

simple concentration patterns commonly observed in single-drug sales analyses and from the highly standardized treatment pathways found in prescriptions from medical institutions, reflecting the combined effects of self-medication practices, pharmacists' recommendations, and individual patient differences in the retail pharmacy context (Nnanga et al., 2025). In particular, diseases with relatively well-defined diagnostic and therapeutic pathways tend to show higher levels of medication combination concentration, highlighting the reliance of primary care medication practices on evidence-based guidelines and empirical treatment pathways. In contrast, in symptom-oriented conditions or diseases characterized by greater heterogeneity, medication-use structures are markedly more dispersed, exhibiting higher levels of combination diversity and individualization.

From the perspective of disease-type differences, the differentiation in medication combination concentration and heterogeneity has clear clinical and behavioral underpinnings. Conditions such as upper respiratory tract infections, pain, and inflammatory symptoms, for which symptom recognition is relatively straightforward and commonly used medications are stable, are more likely to form core medication pathways with high concentration and low heterogeneity. Conversely, mild gastrointestinal conditions, allergic reactions, and medication use related to chronic diseases complicated by multimorbidity show substantial variation in combination size, drug category composition, and patterns of concomitant use (Calzetta et al., 2024).

These findings suggest that heterogeneity in medication combinations should not be equated simplistically with irrational drug use; rather, to a considerable extent, it reflects disease complexity, differences in patient needs, and the expansion of decision-making space for medication use in primary care settings. At the same time, however, increased combination complexity also implies elevated risks of potential drug–drug interactions, duplicate medication use, and other drug-related problems, which warrant particular attention in elderly populations and in long-term medication use for chronic diseases (Ouraou et al., 2025).

At the practical and policy levels, this study demonstrates that indicators of medication combination concentration and heterogeneity can serve as important tools for promoting rational medication management in retail pharmacies. On the one hand, highly concentrated core medication combinations can provide an entry point for identifying “standardized medication pathways,” thereby facilitating focused monitoring and standardized medication guidance in high-frequency transaction scenarios (Hajj et al., 2024). On the other hand, disease areas characterized by high heterogeneity and greater combination complexity require pharmacist-led individualized medication assessments and risk interventions.

Compared with management approaches focused on single drugs, analyzing medication-use structures from the perspective of medication combinations more closely aligns with real-world medication behaviors and is better suited to identifying potential structural risks (Lampe et al., 2023). Future research could further validate these findings across multiple regions and types of retail pharmacies, and integrate medication combination characteristics with clinical outcomes, adherence, and intervention effects, thereby providing more refined empirical evidence to support the development of primary pharmaceutical care systems and rational drug use policies.

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Conflict of Interest Disclosure

The authors affirm that this research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

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