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Access to Healthcare and Deployment of Telemedicine in Madagascar: Context and Methodology

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ABSTRACT: This article explores the structural and organizational barriers limiting access to healthcare in Madagascar and evaluates the potential benefits of telemedicine in addressing these shortcomings. The Malagasy healthcare system, characterized by an unequal distribution of infrastructure and human resources, faces a shortage of medical personnel, particularly in rural areas. Telemedicine emerges as an alternative to improve access to specialized care by reducing geographical and time constraints. However, its deployment requires an adequate digital infrastructure, training for healthcare professionals, and a regulatory framework ensuring the quality of care and the protection of medical data. The study details the methodology for implementing remote medical procedures, emphasizing the importance of a well-structured process, from the collection of clinical information to the secure transmission of medical reports.

KEYWORDS: Barriers to healthcare, Telemedicine, Digital infrastructure, Medical staff training

I. INTRODUCTION

Access to healthcare is a major challenge for the socio-economic development of a country, particularly in developing nations like Madagascar. The recognition of the right to health in the Malagasy Constitution underscores the state's commitment to continuously improving the healthcare system [1]. However, despite concerted efforts, healthcare coverage remains uneven—especially in rural areas where nearly 80% of the population lives [2].

A shortage of healthcare professionals is another significant barrier. In 2019, Madagascar had on average one physician per 10,500 inhabitants, whereas the World Health Organization (WHO) recommends a ratio of one per 10,000 [3]. This average conceals major geographic disparities: urban centers enjoy a higher density of medical personnel, while remote regions suffer from inadequate healthcare coverage due to poor transport infrastructure, persistent insecurity, and living conditions that are unattractive for health professionals [4].

Another limiting factor is the distance to medical facilities. According to WHO recommendations, the acceptable distance between a patient and a primary care facility should be less than 5 km [5]. Yet more than half of the Malagasy population lives over 10 km from a health center, complicating access to quality care [6]. Consequently, many resort to self-medication or traditional medicine, often outside the legal framework [7].

In light of these challenges, telemedicine emerges as an innovative solution to improve access to healthcare—especially in isolated regions. Defined by the WHO as the use of information and communication technologies (ICT) to provide remote medical services [8], telemedicine helps reduce care disparities, optimize healthcare organization, and enhance the quality of patient follow-up. It is implemented in several forms, including teleconsultation, tele-expertise, telemonitoring, and teleassistance [9].

This study aims to analyze the challenges associated with access to care in Madagascar and to explore modalities for implementing a telemedicine system adapted to the local context. Specifically, the objectives of this article are to:

Identify the main structural and organizational barriers limiting access to care in the country;
Evaluate the potential benefits of telemedicine in addressing these shortcomings;
Describe the methodology for deploying remote medical acts and the criteria necessary for their effective implementation.

The study is based on a review of the scientific literature and examples of pilot telemedicine projects implemented in similar contexts. Through this analysis, we propose recommendations to optimize the integration of telemedicine into Madagascar's healthcare system and to promote improved access to care for the entire population.

II. LITERATURE SURVEY

Access to healthcare in Madagascar remains a significant challenge due to various structural and organizational barriers. These limitations make it particularly difficult to deliver quality medical services, especially in rural areas. One of the primary issues is the uneven distribution of human and material resources. Most healthcare professionals are concentrated in urban areas, where access to medical services is relatively easier, while rural regions—home to a large portion of the population—face severe shortages in infrastructure and qualified personnel. According to Madagascar's Ministry of Public Health (MSANP), the doctor-to-population ratio in 2014 was close to the threshold recommended by the WHO, yet significant geographical disparities persisted. Additionally, the aging healthcare workforce and the lack of specialized training in remote areas further exacerbate these inequalities [1], [10].

Madagascar's healthcare system is structured in a hierarchical manner, spanning from central institutions to community-level facilities. Despite the existence of 12 university hospital centers (CHUs) and regional referral hospitals (CHRRs) aimed at enhancing patient care, basic health centers (CSBs), particularly in rural areas, struggle with a severe shortage of qualified staff. More than half of these facilities reportedly operate with only a single healthcare worker, significantly limiting both the accessibility and quality of medical care [10].

In response to these challenges, telemedicine has emerged as a promising solution to improve access to healthcare services. Numerous studies highlight its advantages, including reduced waiting times, enhanced healthcare quality, and lower costs for both patients and medical institutions [8]. The WHO (2020) and the International Federation of Telemedicine and e-Health [9] emphasize telemedicine as a crucial tool to address healthcare system deficiencies, particularly in developing countries where infrastructure and human resources remain limited [9], [11].

However, the successful implementation of remote medical services in Madagascar requires a well-structured approach. Several factors must be taken into account to ensure an effective rollout. Firstly, improving digital connectivity is essential, as the lack of reliable internet infrastructure is a major barrier. The WHO and the International Telecommunication Union (ITU) have recommended increased investment in digital infrastructure to support telemedicine initiatives [5]. Secondly, training healthcare professionals is crucial to ensure the effective adoption of telemedicine technologies and to facilitate high-quality remote consultations [12].

Lastly, the establishment of standardized protocols and a well-defined regulatory framework is vital to guarantee the quality and security of telemedicine services. The WHO and researchers such as Ekeland et al. stress the importance of these regulations in ensuring the effectiveness of telemedicine practices and protecting patient data [8], [12].

III. METHODOLOGY

A. Study Design

The study employs a descriptive and analytical approach to examine the modalities for performing remote medical acts in Madagascar. An analysis of demographic, geographic, and health data was conducted to understand the context in which telemedicine is integrated [13].

B. Data Collection

Data were gathered from institutional and official sources, including:

- The General Census of Population and Housing 2019 (RGPH-3) for demographic data [13].
- Reports from the Ministry of Public Health (MPH) regarding the organization of the healthcare system and the distribution of human and material resources [4].

- Standard protocols for conducting telemedicine acts, based on recommendations by the World Health Organization [11].

C. Implementation of Remote Medical Acts

The deployment of telemedicine is structured into four main steps [14]:

- Request: Identification of the need for remote care, informing the patient, obtaining consent, and validation by the requesting professional.
- Preparation: Collection and transmission of administrative and clinical data, along with logistical and technical planning.
- Execution: Patient observation, data consultation, interaction between healthcare professionals, and medical decision-making.
- Conclusion: Report writing, updating the patient’s record, and disseminating information to the involved professionals.

D. Analysis and Validation

The analysis involves comparing the collected data with international telemedicine standards. Performance indicators—such as access to care, waiting times, and the satisfaction of patients and professionals—will be assessed to measure the system’s effectiveness [12].

IV. RESULTS

A. Geographical, Demographic, and Political-Administrative Context of Madagascar

Madagascar is located in the Southern Hemisphere, between 11° 57’ and 25° 30’ South latitude and between 43° 14’ and 50° 27’ East longitude, near the Tropic of Capricorn. It is situated in the southwest of the Indian Ocean, separated from the southeastern coast of Africa by the Mozambique Channel, approximately 350 km from the African coast [1]. With an area of 596,790 km², Madagascar is the fourth largest island in the world, stretching 1,500 km from Cap Sainte Marie in the south to Cap d’Ambre in the north, and nearly 500 km at its maximum width. The island has over 5,000 km of coastline, bordered on the west by the Mozambique Channel and on the east by the Indian Ocean, along with numerous small islands [13].

Administratively, Madagascar is divided into six provinces, 23 regions, 119 districts, 1,500 communes, and 17,500 fokontany, as provided by the Constitution [1]. These divisions represent decentralized territorial entities organized within autonomous provinces. The most recent general census of population and housing, conducted in 2019, recorded 25,680,342 inhabitants, with an annual growth rate of 3.01%. Nearly 80.5% of the population lives in rural areas [13].



Figure 1: Representation of the geographical, demographic, and political-administrative context of the country

B. Organization of the Healthcare System and the Situation of Health Facilities

Madagascar’s healthcare system is structured into four hierarchical levels to ensure coordinated care across the country. This system includes the central level, the intermediate level, the peripheral level, and the community level [10]. At the central level, Madagascar has 12 university hospital centers (UHC) and one private military hospital (PMH), responsible for overall health sector coordination, policy definition, and setting health standards. The intermediate level comprises 16 regional hospital centers of reference (RHCR) and 7 PMH, under the supervision of the Regional Public Health Directorate (RPHD), which is responsible for planning and evaluating health programs. The peripheral level consists of 157 district hospital centers (DHC) and 3,206 basic health facilities (BHF1 and BHF2)[10]. The community level is responsible for health promotion and managing basic health structures.

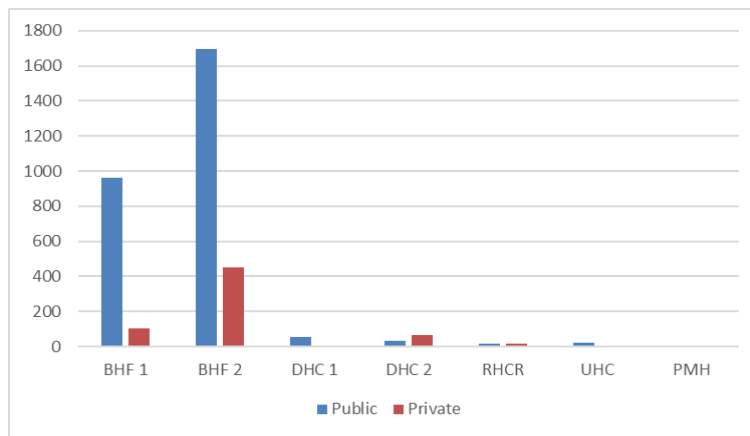


Figure 2: Graphical representation of health facilities at the MPH level

C. Human Resources in the Health Sector

The Ministry of Public Health of Madagascar (MPHM) registers 15,164 public health employees. Among these, 16.13% are physicians, 47.80% are paramedical staff, 16.55% are administrative personnel, and 19.52% are support staff [10]. The concentration of healthcare professionals is higher in urban areas, where 88.56% of the workforce is located, with paramedical staff constituting 42.14% of these human resources.

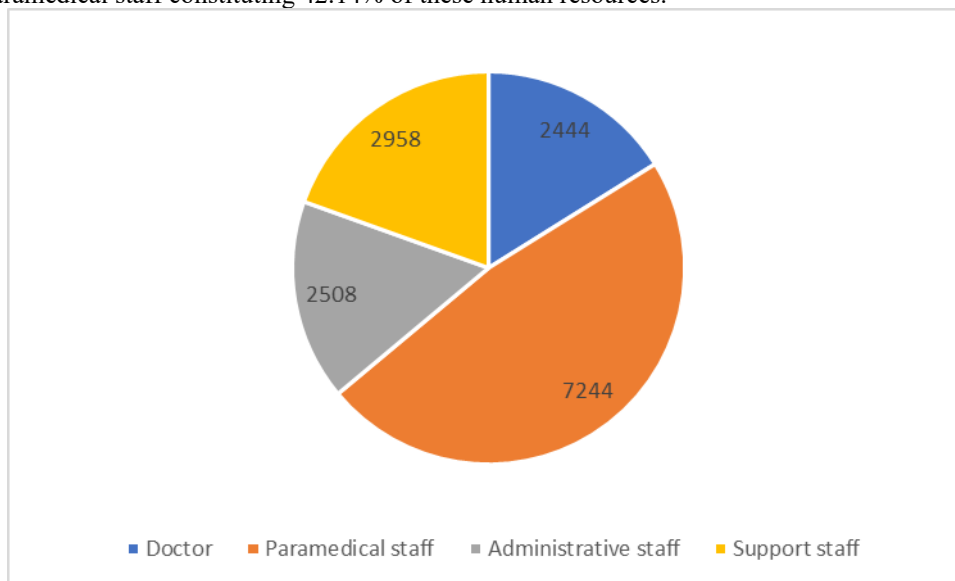


Figure 3: Health sector employees

The unequal distribution of human resources between urban and rural areas remains a major issue. In 2014, the ratio of public physicians per inhabitant was 1 per 10,500, close to the WHO-recommended ratio of 1 per 10,000, but significant geographic disparities exist. Urban areas benefit from better healthcare coverage, while rural regions are severely under-resourced [4]. Additionally, the aging of healthcare personnel is a concern, with an average age of 50.5 years among public employees [10].

Furthermore, an imbalance between public and private facilities, as well as between rural and urban areas, persists. According to an MPH report, 46.6% of level 2 BHF, which are expected to be managed by a physician, lack medical personnel, and more than 50% of BHF are managed by a single employee—15% of whom are nearing retirement [10]. This situation leads to temporary closures of BHF when staff are absent for service-related reasons.

D. Methodology for Performing Remote Medical Acts

This methodology describes the sequence of activities involved in carrying out a telemedicine act. It highlights four key steps [15], [16].

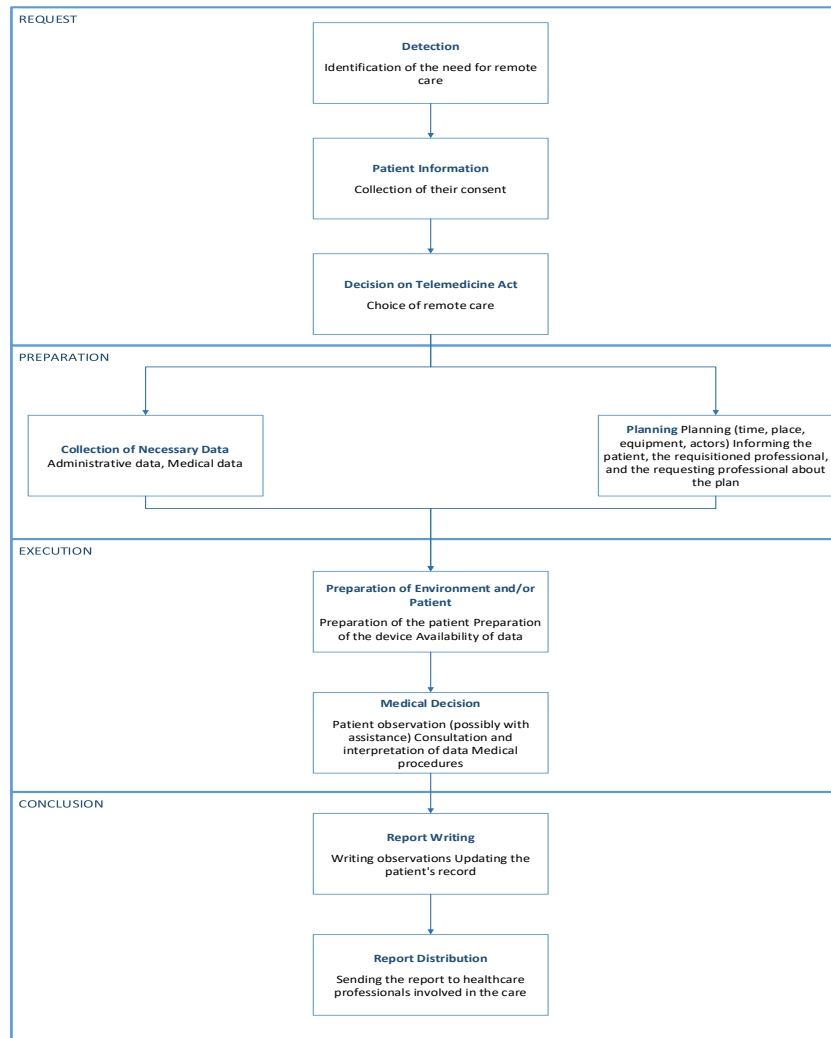


Figure 4: Steps for performing remote medical procedure

The table below details the activities for each step mentioned above. It should be noted that the absence of an indication in the "Actor" column means that there is no specific recommendation regarding the profile of the actor responsible for carrying out the activity.

1) Request

- TLC (Teleconsultation)
- TLE (Tele-expertise)
- TLA (Teleassistance)
- TLM (Telemonitoring)

Table 2: Detailed activities for each step in the execution of telemedicine acts: Request

Activities	Tasks	Actor	TLC	TLE	TLA	TLM
Detection	Identifying the need for a patient's remote care	Healthcare professional	x	x	x	x
	Exit case: Ineligibility for telemedicine (patient refusal, no deployed telemedicine device, existing device temporarily unavailable, etc.)					
Patient Information Collecting their consent	Patient Information	Any healthcare professional within their competencies	x	x	x	x
	Collecting free and informed consent (except in emergencies or impossibility)	Requesting professional	x	x	x	x
	Exit case: Patient refusal					
Decision on Telemedicine Act	Requesting remote care	Requesting professional	x	x	x	x
	Exit case: Contraindication					
	Acceptance of the request for telemedicine	Requisitioned doctor	x	x	x	x

2) Preparation

Table 3: Detailed activities for each step in the execution of telemedicine acts: Preparation

Activities	Tasks	Actor	TLC	TLE	TLA	TLM
Data Collection Required for the Act	Production of the necessary data for patient care: <ul style="list-style-type: none"> • Administrative data • Clinical data (medical examinations, imaging, biology, other tests, photos,..) 	Doctors, other healthcare professionals, individuals bound by professional secrecy	x	x	x	x
	Selection and provision of the necessary data for patient care to the required physician	Requesting professional	x	x	x	x
	Exit case: patient refusal, withdrawal of the request by the requester based on the data.					
	Automatic analysis of transmitted data	Telemonitoring system				x
Planning	Time planning: <ul style="list-style-type: none"> • Dedicated / occasional / emergency slot • Duration • Response time • Start and end date 		x		x	
	Location planning (equipped room)		x		x	
	Planning of necessary equipment and services:					

Activities	Tasks	Actor	TLC	TLE	TLA	TLM	
	• Medical equipment		x		x		
	• Videoconferencing		x		x		
	• Connected device					x	
	Planning the availability of:						
	• Patient		x		x	x	
	• Required physician		x	x	x	x	
	• Healthcare personnel present with the patient		x		x		
	• Healthcare personnel or patient responsible for recording and transmitting data					x	
	• People contributing to the organization: secretary, technician, coordinator...		x		x	x	
	Exit case: Unavailability of resources; planning rules can be standardized to facilitate organization.						
	Informing the patient, the required physician, and the requester of the planning		x	x	x	x	

3) Execution of the act

Table 4: Detailed activities for each step in the execution of telemedicine acts: Execution of the act

Activities	Tasks	Actor	TLC	TLE	TLA	TLM
Preparation	Patient preparation	Healthcare professional	x		x	
	Medical equipment preparation	Authorized professional			x	
	Preparation of technical device and/or videoconferencing (sound, image)		x		x	x
	Training the patient on the use of the telemedicine device "when required by the situation"	Authorized professional				x
	Exit case: Patient not present, unavailable technical device, missing medical equipment.					
Medical Decision	Patient observation and indication of actions to be performed by the healthcare professional present with the patient	Required physician	x		x	
	Consultation of data: • Collected as part of the act • Existing in external data sources	Required physician	x	x	x	x
	Perform medical acts	Required physician	x	x	x	x
	The medical decision may lead to: • Identifying a lack of data or poor data quality preventing a decision • Referring to another medical professional • A prescription • Closing the monitoring	Required physician	x	x	x	x
	Exit case: Lack of data, incorrect patient referral, inability to perform the medical act based on the situation, patient refusal.					

4) Conclusion

Table 5: Detailed activities for each step in the execution of telemedicine acts: Conclusion

Activities	Tasks	Actor	TLC	TLE	TLA	TLM
Report Writing	The patient’s file and observation sheet must include: <ul style="list-style-type: none"> • The date and time of the act • The identity of the healthcare professionals • The medical acts and prescriptions performed within the telemedicine act • The report on the execution of the act • If applicable, any technical incidents that occurred during the act 	Required physician	x	x	x	x
Report Distribution	Sending the report to update the patient’s file and observation sheet, which are maintained by each medical professional involved in the telemedicine act	Requesting physician, Required physician	x	x	x	x

V. DISCUSSION

The findings of this study highlight both the challenges and opportunities related to the implementation of telemedicine in Madagascar. Analyzing demographic and health data reveals a significant disparity in the distribution of medical resources, both in terms of personnel and infrastructure. This imbalance underscores the need for a structured organizational framework to ensure the effectiveness of remote medical services. Currently, most healthcare professionals are concentrated in major urban centers, limiting access to quality healthcare for rural populations. Developing a telemedicine platform could mitigate this issue by facilitating remote consultations, particularly for individuals living in remote and isolated regions.

Data collected from institutional sources have helped pinpoint major technical and organizational challenges. A significant barrier to the widespread adoption of telemedicine is the lack of reliable digital infrastructure, coupled with weak internet connectivity in certain areas. Additionally, effective implementation of telemedicine requires specialized training for healthcare professionals to optimize the use of digital tools and enhance the system’s acceptability. The analysis of standardized telemedicine protocols has further revealed that a well-defined regulatory framework, alongside clear performance indicators, is essential to assess the quality and efficiency of remote healthcare services.

To ensure the delivery of high-quality care, the implementation process for remote medical procedures must follow a well-structured approach. The initial request and preparation phases are particularly crucial, as they involve collecting and transmitting accurate patient data, scheduling consultations, and ensuring that necessary medical equipment is available. The execution phase must enable seamless communication between medical professionals to support informed clinical decision-making. Finally, the concluding phase, which involves updating patient records and distributing medical reports, is essential for maintaining continuity of care and reducing the risk of errors.

Evaluating the performance of the telemedicine system highlights several key benefits, including shorter patient wait times and increased satisfaction among both healthcare providers and patients. However, certain challenges remain, particularly regarding patient trust and acceptance. Some individuals may express hesitation due to the absence of direct physical interaction with physicians. Moreover, ethical and legal concerns, particularly regarding the security and confidentiality of medical data, must be carefully addressed to safeguard patient rights and ensure compliance with healthcare regulations.

These findings emphasize the importance of a comprehensive approach that integrates technological advancements, continuous training for healthcare professionals, and a well-adapted regulatory framework. The successful expansion of telemedicine in Madagascar will depend on strong collaboration between government health agencies, medical professionals, and technology providers. To support the sustainable growth of telemedicine, it is essential to invest in digital infrastructure, raise awareness among stakeholders, and implement policies that encourage its widespread adoption.

VI. CONCLUSION

In conclusion, this article highlights the key structural and organizational barriers limiting access to healthcare in Madagascar, including the concentration of medical resources in urban areas, weak healthcare infrastructure, and significant geographic disparities. Telemedicine emerges as a promising solution to address these challenges, providing opportunities to enhance access to specialized care and reduce treatment delays, particularly in rural and remote regions. However, its effective implementation requires a well-structured approach that incorporates the development of robust digital infrastructure, comprehensive training for healthcare professionals, and the establishment of clear protocols alongside a strong regulatory framework. These elements are crucial to ensuring the success of remote medical services and maximizing the benefits of telemedicine in improving both the quality and equity of healthcare in Madagascar.

REFERENCES

- [1] Republic of Madagascar, « Constitution of the IVth Republic ». 2010.
- [2] « Demographic Report 2021 », National Institute of Statistics Madagascar (INSTAT), Antananarivo, Madagascar, 2021.
- [3] World Health Organization, « World Health Report 2020 », Geneva, Switzerland, 2020.
- [4] Ministry of Public Health of Madagascar, « National Health Development Plan 2020–2024 », Antananarivo, Madagascar, 2020.
- [5] World Health Organization, « Primary Health Care Accessibility Standards ». Geneva, Switzerland, 2018.
- [6] World Bank, « Madagascar: Analysis of Health Infrastructure », Washington, DC, 2019.
- [7] T. Rakotoarimanana, « The Impact of Traditional Medicine on Public Health in Madagascar », Health Dev. J., 2021.
- [8] World Health Organization, « Telemedicine: A Guide for Developing Countries », Geneva, Switzerland, 2020.
- [9] International Federation of Telemedicine and e-Health (FITES), « Telemedicine Best Practices Guide », 2022.
- [10] Ministry of Public Health of Madagascar, « Health Sector Development Plan 2015–2019 », Antananarivo, Madagascar, 2019.
- [11] World Health Organization, « Digital Health Atlas: Telemedicine », Geneva, Switzerland, 2016.
- [12] A. G. Ekeland, A. Bowes, et S. Flottorp, « Effectiveness of Telemedicine: A Systematic Review of Reviews », Int. J. Med. Inf., vol. 79, no 11, p. 736-771, 2010, doi: 10.1016/j.ijmedinf.2010.08.006.
- [13] National Institute of Statistics Madagascar (INSTAT), « Final Results of the Third General Census of Population and Housing (RGPH-3) », Antananarivo, Madagascar, 2019.
- [14] World Health Organization, « WHO Guideline: Recommendations on Digital Interventions for Health System Strengthening », Geneva, Switzerland, 2019.
- [15] Pascale Martin, H. Lehericey, and B. Lemoine, « Telemedicine in Action: Building a Telemedicine Project », 2016.
- [16] H. M. Rabearison, F. Razafison, N. Razafimanjato, M. Zafintsalama, et H. Andriatsihoarana, « Design of a Low-Cost, Energy-Efficient Telemedicine Platform: An Innovative Solution for Medical Consultations in Remote Areas », Int. J. Adv. Eng. Manag., vol. 7, no 3, p. 90-121, mars 2025, doi: 10.35629/5252-070390121.



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