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A Patient-Centered Pharmaceutical Access Model to Improve Medication Uptake and Adherence in Low-income Settings

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Abstract
Access to essential medicines remains a persistent challenge in low-income settings, where systemic barriers often undermine medication uptake and long-term adherence. Patient-centered approaches have gained momentum as effective strategies to address access inequities by integrating socio-cultural, economic, and behavioral dimensions into pharmaceutical service design. This literature-based paper proposes a Patient-Centered Pharmaceutical Access Model (PC-PAM) that emphasizes affordability, availability, accessibility, acceptability, and adherence support within healthcare delivery systems. Drawing on over 100 scholarly and policy sources, the model is framed within the WHO access framework, health behavior theories, and health system strengthening strategies. The paper is structured into an extensive introduction and literature review, followed by model development, discussion, and recommendations for implementation across resource-constrained environments. The proposed model provides actionable insights for healthcare planners, policymakers, and supply chain actors aiming to improve medication access and patient outcomes in low-income regions.

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1. Introduction

Access to medicines is an essential pillar of any functional healthcare system and is indispensable for the realization of universal health coverage (UHC) [1, 2]. However, in many low-income settings particularly in sub-Saharan Africa, South Asia, and parts of Latin America access to essential medicines remains constrained by structural, economic, logistical, and social barriers [3-7]. According to the World Health Organization (WHO), one-third of the global population lacks regular access to the medicines they need. This challenge is even more acute in rural and underserved urban communities where the availability of pharmaceutical products is often sporadic, prices are unaffordable, and supply chain inefficiencies persist [8-11]. Moreover, even when medications are physically available, issues such as health illiteracy, stigma, cultural misconceptions, and lack of follow-up systems contribute to poor adherence, thereby undermining treatment efficacy and health outcomes [12-14].

The problem of access and adherence has implications that extend beyond individual health. It burdens national healthcare systems with preventable complications and contributes to broader societal issues such as antimicrobial resistance, increased morbidity, and mortality from chronic diseases, and poor maternal and child health indicators [15-17]. For example, in low-income settings, non-adherence to antiretroviral therapy (ART) for HIV, antihypertensive medications, or tuberculosis treatment not only jeopardizes patient survival but also poses public health risks through disease transmission or resistance [18-20].

These challenges call for a more nuanced and people-focused approach to pharmaceutical access one that is grounded in the lived realities of patients and that transcends simplistic supply-side fixes.

Historically, pharmaceutical access models have prioritized logistical dimensions such as drug procurement, warehousing, and distribution. While these aspects are essential, they often neglect the human element of medicine usage. In contrast, patient-centered models recognize that medication access and adherence are complex behaviors shaped by a web of individual, familial, community, and systemic factors [21-23]. According to the Institute of Medicine, patient-centered care is defined as "providing care that is respectful of, and responsive to, individual patient preferences, needs, and values" [24]. Applying this principle to pharmaceutical access requires not just the physical provision of medications but also ensuring that medicines are affordable, culturally acceptable, and aligned with patient lifestyles and beliefs [25-27].

Furthermore, the increasing decentralization of health systems and the shift toward community-based care delivery models have created opportunities for more localized, patient-tailored pharmaceutical services. In many low-income contexts, frontline health workers, community pharmacies, and digital health platforms are playing growing roles in extending pharmaceutical care to hard-to-reach populations [28, 29]. These developments underscore the timeliness and necessity of rethinking access frameworks from a patient-centric lens.

This paper proposes a Patient-Centered Pharmaceutical Access Model (PC-PAM) grounded in extensive review of literature across public health, pharmacy practice, behavioral science, health systems research, and health policy domains. The model incorporates five core components availability, accessibility, affordability, acceptability, and adherence support and draws upon theoretical frameworks such as the Health Belief Model, the Theory of Planned Behavior, and the WHO's Access to Medicines framework [30, 31]. It also integrates insights from empirical studies, program evaluations, and global health initiatives such as the Global Fund and Gavi to distill best practices and identify evidence-based strategies for enhancing pharmaceutical service delivery in resource-constrained settings [32].

A patient-centered approach to pharmaceutical access is particularly vital given the rise in chronic non-communicable diseases (NCDs) in low-income countries, which demand consistent long-term medication usage. Studies show that NCDs such as hypertension, diabetes, and asthma are on the rise across Africa and Asia, yet adherence rates remain alarmingly low often less than 50% [33, 34]. Moreover, health system fragmentation, lack of insurance coverage, and informal medication markets exacerbate the problem by disrupting treatment continuity and undermining trust in formal care providers [35, 36]. Addressing these challenges requires a shift away from fragmented, supply-centric solutions toward integrated, people-driven models of pharmaceutical service provision.

Another important dimension of this issue is the economic burden of out-of-pocket expenditure on medications. In many low-income countries, drug costs represent the largest proportion of household health spending [37, 38]. This financial burden disproportionately affects vulnerable populations, particularly women, children, and people with chronic illnesses. Consequently, patients often engage in suboptimal practices such as medicine rationing, pill splitting, or resorting to traditional remedies that may lack scientific validation [39]. A patient-centered model must therefore incorporate affordability mechanisms such as price subsidies, insurance schemes, and generic substitution policies.

Equally critical is the role of behavioral and psychosocial factors in determining adherence. Behavioral science research has shown that individuals are more likely to adhere to treatment regimens when they perceive the benefits to outweigh the costs, when they trust their healthcare provider, and when they receive continuous support and education [40-42]. In resource-constrained settings, these conditions are often absent, necessitating the development of adherence support mechanisms that are scalable, cost-effective, and culturally appropriate. Examples include peer-support groups, mobile phone reminders, and health coaching interventions [43].

This paper builds upon these insights to argue that improving medication uptake and adherence in low-income settings requires a multidimensional strategy that centers on the patient. The proposed PC-PAM is designed to be adaptable across diverse healthcare contexts, scalable through modular implementation, and inclusive of various stakeholder perspectives including those of patients, healthcare providers, pharmacists, policymakers, and non-governmental organizations.

The remainder of this paper is organized as follows: Section 2 reviews the relevant literature on pharmaceutical access, patient-centered care models, and adherence interventions in low-income settings. Section 3 introduces and elaborates on the conceptual framework of the Patient-Centered Pharmaceutical Access Model (PC-PAM). Section 4 provides a critical discussion of the model's relevance, feasibility, and ethical considerations. Finally, Section 5 concludes with actionable recommendations for implementation, monitoring, and further research.

2. Literature Review

The issue of pharmaceutical access and adherence in low-income settings is multifaceted and intersects with numerous domains including public health, behavioral science, health systems policy, and pharmacy practice. To construct a robust theoretical foundation for the Patient-Centered Pharmaceutical Access Model (PC-PAM), this section reviews existing literature on five key themes: (1) barriers to medication access; (2) patient-centered care principles; (3) determinants of medication adherence; (4) systems and policy interventions; and (5) innovative access models.

2.1 Barriers to Medication Access

Access to medications in low-income settings is impeded by both supply- and demand-side factors. Supply-side constraints include weak procurement systems, fragmented distribution channels, stock-outs, and limited regulatory oversight [1, 4]. Inadequate forecasting, corruption, and insufficient warehousing infrastructure exacerbate the problem [5, 6]. On the demand side, high out-of-pocket costs, geographic inaccessibility, and sociocultural norms often prevent timely access to pharmaceuticals [7, 8]. WHO's access to medicines framework identifies four key dimensions—availability, accessibility, affordability, and acceptability—which are frequently used to categorize these barriers [9].

Empirical studies reveal stark disparities in medication availability across rural and urban areas, with rural facilities

often facing longer stock-out durations and fewer therapeutic alternatives [10]. Similarly, cost-related barriers persist in settings where public insurance coverage is absent or poorly implemented. According to Cameron *et al*., even low-cost generics may be unaffordable for low-income households, leading to suboptimal utilization or complete abandonment of prescribed treatments [11].

2.2 Patient-Centered Care Principles

Patient-centered care has emerged as a pivotal paradigm in modern healthcare. It emphasizes personalization, shared decision-making, cultural sensitivity, and respect for individual preferences [12, 13]. In the context of pharmaceutical services, this approach advocates for understanding patients' perspectives on illness, treatment beliefs, economic constraints, and communication needs [14]. Evidence shows that patient-centered communication improves therapeutic relationships, enhances treatment adherence, and reduces medication errors [15, 16]. For instance, studies in sub-Saharan Africa demonstrate that trust in providers and perceived respect significantly influence patient willingness to initiate and continue medication regimens [17]. The inclusion of community voices in healthcare planning, as advocated by the WHO's people-centered health services framework, also aligns with this philosophy [18].

2.3 Determinants of Medication Adherence

Medication adherence is influenced by a range of factors including health literacy, beliefs about medicines, regimen complexity, side effects, and patient-provider interactions [44, 45]. The Health Belief Model (HBM) and Theory of Planned Behavior (TPB) are commonly used to explain adherence behavior [46, 47]. The HBM postulates that perceived severity, susceptibility, benefits, and barriers predict adherence, while the TPB emphasizes attitudes, subjective norms, and perceived behavioral control [25].

In low-income settings, health literacy is often limited, making it difficult for patients to understand dosage instructions or recognize side effects [48, 49]. Cultural beliefs also affect medication use some communities may prioritize traditional remedies or attribute chronic illness to spiritual causes [50-53]. Socioeconomic factors such as income instability, transport costs, and gender dynamics further complicate adherence [54-56].

Programs that integrate behavior change communication, patient education, and social support have demonstrated improved adherence outcomes. For example, the Directly Observed Treatment, Short-course (DOTS) model for tuberculosis and community ART groups for HIV care illustrate the power of patient support systems [57, 58].

2.4 Systems and Policy Interventions

Policy frameworks play a crucial role in enabling or constraining access to essential medicines. National pharmaceutical policies often determine pricing strategies, essential medicine lists, procurement practices, and insurance coverage [50, 60]. Countries with robust public pharmaceutical systems and health financing schemes typically achieve higher medicine availability and lower household expenditure [61, 62].

Strategic purchasing, pooled procurement, and price negotiation mechanisms like those employed by the Global Fund or Gavi have helped drive down costs for critical medicines [63]. However, many low-income countries lack the institutional capacity to implement such mechanisms consistently. Additionally, the regulation of pharmaceutical markets is often weak, enabling the proliferation of substandard or counterfeit medicines [64].

Digital technologies offer new opportunities for policy innovation. Electronic health records, mobile prescription systems, and digital supply chain tracking can enhance accountability and efficiency [64, 65]. Nonetheless, such innovations must be tailored to local infrastructure constraints and user capacities.

2.5 Innovative Access Models

Several models have been proposed to improve medication access in underserved populations. These include task-shifting strategies, mobile health (mHealth) applications, community drug distribution programs, and public-private partnerships [66, 67].

The Accredited Drug Dispensing Outlet (ADDO) program in Tanzania is a notable example of regulatory innovation. It certifies and trains retail drug sellers to expand access while maintaining safety standards [68]. Another example is Novartis' Healthy Family Program, which combines health education, diagnostics, and low-cost medications in rural South Asia [42].

Digital adherence tools such as SMS reminders and mobile apps have also shown promise in improving chronic disease management [69-71]. However, digital divides, user literacy, and privacy concerns remain key limitations [72, 73].

The literature also highlights the importance of integrating medication access initiatives with broader health system strengthening efforts. Aligning pharmaceutical interventions with primary healthcare reforms, community engagement strategies, and financing innovations can enhance sustainability and impact [74, 75].

In summary, while the body of literature reveals a wide array of access-enhancing strategies, there is a clear gap in models that holistically combine patient-centered principles with system-level enablers. The proposed PC-PAM seeks to bridge this gap by synthesizing insights from these diverse streams into a unified, actionable framework.

3. Conceptual Framework: The Patient-Centered Pharmaceutical Access Model (PC-PAM)

The Patient-Centered Pharmaceutical Access Model (PC-PAM) synthesizes insights from public health frameworks, patient-centered care theory, medication adherence research, and systems thinking to address multidimensional barriers in low-income contexts. The model integrates five core components: (1) Access Enablers, (2) Patient Engagement, (3) Adherence Support Systems, (4) Health System Integration, and (5) Community Empowerment. These pillars are operationalized through feedback loops that recognize the dynamic interplay between patient behaviors, healthcare environments, and social determinants of health.

3.1 Access Enablers

This foundational pillar addresses the structural prerequisites for equitable pharmaceutical access. Based on the WHO's four A's—availability, accessibility, affordability, and acceptability—this component guides the alignment of medication supply chains with patient needs. Key elements include:

- Essential medicine availability: Leveraging centralized

procurement and stock monitoring systems [1].
- Affordability schemes: Utilizing generic substitution policies, pooled procurement, and differential pricing models [2].
- Physical accessibility: Decentralizing pharmaceutical services through mobile clinics and community health workers [3].
- Acceptability factors: Ensuring that pharmaceutical care is culturally competent, linguistically appropriate, and stigma-free [4].

3.2 Patient Engagement

Recognizing patients as active agents in healthcare decision-making, this component emphasizes shared understanding, self-efficacy, and informed choice. It builds on the principles of motivational interviewing, health literacy, and behavior change theories. Key strategies include:

- Tailored communication: Using visual aids, pictograms, and verbal counseling adapted to literacy levels [5].
- Shared decision-making: Involving patients and caregivers in medication selection and scheduling [6].
- Feedback mechanisms: Incorporating patient-reported outcomes and satisfaction surveys into quality improvement cycles [7].

3.3 Adherence Support Systems

This element addresses the continuum of care necessary to sustain medication adherence over time. It draws from chronic care models and community-based health programs. Recommended features include:

- Digital health tools: SMS reminders, mobile adherence apps, and tele-counseling platforms [76, 77, 78].
- Peer support networks: Establishing patient clubs, support groups, or buddy systems to reduce isolation [79], [80].
- Provider training: Equipping pharmacists, nurses, and CHWs with skills for motivational interviewing and adherence counseling [10].

3.4 Health System Integration

PC-PAM is designed to interface seamlessly with existing primary healthcare systems. This pillar underscores the need for policy alignment, institutional support, and data-informed decision-making. Implementation mechanisms include:

- Integrated service delivery: Co-locating pharmacy, diagnostic, and clinical services [11].
- Supply chain coordination: Real-time stock tracking, logistics management information systems (LMIS), and last-mile delivery optimization [81, 82].
- Monitoring & evaluation: Defining KPIs related to medication uptake, adherence rates, and user satisfaction [13].

3.5 Community Empowerment

Recognizing that patients are embedded in broader socio-cultural networks, this pillar ensures that pharmaceutical access strategies reflect community values and leverage local assets. Approaches include:

- Participatory planning: Engaging community leaders and patient advocacy groups in service design [14].
- Health promotion campaigns: Conducting culturally sensitive education using radio, drama, or peer educators [15].
- Local ownership: Supporting the development of community pharmacies and medicine cooperatives [16].

3.6 Model Dynamics and Feedback Loops

PC-PAM is non-linear and adaptive. Feedback from patient experiences informs access enablers, while improved system performance enhances patient engagement and adherence. Community engagement serves both as an entry point and a sustainability mechanism, reinforcing all other pillars. Implementation is staged and iterative, allowing for pilot testing, learning, and scale-up.

The model is scalable and context-sensitive. It can be customized to address disease-specific needs (e.g., HIV, diabetes, maternal health), and is designed to align with national pharmaceutical policies and global health initiatives such as UHC2030 and SDG Target 3.8.

4. Discussion

The Patient-Centered Pharmaceutical Access Model (PC-PAM) addresses multifaceted challenges facing medication access and adherence in low-income settings. Its layered, integrative architecture provides a roadmap for stakeholders across the healthcare continuum to tackle barriers in a patient-focused, culturally competent, and systems-oriented manner. This discussion critically evaluates the model's practical relevance, potential implementation hurdles, policy implications, and ethical considerations.

4.1 Practical Relevance of PC-PAM

PC-PAM aligns with global and national objectives, particularly the United Nations' Sustainable Development Goals (SDG 3) and WHO's commitment to universal health coverage (UHC). Its emphasis on tailoring pharmaceutical services to patient contexts enhances its practical applicability across diverse, resource-constrained environments. The incorporation of access enablers—such as affordability and physical accessibility—speaks directly to structural impediments identified in multiple country-level assessments [1, 17]. Meanwhile, behavioral interventions grounded in patient engagement and adherence support address individual-level determinants often overlooked in vertical health programs [18].

Moreover, PC-PAM promotes synergy between community-led initiatives and formal health systems. For instance, the model's community empowerment pillar encourages participatory governance, essential for local ownership and long-term sustainability of pharmaceutical programs [19]. Through digital health tools and task-shifting approaches, the model ensures adaptability to both rural and peri-urban contexts, making it especially valuable in geographically dispersed, infrastructure-poor settings.

4.2 Barriers to Implementation

Despite its conceptual robustness, PC-PAM faces several potential barriers in real-world settings. First, financing constraints remain a major limitation in many low-income countries, with underfunded health systems struggling to maintain consistent medicine supply chains [83, 84]. The introduction of community pharmacies or decentralized access points, while promising, often lacks the necessary fiscal and technical backing.

Second, health workforce shortages may hinder the execution of provider training and patient counseling activities envisioned under adherence support and patient engagement components [85, 86]. In areas with high turnover rates and skill

gaps, sustaining behaviorally informed communication strategies is especially difficult. Third, health information systems needed for monitoring medication uptake, reporting adherence, and evaluating program impact remain underdeveloped in many target environments [87, 88].

Fourth, sociocultural barriers such as stigma associated with certain diseases or distrust in generic medications may reduce patient receptivity despite systemic improvements [89, 90]. Therefore, interventions must be context-specific and developed with deep community consultation.

4.3 Ethical and Equity Considerations

The ethical foundation of PC-PAM lies in promoting distributive justice and equitable health access. By emphasizing culturally responsive services and inclusive participation, the model seeks to mitigate health disparities linked to geography, income, gender, and education [24]. However, ethical risks arise when community involvement is tokenistic or when digital tools widen rather than close access gaps among populations with low technological literacy [25].

Data privacy is another critical consideration, especially in digital adherence platforms. The deployment of mobile health technologies must comply with emerging digital rights frameworks to ensure that patient data is secure, confidential, and not exploited for commercial gain [26].

4.4 Policy and System-Level Implications

For PC-PAM to be operationalized, policy reforms must align with its foundational principles [91, 92, 93]. National pharmaceutical strategies should explicitly incorporate patient-centered metrics into medicine access indicators. Furthermore, regulatory frameworks must enable the safe expansion of community-based pharmaceutical services, including by task-shifting to trained lay providers [94].

Integration into existing health policies also demands inter-ministerial collaboration, especially between health, finance, and telecommunications sectors [95-97]. Leveraging cross-sector partnerships could foster innovations in digital adherence tools, pooled procurement, and medication delivery logistics [34, 98].

Lastly, scaling the model requires strategic investment in M&E systems. Standardized indicators of medication access and adherence must be embedded into national health information systems, ensuring that results are actionable and disseminated across stakeholders [99, 100].

5. Conclusion and Recommendations

Improving medication uptake and adherence in low-income settings demands models that are not only theoretically robust but also pragmatic and grounded in real-world complexities. The Patient-Centered Pharmaceutical Access Model (PC-PAM) meets this need by integrating structural, behavioral, and community-level dimensions into a unified framework. This model acknowledges the lived realities of underserved populations while leveraging systems-thinking and public health best practices.

5.1 Summary of Key Findings

Through a review of more than 100 sources, this paper has identified critical factors influencing pharmaceutical access and adherence, including medicine availability, health system fragmentation, economic barriers, and socio-cultural dynamics. PC-PAM addresses these by:

- Offering a five-pillar structure that centers the patient experience.
- Emphasizing feedback loops and system adaptability.
- Bridging the gap between community-level interventions and national policy.

5.2 Recommendations for Stakeholders

For Health Policy Makers

- Integrate patient-centered metrics into national pharmaceutical policies.
- Create enabling environments for community-based pharmaceutical services.
- Allocate dedicated funding for adherence-support innovations.

For Healthcare Providers and Planners:

- Incorporate PC-PAM into primary healthcare strategies.
- Train staff in culturally sensitive adherence counseling.
- Deploy community health workers and digital tools for decentralized support.

For International Donors and Partners

- Prioritize investments in scalable and adaptable pharmaceutical access models.
- Support country-level customization of PC-PAM through technical assistance.
- Fund impact evaluations to assess outcomes and scalability.

For Community Leaders and CSOs

- Foster local participation in model adaptation and implementation.
- Educate communities on medicine use, side effects, and adherence.
- Monitor services and advocate for accountability in access initiatives.

5.3 Future Research Directions

While the PC-PAM model is grounded in extensive literature, empirical validation is necessary. Future research should:

- Pilot the model in diverse low-income contexts to evaluate feasibility.
- Use mixed-method studies to assess user satisfaction and health outcomes.
- Explore digital health innovations to support adherence in remote areas.

5.4 Final Reflection

Medication adherence is not merely a function of drug supply but of trust, understanding, support, and community engagement. The PC-PAM represents a shift from transactional to relational pharmaceutical services, re-centering the patient as the most important stakeholder in access ecosystems. By applying this model, stakeholders can move closer to achieving equitable health outcomes and ensuring that the right to essential medicines becomes a reality for all.

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