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Effect of Brief Educational Messages on Knowledge Regarding Tuberculosis Prevention and Early Detection among Pharmacy Clients in Two Peruvian Districts

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ABSTRACT

This study evaluated the impact of an educational intervention using short message service (SMS) and WhatsApp messages on the tuberculosis (TB) knowledge of pharmacy personnel. A prospective study was conducted with a random sample of pharmacies and drugstores in two districts of Lima and Chiclayo. The intervention included the development and pilot testing of text messages, content evaluation, selection of participating pharmacies, implementation, and a post-intervention survey to assess changes in TB knowledge. A total of 132 participants completed the final survey, with a median age of 27 years (IQR: 23–30) and 78.46% being female. At baseline, average correct responses were 66.33% for epidemiology, 62.22% for diagnosis, and 54.44% for treatment, with only 45.45% scoring above the 55th percentile. After the intervention, knowledge on TB prevention significantly improved (72.55 vs. 66.33, p = 0.027) among those who read the messages, and overall TB knowledge was higher in this group (p = 0.034). In conclusion, while pharmacy staff had generally adequate TB knowledge, notable gaps remained in treatment-related understanding, which were partially addressed through the SMS-based educational intervention.

Keywords: Pharmacy, Tuberculosis, SMS, Peru, Infection, Primary care

Introduction

Peru represents approximately 30% of the estimated extensively drug-resistant tuberculosis (XDR-TB) cases in Latin America and has one of the highest tuberculosis (TB) incidence rates in the Americas, at 106 per 100,000 population [1]. The government has demonstrated a strong commitment to addressing TB, evidenced by a 600% increase in the national TB budget between 2004 and 2011. Nevertheless, Peru deviates from the global trend of declining TB prevalence alongside economic growth; despite improvements in its Human Development Index (HDI), TB-related mortality remains high, similar to Brazil [2, 3].

Although TB is the second leading infectious cause of death worldwide after HIV, the potential of mobile health (m-health) interventions remains underutilized [4, 5]. Private pharmacies are often more accessible to patients due to extended hours and wider geographic distribution compared with health centers, making them the first point of contact for individuals hesitant to seek care at formal health facilities [6].

Leveraging pharmacies as entry points for healthcare interventions has proven effective in reaching underserved populations. When properly trained, pharmacy personnel can contribute to screening and education for various health conditions, including chronic obstructive pulmonary disease (COPD) [6], sleep disorders [7], diabetes, cardiovascular diseases [8], and sexually transmitted infections. In Peru, studies have shown that trained pharmacy staff can provide condition-specific recommendations [9].

Ensuring that pharmacy workers possess adequate knowledge regarding TB prevention and diagnosis is critical for disease control, highlighting the need for rapid and cost-effective educational interventions. Accordingly, this

study aimed to assess changes in TB knowledge among pharmacy personnel following an educational intervention delivered via SMS messages.

Materials and Methods

Study design and population

A prospective, analytical before-and-after study was conducted to evaluate the effect of an SMS-based educational intervention on TB knowledge among pharmacy staff in Lima and Chiclayo districts. In Lima, the study took place in Breña, a district within DISAV Lima city, selected due to rising TB cases and lack of routine interventions. In Chiclayo, Lambayeque Province, 493 TB cases were reported in 2015 (87 extrapulmonary, 406 pulmonary). The districts of La Victoria and José Leonardo Ortiz, with medium-low economic status, rural areas of extreme poverty, and high pulmonary TB incidence (23%), were included.

Intervention

The intervention was implemented in four phases:

1. Preliminary: Baseline data were collected to inform SMS design. A pilot survey helped tailor messages, which were validated for content.
2. Preparation: Final text messages and a survey questionnaire were developed based on pilot results.
3. Implementation: Eligible pharmacy staff in Lima and Chiclayo were recruited, enrolled, and received SMS or WhatsApp messages after completing a baseline survey.
4. Evaluation: Post-intervention, an exit survey assessed changes in TB knowledge for both intervention and control groups, and data were analyzed for reporting.

Sampling

Each participating pharmacy worker constituted a unit of analysis, provided they had worked in the pharmacy for at least three months and consented to participate. Sample size calculations were performed using Epidat, and statistical analyses were conducted with Stata 15.0. Based on the pilot survey, a sample size of 66 participants was estimated, with a 95% confidence level, 5% alpha error, and 20% beta error.

Data analysis

Initially, univariate descriptive analyses were conducted, using means and standard deviations for quantitative variables and proportions for qualitative variables. The effectiveness of the intervention was assessed by analyzing changes in scores on the 17-item knowledge questionnaire, where each item was scored as correct or incorrect. A score of nine or more correct answers was used as the threshold to indicate a passing level of knowledge.

The knowledge questionnaire was developed based on the concepts from the National Health Strategy for Tuberculosis Prevention and Control and the national TB standard, covering topics illustrated in the following diagram. Baseline data were collected through an entry survey. The intervention assessment was divided into two phases: the first to measure acceptance and baseline knowledge, and the second to evaluate post-intervention knowledge.

Information collected included basic demographics and knowledge on TB prevention (five questions), diagnosis (three questions), treatment (nine questions), and self-perceived TB knowledge. The SMS intervention lasted 15 days, and participants were re-surveyed one month later. Paired Student's t-tests were used to compare knowledge scores, while McNemar tests evaluated changes in perceived knowledge proportions. A p-value < 0.05 was considered statistically significant.

Ethical considerations

Participant confidentiality was strictly maintained, and the intervention was considered risk-free. Verbal informed consent was obtained, and participants could withdraw from the study or stop receiving messages at any time. All participants were adults. The study was approved by the Hospital Regional Lambayeque. Data were coded and stored separately to protect participant privacy, considering the social stigma associated with TB.

Results and Discussion

A baseline survey included 63 participants from Lima and 31 from Chiclayo who met the inclusion criteria.

Baseline survey findings in lima and chiclayo

Most participants were women, with a mean age of 28.7 ± 9.2 years, and 85.7% worked in pharmacies. Participants identified cough as the most common symptom of TB (92.1%) and the sputum test as the most useful diagnostic tool (71.4%). The mean knowledge score was 11.6 ± 1.7 out of 17, with 55.32% of answers being correct; proportions were similar between Lima and Chiclayo (p = 0.560). Pharmacy staff demonstrated better knowledge regarding TB prevention and diagnosis, but substantial gaps remained in treatment knowledge. Sociodemographic details are presented in **Table 1**.

Table 1. Profile of pharmacy staff in Lima and Chiclayo from the initial survey.

Characteristic	Lima		Chiclayo		Overall		p*
	n	%	n	%	n	%	
Gender							0.380
Male	15	23.8	9	29.1	24	24.73	
Female	48	76.2	22	70.9	70	75.27	
Occupation							0.785
Pharmacy technician	43	68.3	19	61.3	62	66.0	
Pharmacist	9	14.3	5	16.1	14	14.9	
Other	11	17.5	7	22.6	18	19.1	
View self as part of the health sector							0.103
Yes	58	92.1	25	80.6	83	86.4	
No	5	7.9	6	19.4	11	13.6	
Prior receipt of TB training from health authorities							0.001
Yes	29	46.0	4	12.9	33	29.5	
No	34	54.0	27	87.1	61	70.5	
Accuracy of answers							0.560
Correct	35	55.6	17	54.8	52	55.3	
Incorrect	28	44.4	14	45.2	42	44.7	

*Test for homogeneity between groups.

Since the Lima group had already received a relatively high level of TB information (46.03% vs. 12.90%), the second phase of the intervention was carried out in Chiclayo.

Intervention outcomes

The study included 66 participants, with a median age of 27 years (IQR: 23–30), of whom 78.46% were women. At baseline, average scores for correct responses were 66.33% for prevention, 62.22% for diagnosis, and 54.44% for treatment, with only 45.45% of participants exceeding the 55th percentile for overall correct answers. By the study's end, six participants (9%) were lost to follow-up.

Those who engaged with the educational messages demonstrated a significant increase in prevention knowledge (72.33% vs. 66.33%; p = 0.027), while gains in diagnosis and treatment knowledge were less pronounced. At the conclusion of the study, 52.27% of message readers scored above the 55th percentile, a statistically significant improvement compared to those who did not read the messages (p = 0.034).

Table 2 summarizes the changes in correct answers, showing clear progress in prevention-related questions. Although improvements in diagnosis and overall scores were observed, these increases were only marginally significant. Participants' self-assessment of adequate knowledge also rose markedly following the intervention (10.17% vs. 31.67%, p < 0.001).

Table 2. Comparison of pre- and post-intervention knowledge levels.

	Pre-intervention X (SD)	Post-intervention X (SD)	p
Percentage of correct answers in prevention	66.33 (2.62)	72.33 (2.33)	**0.027**
Percentage of correct answers in diagnosis	62.22 (2.79)	69.54 (3.19)	0.056
Percentage of correct answers in treatment	54.44 (1.88)	56.66 (2.29)	0.353

Percentage of correct answers total	59.31 (1.53)	63.13 (2.05)	0.064
Perception of knowledge	**n (%)**	**n (%)**	**<0.001**
Adequate	6 (10.17%)	19 (31.67%)	
Inadequate	53 (89.93%)	41 (68.33%)	

* X = mean. SD = standard deviation.

All participants reported being satisfied with the intervention and indicated that they would recommend it to their colleagues.

SMS reminder systems for TB patients have generally been well accepted due to the widespread availability of mobile devices and positive perceptions of this technology. However, their potential in TB prevention efforts remains largely underutilized.

The proportion of participants demonstrating adequate knowledge is comparable to other studies conducted in Peru among different health worker groups, such as community health agents or primary care staff [10]. In a 2013 study involving 301 workers from 66 health centers, most knowledge gaps were related to understanding the consequences of incomplete or improper treatment, recognizing multidrug-resistant TB (MDR-TB), and knowing the frequency of sputum follow-up. Only 50.39% of participants correctly identified all outcomes of incorrect treatment, and 42.17% could accurately define MDR-TB [10]. Treatment-related knowledge was also challenging for our study population, likely because pharmacy and drugstore personnel are less familiar with the regimens used in clinical settings.

A separate study conducted in "El Agustino" found significant differences in TB knowledge among healthcare workers based on professional training, with formally trained professionals scoring higher [11]. In our study, pharmaceutical scientists were included to allow comparison between university-educated staff and those without formal training. Knowledge gaps were most evident in identifying high-risk TB patients, evaluating appropriate treatment, and understanding the consequences of treatment failure [11].

This study represents the first use of educational messages about drug-resistant TB among pharmacy personnel in the interior regions of Peru. The intervention showed a modest positive impact, though some threats to internal validity may provide alternative explanations for these effects. Knowledge deficits remain, particularly regarding TB transmission prevention, and some myths about disease spread persist.

The characteristics of pharmacy workers in Peru have been described in prior studies on pharmacies and sexually transmitted infections (STIs) [12], aligning with our findings. Similar to other low- and middle-income countries (LMICs), pharmacy personnel interact with a large number of clients and often provide advice or treatment for health issues [6]. Despite regulations, many prescription-only medicines are still available without prescriptions. While such practices may not be formally legal, they address gaps in the healthcare system by offering accessibility ("closer to home"), acceptability (clients view pharmacy staff as knowledgeable and impartial), and affordability (no consultation fees) [13]. Pharmacy staff, while operating within business models, often see themselves as community caregivers and aim to provide responsible guidance [14].

Pharmacies frequently serve as the first point of contact for TB patients, particularly in urban areas. For instance, in Delhi, India, pharmacy workers initially consulted with two-thirds of TB patients and provided clinical advice [15]. However, studies tracking patient pathways revealed that almost no drug vendors referred suspected TB patients directly to health facilities, contributing to delays in diagnosis and treatment [13, 15].

In addition, research in Tanzania on diagnostic delays among pulmonary TB patients showed that individuals living farther from pharmacies were less likely to visit health centers, potentially influenced by the guidance received from pharmacies or the availability of healthcare services [16]. Social desirability bias may also have influenced participants' self-reported behaviors.

In Bolivia, a program designed to encourage private pharmacies to refer clients to the National Tuberculosis Strategy resulted in fewer pharmacies selling TB medications and a notable increase in referrals of simulated clients, with referral rates rising from 22 percent to 58 percent after the intervention [17]. Similarly, in Cambodia, pharmacies that partnered with the National TB Strategy have been directing individuals with respiratory symptoms to public health facilities for treatment since 2005, with pharmacy-referred patients representing roughly 9 percent of all TB cases in Phnom Penh [18]. While these findings suggest that pharmacy-based interventions could improve treatment outcomes for pulmonary TB, the overall quality of evidence is limited due to methodological weaknesses and the lack of long-term follow-up in existing studies [19].

This study has some limitations. It was conducted in only one district of Lima and one in northern Peru, which may limit the generalizability of the findings to other regions. Data were gathered from a single staff member per pharmacy, who provided information about activities on other shifts and estimated client numbers. Additionally, the study was not designed to investigate causal relationships. Nevertheless, a key strength is that it included nearly all pharmacies in a district with one of the highest TB prevalence rates in northern Peru, providing a comprehensive view of local pharmacy practices.

Conclusion

Our results indicate that pharmacy personnel generally have a reasonable understanding of TB, although misconceptions and knowledge gaps remain, particularly regarding transmission prevention. The SMS-based intervention led to measurable improvements in knowledge among pharmacy and apothecary staff, and the approach was highly accepted and well-regarded by participants.

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