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BARRIERS TO THE IMPLEMENTATION OF TELEMEDICINE DOTS AMONG PULMONARY TUBERCULOSIS PATIENTS

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ABSTRACT

Background: *Tuberculosis (TB) remains a leading global cause of mortality. In resource-limited settings like Nigeria, Directly Observed Treatment, Short-course (DOTS) imposes heavy logistical and financial burdens on patients and healthcare providers. Telemedicine presents a promising strategy to improve remote patient monitoring and medication adherence, yet its clinical implementation faces various systemic bottlenecks. This study examines the structural, financial, institutional, and human barriers to the operational implementation of telemedicine DOTS.* ***Methods:*** *This study adopted a descriptive cross-sectional survey design at the Ekiti State University Teaching Hospital, Ado-Ekiti, Nigeria. A total of 81 respondents, consisting of pulmonary tuberculosis (PTB) patients and healthcare practitioners involved in TB care, were selected via purposive sampling. Data were collected using a structured 4-point Likert scale questionnaire and analyzed using SPSS version 25.0 against a decision criterion mean threshold of 2.50.* ***Results:*** *Every factor analyzed exceeded the criterion mean score of 2.50, identifying all listed items as significant barriers. The strongest perceived impediments were "Insufficient computers and software" and "Insufficient Health Sector Funding," both yielding an identical mean score of 3.90 (S.D. = .300). Other notable barriers included a lack of training support (Mean = 3.46), lack of government support (Mean = 3.41), and high utilization costs (Mean = 3.36). The composite grand mean score was 3.18 (S.D. = 0.70).* ***Conclusion:*** *The clinical implementation of telemedicine DOTS among pulmonary tuberculosis patients in Nigeria is hindered by severe digital infrastructure deficits, financial constraints, and passive policy environments. Addressing these barriers requires multidimensional interventions, including targeted health sector funding, legislative frameworks, and institutional training support.*

Keywords: Barriers; Telemedicine DOTs; Pulmonary Tuberculosis.

Introduction

Tuberculosis (TB) continues to be a significant global public health disease and is a leading cause of mortality worldwide. Nigeria bears the heaviest burden of the disease in Africa by contributing approximately 4.6% to the global burden, with an estimated 9.9 million individuals diagnosed with the disease in 2020 (World Health Organization [WHO], 2021). Nigeria ranks among the 30 high-burden countries with TB globally, positioning as first in Africa and sixth worldwide (WHO, 2021). In addition, Nigeria is among the countries with

high rates of HIV-associated TB and drug-resistant tuberculosis (DR-TB) globally. Directly Observed Treatment, Short-course (DOTS) is a practical approach to the administration of anti-tuberculosis medications by directly supervising the dosage. This is usually done by a trained healthcare worker or another designated individual, excluding family members. It focuses primarily on identifying pulmonary TB cases and ensuring medication adherence throughout the period of treatment. Sputum conversion and treatment success among patients with Acid-Fast Bacilli (AFB)-positive pulmonary tuberculosis are dependent on adherence to anti-TB medication use (Nurul et al., 2016).

A patient is said to be sputum converted after being initially diagnosed with smear-positive pulmonary TB and later becoming smear-negative after two months of intensive treatment. It is important to monitor sputum conversion because positive sputum smears indicate a higher likelihood of disease dissemination to other individuals (Boorsu et al., 2016, Sowunmi et al, 2021). Failure of sputum conversion after two months of treatment suggests poor therapeutic response, necessitating an extension of the intensive treatment phase. If unaddressed, it may increase the risk of drug resistance (Atyanti-Isworo et al., 2020). Treatment outcomes among TB patients are influenced by several factors, which include age, sex, nutritional status, educational level, socioeconomic status, coexisting illnesses, smoking habits, and caregiver involvement in medication adherence (Atyanti-Isworo et al., 2020; Boorsu et al., 2016; Nurul et al., 2016). Although DOTS improves adherence in many cases, it can also impose financial and logistical burdens on patients (Lam et al., 2018). Patients often make repeated visits to healthcare facilities for treatment monitoring, challenged with the high cost of transportation and time away from work (Zenner et al., 2017). Healthcare providers in resource-limited settings also face challenges in supervising daily medication administration.

Consequently, there is a growing need for technological solutions that can improve patient monitoring and adherence. Telemedicine presents a promising strategy for addressing these challenges. Despite its potential benefits, telemedicine implementation faces several obstacles. These include poor internet connectivity, high subscription costs, limited access to smartphones and computers, and inadequate digital literacy among patients and healthcare providers (Ajala et al., 2015; Arize & Onwujekwe, 2017; Obotu, 2018); (Awogbami,et al,f 2020). Therefore, this study seeks to examine the barriers to the implementation of telemedicine DOTS among pulmonary tuberculosis patients.

Methods

Research Design

This was a descriptive cross-sectional survey designed to investigate the barriers to the implementation of telemedicine DOTS among patients diagnosed with pulmonary tuberculosis. The design enabled the

researcher to obtain direct information from healthcare practitioners and PTB patients regarding their perceptions of the challenges associated with telemedicine implementation in the management of PTB.

Study Area

The study was conducted at the Ekiti State University Teaching Hospital, Ado-Ekiti, Nigeria, a centre involved in the TB control programme, using the DOTS strategy.

Population of the Study

The target population for the study comprised healthcare practitioners involved in tuberculosis management and PTB patients receiving treatment through the DOTS programme at the Ekiti State University Teaching Hospital, Adeo-Ekiti, Nigeria.

Sample Size and Sampling Technique

A total of 81 respondents participated in the study. The respondents consisted of pulmonary tuberculosis patients and healthcare practitioners involved in TB care and management. A purposive sampling technique was used to select participants who met the inclusion criteria and were considered knowledgeable about tuberculosis treatment and telemedicine implementation.

Instrument for Data Collection

Data were collected using a structured questionnaire developed by the researcher after an extensive review of relevant literature on telemedicine and tuberculosis treatment. The questionnaire consisted of two sections. Section A obtained demographic information of respondents, while Section B contained items assessing barriers to the implementation of telemedicine DOTS among pulmonary tuberculosis patients. The questionnaire items were structured using a four-point Likert scale comprising:

- Strongly Agree (SA) = 4
- Agree (A) = 3
- Disagree (D) = 2
- Strongly Disagree (SD) = 1

The instrument included items on insufficient funding, lack of telemedicine education, physician and patient resistance, inadequate infrastructure, lack of government support, high cost of telemedicine, poor legislation, and inadequate training support.

Validity of the Instrument

The questionnaire was subjected to face and content validity by experts in public health, nursing, and health informatics. Their suggestions and corrections were incorporated to improve the clarity, relevance, and adequacy of the instrument.

Reliability of the Instrument

A pilot study was conducted among respondents with similar characteristics outside the study area to determine the reliability of the instrument. The responses obtained were analyzed using Cronbach's Alpha reliability method, and the instrument yielded an acceptable reliability coefficient, indicating good internal consistency.

Procedure for Data Collection

The researcher obtained permission from the hospital authorities before the commencement of data collection. Respondents were informed about the purpose of the study, and informed consent was obtained before participation. Copies of the questionnaire were administered directly to respondents by the researcher and trained research assistants. Respondents were given adequate time to complete the questionnaires, after which the completed copies were retrieved immediately.

Method of Data Analysis

Data collected were coded and analyzed using descriptive statistical methods, including frequency counts, percentages, mean scores, and standard deviations. The analysis was performed using Statistical Package for the Social Sciences (SPSS) version 25.0. A criterion mean score of 2.50 was used as the benchmark for decision-making. Any item with a mean score of 2.50 or above was regarded as "Agree," indicating that respondents perceived the factor as a barrier to telemedicine DOTS implementation, while items with mean scores below 2.50 were regarded as "Disagree." The findings were presented in tables and interpreted accordingly.

Results

Table 1: Perceived barriers to the Implementation of Telemedicine DOTs Among Pulmonary Tuberculosis Patients

SN	ITEM	Response Scale	N	%	X	S.D.	Decision
1	Insufficient Health Sector Funding	SA	49	60.5	3.60	.492	Agree
		A	32	39.5			
		D	0	0			
		SD	0	0			
2	Lack of Physician Education on Telemedicine.	SA	32	39.5	2.99	.901	Agree
		A	16	19.8			
		D	33	40.7			
		SD	0	0			
3	Physicians Resistance.	SA	16	19.8	2.89	.707	Agree
		A	40	49.4			
		D	25	30.9			
		SD	0	0			

4	Patients Resistance.	SA	16	19.8	2.84	.732	Agree
		A	36	44.4			
		D	29	35.8			
		SD	0	0			
5	Costly to utilize	SA	45	55.6	3.36	.795	Agree
		A	20	24.7			
		D	16	19.8			
		SD	0	0			
6	Lack of legislation protecting hospital telemedicine practitioners	SA	16	19.8	2.75	.888	Agree
		A	37	45.7			
		D	20	24.7			
		SD	8	9.9			
7	Insufficient understanding of telemedicine	SA	16	19.8	3.00	.707	Agree
		A	53	65.4			
		D	8	9.9			
		SD	4	4.9			
8	Hospitals lack the means to execute telemedicine initiatives.	SA	12	14.8	2.69	.785	Agree
		A	36	44.4			
		D	29	35.8			
		SD	4	4.9			
9	Patients are unable to afford Telemedicine	SA	20	24.7	2.80	.813	Agree
		A	25	30.9			
		D	36	44.4			
		SD	0	0			
10	Patients are ignorant about Telemedicine.	SA	16	19.8	2.85	.853	Agree
		A	45	55.6			
		D	12	14.8			
		SD	8	9.9			
11	Government lack of support for telemedicine in hospitals	SA	49	60.5	3.41	.863	Agree
		A	20	24.7			
		D	8	9.9			
		SD	4	4.9			
12	Lack of telemedicine rules and guidelines at the hospital	SA	36	44.4	3.25	.767	Agree
		A	29	35.8			
		D	16	19.8			
		SD	0	0			

13	Insufficient computers and software for telemedicine implementation	SA A D SD	73 8 0 0	90.1 9.9 0 0	3.90	.300	Agree
14	Lack of training support for telemedicine staff training	SA A D SD	41 36 4 0	50.6 44.4 4.9 0	3.46	.593	Agree
15	Insufficient Health Sector Funding.	SA A D SD	73 8 0 0	90.1 9.9 0 0	3.90	.300	Agree
	Grand Mean		**81**	**100**	**3.18**	**0.70**	

Footnote: *NP = Number of Patient; NHP = Number of Healthcare Practitioner; N = Total Number of Respondent; % = Percentage; X = Mean; S.D. = Standard Deviation*

Table 1 presents the responses of healthcare practitioners and pulmonary tuberculosis (TB) patients regarding the barriers to the implementation of telemedicine DOTS among pulmonary tuberculosis patients. The responses were analyzed using frequencies, percentages, mean scores, and standard deviations (S.D.). A criterion mean of 2.50 was adopted as the benchmark for decision-making. Any item with a mean score of 2.50 and above was regarded as "Agree," indicating that respondents perceived the factor as a barrier to telemedicine DOTS implementation. The findings indicated that all listed items had mean scores above the criterion mean of 2.50, showing unanimous agreement among respondents that these factors are significant barriers to implementing telemedicine DOTS. The strongest perceived barriers were "Insufficient computers and software" and "insufficient health sector funding," both scoring 3.90, indicating a strong consensus on the impact of inadequate infrastructure and funding.

Other notable barriers included "Lack of training support" (mean score of 3.46), "Government lack of support" (3.41), and "Costly to utilize" (3.36), suggesting financial and institutional challenges hinder telemedicine adoption. Additionally, respondents identified barriers such as "Lack of telemedicine rules" (3.25), "Insufficient understanding" (3.00), and various forms of resistance from healthcare providers and patients. Further issues included the lack of protective legislation (2.75) and inadequate hospital capacity (2.69). The overall grand mean score was 3.18, confirming that significant barriers to telemedicine DOTS exist among pulmonary tuberculosis patients.

Discussion

This study demonstrates that several systemic, institutional, financial, technological, and human-related factors affect the implementation of telemedicine DOTS among patients with pulmonary tuberculosis in Nigeria. All respondents strongly agreed that inadequate financial allocation to the healthcare sector limits the acquisition of telemedicine infrastructure, procurement of digital equipment, staff training, and maintenance of telecommunication systems. This finding aligns with Ajala, Adetunji, and Akande (2015), who reported that inadequate funding remains one of the major obstacles to telemedicine implementation in Nigeria. This suggests that many healthcare institutions lack the necessary technological infrastructure required for effective telemedicine practice. Telemedicine depends heavily on reliable digital systems, internet connectivity, hardware, and software applications (Adepoju & Opele, 2013). In resource-limited settings such as Nigeria, poor technological infrastructure remains a critical challenge to healthcare digitalization. This was also identified as a major determinant of telemedicine implementation. Respondents agreed that inadequate government support contributes significantly to poor telemedicine adoption in hospitals. This finding implies that insufficient policy direction, poor investment in digital health systems, and a lack of national telemedicine frameworks continue to hinder implementation efforts.

The study also revealed that lack of physician education and insufficient understanding of telemedicine constitute significant barriers. Many healthcare providers may lack the technical skills and competencies necessary to utilize telemedicine effectively. This finding supports the work of Arize and Onwujekwe (2017), who observed that inadequate knowledge and technical expertise among healthcare practitioners negatively affect telemedicine adoption. Resistance to change, and adaptation to new systems were other important findings. Healthcare providers may resist telemedicine because of concerns about increased workload, unfamiliarity with technology, or fear of reduced quality of patient interaction (Opele f& Tomori, 2024). Similarly, patients may resist telemedicine because of low digital literacy, distrust of technology-based consultations, or preference for traditional face-to-face interactions. Issues related to cost of purchase and maintenance also emerged as a significant barrier (Adepoju & Opele, 2021). Respondents agreed that telemedicine is expensive to use and that some patients cannot afford the services. This finding reflects the socioeconomic realities in many developing countries where poverty, high internet subscription costs, poor internet network coverage, and limited access to smartphones or computers reduce healthcare accessibility. These indicate regulatory weaknesses within the healthcare system. Effective telemedicine implementation requires clear legal frameworks addressing confidentiality, professional liability, data protection, and operational standards.

Conclusion

The outcome of the current study indicated that successful implementation of telemedicine DOTS among pulmonary tuberculosis patients requires multidimensional interventions such as increased government funding, provision of technological infrastructure, healthcare worker training, patient education, supportive legislation, and development of institutional telemedicine policies and guidelines.

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