**Improving travel efficiency**
P1: "Not all teleconsultations are in real-time. The exams introduced on the platform are also considered teleconsultations in deferred time."	Introduced in the platform	**Good data management procedures**

Interview Question (Q1) :. How are the telemedicine service activities (daily clinical and technical routine)?		
Open Coding		**Axial code**
Participants´answer	**Code**	**Category**
P1: "The telemedicine is integrated into the imageology hall, at the HAM, in a room with a computer and the ophthalmological and otorhinolaryngology equipment."	Telemedicine service integrated into the HAM´s	**Infrastructure**
P1: "In the sanitary evacuation, the system foresees the remote identification of the patient's clinical situation, allowing to prepare and identify the hospital and doctor(s) that will be available to receive the patient in Portugal."	Face-to-face physical visits within the field missions.	**Improving travel efficiency**
P1: "Not all teleconsultations are in real-time. The exams introduced on the platform are also considered teleconsultations in deferred time."	Introduced in the platform	**Good data management procedures**
P2: Every final report was introduced in the platform to the referring physician, the content of which can be remotely accessed."		

Interview Question (Q1): How are the telemedicine service activities (daily clinical and technical routine)?		
Open Coding		**Axial code**
Participants´answer	**Code**	**Category**
P2: "The ophthalmology service is currently out-of-service due to technical problems. Problems with the equipment, we expect that soon this problem will be solved to resume consultations. Generally, it works once a week."	Technical problems, problems with the equipment	**Some technical problems**
P2: "We were able to easily access the platform and have access to the number of consultations, by specialty, the time of each consultation."	Easily access the platform	**Technology is user-friendly**
P1: "Many communications are made using Whatsapp, so we can easily communicate with the experts."	Communications are made by Whatsapp	**Different communication channels**
P2: "I was already familiar with the system and I was accompanied from the beginning the whole process and evolution. Any problem can be solved by the local technician who is constantly communicating with colleagues in Portugal."	Technical Cooperation for maintenance and troubleshooting of equipment.	**Technical Cooperation**

<table>
<tr><th colspan="3">Interview Question (Q1): How are the telemedicine service activities (daily clinical and technical routine)?</th></tr>
<tr><th>Open Coding</th><th colspan="2">Axial code</th></tr>
<tr><th>Participants´answer</th><th>Code</th><th>Category</th></tr>
<tr><td>P2: “ We already had a telemedicine program before the current one, with great equipment, there was a big investment, but it was in English, which caused some difficulties.”</td><td rowspan="2">Other telemedicine projects in STP</td><td>Most accessed specialties</td></tr>
<tr><td>P2: “The program with China is still very embryonic, we are still waiting for the guidelines.”</td><td>Teleradiology has become part of the workflow</td></tr>
<tr><td>P2: “The process starts in the emergency room ... ophthalmology has a different process, the nurse who accompanies the process is familiar with the process, she can explain it in detail.”</td><td>Teleophthalmology Program</td><td>HAM’s regular workflow to help balance workload</td></tr>
<tr><td>P1: “Since 2011, this service has consisted of one radiologist located in Portugal, who communicated with physicians and radiology technicians in STP via the internet.”</td><td>One radiologist available in Portugal</td><td rowspan="2">Teleradiology program</td></tr>
<tr><td>P1:” It is the doctors of general practice, in Sao Tome, who refer the patients to access the teleconsultation.”</td><td>HAM’s complementary means of diagnosis is today entirely digitized</td></tr>
</table>

Interview Question (Q2): How are the telemedicine service specialties?		
Open Coding	**Axial code**	
Participants´answer	**Code**	**Category**
P1: “In 2016 teleotorhinolaryngology was introduced, using endoscopes, otoscopes, and laryngoscopes. This service generally works twice a week.”	One otorhinolaryngologic located in Portugal available for TC	**Teleotorhinolaryngology program**
P1: “Teleotorhinolaryngology has been facilitated by two local physicians and it also worked as a regular online medical education program.”	Online medical education program	
P1:: “The teleophthalmology program was not operating because of technical issues. The patient (supported by a local technician) is consulted by one ophthalmologist located in Portugal, available for TC once a week, receiving the images captured by the referred equipment through the telemedicine platform.”	One ophthalmologist located in Portugal, available for TC once a week	**Teleophthalmology Program**
P1: “There are specialties in which telemedicine is far more common. “	Specialties	**Telemedicine has several specialties**
P1: “The number of patients enrolled, and how the patients were managed in the service.”	Data management	

Interview Question (Q3): How are the legal and security issues of the service?		
Open Coding		**Axial code**
Participants´answer	**Code**	**Category**
P1 "In the context of the system under study, no specific telemedicine legislation has yet been published."	Personnel groups affected by these shifts in tasks	**No telemedicine legislation**
P2: "A Cooperation Protocol was signed for the medical evacuation process between STP and Portugal"	Cooperation Protocol	**International cooperation**
P1: "The telemedicine service does not give a healthcare professional or other health service employees access to patients' health information."	Restrict access	**The data transfer and access**
P2: "The methods of authentication are used to obtain access to the telemedicine service. To sign in to the platform you have to have a username and a password."	All access to the system is logged	

Table 17 – Questionnaire results

I. Strategy and Management [Questions # 1 – 5]	
1. Respondents	
1.1 What level of experience does your organization and yourself have with telemedicine?	This telemedicine service is in daily operation, defined as a service that a. is part of the regular way of providing care or treatment to a significant number of patients.
2. Description of service and main beneficiary	
2.1. Please describe the overall aim of the service and the outcomes/results that you expected as a result of the introduction of the intervention (e.g. cost-savings; clinical effectiveness; quality of life)?	The teleconsultations and diagnostic exams uploaded in the telemedicine platform. It supports regular medical short-term missions to STP, about three times per year in each speciality to ensure the coverage of specialized care.
3. Current status of telemedicine service	
3.1. Is the telemedicine service that you describe in operation and running as part of mainstream service delivery?	Yes

Table 18. Questionnaire results (cont.)

I. Strategy and Management [Questions # 1 – 5]	
4.Targeted population and condition	
4.1. Please describe in your own words and more detail the targeted population of the service (e.g., who is the telemedicine service intended for?; what is their condition or problem?; etc.	All of the population would potentially benefit from the program through the HAM physician's referral.
4.2. Please indicate the number of patients who received it on a monthly basis.	See excel data base.
5.Characteristics of the service	
5.1. Overall, what is the relationship between the key actors in your telemedicine service?	The actors directly involved in the development and planning of the telemedicine service were the IMVF and the STP Ministry of Health and Social Affairs by the Board of Directors of HAM. It is based on historical and cultural affinities between these countries.

I. Strategy and Management [Questions # 1 – 5]	
5.Characteristics of the service	
5.2. Please describe the telemedicine service in terms of e.g., its type of treatment, technology (telecommunications, service platform), set-up, and parties involved.	Telemedicine services use the Mediagraf platform, linking the (medical specialists in Portugal and the Dr. Ayres de Menezes Hospital in STP. Medigraf is an integrated platform for transfer and remote diagnosis management of medical exams. The technology used to run the telemedicine service has been adapted to the context of Sao Tome and Principe, so as not to require much bandwidth to function under satisfactory conditions.

<table>
<tr><th colspan="5">II. Strategy and Management [Questions # 6 -9]</th></tr>
<tr><td colspan="5">6. Policy context and support and role of political environment</td></tr>
<tr><td>6.1. Has the decision to implement the telemedicine service been influenced by a particular policy or the entry into force of some new legislation?
(1) If Yes, please state which policy or which legislation</td><td colspan="4">Cooperation Protocol was signed between the Ministry of Health Portugal, the Marques de Valle Flor Institute and the Ministry of Health and Health STP Social Affairs, on the process of sanitary evacuations between Sao Tome and Principe and Portugal under the “Health for All” Project in the medical missions and telemedicine.</td></tr>
<tr><td colspan="5">7. Decision-makers and stakeholders</td></tr>
<tr><td>7.1. At which institutional level has it been generally decided which telemedicine services are to be implemented?</td><td>Central
X</td><td>Local</td><td>Regional</td><td>I don´t know</td></tr>
<tr><td>7.2. For the institution that you think was the most influential in the decision to implement the service, who generally makes the final decision on whether to implement/not to implement telemedicine services?</td><td colspan="4">Marques de Valle Flor Institute</td></tr>
</table>

II. Strategy and Management [Questions # 6 -9]	
8. Financing	
8.1. Is the financing of the telemedicine service different from the financing of the health or care sector in your country that is not using telemedicine services?	yes
8.2. Please describe the payment structure of the service; i.e. who pays and how?	We don´t received the payment for each consultation.
8.3. Does the principle of a direct user fee apply to the delivery of the telemedicine service?	No
9. Assessment of outcomes	
9.1. How were the effects and consequences of the implementation of the telemedicine service measured/evaluated?	Throught indicators
9.2. What methods were used to collect evidence/documentation of the effects of the telemedicine service?	Throught indicators
9.3. Which topics were included in the evaluation/assessment you performed?	Number of specialities, number of teleconsultations, number of exams

III. Organisational Implementation and Change Management [Questions # 10 – 13]					
10. Involvement in process					
10.1. On a scale from 1-5, how involved was the department management team in the development and planning of the telemedicine service? [5 being the highest score]	**1**	**2**	**3**	**4**	**5** X
10.2. On a scale from 1-5 how involved was the department management team in the actual carrying out of the telemedicine service? [5 being the highest score]	**1**	**2**	**3**	**4**	**5** X
11. Patient flow and work processes					
11.1. Was the patient flow directly affected by the telemedicine service, e.g. physical vs. virtual consultations, passive measurement vs. own measurement, and/or entry of health data?	**Yes** X	**No**		**I don´t know**	

Organisational Implementation and Change Management [Questions # 10 – 13]			
11. Patient flow and work processes			
11.2. How did the service affect the work processes?	Patients began to have access to specialist appointments if complementary diagnostic tests they had not done before in the hospital. The evacuation system has been changed and patients only evacuate after undergoing a teleconsultation with the specialist in the area concerned.		
11.3. Which personnel groups were affected by these shifts in tasks?	Radiology technicians, electromedical technician, nurse, physicians were most affected by these changes .		
12. Collaboration with external institutions/organizations			
12.1. Was delivery of the telemedicine service dependent on collaboration with healthcare and/or care institutions and organizations outside your own?	**Yes** X	**No**	**I don't know**
13. Ethical issues relating to patients			
13.1 Is there an alternative service available for patients who refuse or are not able to manage the telemedicine treatment?	Yes		

IV. Legal, regulatory and security issues [Questions # 14 – 20]	
14. Telemedicine legislation	
14.1. There are any changes to legislation or other legal rules been made as a result of your particular telemedicine service? If there is specific telemedicine legislation as a result of your telemedicine initiative, please outline its core elements and provide a reference to it.?	No
14.2. Is it your opinion that further changes in legislation in your country are necessary for wider and easier implementation of sustainable telemedicine services? If yes, please describe in what way.?	Yes
15. National guidelines for clinical responsibility and liability	
15.1. Are there any national guidelines or recommendations regarding distribution of legal liability between institutions involved in telemedicine services? If Yes, which institution is responsible for the guidelines	Marques de Valle Flor Institute

IV. Legal, regulatory and security issues [Questions # 14 – 20]	
16. Consent, ethical approval and concerns	
16.1. Do patients need to give their explicit and informed consent in order to receive the telemedicine service? (1) If patients have to give their informed consent, how do they do it? (2) How is information about the telemedicine service provided to the patients?	Yes, they give their informed consent orraly during the consultation with the physcians.
17. Data management procedures	
17.1. Is it obvious to you which organization or individual is responsible for the security and legal standards of your telemedicine service?	Yes
17.2 Has a data controller been identified	Yes
17.3. Did you have to make any changes to your normal data management procedures to implement your telemedicine service? If you had to change a data management procedure, please describe the changes:	We install the PACS, it consists of the patient's clinical file and a range of new solutions for complementary means of diagnosis and therapeutic indications in real-time and deferred.

IV. Legal, regulatory and security issues [Questions # 14 – 20]			
18. Security issues			
18.1. Does the telemedicine service gives a healthcare professional or other health service employees access to patients' health information? If Yes, which methods of authentication are used to obtain access to the telemedicine service, including the patients' health information?	The methods of authentication are used to obtain access to the telemedicine service, including the patients' health information. To sign in the platform you have to had a user name and password. All-access to the system/service is logged.		
19. Privacy training for personnel			
19.1. Have all personnel had privacy training? If Yes, how often is this training repeated	Yes		
20 General strategy and legislation on telemedicine	**Yes**	**No**	**I don´t know**
201.1 Does the regional / national authority have a written telemedicine strategy?	X		
20.2 . Does the regional / national authority have an IT strategy or domains in itself that includes telemedicine?	X		

IV. Legal, regulatory and security issues [Questions # 14 – 20]			
20. General strategy and legislation on telemedicine	**Yes**	**No**	**I don´t know**
20.3. Does the country have legislation that specifically deals with telemedicine? The issue of liability (medical, legal) is addressed in telemedicine legislation?		X	
20.4. Is there any legislation that in any way hinders or prevents the implementation of telemedicine services?		X	

V. Technology [Questions # 21 – 25]	
21. Technical Infrastructure and Market Relations	
21.1. Please indicate the specific infrastructure used to run the telemedicine service	The technology used to run the telemedicine service has been adapted to the context of Sao Tome and Principe, so as not to require much bandwidth to function under satisfactory conditions, requiring internet with only 2 megs bandwidth, which has improved the issue of network failures and consequent interruption of teleconsultations. Medigraf is an integrated platform for transfer and remote diagnosis management of medical exams, with video telephony services and clinical data sharing.
22. Connections and networks	
22.1. Please describe the connections and networks and the locations on which your service is dependent. i.e. what you need for the devices and systems to function and where (e.g. wireless network for mobile devices; telephone line, broadband, ADSL, Videoconferencing or satellite in the home)	Remote internet consultation The Medigraf® teleconsultation solution works by installing two terminals, equipped with specific software. In one terminal is the specialist doctor, on the other side is the patient and non-specialist health professional. The solution has a computer, camera, microphone, headset, and speakers.

V. Technology [Questions # 21 – 25]			
23. Integration, standards and interoperability	**Yes**	**No**	**I don´t know**
23.1. Please indicate if the technology used to run the telemedicine service (devices and/or systems) and basic IT-system are integrated.	X		
23.2. Is the integration of your telemedicine system achieved using standards?	X		
23.3. Were relevant identity (ID) verifications technically and legally interoperable (i.e., were the IDs valid across organisations borders)?	X		
23.4. Did all the necessary sensor devices used in the telemedicine service automatically interact with the controlling devices?			X

<table>
<tr><th colspan="4">V. Technology [Questions # 21 – 25]</th></tr>
<tr><th>23. Integration, standards and interoperability</th><th>Yes</th><th>No</th><th>I don´t know</th></tr>
<tr><td>23.5 Could the data be seamlessly transferred between home or other location for monitoring and the receiving part, e.g. telemedicine service center, hospital?</td><td>X</td><td></td><td></td></tr>
<tr><td>23.6. Could the data be seamlessly transferred between the receiving part (e.g. the telemedicine service center) and other actors in health and social care?</td><td>X</td><td></td><td></td></tr>
<tr><th colspan="4">24. Risk management</th></tr>
<tr><td>24.1. Do you have methods in place for the risk management of the devices and/or systems of the telemedicine service (e.g. to ensure effectiveness, security and safety)?
If yes, which one(s)?</td><td colspan="3">Yes</td></tr>
<tr><th colspan="4">25. Integration and documentation of the telemedicine treatment</th></tr>
<tr><td>25.1. Are the telemedicine service events integrated with an Electronic Health Record?
If no, is there a separate documentation system for medical treatment including clinical data delivered and collected via the telemedicine solution?</td><td colspan="3">Yes</td></tr>
</table>

Theme	Momentum Framework Topic
▪ The health policy influenced the strategy for implementing ▪ Telemedicine became an integral part of the "Health for All" Program. ▪ International Cooperation (technical and funding) ▪ Service provided in Portuguese (communication in native language) ▪ Support field missions ▪ The stakeholders managed to obtain the resources to implement the service ▪ There were several champions at different levels. ▪ Health professionals and technicians were trained at STP and abroad	Telemedicine strategy and management
▪ several actors directly involved in the planning and development	Organizational implementation and change management
▪ No specific telemedicine legislation has yet been issued in STP. ▪ There is one person responsible for the security, legal standards and data management. ▪ Lower risks to the confidentiality, the integrity of information, or the availability of telemedicine services.	Legal, regulatory, and security issues
▪ The technologies used to run TC are integrated. ▪ Less complex technologies.	Technical infrastructure and market relations

A.3.8 Portuguese's hospitals that support STP

Table 19. Portuguese hospitals that support STP

Hospital	Occupation area
1. Hospital Professor Doutor Fernando Fonseca [Amadora-Sintra]	Pathological anatomy, General clinic, Ophthalmology, Pediatrics and Psychiatry
2. Hospital de Santo António [Porto],	Anesthesiology, General surgery, and Nursing
3. Centro Hospitalar de Lisboa Ocidental: Hospital de Egas Moniz [Lisboa]	Nursing, Ophthalmology, and Urology
4. Hospital CUF Infante Santo [Lisboa];Hospital CUF Descobertas [Lisboa]	Audiophonology, Nursing and Otorhinolaryngology, and Speech Therapy; Orthopedics
5. Hospital Pulido Valente [Lisboa]	Pneumology
6. Hospital D. Estefânia [Lisboa]	Anesthesiology, Pediatric Surgery, Nursing and Orthopedics
7. Hospital de S. José [Lisboa]	Pediatric Surgery, Nursing and Physiotherapy
8. Escola Superior de Saúde do Instituto Politécnico de Setúbal	Physiotherapy
9. Clínica de Santo António [Reboleira]	Nursing
10. Hospital Beatriz Ângelo [Loures]	Gynecology-Obstetrics
11. Hospital de Vila Franca de Xira [Vila Franca de Xira]	Orthopedics
12. Hospital Asepeyo de Coslada [Madrid, Espanha]	Orthopedic and Traumatology Surgery, Anesthesiology and Resuscitation and Nursing
13. Hospital del Bierzo [Ponferrada, Espanha]	Plastic and Reconstructive Surgery, Anesthesiology and Resuscitation and Nursing
14. Universidade Católica Portuguesa [Lisboa]	Linguistics and Sign Language for the Deaf
15. Centro Hospital Universitário de Coimbra [Coimbra]	Cardiology and Pediatric Cardiology
16. Instituto Pedro Nunes [Coimbra]	Molecular biology
17. Laboratório Roriz [Lisboa]	Pathologic anatomy
18. Instituto de Higiene e Medicina Tropical [Lisboa]	Parasitology and Virology

A.4 Appendix Chapter 4

A.4.1 Questionnaire matrix (M_2)

The questionnaire compile a series of relevant close and open questions relating to the key topics: Telemedicine knowledge transfer, organizational tools

	Guide	Inclusion criteria	The participating key-members	Results
Questionnaire (Q_2)	**Additional file 9**	Physicians or other professionals that used the telemedicine platform at Hospital Aires de Menezes (HAM).	14 general practitioners and one nurse.	**Table 4**

A.4.2 Questionnaire (Q2) guide

Guião:Questionário aos profissionais de saúde de telemedicina em São Tomé Príncipe

Função: ____

Nome do inquirido ____

Sexo: Feminino ☐ Masculino ☐

Idade: ____________(anos)

Questões introdutórias
1. Inquirido
1.1 Qual o nível de experiência que tem com a telemedicina? (tempo de prática, tipo de experiência, etc.)?
2. Situação actual do serviço de telemedicina
2.1. O serviço de telemedicina está em funcionamento como parte dos serviços prestados na sua estrutura de saúde? Sim ☐ Não ☐ Não sei ☐
2.2. Por favor, descreva o serviço de telemedicina em termos, por exemplo, de tipo de serviço prestados, equipamentos, parceiros envolvidos:
3. Utilização do serviço
3.1 Com que frequência recorre aos serviços de telemedicina para partilhar experiências ou procurar apoio de outros colegas? **Nunca** ☐ Porquê?____________________ **Uma única vez** ☐ Porquê?____________________ **Uma vez por mês** ☐ Porquê?____________________ **Regularmente (Mais do que uma vez por mês)** ☐ De que forma considera que a utilização regular da Telemedicina ajudou-o/a a melhorar o seu desempenho profissional? Pode dar um exemplo?

3. Formação para utilização da Telemedicina
3.1 Recebeu alguma formação/informação/ capacitação para utilizar os serviços de telemedicina oferecidos pelo hospital? Sim ☐ Não ☐ **3.1.1** Se teve formação. Refira em que ano, qual a duração da formação, os formadores e os temas principais. ____ ____ **3.1.2** Se não teve formação, que tipo de formação ou educação considera necessária para capacitar os profissionais de saúde para trabalhar com a Telemedicina? ____ ____
4. Tecnologia "friendly-use"
4.1 Se já utilizou o serviço de Telemedicina, considera que é um sistema fácil de utilizar, ou seja a tecnologia é simples?
5. Vantagens da Telemedicina
5.1 Para si, quais as vantagens da utilização da Telemedicna na rotina de prestação de serviços de saúde, no hospital onde trabalha?
5.2 Numa escala de 1-5 como vê a necessidade de telemedicina em São Tomé e Príncipe? 1 2 3 4 5
6. Futuro da Telemedicina em São Tomé e Primcipe
6.1 Que fatores considera que mais influenciarão o futuro da Telemedicina em São Tomé e Príncipe?

Muito obrigada, pela sua colaboração!

A.4.3. Trainings performed in STP

<table>
<tr><th></th><th>Formação on the job e em sessões clínicas</th><th>Aconselhamento e orientação técnica à distância; (exames e consultas)</th><th>Estágios de formação de curta duração em Portugal</th></tr>
<tr><td>2012</td><td>300 profissionais de saúde</td><td>11.438</td><td>4 estágios médicos (Pediatria)</td></tr>
<tr><td>2013</td><td>300 profissionais de saúde</td><td>9.902</td><td>1 (enfermagem, em Cirurgia Pediátrica)
1 estagio medico Mamografia
1 estagio medico Dermatologia</td></tr>
<tr><td>2014</td><td>300 profissionais de saúde</td><td>9.000</td><td>1 estágio médico de Ginecologia/Obstetrícia
1 estágio à técnica de saúde Técnicas CardioPneumológicas realizado</td></tr>
<tr><td>2015</td><td>300 profissionais de saúde</td><td>5.670</td><td>1 estágio técnico (Mamografia e Ecomamária)
1 estágio médico em Ortopedia
1 estágio técnico (manutenção de equipamentos de imagiologia e laboratório)</td></tr>
<tr><td>2016</td><td colspan="3">300 profissionais de saúde, entre médicos, enfermeiros e técnicos de saúde, a receber formação, em diversas especialidades, quer no âmbito das missões de especialidade- quer através da Plataforma de Telemedicina</td></tr>
<tr><td rowspan="2">2017</td><td rowspan="2">300 profissionais de saúde</td><td rowspan="2"></td><td>4 profissionais nas áreas da Imagiologia, Administração Hospitalar, Informação Sanitária e Estatística e Manutenção de Equipamentos</td></tr>
<tr><td rowspan="2">5 médicos São-tomenses formados em Portugal nas especialidades de Oftalmologia, Gastroenterologia, Ginecologia e Obstetrícia e Imagiologia.</td></tr>
<tr><td>2018</td><td>363</td><td>22.788</td></tr>
<tr><td>2019</td><td colspan="3"></td></tr>
</table>

A.4.4 Questionnaire to health professionals working in the HAM from different departments results

Table 20. Questionnaire to health professionals working in the HAM from different departments results

		Health professionals working in the HAM from different departments n total = 17		
			n	%
		Gender		
		Male	6	65.0
		Female	11	35.0
		Age groups (years old)		
		25 or younger	3	17,6%
		26-35	7	41,2%
	I	36-45	3	17,6%
		46-55	1	5,9%
		56-65	3	17,6%
		Function		
		Physician	13	76,5%
		Specialist	1	5,9%
		Nurse	1	5,9%
		Technician	2	11,8%
		Level of experience by using telemedicine service (years)		
		n/d	2	11,8%
	IV	None	3	17,6%
		<=1	4	23,5%
		2-3	6	35,3%
		4-5	1	5,9%
		more than 5	1	5,9%

Health professionals working in the HAM from different departments n total = 17				
	V	**Frequency of use (times)**		
		None	3	17,6%
		one time/year	2	11,8%
		one time /month	2	11,8%
		two times/month	1	5,9%
		>= four times/month	9	52,9%
	VI	**Training about telemedicine**		
		Yes	9	52,9%
		No	8	47,1%
	VII			
		Technology is user-friendly		
		Yes	13	76,5%
		No	0	0,0%
		did not know	4	23,5%
	VIII			
		The necessity of use telemedicine		
		1 = Very low	0	0,0%
		2 = Low	1	5,9%
		3 = Average	3	17,6%
		4 = High	4	23,5%
		5 = Very high	9	52,9%

Table 21. Questionnaire to health professionals working in the HAM from different departments results (cont.)

nº	Função	Sexo	Idade	Frequência	Vantagens da utilização da Telemedicna	Futuro da Telemedicina
1	Medicina mulher	F	30	2 vezes por mês	Auxilia na evacuação, através do diagnóstico	Tecnologia Recursos Humanos: Disponibilidade de especialistas
2	Medicina mulher	F	25	Nunca	Reforça as especialidades, devido à falta de especialistas. A telemedicina permite ter o ponto de vista dos especialistas, melhorando o diagnóstico e validação da terapeutica	Recursos Humanos: falta de especialistas, elevado tempo de espera Necessidade de junta de evacuação A cooperação pode ser positiva
3	Pediatria	M	26	Regularmente	. Melhoria da percepção do caso através da partilha de casos semelhantes. Formação indireta	Organização so sistema, opinião mais especializada, auxilia a carencia de especialistas; Disponibilidade de recursos humanos Tecnologia como complemento á medicina Economica: necessidade de manutenção dos equipamentos
4	Medicina mulher	F	26	1 vêz por ano	segunda opinião Falta de estudos no país	Tecnologia: meios de diagnóstico Recursos humanos

nº	Função	Sexo	Idade	Frequência	Vantagens da utilização da Telemedicna	Futuro da Telemedicina
5	Oftalmologia (enfermeira)	F	41	Regularmente	Segunda opinião: diagnostico e tereapeutico	nd
6	Imagiologia	M	58	Regularmente	Declaração, o que tem dúvida Tempo real e remoto (exames), conhecimento diminuto	Técnicos formados disponiveis a nível nacional;
7	Pediatria	F	25	Nunca	Defice de especialistas , discutir casos e melhorar a conduta do paciente, aprendizagem.	Politica (dirigentes);
8	Pediatra	F	40	1-2 vezes por mês	Apoio ao diagnostico e orentação terapeutoca para minimizar os defices em recurso humanis especialix«zados bem como em equipamentos	Financiamento Disponibilidade dos parceiros
9	Pediatria	F	27	Regularmente	Aprensizagem e melhoria de procedimentos	Está centralizado (Água grande , Cantagalo), deveria haver uma descentralização dos cuidados.
10	Pediatria	M	25	1 vez por mês	Falta de quadros especializados, orientação terapeutica. Meios complementares de diagnostico	Disponibilidade de quadros (médicos especialistas) Motivação para a transferencia de conhecimento, pouca familiarização com o proaprio serviço)

nº	Função	Sexo	Idade	Frequência	Vantagens da utilização da Telemedicna	Futuro da Telemedicina
11	Oftalmogia	F	60	Regularmente	Melhor diagnóstico Diminuir evacuação	Tecnologia Politica (mudança do governo) Economia (dependencia da cooperaçãom não sendo um sistema autossustentavel
12	Oprtometria	M	28	Nunca	Encaminhamento dos doentes Auxilia o diagnóstico e o tratamento	Epidemiologia Cirurgias de urgencia
13	ORL)	M	60	Regularmente	Sim	Melhorar o acesso à tecnologia Disponibilidade dos médicos em Portugal
14	Medicna Homem	F	55	Regularmente	segunda opinião Intercambio, aprendizagem	Economico, muitos casos são resolvidos sem custos com a participação dos familiares Fator social , evacuação
15	Medicna Homem	F	31	Regularmente	Discutir com os colegas mais experientes , defice de espera, demora muito o tempo de espera	Recurso Humanos Especialistas Não Formação
16	Medicna Interna	F	43	1 vêz por ano	Permite a discussão de casos	nd
17	ORL	F	34	Regularmente	Diagnóstico mais rápido, já não tem de esperar a chegada da missão a São Tome.	Aulas a distancia