Data Mining of Pharmacy Usage Patterns in Low-Income Areas

Tresna Dey

Abstract

In the narrow, bustling lanes of Dhaka's Kamrangirchar or the remote marketplaces scattered across the Chittagong Hill Tracts, the first stop for a feverish child, a persistent cough, or abdominal discomfort is rarely a doctor—it is often the local pharmacy. For millions of Bangladeshis, the neighborhood medicine shop has evolved into an informal clinic, serving as the first and sometimes only point of contact with the healthcare system.

These pharmacies, staffed by pharmacists or unlicensed salespersons, operate at the intersection of accessibility, affordability, and immediacy, functioning as gatekeepers for populations who cannot navigate the financial, geographic, or bureaucratic barriers of formal healthcare.

As we progress through 2026, the intersection of Retail Analytics, Public Health Data Mining, and Geographic Information Systems (GIS) is offering a new lens to understand healthcare inequities. By analyzing pharmacy transaction logs, we can trace the hidden architecture of healthcare behavior, uncovering patterns of self-medication, prescription bypassing, and regional disparities. These insights provide critical evidence for policymakers aiming to strengthen healthcare accessibility in the context of "Smart Bangladesh."

The reliance on local pharmacies in low-income areas is both stark and instructive. Recent surveys and data from 2025–2026 reveal that in urban slums, 42.6% of health-seeking events are directed toward neighborhood pharmacies, whereas only 13.5% involve government hospitals. Rural areas show a slightly lower but still dominant reliance, with 30.1% of patients visiting pharmacies compared to 8.9% attending government clinics. Self-medication is pervasive: nearly 69% of patients report administering treatments without formal prescriptions, with respiratory tract infections (27.5%) and gastrointestinal disorders (21.5%) topping the list of bypassed medical consultations. Alarmingly, self-medication with antibiotics remains a critical public health concern. Over 55% of households in low-income and indigenous communities purchase antibiotics like Azithromycin over-the-counter, often for viral illnesses for which

these medications are ineffective, thereby exacerbating the threat of antimicrobial resistance.

The application of data mining techniques, such as K-means clustering and Density-Based Spatial Clustering (DBSCAN), has allowed researchers to move beyond descriptive statistics to uncover spatial and behavioral patterns of pharmacy use. Geographic clustering identifies high-dependence regions, demonstrating that pharmacy reliance is often not a matter of preference but a response to structural barriers in accessing formal healthcare. Overlaying pharmacy transaction data with GIS information on hospital accessibility reveals clear correlations: in areas where the interaction cost of visiting a hospital—which includes travel time, consultation fees, and waiting periods—exceeds approximately 500 BDT or two hours, pharmacy sales of prescription-only medicines increase by as much as 34%. These regions emerge as “high-dependence clusters,” highlighting where the healthcare system is failing to meet basic needs.

Within these clusters, socioeconomic factors further shape patterns of pharmacy usage. Daily wage earners, who cannot afford to lose an entire day to the queues of public outpatient departments (OPDs), form the “frequent pharmacy visitor” segment. For them, a 15-minute stop at a local pharmacy represents not only expediency but survival. Pharmacies often offer medicines on credit, providing crucial financial flexibility in times of crisis—a service that formal hospitals rarely offer. Data mining confirms that household food insecurity, lack of access to clean water, and non-hygienic sanitation are strong predictors of pharmacy reliance, reinforcing the link between structural poverty and informal health-seeking behaviors.

Retail analytics can transform this behavioral data into actionable public health intelligence. For example, sudden spikes in the sale of antidiuretics, oral rehydration salts, or antibiotics within a specific slum can serve as a digital flare, alerting health authorities to a potential outbreak of diarrheal or water-borne diseases weeks before cases reach hospital records. This provides an unprecedented early-warning capability, allowing rapid interventions that could save lives. Similarly, the analysis identifies areas where pharmacist training is most urgently required. Data shows that 74% of self-medicating patients rely on the advice of the pharmacist, who is often an unlicensed salesperson with limited clinical knowledge. By targeting educational interventions and workshops in high-reliance clusters, health authorities can improve rational drug use, promote antibiotic stewardship, and reduce the risk of adverse events.

Beyond acute care, data mining of pharmacy transactions sheds light on the “shadow” costs associated with chronic disease management in low-income populations. Conditions such as hypertension, diabetes, and asthma are increasingly managed informally through pharmacy purchases, often without formal monitoring or adherence to clinical guidelines. By quantifying these patterns, public health planners can design targeted interventions, such as distributing essential medications in government NCD (Non-Communicable Disease) corners or integrating pharmacies into telemedicine networks. This approach transforms informal providers into allies within the formal health system, ensuring that pharmacies become part of the solution rather than perpetuating health inequities.

Another key insight from pharmacy transaction data is the spatial inequity of healthcare access. High-dependence clusters often correspond to regions with limited hospital availability, poor transportation infrastructure, and high population density. Using GIS-based friction modeling, researchers can simulate the “interaction cost” across different terrains and seasons. For example, during the monsoon, travel times to government clinics in low-lying districts can double, turning pharmacies into the only viable option for urgent care. These spatial analyses provide policymakers with the tools to optimize clinic placement, mobile medical units, and targeted outreach, aligning infrastructure development with actual healthcare-seeking behaviors.

Data-driven insights from pharmacy usage also offer opportunities for predictive health interventions. By integrating transaction logs with demographic and socioeconomic data, machine learning models can identify households at heightened risk of preventable disease. For instance, patterns in repeated purchases of antibiotics, antipyretics, or oral rehydration solutions can signal recurring infections or environmental health hazards, prompting community-level interventions. This predictive capability allows healthcare authorities to move from reactive responses to anticipatory planning, ensuring that resources are allocated efficiently and equitably.

The integration of pharmacy data into national health strategies also supports transparency and accountability. By systematically monitoring informal health-seeking behaviors, health ministries can evaluate the effectiveness of public clinics, identify gaps in service delivery, and track improvements over time. Retail analytics thus becomes both a diagnostic and a strategic tool, allowing for evidence-based decision-making that aligns with the goals of universal health coverage and equitable access.

Moreover, the social dimension of pharmacy reliance must be considered. Pharmacies do not merely provide medicines; they offer advice, social reassurance, and a sense of immediacy that hospitals cannot match. Data mining helps quantify these intangible benefits, allowing health planners to design interventions that respect community behaviors rather than attempting to override them. For example, integrating pharmacy-based reporting with community health worker networks can create a hybrid model in which pharmacies act as first responders, feeding data into broader public health surveillance systems while ensuring that critical cases are escalated to formal facilities.

Ultimately, the patterns revealed by pharmacy usage data illuminate the broader structural inequalities in Bangladesh’s healthcare system. They demonstrate that access is not simply a matter of supply, but of geography, economics, and social norms. In urban slums and remote rural markets alike, pharmacies serve as both a safety net and a signal of systemic gaps. By mining these patterns, public health authorities gain the ability to map inequities, anticipate crises, and deploy resources where they will have the greatest impact.

In conclusion, pharmacy usage patterns in Bangladesh are not merely retail trends; they represent a complex, data-rich portrait of healthcare behavior in low-income communities. Through rigorous data mining, GIS analysis, and predictive modeling, these informal healthcare pathways can be integrated into formal planning, transforming the neighborhood pharmacy from a “blind spot” into a partner in public health. Early warning systems, targeted training, predictive interventions, and spatial optimization all emerge from a careful analysis of pharmacy transaction logs, offering a roadmap toward greater equity and efficiency. In the era of AI and Smart Bangladesh 2041, understanding and leveraging these patterns is essential: the neighborhood pharmacy is no longer an informal detour—it is a vital node in the national health system, capable of guiding millions toward better, more equitable care.