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# The Predictors of Medication Adherence among TB Patients on the E-Refill Prescription System in Health Care Facilities in Lagos State

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**Abstract:-**

- ***Background:***

**Tuberculosis (TB) has continued to be a major health concern to man and has affected majority of the population around the world. In the World Health Organisation (WHO)'s estimate, Nigeria is second in Africa and seventh in the world with regard to cases. Since Lagos is the most populous state in Nigeria, it has made a high number of tuberculosis cases. Since there is no cure for TB without taking the prescription drugs, noncompliance has been as frequent as the disease, leading to treatment failure, drug resistant TB and increased cost of healthcare. The e-refill prescription system which is an electronic prescription refill system is targeted to increase medical compliance amongst TB patients consequently improving overall health.**

- ***Aim:***

**The purpose of this study is therefore to evaluate the factors which determine medication compliance among TB patients on the e-refill prescription in health facilities in Lagos state.**

- ***Setting:***

**Various healthcare facilities across Lagos.**

- ***Methodology:***

**This study employed the cross-sectional method. For sampling, we opted for a purposive sampling approach to select the patients. The sample size, determined using the Kish formula, comprised approximately 338 TB patients. In order to collect data on critical factors such as patient's satisfaction, factors influencing e-refill medication adherence, and the willingness to adopt the e-refill system, this study made use of in-depth interview and semi-structured question. Furthermore, the collected data was analysed with SPSS software, with two team members independently coding the interview transcripts to identify emerging themes and resolve discrepancies through consensus discussions.**

- ***Results:***

**A large proportion of the participants fell between the ages of 28 to 38 years (45.9%), (53.0%) were married, and the Yoruba ethnic group dominated the population at (49.4%). Most patients received care from government-owned facilities (75.1%). 68.6% considered medical adherence important. Of factors influencing medical adherence, (47%) said that forgetfulness often affected their adherence, and (23.7%) cited the side effect. Of those surveyed, 54.4% expressed interest in using the e-Refill system, and 60.7% were knowledgeable about it. Ease of use (32.8%) and system trust (29.9%) are the main variables influencing readiness to utilise the e-Refill system.**

- ***Conclusion:***

**The e-Refill system has shown potential for success in improving medication adherence among TB patients in Lagos state. However, it is important to address challenges such as limited access to healthcare and reluctance among certain patient groups need to be addressed. To get maximum result possible from the system, it is important to take steps to enhance patient engagement, address stigma associated with the illness, and ensure sustained support over the duration of the treatment.**

- ***Contribution:***

**The study highlights the significance of niche interventions geared towards promoting medication adherence and improving TB treatment outcomes in resource-constrained environments.**

***Keywords:-*** *Tuberculosis, e-Refill Prescription System, Medication Adherence*.

## I. INTRODUCTION

Tuberculosis (TB) is a global health concern caused by *Mycobacterium Tuberculosis.* The disease primarily affects the lungs but can also manifest in pulmonary forms (1), According to the World Health Organization, Nigeria ranks among the first 30 countries affected by TB, reflecting the prevalence of the disease within its border (2). Lagos has more people per square mile and is the most populated state in Nigeria, and as a result, sees more tuberculosis cases (3). In order to successfully treat TB, there has to be utmost compliance to the medication regimen, unfortunately, many patients are non-compliant, resulting in treatment failure, drug resistant TB, and increased health cost (4). WHO developed directly observed treatment in order to address the issue of poor adherence among TB patients (5). Factors such as poverty, overcrowded residency, poor healthcare services (particularly in rural area), worsened the TB burden (6).

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The electronic refill (e-Refill) prescription system is a technology built as a means to promoting medication adherence and achieving better health outcomes (7). An optimal TB treatment should include sufficient intake of anti-tuberculosis drugs, but the tendency of various people to be non-compliant is high, with a possibility of disease relapse, multi-drug resistant TB, and extra healthcare cost (8). This e-refill prescription system is of utmost importance to enhance medication adherence among TB patients. Although, the way the system is being used may influence medication adherence: for instance, increased frequency of use, or technical issues could have some effect on medication adherence according to (9). However, the compliance and the effectiveness largely depend on the patient demographics, clinical characteristics, and system usage (5). This study generally aimed to assess the predictors of medication adherence among TB patients on the e-Refill prescription system in public healthcare facilities in Lagos.

➢ *The Specific Objectives were to;*

- To assess the level of medication adherence to TB drugs among patients attending secondary health care facilities in Lagos
- To assess patients' motivations and concerns of patients regarding E-refill for TB medication adherence
- To assess the level of satisfaction with e-refill prescription system among TB patients
- To assess the willingness of the patients to adopt the e-refill prescription system.

➢ *The following are the Hypothesis of the Study*

- There is no significant association between the socio-demographic characteristics of the respondent and TB medication adherence.
- There is no significant association between the socio-demographic characteristics of the respondent and the willingness to adopt e-refill prescription system.

## II. METHODOLOGY

➢ *Study Design:*

This study employed a cross-sectional mixed method research design. Data in this study were both qualitative and quantitative in nature and data analysis was done with the use of SPSS. The qualitative aspect was conducted through in-depth interview which is a critical technique of studying the research questions concerning the medication adherence behaviours.

➢ *Setting:*

Various healthcare facilities across Lagos.

➢ *Sampling Technique and Study Population*

The technique of sample collection in effect of this study was done through purposive sampling. Purposeful sampling technique means that the participants are chosen in a way that will help in comparing them to the certain criteria that are thought to be important when attaining the research goals. 338 TB patients participated in this study.

➢ *Data Collection:*

Semi structured questionnaire was used to collect quantitative data which made it ideal for developing response to the research questions. The collection of Qualitative data was done through in-depth interviews. A number of patients who provided verbal consent were also interviewed over the telephone. The interview was audio recorded ensuring consistency in the data collection process, the respondents were asked open ended and semi structured questions designed to get in depth and accurate responses.

➢ *Data Analysis*

The quantitative data gotten from the semi-structured questionnaire was analysed with SPSS v25 statistical software. The numerical data retrieved from the selected respondents under study were subjected to descriptive and inferential analysis while the qualitative data collected from the in-depth interviews were subjected to thematic analysis. To extract the qualitative data, the responses from the in-depth interview first have to be transcribed, analyzed, and patterns (themes) within the data were recorded. The themes were identified based on their prevalence and significance in relation to the research objectives.

➢ *Ethical Considerations:*

The researcher obtained ethical approval from the Ministry of Health, Lagos state. All the interviews were done under anonymity and confidentiality. The audio recordings were transcribed after which the data was analyzed and further integrated into the whole study outcomes.

## III. RESULTS

➢ *Socio-Demographic Characteristics of Patients.*

Table 1 shows the results of participants regarding age distribution, the majority of patients fell within the age range of >28 to ≤38 years (45.9%). This was followed by the age group of >38 to ≤48 years (23.1%). The data also show significant representation across other age groups, indicating a diverse range of patients in terms of age. The analysis indicates that a substantial portion of patients were married (53.0%), while 33.4% were single. Only a small proportion of patients were either divorced (4.7%) or widowed (1.8%). This suggests that the majority of patients seeking care were in marital unions. Regarding family structure, the data show that the majority of patients came from monogamous family set-ups (53.6%), followed by polygamous set-ups (24.0%). A smaller proportion of patients came from single-parent households (13.3%). This distribution highlights the diversity in family structures among the patient population. In terms of educational attainment, a notable proportion of the patients (42.6%) had received secondary education, 23.4% received only primary education, a smaller number (11.5%) had received tertiary education, while 14.2% of the patients never received formal education. This suggests a varied educational background among the patient cohort.

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The analysis reveals that a considerable proportion of patients were gainfully employed (51.8%), while 35.2% were unemployed. This distribution underscores the employment status diversity among patients seeking care. The results revealed that majority of the patients were from the Yoruba ethnic group (49. 4%) while the Igbo ethnic group consisted of 29. 0% of patients and the remaining minority of the patients were of Hausa ethnic group (16. 0%). This indicates a diverse representation of ethnicities among patients receiving care. Regarding family income, the data exhibit variability in reported income levels, with a notable proportion of patients not specifying their income (8.6%). However, among those who provided data, the majority reported average monthly incomes. This variability suggests diversity in socio-economic backgrounds among patients. In terms of healthcare facility type, the analysis indicates that the majority of patients received care from government-owned facilities (75.1%), while a smaller proportion sought care from private-owned facilities (13.3%). This distribution reflects the utilization of both secondary and private healthcare services by patients.

Table 1 Patients' Socio-Demographic Characteristics

| Variable | Frequency | Percentage (%) |
|---|---|---|
| **Gender** | | |
| Female | 124 | 36.7 |
| Male | 214 | 63.3 |
| **Age** | | |
| ≤18 | 8 | 2.4 |
| >18≤28 | 52 | 15.4 |
| >28≤38 | 155 | 45.9 |
| >38≤48 | 78 | 23.1 |
| >48≤58 | 26 | 7.7 |
| >58 | 19 | 5.7 |
| **Mean ± SD** | 3.29 ± 1.013 | |
| **Marital Status** | | |
| Single | 113 | 33.4 |
| Married | 179 | 53.0 |
| Divorced | 28 | 5.4 |
| Widowed | 18 | 3.6 |
| **Family Structure** | | |
| Monogamous | 181 | 53.6 |
| Polygamous | 92 | 27.2 |
| Single Parent | 65 | 19.2 |
| **Educational Status** | | |
| No Formal Education | 52 | 15.4 |
| Primary Education | 79 | 23.4 |
| Secondary Education | 144 | 42.6 |
| Tertiary Education | 63 | 18.6 |
| **Occupation** | | |
| Gainfully Employed | 196 | 58 |
| Unemployed | 142 | 42 |
| **Ethnicity** | | |
| Yoruba | 167 | 49.4 |
| Igbo | 98 | 29.0 |
| Hausa | 54 | 16.0 |
| Other | 19 | 5.6 |
| **Family Average Monthly Income** | | |
| Less than 50k | 25 | 7.1 |
| 50k and above | 27 | 8.0 |
| Unspecified | 287 | 84.9 |
| **Type of Facility** | | |
| Government-owned | 254 | 75.1 |
| Private-owned | 45 | 13.3 |
| NGO-owned | 0 | 0 |
| Don't know | 39 | 11.5 |

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Table 2 Medication Adherence

| Variable | Frequency | Percentage |
|---|---|---|
| **How often do you miss taking your TB medication?** | | |
| Never | 198 | 58.6 |
| Rarely | 49 | 14.5 |
| Sometimes | 38 | 11.2 |
| Often | 1 | 0.3 |
| Always | 1 | 0.3 |
| Other | 51 | 15.1 |
| **What are the reasons for missing your TB medication?** | | |
| Forgetfulness | 188 | 55.6 |
| Side Effects | 63 | 18.6 |
| Lack of access to medication | 6 | 1.8 |
| Other | 81 | 24.0 |
| **How often do you refill your TB medication using the c-refill prescription system?** | | |
| Always | 146 | 43.2 |
| Often | 11 | 3.3 |
| Sometimes | 9 | 2.7 |
| Rarely | 13 | 3.8 |
| Never | 72 | 21.3 |
| Other | 87 | 25.7 |
| **What are the reasons for not refilling your TB medication using the e-refill prescription system?** | | |
| Lack of access to technology | 44 | 13.0 |
| Lack of knowledge on how to use the system Prefer traditional | 92 | 27.2 |
| refill system | 24 | 7.1 |
| Other | 178 | 52.6 |
| **What factors, if any, contribute to missed doses or irregular medication intake?** | | |
| Forgetfulness | 86 | 25.4 |
| Side effects | 34 | 10.1 |
| Busy schedule | 90 | 26.6 |
| Lack of understanding | 6 | 1.8 |
| Other | 122 | 36.1 |
| **How confident are you in using the e-refill prescription system to refill your TB medication?** | | |
| Very confident | 148 | 43.8 |
| Confident | 26 | 7.7 |
| Neutral | 8 | 2.4 |
| Not confident | 46 | 13.6 |
| Not at all confident | 33 | 9.8 |
| Other | 77 | 22.8 |

The majority of participants (58.6%) stated that they consistently took their TB medication, while 14.5% reported rarely missing it. However, a significant portion (24%) admitted to occasionally, frequently, or always missing their medication. The main reason for missing medication was forgetfulness, as reported by over half (55.6%) of participants. Side effects were also a notable factor, affecting 18.6% of participants. Concerning refilling the prescriptions only 43.2% of the participants reported to have used the e-refill system for the TB drugs. Some of the reasons identified for non-use of e-refill were: 27.2% of the participants stated that they had no knowledge of the e-refill system, 13.0% of them stated that they had inadequate access to technological devices and tools, while 7.1% of them stated that they preferred using traditional refill techniques.

- *Satisfaction with e-Refill Prescription System*

Table 3 present the current satisfaction of the participants with E-Refill Prescription System. The majority of respondents (63%) expressed high satisfaction with the ease and convenience of collecting drugs from the facility. An additional 27.8% were also satisfied with this process. Only a small percentage indicated neutrality (1.3%) or dissatisfaction (1.5%). In terms of procuring medication outside the facility, just fewer than 60% of respondents (59.8%) reported being very satisfied with the process, while 17% were satisfied. Dissatisfaction was slightly higher for this aspect, with 8.6% expressing dissatisfaction and 8.5% providing other reasons for their dissatisfaction. People are very satisfied with the ease of collecting prescriptions at the facility (almost 91% very or satisfied) and fairly satisfied with obtaining medications elsewhere (nearly 77% very or satisfied). However, a little fewer than 17% of respondents were dissatisfied with obtaining medications outside the facility.

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Table 3 Satisfaction With e-Refill Prescription System

| Variable | Frequency | Percentage |
|---|---|---|
| **Are you satisfied with the ease and convenience of collecting drugs from the facility?** | | |
| Very satisfied | 213 | 63.0 |
| Satisfied | 94 | 27.8 |
| Neutral | 1 | 0.3 |
| Dissatisfied | 0 | 0.0 |
| Very Dissatisfied | 0 | 0.0 |
| Other | 30 | 8.9 |
| **Are you satisfied with your perceived interpretation and understanding of the prescription notes?** | | |
| Very satisfied | 200 | 59.4 |
| Satisfied | 92 | 27.2 |
| Neutral | 4 | 1.2 |
| Dissatisfied | 0 | 0.0 |
| Very Dissatisfied | 2 | 0.6 |
| Other | 40 | 11.8 |
| **Are you satisfied with the ease of procuring the drugs outside the facility?** | | |
| Very satisfied | 202 | 59.8 |
| Satisfied | 17 | 5.0 |
| Neutral | 10 | 3.0 |
| Dissatisfied | 29 | 8.6 |
| Very Dissatisfied | 32 | 8.5 |
| Other | 48 | 14.2 |
| **Are you satisfied with the ease of procuring the drugs from the facility?** | | |
| Very satisfied | 269 | 79.6 |
| Satisfied | 17 | 5.0 |
| Neutral | 7 | 2.1 |
| Dissatisfied | 5 | 1.5 |
| Very Dissatisfied | 4 | 1.2 |
| Other | 36 | 10.7 |

➢ *Willingness to Adopt e-Refill Prescription System*

Table 4 below present the willingness of the participants to adopt the e-refill prescription system. A notable percentage of the respondents (60.7%) have heard of the e-Refill prescription system. 46.2% heard about the system from the internet, (28.7%) got to know about the system from healthcare facilities. Majority of the patients (54.4%) showed interest in using the e-Refill system for their medication. The most common factor influencing willingness to adopt the system was ease of use (32.8%), trust in the system (29.9%). Nearly half of the survey population (48.1%) said that they were very willing (on a scale of 8-10) to adopt the e-Refill system, remarkably, a significant proportion (38.2%) were absolutely unwilling (1 on the scale) to adopt the system.

Table 4 Willingness to Adopt e-Refill Prescription System

| Variable | Frequency | Percentage |
|---|---|---|
| **Have you ever heard of the e-refill prescription system?** | | |
| Yes | 205 | 60.7 |
| No | 9- | 26.6 |
| Other | 43 | 12.8 |
| **Where did you hear about it?** | | |
| Internet | 97 | 28.7 |
| Healthcare facilities | 156 | 46.2 |
| Friends | 9 | 2.7 |
| Other (radios etc.) | 76 | 22.5 |
| **Are you interested in using the c-refill prescription system to refill your TB medication??** | | |
| Yes | 184 | 54.4 |
| No | 99 | 29.3 |
| Other | 55 | 16.3 |
| **What are the factors that influence your willingness to adopt the e-refill prescription system?** | | |
| Ease of use | 111 | 32.8 |

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| | | |
|---|---|---|
| Access to technology | 6 | 1.8 |
| Trust in the system | 101 | 29.9 |
| Other | 120 | 35.6 |
| **How willing are you to adopt the e-refill prescription system on a scale of 1 to 10?** | | |
| (1) Not willing at all | 129 | 38.2 |
| (2-4) Slightly willing | 22 | 6.6 |
| (5-7) Moderately willing | 24 | 7.1 |
| (8-10) Very willing | 129 | 48.1 |

➢ *Patient Motivations and Concerns Regarding e-Refill for TB Medication Adherence*

This study explored patient motivations and concerns regarding the e-refill prescription system for TB medication adherence. The participant in this study revealed several factors that act as motivators for patients. Participants highlighted the potential benefits of e-refill systems, such as reduced transportation costs and increased convenience. These factors can act as positive reinforcements for adherence. Some of the quotes below show the direct responses of the participants that form the basis of the thematic coinage:

*"One of the advantages is that when they come to primary health level for their drugs, it makes them not to be a defaulter patient. Also, it reduces the crowd. Then it will stop them from spreading it among the health workers and the patients at the place." (participant 1)*

*"The advantage is we need to reduce patients travel time. Cost of transportation and stress of having to come and even wait long hours. For those who do an organized labour who have to be in their place or very early in the morning. It's possible for them to have it delivered."*

*"For me, to my own perspective, it's good for us. The system is good. In the sense of nowadays when we look at our patients that are doing the positive, that is coming to come and collect drug in the facility. So we will reduce their transport fee. Due to the economic in this Nigeria nowadays, you know, everything is going, Increase, increase, increase. So they will be happy for them, for somebody to come to the house, to be given the medicine. So we are giving them the drug time to time. So such thing again will help us for not having a much of defaulter in this case."*

The e-refill system eliminates this financial burden, making it easier for them to access their medication consistently. Similarly, as revealed by the participants increased convenience is a significant motivator. For patients with busy schedules or those living far from the clinic, e-refill deliveries can remove a logistical barrier to adherence. They no longer need to carve out specific time slots for clinic visits, potentially leading to improved adherence rates.

However, the interviews also reveal potential concerns that could act as de-motivators for patients. Stigma associated with TB, a recurring theme, suggests that some patients might be hesitant about home deliveries for fear of judgement from neighbours.

*"Not really to me. The reason why is that taking it to their doorstep might not really be the best option to them. For example, some of these patients don't like people around them to know that they are victims of DART case. Also, taking drugs to their doorstep can cause a lot of dangers to the health workers.So in a nutshell, what we are trying to say is it is not going to work to patients because if we allow ourselves to be taking the drugs to their doorstep, then we misuse the opportunity. Of course. And at times they might harass health workers. It is very possible"*

*"You know, there are some patient thing. They don't want people at home to know that they are TB patients. They don't want anybody to know that they are this, they are that. Especially the one that has a couple with maybe hypertension or something like that. TB is alarming. For anyone that notices that, ah, my neighbour is having TB, stigmatization, they will start running and running away from the person."*

This fear could outweigh the convenience factor, leading them to prioritize privacy over adherence. Furthermore, concerns surrounding privacy itself, particularly regarding the medication packaging or delivery personnel, pose another barrier. Patients might be worried about someone finding out about their illness, leading them to avoid using the e-refill system altogether. These findings highlights the importance of understanding the multifaceted nature of patient motivation in relation to the e-refill system for TB medication adherence. Ultimately, this knowledge can be used to optimize the system and ensure its effectiveness in supporting successful TB treatment.

➢ *Hypothesis Testing*

- *Association between the Socio-Demographic Characteristics of the Respondent and TB Medication Adherence.*

The Chi-square test of association was used to determine any significant association between socio-demographic characteristics and TB medication adherence. There were significant association between TB medication adherence and the following: Age (Chi-square = 20.009, p-value = 0.001), educational status (Chi-square = 19.526, p-value = 0.001), family monthly income (chi-square = 8.035, p-value = 0.018) and type of facility (chi-square = 16.095, p-value = 0.001). Regression analysis reveal the strength of the association, the age group >48≤58 are 9.3 times more likely to adhere to the medication (O.R = 9.375, p-value = 0.851, A.OR =8.180, P-value = 0.102), 50k and above category is 0.5 times more likely to adhere than the other category (O.R = 0.514, p-value = 0.243, A.OR =1.471, P-value = 0.619),

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users of government owned facility are 1.6 times likely to adhere (O.R = 1.692, p-value = 0.369, A.OR =2.212, P-value = 0.246).

Hence, the null hypothesis that states that 'There is no significance association between the socio-demographic characteristics of the respondent and TB medication adherence' is rejected and we accept the alternative hypothesis.

Table 5 Association of Patients' Socio-Demographic Characteristics and TB Medication Adherence

| Variable | Medication Adherence | Frequency | Chi-square | P-value |
|---|---|---|---|---|
| | Yes | No | | |
| **Gender** | | | 0.192 | 0.661 |
| Female | 14 (11.1) | 112 (88.9) | | |
| Male | 20 (9.6) | 188 (90.4) | | |
| **Age** | | | 20.009 | 0.001** |
| ≤18 | 4 (50.0) | 4 (50.0) | | |
| >18≤28 | 6 (11.5) | 46 (88.5) | | |
| >28≤38 | 13 (8.4) | 142 (91.6) | | |
| >38≤48 | 6 (7.7) | 72 (92.3) | | |
| >48≤58 | 1 (3.8) | 25 (96.2) | | |
| >58 | 3 (27.3) | 8 (72.7) | | |
| **Marital Status** | | | 6.383 | 0.094 |
| Single | 8 (7.1) | 105 (92.9) | | |
| Married | 15 (8.4) | 164 (91.6) | | |
| Divorced | 4 (25.0) | 12 (75.0) | | |
| Widowed | 0 (0) | 6 (100) | | |
| **Family Structure** | | | 0.281 | 0.869 |
| Monogamous | 19 (10.5) | 162 (89.5) | | |
| Polygamous | 7 (8.6) | 74 (91.4) | | |
| Single Parent | 6 (11.1) | 48 (88.9) | | |
| **Educational Status** | | | 19.526 | 0.001** |
| No Formal Education | 7 (10.3) | 61 (89.7) | | |
| Primary Education | 9 (11.4) | 70 (88.6) | | |
| Secondary Education | 11 (7.6) | 133 (92.4) | | |
| Tertiary Education | 4 (10.3) | 35 (89.7) | | |
| Others | 3 (75.0) | 1 (25.0) | | |
| **Occupation** | | | 0.808 | 0.369 |
| Gainfully Employed | 22 (11.5) | 170 (88.5) | | |
| Unemployed | 12 (8.5) | 130 (91.5) | | |
| **Ethnicity** | | | 3.068 | 0.381 |
| Yoruba | 13 (7.8) | 154 (92.2) | | |
| Igbo | 14 (14.3) | 84 (85.7) | | |
| Hausa | 5 (9.3) | 49 (90.7) | | |
| Other | 2 (13.3) | 13 (86.7) | | |
| **Family Average Monthly Income** | | | | |
| Less than 50k | 11 (20.0) | 44 (80.0) | 8.035 | 0.018* |
| 50k and above | 4 (13.8) | 25 (86.2) | | |
| Unspecified | 19 (7.6) | 231 (92.4) | | |
| **Type of Facility** | | | 16.095 | 0.001** |
| Government-owned | 18 (7.1) | 236 (92.9) | | |
| Private-owned | 12 (26.7) | 33 (73.3) | | |
| Don't know | 4 (11.4) | 31 (88.6) | | |

*-significant at p-value< 0.05, **-significant at p-value < 0.01

Table 6 Regression Analysis

| Variables | Odd Ratio | P-value | A.O.R | P-value |
|---|---|---|---|---|
| ≤18 | .375 | .055 | .276 | .255 |
| >18≤28 | 2.875 | .594 | 3.033 | .226 |
| >28≤38 | 4.096 | .967 | 3.107 | .176 |
| >38≤48 | 4.500 | .939 | 3.114 | .207 |
| >48≤58 | 9.375 | .851 | 8.180 | .102 |
| >58 (ref) | 1 | | 1 | |

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| | | | | |
|---|---|---|---|---|
| **Family Average Monthly Income** | | | | |
| Less than 50k | 0.329 | 0.017 | .332 | .018 |
| 50k and above | 0.514 | 0.243 | 1.471 | .619 |
| Unspecified (ref) | 1 | | 1 | |
| **Educational Status** | | | | |
| No Formal Education | 26.143 | 0.008 | 38.694 | .009 |
| Primary Education | 23.333 | 0.009 | 25.892 | .018 |
| Secondary Education | 36.273 | 0.003 | 54.187 | .004 |
| Tertiary Education | 26.250 | 0.010 | 39.120 | .011 |
| Others (ref) | 1 | | 1 | |
| **Type of facility** | | | | |
| Government-owned | 1.692 | 0.369 | 2.212 | .246 |
| Private-owned | 0.355 | 0.100 | .333 | .133 |
| Don't know (ref) | 1 | | | |

- *Association between the Respondent's Socio-Demographic Characteristics and the Willingness to Adopt e-Refill Prescription System*

The Chi-square test of association was used to test the hypothesis on the relationship between the specific characteristics and the willingness to adopt e-refill system. There were significant association between willingness to use the e-refill and the following: marital status (Chi-square = 8. 479, p-value = 0.037), family structure (Chi-square = 11. 332, p = 0. 003), and family monthly income (Chi-square = 10. 206, p = 0. 006). Regression analysis show how strong the relationship is, the divorced are 1. 4 times more willing to adopt the e-refill system (O. R = 1. 358, p-value = 0. 015, A. OR =3. 939, P-value = 0. 038), polygamous family is 0.4 times ready to use the e-refill (O. R = 0. 416, P-value = 0. 022, A. OR = 1. 618 P-value = 0. 019), the 50k and above category is 2.5 times more willing to adopt the e-refill than other category (O. R = 2. 501, p = 0. 005, A. OR = 2. 895, p = 0. 003).

Therefore, the null hypothesis developed for the study is; "In light of this study, there is no significance relationship between the socio demographic characteristic of the respondent and their willingness to adopt e-refill prescription system".

Table 7 Association of Patients' Socio-Demographic Characteristics and Willingness to Adopt the e-Refill System

| Variable | Willingness | Frequency | Chi-square | P-value |
|---|---|---|---|---|
| | Yes | No | | |
| **Gender** | | | 0.553 | 0.457 |
| Female | 61 (48.4) | 65 (51.6) | | |
| Male | 92 (44.2) | 116 (55.8) | | |
| **Age** | | | 5.760 | 0.330 |
| ≤18 | 1 (12.5) | 7 (87.5) | | |
| >18≤28 | 24 (46.2) | 28 (53.8) | | |
| >28≤38 | 78 (50.3) | 77 (49.7) | | |
| >38≤48 | 33 (42.3) | 45 (57.7) | | |
| >48≤58 | 11 (42.3) | 15 (57.7) | | |
| >58 | 4 (36.4) | 7 (63.6) | | |
| **Marital Status** | | | 8.479 | 0.037* |
| Single | 53 (46.9) | 60 (53.1) | | |
| Married | 87 (48.6) | 92 (51.4) | | |
| Divorced | 4 (25.0) | 12 (75.0) | | |
| Widowed | 0 (0) | 6 (100) | | |
| **Family Structure** | | | 11.332 | 0.003** |
| Monogamous | 94 (51.9) | 87 (48.1) | | |
| Polygamous | 37 (45.7) | 44 (54.3) | | |
| Single Parent | 14 (25.9) | 40 (74.1) | | |
| **Educational Status** | | | 2.135 | 0.711 |
| No Formal Education | 27 (39.7) | 41 (60.3) | | |
| Primary Education | 34 (43.0) | 45 (57.0) | | |
| Secondary Education | 71 (49.3) | 73 (50.7) | | |
| Tertiary Education | 19 (48.7) | 20 (51.3) | | |
| Others | 2 (50.0) | 2 (50.0) | | |
| **Occupation** | | | 0.188 | 0.665 |
| Gainfully Employed | 86 (44.8) | 106 (55.2) | | |
| Unemployed | 67 (47.2) | 75 (52.8) | | |

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| | | | | |
|---|---|---|---|---|
| **Ethnicity** | | | 6.535 | 0.088 |
| Yoruba | 86 (51.5) | 81 (48.5) | | |
| Igbo | 44 (44.9) | 54 (55.1) | | |
| Hausa | 18 (33.3) | 36 (66.7) | | |
| Other | 5 (33.3) | 10 (66.7) | | |
| **Family Average Monthly Income** | | | 10.206 | 0.006** |
| Less than 50k | 15 (27.3) | 40 (72.7) | | |
| 50k and above | 17 (58.6) | 12 (41.4) | | |
| Unspecified | 121 (48.4) | 129 (51.6) | | |
| **Type of Facility** | | | 3.623 | 0.163 |
| Government-owned | 119 (46.9) | 135 (53.1) | | |
| Private-owned | 21 (46.7) | 24 (53.3) | | |
| Don't know | 13 (37.1) | 22 (62.9) | | |

*-significant at p-value< 0.05, **-significant at p-value < 0.01

Table 8 Regression Analysis

| Variables | Odd Ratio | P-value | A.O.R | P-value |
|---|---|---|---|---|
| **Marital status** | | | | |
| Single | 0.512 | .001 | 1.722 | 0.008 |
| Married | 0.478 | .004 | 1.789 | 0.002 |
| Divorced | 1.358 | .015 | 3.939 | 0.038 |
| Widowed (ref) | 1 | | 1 | |
| **Family Structure** | | | | |
| Monogamous | 0.324 | 0.001 | 1.053 | .001 |
| Polygamous | 0.416 | 0.022 | 1.618 | .019 |
| Single Parent (ref) | 1 | | 1 | |
| **Family Average monthly income** | | | | |
| Less than 50k | 0.662 | .300 | .551 | .212 |
| 50k and above | 2.501 | .005 | 2.895 | .003 |
| Unspecified (ref) | 1 | | 1 | |

## IV. DISCUSSION

According to the findings of this study, demographics and social characteristics of the participants greatly influenced TB patients' adherence to medication, a conclusion backed by various studies. Social factors such as marital status, age, gender, family structure, level of education, ethnicity, family income, type of healthcare facility, and duration of attendance showed to have an impact on adherence to TB treatment. Furthermore, other factors such as social support from family, friends, or support groups positively affects adherence, underscored the importance of a strong support system. Participants with high education levels showed better compliance due to improved health literacy and awareness, thus higher education level impacts medical adherence. Having medication supervisors, whether family members or healthcare providers, proved to be impactful in ensuring medication adherence through reminders, medication administration, and emotional support. Adherence is higher among older individuals, those employed, with better TB knowledge, and those abstaining from alcohol. (11) noted that social and economic factors are crucial in understanding adherence behaviours, with (12) pointing out that lower socio-economic status often leads to obstacles such as limited healthcare access and financial difficulties. Stigma associated with TB exacerbates adherence problems, especially in marginalized populations (13). (14) emphasized the need for social class equality to improve adherence and reduce health disparities. Marital status also affects adherence, with married individuals showing higher adherence due to familial support, a finding consistent with (15). Conversely, stigma experiences lead to lower adherence, reflecting the negative impact of societal attitudes towards TB.

The findings of this study indicate a high level of satisfaction among respondents regarding the ease and convenience of collecting medications from healthcare facilities, with 63% expressing high satisfaction and an additional 27.8% satisfied, suggesting that nearly 91% are pleased with the facility-based process. This can be attributed to the structured and predictable nature of healthcare facilities, where established procedures, professional oversight, and immediate access to healthcare personnel ensure a smooth and reliable experience. This aligns with (16), who noted that the reliability and predictability of in-facility services significantly enhance patient satisfaction. In contrast, procuring medications outside the facility, though still generally satisfactory (nearly 77% very or somewhat satisfied), shows a slightly lower satisfaction rate and higher dissatisfaction (16.6%). This disparity can be explained by the logistical challenges, variability in service quality, and potential uncertainties patients face when dealing with external pharmacies, as highlighted by (17), who found that external pharmacies often lack the consistency and professional guidance provided within healthcare facilities.

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Furthermore, the slightly higher dissatisfaction rates for external procurement (8.6%) and other reasons for dissatisfaction (8.5%) reflect broader systemic issues such as variability in pharmacy standards and potential errors in medication dispensing, concerns that align with the observations of (18). The trust and confidence patients place in the controlled environment of healthcare facilities, where risks of counterfeit or substandard drugs are minimized (19), contribute to higher satisfaction levels compared to the more fragmented and uncertain experiences associated with external sources. (20) support this by emphasizing that structured, facility-based care models significantly improve patient satisfaction and health outcomes compared to more fragmented, external care models. These findings underscore the critical role of a reliable and supportive healthcare infrastructure in enhancing patient satisfaction and adherence to medication regimens, suggesting that improvements in external procurement processes should focus on addressing logistical challenges and trust issues to align more closely with the high standards of in-facility experiences.

In addition, the findings of this study reveal that over half of the respondents (60.7%) are aware of the e-Refill prescription system, with healthcare facilities (28.7%) and the internet (46.2%) being the primary sources of information. This indicates a significant penetration of digital health information channels, which is consistent with the growing trend of internet usage for health-related information (21). A majority of respondents (54.4%) expressed interest in using the e-Refill system, primarily influenced by its ease of use (32.8%), followed by trust in the system (29.9%). This is in consistent with the findings of studies like (22), which highlight perceived ease of use and trust as critical factors in technology adoption. The willingness to adopt the e-Refill system was notably high, with 48.1% of respondents rating their willingness as very high (8-10 on the scale), suggesting a strong potential for adoption among this group.

However, the significant portion (38.2%) of respondents not willing at all (1 on the scale) to adopt the system points to substantial barriers that need addressing. These barriers may include concerns about digital literacy, privacy, and security, which have been documented in other studies as critical impediments to the adoption of digital health technologies (23). The high percentage of respondents who heard about the system from the internet suggests that digital platforms are effective in spreading information, but also highlights the digital divide where not everyone has equal access or proficiency with online resources.

Comparatively, the reliance on healthcare facilities for information underscores the traditional trust placed in medical professionals and institutions, aligning with findings by (24) that emphasize the critical role of healthcare providers in patient education and technology acceptance. The mixed levels of willingness to adopt the e-Refill system reflect a broader trend observed in healthcare technology adoption, where enthusiasm is tempered by significant concerns over usability, security, and trust (25). Addressing these concerns through targeted education, enhancing system security, and improving user experience could significantly enhance the adoption rates. In order to improve and maximize the potential of e-Refill system in improving medication adherence and healthcare delivery, it is important to understand the role digital and traditional information channels play in information dissemination. Barriers to the adoption of the e-Refill system also have to be addressed and eliminated for best results.

## V. CONCLUSION

The discoveries of this study have brought to fore the effectiveness and challenges of the e-Refill system. This study has shown how the e-Refill system will help improve medication adherence among tuberculosis patients in healthcare facilities in Lagos, Nigeria. The findings of this study show the importances of factors such as adherence packaging, medication therapy management, and refill synchronization in influencing patients' perceived benefits and ultimately, treatment outcomes.

While the e-Refill system offers convenience and potential improvements in adherence rates and treatment compliance compared to traditional systems, challenges such as limited access to healthcare and initial reluctance among certain patient groups need to be addressed.

Moving forward, it is crucial for healthcare providers and policy-makers to consider the insights provided by this study in enhancing the implementation of digital adherence technologies like the e-Refill system. Strategies to improve patient engagement, address stigma, and ensure sustained support throughout the treatment process are essential for maximizing the system's effectiveness. Furthermore, ongoing evaluation and monitoring of key performance indicators will be instrumental in optimizing the e-Refill system and ultimately improving TB treatment outcomes in resource-constrained settings.

Stakeholders can work towards developing tailored interventions by leveraging on the findings of this study. These tailored interventions will prioritise patient-centric, advocate for medication adherence among patience, and contribute to more successful TB treatment outcomes in the context of evolving healthcare systems. This study serves as an invaluable contribution and provides a foundation for future research and interventions formulated towards enhancing patient care and treated adherence in the war against tuberculosis.

## RECOMMENDATION

Med360 is a software platform designed to further improve access to healthcare services and medication delivery. Furthermore, Med360 grants patients access to their prescriptions and allows them communicate remotely with health workers. The platform facilitates remote consultations and makes medical advice instantaneous. In addition, Med360 allows doorstep delivery of monthly medication, further making adherence to medical regimen easier and, by consequence, treatment outcomes better. Med360 looks to revolutionize healthcare delivery, especially in the treatment

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and care of Tuberculosis (TB) patients, by enhancing the overall treatment access and management. Health workers can leverage Med360 as a platform to provide quality care to patients, especially those in remote areas.

## IMPLEMENTATION PLAN FOR MED360

Med360 is a cutting-edge health platform capable of revolutionizing the treatment of Tuberculosis (TB) in Lagos state. It streamlines patient data management, provides real-time monitoring, and facilitates personalized care plans. By leverage Med360, healthcare workers can improve patient medication adherence and patient outcomes, they can increase patient engagement, optimize resource allocation, and make data-driven decisions on each unique patient. The objective of Med360 are improved treatment success rates, reduced relapse rates, and enhanced patient quality of life. With Med360, the fight against TB has become more efficient, effective, and patient-centric.

➢ *Key Steps Include:*

- *Integration with Existing Systems:*

Partner with healthcare providers to integrate Med360 with existing electronic health records (EHR) and pharmacy management systems.

- *Training and Support:*

Carry out training sessions for healthcare providers and patients on how to navigate Med360 and Provide swift technical support to address any issues promptly.

- *Awareness and Promotion:*

Awareness campaigns will be launched in order to educate both patients and health care workers on the advantages of using Med360. Particularly in remote and underserved areas,

- *Monitoring and Evaluation:*

Montoring systems will be implemented in order to track the usage and effectiveness of Med360. Regular evaluations will be carried out to assess impact on medical adherence, performance, and functionality. The necessary adjustments and updates will be formulated and adopted.

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