



POLITECNICO
MILANO 1863

SCUOLA DI INGEGNERIA INDUSTRIALE
E DELL'INFORMAZIONE

Telemedicine in International Cooperation: how digital technologies can improve access to healthcare in Africa

TESI DI LAUREA MAGISTRALE IN
MANAGEMENT ENGINEERING - INGEGNERIA
GESTIONALE

Author: Alessandra Soldati

Student ID: 945826
Advisor: Cristina Masella
Academic Year: 2020-2021

Abstract

International cooperation has fostered the growth of developing countries over the years, focusing especially on Africa. Telemedicine, with the advent of Covid-19, has shown its usefulness in increasing access to care and improving the quality offered. Nevertheless, the focus on digital technologies, in particular telemedicine, in international cooperation projects in Africa is still very limited.

The research context has confirmed the importance and utility that telemedicine can bring to the Africa context, but is affected by the lack of barriers specific to the context and recommendations can guide the different actors interested in its implementation.

The final objective of this work is to provide a more complete view of the barriers encountered in the African territory by telemedicine and the guidelines useful to successfully manage its development.

To this end, an analysis of the research and literature review context was conducted in order to acquire the knowledge necessary to structure the work. A first classification of five classes of barriers was made on the basis of contributions from the literature. Subsequently, a series of interviews were conducted at telemedicine centers to validate the identified barriers. Finally, from the information collected were extrapolated "lessons learned" usable as guidelines.

Through the analysis of an international cooperation project, the real presence of barriers in a local context was assessed, identifying four classes of barriers specific to an African context.

The work aims to provide a more comprehensive view of the usefulness of digital technologies in Africa and the specific barriers that can be encountered, defining key aspects for the implementation and sustainability of telemedicine.

Key-words: international cooperation, telemedicine, Africa, barriers.

Abstract in lingua italiana

La cooperazione internazionale ha favorito negli anni lo sviluppo di Paesi in via di sviluppo, concentrandosi maggiormente in Africa. La telemedicina, con l'avvento del Covid-19, ha mostrato la sua utilità nell'aumentare l'accesso alle cure e migliorarne il livello offerto. Ciò nonostante, l'attenzione per le tecnologie digitali, in particolare della telemedicina, nei progetti di cooperazione internazionale in Africa è ancora molto limitata.

Il contesto di ricerca ha confermato l'importanza e l'utilità che la telemedicina può portare al contesto Africa, ma risente della mancanza di barriere specifiche che ostacolano la sua fruizione e di raccomandazioni che possano guidare i diversi attori attori interessati alla sua implementazione.

L'obiettivo finale di questo lavoro è di fornire una visione più completa delle barriere riscontrate nel territorio Africano dalla telemedicina e delle linee guida utili a gestire con successo il suo sviluppo.

A tal fine, un'analisi sul contesto di ricerca e di revisione della letteratura è stata condotta per acquisire le conoscenze necessarie per strutturare il lavoro. Una prima classificazione di cinque classi di barriere è stata realizzata sulla base dei contributi ottenuti dalla letteratura. Successivamente, sono state condotte una serie di interviste a centri di telemedicina per validare le barriere identificate. Infine, dalle informazioni raccolte sono state estrapolate delle "lessons learned" utilizzabili come linee guida.

Attraverso l'analisi di un progetto di cooperazione internazionale, si è valutata la reale presenza delle barriere in un contesto locale, andando ad identificare quattro classi di barriere specifiche di un contesto Africano.

Il lavoro mira a fornire una visione più completa dell'utilità delle tecnologie digitali in Africa e delle barriere specifiche che si possono incontrare, definendo degli aspetti chiave per l'implementazione e la sostenibilità della telemedicina.

Parole chiave: cooperazione internazionale, telemedicina, Africa, barriere

Contents

Abstract	i
Abstract in lingua italiana	iii
Contents	v
Introduction	1
1. International cooperation in healthcare in Africa	3
1.1. International cooperation	3
1.1.1. Development cooperation.....	4
1.1.2. Objectives of development cooperation.....	5
1.1.3. Interests of development cooperation.....	5
1.1.4. Actors of development cooperation	6
1.2. Healthcare situation in Africa.....	7
1.3. Healthcare projects in Africa.....	8
1.3.1. Eni Foundation	12
1.3.2. The Bambino Gesù Pediatric Hospital	18
1.3.3. Cooperazione Paesi Emergenti.....	20
1.3.4. Comitato Collaborazione Medica	23
1.3.5. Comunità Solidali nel Mondo	26
1.3.6. Organismo di Volontario per la Cooperazione Internazionale – La Nostra Famiglia 29	
1.3.7. Africa Mission Cooperation and Development Onlus	31
1.3.8. Medici con L’Africa CUAMM	33
1.4. Final consideration	38
2. Objectives and research design	39
2.1. Objectives.....	39
2.2. Research design.....	40

3. Literature review	43
3.1. Methodology	43
3.2. Findings.....	45
3.2.1. General information on telemedicine.....	46
3.2.2. Application.....	47
3.2.3. Example/case study.....	48
3.2.4. Recommendation for telemedicine	49
3.2.5. Benefits of telemedicine.....	52
3.2.6. Challenges of telemedicine	52
4. Understanding telemedicine in Africa	57
4.1. Global Health Telemedicine.....	57
4.1.1. GHT Online Platform.....	58
4.2. Selection of GHT centers to interview	60
4.2.1. Cameroon	61
4.2.1. Kenya.....	62
4.2.2. Malawi	62
4.2.3. Tanzania.....	63
4.2.4. Egypt	64
4.2.5. Madagascar	65
4.3. Final selection.....	65
4.4. Interviews	66
4.4.1. Structure of the interview	66
4.4.2. Answer to the interview: Tanzania.....	67
4.4.3. Answer to the interview: Malawi	68
4.4.4. Answer to the interview: Egypt	69
4.5. Obtained results	70
4.6. Lesson learnt.....	72
5. Case study - Tanzania	73
5.1. Tanzania.....	73
5.1.1. Country profile	73
5.1.2. Healthcare system in Tanzania	75

5.1.2.1.	Primary health care	77
5.1.2.2.	Structure of the healthcare system.....	78
5.1.3.	Financing, accessibility, availability	79
5.1.4.	Barriers to success	79
5.1.5.	Main diseases and cause of death.....	80
5.2.	“Golfini Rossi” Onlus.....	81
5.2.1.	Benedictine Monastery of Mvimwa.....	83
5.2.2.	Areas of intervention	83
5.3.	Health project in Mvimwa – Evolution of the dispensary.....	85
5.3.1.	Phase 1 – New maternity ward	86
5.3.2.	Phase 2: Pediatric department	87
5.3.3.	Phase 3: Allocation of a mobile clinic	88
5.3.4.	Phase 4: Local canteen and kitchen construction.....	89
5.3.5.	Phase 5: Continuing health training and telemedicine.....	89
5.3.6.	Phase 6: Motor rehabilitation department and disable reception	90
5.3.7.	Phase 7: Reorganization/expansion of the old dispensary	90
5.4.	Telemedicine project in Mvimwa.....	91
5.4.1.	Phase 1: Installation.....	92
5.4.2.	Phase 2: Testing	93
5.4.2.1.	Limitation of the testing phase	95
5.5.	Discussion	95
6.	Conclusion and future development	101
	Bibliography.....	105
	List of Figures.....	113
	List of Tables	115
	Acronyms.....	117

Introduction

International cooperation is today one of the main tools to support the growth of developing countries. Many of the projects carried out focus on Africa, specifically to the health sector. Despite the different areas of intervention, the interest in telemedicine, which provided its usefulness during the Covid-19 pandemic, is not spread in African countries.

Telemedicine is defined as “the delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities”.

To date there are general information about the main causes of failure of digital technologies such as telemedicine. To his aim, the work purpose is to identify the main barriers related to the implementation of telemedicine in Africa and provide some lesson learned as a practical support.

The paper is structured as follows.

Chapter 2 provides a complete overview on the research context, including international cooperation, healthcare situation in Africa and cooperation project in the African health sector.

Chapter 3 explains the main objectives and research methodology followed.

Chapter 4 displays the methodology used for the literature analysis and the major findings about the main topic, telemedicine.

Chapter 5 is dedicated to the second part of the results, obtained by interviews. Concludes the chapter the final classification of barriers identified, and the lesson learned extrapolated from them.

Chapter 6 discusses the case study, taking into account the information obtained in the previous sections. At the end, a final classification of barriers is presented, providing a series of KPIs to measure the performances of a telemedicine project.

Finally, the last section argues some conclusion and debate future development of the work.

1. International cooperation in healthcare in Africa

The chapter offers a complete overview of the knowledge developed on the topics of international cooperation and healthcare in Africa.

Section 1.1 focuses on international cooperation, specifically related to development. The definitions, objectives, interests and actors involved in development cooperation are presented to provide a broader idea of the subject.

Section 1.2, specifically related to Africa, analyses the continent's key characteristics and the actual healthcare situation, with a focus on the main diseases and problems the sanitary sector is facing.

The following section, 1.3, is related to the analysis of different healthcare cooperation projects carried out in Africa from different actors. A total of eighteen projects are presented and for each a standardized "project card" is filled, including the place, period, description of the project, financiers and donors and achieved results. Among the eight actors studied, are cited NGOs, private associations and hospitals.

Section 1.4 concludes the chapter with a considerations on the previous information provided.

1.1. International cooperation

Since the early 1980s the field of international relations has largely been dominated by debates about the concept of international cooperation. Risen in importance after the Second World War, it is today one of the main tools used by countries to provide different kinds of international relations [1].

The inception of international cooperation generally refers to the introduction of the Marshall Plan in 1947 by US foreign Minister George Marshall. The plan, also called "European Recovery Plan", had the aim to economically rebuild Europe after the

Second World War and create the United Nation Organization and the Bretton Woods Institutions (World Bank and the International Monetary Fund) [2].

The reasons for the introduction of the Marshall Plan were both for national security and commercial considerations. On the one hand, the USA's national interests in stopping the expansion of communism in Easter Europe. On the other hand, the benefits gained from the reconstruction of a free Europe for American business [3].

International cooperation is a broadly concept that can be described as *"the global teamwork by the countries of the world towards joint action in areas of mutual interest and sustainable development"* [2].

Today, the term is used to generally describe the flow of long-term financial resources between developed and developing countries. Since there are fields of international cooperation that are not only related to development, from this moment the focus will be only on development cooperation.

1.1.1. Development cooperation

Development cooperation is defined as *"the activity that aims explicitly to support national or international development priorities, is not driven by profit, discriminates in favor of developing countries, and is based on cooperative relationships that seek to enhance developing country ownership"* [4].

To define an activity of development cooperation four criteria need to be met:

1. *"Aims explicitly to support national or international development priorities"*, related to the willingness of reaching common agreed goals, mainly the Sustainable Development Goals (SDGs) and other international or regional development agreements.
2. *"Is not driven by profit"*, since not-for-profit organizations accepts to work on those fields in which the traditional fails, accepting a lower profit.
3. *"Discriminates in favor of developing countries"* meaning the aim to create new opportunity for those states. A list of developing countries is updated every three years, based on the indicator *"per capita income"*, which distinguishes between poorest and poor countries and other two groups of middle-income countries [5].
4. *"Is based on cooperative relationships that seek to enhance developing country ownership"*, so based on non-hierarchical relationships between worldwide actors that pursue to complement resources and capacities.

Most of the assistance provided by development cooperation actors goes to Africa, especially the Sub-Saharan part, which represents the 37,9% of the activities in 2010.

1.1.2. Objectives of development cooperation

According to the Organization for Economic Co-operation and Development (OECD), the objectives of development cooperation, and more in general of international cooperation, regard the economic, social, political and environmental side [2].

They can be classified in four main groups:

1. *“Promotion of economic well-being”*: The 1995 Copenhagen Declaration and Program of Action set forth the goal of eradicating poverty in the world, through decisive national actions and international cooperation “as an ethical, social, political, and economic imperative of humankind”.
2. *“Integration of Developing Countries into the World Economy”*: Developing countries faces severe challenges in position their self in the international market. The difficulties in selling their product makes them marginalized and not taken into consideration during decision-making at international forums.
3. *“Ensuring social development”*: The goal of international cooperation is not only related to the economic field, but also to the social one. It aims to promote universal primary education in all countries; gender equality and the empowerment of women by eliminating gender disparity in primary and secondary education; the reduction of mortality rates for infants and children under the age of five.
4. *“Environmental Regeneration and Sustainable Development”*: The current trends in the loss of environmental resources, such as forests, fisheries, fresh water, climate, soils, biodiversity, stratospheric ozone, the accumulation of hazardous substances, desertification, and other major negative impacts, have to be the hearth of some programs of cooperation.

1.1.3. Interests of development cooperation

Carrying out an international cooperation activity can arise from various reasons and interests, especially for who will provide the necessary resources for the development. In particular, the main motives can be articulated in two fields: moral and humanitarian on the one side and political and economic on the other side.

Concerning the first, the idea that “a person who is well endowed and well situated has a definite obligation to help people who are poor and have poor access to resources” explains the reasons behind the human interest of development cooperation [3]. As for individuals, the same concept has to be applied between rich and poor countries. Multilateral cooperation through the United Nation has from the start been rooted in moral and global security motives. To them, also activities carried out by non-profit organizations (NGOs) can be associated to mainly moral interests.

Nevertheless, it has to be considered that in the international market the purely moral and humanitarian motives are rare and, often, givers are driven by a self-interest. In this perspective, political and economic interests play an important role in the field of international cooperation, which represent a tactic source for choosing beneficiary countries. Since the beginning, the former colonials have concentrated their activities to maintain privilege access to resources and markets in the decolonized areas. Today, many firms benefit from establishing international relations in order to take advantage of the resources provided by the host country [3].

The motives and interests defined focus on the perspective of the country that provide the assistance. For the point of view of the emerging country, the interests are quite clear, but the importance of development cooperation varies from country to country. The dependence on such activities is linked to the country's economic strength: the lower this is, the more the necessity of aid will be high.

1.1.4. Actors of development cooperation

International development cooperation involves a very broad number of actors. Generally speaking, they can be distinguished between Governmental donors and non-governmental/private donors.

The first group include three different clusters of actors. The so-called traditional donors, which have joined to form the OECD's Development Assistance Committee, is composed by 24 members, 23 states and the Commission of the European Union, the World Bank, the International Monetary Fund and the United Nations Development Program. Traditional donors provide 70 to 90 percent of global development cooperation funds. Secondly, the Arab donors are active in the development cooperation since the 1970s, which includes Kuwait, Saudi Arabia and the United Arab Emirates. Furthermore, Arab donors have made large amounts of development investment by comparison with their economic strength. The last group is represented by the so-called "emerging donors", among them China, India, Brazil, Chile, Venezuela, Mexico and South Africa. Emerging donors usually stress the mutual benefits of cooperation, focusing mainly on infrastructure projects [5].

Concerning non-governmental and private organizations, generally part of the "civil society organizations" group, include both the third-party organization and private foundation, mainly pure philanthropic donors. Among them, many successful projects have been undertaken by NGOs, which dedicate themselves and their resources to development goals and finance their activities with private donations or from members' contributions [6]. As important as the actors involved, is the connection between them, since it affects the sustainability of the projects developed.

The International Development Cooperation Octangle, or “Octangles” demonstrates the realistic and complex tangle of relationships involved in the international cooperation [6].

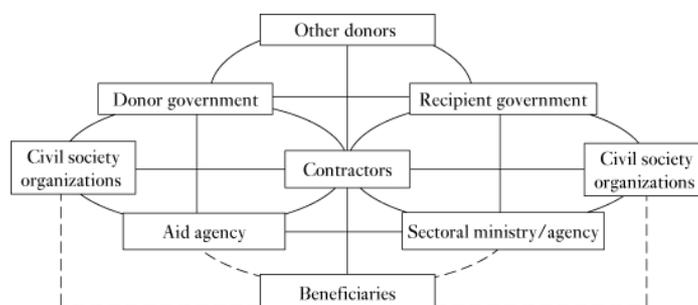


Figure 1: The International Development Cooperation Octangle

1.2. Healthcare situation in Africa

Among the developing countries, Africa is the continent of interest for this work. With a population of 1.3 billion people, is the second largest continent after Asia. Despite the growth rate, which sees the population increase to 2.5 billion people by 2050, health care remains one of the biggest challenges.

According to the World Health Statistics, life expectancy in 2019 is 59.0 years old, with a global average of 63.7.

Infant mortality and under-five mortality are 51 and 74 respectively (per 1000 live births), again much higher than the global average, set to 28.6 and 37.7. Main causes of these gaps with the rest of the world are given by diseases such as HIV/AIDS, tuberculosis, malaria, Ebola, hepatitis, meningitis and others. However, Africa health system is not adequate to address the country condition. First of all, the lack of access to health infrastructure is the main problem. Most of the population live in rural areas, while most of the health facilities are positioned in the urban ones. It is also defined a lack of complementary infrastructure, such as access roads and constant electricity supply.

Moreover, Africa counts only the 3% of the world’s health professionals, who are also mainly located in urban areas, with major shortages in physicians, nurses, health managers and planners.

To conclude, the economic resources reserved to the health sector remains one of the lowest in the world. The average expenditure does not exceed 5%, having countries spending less than US\$ 34 overall per year.

1.3. Healthcare projects in Africa

After an analysis of the continent and the contribution of international cooperation in developing countries, the goal was to identify which typologies of projects have been developed in the context of international cooperation in the healthcare sector in Africa.

First of all, from a web research have been identified the main NGOs operating in the territory, with a focus on projects in the health sector. To them, also foundations of private and public companies, having an interest in working in developing countries, were analyzed. Secondly, additional actors were identified from a list of all the NGOs active in Tanzania, provided the Italian Embassy in Dar Es Salaam.

Despite was not possible to analyze all international cooperation projects, are presented the ones from the main actors involved in Africa.

Below, *table 1* provides the eighteen projects selected, based on the activities carried out and the beneficiaries involved.

Three main categories of beneficiaries were identified. On the one hand, some projects addressed the whole community, independently from age and sex. On the other hand, some programs focused their attention on a specific category, such as children, approximately with an age between 0-5, and mother-children.

The areas of intervention covered instead five dimensions: general improvement of primary healthcare, focus on disability and creation of rehabilitation center; prevent HIV/AIDS; training staff and develop infrastructure for the health sector.

	CHILDREN	MOTHER & CHILDREN	ENTIRE POPULATION
PRIMARY HEALTHCARE	Salissa Mwana project	Mozambique natal care project	Universal and equitable access to quality health service project
	Sisi ni kesho – noi siamo il futuro project	Healthcare mother and child project	Dispensary – health care project
	Care of child malnutrition project	Kilamba Kiaxi project	St. Kizito hospital support project
		Mothers and children first project	
DISABILITY	Kituo cha afya project		Inuka CBR project
	Usratuna rehabilitation center project		
	Kila Siku project		
HIV/AIDS		Kento Mwana project	Ight against HIV in Shinyanga region project
		Kituo cha afya project	
STAFF TRAINING	Salissa Mwana project		Kilamba Kiaxi project
			St. Gaspar referral and teaching hospital formation project
			Strengthening the primary care system for the country population project
INFASTRUCTURE		Healthcare mother and child project	Kilamba Kiaxi project
			Kituo cha afya project

Table 1: International cooperation projects in healthcare in Africa

The first area of interest regards the improvement of primary health care. In this field, three programs address as target beneficiaries' children.

Eni Foundation, with “The Salissa Mwana” project, supported children in rural areas, increasing the capacity of the healthcare centers so to reduce childhood illnesses [7]. “Sisi ni kesho – noi siamo il futuro” by Cooperazione Paesi Emergenti (COPE) focused on 0-5 years orphaned kids, providing care and basic assistance [8]. The same aging target has been addressed by the “Care of child malnutrition” project of Medici con L’Africa CUAMM, with screening activities nutritional status to fight against malnutrition [9]. Other four projects, instead, focus on mother and children. The first three, “Mozambique natal care”, “Healthcare mother and child” and “The Kilamba Kiayi” project, still financed by Eni Foundation, aimed to improve quality of medical services for mother and children. Respectively, in order to reduce neonatal, infant and maternal mortality, to improve knowledge of hygiene and health issues and to generally expand the service [10], [11], [12]. The Medici con L’Africa CUAMM project “Mothers and children first” [9], as the first cited, pursue to reduce maternal and perinatal mortality, through the offer of free assistance during childbirth.

To conclude the first classification, three programs address the entire population for improving the primary health care. “Universal and equitable access to quality health service” of Comitato Collaborazione Medica (CCM) [13] and “The Dispensary – health care” project by Africa Mission [14] aim to enhance the accessibility and quality of health services for the whole community. Lastly, through the management of the “St. Kizito hospital” by Medici con L’Africa CUAMM, all inhabitants have access to good quality services at the lowest possible price [9].

The second area refers to disability and rehabilitation centers, with three projects focused on children and one related to the entire population.

The POLE POLE rehabilitation center of the “Kituo cha afya” project mainly treats children minor disabilities [15]. The “Usratuna rehabilitation center”, carried out by Organismo di Volontariato per la Cooperazione Internazionale (OVCI) La Nostra Famiglia, is instead a broader center, aiming to improve rehabilitation, health and educational services for children with disabilities [16]. Lastly, the “Kila Siku” project of Comunità Solidali nel Mondo mean to enhance the quality of life of the disable children and their families [17]. The “Inuka CBR” is the only project considered that do not focus only on children but treats also adults with disabilities and rehabilitation needs [18].

HIV/AIDS represents one of the main diseases in Africa. In this area, two projects focus on the transmission between mother and children.

As last area of intervention of Eni Foundation, “The Kento Mwana” project works for the reduction of the HIV/AIDS transmission from mother to child to 2-3 percent [19].

The “Kituo cha afya” project, beyond the rehabilitation center, provides programs for HIV/AIDS counselling [15].

The last project, “Ight against HIV in Shinyanga region”, covers instead the whole population. The pursue is to increase the number of people getting tested for HIV to put into treatment and spread awareness of the disease. [9]

A number of projects are focused on the third classification, formation of local personnel and staff training. Only one program is specific for children as target. “The Salissa Mwana” project, as already explained, supports children in rural areas [7]. Among others, the goal is to enhance the knowledge of local healthcare workers regarding vaccination and prevention.

In the same classification, three training programs are carried out to cover the entire population. “The Kilamba Kiaksi” project improves technical and management skills of healthcare staff in gynecology, pediatrics, nutrition and biology [12]. The Bambino Gesù Pediatric Hospital is well known for transfer skills to African personnel. The “St. Gaspar referral and teaching hospital formation” project is specified in share knowledge and skills on specific therapeutic, diagnostic and assistance paths in the field of plastic and maxillofacial surgery [20].

The African hospital, thanks to an agreement with the Global Health Telemedicine (GHT) Onlus is accessing to a telemedicine service able to share medical information and discussion electronically with other distant medical experts, they can reach a consensus about the diagnosis and appropriate management of patients.

Indeed, not only provide a chance for patients to receive quick and possibly correct diagnosis from international specialists, but also a chance for medical personnel to expand their professional knowledge through interaction with other international consultants. To conclude, “Strengthening the primary care System for the country population” project of CCM offers services through the presence and training of qualified personnel, such as nurses, midwives and clinical officers. [13]

The fifth category refers to infrastructure, in particular those missions in the field of build or rebuild hospitals or provide transportation resources. No project has the sole objective of improving the infrastructure of a territory, but they are portions of much larger projects. For this, all those now mentioned have already been analyzed in other categories. Here the distinction of the three types of beneficiaries refers to target of the services provided by the specific program.

In “The Healthcare mother and child” project, a focus on developing infrastructure played a key role. Eight Community-based Health Planning and Services compounds were built. Ten health centers were renovated and supplied them with equipment, water and electricity. Four ambulances and an ambulance boat were donated. [11]

Lastly, a new prenatal block was created in the hospital. In the “Kilamba Kiaxi” project, new health infrastructures and a nutrition therapy center were developed. [12] The “Kituo cha afya” project consisted in the realization of a hospital in an area with very low health coverage. Both hospitals and centers addressed the entire population [15].

The study performed confirmed the crucial role of international cooperation in the health sector. All programs cover different areas of intervention and different countries of the continent. For each project, the place, the period, a brief description and the results obtained, and finally the financiers/donors involved were reported. In addition, will be defined for each actor the strategy in undertaking such international cooperation projects in Africa.

1.3.1. Eni Foundation

With its foundation, Eni foundation, the company started to work in Africa in 1954. Today the country is increasing its strategic role in the international scene, geopolitically and economically speaking.

According to the International Renewable Energy Agency, “it could be able to satisfy a quarter of its energy needs through the use of renewable energy by 2030”. To ensure this result, there is the necessity to develop its resources, in particular gas, to contribute to the decarbonization of the energy mix.

For Eni, the main goal is to achieve complete carbon neutrality by 2050 and African countries have the potential to become large producer of green hydrogen, which could be transported in Europe via existing pipelines. In this perspective, the company’s mission is aligned with the UN’s Agenda 2030 SDGs, especially goal n.7 and goal n.13, respectively “Ensure access to affordable, reliable, sustainable and modern energy” and “Take urgent action to combat climate change and its impacts”.

Through the development of international cooperation programs, Eni is able to intensify agreements with the African continent, so as to benefit from both sides of this relationship [21].

MOZAMBIQUE NATAL CARE PROJECT	
PLACE	Districts of Palma, in the Cabo Delgado region of Mozambique
PERIOD	From 2013 to 2017
DESCRIPTION OF THE PROJECT	The project aimed to support the Mozambican authorities in reducing neonatal, infant and maternal mortality by improving the quality of medical services for mothers and children and their access to them.
FINANCERS AND DONORS	<p><i>Financer:</i></p> <ul style="list-style-type: none"> – Eni Foundation <p><i>Partners:</i></p> <ul style="list-style-type: none"> – The Mozambican Ministry of Health – The Province of Capo Delgado Provincial Health Administration – The District Health Office Administration – The management of the Palma District Health Centre – Medici con L’Africa CUAMM
ACHIEVED RESULTS	<ul style="list-style-type: none"> – A suite of operating theatres at Palma Health Centre, for emergency obstetric care and supplied with radiology, ultrasound and lab equipment to improve the accuracy of diagnoses – A delivery house, to accommodate pregnant women from the most remote and difficult to access areas – Provided an off-road vehicle to offer various mobile clinical services and monitor outlying healthcare centers – Training program, dedicated to medical, nursing, technical and administrative staff throughout the district

Table 2: Mozambique Natal care project, Eni Foundation

HEALTHCARE MOTHER AND CHILD PROJECT	
PLACE	Districts of Jomoro, Ellembele and Ahanta West in Ghana
PERIOD	From 2012 to 2017
DESCRIPTION OF THE PROJECT	The project aimed to manage and provide services for mothers and children by improving the medical and management skills of staff, developing infrastructure (water/electricity, equipment, medical facilities and emergency transport) and improving knowledge of hygiene, health issues and healthy living among the community.
FINANCERS AND DONORS	<p><i>Financer:</i></p> <ul style="list-style-type: none"> – Eni Foundation <p><i>Partners:</i></p> <ul style="list-style-type: none"> – The Ghanaian Ministry of Health – The Ghana Health Service – The Christian Health Association of Ghana – The Bambin Gesù Pediatric Hospital
ACHIEVED RESULTS	<ul style="list-style-type: none"> – Built, equipped and opened eight Community-based Health Planning and Services compounds – Renovated 10 health centers and supplied them with equipment, water and electricity in New Town Samaye, Tikobo, Ekabeku, Aido Suazo, Aiyinasi, Asasetre, Essiama, Nkroful and Agona Nkwanta – Four ambulances and an ambulance boat were donated to the district of Jomoro – Created a new prenatal block at Saint Martin des Porres Hospital and provided a 4x4 vehicle to improve the preventive medicine and healthcare services in poorly equipped villages in the region. An operating theatre was built and equipped at Half Assini Hospital and the maternity block and inpatient wards expanded – A training program was drawn up for the staff

Table 3: Healthcare mother and children project, Eni Foundation

THE KILAMBA KIAXI PROJECT	
PLACE	City of Luanda, Angola
PERIOD	From 2009 to 2012
DESCRIPTION OF THE PROJECT	<p>The project aimed to make a difference in four key sectors:</p> <ul style="list-style-type: none"> – Infrastructure: New health centers supporting existing facilities and a new emergency transportation system – Training: Improving the technical and management skills of healthcare staff – Public health surveillance: Improving the system by training healthcare workers on how to collect, analyze and interpret data, providing all centers with IT systems – Maternal and child health: Strengthening and expanding medical services for mothers and children.
FINANCERS AND DONORS	<p><i>Financer:</i> Eni Foundation</p> <p><i>Partners:</i></p> <ul style="list-style-type: none"> – The Angolan Ministry of Health – The NGO Obra da Divina Providência – The Professor Fernando Figueira Integral Medical Institute – David Bernardino University Pediatric Hospital
ACHIEVED RESULTS	<ul style="list-style-type: none"> – Infrastructure: New health centers built in densely populated areas, improving access to maternal and child services. Plus, a nutrition therapy center and a nutritional assistance center has been developed – Training: Technical and management skills improved in gynecology, pediatrics, nutrition – Public health surveillance: Trained technicians to integrate their systems for the collection and analysis of data in the municipality – Maternal and child medicine: 600 children visited per day and more than 800 vaccinations per day

Table 4: The Kilamba Kiaxi project, Eni Foundation

THE KENTO MWANA PROJECT	
PLACE	The Kouilou, Niari and Cuvette regions of The Republic of Congo
PERIOD	From 2009 to 2012
DESCRIPTION OF THE PROJECT	<p>The project aimed to use preventive methods to reduce the transmission of HIV/AIDS from mother to child to 2-3 per cent. In particular, by offering medical advice to pregnant Congolese women. The cornerstone of the initiative was an advanced laboratory dedicated to the diagnosis of HIV infection, followed by a training session to reinforce the skills of staff and gradually transferring knowledge to Congolese health professionals on how to prevent mother-child infection.</p>
FINANCERS AND DONORS	<p><i>Financer:</i></p> <ul style="list-style-type: none"> - Eni Foundation <p><i>Partners:</i></p> <ul style="list-style-type: none"> - The Congolese Ministry of Health - The National Council for the Fight Against AIDS of the Republic of Congo - The Infectious Disease Clinic at the University of Genoa
ACHIEVED RESULTS	<ul style="list-style-type: none"> - Offered medical advice to more than 30,000 women. The new healthcare facilities and the laboratory were equipped with HIV screening apparatus, radiology and other diagnostic equipment - Expanded the prevention program to other conditions transmitted between mother and child - 26 training sessions, attended by 781 medical staff on the topics of: HIV test counselling, care for HIV-positive women during pregnancy, pediatric care for children of HIV-positive women - Two local doctors completed a month-long placement at the University of Genoa, specializing in HIV infection

Table 5: The Kento Mwana project, Eni Foundation

THE SALISSA MWANA PROJECT	
PLACE	The Kouilou, Niari and Cuvette regions of The Republic of Congo
PERIOD	From 2007 to 2012
DESCRIPTION OF THE PROJECT	<p>The project aimed to support and improve healthcare, and particularly children’s healthcare, in these rural areas. The main goals were to increase the capacity of outlying healthcare centers in the three regions covered; to reduce rates of the most common childhood illnesses through vaccination programs; to increase the knowledge of local healthcare workers regarding vaccination and prevention and to raise awareness among the local population about the prevention of communicable illnesses.</p>
FINANCERS AND DONORS	<p><i>Financer:</i></p> <ul style="list-style-type: none"> – Eni Foundation <p><i>Partners:</i></p> <ul style="list-style-type: none"> – The Congolese Ministry of Health – The Congo Assistance Foundation – The Department of Pediatrics at Sapienza University in Rome
ACHIEVED RESULTS	<ul style="list-style-type: none"> – Infrastructure: 30 outlying health centers were completely renovated and fully equipped – Vaccination campaigns: vaccination in support of the Congolese Ministry of Health’s national vaccination program. In total were organized 4855 vaccination campaigns, with 439,132 vaccines administered – Training: 870 training sessions were held with 712 people trained, comprising 470 medical staff, 57 healthcare managers, 25 trainers and 160 healthcare workers in the maternity sector – Awareness campaigns: for the prevention of communicable children's diseases and the importance of vaccination

Table 6: The Salissa Mwana project, Eni Foundation

1.3.2. The Bambino Gesù Pediatric Hospital

On behalf of the Salviati dukes, in 1869 born in Rome “The Bambino Gesù Paediatric Hospital”, as the first true Italian pediatric hospital. Following the structure of the Hôpital des Enfants Malades in Paris, in 1924 it was donated to the Holy See, becoming in effect the Pope's Hospital. Originally named “Caro bambino”, was then renamed by Pope John Paul II as “Bambino Gesù”.

The Hospital has always been characterized by its commitment on an international level. In fact, since the '80s it has promoted many cooperation projects in 12 countries in the world. These activities concern the support of international research and care agreements, the reception of the neediest children suffering from serious illnesses and training session in the pediatric field.

The purpose is not only to treat children on site but is above all to transfer scientific and clinical skills, through the training of doctors and local health personnel, so that they will be able to provide independent care and assistance.

Thanks to the implementation of telemedicine services, promoted by GHT, the hospital was able to provide continuous training and consultations even remotely.

The international programs are based on specific contracts with the local government or the health institution, which include both on-the-job training sessions carried out by Italian hospital operators and residential training periods in Rome for local staff.

Only in 2019 the hospital was able to transfer knowledge in more than 20 pediatric specialties. The choice of which are the best skills to transfer depends on the specific Country, determined in particular after an analysis of local needs.

The results obtained by the Bambino Gesù Pediatric Hospital are therefore guided by a sense of responsibility, which can be summarized in the words of Pope Francis: "We must never forget that the value of the successes achieved is measured by the ability to improve the quality of care and assistance. Children, young people and their families are and must remain at the center of every activity of every process and of every initiative that is undertaken". [22]

ST. GASPAR REFERRAL AND TEACHING HOSPITAL FORMATION PROJECT	
PLACE	The Itigi city in the Singida Region of Tanzania
PERIOD	From 2012- From 2018-2021
DESCRIPTION OF THE PROJECT	The initial project aimed to co-manages the Department of Pediatrics of the Hospital. The second project aims to transfer to medical personnel of the African hospital, knowledge and skills on specific therapeutic, diagnostic and assistance paths in the field of plastic and maxillofacial surgery. Assistance is also provided second opinion in radiology and for the reading of CT scans (telemedicine service). The goal is to train a doctor from St. Gaspar Hospital who wants to stay in Itigi through a period of residential training at the Bambino Gesù Paediatric Hospital and two on-the-job training missions a year.
FINANCERS AND DONORS	<i>Financer:</i> – Bambino Gesù Pediatric Hospital – Congregation of the Precious Blood
ACHIEVED RESULTS	With the first project has been realized an intensive Care Unit (4 beds) and a dedicated clinic (Dentistry and Ophthalmology) From 2005 to 2008: – 3700 patients have been visited in the pediatric department, where only in 2008 1400 babies' birth were assisted From 2006 to 2010: – 378 patients were visited in the cardiology department and 13 of them have been sent to Rome for surgery – In May 2019, a total of 32 patients suffering from cleft lip, burns and swelling were examined, 18 of these underwent surgery

Table 7: St. Gaspar Referral and teaching hospital formation project, the Bambino Gesù Pediatric Hospital

1.3.3. Cooperazione Paesi Emergenti

COPE is an international NGO founded in Catania in 1983. The main objective is to create models of more just and supportive relations between the North and the South of the world.

It is currently present in Africa with 3 offices in Tanzania (Dar es Salaam, Nyololo and Nambehe), 1 in Madagascar (Ambanja), 1 in Guinea Bissau (Cacheu region), 1 in Tunisia (Tunis) and 1 in Senegal (Dakar).

On the one hand, at national level, the NGO deals with fundraising, information, awareness raising and training activities, in particular on Global Citizenship Education at national, regional and local level in collaboration with other local associations. In the international field, on the other hand, through cooperation, projects are carried out in the health, agricultural, educational and social fields, with the aim of building economic models that reduce inequalities in the distribution of global wealth and overcome barriers and prejudices at the origin of conflicts and discrimination.

The organizational structure of the projects follows a specific philosophy:

- The implementation of interventions that can have a direct impact on the living conditions of the communities in which one operates.
- The training of local staff to ensure an autonomous and sustainable management of interventions over time.
- The use of appropriate technologies, that is, to be easily managed by local technicians without triggering further dependence mechanisms from abroad.

The vision of the Organization is based on the "desire to build a world in which every person can enjoy fundamental rights including the right to food, health, education and a dignified life, promoting the self-development capacity of each people". [23]

SISI NI KESHO – NOI SIAMO IL FUTURO PROJECT	
PLACE	The village of Nyololo in the Iringa region of Tanzania
PERIOD	From 2004 to 2007
DESCRIPTION OF THE PROJECT	<p>The project welcomed orphaned children of one or both parents (usually because of HIV), aged between 0 and 5, providing them with the care and assistance necessary for their growth and subsequent reintegration into their family of origin or adoptive families. The main activities regarded:</p> <ul style="list-style-type: none"> – Care and assistance of hosted newborns – Theoretical and practical training of the 8 nurses (mamà) on the subject of infant health – Organization of recreational, recreational and psychomotor activities for children – Periodic health care and creation of a food calendar to prevent child malnutrition – Monitoring during reintegration into families of origin or adoptive.
FINANCERS AND DONORS	<p><i>Financers:</i></p> <ul style="list-style-type: none"> – Ministero degli Affari Esteri e della Cooperazione Internazionale (MAECI) – EuropeAid (EA) – Agenzia italiana cooperazione allo sviluppo (AICS) – MISEREOR <p><i>Donors:</i></p> <ul style="list-style-type: none"> – OPM Chiesa Cattolica – OPM Valdesi – Regione Sicilia – Filo Diretto ONLUS – Foundation Assistance Internationale (FAI)
ACHIEVED RESULTS	<ul style="list-style-type: none"> – 31% of the children were reintegrated into their families of origin – Life expectancy increased by 90% from 2 months to 10 years

Table 8: Sisi Ni Keisho-Noi siamo il futuro project, C.O.P.E.

KITUO CHA AFYA PROJECT	
PLACE	The village of Nyololo in the Iringa region of Tanzania
PERIOD	From 2004 to 2007
DESCRIPTION OF THE PROJECT	The project consisted in the realization of a hospital in an area with very low health coverage. Internally to the hospital, the government program dedicated to maternal and child health has been implemented, which provides for vaccinations and check-ups for pregnant women and for children under the age of 5, and the program of mobile clinics in neighboring villages where it deals with the control of pregnant women, immunization, child growth and HIV / AIDS counselling. The POLE POLE rehabilitation center inside the hospital and realized thanks to the co-funding of Filo Diretto Onlus is addressed to children's disabilities and includes monitoring, treatment of minor disabilities and transport in specialized centers for the most severe disabilities.
FINANCERS AND DONORS	<p><i>Financers:</i></p> <ul style="list-style-type: none"> - MAECI - EA - AICS <p><i>Donors:</i></p> <ul style="list-style-type: none"> - OPM Chiesa Cattolica and OPM Valdesi - Regione Sicilia - Filo Diretto ONLUS - FAI
ACHIEVED RESULTS	<ul style="list-style-type: none"> - 4259 annual patients - 259 hospitalizations: 51% men, 49% women and 235 hospitalizations of pregnant women - Treated 44 women with HIV pregnancies - 157 deliveries (28% were HIV-positive mothers) - 4244 childhood vaccines carried out

Table 9: Kituo Cha Afya project, C.O.P.E.

1.3.4. Comitato Collaborazione Medica

CCM is an NGO founded in Turin in 1968 by a group of doctors and medical students. In January 2021, was completed the merger between CCM and Amref Health Africa. In particular, both associations are aimed at development cooperation activities in Africa, in order to promote and guarantee the right to health for all.

CCM, engaged in the African continent for over fifty years, has carried out programs not only in the health sector, but also in education for world citizenship, health training courses, activities to promote fair policies, health protection actions and inclusion of vulnerable groups, brings skills, care and assistance to the most isolated human contexts both geographically and socially. Amref Health Africa, instead, mainly focused on the health plan, has an international network active in 35 African countries with over 160 health promotion projects.

The aim of the new organization is to increase and make sustainable access to health for African communities, through the training of health personnel, investments in public health and a wider offer of innovative services.

The projects later considered has been implemented before the merger of the two associations, which is why the history of the Organization before 2021 will be considered.

Currently present in Burundi, Ethiopia, Kenya, Somalia, South Sudan, Uganda and Italy, the main areas of intervention concerned:

- Health of mothers, children and adolescents
- Fight against malnutrition and major pandemics
- Surgery, emergency medicine and traumatology
- Water and hygiene

The NGO considers "health in its complexity as the general well-being of the individual and the community" for this reason it promotes collaborations and synergies with realities in the non-profit sector, public institutions, universities, companies and foundations by bringing together experiences and skills from different areas. [24]

UNIVERSAL AND EQUITABLE ACCESS TO QUALITY HEALTH SERVICE PROJECT	
PLACE	The district of Filtu and Dekasuftu, in the Somali region of Ethiopia
PERIOD	From 2016 to 2019
DESCRIPTION OF THE PROJECT	The project aimed to improve the accessibility and the quality of Primary Health Care Unit services, ensuring the continuum of care from the community to the hospital level. The services were strengthened both from an infrastructural point of view and the availability of health equipment, and through the training and continuous supervision of operators. The intervention also provided for the strengthening of the patient reference system from communities to first-level health facilities, through the activation of protocols, communication mechanisms and the transfer of urgent cases to qualified facilities.
FINANCERS AND DONORS	<p><i>Financers:</i></p> <ul style="list-style-type: none"> – AICS – 8x1000 Conferenza Episcopale Italiana (CEI) – Federazione Nazionale degli Ordini dei Medici Chirurghi e Odontoiatri
ACHIEVED RESULTS	<ul style="list-style-type: none"> – 83 operators benefited from continuous training and supervision courses – 4,866 women were cared for during pregnancy and childbirth – 8,904 children were treated and vaccinated – 3,470 people from the community were made aware and informed about maternal and child health issues

Table 10: Universal and equitable access to quality health service project, CCM

STRENGTHENING THE PRIMARY CARE SYSTEM FOR THE COUNTRY POPULATION PROJECT	
PLACE	The district of Tonj South and Tonj East in Sud Sudan
PERIOD	From 2013 to 2018
DESCRIPTION OF THE PROJECT	The project aimed at strengthening hospital services through the presence and training of qualified personnel (nurses, midwives and clinical officers) and the continuous supply of drugs and medical material has allowed the management of obstetric emergencies and the enhancement of neonatal services.
FINANCERS AND DONORS	<p><i>Financers:</i></p> <ul style="list-style-type: none"> – Health Pooled Fund – UNICEF – 8 x Mille Chiesa Valdese – Presidenza del Consiglio tramite finanziamenti 8x1000 <p><i>Donor/partners:</i></p> <ul style="list-style-type: none"> – Ministry of Health of the State of Greater Tonj and Twic – Hospital management of the Hospital of Tonj, Marial Lou and Turalei – Diocese of El Obei – Local communities
ACHIEVED RESULTS	<ul style="list-style-type: none"> – 170,563 people benefited from prevention and treatment services – 7,592 women assisted during pregnancy and childbirth – 47,969 children vaccinated and treated – 2,852 people assisted with surgery – 31,416 people were reached by awareness-raising and health education activities on good maternal and child health practices.

Table 11: Strengthening the primary care system for the country population project, CCM

1.3.5. Comunità Solidali nel Mondo

Initially born from the commitment of young people to carry out civil service in various countries of the world, “Comunità Solidali nel Mondo Onlus” became an NGO in 2007, with its headquarter in Rome.

It operates in the countries of the South: from poor and forgotten South Africa to Latin America, also passing through the southern territories of the more developed countries.

The founding of the association has guaranteed the launch of activities in favor of children with disabilities in the countries of sub-Saharan Africa, projects in favor of minors and rural development and aid to micro-entrepreneurship of small farmers and indigenous populations in rural areas of Ecuador and Bolivia.

The Organization bases its work in response to the needs of the most fragile sections of the population, with an important focus on children with disabilities. Over the years he has developed projects based on the Community Based Rehabilitation (CBR) methodology, "a multisectoral approach that aims to achieve and maintain maximum independence, full physical, mental, social and professional capacity and full inclusion and participation by all aspects of the life of people with disabilities".

The purposes pursued by the Organization concern exclusively social solidarity, such as:

- Social assistance to the marginalized and the poor of all continents by promoting their integral development of the person
- Promotion of development cooperation and humanitarian aid for the populations of developing countries, to improve their living conditions at all levels: social, economic, cultural, working, health, educational, respecting culture, values and creative spirit of each

Promotion of solidarity, social justice, peace, globalization, cooperation between peoples, gratuity and voluntary work, respecting the local environment, the cultural and religious roots of each population. [25]

INUKA CBR PROJECT	
PLACE	The Inuka village in the Njombe region of Tanzania
PERIOD	From 2011-
DESCRIPTION OF THE PROJECT	The project aims to improve the life of children and adults with disabilities and all other patients with rehabilitation needs. The hospital provides high quality health and rehabilitation services through a specialized and multidisciplinary team. The services provided are physiotherapy, occupational therapy, speech therapy, psychological and nutritional counselling, production and delivery of assistive devices. About the latter, services regard diagnosis and treatment of acute and chronic illnesses, early detection and referral to specialized care, preventive care and health education. In addition, in 2014 a laboratory for the production and application of orthopedic aids was built and started with the aim of facilitating more effective motor rehabilitation, with greater results in functional recovery and the acquisition of autonomy.
FINANCERS AND DONORS	<i>Financers:</i> <ul style="list-style-type: none"> – CEI – CESC Project
ACHIEVED RESULTS	Results of 2019: <ul style="list-style-type: none"> – 2800 children with disabilities taken care of – 1080 patients attended weeks of intensive treatments – 1800 individual rehabilitation treatments for adults – 750 orthopedic treatments – 6300 outreach treatments – 450 supportive devices delivered

Table 12: Inuka CBR project, Comunità Solidali nel Mondo

KILA SIKU PROJECT	
PLACE	The Kinondoni district in Dar Es Salaam region of Tanzania
PERIOD	From 2019-
DESCRIPTION OF THE PROJECT	<p>The project aimed to improve the quality of life of the disable children and their families, inspired by the CBR logic. A multidisciplinary team is operating within the center, made up of various professional figures trained during the project: physiotherapists, educators, social workers, pedagogues and health personnel. Inside the Rehabilitation Center are present:</p> <ul style="list-style-type: none"> - A gym - Four doctors' offices - The coordination offices - A training room for basic operators - Afterwards, a second gym to accommodate many more children.
FINANCERS AND DONORS	<p><i>Financers:</i></p> <ul style="list-style-type: none"> - AICS
ACHIEVED RESULTS	<p>Results of 2019:</p> <ul style="list-style-type: none"> - 360 home treatments - 2,500 individual treatments - 120 trained parents - 10 trained operators

Table 13: Kila Siku project, Comunità Solidali nel Mondo

1.3.6. Organismo di Volontario per la Cooperazione Internazionale – La Nostra Famiglia

“OVCI La Nostra Famiglia” is a non-partisan NGO, born in 1982 from the commitment of the two promoters: the “Gruppo Amici”, a free association that is committed to spreading the spirit of fraternity and it promotes the cause of canonization, together with the Association “la Nostra Famiglia”, dedicated to the care and rehabilitation of people in developmental age with disabilities.

Recognized by the Italian Ministry of Foreign Affairs and registered with the AICS since 2016, it is inspired by the Blessed Luigi Monza, stating that *“good is done well”, and according to a motivation of social solidarity; a “human solidarity - because human is the field in which it is implemented - but at its root it is divine command”, to promote the professionalism and training of local operators because “what matters to us is man, every man, every group of men, to the point of understanding the whole of humanity”.*

The Organization, as well as in Italy, is active in China, Ecuador, Morocco, Sudan, South Sudan, Brazil and Palestine.

OVCI was created above all to carry out initiatives that develop the human and social promotion of citizens of developing countries, with particular regard to interventions in favor of the disabled, promoting training and the development of autonomy; secondly, to support a testimony of social awareness, urging public opinion to be aware and responsible in the face of human problems and in particular of developing peoples.

It carries out development cooperation projects to respond to the numerous reports of needs, in particular of Rehabilitation, for people with disabilities in developmental age.

Other areas of interventions concern training, social care, basic medicine and global education. [26]

USRATUNA REHABILITATION CENTER PROJECT	
PLACE	The Juba city in Sud Sudan
PERIOD	From 1984 -
DESCRIPTION OF THE PROJECT	<p>The project aims to improve rehabilitation, health and educational services for children with disabilities. The services offered are physiotherapy and occupational therapy, as well as speech therapy interventions for children with deafness and language disorders. Children are also followed for the educational part with a pre-school service organized at the Centre and placement in primary school in government and private schools in the County of Juba. The main activities are: Usratuna pre-school management and school integration in local schools, rehabilitation center management, orthopedic workshop management, health center management and staff training.</p>
FINANCERS AND DONORS	<p><i>Financers:</i></p> <ul style="list-style-type: none"> - AICS - Confederation Swiss - United Nation World Food Program (WFP) - The Church of Jesus Christ
ACHIEVED RESULTS	<p>In 2014:</p> <ul style="list-style-type: none"> - 350 children benefited from rehabilitation services - 200 children were referred to Uganda for surgery - 30 children were followed in pre-school and 73 during the school inclusion process <p>In 2018:</p> <ul style="list-style-type: none"> - An Orthopedic Workshop was set up for the production and repair of aids and orthoses for people who belong to the Center (average production of more than 300 devices per year).

Table 14: Usratuna rehabilitation center project, OVCI

1.3.7. Africa Mission Cooperation and Development Onlus

In 1972, a group of lay Christians from Piacenza founded the Africa Mission movement, with the aim of living their faith by helping the troubled populations of the Third World and Eastern Europe.

Ten years later, two members of the Movement founded "Cooperation and Development", an NGO that becomes the operational tool of Africa Mission, through the implementation of cooperation projects and development plans.

Mainly active in Uganda, they carry out community awareness works, support for missionaries to the local Church and associations involved in the work of promoting life. The goal of the NGO is in fact "to support and promote human development in the poorest countries in the world by promoting the dignity of the human person in all its aspects, carrying out emergency interventions in support of local realities".

In Italy, it is engaged in training activities to raise awareness of solidarity issues, development education, promotion of national and international volunteering. In Uganda, the development programs concern various sectors of social life, including the sectors of water, health, socio-educational and agricultural-zootechnical.

Africa Mission Cooperation and Development Onlus follows six principles:

- The centrality of man and the recognition of his dignity as an absolute value
- The enhancement of man in the entirety of him
- Solidarity as a duty of sharing, of justice, of equity
- The principle of subsidiarity to enhance the priority role of the individual within the society in which he lives
- The principle of partnership as recognition of the value of comparison and collaboration between the various social organizations, as an affirmation of the value of diversity and of the fact that every culture, however different, has an intrinsic quality to communicate
- The principle of sustainability, which requires you to catch up with those who walk more slowly, that is, to carry out projects that local communities are able to continue independently with their own strengths and abilities. [27]

DISPENSARY – HEALTH CARE PROJECT	
PLACE	Loputk e Tapac, Karamoja region in Uganda
PERIOD	From -
DESCRIPTION OF THE PROJECT	The project aims to guarantee the right to health for the most vulnerable populations of Karamoja, in particular to support health structures for the promotion and protection of health in Karamoja, to increase the accessibility, equity and quality of health services of base.
FINANCERS AND DONORS	<p><i>Financers:</i></p> <ul style="list-style-type: none"> – Diocesi Cattolica di Moroto
ACHIEVED RESULTS	<p>In 2019:</p> <ul style="list-style-type: none"> – 2522 patients were examined during the year, offering 23 beds (10 in the Loputk dispensary, 13 in the Tapac one) – 3,814 vaccines were administered to prevent the most common diseases such as diphtheria, measles, tuberculosis, tetanus and pertussis – 4 sessions are foreseen in the cycle of pre-natal visits; 754 women attended at least one visit, 348 completed the entire cycle – 11,280 HIV tests were carried out. As both are level 3 dispensaries, they provide comprehensive assistance against HIV – The dispensaries guaranteed the daily presence of 23 qualified people (13 in the Loputk dispensary, 10 in the Tapac one). – Continued community awareness of excessive alcohol consumption, the cause of many deaths in recent years.

Table 15: Dispensary-healthcare project, Africa Mission

1.3.8. Medici con L’Africa CUAMM

Founded in Padua in 1950, Medici Con L’Africa CUAMM is the first NGO in the health field recognized in Italy and the largest Italian organization for the promotion and protection of the health of African populations.

To date, more than 2000 operators, including doctors, paramedics and technicians, have served in African countries, especially sub-Saharan Africa, for an average duration of about 3 years.

The main commitment of the Organization concerns the accessibility of health services to the entire population, especially the poorest and most marginalized. Through long-term assistance projects, aimed at the development of health structures and training of health personnel, the population is also actively involved in the initiatives. Mothers and children are offered treatment and prevention programs for the main infectious diseases, HIV / AIDS, tuberculosis, malaria.

The two main purposes of the NGO regards:

- Improve the state of health in Africa, in the belief that health is not a consumer good, but a universal human right for which access to health services cannot be a privilege
- Promote a positive and supportive attitude towards Africa, that is the duty to help raise interest, hope and commitment for the future of the continent in institutions and public opinion.

The organization is active today in 8 countries of sub-Saharan Africa (Angola, Ethiopia, Mozambique, Central African Republic, Sierra Leone, South Sudan, Tanzania and Uganda) with long-term health care projects for hospitals, small health centers, villages, universities. [28]

MOTHERS AND CHILDREN FIRST PROJECT	
PLACE	The Tosamaganga city in the Iringa District Council of Tanzania
PERIOD	From 2011 -
DESCRIPTION OF THE PROJECT	The project aims to reduce maternal and perinatal mortality, offering free and qualified assistance during childbirth, both in the Tosamaganga hospital and in the Iringa District Council to improve obstetric assistance and emergency services, basing them on quality and equity. The goal is, in fact, to increase the number of women who choose to be assisted free of charge by qualified health personnel during childbirth.
FINANCERS AND DONORS	<p><i>Financers/donors:</i></p> <ul style="list-style-type: none"> - Cariparo Foundation - Cariverona Foundation - Cariplo Foundation - San Paolo Company - CEI - MAECI - Department for International Development (DFID) - Private Donors
ACHIEVED RESULTS	<p>In 2019:</p> <p>In the Tosamganga hospital:</p> <ul style="list-style-type: none"> - 1,389 antenatal visits - 1,575 natural births assisted and 775 caesareans <p>In peripheral structures:</p> <ul style="list-style-type: none"> - 5,801 assisted births - 9,147 antenatal visits <p>In total, they were able to cover 90.4% of the expected deliveries in the district.</p>

Table 16: Mother and children first project, Medici con L' Africa CUAMM

CARE OF CHILD MALNUTRITION PROJECT	
PLACE	The Iringa and Njombe regions of Tanzania
PERIOD	From 2011 -
DESCRIPTION OF THE PROJECT	Medici con L’Africa CUAMM trains and supervises 1,019 community health workers (CHWs), in order to increase the demand for health services, to promote assisted birth and the screening of the nutritional status of communities. The work of the CHWs also supports the health authorities of the two Regions and districts most involved in the fight against malnutrition in children under the age of 5.
FINANCERS AND DONORS	<p><i>Partners:</i></p> <ul style="list-style-type: none"> - DFID - UNICEF - MAECI - CEI - Fondazione Cariparo - Fondazione Cariplo - Fondazione Cariverona - Fondazione Intesa San Paolo Onlus - Fondazione Zanetti Onlus - Compagnia di San Paolo - Gruppo CUAMM Modena - Soroptimist International d’Italia – Club di Padova
ACHIEVED RESULTS	<ul style="list-style-type: none"> - 767 children identified and being treated for Severe Acute Malnutrition (SAM) - 105 operators formed to treat SAM - 45% treatments coverage of SAM cases in Iringa and Njombe

Table 17: Care of child malnutrition project, Medici con L’Africa CUAMM

ST. KIZITO HOSPITAL SUPPORT PROJECT	
PLACE	The Mikumi city in the Kilosa district of Tanzania
PERIOD	From 2008 -
DESCRIPTION OF THE PROJECT	<p>The project intends to strengthen the management of the Mikumi hospital and ensure accessible and good quality services to the 123,000 inhabitants who represent its users.</p> <p>Thanks to the support to the hospital for the purchase of drugs, reagents and consumables, it is possible to monitor and keep the rates required from patients for healthcare services and, in particular, for maternal services at the lowest possible level.</p>
FINANCERS AND DONORS	<p><i>Donors:</i></p> <ul style="list-style-type: none"> - MAECI - Private donors
ACHIEVED RESULTS	<p>In 2015:</p> <p>Hospital activities:</p> <ul style="list-style-type: none"> - 16,733 outpatient visits - 8,101 hospitalizations, of which 2,096 are pediatric - 2,331 deliveries of which 375 caesareans <p>Other activities:</p> <ul style="list-style-type: none"> - 42 beds in the new maternity hospital, inaugurated in May 2013 - Recovery of the Outpatient Department - Supply of solar panels for the laboratory, the departments of Medicine, Pediatrics, Maternity, outpatient clinics outside the hospital, and operating room - Installation of a software for the management of the pharmacy warehouse - 603 participants in 14 refresher courses - 4 scholarships awarded to 3 obstetric nurses and 1 clinical officer

Table 18: St. Kizito hospital support project, Medici con L'Africa CUAMM

IGHT AGAINST HIV IN SHINYANGA REGION PROJECT	
PLACE	The Shinyanga region of Tanzania
PERIOD	From 2015 -
DESCRIPTION OF THE PROJECT	<p>The ongoing project involves the Bugisi health center to which the inhabitants of all 35 villages in the area (75,000 people) belong. The goal is to increase the number of people who get tested for HIV and are put into treatment. Work is underway to strengthen counselling and testing services; better management of antiretroviral drugs; the prevention of the transmission of the virus from mother to child; the improvement of laboratory services for diagnosis; to staff training. At the level of the reference territory, work is being done to increase the number of visits also to the villages and for raise awareness and involve the beneficiary population more by increasing awareness of the disease.</p>
FINANCERS AND DONORS	<p><i>Donors:</i></p> <ul style="list-style-type: none"> - Fondazione Buon Samaritano del Pontificio Consiglio per la Salute
ACHIEVED RESULTS	<p>In 2015:</p> <ul style="list-style-type: none"> - 1321 patients at the moment in antiretroviral therapy of whom 115 under 14 years - 24302 people tested for HIV - 630 new patients placed on therapy

Table 19: IGHM against HIV in Shinyanga region project, Medici con L'Africa CUAMM

1.4. Final consideration

The success of cooperation carried out in developing countries from the different actors revealed their importance in the territory's progress, economically, culturally and socially speaking.

From the analysis, it is clear the need to train health workers to meet the many challenges facing the continent. Especially today, Coronavirus 19 (Covid-19) pandemic showed the necessity of spread health skills all over the world.

Over the past two years, a tool that effectively enables the transmission of information and knowledge and has been popular in Western countries is telemedicine. However, from the previous study has been shown how the interest in telemedicine is still very limited in cooperation projects, especially in Africa. Among the different programs, only "Bambino Gesù Pediatric Hospital" has supported the development of this model, showing its benefits. Indeed, the St. Gaspar Hospital is now recognized not only as a dispensary of outpatient country dispensary, but as a hospital center of reference with a wide range of diagnostic tools.

With the use of remote consultation, emerging countries, even the most remote areas, may be have access to the necessary knowledge for health facilities that are not yet sufficiently developed.

2. Objectives and research design

This chapter is dedicated to the definition of the specific objective of the thesis in the light of the lack emerged from the previous considerations, specifically related to the limited presence of telemedicine in cooperation projects.

Therefore, section 2.1 provides an analysis of the main purpose of the work, considering also the related sub-goals.

Section 2.2 is focused on the research setting of analysis, analyzing the three main steps of the research design: the literature review for collect theoretical information, interviews as a qualitative method to validate the previous data collected and the definition of a real case in which to use the identified lesson learnt.

2.1. Objectives

Given the limited spread of telemedicine in Africa, the thesis aims to define its role in the continent, the presence of barriers on its application and provide specific recommendation for develop a successful and sustainable telemedicine project.

In order to reach the final goal, some sub-objectives have to be considered. Firstly, identifying the use of new technologies, in particular telemedicine, in health processes. Different definitions were given through years about telemedicine, and the different fields of application has been supported by examples of real cases. These lasts showed the presence of barriers and determinant factors influencing the success of telemedicine in developing countries. All the information collected can support the work in the definition of some lesson learned for telemedicine implementation.

To conclude, the thesis aims to provide some Key-performance indicators (KPIs) to be measured to assess the progress of the project, based on the main barriers will be identified.

2.2. Research design

To meet the final objective, and the related sub-goals, is required to define the research design. In particular, it follows a process involving three steps. The analysis of the literature review was successively used to create an interview to validate the theoretical results. At the end, all the information collected were implemented in the definition of a model for a real case.

The first step consisted in using online databases for the definition of the literature: PubMed, Scopus and Web of Science were filled with specific queries. The main words used concerned telemedicine in Africa, then, a number of filters were introduced to make the search as accurate as possible. Typology of document, language and subject matter led to a number of articles relevant to the work. The final papers were read and classified, based on the topic.

Through years, many definitions of telemedicine have been given, as the number of fields of implementation increased. Through examples of real cases the main challenges and determinants factors were highlighted, giving at the end a detailed picture of telemedicine in Africa. The results are presented in *chapter 3*.

As the interest was to specify telemedicine's problems, to validate the challenges identified in the previous phase, it was decided to conduct interviews to telemedicine centers operating in Africa. Has been chosen to collaborate with Michelangelo Bartolo, founder of the GHT Onlus. The Association, founded in 2013, followed the experience of the Dream program of the Community of Sant'Egidio for the treatment of HIV and other acute and chronic diseases of many countries of Sub-Saharan Africa. It offers telemedical consulting services and, to date, has 39 remote health centers active in 14 African countries, Peru, Brazil and Italy.

The choice of which centers consult was based on the analysis of the Onlus' digital platform. Looking at each nation in which the NGO works, was studied the trend of the telemedicine stations in each of them, based on the number of teleconsultation requests made in the last 3 years. Considering the centers that no longer transmit from a significant amount of time, at the end, three technicians, referents from the three states, Tanzania, Egypt and Malawi, were interviewed.

To each of them, have been asked the role, the active centers of the nation of interest and were interviewed about the ones no longer operative.

Subsequently, based on the challenges identified, the interview started asking about technical problems, such as lack of connection or infrastructure, followed by economic considerations. The human factor was addressed asking about the identification of lack of computer literacy from health workers, their position about telemedicine or any

other problems incurred with them. Later, questions about the coordination and organization, and relative issues with that, has been highlighted, also considering political or legal issues. The interview concluded with demands about problems encountered by patients, such as privacy of data.

After concluding the interviews, the information acquired were compared with the theoretical ones. Settled the validation, some considerations about the obtained results lead to the definition of a model for telemedicine implementation in Africa.

Details about the second phase, including the actors involved, the structure of the interview and the respective answers, and the final lesson learnt are given in *chapter 4*.

The third and last step concerned the application of the lesson learnt for a real case.

The case study consists of a cooperation project for the extension of a dispensary in one of the poorest regions of Tanzania. The goal is to make it evolve by 2023 in modern and well-equipped hospital, perfectly integrated with other health facilities in the area and with main focus women and children.

The project has been developed by the author, working for the past months with “Golfini Rossi” Onlus, an NGO born in Milan in 2015. It carries out missions to support poor and weak economies through international cooperation, particularly in favor of African realities. It collaborates with the Benedictine Monastery of Mvimwa, located in the Rukwa region of Tanzania. To date, it has about 100 missionary monks who offer support by generating work, health care at their dispensary and especially educational programs.

The project includes three sub-projects in the first phase of the extension of the dispensary: the extension of the surgical room, the introduction of a rehabilitation center and the inclusion of a telemedicine service. This thesis focuses on the latter, which sees its conclusion by December 2021.

For this purpose, *chapter 5* provides exhaustive material about the real case. Firstly, was studied the country of interest, Tanzania. In particular, the demographical, political, cultural information, followed by an analysis of the healthcare national system.

Secondly, the organization and the actor involved are presented, the history of “Golfini Rossi” Onlus and the “Benedictine Monastery of Mvimwa”.

Finally, the project is presented. Has been chosen GHT as provider of the service. Later, a study was conducted to understand how many centers, and their location, to install. All the aspects about the strategy to follow and the KPIs to measure in order to build a durable and efficient service conclude the chapter.

3. Literature review

Chapter 3 studies the methodology and findings related to the literature review.

Specifically, section 3.1 shows the queries used in the three online electronic databases for identifying the relevant publication on the interested fields, generally related to “telemedicine” and “Africa”. Specifying also the reasons for which the theme “Covid-19” has been considered only in part, it defines the final number of scientific articles studied for the thesis.

Section 3.2 analyses in detail the final 48 selected items. General information on telemedicine, applications, examples and case studies, recommendation and benefits are presented. The chapter concludes with an exhaustive study on the main challenges, specifying those supposed strictly related to Africa.

3.1. Methodology

This section explores the methodology employed to identify the relevant literature on the topic of telemedicine in developing countries. In particular, the objective was to understand the general concept of telemedicine, focusing on definitions, fields of application and examples. Then, specifying its problems and potentiality when applied to Africa.

To guide the choice of the scientific literature three online electronic databases were searched for publication: Scopus; PubMed; Web of Science. For the three of them the query “*telemedicine*” AND “*Africa*” were examined, showing an initial number of results of 541 in Scopus, 567 in PubMed and 278 in Web of Science. Here, a number of limited criteria were implemented.

Looking to the titles, many results were related to the actual situation of Covid-19. As further explained in the *section 3.2*, the use of telemedicine during the pandemic was found to be of considerable importance. Nevertheless, the situation in Africa also has shortcomings in providing basic health services. For this reason, the thesis focuses on the use of telemedicine apply in every health sector.

Therefore, only a few articles were considered about “*Covid-19*”, after which it was excluded from the research. The new query becomes “*telemedicine*” AND “*Africa*” AND NOT “*Covid-19*” for all the databases. The screening phase recognized respectively 495, 518 and 263 outcomes.

The results were limited to specific types of documents. In Scopus has been considered only articles, conference papers and reviews, leading to a number of 438. In PubMed, being a medical database, were excluded results related to clinical trials, or in general with specific medical information. Limiting to articles, journal articles, corrected and republished articles, scientific integrity review and clinical conference the number decreases to 88 results. Lastly, in Web of Science, considering only articles and review, has been obtained a value of 210.

Focusing on English results and limiting the timespan to ten years, from 2011 to 2021, the records shifted to 323 for Scopus, 71 for PubMed and 158 for Web of Science.

The last exclusion criteria implemented regarded themes, such as agriculture, chemical, biology, environment, physics, energy, earth science, pharmacology, not interesting for the purposes of the thesis. In Scopus, obtained a final number of 278 articles, were excluded also mathematics and arts and humanities. In Web of Science public environment, which led to 137 results. PubMed findings, not having the option of theme exclusion, remains 71.

A total number of 487 records has been identified from the sum of the three databases. Within them, different duplicates were present. After a review of the titles, 380 was the final number of papers considered.

Both title and abstract were read for all of them, removing those non useful for the research, leading to 105 articles, which have been fully read.

The scheme below provides a synthesis of the methodology used.

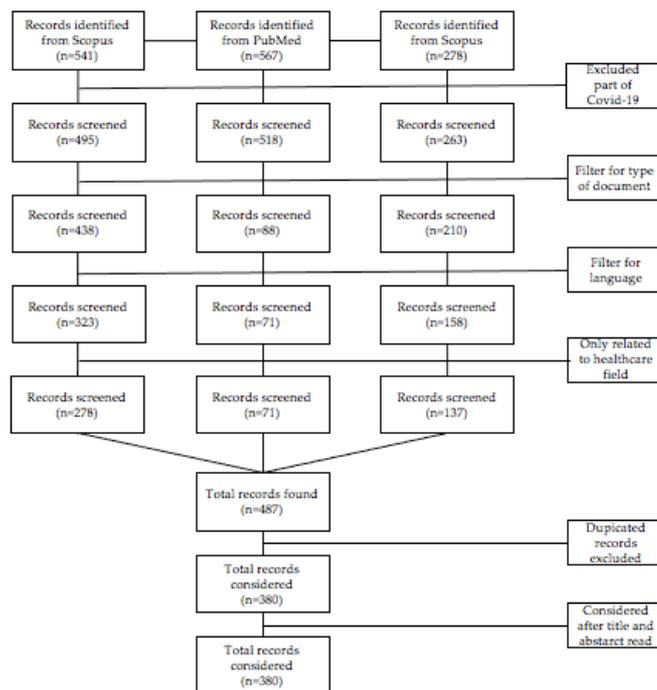


Figure 2: Flow diagram of the search strategy and search results

3.2. Findings

Among the final 105 articles, 48 were identified to be in line with the purpose of this thesis. An analysis of the main results will be proposed in the following section. Before introducing the results obtained, a consideration of the relationship between telemedicine and Coronavirus has been reported.

Covid-19 has dramatically affected the health system of every country in the world. Indeed, all the restrictions applied to limit the spread of the virus to patients and health practitioners have made it more difficult to provide medical services. [29]

Telemedicine can play, in this scenario, an important role. Digitalized services can reduce the risk of infections and allows experts, even international ones, to provide support to less-experienced workers. However, tracing and controlling the spread of the virus requires resources, which may not be available in many Africa realities. [30]

It is necessary to consider that, although most of the focus of the health system has gone to Covid-19, in Africa it represents an additional problem. The unacceptable treatment, even the most basic, was already present before the arrival of the pandemic. [31] Taking this into account, from now on it will be telemedicine not related to the pandemic situation but applied to every possible health field.

Many works focused on the general concept of telemedicine, providing definitions and main characteristics. Others, from one side addressed the main application fields, from the other side studied case studies of its application in Africa. To conclude, benefit, recommendation and challenges recognized will be analyzed.

3.2.1. General information on telemedicine

Before introducing the concept of telemedicine, a distinction among e-Health and telemedicine needs to be discussed.

Van Dyk [32] defined telemedicine as a subset of telehealth, which, in turn, is a subclass of e-health. In particular, telehealth incorporates, among the scope of telemedicine, a broader set of activities, such as provide education. E-health, instead, differs from the previous term since is not limited to healthcare over a distance.

This work focuses on the specific application of e-health in the telemedicine field. The term is not new. Deriving from the Greek “tele” meaning “at a distance” and the present word “medicine,” which itself derives from the Latin “mederi” meaning “healing” [33], its history has followed the progress and evolution of information and communication technologies (ICT) over time. During the American Civil War, in 1862, the telegraph has been used to order medical supplies. Later, followed by the telephone, radio, television, satellite links, computer networks, Internet, wireless networks and more recently the mobile phone. [34]

In literature, a plurality of definitions is associated with it. The most common one, used by Combi, Pozzani & Pozzi [35], Traore, Kamsu-Foguem & Tangara [36] and Edoh, Pawar & Kora [37], is provided by the World Health Organization (WHO), which describes telemedicine as *“the delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities”*.

The classification of The American Telemedicine Association, adopted by Suzuki et al. [38] and Mars [39] describes telemedicine as *“the use of medical information exchanged from one site to another via electronic communications for the health and education of the patient or healthcare provider and for the purpose of patient care”*.

To summarize, telemedicine is the subset of e-health characterized by the use of ICT to facilitate exchange of health information, and in general for health care delivery, particularly in poor settings. [40]

As specialists tend to live in large cities, contributing to geographical inequality to healthcare provision, telemedicine has the potential to improve its access and the quality offered. Both synchronous and asynchronous ways are effective solutions. [41] The former, real-time or synchronous, are services using technologies such as videoconferencing or telephone for a live and interactive consultation. With this solution, devices such as electronic stethoscopes and video-otoscopes are frequently used. Store-and-forward, or asynchronous services, instead, involve the transmission of medical data to another health professional for diagnosis or second opinion at a later time. Examples are photographs of an ECG or a skin lesion attached to an email or uploaded on a platform with the patient history [39], [42]. Tchoa et al. [43] identifies a third category of remote monitoring. It helps medical specialists in monitoring the condition of a patient by using various devices remotely.

3.2.2. Application

The fields of application of telemedicine vary depending on the request of the country. However, the literature has emerged a high demand in specific subjects regarding telemedicine consultation in Africa.

Cardiology seems to be one of the main gills for which the use of tele-consults is required. In Africa, as reported by Joubert et al. [44], hypertension is one of the most significant vascular risk factors. The pilot study undertaken in Botswana showed that only 37% of participants had been exposed to any kind of education about raised blood pressure, cardiac disease or stroke. As a conclusion, he argued a telemedicine model could support existing and potential cardiovascular disease by linking communities with centers of excellence.

The same concept was taken up by Muiruri et al. [45], which highlighted how the recent development of technology availability in Sub-Saharan Africa may lead to the use of telemedicine strategies into the control over hypertension. Mars [39] focused on different application fields. Radiology, dermatology, pathology, obstetrics, psychiatry and ophthalmology are the ones cited by the author, counting cardiology too. In particular, two of them are taken into considerations by other authors.

Teleradiology, defined as one of the simplest telemedicine solutions to implement in Africa, also includes the use of telemedicine in orthopedic surgery [46] and can contribute to improve the management of pediatric orthopedics patients.

As only seven African countries have dermatopathology, two reports analyzed by Mars reported one case sent per country per month. Moreover, Colven et al. [47] claim that in South Africa, there is an average of one dermatologist to two million people within the public sector. Despite it, again the grow of information and communication

technology adapted to dermatology, may enhance the diagnostic acumen of referring primary care providers.

Sarfo et al. [48] focused on the innovative approach of telemedicine application in neurology. Though, it is important to highlight the citation of the authors about the success of telemedicine in different areas, such as dermatology, ophthalmology, HIV prevention and care, clinical psychology and psychiatry, neurosurgery, radiology and non-communicable diseases including hypertension.

Govender & Mars [49] studied the specific application on children with hearing loss. Tele-audiology is defined to be feasible to implement and helpful in identifying auditory pathology for children in rural and remote areas.

The last article to be cited in this category do not address a medical field but highlight the importance of telemedicine in the area of education. Chipps et al. [50] defined the difficulty in recruiting nursing and medical staff in rural areas. Videoconference-based education, the use of videoconference equipment to provide teaching to participants with live visual and verbal interaction, is considered an area of tele-education. The study defined a case reporting an increase in knowledge using videoconference and two cases with no significant different respect to the tradition, or face-to-face training activities.

3.2.3. Example/case study

Focusing on specific African countries, different telemedicine projects has been implemented. Among them, some with successful results, others instead lead to a failure. Before introducing the determinant factors and challenges occurred in the literature, here are presented selected case studies emerged from the literature. In Cabo Verde, the telemedicine program, called IteHP-CV, was launch in 2013 by the IveH and supported by the Cabo Verde Government. The initial results were encouraging, registering 63 tele-consults during the first seven months of application, of which 22 refereed only to the last month of the year. [51]

Later, has been provided a follow-up study covering the results from 2014 and 2018 by Azevedo et al. [52]. Moving from 128 patients in 2014 to 796 in 2018, they affirmed the robustness of the program, ensuring a long-term sustainability.

Tchao et al. [43] analyzed projects of application of telemedicine in Ghana. Most of them were done using the asynchronous methodology, due to its easiness to implement. A web-based tele- ophthalmology system was set up to share photos with a case history online and receive help on the case from a specialist at Moorfields Eye Hospital in London. During the first 12 months, 132 cases were posted from five of the six centers participating.

In Ethiopia, an Ethion-Indian telemedicine center was established in 2005. Funded by the Indian Government and supported by the Ethiopian one, initially was designed to provide consultation services in radiology, cardiology, pathology and dermatology. However, has been registered over time an underutilization of the system, with a decrease in the number of consults requested. [53]

3.2.4. Recommendation for telemedicine

Among the telemedicine programs carried out in developing countries, some have been able to maintain their sustainability over time; others, instead, led to a failure. The output of telemedicine projects depends on different factors that may influence their results. “The ideal tele-rehabilitation intervention for low-middle income countries (LMICs) should be simple, robust, user-friendly for easily operability by a less sophisticated population in resource limited settings” [54].

Despite the general characteristics that tele-rehabilitation, in general telemedicine, intervention should have, from the literature, have been identified some critical factors and challenges that must be considered when starting a new program.

Gurman et al. [55] identified ten recommendations to incorporate into telemedicine interventions. The most important are summarized in the following points:

- Selecting the appropriate technology
- Ensuring privacy
- Long-term evaluation
- Understanding the audience

The last point discusses the need to understand the referring population, especially regarding the cultural background.

Furthermore, Edoh et al. [37], Mburu & Oboko [56], Adenuga et al. [57] and Zolfo et al. [58] analyzed in their works the importance of awareness of healthcare professionals and patients about telemedicine. To conclude, the acceptance from principal users represents a critical factor to maintain the success and the sustainability of the program.

Interesting for the purpose of this work can be considered also the steps provided by Ekanoye [59]. In particular, a company providing telemedicine services in Sub-Saharan Africa should consider:

1. Vision Layout: estimate the initial costs and setting certain goals.
2. Finance Layout: considering funding and support strategies.
3. Location: place of necessary equipment, positioned in the patient room.

4. Training Programs: to secure successful practices on those in need, including both technical and communication aspects.
5. Enough Doctors on call: keep a certain number of doctors on call at any moment.
6. Market: the more the people aware of telemedicine, the better the success.
7. Hierarchy: have the right people in charge, to keep telemedicine alive.

Some of these aspects are also cited by Shiferaw & Zolfo [60], which also stressed the importance of an eHealth policy and an enabling-policy environment, of simple and locally adopted user-friendly software. Moreover, if encouraging by private institution and sustained by a business model, which encourage active participation of all the actors involved, could lead to a better success.

To conclude, all these considerations are summarized and classified by Combi et al. [35] in major recommendations on how to plan, manage and continue future telemedicine projects. The table provide a scheme of them. Although only articles on telemedicine in Africa have been sought, the recommendations below are also valid outside developing countries. Some of them, however, may be considered context specific. Train the personnel and increase the accessibility via telecommunication and Internet connectivity are two central factors for the development of telemedicine in Africa. As further explained in the following challenges section, the Continent has one of the lowest rates to internet connection, which leads to a low use of any ICT equipment. In addition, the lack of medical personnel, especially in rural areas, makes even more important to train and increase the acceptance of telemedicine system.

On the other side, set clear goals and define suitable duration for the project may not be of primary importance for developing countries.

<i>Set clear goals for the project</i>	Selecting clear goals to be achieved by the project is the key issue for success in any project: features such as language, culture, local habits, religion, and lack of resources
<i>Select the proper application medical domain and priorities</i>	Domain and priorities would be selected in strict accordance with the major needs of the country
<i>Adopt user-friendly interfaces</i>	When dealing with remote users whose skills may be not at a high level, user interface would be as easier as possible
<i>Train the personnel</i>	Locally organized courses may significantly increase the overall acceptance of the telemedicine system, and so increasing the overall results
<i>Increase the accessibility via telecommunications and Internet connectivity</i>	The level of the quality system depends on the connectivity of the remote health care center
<i>Foster continuing use</i>	Long-term analysis highlights that after the initial enthusiastic approach, the everyday practice forgets about the tele- medicine system
<i>Motivate and stimulate shy or touchy users</i>	It would be clear to all the personnel involved in the telemedicine project that asking for a remote consultation does not mean lack of skill, incompetence, or inadequacy in managing the patient.
<i>Implement standards and protocols, consider practices and guidelines</i>	adopting standards, shared protocols and guidelines helps a lot in enabling easy communication between different health care centers.
<i>Define a suitable duration for the project</i>	Again, choosing the proper application domain as well as the goals of the project is an extremely relevant issue.
<i>Start small, then escalate up</i>	Asynchronous communication is a very good starting point for telemedicine projects in poor countries. After the original impact, the service can be extended and enriched
<i>Measure cost-effectiveness and user satisfaction</i>	Due to the high costs generally requested in telemedicine projects, the decision of continuing or discontinuing the project requires some cost-effectiveness and user satisfaction metrics

Table 20: Recommendation for implementing a telemedicine project by Combi et al.

3.2.5. Benefits of telemedicine

As previously explained, telemedicine can be used to improve access to healthcare system, especially in low-middle income countries. Cilliers & Flowerday [61] identified the main benefits of telemedicine as:

- Increased quality of care: increased access to specialized services with fewer unnecessary referrals to urban hospitals. Usually located in cities, patients could require days to reach a specialized hospital.
- Saving time and cost: both for the patient, as discussed in the previous point, and for health care workers attending educational opportunities. It is also more cost efficient to make use of telemedicine than to employ and retain specialists in rural areas. By receiving second opinions and advices from more experienced doctors, local workers will be able to increase their knowledge and improve level of service offered. At the end, they will be able to provide an autonomous service for similar cases.
- Decreased isolation of healthcare workers: providing educational and supervisory opportunities in rural areas to continue the development of the region. Mobile health, and connected telemedicine, may enhance health behaviors, and, therefore, health outcomes at population level.

Mobile health, and connected telemedicine, may enhance health behaviors, and therefore health outcomes at population level. [62]

3.2.6. Barriers of telemedicine

18 articles, out of the 48 selected, addressed the main causes of failure and difficulties of telemedicine. It is here presented a sum of the main barriers a company might encounter when starting a telemedicine program in developing countries, especially Africa.

Kachieng'a [63] and Mars [39] identified as the main problem the poorness of Africa's telecommunication infrastructure. It both includes inadequate infrastructures and connectivity problems, such as Internet connection and bandwidth problems. Also mentioned by the second author is the limited awareness of telemedicine by healthcare workers, which lead to a lack of a change management plan, no business model and limited ability of using that infrastructure.

Some of these challenges are similarly cited by Combi et al. [35], including the high costs of telemedicine solutions, the user acceptance and the resistance to change, lack of standards, lack of regulatory bodies, necessity of accreditation of service providers, absence of licensed health care professionals and undefined business models.

User acceptance, as showed by the literature, is translated into telemedicine reluctance from healthcare professionals. It can be linked to the fear of handling computers, anxiety of losing job security [64] and fear in changing the traditional relation doctor-patient [65].

The fear of changing the status quo [66], the resistance to new processes and the negative attitudes towards use of ICT refer to the class of individual challenges that telemedicine has to face.

Lack of standards and regulations are other two factors often cited mainly by Combi et al. [35], T.O.C. Edoh et al. [67]. The adoption of standards could help the communication between different centers, which can be supported by the presence of regulatory bodies.

Connected to the problem of lack of standards and regulation, the country-specific legal and policy barriers should be considered [68]. The lack of strong political leadership and coordination, a political scenario not free of corruption and an insecure environment are additional potential causes of failure of telemedicine [69].

As previously mentioned by Combi et al. [35], Scott & Mars [69] highlighted in the social domains the absence of health human resources. This is especially common in rural areas, already facing health system challenges, where are mainly missing healthcare workers, but with more need of telemedicine.

If health workers do not represent an issue, the problem of lack of knowledge may exist. Due to the low level of ICT infrastructure, the theoretical and physician computer literacy and an adequate information technology knowledge remain scarce in the country [70], [71]. Thus, the lack of end users training increases the individual and human challenges.

The lack of no well-defined business models does not ensure sustainability over a telemedicine project. They are relevant also from an economic and business perspective, to estimate costs, revenues and return of investments. [35]

The novelty of telemedicine in developing countries and the immaturity of the market make the financial sustainability a major issue. [72] Many companies are not able to sustain their site, also due to the high costs of equipment and maintenance. Avanesova & Shamliyan [68] stressed the point emphasizing the inadequate funding both related to the healthcare sector and to the telemedicine site.

Additional relevant barriers studied by different authors already cited regard: other technological challenges, such as the problem of privacy, security, data protection, data-storage; non-technological challenges accountability, lack of space, employee turnover, communication, weak organizational capacities and lack of funding. [73]

Akhlaq et al. [74] and Van Dyk [32] provided two different classification of the main barriers so far discussed.

The former divided them into seven categories:

- Socio-political: lack of leadership and coordination, corruption, insecure environment and lack of evidence-based decisions.
- Financial: lack of funds and sustainable cost.
- Infrastructure: lack of equipment, office space, power shortage and poor telecommunication.
- Organizational: lack of training, lack of human resource and absence of supervision.
- Technical: faulty, rigid and incomplete system and system design issues.
- Individual: unawareness, privacy concerns, resistance to the new process.
- Data management: lack of timely reporting, feedback and data analysis tools and poor data quality.

The latter instead listed them in four categories:

- Technical barrier: availability of the technology, as well as knowledge.
- Behavioral barrier: change management, respect to resistance to change, power and politics around telehealth.
- Economical barrier: reimbursement healthcare workers consultations and to open up new patient markets.
- Organizational barrier: integration of telemedicine services into existing organizational structures and provide support.

To conclude, considering the classification provided and the most diffused barriers, a final taxonomy has been defined, that will be used in the next step of this work.

Compared to the typical challenges of telemedicine, below are proposed five classes that belong specifically to Africa.

The first concerns technical problems, which includes lack of infrastructure and connectivity. The former encompasses the physical infrastructure, equipment, transport, and ICT requirements. Over years, despite the investments in the healthcare sector, there has been limited focus in health infrastructure across the Country. To evaluate the status, is used the emerging health infrastructure score, based on averaging country normalized values within a range from 0 to 1, where 1 is the highest value. Depending on the region, the highest is 0,67 in Guinea Bissau to the lowest of 0,06, touched by many African countries. [75]

Concerning the latter, according to the International Finance Corporation of World Bank Group, Africa has the lowest number of internet connection. Despite the largest potential for progress, only the 22% of the continent have access to internet.

The second class refers to the financial contest, including lack of funding.

As previously mentioned, the lack of substantial funds in the health sector has limited its development. In particular, the high cost of a telemedicine service, in terms of equipment, staff and economic support, makes its dissemination difficult.

Moving on, individual challenges were analyzed. From a medical side, it consisted in low level of computer literacy and lack of trained workers and low user acceptance.

The missing ICT infrastructures and connectivity problems make not only limited the use of technologies, but also the computer familiarity itself. A precarious level of IT knowledge has been found especially in rural areas, where most of the information is still managed with paper tools. Moreover, the health staff remains a critical factor for health systems in terms of numbers, quality and management. Indeed, based on the health workforce score, measured by the number of staff available across countries, the range wide from a high of 0,74 to a low of 0,02, which characterized most of the nations. [75]

Despite the benefits of telemedicine, it has seen as an additional workload to already overburdened healthcare workers, due to their low availability in Africa. Being not aware of the technology and concerns about remuneration are others importance factors for the low user acceptance. [61]

The scarcity of coordination and management of telemedicine centers represents the organizational issues. The low level of spread of telemedicine in Africa makes difficult to definition of real business models.

The high level of staff turnover contributes to a difficult and lasting management of the centers, given by the migration of nurses, and medical staff in general, from rural to urban or from public to private hospital, where a higher level of care and salary is insured. [76]

The last category regards political challenges. Lack of political issues and lack of standards are specific of each country. However, the great variety of local diplomatic models and the resistance movements and periodic revolts in many of the African countries, made the stability of a political leadership hard to reach. Finally, sharing personal data with other doctors outside of your own may be a problem for some patients.

The table below provides a summary of what has just been discussed.

Technical challenges	Financial challenges	Individual challenges	Organizational challenges	Political challenges
Lack of infrastructure	Lack of funding	Low level of computer literacy	Absent of coordination and management	Political and legal issues
Connectivity problems		Lack of trained personnel	Staff turnover	Lack of standards
		Low user acceptance		Privacy problems

Table 21: Five classes of challenges identified from the literature review

4. Understanding telemedicine in Africa

The following chapter aims to validate the challenges presented in the previous chapter, to provide a strategy for the implementation of telemedicine in Africa.

To obtain the essential information, has been chosen to interview telemedicine centers currently working in the country, taking as reference the "GHT Onlus. As subsequently explained in *chapter 6*, the NGO will be the service provider for the case study in Tanzania.

On this purpose, the history and the online platform of GHT are presented in the first section, 4.1. It also shows an example of a new tele consult webpage creation.

Section 4.2 is dedicated to the selection of the Onlus' telemedicine centers active in Africa to interview, based on the analysis of the public tableau of GHT. The choice is concluded in section 4.3, considering only the centers the author was able to interview. The next unit, 4.4, provides the structure and the transcriptions of the interviews carried out for Tanzania, Malawi and Egypt.

Section 4.5 presents the obtained results, considering both the theoretical challenges and the information extrapolated from the interviews.

Concludes the chapter the last section 4.6, in which the lessons learnt for implementing a telemedicine service in Africa are presented.

4.1. Global Health Telemedicine

GHT, founded in 2013 by Michelangelo Bartolo, followed the experience of the Disease Relief through Excellent and Advanced Means (DREAM) program of the Sant'Egidio Community, a Christian community born in 1968 on the initiative of Andrea Ricciardi. It offers a medical, open source, free, multidisciplinary tele consult service that makes use of a pool of Italian specialists who lend their free of charge. It is a clear example of a new way to make international cooperation with a high-impact and low-cost.

The origin of the DREAM program dates back to the late 1990s as a concrete response to the injustice of different standard of care between rich countries and the south of the world. Indeed, DREAM was born for the right to health, the fight against AIDS and malnutrition in Africa.

The training of local health workers, free treatment and care procedures, the help of African professionals, therapeutic-diagnostic protocols have ensured the continuity and sustainability of interventions in the medium-long term. Over years, it has become a network of communities that, in more than 70 countries of the world, is committed to offer voluntary and free help to the less advantaged. In detail, in collaboration with the DREAM program, the Association offers services in the field of telemedicine in the most deprived places, creating a bridge between the north and the south of the world.

Currently, there are 39 remote health centers active between 14 African countries, Peru, Brazil and Italy. Through an asynchronous service of multidisciplinary medical tele consult in different specialization, such as cardiology, dermatology, neurology, pediatrics, radiology, ophthalmology, surgery, hematology, internal medicine, endocrinology, orthopedics, urology, antalgic medicine, oncology, gastroenterology and burns, to date, it has guaranteed more than 14'000 diagnostic and therapeutic indications.

The NGO refer to a pool of 160 Italian and European doctors who give free advice to doctors' applicants, belonging to hospitals, dispensaries or small remote health centers, managed by missionaries, NGOs or government health.

4.1.1. GHT Online Platform

Communication takes place through a web-based platform, where African doctors can send a request through a dedicated space. Created by Ttre informatics, the platform has the particularity of working also offline, fundamental for health centers with poor access to Internet.

In the platform, there is a specific page for the creation of a tele consult. The upper part is dedicated to patient's data: name, sex and birth date/estimated age. The lower part is given information about the tele consult. At the beginning, is asked to define the level of triage; there are four levels of emergency: white, green, yellow and red. Since the platform has been created to work asynchronous, there are not emergency consults, however each is assigned a risk-based priority index. Then, is given the possibility to add some medical observation, while is mandatory the main answer.

There is an optional setting called Wizard that adds basic questions for an objective exam, depending on the specialization. Currently there are Wizards for general medicine, cardiology, dermatology and otolaryngology.

When the consult is ended, is chosen the medical specialty of destination. Each request is automatically sorted to a selected group of specialists, which receives an email or SMS that informs about a tele consult and allows to interact quickly between applicants and referrers.

Finally, the answer can be consulted in the software or online through any device. The entire activity is monitored by the Service Center, which provides two help desks: a health service, which intervenes to ensure the conclusion of each request and a technological first and second level to provide assistance to applicants and receivers.

Patient information is stored on the cloud, to create a medical record. Diagnostic or instrumental examinations from electromedical devices installed in remote centers may be attached. The equipment of each remote health center is modular and include a portable computer, dedicated exclusively to telemedicine, an electrocardiograph, a saturator, an HD webcam, an ophthalmoscope, an otoscope, an Rx scanner and various other health devices.

The image below provides an example of a new tele consult creation page.

The screenshot displays the 'Request : New' form on the GHT platform, organized into three main sections: Patient registry, Request details, and Recipients.

Patient registry

- Clinical Center:** A dropdown menu.
- DREAM Integration:** A dropdown menu with 'Code' and 'BANGUI' options.
- Name:** A text input field.
- Surname:** A text input field.
- Sex:** A dropdown menu.
- Date of birth / Age:** A dropdown menu with radio buttons for 'Date of birth known' (selected) and 'Approximate age'.
- Year of birth:** A dropdown menu.
- Month of birth:** A dropdown menu.
- Day of birth:** A dropdown menu.
- Anonymisation:** A checkbox labeled 'Make this patient anonymous for everyone'.

Request details

- Triage:** A row of four colored circles (blue, green, yellow, red).
- B.P. Max, B.P. Min, H.R., O.S. %:** Four text input fields.
- Medical Remarks:** A large text area.
- Attachments:** A 'Load files' button.
- ICD-10:** A text input field with an 'Open' button.
- Wizard Physical Examination:** A text input field with an 'Open' button.
- Wizard Derma:** A text input field with an 'Open' button.
- Wizard Cardio:** A text input field with an 'Open' button.
- Wizard Ear:** A text input field with an 'Open' button.
- Main Question:** A text input field.
- Medical History:** A text input field.

Recipients

- Requested Medical Specialties:** A dropdown menu with 'Select...'.
- Default Languages for this request:** A dropdown menu with 'English X'.
- Privacy Policy:** A checkbox labeled 'The Patient has expressed consent to allow the processing of Sensitive and Personal Information.'
- More details:** A button.
- Exit without saving:** A yellow button.
- Save as draft:** A grey button.
- Send Request:** A blue button.

Figure 3: New tele consult creation page on GHT platform

4.2. Selection of GHT centers to interview

The choice of which centers to interview was based on the analysis of the Onlus' organization. Each state in which GHT works has a computer technician who oversees all active centers in the nation. In addition to intervening in the various centers in case of technical problems, the technician in charge is responsible for the installation of the new centers and the training of medical staff on the operation of the platform.

Consequently, the choice was not based on the single telemedicine station but on the analysis of all the centers in the states in which GHT operates.

GHT has a public tableau that provides real-time data on all centers, in terms of consultations and specialist requests. An important limitation to report is the amount of data available on the platform. Although all the states in which are present telemedicine stations are listed, only some of them can have access to information.

Between those meeting the criteria, namely available data and active and no longer functioning centers, the following countries were selected for the analysis: Cameroon, Kenya, Malawi, Tanzania. Given the low number of states identified, it has been chosen to include those that no longer have operational centers. Among them, Egypt and Madagascar.

Of all countries selected data refer to the last 3 years. The choice is given by the need to observe their activity even before the arrival of Coronavirus 2019. The data presented are updated to August 2021, 11th.

4.2.1. Cameroon

In Cameroon have been activated 2 centers, in Dschang and Nkoleniong.

The former presents only 4 requests all dated to May 2019, after which no other teleconsultations have been carried out. The latter, instead, started in June 2021. In the following month the requests continued, for a total of 71 tele consults in the first two months of operation of the center.

The main clinical categories for which a consultation is required are infectious diseases, pediatrics and nutrition, respectively 36, 31 and 21 out of the 75 totals.

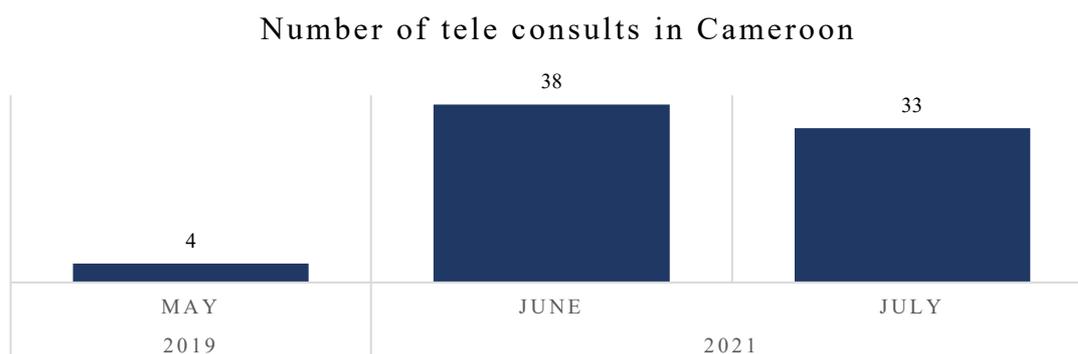


Figure 4: Number of tele consults in Cameroon, 2019-2021

4.2.1. Kenya

Since 2019, Kenya counts the activation of 4 centers.

Of these, two appear to have been operational only in the first year. In particular, from Nyandiwa were sent respectively 4 tele consults in February, 4 in May and 4 in July. From Nairobi, however, 6 date back to July and 18 to September. Subsequently, no further use of the platform was recorded. The third center of the country, Meru, was also activated in 2019, contact 5 tele consults in July and 11 in December. After that, in 2020 only 10 interventions were requested. The activity resumed in 2021 with 7 requests in May and 3 in June.

The last station, activated in Chaaria in 2020, recorded 19 activities in August of the same year and 10 in 2021, respectively 7 in May and 3 in June.

Bronchus Pneumology, internal medicine and nutrition are the main categories consulted, all fair with 19 requests each.

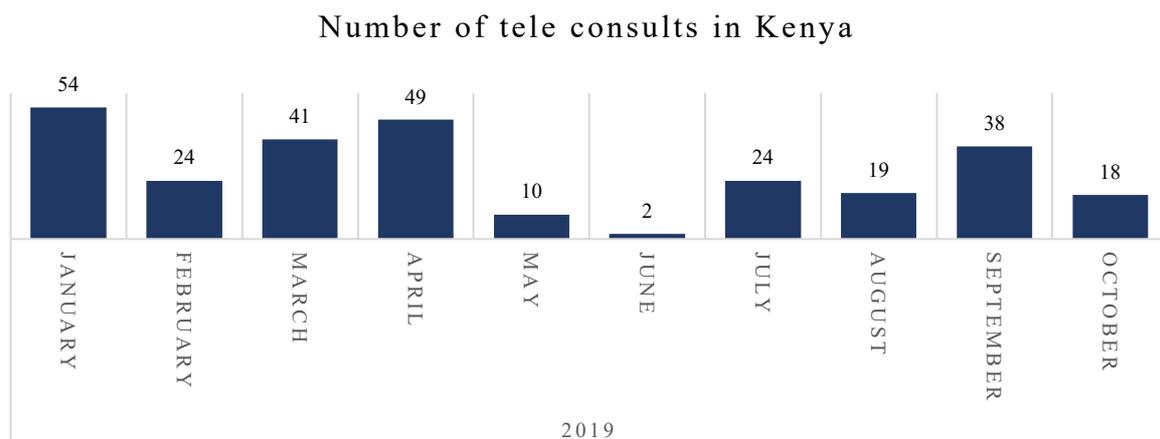


Figure 5: Number of tele consults in Kenya, 2019-2021

4.2.2. Malawi

Malawi is one of the states with the most active centers in Africa.

In Blantyre, Balaka and Mtenga Wanthenga they were already operating in the first month of 2019. Subsequently, Machinga started recording in November of the same year. The first two showed a linear trend over the years, with requests for consultation in almost every month of the two subsequent years.

Mtenga Wanthenga, which had the same trend for 2019 and early months of 2020, from August 2020 did not ask any request, until April 2021, only month in the year to count tele consults.

The last named, Machinga, after 14 teleconsultations required in November 2019, was no longer used, excluding 3 requests matches in October and November 2020.

In 2020 the centers of Masuku and Kanepi were activated. Both still active today, with 2 teleconsultations each in July 2021, are those with the lowest use of the state.

Cardiology, neurology and internal medicine, with respectively 470, 461 and 440 tele consults, are the most required.

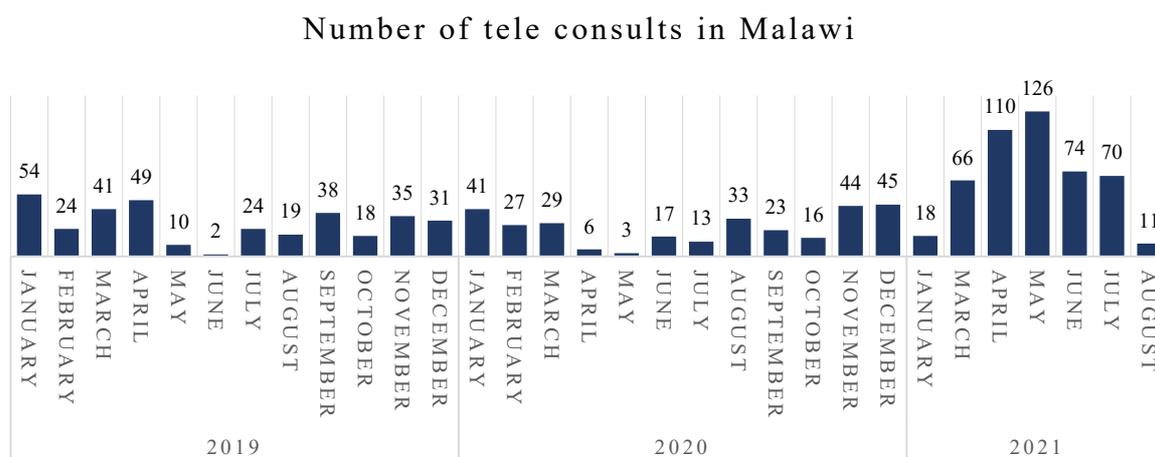


Figure 6: Number of tele consults in Malawi, 2019-2021

4.2.3. Tanzania

In Tanzania, of the 4 open centers, 2 are still in use. In particular, Arusha and Iringa registered the last tele consults respectively in July 2021 and May 2021, both with 8 requests.

In Masanga, the last contact occurred in May 2020, despite a large use of the center in the previous year, where the same month in 2019 registered 39 requests.

In Itigi the platform was used only in 2019, with a high number at the beginning of the year, 55 in January and concluding with 16 consultations in November.

In the country, the main clinical categories required are infected diseases, with 442 requests, radiology, with 374 and internal medicine with 309.

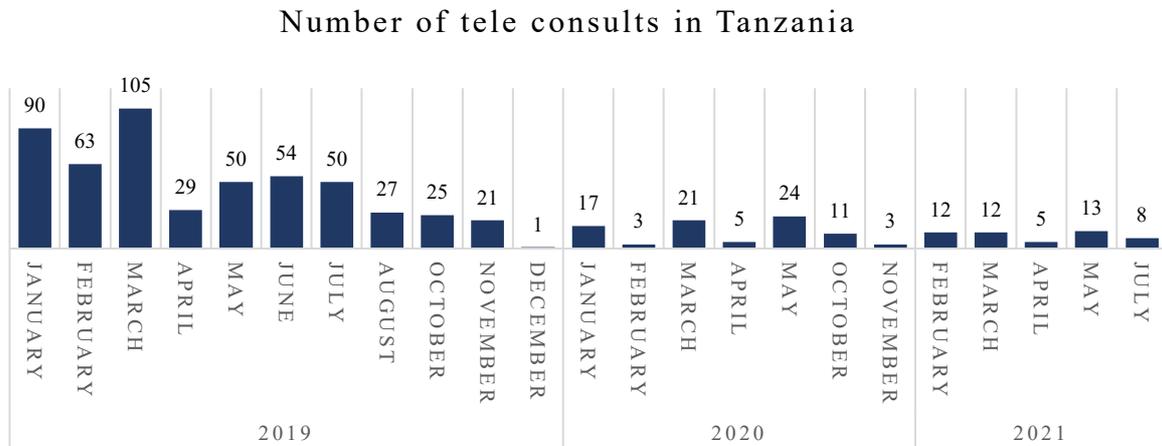


Figure 7: Number of tele consults in Tanzania, 2019-2021

4.2.4. Egypt

In Egypt only one center was activated in 2019 in Cairo. The number of requests sent has always been very low, counting that the peak months were registered in February and July 2019 with 3 requests. Subsequently, in 2020, only one request was sent in January and one in December. Since then, no further use of the platform has been reported.

Out of all the 12 requests, the most popular medical class was oncology.

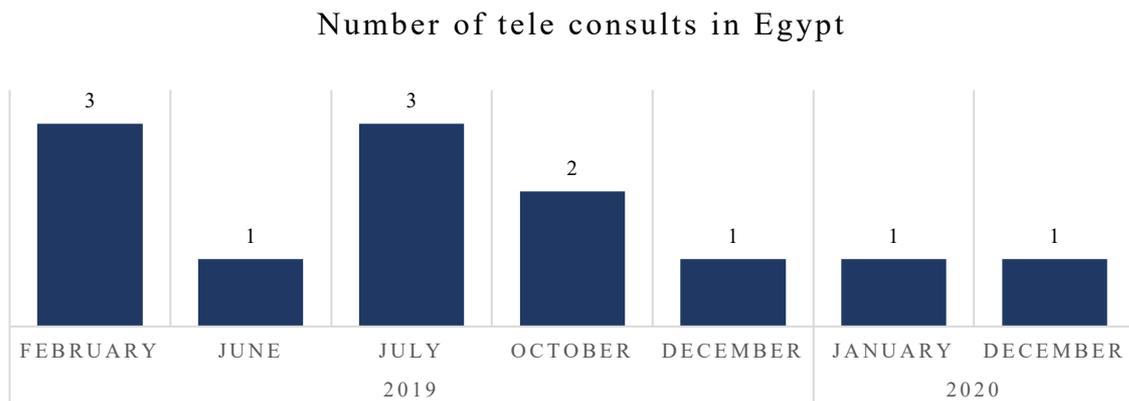


Figure 8: Number of tele consults in Egypt, 2019-2020

4.2.5. Madagascar

Madagascar also has only one center in the state, in Andavadoaka.

The platform was widely used in 2019, counting a peak in September of 71 requests. In 2020, after 16 teleconsultations in February and 3 in March, it was no longer used. In total, 149 applications were sent in the two years considered.

In many cases, multiple medical specialties were selected in the same consultation. The most-named concern cardiology, application 116 times, orthopedics and infectious diseases 31 times each.

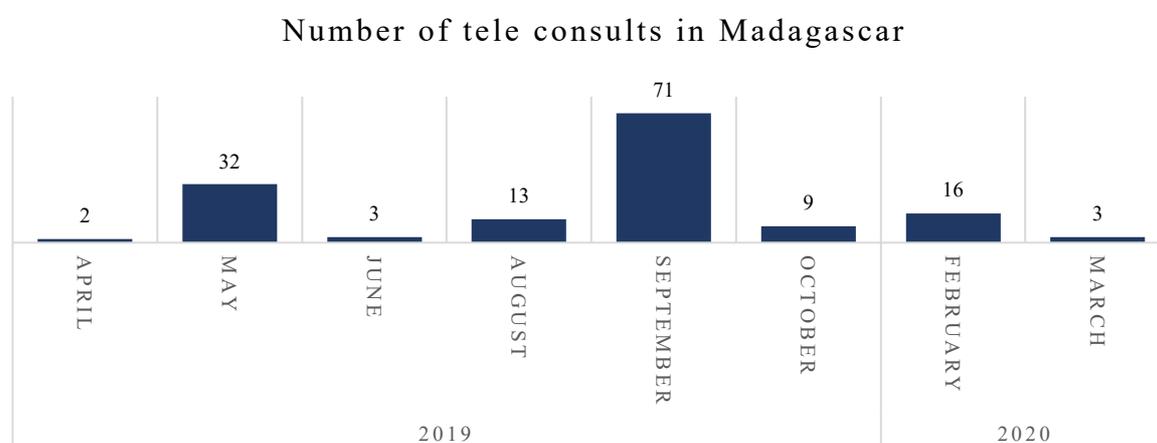


Figure 9: Number of tele consults in Madagascar, 2019-2020

4.3. Final selection

All the States concerned have at least one center which has not been active for more than one year: Dschang in Cameroon, Machinga in Malawi, Itigi in Tanzania, Cairo and Andavadoaka in Egypt and Madagascar.

The objective was to interview the technical referents of these states in order to understand the problems encountered and verify a match with the challenges identified in the literature review.

A further limitation is, however, to be mentioned. The necessary contacts were from GHT, which could only connect the author with some of these technicians. In the end, the interview was done for Tanzania, Malawi and Egypt.

Below will be proposed the track of the interview used for the first two states. As for Egypt, the focus was on the issues faced with the center in Cairo.

An analysis was also made on the clinical categories mainly required by different states.

Although the platform has been used for several specialized, including pediatrics, neurology and orthopedics, there is a clear majority of demands in internal medicine and infectious diseases.

4.4. Interviews

4.4.1. Structure of the interview

This section presents the method in which the data from real cases were collected. In order to obtain targeted and useful information for the purpose of the thesis work, an interview was structured with the technical referents. All interviews took place online, using digital platform such as Zoom and Messenger.

Before entering in detail with the questions, the author has stated the purpose of the interview: validate the challenges identified in the literature and possible further weaknesses to be taken into account for the case study later analyzed.

Since was not clearly defined the rule of referents, has been asked first their task, the centers controlled in the country, considering both the active ones and those that no longer worked.

From *table 21* were identified five categories of challenges for telemedicine in Africa. They have been used to structure the second part of the interview.

For technical problems, questions focused on eventual connection problems and difficulty in positioning the platform, in terms of infrastructure availability.

Regarding the financial part, was asked if the centers controlled were able to sustain their self, mainly due to the high-cost telemedicine requires.

Following with individual challenges, was asked about medical staff: if a lack of computer literacy has been detected, if they were reluctant in the adoption of telemedicine and, in general, if they verified any other problems.

For legal problems, was asking about eventual regulatory and/or political problems encountered due to the adoption of telemedicine in the specific interest.

Lastly, the interview ended up with questions were related on how the centers are organized and manage, therefore if any issue were found in this field.

The final structure of the interview used is shown below.

First part

1. Which is your role within the Organization?
2. Which are the centers you are controlling? Are they all active or not?

Second part

Initially, when you installed the platform:

1. Did you encounter in any technical problem, such as lack of connection?
2. Was the station easy to install? Did you find a lack of infrastructure that was necessary for the platform?
3. At economic level, are the centers able to sustain them self?
4. Considering medical workers:
 - 4.1. Did you notice a lack of computer literacy?
 - 4.2. Were they reluctant in the telemedicine use?
 - 4.3. Did you face any other problem with them?
5. Specifically of your country, there has been legal or political problems for the adoption of the system?
6. Considering now, how are the centers coordinated?
7. Has been detect any problem for the management and organization of each of them?
8. Are patients reluctant in sharing they data?

4.4.2. Answer to the interview: Tanzania

The first interview has seen as subject the technical referent of Tanzania, H.H. He is responsible for the installation and the training of local doctors are going to use the platform. In every center there is an IT technician, but occasionally he passes through all the centers to check any possible problem the IT referent is not able to solve, or to update the platform when Michelangelo Bartolo send the new vision and characteristics of the system.

As shown by the digital tableau, there are four centers in Tanzania: three of them active, in Iringa, Arusha and Masanga, and one no more working in Itigi. All answers are related to centers that are currently functioning.

Concerning technical challenges, there has not been any problem with infrastructural: the platform, easy to be installed, requires a small place, usually where the patient is visited.

On the other side, some difficulties have been registered with internet connection. In Arusha and Iringa, being located in the center of the city, the connection is almost always stable. In Masanga, instead, located in a more rural area, the connection is often

interrupted, making it more difficult to use the platform. This can be identified as the main reason why the platform has stopped working in the last year.

H.H. has declared that economic administration of the platform is not his concern. However, he reported that, to date, no issues have occurred regarding maintenance payments.

Moving to individual challenges, no medical doctors had experienced a lack of computer literacy, mainly because all the centers already used other IT software beyond telemedicine. On the contrary, they are not familiar with the latter. Besides, neither reluctance towards telemedicine was not found. Many doctors often encounter situations difficult to face and identify telemedicine as a concrete help for both them and the patient, providing more accurate diagnosis.

Iringa, Arusha and Masanga centers are private hospital, in which administration controls doctors' work, including the use of the platform. There are not specific days in which it is used, it depends on the patients' necessity. Also, all the medical staff can use the service. In particular, two of the three doctors in Iringa and the two in Arusha are able to experience it.

To conclude, both political and legal and privacy issues were not faced by Tanzania.

Itigi, the center no longer active, faced organizational problems. In particular, there has been a problem with doctors who were not willing to practice telemedicine, seeing it as "working for free". Since the use of the platform did not constitute an increase in salary for staff, it was seen as additional unpaid work. The lack of effective management and coordination of the center has led to the failure of the service.

In Masanga, the IT responsible for the center declared that the doctor performing the ECG, one the instruments used in telemedicine, stop working with the hospital, and the new one was not trained to replace him. Thus, a problem of turnover of the personnel characterized the lower performance of the station.

4.4.3. Answer to the interview: Malawi

In Malawi, P.M. is the technical referent of the country, in charge of solve system problems and provide user support to all the centers. Differently from the previous case, there is not a specific IT referent for each station, thus he has to often visit them and provide his services.

Among the six centers activated in Malawi, five are now still working. Considering all the challenges, P.M. declared that:

The main technical problems were related to Internet connection, where, especially in rural areas, the connection goes down during the working period, from 8am to 4.30pm.

Thus, the possibility to use the platform offline solves, most of the time, this issue. About infrastructural challenges, it depends on the service installed. For the basic equipment is not need much space, however, the more the instruments used, the more the space will be necessary.

Again, the economic side was not on his concerned. Nevertheless, the high stability for a long period of time of all the centers suggest the maintenance cost does not represent a challenge. What is instead more problematic are the costs of connection they have to face.

Moving to those highlighted as individual challenges, the lack of computer literacy was experienced based on the provenance of doctors. Mainly related to the school they followed, P.M. encountered medical doctors with already formed computer skills and others without. The concept of telemedicine has been welcomed in a positive way, being seen as a way to assist them in their work. However, is challenging at first having to interface with something new.

Another problem is about the high turnover of medical staff. In one of the centers, they faced a turnover of 3 new doctors in a year. Being new, they are not familiar with the platform and lead to a lower use of telemedicine.

Organizational issues were not faced, the administration of the hospital provides to the staff the program, which includes telemedicine. It is a free service provided on a daily basis from Monday to Friday.

In conclusion, P.M. did not express any issues about the political and privacy side. Regarding the latter, patients are informed about the procedure and usually are not interested in sharing their information to other doctors.

4.4.4. Answer to the interview: Egypt

The last interview took place with the Egyptian referent, D.M., an Italian doctor who, for years, lives and owns a private center in Cairo.

Since the only center of the country is no longer working, the structure of the interview has been slightly modified. In particular, the purpose was to understand what had happened in the last year, as the last tele consultation dates back to 2020. The main reason was attributed to the advent of Covid-19 in Egypt.

As a private center, pandemic cases are handled at patient-home, while the platform, located in the center, is only used for non-urgent cases. Moreover, most of the situations require immediate intervention, thus there is no reference to the use of the platform.

The organization of the platform appears to be different from the cases previously analyzed. As stated by the D.M., to ensure 100% of the telemedicine effectiveness, he is the only person to interface with the platform, despite are working several local doctors in the center.

The different language and the different clinical approach that African doctors have compared to Italian ones, who respond to tele consults, appears to be the main reason for this organization choice.

As second reason, the cases that require the use of telemedicine are chosen only by himself, due to the possibility of abuse of the platform from local colleagues. The latter could, in fact, use it in a non-exclusive way, even for those cases that would not require a second opinion.

Considering the structure of the interview, has been ask about those topics that did not emerge from this first part. Any technical problems were registered: the presence of 4G/5G throughout the territory makes effective the internet connection. Moreover, since the platform is installed in a room of an already existing workspace, also infrastructural issues were not encountered.

Not even on the political/regulatory problems were identified. Since the tele consult is interpreted by himself, the final results in given by a doctor, so this does not imply any political issues.

To conclude, has been highlighted that there is a different idea of privacy in Africa respect to developed countries. Thus, no patient has ever shown reluctance to use his data.

4.5. Obtained results

This section provides an analysis of the results obtained from interviews with respect to the theoretical challenges identified in *Chapter 4*.

As mentioned before, five categories of challenges were selected from the literature review: technical challenges, including lack of infrastructure and connectivity problems; financial challenges concerning lack of funding; individual challenges for low level of computer literacy and low user acceptance; organizational challenges for absent of coordination and management and staff turnover; political challenges including political and legal issues, lack of standards and privacy problems.

Used to define the interview described above, it was possible to define which of these were actually detected by the centers.

Starting from the first category, on the one hand all three countries encountered connection problems, confirming what had been highlighted by the International Monetary Fund (IMF) of World Bank Group. Especially Malawi, who has experienced the closure of one of its centers for this issue. The main connection difficulties occurred during working hours, while a good bandwidth was spot in the evenings. On the other hand, infrastructure does not represent a key issue. GHT provides the essential equipment for telemedicine, which can be easily place in the patient room.

For what regards financial challenges, none of the respondents were aware of the economic management of the centers. Nevertheless, connection costs were considered weightier than maintenance ones.

Individual challenges were validated only on one side. The lack of computer literacy has been experienced only on medical staff coming from more rural areas. Today, the level of computer use in hospital is quite spread among the country. In contrast, was not noticed a reluctance in the adoption of telemedicine. It can therefore be said that, especially in Africa, a second opinion is well received by doctors.

The absent of coordination and management, together with the connectivity problem, is one of the major reasons of telemedicine failure. For two different causes, but still considering the organization of the service, both Egypt and Tanzania faced a drastic decline of the platform's usage.

The category none of the interviews encountered was about political challenges. No legal or political issues were related to the three countries selected. However, this point cannot be generalized to Africa as each country has different laws.

On the same level are privacy problems, as declared by the technician. Can be concluded that data privacy in Africa is of secondary concern to receiving more complete care.

The final challenges to be considered, based on the results obtained, are shown in the table below.

Technical challenges	Individual challenges	Organizational challenges
Connectivity problems	Lack of computer literacy	Absent of coordination and management
Staff turnover		

Table 22: Three classes of challenges validated from the interviews

4.6. Lesson learnt

From the major insights obtained in the results, were defined some lesson learnt for a telemedicine service in Africa.

In details, for ensuring its success, the following aspects have to be assimilated in the project:

1. *Connection problems*

Ensure an adequate level of Internet connection, especially during working hours. Even if the platform can be used offline, centers need to be able to send the request quickly.

How? Dedicate days or hours to telemedicine, making less use of the connection by other departments.

2. *Lack of computer literacy*

The training for computer using and basic IT knowledge have to precede telemedicine, to exploit 100% the resources of the platform.

How? Dedicate a training day by doctors with IT skills for those who need it.

3. *Staff turnover*

Always have at least one person capable of using the platform, so that if personnel changes occur, the platform does not remain unused but only less exploited. In the meanwhile, teaching its use to a new doctor.

4. *Organization*

Insert telemedicine within the daily program of the hospital, not leaving the doctor the free choice on its use.

How? Define the specific days/hours within the day in which the patients' visits is done using the platform.

Still, have more than one doctor using the platform to ensure its exploiting even during medic's urgent requests or requests do not involve telemedicine.

5. Case study - Tanzania

This chapter is dedicated to the definition of the case study considered for this thesis. In particular, will be present the international cooperation project carried out by "Golfini Rossi" Onlus for the evolution of a dispensary in Mvimwa, Tanzania.

The first section focuses on Tanzania, with the aim of creating a general picture of the country, from the demographic, cultural, political and health point of view.

Next, it follows a description of the main actors related to the case study, the Italian NGO "Golfini Rossi" and the Benedictine Monastery of Mvimwa, providing information on their history, partners and the main areas of intervention.

Section 5.3 is dedicated to the general presentation of the whole project, in which all the seven steps are presented. Considering a timeline of five years, both those already accomplished, and the current and future stages will be analyzed.

Concludes the chapter the *section 5.4*, in which is offered in detail the design of the telemedicine step. The guidelines stipulated in the previous analysis will be used in the case to define the current preparation of the project. The goal of this last section is to identify the current level of preparation of the Mvimwa dispensary, to highlight the areas of intervention necessary to ensure sustainability to the platform. At the end, will be presented some limitation, due to timing, which hat do not allow to have, at the moment, a complete vision of the required interventions.

5.1. Tanzania

5.1.1. Country profile

The United Republic of Tanzania includes the mainland Tanganyika and the Zanzibar island, which administratively includes the other island of Pemba.

Situated on the East Coast of the continent, bordering with Kenya and Uganda to the north, Rwanda, Burundi and the Democratic Republic of Congo to the west, and

Zambia, Malawi and Mozambique to the south, it is bathed by the Indian Ocean on the east side [77].

The federation also includes large parts of lakes Victoria (North), Tanganyca (West) and Malawi (South- West). The country is divided into 26 administrative regions, 21 on the mainland, three in Zanzibar and two in Pemba. The regions are then divided into 99 districts.

Since 1974 the capital of the federation is Dodoma, located in the center of Tanzania, while Dar Es Salaam, previous capital, remains the largest urban, commercial and industrial center of the country. The population, about 58,01 million people, is growing rapidly, with an annual population growth rate of 2,9%, respect to the global rate of 1,9%. It is in fact expected to reach 186 million people by 2100. The life expectancy, now around 65 years old, is estimated to increase of 15 years in eighty years.

Today, the 44% is under 15 and less than 3% presents over 65. Socio-economic factors, such as poverty, cost of living and education levers are contributing to the decline in population rates. Moreover, only 26% of its populace is residing in urban areas.

The actual social policy follows the Tanzania Development Vision 2025, which defines three principal objectives: “achieving quality and good life for all; good governance and the rule of law; and building a strong resilient economy that can effectively withstand global competition.”

Recognized as independent in 1961, Tanzania was under British rule for 42 years. The island of Zanzibar joined the country in 1963, after gaining independence from the United Kingdom. Thus, was born in 1964 The United Republic of Tanzania.

The country’s Prime Minister was Julius Nyerere, who became president several years later. Under his rule, the African National Union of Tanganyika was recognized as the only political party on the mainland and the Afro-Shirazi Party the only party on the islands. The two merged into a single party in 1977.

Despite the various reforms implemented, to achieve social equality through the development of the education and health sectors, Tanzania’s economic situation had not improved, and for this reason the president resigned in favor of Ali Hassan Mwinyi. During his mandate, the constitution was changed to allow for a multi-party state and in the first elections of 1995 Benjamin Mkapa was elected president and ruled until 2005. In fact, in December 2005, Jakaya Kikwete of the ruling CCM party came out victorious in the general election and soon took over the presidency. Kikwete has also been president of the African Union since January 2008. In 2015, John Pombe Joseph Magufuli won the presidential elections and remained until his death in 2021. Samia Suluhu Hassan was elected his successor. Tanzania’s president is

democratically elected for five years, while Zanzibar maintains a semiautonomous system of government [78].

After the economic crisis of 1970s, Tanzania started an economic reform with the support of bilateral donors, mostly Nordic countries. In the following decade started to receive funding from the IMF and World Bank which led to further economic reforms. Thanks to those macro-economic regulations, the GDP growth averaged 3,5%; although the low level, it was double the average growth of the previous decade. It reached 6,8% in 2005.

The economy of the Country is still driven by agriculture, which make the largest contribution to the gross domestic product (GDP), respectively the 29%. Almost the 70% of the employed work in this sector. Nevertheless, the importance of other sectors is increasing, such as manufacturing and mining exports, while industry is still having one of the lowest impact on GDP among Sub-Saharan African countries [77].

Tanzania population is today clustered into different ethnic groups. Due to the rural-to-urban migration and modernization, some of the smallest groups are gradually declining. The majority of Tanzanian are descent from the Bantu ethnic, but others group such as Zaramo, Sukuma and Zanaki constituted others.

The colonial period was characterized by immigration from Asia and Europa. Thus, today are existing minorities. Regarding the latter, primarily English, German and Greek communities are present.

Swahili and English represent the two official languages of Tanzania. The former is the national language, coming from the composition of different Bantu dialects and Arabic. It is also one of the six official language of The African Union. Being historically linked to maritime trade, it is also diffused in some communities outside Africa. The latter is spoken at higher levels of education and widely used in government offices. Beyond Swahili, others African idioms come from the tradition of the different ethnic groups. The main are Gujarati, Hindi, Punjabi and Urdu.

Concerning religion, data cannot be considered completely truthful, as may rural Tanzanians adhere to elements of their indigenous religious practice. Statistically, about one-third of the population is Muslim, where the majority are Sunni. Another one-third professes Christianity, which include Roman Catholic, Lutheran, Methodist and Baptist sects. The remain population hold traditional beliefs [79].

5.1.2. Healthcare system in Tanzania

As mentioned above, Tanzania focused its development strategies on enhancing the social equality of its citizens. Increase the level of health services is essential to increase

the quality of life, and to build a solid country. However, the many socio-economic challenges the Government still have to face makes difficult to enforce the healthcare system of the country.

In this view, Tanzania has adopted the over the years the following strategies, especially to improve the healthcare sector:

The Tanzania Development Vision 2025

Started to be developed in 1995, the vision aims to reach a good quality of live for the citizens and identifies in the healthcare sector the main component.

Specifically, the strategy shows five attributes on which Tanzania of 2025 will be based on:

- High quality livelihood: creation of wealth and an equal and free distribution of it. By that year, racial and gender imbalances will have been regressed.
- Peace, stability and Unity: nation enjoying peace, political stability, nation unity and social cohesion in a democratic environment.
- Good Governance: culture of accountability, rewarding good performances and reducing corruption.
- A well education and learning society: enhance the quality of education to be able to respond to development challenges and being able to compete both nationally and internationally.
- A strong and competitive economy: create a resilient and competitive economy to adapt itself to market changing and technological conditions. [80].

The Second Five Year Development Plan (FYDP II) 2016/17–2020/21: “Nurturing Industrialization for Economic Transformation and Human Development”

The strategy represents an integration of the Five-Year Development Plan (FYDP) and the National Strategy for Growth and Reduction of Poverty. Mainly focused on growth and transformation and poverty reduction, outlines new intervention to industrialize the country.

The plan, built on three pillars, industrialization, human development, and implementation effectiveness, aspires to:

- Build a base for converting Tanzania into a semi-industrialized nation by 2025.
- Accelerate poverty-reducing economic growth and inclusive.
- Improve quality of life and human wellbeing.
- Foster development of self-propelling domestic productive and exporting capacities.

- Promote requisite industrial human skills, production and trade management, operations, and quality assurance.
- Consolidate Tanzania’s strategic geographical location through improved environment of doing business to position itself as a regional trade.
- Foster and strengthen plan implementation effectiveness, including prioritization, sequencing, integration and alignment of interventions.
- Emphasize the role of local actors in planning and implementation.
- Assimilate global and regional solidarity agreements, specifically SDGs with the aim of mainstreaming them into the national development planning and implementation frameworks. [81]

5.1.2.1. Primary health care

As other many African countries, Tanzania’s healthcare system is based on the concept of Primary health care (PHC).

Uniced and WHO, in the report “A vision for primary health care in the 21st century: Towards UHC and the SDGs” of 2018 defined that *“PHC is a whole-of-society approach to health that aims at ensuring the highest possible level of health and well-being and their equitable distribution by focusing on people’s needs and as early as possible along the continuum from health promotion and disease prevention to treatment, rehabilitation and palliative care, and as close as feasible to people’s everyday environment.”*

The definition incorporates three related components:

1. Satisfy people’s health needs through comprehensive lifelong promoting, protective, preventive, curative, rehabilitative and palliative care, giving strategic priority to key health services targeting individuals and families through primary and population care through the public health functions as a center elements of integrated health services.
2. Systematically address the broader determinants of health (including social, economic and environmental factors, as well as individual characteristics and behaviors) through evidence-based policies and actions across all sectors.
3. Enable individuals, families and communities to optimize their health, as advocates of policies that promote and protect health and well-being, as co-developers of health and social services, and as self-helpers and caregivers.

PHC proved to be an efficient and effective approach to improve people health and well-being.

In fact, the continuous world challenges, due to economic, environmental, technological and demographic changes, are affecting both health and well-being.

PHC allows to consider a wide range of stakeholders at national and sub-national levels to draw strategies able to respond to these challenges.

Moreover, only with a strong emphasis on PHC can be achieved the health-related SDGs. [82]

5.1.2.2. Structure of the healthcare system

Health services are delivered following a decentralized system, that falls into three functional levels: National, Regional and District; in addition, a zonal level, similar to the national one. Each district is furthermore divided into divisions, wards, villages and 'vitongoji/mitaa.'

The structure follows a pyramidal referral system, where each level provides different services.

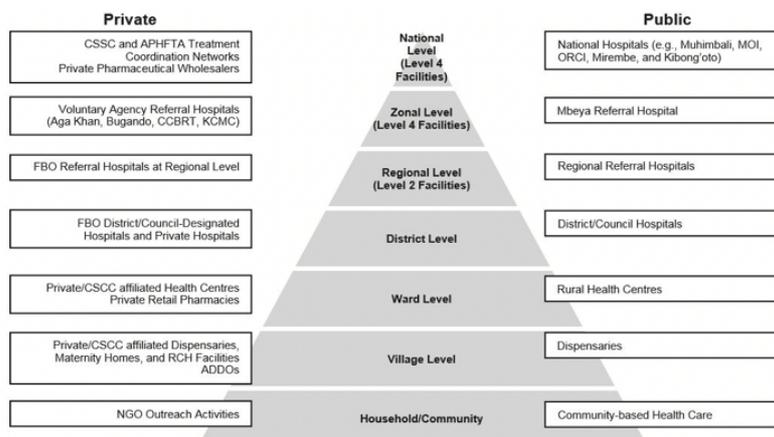


Figure 10: pyramidal referral system of the healthcare sector in Tanzania

At each level both public and private entities are in charge of providing health services by combining efforts in some instances. Even if is present a private sector, is still in this case the Ministry of Health to regulate the establishment of health facilities and services.

Considering the main three level, the first is the district level. Communities-based health activities are in charge of promotion and prevention to the families in villages, covering an average population of 10000. Dispensaries and health centers provide preventive and curative services, with the different that the second can also admit patients. The range is slightly broader, with an average population of 50000.

Lastly, council hospitals provide health care to referred patients and basic surgical services for about 250000 people. At the second level, regional referral hospitals are able to provide specialist medical care.

To conclude, zonal and national hospital offer advanced medical care and training courses for medical, paramedical and nurses [83]

5.1.3. Financing, accessibility, availability

Healthcare services are mainly financed by the Government, with some tax-based funds through local government council tax collection and other earnings but is also very frequent the involvement and participation of voluntary communities.

Over the decades, there has been an increase in the health budget, especially thanks to the reforms actuated in the past years. Health spending US\$ per capita moved from 12,6 in 2000 to 36,8 in 2018 (Global Health Expenditure database).

However, most of the funds still are coming from development partners, with an increase of donor dependence to fund the primary health care of the country.

Regardless of the context within which health care has to occur, fundamental to ensuring the health of the nation is the availability of appropriate numbers and quality of human resources for health. A country such as this, with a decentralized system of health care provision, requiring dispersed access to HRH, coupled with a burden of disease concentrated at the periphery of society, could benefit from the specific health service characteristics that MLHWs can provide. [84]

The availability and accessibility of services varies depending on the geographical location. In particular, rural and hard to reach areas are more disadvantages compared to urban areas. An average of 66% of the population live within five kilometers of a health service, moving from 25% in Kagera region to 100% in Dar Es Salaam. Even if the number of infrastructures is increasing, only the 70% are able to provide health services.

5.1.4. Barriers to success

Five areas as been identified as barriers to success for improving PHC services.

1. Public expenditure on PHC: as previously discussed, health financing faces many challenges. The main source of finance comes from external donors, while the level of national expenditure in this sector is still too low.
2. Human resources for health: not only the number of medical workers, especially the clinical ones, is low compared to the population, but also the existing one is

maldistributed. Many staff prefer to work in urban rather than rural areas due to the poor working and living environment in the latter.

3. Availability of medicine: as for medical personnel, the availability of key medicines remains low.
4. Funding of medical supplies: connected to the lack of improvement of funding for medical supplies.
5. Public-private partnership: the concept is ill understood and the definition of public-private partnership in the health and social welfare context differs respect to the commercial sector. [84]

5.1.5. Main diseases and cause of death

According to the Global Burden of Disease Study, the main diseases, which also represent the main causes of death in Tanzania, are neonatal disorders, lower respiratory infect, HIV/AIDS, stroke, tuberculosis, ischemic heart disease and malaria. Based on their impact as cause of death, they are presented below.

Neonatal disorders:

The first cause of death in Tanzania is represented by neonatal disorders. They are referring to the disturbance of normal state of body, organs and abnormal function of a newborn. In fact, the mortality trend under-1 age group, even if is decreasing, is still one of the highest in Africa. Respect to 1990, when the value registered was 96.6 deaths for 1'000 live births, in 2019 was 40.4.

Lower respiratory infect:

Lower respiratory tract infections, second cause of death, are any infections in the lungs or below the voice box. It usually refers to pneumonia, but can also consider other infections such as bronchitis, lung abscess and influenza. They are affecting typically babies, infants and elderly adults.

HIV/AIDS:

Third cause of death, and the most common virus present in Tanzania, is HIV/AIDS. According to the Tanzania national health portal, in 2020 almost 300'000 tested people, 7'900'000, resulted positive. In 2019, has been estimated that 1.64 million people are living with HIV in the country. Even if the incidence in death is decreasing, moving from the first to the third cause in the last ten years, it still represents one of the main challenges of the country.

The spread in the country is generalized, with picks among key populations and women, which then transmit the virus to their child. In 2016 UNAIDS reported, HIV prevalence for women as 5.8%, compared to 3.6% for men.

Stroke:

Stroke, the medical condition in which poor blood flow to the brain causes cell death, is the fourth Tanzania death cause. In the last ten years the incidence of death for stroke has increased of 23,7%, reaching 13'114 or 3,61% of total deaths in 2018.

Tuberculosis:

Fifth cause of death, and second infectious disease in the country, is tuberculosis. It is usually caused by the *Mycobacterium tuberculosis* bacteria. 2019 registered an incidence of 111.2 every 100'000 inhabitants and the 7,86% of the total deaths.

Ischemic heart disease:

Ischemic heart disease, the principal component of cardiovascular diseases, also called coronary artery disease, is the term given to heart problems caused by narrowed heart (coronary) arteries that supply blood to the heart muscle. According to the latest WHO data published in 2018 Coronary Heart Disease (CHD) Deaths in Tanzania reached 23'728 or 6.58% of total deaths, which represents the 6th cause of death in the country. Age-standardized CHDs mortality rates showed higher death rates among Tanzanian men compared to women (473 versus 382 per 10,000 population).

Malaria:

Seventh cause of the death is malaria, a life-threatening disease. It's typically transmitted through the bite of an infected *Anopheles* mosquito. Infected mosquitoes carry the *Plasmodium* parasite. When this mosquito bites you, the parasite is released into your bloodstream. The country is one of the ten with the highest malaria cases, especially in women and children.

Over the last years, there has been an increase in the case incidence and mortality: between 2015 and 2018, it has plateaued at between 122 to 124 per 1'000 population at risks, while deaths fell by about 4% (from 0.4 to 0.38 per 1'000 of the population at risk) during the same period.

5.2. "Golfini Rossi" Onlus

"Golfini Rossi" Onlus, so called to remember the uniforms of some African primary schools' children, is a non-profit organization, born in 2015 in Cornaredo, on the outskirts of Milan.

It pursues objectives of social solidarity in the fields of training, micro-enterprise start-ups to support poor and weak economies through international cooperation, in particular in favor of African realities.

The adventure of "Golfini Rossi" begins in 2014 after a volunteer holiday to Tanzania. Reached the Benedictine Monastery of Mvimwa in the Rukwa regions, the founders

decided to stop for helping the Monastery in its missionary work for the benefit of the poor and disadvantaged of the neighboring villages. The initiative, which has taken on the name of Mvimwa Volunteer Management is sponsored by the Italian Embassy in Dar Es Salaam and by the Municipality of the City of Parabiago.

To date, the association notes among the main partners the University Campus Biomedico of Rome (UCBM) and the University of the Studies of Parma. Fundamental is the role of some professionals of the two Italian Universities who have provided skills and fiduciary relations of their network to support the humanitarian cause.

Strategic are also the alliances with the Council for the research in agriculture and the analysis of the agricultural economy, the Strathmore University of Nairobi and the St. Joseph University of Dar Es Salaam, local government and health institutions and the network of religious of the Diocese of Sumbwanga. The fundraising activities of the NGO are mainly aimed at private donors and companies. Some institutions have allowed in these years to accelerate implementation on specific design segments, including Caritas Antoniana, Mediolanum Foundation, Avis Torino, Happy Child Foundation, the UniCredit Gift Matching program, a fundraising program for UCBM students.

Since 2020, it is registered in the Register of Civil Society Organization of the AICS.

Among the various projects already completed by the NGO, mention should be made of:

- The installation of the first radio device at the Monastery (April 2015) in collaboration with Radio Maria World Family Tanzania in order to raise awareness of the monastery and broadcast educational programs throughout the country.
- The reproduction of textbooks thanks to the purchase of a professional printer (December 2016); this will allow schools and villages to benefit from handouts and books with new educational content that the network of Italian and African universities is bringing in hygiene and nutrition
- The start of a wedding dresses start-up (August 2016), setting up an atelier of wedding dresses with the prospect of creating a micro enterprise that will design, create and rent dresses for events. To start the micro-enterprise, were trained in advance in the months of April/May/June in Italy, four young Tanzanian newly graduated, offering qualified courses in project management, planning & control, risk evaluation, effective communication.
- Purchased a dryer with a capacity of 800 kg (July 2018), and then shipped to the Nutritional Lab (born in August 2017) to start a first semi-industrial production.

5.2.1. Benedictine Monastery of Mvimwa

As mentioned, the NGO is particularly active in supporting the Benedictine Monastery of Mvimwa in Tanzania, in order to strengthen it in its educational and social role for the benefit of the poor and disadvantaged populations. The Benedictine monastery of Mvimwa belongs to the Congregation of St. Ottilien along with 53 other monasteries in the world, located in the Rukwa region, the poorest of Tanzania, in the Nkasi district, between the towns of Sumbawanga (capital of the region and about 60 km away) and Namanyere, moreover it is just over 50 km from Lake Tanganyika.

In a region where electricity is not available, water is collected in natural wet patches, agriculture is minimal and houses are rudimentary, the monastery is the center of aggregation for all the small neighboring villages, that together make a population of over 20,000, representing the Community of Mvimwa.

The Nkasi District has a basically rural connotation, people live in 93 villages spread over an area of 13,000 square kilometers in very precarious conditions and child malnutrition represents a real social scourge. In the 10 villages near the Monastery where there are wells of water, these do not have regular maintenance and it is frequent the use of wells dug extemporaneously and without criteria of hygiene. Houses lack water, electricity and even floors. The rainy season represents a risk of deterioration of food, while in drought periods food is scarce.

Today it has about 100 missionary monks, all Tanzanians, and is led by Abbot Pambo Assumptho Martin Mkorwe.

The monks offer support by generating work, health care at their dispensary and especially educational programs. They created and run St. Placidus Primary School with over 250 children, St. Maurus Chemchemical Secondary School in Sumbawanga with over 1000 students, a college for future teachers and professional schools for electricians, carpenters, blacksmiths, seamstresses and mechanics. The dispensary, which ensures distribution of drugs and vaccines and medical examinations, is also able to offer 30 hospitalization beds and small surgeries.

5.2.2. Areas of intervention

The NGO works in four main areas of intervention: health, nutrition, education and development.

Health: In the health field, the focus is on the evolution of the Mvimwa dispensary into a specialized hospital for women and children. Are planned specialized departments of maternity, gynecology, prevention and treatment of breast and cervical cancer, neonatology, pediatrics, physical and motor rehabilitation of first and second

childhood (0-12), dermatology, cardiology and ophthalmology. To these, is added the construction of an operating room.

The reorganization of the old dispensary includes the reconfiguration of the use of existing spaces, a pharmacy and an analysis laboratory. Telemedicine, the production of pharmaceuticals and curative soaps, a new canteen with adjoining didactic cuisine and a mobile clinic are collateral services included in health projects.

Finally, "Golfini Rossi" Onlus plays workcamp with students and university professors for thesis projects.

Nutrition: The "Nutrition" project aims, through sustainable economic development and skills development, to fight the scourge of child malnutrition in the Rukwa Region and to improve, for some diseases, the general health status of the population.

The main topics developed are the processes of food transformation and conservation; the dryers with solar panels; contrast to child malnutrition (la Pappa di Parma, dissemination of science school education and roll out of production/distribution in the 46 dispensaries of the Nkasi District); water sanitization processes; the production of sanitizers and training in presence (in the future via the web) on nutrition and basic hygiene issues.

Education: In the school sector, 23 children selected in rural villages for family poverty rate are guaranteed the completion of the entire course of study (from primary school to graduation and eventual access to the University). In addition to the study plan is offered board and lodging for 11 months at the Monastery of Mvimwa.

The creation of a reception center for disabled children is under consideration: school attendance, food and accommodation, access to health services for motor rehabilitation and vocational schools for starting work.

The Association participates in the improvement of the teaching and school environments of the schools of the Monastery (a primary with 250 children, a secondary with over 1000 students and vocational schools with 60 members), also completing the missing structures (local kitchen and canteen, infirmary, library, nurseries for the support of working mothers).

The Study Centre - High Education School will be the scientific and cultural tool to promote the improvement of the health conditions of the population. Here will be guaranteed professional updates and specialization for health professionals (doctors, nurses and nutritionists) of Dispensaries and Hospitals in the area. Specific courses on environmental protection, agriculture, nutrition sciences, hygiene and basic health, first aid will also be organized in the presence and via the web.

Development: The sustainable economic development of the rural territories of Mvimwa goes through the creation of micro-enterprises and enterprises in the fields of manufacturing, agriculture, livestock and energy. There are active workshops of arts and crafts, including tailors, carpenters and electricians.

The NGO is also active on the topics of circular economy of bio territories, with projects for the production of corn, soya, moringa and spirulina, water collection and distribution plants, organic feed, livestock and aquaculture and bio-plants gas for energy production.

5.3. Health project in Mvimwa – Evolution of the dispensary

The Mvimwa Monastery has a dispensary active for over 20 years but was built without health safety criteria and is currently inadequate for the number of beds, especially during periods of acute malaria. Frequented by about 150-200 people per day, due to the distances between villages and lack of transports, the dispensary provides medical examinations, distributes drugs and vaccines, runs a small laboratory for examinations, houses pregnant women and sick people (30 beds) and carry out simple surgical operations.

The healthcare project in Mvimwa, launched in 2019, has the precise aim of creating conditions of sustainability and local autonomy not only for the Monastery, but for all the villages around. The hospital design project, divided in blocks, presents a first block, ended at the end of October 2021, including a waiting room, a laboratory analysis and the telemedicine local. The other blocks, dedicated to specialists, are:

- Obstetrics, including a waiting room, two delivery rooms, a labor room, hospital (12 places), an operating wing for small interventions and gynecology surgeries, neonatology, pediatrics and pediatric neurology and toilets.
- Eye clinic, with a waiting room, an eye clinic, an eye surgery, an eye surgery, place for common hospitalization and toilets.
- Surgery, in which there will be two operating rooms for orthopedics, general and reconstructive surgery and other interventions and place of stay 30 places (20-40 flexible stays) and bathrooms.
- Radiology, with a waiting room, surgery and Medical Offices, one traditional RX unit, one mammography unit, one ultrasound unit and toilets.
- Rehabilitation, including a waiting room, a surgery room for motor rehabilitation, disabled accommodation (10 places), medical offices and toilets.
- Nutrition with a waiting room, a clinic for malnutrition, offices and toilets

Finally, blocks are planned for transport, waste management, cleaning and storage services and R&D.

Temporally speaking, the project has been divided into seven phases, which will cover the blocks just exposed, for a total duration of five years. In 2019 and 2020 the following were concluded:

- Phase 1: new maternity ward
- Phase 2: pediatric department
- Phase 3: allocation of a mobile clinic
- Phase 4: local canteen and kitchen construction

In 2021, 2022 and 2023 are planned:

- Phase 5: continuing health training and telemedicine
- Phase 6: motor rehabilitation department and disabled reception
- Phase 7: reorganization/expansion of the old dispensary

It will complete the Healthcare project in Mvimwa the start of a postgraduate specialization school in health and nutritional disciplines in Sumbawanga. Indeed, it is intended to ensure continuing training both in presence and via web to all medical staff of the center and, more generally, to the medical staff of the Ruwka region.

5.3.1. Phase 1 – New maternity ward

The new maternity ward, designed by architects and volunteer doctors, occupies about 360 square meters and has labor rooms, delivery room, bathrooms, rooms with shower, laundry room and linen over 1 room for dressings and small surgeries. The rooms are paved with ceramic, the walls of the delivery room and the room for dressing are tiled and, therefore, washable. The other walls are whitewashed, the windows are all aluminum and the rooms have been prepared to have electricity through solar panels. There is also an air conditioning system in the delivery room.

The electrification of the territory is on the move by the Government, but with still quite a long time. The Monastery, for a few months, uses an important plant of solar panels funded by the Congregation of St. Otilien, able to produce electricity for both the dispensary and for other real estate units.

The separation of the maternity ward from the existing dispensary has made it possible to limit the risk of contamination of mothers and infants from the rest of the patients, to have a hygienic sanitary environment suitable for pregnant women and children and to increase the number of beds in the current dispensary (freeing those destined for labor).

Thanks to Caritas Antoniana, it was possible to complete the space with the necessary furniture and sanitary tools. The technology made available, new and modern, has allowed a significant leap in the quality of the department for the benefit of patients.

In February 2020 the first course of off-site training saw the participation of the dispensary nurse, at the neonatology department of the Hospital-University of Parma for over 1 month.



Figure 11: New maternity ward in Mvimwa

5.3.2. Phase 2: Pediatric department

The pediatric department, adjacent to the maternity one, occupies 340 square meters and has already been realized thanks to the financial contribution of “Golfini Rossi” Onlus disbursed at the beginning of 2020.

The workers of the local villages took part in the construction, while the furnishings and the electrical system were made respectively by the carpentry school and electricians of the Monastery. The department can accommodate 8 mothers and 8 children at the same time. At the moment, all that is missing are the beds with a safety structure, for which funds are being sought.

The Monastery is making arrangements with local pediatricians to ensure their periodic presence or call while the network of scientific partners of the Onlus, after the emergency Covid-19, is ready to organize health workcamp (at least three times a year) aimed at providing training to healthcare professionals, medical examinations and surgeries. During these years, workcamp doctors have detected a very frequent phenomenon of abnormal umbilical hernias in primary school children. The first health workcamp that will be organized aims to surgically intervene on at least 50 children already identified in the village of Kate.



Figure 12: Pediatric department in Mvimwa

5.3.3. Phase 3: Allocation of a mobile clinic

The transports, already usable by the dispensary, include a mobile clinic and an equipped ambulance.

Thanks to AVIS Torino, were donated a mobile clinic, adapted as a surgery on wheels to ensure health care, even diagnostic, directly in the villages. The NGO intervened supporting the costs of complete review of the medium, shipping, registration and import taxes while some doctors who attended the health workcamps in equipped the mobile clinic with a portable ultrasound and health tools.

The maintenance of the vehicle is ensured by the school for mechanics present at the Monastery and the guide, being a medium of 12 meters, is guaranteed by an authorized driver already employed.



Figure 13: Mobile clinic in Mvimwa

5.3.4. Phase 4: Local canteen and kitchen construction

The new kitchen and canteen, completed in the early 2021, provides warm meals to the hospitalized and families. The new space also provides classrooms to teach new mothers principles about hygiene and malnutrition, a real social scourge in the territory. About this point, in January 2022 three graduates from Parma will join Mvimwa to consolidate the educational processes in the hand of the dispensary health staff for the use of the “Pappa di Parma”, a mix of local natural nutrients suitable for weaning and in line with food safety principles.

The canteen is able to provide space for around 100 people. For guarantee hygiene are available bottles of disinfectant, produced autonomously by monks, and sulphury soaps.



Figure 14: New kitchen in Mvimwa

5.3.5. Phase 5: Continuing health training and telemedicine

Since 2015, many professional courses have been provided directly on site by doctors, nutritionists, interns and students of the UCBM and University of Parma. “Golfini Rossi” Onlus, with the contribution of scientific partners, continues to ensure health care and training to the staff of the dispensary of Mvimwa through on-site attendance of professors-doctors-students (so-called workcamps). The workcamp mode will be complemented by distance training.

The training for African health personnel will see the gradual involvement of the 46 dispensaries of the District of Nkasi and the hospitals of Namanyere and Sumbawanga, thanks to an agreement already signed by the parties.

“Golfini Rossi” Onlus is finalizing a collaboration agreement with GHT for the installation and start-up of the telemedicine service, scheduled for autumn 2021. This service, which will be installed at the dispensary in Mvimwa, and later at the hospital in Namanyere, will be able to guarantee constant and concrete support to local medical personnel thanks to the opinions of Italian professionals registered on the platform and specialized in different areas.

The meeting for the illustration and explanation of the telemedicine platform and negotiating with GHT was attended by the head of the health area of the Nkasi District, Dr. Mvogogo.

5.3.6. Phase 6: Motor rehabilitation department and disable reception

Physical and mental disability in Africa, especially in the poorest areas, is considered a "curse" and the disabled live situations of almost total marginalization.

The creation of a motor rehabilitation department is necessary and will become central from 2021, to give concrete response to over 20 disabled people present at the Monastery of Mvimwa. The rehabilitation block includes the clinical, therapeutic, physical, psychological-educational aspect, also for family members, but considering additionally the work, play and sport side.

In the coming years, priority will be given to the consolidation of processes for the management of motor disabilities and related motor rehabilitation, but below you will need to start the path of stimulation and rehabilitation of cognitive functions with priority language rehabilitation.

5.3.7. Phase 7: Reorganization/expansion of the old dispensary

Starting in 2022 and throughout 2023, the Mvimwa dispensary will evolve to become a hospital facility. It will be necessary to redevelop the old dispensary and build, as was done for the new maternity and pediatrics department, other departments for specialist fields. The enlargement process will be gradual, on the basis of economic and management availability. However, the monks of the dispensary are already studying the hospital reorganization.

5.4. Telemedicine project in Mvimwa

The telemedicine project in Mvimwa took shape when was felt the need to constantly and continuously train the healthcare personnel of the dispensary. Especially after the Covid-19 event, it became increasingly difficult to train on spot. Therefore, telemedicine represented a solution to guarantee constant support and training for local staff.

The first step concerned the choice of the service providers. Previously had been carried out an analysis by "Golfini rossi" to understand all the possible alternatives. Since the research had not produced any useful results, has been suggested by an organization's volunteer GHT as a potential provider.

Given the previous experience in Africa of over 13 years and the presence on the territory in several states, including Tanzania, GHT was considered the best choice for the case.

The cost of a station is € 12'000, which includes training, technologies (hardware and software), electromedical equipment, platform management costs, technical and health help desk and overall supervision of service quality. Moreover, every year a fee of € 500 has to be paid for maintenance and software management costs. The telemedicine project has been integrally financed by "Golfini Rossi" through a private donation.

The second step regarded the choice of the initial number of stations to install, in particular between one or two. Due to the high costs to sustain, the economic availability of the NGO was not able to fully finance two projects. Moreover, it was considered necessary to introduce the project gradually, given the monastery's unfamiliarity with new technologies such as telemedicine. For these two main reasons, was decided to start with the installation of a single station.

The last decision involved the geographical location of the service. Strategically speaking, the use of the platform would be more exploited if located in one of the two regional hospitals, in Namanyere or Sumbawanga, given the greater number of patients rather than the ones in the dispensary. However, the project aims at an expansion and an evolution of the dispensary itself, which would be helped in the medium to long term by the presence of the platform. In addition, the monks would have more control over the equipment. For this reason, despite a minor initial use of the service, telemedicine was installed inside the dispensary.

On August 30th, 2021, the collaboration agreement between GHT and "Golfini Rossi" and African Benedictine of Mvimwa Abbey was signed.

5.4.1. Phase 1: Installation

All the equipment necessary for the operation of the platform are created and assembled in Italy by GHT, then are transported and installed on site. Due to the Covid-19 emergency, it was decided to limit travel and the risk of contagion. Thus, the platform was brought and installed by the team of volunteers of "Golfini Rossi" who went to Tanzania for a mission in October 2021.

The team consisted of a medical surgeon, E.D., health coordinator of the project, and two recent medical graduates of the UCBM. The mission, lasting ten days, was intended to evaluate the progress of ongoing projects, carry out training activities and small surgeries and, finally, initialize the telemedicine project. Before the departure, which took place in early October 2021, the two graduates went to the headquarters of GHT in Rome to learn how to use and install the platform.

Once the equipment was received, the first choice was to define the exact place within the dispensary to place it. In the last two years the development plan of the dispensary made possible to have a laboratory of analysis, in which telemedicine was set. The choice was dictated by the fact that the laboratory, in addition to being adjacent to the new maternity wards and others under construction, is currently the only one with a support room.

In addition, the second step was to identify a referee for the platform. In fact, according to the agreement previously entered into, it was necessary to provide the GHT with a reference contact to supervise and manage the service.

In October 2021, during the first mission of the team in Mvimwa, a series of problems were encountered for the development of the telemedicine project.

To start, the laboratory of analysis was still under construction; the room, therefore, could not be used as a base for the project. Since the necessity of testing the platform, it was decided to temporarily install it in the reception room of the pre- and post-natal building, until the laboratory is completed.

The second problem faced regarded the Internet connection. At the moment, despite the recent installation of a satellite antenna, the whole area of the dispensary, and therefore also the room with telemedicine, was devoid of internet. In order to be able to test the platform and verify its functioning, it was chosen to use a hotspot connection until a permanent solution was founded.

Lastly, the lack of a referent doctor who can immediately use the platform. Although the presence of few nurses, all the doctors working at the dispensary are coming from the near hospitals, so they are not able to constantly oversee the platform. For this

reason, has been preferred to form a technician of the Monastery, who, once selected the referring doctor, will be in charge of training the latter on telemedicine.

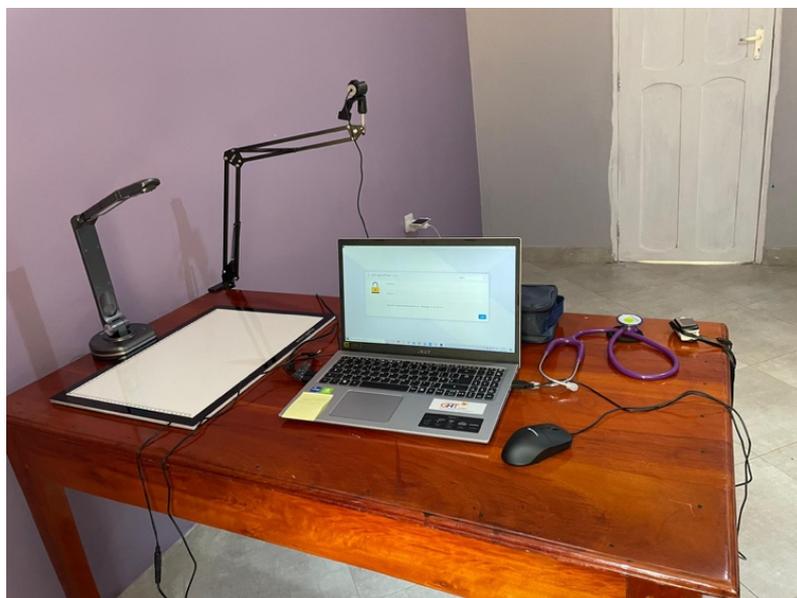


Figure 15: Telemedicine station placed in Mvimwa in October 2021

5.4.2. Phase 2: Testing

Once installed the platform, the second phase was about testing the functionality and the readiness of the environment, in terms of connectivity and human resources.

Regarding internet connectivity, as previously discussed, the team was still able to test thanks to the use of the hotspot connectivity.

A first test was carried out on October 9th. The following timeline shows the submission and response time. The upper part of the arrow indicates the sending times by the Monastery, while the lower one shows the response times.

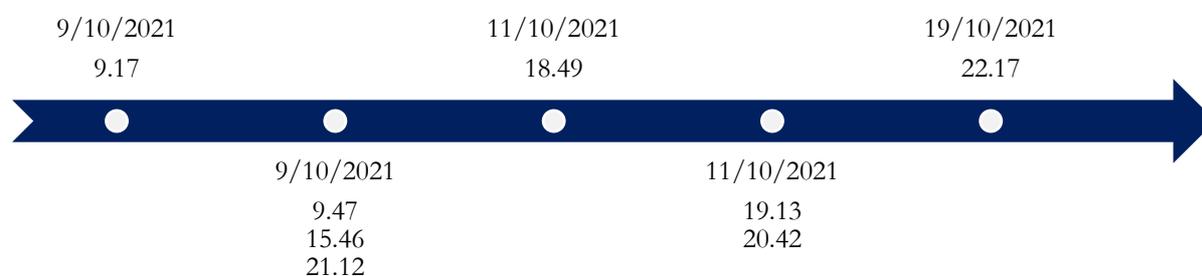


Figure 16: Timeline for the submission and response time

Considering this specific case, it can be observed that the response times from the first request, which occurred at 9.17, were quite immediate (one at 9.47, one at 15.46 and one at 21.12). Subsequently, there was a sharp decrease in the connection, which did not allow to connect to the platform, and then to display the response, until 18.49 two days later. As first, the answer arrived on the same night. The time span of eight days was due to a lack of use of the platform by the team, engaged in other activities, which returned to use it on October 19th.

Since then, three further teleconsultation requests have been sent. In all cases, there are no activities on the Monastery's side after the first tele consult's answer from Italian doctor.

To conclude, the result of these first tests showed a not optimal connection, very slow, where most of the time it was not possible to visualize the response.

Concerning human resources, due to the lack of a referring doctor, a Monastery technician was selected. The choice of the specific human resource was not casual; indeed, it was decided to train who had the most skills in terms of language and computer knowledge. Thus, this resource can be considered as the representation of the best possible situation can be found at this moment of the project. Not being his profession related to health, it was not possible to test his skills on the use of digital medical tools, but only digital ones.

After the team showed the basic operations of the platform, was observed technician's familiarity with computer tools. Very basic digital knowledge was immediately found, accompanied by a conspicuous slowness in the use of instruments, such as the keyboard. Notions like attaching images, entering text and connecting to the hotspot connection were not known by the person taken in reference.

However, the use of the platform is very simple and designed specifically for Africa. Thus, the teaching of basic features did not take a long time, although it was necessary to introduce additional notions compared to the only use of the platform.

During the training of the technician, a test was made by the latter to verify his learning and evaluate potential difficulties. In addition to the one just presented, there was a serious lack of knowledge of the English language, especially written. At the time of the choice, knowledge of the language was taken into account, also in order to provide a more efficient interaction with the team. Although there were no particular communication problems, what has emerged is a serious inconsistency of medical words in the English language.

5.4.2.1. Limitation of the testing phase

Before drawing the first conclusions, it is necessary to highlight the limitations of this second phase of testing.

First of all, the premature moment of the project: in October 2021, at the time of the first mission and the installation of telemedicine in Mvimwa, the Monastery had never had to deal with these types of technologies. In addition, the Internet connection, which is essential for the success of the project, was not yet active at the time considered. Therefore, evaluating the progress of the project and defining the subsequent operational choices will require a time that this work is not able to analyze.

Secondly, the results are based on tests carried out with a single person. Although the resource with the most computer and linguistic knowledge has been identified, since it does not have the necessary medical knowledge, it was not been possible to evaluate its preparation in the use of digital medical tools. In order to have more detailed information, it would have been necessary to expand the tested sample. However, the absent of a referral in the territory who will lead the telemedicine project did not make it possible.

The premature moment of the project, therefore, is also reflected in not being able at the time of writing the work, to assess the potential use of the platform, and therefore a clear sizing around it.

5.5. Discussion

A number of conclusions can be draw from the case. Analyzing in the literature the main barriers to telemedicine in Africa, five classes were found, technical, economic, individual, organizational and political. Subsequently, after collecting information from telemedicine centers in Africa, these theoretical barriers were traced back to practical cases, arriving at the definition of 3 classes: technical barriers concerning connection problems; individual barriers, lack of digital literature and staff change respectively; organizational barriers, as regards lack of coordination and management.

Finally, analyzing the specific case of Mvimwa, the following challenges were validated.

The lack of internet connection, the main technical barrier, was found. Despite the presence of a satellite antenna, the connection on the territory is very poor and the use of the hotspot connection is also too weak for a proper functioning of the platform.

As for the individual ones, was highlighted a lack of computer literacy: as already defined, the resource considered was the most qualified in the field. As a result, there

may be a serious lack of computer knowledge on the part of all the actors involved in the dispensary.

Concerning staff turnover, in this specific case, it is not considered a problem. Nevertheless, the medical resource that will accompany the telemedicine project will be external, so the problem could occur if this latter changes place of work.

The shortage of medical personnel, a problem that had been identified as a challenge in the literature but not emerged from the interviews, is instead present in the case. This missing, in addition to causing a problem in all medical fields, can lead to a lower use of the platform, given the limited number of doctors present and, above all, that is able to approach telemedicine.

Finally, a lack not identified in the literature and not even by interviews, is a cultural diversity between the two parties involved in telemedicine, especially in terms of different language.

The lack of knowing English language, especially written and in the medical field, makes it difficult to have an efficient and targeted communication.

To conclude, the organizational barriers are the most difficult to analyze at this time of the project. In fact, the premature phase in which the project is found does not permit to define a stable management and organization of the platform.

The table below contains the main challenges to consider for a telemedicine project in Africa, based on the validated case.

Technical challenges	Individual challenges	Organizational challenges	Cultural challenges
Connectivity problems	Lack of computer literacy	Absent of coordination and management	Communication problems due to different languages

Table 23: Final classes of challenges identified

The critical elements found in the literature review do not appear to be specific to Africa. Through an analysis of some centers and the case study, it was possible to circumscribe more to the specific Continent.

Nevertheless, interviews may have given only a partial view of the problems, given the low number of States surveyed and the presence of more urban than rural

locations. However, based on the information gathered, have been confirmed the presence of certain barriers and their intensity. In addition, the early times of the telemedicine installation in Mvimwa, which were dictated by external needs, such as the mission of Italian doctors and the willingness to reactivate the relations buried for the Covid-19, have confirmed the relevance of those barriers.

In order to assess the progress of the project, with a focus on these four barriers, some KPIs have been defined to guide in the measurement of performance over time.

Considering technical challenges, two KPIs are presented:

- *Transmission rate (kbit/s)*
- *Number of tele consults sent in one day*

Individual challenges are monitored based on:

- *Healthcare personnel with digital skills / Total healthcare personnel*
- *Number of persons enrolled in training courses for digital knowledge during the first year*

Organizational barriers, even if not yet defined in the case, can be evaluated on:

- *Number of days in a week dedicated to telemedicine / Total days in a week*
- *Number of tele consults in one month*

Cultural challenges, as for individual ones, are monitored on:

- *Healthcare personnel with English skills / Total healthcare personnel*
- *Number of persons enrolled in training courses for English knowledge during the first year*

To conclude, a KPI to assess the status of the project is given by the increment of tele consults performed over years:

- $(\text{Number of tele consults}_{t+1} - \text{number of tele consults}_t) / \text{number of tele consults}_t$

Table below provides the main KPIs defined for the measurement of the project.

Connectivity problems	<i>Transmission rate</i> <i>Number of tele consults sent in one day</i>
Lack of computer literacy	$\frac{\text{Healthcare personnel with digital skills}}{\text{Total healthcare personnel}}$ <i>Number of personnel enrolled in training courses for knowledge during the first year</i>
Absent of coordination and management	$\frac{\text{Days in a week dedicated to telemedicine}}{\text{Total days in a week}}$ <i>Number of tele consults in one month</i>
Communication problems for different language	$\frac{\text{Healthcare personnel with English skills}}{\text{Total healthcare personnel}}$ <i>Number of persons enrolled in training courses for English knowledge during the first year</i>
Sustainability of the project	$\frac{\text{Number of tele consults}(t + 1) - \text{number of tele consults}(t)}{\text{Number of tele consults}(t)}$

Table 24: KPIs for the telemedicine project's performances measurement

On the basis of the emerged conclusions, the thesis now intends to provide a series of future actions in order to solve and prevent the problems that telemedicine encounters most.

In order to bring Internet to the affected area, a cable of 400 m length will be installed to bring the connection from the satellite antenna to the dispensary. Once on site, there will need to carry out other tests, as done with the hotspot connection, to verify the sufficient power of the network.

On the arrival of the referral doctor, scheduled for November 2021, it will be necessary to train him on the use of the platform.

In addition, it is necessary to identify at least two other operators who will practice telemedicine to anticipate potential staff turnover and tool's uselessness. A more precise number will depend on the number of patients and cases that the hospital will be able to receive once the project is completed. Considering the time, the choice to use it every day or dedicate specific days of the week will depend mainly on these analyses too.

All health professionals, and in particular those who will face telemedicine, will have to take training courses to develop digital and language skills. The monastery, in its many activities in the area, provides a school service where professors, already active in the territory, teach the English language from the first classes.

Therefore, it is necessary to exploit present teachers and create ad hoc courses for doctors in the dispensary, in order to provide a more specific knowledge of the language, especially in the medical field.

Considering technology, informatic courses are provided in the nearby town of Sumbawanga. As a result, another step will be to enroll health care professionals in these courses to improve their familiarity with computer tools. Moreover, "Golfini Rossi" Onlus intends to carry out fund raising activities in order to equip the Monastery with computers. These tools will not only improve their knowledge on the ground but will be the basis of a development of the entire hospital, succeeding to digitalize not only telemedicine but also all other departments under construction.

To conclude, it will be necessary to assess the need for new specialists to be included in the platform, in order to compress the most requested areas of medicine. The network of doctors of the UCBM, on which "Golfini Rossi" can count on, can add value to telemedicine and provide continuous training to the territory even if it is not possible to go on site.

6. Conclusion and future development

The analysis has concentrated on the main context of international cooperation and telemedicine. In this sense, the purpose was to acquire insights on the role of international cooperation and the existence of telemedicine in Africa. The literature results showed a low interest in the field, mainly due to some barriers a project may encountered. However, not specific recommendation where provided by the literature analysis.

Therefore, the thesis tends to provide some lesson learnt to consider when implementing a sustainable and efficient telemedicine service by international cooperation actors. Moreover, the definition of some KPIs to measure over time the performances.

The literature analysis proved as a major output the definition of five classes of barriers: technical, financial, individual, organizational and political. On the one hand, technical, individual and organizational barriers were also recognized by interviewed actors, defining some of them as the main reasons for which the centers in their states of reference have failed. Nevertheless, lack of infrastructure, lack of trained personnel and low user acceptance were no more considered as possible challenges.

On the other hand, financial and political barriers were completely excluded since any situation interviewed faced any of these problems. For this reason, only the remaining have been used in the lesson learnt definitions as warnings to be aware of during the development of a project.

Indeed, solutions for connectivity problems, lack of computer literacy, staff turnover and absent of coordination and management are some of the main requirements to provide an optimal telemedicine service.

The identified lessons learnt served to guide the initial stages of an international cooperation project carried out by the NGO "Golfini Rossi" in Tanzania. Among the whole project of expansion of a dispensary, the thesis focused phase related to the implementation of a telemedicine service in the dispensary. During the initial phases

of installation and testing, the analysis focused on the previously defined barriers and lesson learnt.

On the basis of the first results obtained, other limitations have been defined which had not emerged or had not been previously validated. Thus, the theoretical findings were enriched by the results obtained in the case study considered.

To conclude, when developing a telemedicine project in Africa, it is necessary to consider as potential barristers the lack of internet connection, the lack of computer literacy, the lack of coordination and management of the project and cultural diversity in terms of language. To access the project's performances, some KPIs for the measurement of these barriers were provided.

This work represents an initial step to provide a complete approach for the implementation of a telemedicine project. The future progress of the project may provide a deeper knowledge from which other experiences could benefit.

Moreover, the lesson learnt and KPIs suggests a further development over time, being able to assess several aspects that this thesis, given the premature phase of the project, was not able to define.

Future research developments could assess how the impact of large-scale digital training interventions can accelerate telemedicine placement. Moreover, an aspect that this thesis has not considered concerns the actual completion of tele consults, in terms of quality delivered.

Bibliography

- [1] C. Rich, B. Potter, and E. Bobenrieth, *Global public good*, no. January. New York: The United Nations Development Programme, 1997.
- [2] E. K. Boon, *Area Studies - Regional Sustainable Development: Africa*, vol. 2. 2012.
- [3] J. Degnbol-Martinussen and P. Engberg-Pedersen, *Aid: Understanding International Development Cooperation*. 2003.
- [4] J. A. Alonso and J. Glennie, "What is Development cooperation?," *N. Z. J. Geogr.*, vol. 87, no. 1, pp. 13–15, 1989, doi: 10.1111/j.0028-8292.1989.tb00410.x.
- [5] S. Klingebiel, *Development cooperation Challenges of the new Aid architecture*. 2014.
- [6] C. C. Gibson, K. Andersson, E. Ostrom, and S. Shivakumar, "The Samaritan's Dilemma: The Political Economy of Development Aid," *Samaritan's Dilemma Polit. Econ. Dev. Aid*, no. April 2014, pp. 1–288, 2005, doi: 10.1093/0199278857.001.0001.
- [7] Eni Foundation, "The Republic of Congo - Salissa Mwana," *enifoundation.it*. The Republic of Congo - Salissa Mwana (accessed Nov. 02, 2021).
- [8] COPE, "TANZANIA-Centro di accoglienza per bambini" Sisi ni Kesho – Noi siamo il futuro", *cope.it*. <https://cope.it/it/progetti/sisi-ni-kesho-noi-siamo-il-futuro/> (accessed Nov. 02, 2021).
- [9] Medici con L'Africa CUAMM, "Social report 2020," 2020.
- [10] Eni Foundation, "Mozambique," *enifoundation.it*. <https://www.eni.com/enifoundation/en-IT/where-we-operate/mozambique.html> (accessed Nov. 02, 2021).
- [11] Eni Foundation, "Ghana," *enifoundation.it*. <https://www.eni.com/enifoundation/en-IT/where-we-operate/ghana.html> (accessed Nov. 02, 2021).

- [12] Eni Foundation, "Angola," *enifoundation.it*. <https://www.eni.com/enifoundation/it-IT/dove-operiamo/angola.html> (accessed Nov. 02, 2021).
- [13] Comitato collaborazione medica, "Relazione attività CCM," 2019.
- [14] Africa Mission, "Dispensary - Healthcare," *africamission.org*. https://www.africamission.org/documents/Scheda-sintesi_Dispensari_2020-728.pdf (accessed Nov. 02, 2021).
- [15] COPE, "Tanzania- Il centro di salute rurale-Ospedale di Nyololo," *cope.it*. <https://cope.it/it/progetti/tanzania-centro-di-salute-rurale-ospedale-di-nyololo/> (accessed Nov. 02, 2021).
- [16] OVCI, "Ordinary management of the Usratuna Center," *ovci.it*, 2020. <https://ovci.it/index.php/en/what-we-do/south-sudan/ordinary-management-of-the-usratuna-center> (accessed Nov. 02, 2021).
- [17] Comunità Solidali nel Mondo Onlus, "Programma Kila Siku," *solidalinelmondo.org*. <https://www.solidalinelmondo.org/dar-es-salaam/> (accessed Nov. 02, 2021).
- [18] Comunità Solidali nel Mondo Onlus, "Inuka," *solidalinelmondo.org*. .
- [19] Eni Foundation, "Repubblica del Congo - Kento Mwana," *enifoundation.it*. <https://www.eni.com/enifoundation/it-IT/dove-operiamo/congo-kento.html> (accessed Nov. 02, 2021).
- [20] St. Gaspar Hospital, "Le attività internazionali," *stgasparhospital.com*. <https://www.stgasparhospital.org/collaborazioni-internazionali/> (accessed Nov. 02, 2021).
- [21] Eni, "enifoundation," *enifoundation.it*. <https://www.eni.com/enifoundation/en-IT/who-we-are.html> (accessed Nov. 02, 2021).
- [22] Ospedale pediatrico Bambino Gesù, "Ospedale pediatrico Bambino Gesù - Chi siamo," *ospedalebambinogesu.it*. <https://www.ospedalebambinogesu.it/chi-siamo-97235/> (accessed Nov. 02, 2021).
- [23] COPE, "COPE - Chi siamo," *cope.it*. .
- [24] CCM, "CCM - Chi siamo," *ccm-italia.org*. <https://www.ccm-italia.org/> (accessed Jun. 15, 2021).
- [25] Comunità Solidali nel Mondo Onlus, "La Nostra Storia," *solidalinelmondo.org*. <https://www.solidalinelmondo.org/chi-siamo/> (accessed Nov. 02, 2021).

- [26] Associazione La Nostra Famiglia, "OVCI - La Nostra Famiglia, Organismo di Volontariato per la Cooperazione Internazionale," *lanostrafamiglia.it*. <https://lanostrafamiglia.it/chi-siamo/enti-collegati/ovci> (accessed Nov. 02, 2021).
- [27] Africa Mission, "Africa Mission," *africamission.org*. <https://www.africamission.org/chi-siamo/africamission.html> (accessed Nov. 02, 2021).
- [28] Medici con L'Africa CUAMM, "Chi siamo," *mediciconl'africa.org*. <https://www.mediciconlafrica.org/chi-siamo/> (accessed Nov. 02, 2021).
- [29] Bokolo Anthony Jnr, "Use of Telemedicine and Virtual Care for Remote Treatment in Response to COVID-19 Pandemic," *J. Med. Syst.*, vol. 44, no. 7, 2020, doi: 10.1007/s10916-020-01596-5.
- [30] M. F. Chersich *et al.*, "Covid-19 in Africa: Care and protection for frontline healthcare workers," *Global. Health*, vol. 16, no. 1, pp. 1–6, 2020, doi: 10.1186/s12992-020-00574-3.
- [31] K. B. David *et al.*, "Telemedicine: an imperative concept during COVID-19 pandemic in Africa," *Pan Afr. Med. J.*, vol. 35, no. Supp 2, p. 129, 2020, doi: 10.11604/pamj.supp.2020.35.25281.
- [32] L. Van Dyk, "A review of telehealth service implementation frameworks," *Int. J. Environ. Res. Public Health*, vol. 11, no. 2, pp. 1279–1298, 2014, doi: 10.3390/ijerph110201279.
- [33] I. J. Okoroafor, F. N. Chukwuneke, N. Ifebunandu, T. C. Onyeka, C. O. Ekwueme, and K. K. Agwuna, "Telemedicine and biomedical care in Africa: Prospects and challenges," *Niger. J. Clin. Pract.*, vol. 20, no. 1, pp. 1–5, 2017, doi: 10.4103/1119-3077.180065.
- [34] R. Odhiambo and M. Mars, "Patients' understanding of telemedicine terms required for informed consent when translated into Kiswahili," *BMC Public Health*, vol. 18, no. 1, pp. 1–7, 2018, doi: 10.1186/s12889-018-5499-1.
- [35] C. Combi, G. Pozzani, and G. Pozzi, "Telemedicine for Developing Countries," *Appl. Clin. Inform.*, vol. 07, no. 04, pp. 1025–1050, 2016, doi: 10.4338/aci-2016-06-r-0089.
- [36] B. B. Traore, B. Kamsu-Foguem, and F. Tangara, "Integrating MDA and SOA for improving telemedicine services," *Telemat. Informatics*, vol. 33, no. 3, pp. 733–741, 2016, doi: 10.1016/j.tele.2015.11.009.

- [37] T. Edoh, P. A. Pawar, and A. D. Kora, "Evaluation of Telemedicine Systems User Satisfaction in Developing Countries: The Case of Mali and Senegal," *Int. J. E-Health Med. Commun.*, vol. 9, no. 3, pp. 62–78, 2018, doi: 10.4018/IJEHMC.2018070104.
- [38] T. Suzuki *et al.*, "Possibility of introducing telemedicine services in Asian and African countries," *Heal. Policy Technol.*, vol. 9, no. 1, pp. 13–22, 2020, doi: 10.1016/j.hlpt.2020.01.006.
- [39] M. Mars, "Telemedicine and advances in urban and rural healthcare delivery in Africa," *Prog. Cardiovasc. Dis.*, vol. 56, no. 3, pp. 326–335, 2013, doi: 10.1016/j.pcad.2013.10.006.
- [40] V. M. Kiberu, R. E. Scott, and M. Mars, "Assessment of health provider readiness for telemedicine services in Uganda," *Heal. Inf. Manag. J.*, 2018.
- [41] M. Mars, "Building the capacity to build capacity in e-health in sub-Saharan Africa: The KwaZulu-Natal experience," *Telemed. e-Health*, vol. 18, no. 1, pp. 32–37, 2012, doi: 10.1089/tmj.2011.0146.
- [42] M. J. Treurnicht and L. van Dyk, "A decision support system for equipment allocation in a telemedicine referral network," *South African J. Ind. Eng.*, vol. 25, 2014.
- [43] E. T. . Tchao, I. Acquah, S. D. . Kotey, C. S. . Aggor, and J. J. Kponyo, "On telemedicine implementations in Ghana," *Int. J. Adv. Comput. Sci. Appl.*, vol. 10, no. 3, pp. 193–201, 2019, doi: 10.14569/IJACSA.2019.0100325.
- [44] J. Joubert *et al.*, "A community survey of cardiovascular risk factors in an urban population in Botswana exploring potential for telemedicine," *Eur. Res. Telemed.*, vol. 3, no. 3, pp. 95–103, 2014, doi: 10.1016/j.eurtel.2014.07.001.
- [45] C. Muiruri, P. Manavalan, S. A. Jazowski, B. A. Knettel, H. Vilme, and L. L. Zullig, "Opportunities to Leverage Telehealth Approaches Along the Hypertension Control Cascade in Sub-Saharan Africa," *Curr. Hypertens. Rep.*, vol. 21, no. 10, 2019, doi: 10.1007/s11906-019-0983-2.
- [46] A. Bertani, F. Launay, P. Candoni, L. Mathieu, F. Rongieras, and F. Chauvin, "Teleconsultation in paediatric orthopaedics in Djibouti: Evaluation of response performance," *Orthop. Traumatol. Surg. Res.*, vol. 98, no. 7, pp. 803–807, 2012, doi: 10.1016/j.otsr.2012.03.022.

- [47] R. Colven, M. H. M. Shim, D. Brock, and G. Todd, "Dermatological diagnostic acumen improves with use of a simple telemedicine system for underserved areas of South Africa," *Telemed. e-Health*, vol. 17, no. 5, pp. 363–369, 2011, doi: 10.1089/tmj.2010.0163.
- [48] F. S. Sarfo, S. Adamu, D. Awuah, and B. Ovbiagele, "Tele-neurology in sub-Saharan Africa: A systematic review of the literature," *J. Neurol. Sci.*, vol. 380, pp. 196–199, 2017, doi: 10.1016/j.jns.2017.07.037.
- [49] S. M. Govender and M. Mars, "The use of telehealth services to facilitate audiological management for children: A scoping review and content analysis," *J. Telemed. Telecare*, vol. 23, no. 3, pp. 392–401, 2017, doi: 10.1177/1357633X16645728.
- [50] J. Chipps, P. Brysiewicz, and M. Mars, "A Systematic Review of the Effectiveness of Videoconference-Based Tele-Education for Medical and Nursing Education," *Worldviews Evidence-Based Nurs.*, vol. 9, no. 2, pp. 78–87, 2012, doi: 10.1111/j.1741-6787.2012.00241.x.
- [51] R. Latifi *et al.*, "Cabo Verde Telemedicine Program: Initial Results of Nationwide Implementation." pp. 90–91, 2019, doi: 10.18356/8d5fe232-en.
- [52] V. Azevedo, R. Latifi, A. Parsikia, F. Latifi, and A. Azevedo, "Cabo Verde Telemedicine Program: An Update Report and Analysis of 2,442 Teleconsultations," *Telemed. e-Health*, vol. 27, no. 2, pp. 172–177, 2021, doi: 10.1089/tmj.2020.0001.
- [53] G. H. Mengesha, A. A. Kebede, M. J. Garfield, and P. F. Musa, "Stakeholders analysis of ethiopian telemedicine projects: The case of black lion hospital, Addis Ababa, Ethiopia," *19th Am. Conf. Inf. Syst. AMCIS 2013 - Hyperconnected World Anything, Anywhere, Anytime*, vol. 4, no. August 2017, pp. 3066–3075, 2013.
- [54] F. S. Sarfo, S. Adamu, D. Awuah, O. Sarfo-Kantanka, and B. Ovbiagele, "Potential role of tele-rehabilitation to address barriers to implementation of physical therapy among West African stroke survivors: A cross-sectional survey," *J. Neurol. Sci.*, vol. 381, pp. 203–208, 2017, doi: 10.1016/j.jns.2017.08.3265.
- [55] T. A. Gurman, S. E. Rubin, and A. A. Roess, "Effectiveness of mHealth behavior change communication interventions in developing countries: A systematic review of the literature," *J. Health Commun.*, vol. 17, no. SUPPL. 1, pp. 82–104, 2012, doi: 10.1080/10810730.2011.649160.

- [56] S. Mburu and R. Oboko, "A model for predicting utilization of mHealth interventions in low-resource settings: case of maternal and newborn care in Kenya," *BMC Med. Inform. Decis. Mak.*, vol. 18, no. 1, pp. 1–16, 2018, doi: 10.1186/s12911-018-0649-z.
- [57] K. I. Adenuga, N. A. Iahad, and S. Miskon, "Towards reinforcing telemedicine adoption amongst clinicians in Nigeria," *Int. J. Med. Inform.*, vol. 104, pp. 84–96, 2017, doi: 10.1016/j.ijmedinf.2017.05.008.
- [58] M. Zolfo, M. H. Bateganya, I. M. Adetifa, R. Colebunders, and L. Lynen, "A telemedicine service for HIV/AIDS physicians working in developing countries," *J. Telemed. Telecare*, vol. 17, no. 2, pp. 65–70, 2011, doi: 10.1258/jtt.2010.100308.
- [59] F. Ekanoye, "Telemedicine Diffusion in a Developing Country: A Case of Ghana," *Sci. J. Public Heal.*, vol. 5, no. 5, p. 383, 2017, doi: 10.11648/j.sjph.20170505.14.
- [60] F. Shiferaw and M. Zolfo, "The role of information communication technology (ICT) towards universal health coverage: The first steps of a telemedicine project in Ethiopia," *Glob. Health Action*, vol. 5, no. 1, p. 15, 2012, doi: 10.3402/gha.v5i0.15638.
- [61] L. Cilliers and S. Flowerday, "User acceptance of telemedicine by health care workers a case of the Eastern Cape province, South Africa," *Electron. J. Inf. Syst. Dev. Ctries.*, 2014.
- [62] C. S. Hall, E. Fottrell, S. Wilkinson, and P. Byass, "Assessing the impact of mHealth interventions in low- and middle-income countries – what has been shown to work?," *Glob. Health Action*, vol. 17, no. 6, pp. 77–83, 2014, doi: 10.1002/aehe.3640170610.
- [63] M. O. Kachieng'a, "Challenges in managing diffusion of telemedicine technology in South Africa," in *Proceedings of the 1st International Technology Management Conference, ITMC 2011*, 2011, pp. 121–125, doi: 10.1109/ITMC.2011.5995936.
- [64] Y. Xue, H. Liang, V. Mbarika, R. Hauser, P. Schwager, and M. Kassa Getahun, "Investigating the resistance to telemedicine in Ethiopia," *Int. J. Med. Inform.*, vol. 84, no. 8, pp. 537–547, 2015, doi: 10.1016/j.ijmedinf.2015.04.005.
- [65] B. A. Townsend, R. E. Scott, and M. Mars, "The development of ethical guidelines for telemedicine in South Africa," *South African J. Bioeth. Law*, vol. 12, no. 1, p. 19, 2019, doi: 10.7196/sajbl.2019.v12i1.662.

- [66] A. Shovlin, M. Ghen, P. Simpson, and K. Mehta, "Challenges facing medical data digitization in low-resource contexts," *Proc. 3rd IEEE Glob. Humanit. Technol. Conf. GHTC 2013*, pp. 365–371, 2013, doi: 10.1109/GHTC.2013.6713713.
- [67] T. O. C. Edoh, A. D. Kora, P. Pawar, G. C. Coulibaly, and B. R. U. Alahassa, "Predicting telemedicine system user satisfaction in sub-Saharan Africa," *ICT Express*, vol. 2, no. 4, pp. 163–167, 2016, doi: 10.1016/j.icte.2016.10.006.
- [68] A. A. Avanesova and T. A. Shamliyan, "Worldwide implementation of telemedicine programs in association with research performance and health policy," *Heal. Policy Technol.*, vol. 8, no. 2, pp. 179–191, 2019, doi: 10.1016/j.hlpt.2019.04.001.
- [69] B. Ncube, M. Mars, and R. E. Scott, "The need for a telemedicine strategy for Botswana? A scoping review and situational assessment," *BMC Health Serv. Res.*, vol. 20, no. 1, pp. 1–8, 2020, doi: 10.1186/s12913-020-05653-0.
- [70] F. Verbeke, G. Karara, and M. Nyssen, "Evaluating the impact of ICT-tools on health care delivery in sub-Saharan hospitals," *Stud. Health Technol. Inform.*, vol. 192, no. 1–2, pp. 520–523, 2013, doi: 10.3233/978-1-61499-289-9-520.
- [71] H. J. Watson, "Assessment of Ethiopian Health Facilities Readiness for Implementation of Telemedicine," *Commun. Assoc. Inf. Syst.*, vol. 34, no. 1, pp. 1247–1268, 2014, doi: 10.17705/1cais.03465.
- [72] G. Bediang *et al.*, "The RAFT telemedicine network: lessons learnt and perspectives from a decade of educational and clinical services in low- and middle-incomes countries," *Front. public Heal.*, 2014.
- [73] D. Wamala and K. Augustine, "A meta-analysis of telemedicine success in Africa," *J. Pathol. Inform.*, vol. 4, no. 1, p. 6, 2013, doi: 10.4103/2153-3539.112686.
- [74] A. Akhlaq, B. McKinstry, K. Bin Muhammad, and A. Sheikh, "Barriers and facilitators to health information exchange in low- and middle-income country settings: A systematic review," *Health Policy Plan.*, vol. 31, no. 9, pp. 1310–1325, 2016, doi: 10.1093/heapol/czw056.
- [75] WHO, "The State of Health in the WHO Africa Region," 2018. [Online]. Available: [https://www.afro.who.int/sites/default/files/sessions/documents/State of health in the African Region.pdf](https://www.afro.who.int/sites/default/files/sessions/documents/State%20of%20health%20in%20the%20African%20Region.pdf).
- [76] M. Babhekile Rejoice, "Exploring Reasons for the High Staff Turnover Amongst," University of KwaZulu-Natal, 2017.

- [77] R. Lugg, L. Morley, and F. Leach, "Country Profiles for Ghana and Tanzania: Economic, social and political contexts for widening participation in higher education," *An ESRC/DfID Poverty Reduct. Program. Funded Res. Proj.*, 2007.
- [78] The World Bank, "Tanzania: Country brief," 2009. doi: 10.1596/978-0-8213-7868-7.
- [79] A. C. Mascarenhas, D. F. Bryceson, and F. M. Chiteji, "Tanzania," *Encycl. Br.*, 2021, [Online]. Available: <https://www.britannica.com/place/Tanzania>.
- [80] The United Republic of Tanzania, "The Tanzania Development Vision 2025," 1999.
- [81] The Ministry of Finance and Planning, "National Five Year Development 'Nurturing Industrialization for Economic Transformation and Human Development' .," 2016.
- [82] WHO and UNICEF, "A vision for primary health care in the 21st century: towards universal health coverage and the Sustainable Development Goals," 2018. doi: 10.1046/j.1466-7657.46.no4issue346.4.x.
- [83] WHO, "Country Case Studies: Tanzania," 2013. [Online]. Available: https://www.who.int/workforcealliance/knowledge/resources/MLHWCountryCaseStudies_annex5_Tanzania.pdf
http://www.who.int/workforcealliance/knowledge/resources/MLHWCountryCaseStudies_annex5_Tanzania.pdf.
- [84] S. Maluka, "Primary Healthcare Systems (PRIMASYS) Comprehensive case study from United Republic of Tanzania.," *World Heal. Organ.*, 2017, [Online]. Available: <http://apps.who.int/bookorders>.

List of Figures

Figure 1: The International Development Cooperation Octangle.....	7
Figure 2: Flow diagram of the search strategy and search results	45
Figure 3: New tele consult creation page on GHT platform	60
Figure 4: Number of tele consults in Cameroon, 2019-2021.....	61
Figure 5: Number of tele consults in Kenya, 2019-2021	62
Figure 6: Number of tele consults in Malawi, 2019-2021.....	63
Figure 7: Number of tele consults in Tanzania, 2019-2021	64
Figure 8: Number of tele consults in Egypt, 2019-2020.....	64
Figure 9: Number of tele consults in Madagascar, 2019-2020.....	65
Figure 10: pyramidal referral system of the healthcare sector in Tanzania.....	78
Figure 11: New maternity ward in Mvimwa.....	87
Figure 12: Pediatric department in Mvimwa	88
Figure 13: Mobile clinic in Mvimwa	88
Figure 14: New kitchen in Mvimwa	89
Figure 15: Telemedicine station placed in Mvimwa in October 2021	93
Figure 16: Timeline for the submission and response time.....	93

List of Tables

Table 1: International cooperation projects in healthcare in Africa	9
Table 2: Mozambique Natal care project, Eni Foundation	13
Table 3: Healthcare mother and children project, Eni Foundation	14
Table 4: The Kilamba Kiaxi project, Eni Foundation.....	15
Table 5: The Kento Mwana project, Eni Foundation.....	16
Table 6: The Salissa Mwana project, Eni Foundation.....	17
Table 7: St. Gaspar Referral and teaching hospital formation project, the Bambino Gesù Pediatric Hospital	19
Table 8: Sisi Ni Keisho-Noi siamo il futuro project, C.O.P.E.	21
Table 9: Kituo Cha Afya project, C.O.P.E.	22
Table 10: Universal and equitable access to quality health service project, CCM	24
Table 11: Strengthening the primary care system for the country population project, CCM	25
Table 12: Inuka CBR project, Comunità Solidali nel Mondo	27
Table 13: Kila Siku project, Comunità Solidali nel Mondo	28
Table 14: Usratuna rehabilitation center project, OVCI.....	30
Table 15: Dispensary-healthcare project, Africa Mission	32
Table 16: Mother and children first project, Medici con L’Africa CUAMM.....	34
Table 17: Care of child malnutrition project, Medici con L’Africa CUAMM	35

Table 18: St. Kizito hospital support project, Medici con L'Africa CUAMM	36
Table 19: IGHT against HIV in Shinyanga region project, Medici con L'Africa CUAMM	37
Table 20: Recommendation for implementing a telemedicine project by Combi et al.	51
Table 21: Five classes of challenges identified from the literature review	56
Table 22: Three classes of challenges validated from the interviews	71
Table 23: Final classes of challenges identified	96
Table 24: KPIs for the telemedicine project's performances measurement.....	98

Acronymous

Abbreviation	Description
SDG	Sustainable development goals
NGO	Non-governmental/profit organization
OECD	Organization for Economic Co-operation and Development
COPE	Cooperazione Paesi Emergenti
CCM	Comitato Collaborazione Medica
OVCI	Organizzazione Volontariato per la Cooperazione Internazionale
GHT	Global Health Telemedicine
MAECI	Ministro degli Affari Esteri e Cooperazione Internazionale
EA	EuropeAid
AICS	Agenzia Italiana Cooperazione e Sviluppo
FAI	Foundation Assistance Internationale
CEI	Conferenza Episcopale Italiana
CBR	Community-Based Rehabilitation

DFID	Department for International Development
CHW	Community Health Workers
SAM	Sever Acute Malnutrition
COVID-19	Coronavirus-19
KPI	Key-performance Indicators
ICT	Information and Communication Technology
WHO	World Health Organization
LMIC	Low-Middle Income Country
DREAM	Disease Relief through Excellent and Advanced Mean
IMF	International Monetary Fund
GDP	Gross Domestic Product
PHC	Primary Health Care
CHD	Coronary Health Disease
UCBM	University Campus BioMedico

Ringrazio la mia relatrice, la prof.ssa Masella per il supporto e la grande disponibilità dimostratami nell'affiancarmi in questo percorso di tesi.

Ringrazio Tiziana, Bianca e tutta Golfini Rossi per avermi accolto nella loro realtà, mostrandomi la bellezza e la grande passione per il loro lavoro.

Ringrazio più di tutti i miei genitori per il loro costante supporto. Avete saputo accompagnarmi in questo percorso standomi accanto nei momenti felici ma ancora di più in quelli difficili.

Vi voglio bene.

Mia sorella Federica, per essere stata in ogni occasione dalla mia parte. Sei da sempre il mio punto di riferimento.

I miei nonni e mio zio Giorgio, per avermi sempre dimostrato l'amore che solo la famiglia può dare.

Riccardo, per avermi supportata e accompagnata in questi cinque anni. Non avrei voluto condividere questo momento con nessun'altro se non te al mio fianco.

Le mie amiche, Rachele, Silvia, Giovanna e Greta, per aver gioito con me ad ogni successo raggiunto. Benedetta e Priscilla, per esserci sempre state, anche quando i nostri percorsi si sono divisi. Oggi è solo uno dei mille traguardi che spero raggiungeremo insieme.

Infine, i miei compagni di università, Riccardo, Federico, Gianluca, Ferdinando, Luca, Gianmarco ed Elena, grazie per aver reso ogni giorno a Bovisa un giorno felice. Emilia ed Antonio, per la vostra amicizia e l'incondizionato supporto, sarebbe stato nulla senza di voi.

