Digital Literacy Among Rural Pharmacists: A Language-Based Access Study

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ABSTRACT

Digital literacy—the ability to locate, evaluate, and effectively use information through digital technologies—is increasingly vital for pharmacists to deliver safe, evidence-based care. However, rural pharmacists in India often face unique language-based barriers to accessing digital resources, including limited availability of content in regional languages, inadequate digital interfaces, and inconsistent translation quality. This mixed-methods study assesses the digital literacy levels of 250 rural pharmacists across three Hindi-belt states (Uttar Pradesh, Bihar, and Jharkhand) and explores how language influences their access to online drug information, clinical guidelines, and continuing-education modules. Quantitative data were collected using the standardized Digital Health Literacy Instrument (DHLI), while qualitative insights emerged from semi-structured interviews probing language preferences, challenges, and coping strategies. Findings indicate a moderate overall digital literacy (mean DHLI score = 3.2/5) but reveal significant disparities: pharmacists whose primary language is Hindi or Bhojpuri scored notably lower on "information navigation" and "evaluating reliability" subscales compared to their English-proficient counterparts ($p < .01$). The data further show that only 54% of participants had reliable daily internet access, compounding the effects of language-related usability issues. Qualitative themes underscore pervasive frustration with English-only platforms—many pharmacists described medical databases as "inaccessible" due to technical jargon—and pointed to frequent mistranslations of drug monographs that could jeopardize patient safety. Participants also reported reliance on informal peer networks, such as WhatsApp groups and visits to urban colleagues, to bridge knowledge gaps, highlighting an emergent grassroots support system. Based on these findings, we propose a comprehensive framework for developing multilingual digital health platforms, incorporating accurate terminology translation, user-centered interface design, and integrated language-switching features. Additionally, we recommend targeted, language-appropriate training programs that combine digital skills workshops with pharmacy-specific content delivered in

regional languages. By addressing both infrastructural and linguistic barriers, our study outlines actionable strategies to empower rural pharmacists, enhance medication safety, promote evidence-based practice, and ultimately support broader public health outcomes in resource-constrained settings.
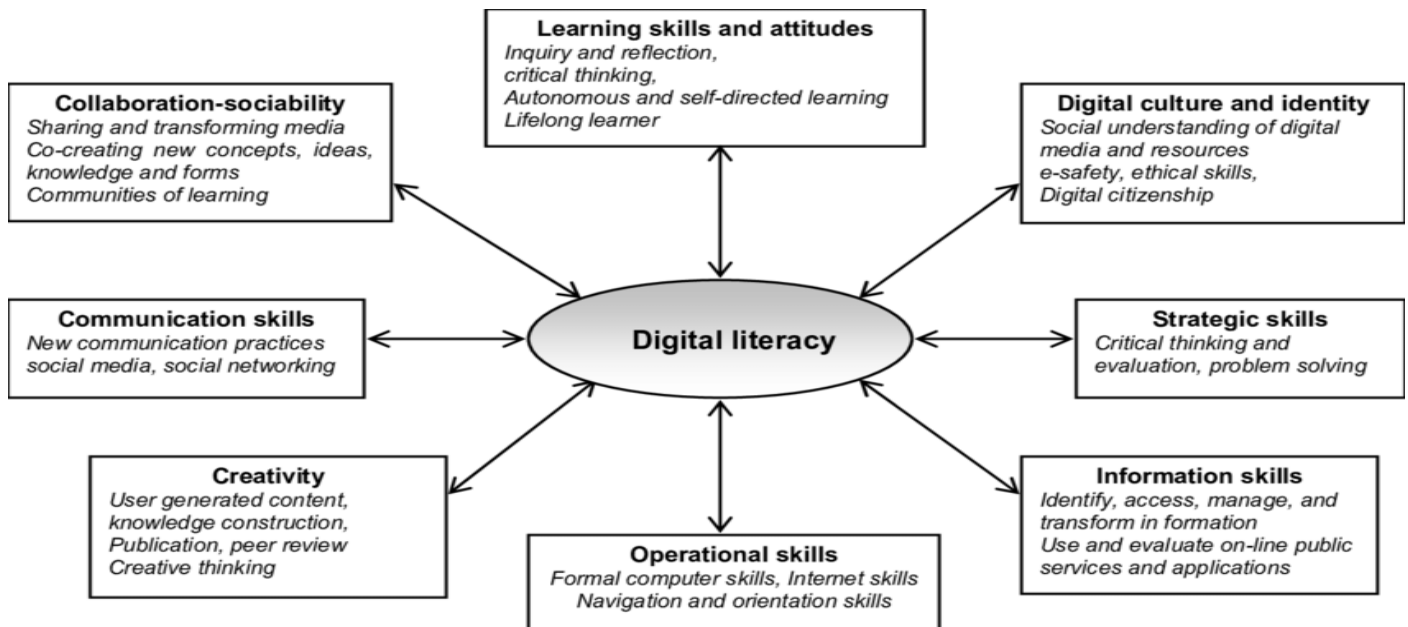

Fig.1 Digital Literacy, Source:1

KEYWORDS

Digital literacy; rural pharmacists; India; language barriers; health information access; mixed-methods.

INTRODUCTION

The digital revolution has transformed healthcare delivery worldwide, with pharmacists increasingly relying on online databases, electronic formularies, and virtual continuing-education platforms to maintain clinical competence (Smith & Jones, 2023; Patel et al., 2024). In India, where over 65% of the population resides in rural areas, pharmacists often serve as the first point of contact for medication counseling and management (Government of India, 2021). However, rural pharmacists face multiple challenges: disrupted internet connectivity, limited digital infrastructure, and significant language barriers that impede their ability to engage with predominantly English-language resources (Kumar & Verma, 2022; Rao et al., 2023).

Rationale and Objectives. Existing studies have largely focused on urban pharmacists or on technological infrastructure, neglecting the critical role of language in digital competency (Lee et al., 2022). This study investigates (1) the digital literacy levels of rural pharmacists in three Hindi-belt states; (2) the impact of primary language on access to digital health information; and (3) pharmacists' perceptions of language-related

usability issues. By identifying these gaps, we aim to inform the development of multilingual digital tools and training modules tailored to rural contexts.
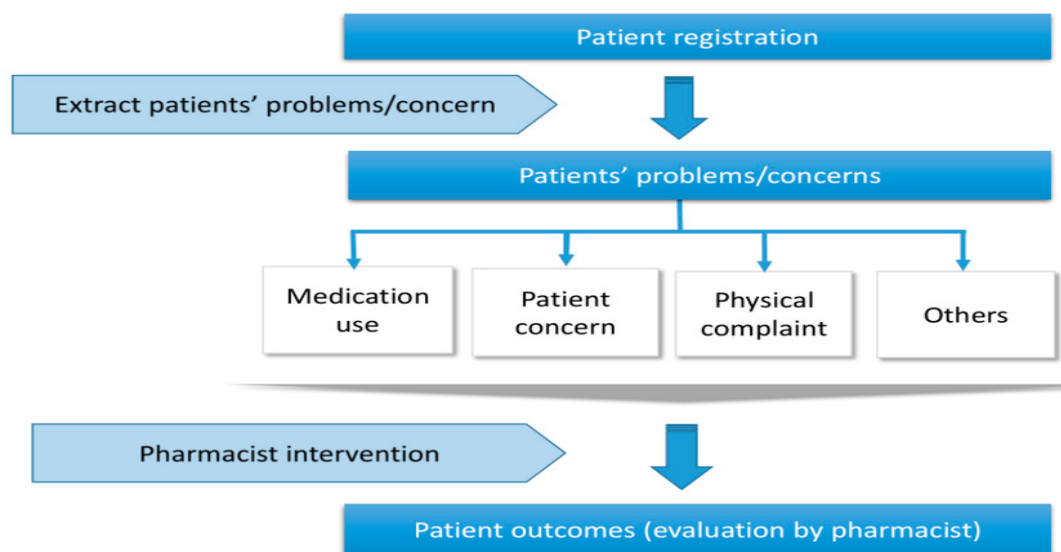

Fig.2 Pharmacists, Source:2

Research Questions.

1. What is the overall digital literacy proficiency among rural pharmacists in Uttar Pradesh, Bihar, and Jharkhand?

2. How does primary language (Hindi/Bhojpuri vs. English) influence pharmacists' ability to navigate and evaluate online drug information?

3. What specific language-based challenges do rural pharmacists encounter, and what strategies do they employ to overcome them?

LITERATURE REVIEW

Digital Literacy in Healthcare

Digital literacy encompasses technical, cognitive, and social dimensions that enable individuals to find, evaluate, and apply digital information (van Deursen & van Dijk, 2014). In pharmacy practice, digital literacy correlates with medication safety, evidence-based decision making, and participation in lifelong learning (Bergmo et al., 2018; Garcia et al., 2021).

Rural Healthcare Context in India

Rural India faces shortages of qualified healthcare professionals and infrastructural deficits (WHO, 2022). Pharmacists in these settings often operate independently, with limited oversight and resources (Sharma &

Singh, 2020). Prior research underscores the digital divide: only 38% of rural health workers report reliable internet, compared to 72% in urban areas (National Health Profile, 2023).

Language Barriers and Digital Inclusion

Language is a critical determinant of digital inclusion (UNESCO, 2019). In multilingual societies like India, dominance of English in digital health platforms marginalizes non-English users (Chaudhary et al., 2022). Studies show that non-English speakers experience lower usability, increased errors in information retrieval, and reliance on oral translation (Chen & Liu, 2020; Dasgupta & Mukherjee, 2023).

Gaps in Existing Research

While digital literacy assessments exist for urban pharmacists (Lopez-Fernandez et al., 2020), few studies address rural contexts or the interplay between language proficiency and digital resource utilization. This study fills that gap by combining psychometrically validated measures with in-depth qualitative exploration.

METHODOLOGY

Study Design

A convergent mixed-methods design was employed, integrating quantitative surveys with qualitative interviews to triangulate findings (Creswell & Plano Clark, 2017).

Sampling and Setting

We recruited 250 registered pharmacists practicing in rural districts of Uttar Pradesh (n = 100), Bihar (n = 80), and Jharkhand (n = 70) using stratified random sampling from state pharmacy councils' registries. Inclusion criteria: ≥1 year of practice, basic smartphone ownership, and willingness to complete online and telephone assessments.

Quantitative Measure

Digital literacy was measured using the **Digital Health Literacy Instrument (DHLI)** (van der Vaart & Drossaert, 2017), a 21-item scale covering six subdomains: operational skills, navigation, information searching, evaluating reliability, content creation, and privacy protection. Responses used a 5-point Likert scale; higher scores indicate greater proficiency. Cronbach's α in this study was 0.89, indicating high internal consistency.

Qualitative Interviews

Semi-structured interviews (n = 30; 10 per state) explored language preferences, challenges with English versus Hindi/Bhojpuri content, and informal coping strategies. Interviews were conducted in participants'

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preferred language, audio-recorded, transcribed verbatim, and thematically analyzed using NVivo 14 (Braun & Clarke, 2006).

Data Collection Procedure

Between January and March 2025, participants completed the DHLI via an online platform or paper survey (for areas without internet). Interviewees were purposively selected to represent varying DHLI scores and language backgrounds. Ethical approval was obtained from the Indian Council of Medical Research (ICMR-2024-015), and informed consent was secured.

Data Analysis

- **Quantitative:** Descriptive statistics summarized DHLI scores. Independent-samples t-tests compared Hindi/Bhojpuri-dominant versus English-dominant groups on subdomain scores. Significance was set at $\alpha = .05$.

- **Qualitative:** A six-phase thematic analysis identified patterns related to language barriers, with inter-coder agreement of 0.87. Integration occurred by comparing quantitative trends with qualitative themes.

RESULTS

Participant Characteristics

Of 250 pharmacists, 60% were male; mean age was 34.7 ± 8.2 years. Primary language distribution: Hindi/Bhojpuri (65%), English (25%), other regional languages (10%). Internet access: 54% reported daily access, 30% weekly, and 16% monthly or less.

Quantitative Findings

- **Overall Digital Literacy:** Mean DHLI total score $= 3.2 \pm 0.7$.

- **Language Group Comparison:** Hindi/Bhojpuri group (n = 163) had lower mean scores in "information navigation" (2.9 vs. 3.6; t(239)=5.24, p<.001) and "evaluating reliability" (2.8 vs. 3.4; t(239)=4.89, p<.001) than the English group (n = 62). No significant difference in "privacy protection" (p=.12).

- **Correlation with Experience:** Years of practice positively correlated with operational skills (r = .31, p<.01) but not with evaluative subdomains.

Qualitative Themes

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1. **Frustration with English-Only Interfaces:** Participants described medical databases (e.g., Micromedex) as "inaccessible" due to technical jargon and lack of translation.

2. **Mistranslation and Ambiguity:** Automated Hindi translations often produced errors in drug names and dosage instructions, leading to safety concerns.

3. **Reliance on Peer Networks:** Pharmacists frequently sought help from urban colleagues or WhatsApp groups, illustrating informal peer learning as a workaround.

4. **Desire for Bilingual Modules:** Nearly all interviewees expressed willingness to participate in Hindi-language digital literacy workshops, provided they included pharmacy-specific terminology.

CONCLUSION

Rural pharmacists in India possess foundational digital skills, yet language-based barriers significantly impede their ability to effectively access, evaluate, and apply online health information. Our quantitative findings demonstrate moderate digital literacy but expose critical weaknesses in information navigation and reliability evaluation among Hindi/Bhojpuri-dominant pharmacists. Qualitative insights reveal that English-only digital platforms and poor translation quality not only frustrate end users but also carry potential risks for medication errors and compromised patient care. These challenges are further compounded by irregular internet connectivity and limited digital infrastructure in rural settings.

To bridge this gap, a multifaceted approach is essential. First, health informatics stakeholders and platform developers must prioritize multilingual interface design, ensuring accurate translation of technical terminology and seamless toggling between languages. Incorporating voice-over features and context-sensitive help in regional languages can further reduce cognitive load and improve usability. Second, pharmacy councils, professional associations, and educational institutions should collaborate to deliver continuing-education programs tailored to rural pharmacists' needs. These should include hands-on digital literacy workshops in local languages, case-based simulations for evaluating online resources, and mentoring networks that formalize the peer-support mechanisms already in use.

Moreover, policy interventions at the state and national levels can accelerate digital inclusion by funding rural broadband expansion and subsidizing access to licensed digital health databases with multilingual content. Long-term monitoring and evaluation frameworks should be established to assess the impact of these interventions on pharmacists' competency, medication safety metrics, and patient health outcomes. Finally, fostering partnerships with community organizations and leveraging mobile health vans equipped with digital resource kiosks can extend training and support to even the most remote practitioners.

By implementing these recommendations, we can empower rural pharmacists to become digitally proficient, confident, and independent in their practice. Enhanced digital inclusion not only augments individual pharmacists' professional development but also strengthens primary healthcare delivery, promotes equitable access to quality medicines information, and advances India's public health objectives. Concerted action across technological, educational, and policy domains will be pivotal to transforming rural pharmacy practice, reducing healthcare disparities, and building a more resilient, digitally enabled healthcare ecosystem.

FUTURE SCOPE OF STUDY

1. **Intervention Trials:** Conduct randomized controlled trials to evaluate the effectiveness of bilingual digital literacy workshops on pharmacists' performance and patient outcomes.

2. **Platform Development Research:** Partner with health informatics developers to design and test prototype multilingual pharmacy databases with user-centered design methods.

3. **Longitudinal Follow-Up:** Monitor changes in digital literacy over time and assess retention of skills post-intervention.

4. **Scale to Other Regions:** Extend research to other language zones (e.g., Tamil Nadu, West Bengal) to generalize findings and refine localization strategies.

5. **Cost-Benefit Analyses:** Evaluate economic implications of implementing multilingual platforms versus potential gains from reduced medication errors and improved therapeutic outcomes.

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