

The Role of Clinical Pharmacy in Preventing Complications of Metabolic Syndrome

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ABSTRAK

Metabolic syndrome is a cluster of interacting metabolic risk factors, including central obesity, hypertension, insulin resistance, hyperglycemia, and atherogenic dyslipidemia, which significantly increase the risk of cardiovascular disease and type 2 diabetes mellitus. The prevalence of metabolic syndrome continues to increase globally due to changes in sedentary lifestyles and high-calorie consumption patterns, making it a public health issue with serious clinical, social, and economic impacts. The resulting complications, such as coronary heart disease, stroke, chronic kidney failure, and neuropathy, not only worsen patients' quality of life but also increase long-term healthcare costs. Therefore, preventing complications needs to be prioritized with strategies that integrate healthy lifestyle modifications, medical interventions, and rational pharmacotherapy. Clinical pharmacists play a strategic role in the management of metabolic syndrome through medication therapy management (MTM), patient education, drug interaction detection, and increased therapy adherence. Interdisciplinary collaboration between pharmacists, physicians, nurses, nutritionists, and psychologists strengthens the effectiveness of comprehensive, more personalized interventions. This study uses qualitative methods through a literature review to analyze the role of clinical pharmacists in preventing metabolic syndrome complications. The results show that integrating the role of clinical pharmacists into the healthcare team, supported by regulations, technology, and ongoing training, is key to reducing the risk of complications and improving people's quality of life.

INTRODUCTION

Metabolic syndrome is a clinical condition characterized by a cluster of metabolic risk factors, such as central obesity, hypertension, insulin resistance, hyperglycemia, and atherogenic dyslipidemia. This condition is not a single disease entity, but rather a syndrome that can progressively worsen an individual's quality of life. Various studies have shown that the prevalence of metabolic syndrome continues to increase along with changes in modern lifestyles that tend to be sedentary and consumption patterns high in saturated fat and sugar (Sinuraya et al., 2019). This phenomenon makes metabolic



syndrome a pressing global public health issue. The high prevalence also has a direct impact on the increasing burden of healthcare costs, both on the national healthcare system and on patients' families. Furthermore, metabolic syndrome has been shown to increase the risk of developing chronic degenerative diseases that require long-term management. Therefore, prevention and control of metabolic syndrome cannot be ignored within the healthcare framework. Comprehensive and systematic efforts are key to addressing this issue.

Complications caused by metabolic syndrome are often serious and life-threatening, reinforcing the urgency of early intervention (Puspitasari et al., 2025). Patients with metabolic syndrome are at higher risk of cardiovascular diseases such as coronary heart disease and stroke. Additionally, other complications include chronic kidney failure, neuropathy, retinopathy, and an increased risk of certain cancers. These conditions worsen the patient's prognosis and have significant socioeconomic impacts (Yamin & Putra, 2024). The costs of managing these complications far outweigh the costs of early prevention. Therefore, the primary focus in metabolic syndrome management is complication prevention through risk factor control (Gharrieni & Angraini, 2025). Management strategies encompass not only medical aspects but also consistent lifestyle modifications. Therefore, complication prevention should be viewed as a long-term investment in improving quality of life and reducing the national health burden.

Metabolic syndrome management requires an integrated and continuous interdisciplinary approach. Physicians, nurses, nutritionists, psychologists, and clinical pharmacists need to collaborate to develop a holistic management model. A single medical approach is often insufficient, as metabolic syndrome is influenced by multidimensional factors encompassing biological, environmental, social, and behavioral aspects. In clinical practice, interprofessional coordination can help patients understand their condition and improve adherence to therapy (Pamungkas et al., 2025). This collaboration also allows for early detection of potential problems that may arise during therapy. Thus, an interdisciplinary approach not only increases the effectiveness of treatment but also reduces the risk of long-term complications. Good service integration will foster patient trust in the healthcare system they are using. Therefore, building interprofessional synergy is essential in the context of metabolic syndrome care.

Clinical pharmacists play a strategic role within the healthcare team due to their specialized competence in pharmacotherapy. Their role in the clinical setting extends beyond providing medication and also involves assessing the rationale for therapy. Clinical pharmacists can identify potential drug interactions, side effects, and dosage discrepancies that can increase the risk of complications. Furthermore, clinical pharmacists play a key role in ensuring that patients fully understand how to use their medications correctly and consistently. This is crucial because patient adherence to treatment is often low, especially with long-term therapy. The presence of clinical pharmacists allows for more focused education about the benefits, risks, and importance of risk factor management. Counseling can help patients internalize the importance of lifestyle changes that support successful therapy. The role of clinical pharmacists is thus both preventive and promotive in preventing complications of metabolic syndrome.

The role of clinical pharmacists in preventing complications is also reflected through their involvement in medication therapy management (MTM) programs. This program allows clinical pharmacists to conduct a comprehensive review of a patient's medication regimen, including its effectiveness, safety, and affordability. Through MTM,

potential duplication of therapy and inappropriate medication use can be identified early. This is particularly important for patients with metabolic syndrome, who often undergo polypharmacy therapy due to various comorbidities. With clinical pharmacist intervention, the potential for adverse drug reactions (ADRs) can be minimized. This intervention not only prevents complications from inappropriate medication use but also improves the patient's overall quality of life. MTM is a tangible contribution of pharmacists to improving patient safety. Therefore, the implementation of such programs should be an integral part of healthcare services.

In addition to pharmacotherapy, clinical pharmacists are also responsible for educating patients about a healthy lifestyle. Dietary changes, regular physical activity, stress management, and smoking cessation are key pillars in preventing complications of metabolic syndrome (Habsy, 2024). Clinical pharmacists can provide evidence-based counseling regarding healthy food choices, weight management, and the importance of adherence to an exercise schedule. This education complements medical therapy provided by physicians. This allows patients to gain a more comprehensive understanding of the steps they need to take to manage risk factors. This educational role is increasingly important because patients often receive insufficient attention to non-pharmacological aspects. Clinical pharmacists can act as a bridge connecting health theory with patients' daily practices. With the right educational strategies, the potential for complications can be significantly reduced.

The success of clinical pharmacists in preventing metabolic syndrome complications also depends on policy support and the healthcare system. Without regulatory support, pharmacists' freedom to carry out their roles is often limited. Therefore, formal recognition of clinical pharmacists' contributions to the healthcare team is urgent. Furthermore, ongoing training for pharmacists is necessary to enable them to keep up with the dynamic developments in pharmacotherapy. The role of pharmacists in clinical care must also be supported by technological tools, such as electronic medical record systems, which enable more effective interprofessional collaboration (Al Adawi et al., 2020). This integration offers significant opportunities to improve service quality and accelerate data-driven decision-making. With supportive policies and systems, the role of clinical pharmacists can be optimized, ultimately contributing to more comprehensive complication prevention.

Overall, metabolic syndrome is a global health challenge that requires multidimensional and sustainable interventions. Complications can be prevented through integrative efforts involving various healthcare professionals, including clinical pharmacists (Clements et al., 2021). The role of clinical pharmacists in pharmacotherapy, education, and adherence management makes them crucial in reducing the risk of complications. The presence of clinical pharmacists not only improves patient safety but also reduces long-term healthcare costs. Therefore, investing in increasing the capacity of clinical pharmacists and integrating them into the healthcare system needs to be a priority. With these measures, preventing complications from metabolic syndrome can be more effective. These efforts also contribute to achieving health development goals that focus on improving the community's quality of life. Therefore, the urgency of the role of clinical pharmacists in preventing complications from metabolic syndrome is increasingly undeniable.

METHODOLOGY

This study used a qualitative approach with a literature review to explore the role of clinical pharmacy in preventing metabolic syndrome complications. This approach was chosen because it provides a critical analysis of existing scientific findings and synthesizes relevant evidence. According to Snyder (2019), a literature review is an effective method for building a conceptual framework, assessing the consistency of research findings, and formulating practical recommendations in the health sector.

Data sources were obtained from reputable international and national journal articles, clinical pharmacy textbooks, and metabolic health practice guidelines. Searches were conducted through electronic databases such as PubMed, Scopus, ScienceDirect, and Google Scholar using the keywords "clinical pharmacy," "metabolic syndrome," "complication prevention," and "pharmacist role." Selected articles were limited to relevant publications within the last 10 years; publications not meeting the exclusion criteria were not analyzed further.

Data analysis was conducted using content analysis techniques, identifying and grouping key themes related to the role of clinical pharmacists, prevention strategies, and their implications for metabolic syndrome complications. This process aligns with Krippendorff's (2018) opinion, which states that content analysis is effective for uncovering meaning, patterns, and trends from diverse scientific texts. The validity of the results was strengthened through source triangulation by comparing literature from various credible publications.

Using this method, the research is expected to produce a comprehensive synthesis that can serve as a basis for developing evidence-based clinical pharmacy practice. Furthermore, the results of the literature review can provide theoretical contributions to the development of clinical pharmacy science and practical recommendations for health policy.

RESULTS AND DISCUSSION

1. The Urgency of Preventing Metabolic Syndrome Complications

The urgency of preventing metabolic syndrome complications is inextricably linked to the fact that this syndrome is a collection of interacting metabolic risk factors that accelerate the progression of various chronic degenerative diseases. Various epidemiological studies have shown that patients with metabolic syndrome are two to three times more likely to develop atherosclerotic cardiovascular disease and five times more likely to develop type 2 diabetes mellitus than individuals without the syndrome. The resulting complications, such as myocardial infarction, stroke, diabetic nephropathy, and chronic kidney failure, not only increase morbidity and mortality but also burden the health system with significant long-term costs (Nilsson et al., 2019). This condition becomes even more relevant when compared to global prevalence data, which shows a variation of 12.5% according to the ATP III criteria to 31.4% according to the Joint Interim Statement (JIS) criteria. Some reports even estimate that approximately 25% of the world's adult population has metabolic syndrome, with some studies reporting even higher figures reaching 40–46%. In children and adolescents, the prevalence is indeed lower, namely around 3% in children and 5% in adolescents, but the increasing trend in young ages remains a serious concern because it has the potential to increase the burden of chronic diseases in the future.

In Indonesia, the prevalence of metabolic syndrome is also significant, ranging from

21–23% of the adult population, with a trend of increasing over time. Cohort data in Bogor showed a significant increase from 18.2% in 2011–2012 to 28.6% in 2018, and remained at around 27.5% in 2021. National surveys recorded a prevalence of 23%, with a marked difference between the sexes, namely 26.6% in women and 18.3% in men, indicating the contribution of biological, hormonal, and lifestyle factors. In the age group above 40 years, the prevalence also reached 21.66%, indicating that the risk of metabolic syndrome becomes more pronounced with age. These epidemiological findings illustrate that metabolic syndrome is not merely an individual clinical problem, but a real public health challenge, especially amidst the increasing prevalence of obesity, hypertension, dyslipidemia, and insulin resistance due to changes in diet, physical activity, and urbanization (Rachman & Ismaniar, 2025).

Preventing complications in metabolic syndrome has dual significance, both at the individual and societal levels. At the individual level, early prevention through regular screening, identification of risk factors, and adoption of a healthy lifestyle has been shown to delay or even prevent the onset of cardiometabolic disease. Meanwhile, at the population level, prevention strategies have implications for economic efficiency, by reducing expenditures on treatment for complications, which tend to outweigh investments in promotive and preventive programs (Listyandini et al., 2020). This aligns with the World Health Organization (WHO) recommendation that prevention of non-communicable diseases, including metabolic syndrome, is a global priority in reducing the burden of chronic disease.

An ideal prevention strategy encompasses two main pillars: healthy lifestyle modifications and the rational use of pharmacotherapy. Lifestyle modifications, such as a balanced diet low in saturated fat, increased fiber intake, regular physical activity, and weight control, have been shown to reduce the incidence of diabetes and cardiovascular disease in high-risk groups. Pharmacotherapy, for example, is used when lifestyle interventions alone are insufficient, including the use of antihypertensives, statins, or antidiabetic agents, which must be tailored to the individual's risk profile (Choirionisa, 2022). Therefore, the urgency of preventing metabolic syndrome complications extends beyond clinical aspects and is also closely linked to socioeconomic dimensions and public health policy. The earlier preventive efforts are implemented, the greater the potential to reduce the disease burden and improve the community's quality of life. Metabolic syndrome is a health issue requiring interdisciplinary attention, including medicine, pharmacy, nutrition, and health policy.

2. The Strategic Role of Clinical Pharmacy in Metabolic Syndrome Management

The strategic role of clinical pharmacy in metabolic syndrome management is highly complex, encompassing pharmacotherapy, patient education, and contributions to the broader health system. Clinical pharmacists function not only as drug providers but also as therapeutic consultants, ensuring the safety, effectiveness, and efficiency of medication use in patients with multifactorial metabolic conditions. In the case of metabolic syndrome, which is often characterized by hypertension, dyslipidemia, obesity, and insulin resistance, pharmacists play a role in integrating pharmacological approaches with ongoing non-pharmacological interventions. Pharmacist involvement in the clinical decision-making process significantly contributes to reducing the risk of cardiovascular complications and type 2 diabetes. Scientific literature emphasizes that successful therapy for metabolic syndrome relies not only on drug therapy but also requires intensive support in lifestyle changes (Rask Larsen, 2018). Pharmacists have the capacity to facilitate this

transition through a systematic, counseling-based approach and therapeutic communication. The presence of pharmacists within the multidisciplinary team allows for a more targeted synergy between medical interventions, nutrition, and physical activity. Thus, pharmacists contribute not only to the curative aspect but also to strengthening the preventive and promotive dimensions of healthcare. This role demonstrates that pharmacists are a key element in a sustainable strategy to address metabolic syndrome. Therefore, integrating the role of clinical pharmacists across various healthcare sectors is increasingly relevant in an era of increasing global prevalence of metabolic syndrome (Sud et al., 2021).

The contribution of clinical pharmacists in medication therapy management (MTM) has been proven significant in reducing the risk of cardiovascular and diabetes complications through comprehensive evaluation of medication regimens. Through MTM, pharmacists can early identify potential drug interactions, duplication of therapy, and inaccurate dosing, which are often found in patients with polypharmacy (Akmal, 2024). The MTM program also provides pharmacists with the opportunity to develop individualized therapy recommendations tailored to each patient's clinical profile. Empirical research shows that pharmacist interventions in MTM can reduce hospitalization rates due to adverse drug reactions and improve control of key clinical parameters, including blood pressure, blood glucose levels, and lipid profiles (Pratama et al., 2021). This impact not only improves individual patient clinical outcomes but also significantly contributes to reducing systemic healthcare costs. This demonstrates the role of pharmacists in maintaining the quality of ongoing therapy. Furthermore, MTM is a crucial tool in strengthening the therapeutic relationship between patients and the healthcare team because the process involves intensive communication and ongoing monitoring. Thus, the presence of pharmacists in MTM is not only oriented towards pharmacotherapy control but also towards building patient trust in the healthcare system. This role emphasizes that pharmacists are key players in maintaining the continuity of safe, effective, and evidence-based therapies. Therefore, the widespread implementation of MTM can be viewed as a strategic strategy in managing metabolic syndrome.

Beyond pharmacotherapy, pharmacists' educational role in improving patient adherence to therapy and a healthy lifestyle is crucial. Metabolic syndrome requires long-term behavioral changes that include adopting a healthy diet, increasing physical activity, and cessation of smoking. Through counseling based on therapeutic communication, pharmacists can help patients understand the rationale for their therapy and address misconceptions related to medications and diseases. Pharmacist education can increase patients' intrinsic motivation to maintain the necessary healthy lifestyle changes. This approach also aligns with the patient-centered care paradigm, which places the patient at the center of all health interventions. Pharmacists can design educational strategies based on individual needs, ensuring interventions are not generic but tailored to the patient's social, cultural, and economic circumstances. These efforts demonstrate that targeted education has the potential to improve long-term therapy adherence. Improved adherence implies more optimal control of the clinical parameters of metabolic syndrome. Thus, pharmacists' educational interventions can bridge the gap between medical therapy planning and patients' daily behavioral practices. This role underscores the importance of pharmacists in ensuring the successful management of metabolic syndrome comprehensively.

Furthermore, clinical pharmacists contribute significantly to the promotive and preventive aspects of health by conducting metabolic risk screenings and providing early

intervention for high-risk populations. This role is not limited to individual clinical settings but also extends to the community through public education programs and outpatient clinics. Pharmacists can detect inappropriate medication use patterns, identify patients with suboptimal glycemic control, and recommend referrals to specialists when necessary. With this involvement, pharmacists play a vanguard role in preventing the progression of metabolic diseases to serious complications. Pharmacists' promotive activities include education on a balanced diet, the importance of physical activity, and stress management, which are closely related to metabolic risk. Meanwhile, their preventive role involves routinely monitoring clinical parameters to detect changes that indicate potential health problems. With this strategic position, pharmacists are able to contribute to reducing the incidence of long-term complications such as coronary heart disease and stroke. This also strengthens the role of pharmacists as public health agents, functioning beyond their traditional roles. This promotive-preventive role aligns with the global health mission to reduce the increasing prevalence of non-communicable diseases. Therefore, optimizing the function of clinical pharmacists in the preventive dimension is an important investment in a modern health system.

3. Implications of Interdisciplinary Collaboration and Health Policy

Interdisciplinary collaboration in the management of metabolic syndrome is fundamental due to the complexity of risk factors that involve biological, psychological, social, and lifestyle aspects of the patient. Physicians play a role in diagnosis and medical management, while nurses support the continuity of care and long-term, holistic monitoring of the patient's condition. Nutritionists contribute to the development of evidence-based individualized dietary plans, which are then reinforced by psychologists through behavioral interventions and motivational counseling to improve patient adherence. Clinical pharmacists play a strategic role in bridging pharmacological therapy with patient needs, through drug therapy monitoring, drug interaction detection, and education regarding side effects. Research shows that this interprofessional synergy has a significant impact on improving the quality of life of patients with metabolic syndrome, particularly through the control of blood pressure, glucose levels, and lipid profiles (Bachynsky, 2020). With interprofessional coordination, complication prevention strategies can be designed more comprehensively and personalized, thus increasing the effectiveness of interventions. This collaboration also has implications for healthcare cost efficiency by reducing hospitalization rates due to preventable complications. The multidisciplinary care model ultimately creates a more integrated continuity of patient care, rather than the partial efforts of a single profession. Thus, interprofessional collaboration not only strengthens the clinical dimension but also strengthens patient trust in the healthcare system. This also emphasizes that a partial approach is no longer sufficient; a shift to a systematic collaborative paradigm is necessary.

The health policy implications of expanding the role of clinical pharmacists are crucial because regulations determine the scope of practice and legitimacy of the profession within the healthcare system. Without a clear legal framework, pharmacists' involvement in interdisciplinary teams is often limited to the technical functions of drug distribution, thus under-realizing their potential clinical contribution. A literature review shows that countries with regulations supporting the integration of clinical pharmacists tend to be more successful in reducing the number of chronic disease complications, including metabolic syndrome (Yasaka et al., 2024). Policy support also involves providing proportional incentives so that interprofessional collaboration is not only

normative but also practically implemented. Good regulations enable clinical pharmacists to engage in clinical decision-making alongside physicians, resulting in more comprehensive and evidence-based decisions. Furthermore, progressive health policies can encourage interprofessional education models from the academic level, so that new healthcare workers become accustomed to working across professions early in their careers. Strengthening the role of clinical pharmacists through policy also impacts patient adherence to therapy because education is provided more intensively and consistently. Without supportive regulations, interprofessional collaboration tends to be hampered by professional hierarchies and asymmetrical perceptions of each other's roles. Therefore, clear policies not only facilitate collaboration but also ensure the sustainability of a health system that is more adaptive to multifactorial chronic diseases. Consequently, optimizing the role of clinical pharmacists should be viewed as an indicator of the quality of health policies based on professional integration.

In addition to regulatory aspects, technological support and ongoing training are crucial factors in determining the successful implementation of interdisciplinary collaboration. Electronic medical records enable clinical pharmacists to access patient data in real time, enabling faster, more accurate, and coordinated pharmacotherapy decisions with other professionals (Tanjung et al., 2023). This technology also minimizes the risk of duplicate prescriptions, undetected drug interactions, and medication administration errors. Ongoing training is necessary to keep clinical pharmacists abreast of the latest therapeutic developments, including pharmacogenomics and personalized medicine. Digital technology-based interprofessional education also strengthens interprofessional understanding of their respective roles in metabolic syndrome management. The simultaneous integration of technology and training creates a dynamic collaborative environment, enabling more responsive adaptation to patient needs. Literature studies confirm that health systems that emphasize updating the competencies of healthcare workers have a higher success rate in reducing the rate of chronic disease complications. Furthermore, the use of telemedicine and mobile applications supports remote patient monitoring, expanding the reach of clinical pharmacists' services. The practical implication of this technological support is increased efficiency and effectiveness of services without compromising the quality of interprofessional interactions. Thus, the integration of technology and ongoing training becomes a systemic foundation to ensure that the role of clinical pharmacists is truly optimized in interdisciplinary teams.

CONCLUSION

In conclusion, the urgency of preventing metabolic syndrome complications demands a comprehensive approach that simultaneously encompasses clinical, social, economic, and health policy dimensions. This syndrome has been shown to increase the risk of cardiovascular disease, type 2 diabetes mellitus, and other serious complications that impact quality of life and healthcare costs. Global and national epidemiological data show a consistent upward trend in prevalence, therefore, prevention must be positioned as a top priority within the health system. Healthy lifestyle-based prevention efforts have proven effective, but require rational pharmacotherapy support in certain cases to achieve optimal results. The role of clinical pharmacists is key in bridging pharmacological interventions with patient needs, through medication therapy management, education, and long-term therapy monitoring. Pharmacist involvement not only improves patient compliance but also

reduces the risk of drug interactions and frequent polypharmacy. Synergy with physicians, nurses, nutritionists, and psychologists strengthens a more integrated and personalized prevention strategy. Health policies that support the integration of clinical pharmacists have been shown to strengthen the effectiveness of interprofessional collaboration in reducing complication rates. Furthermore, digital technology support and ongoing training ensure that collaboration implementation is adaptive to scientific developments. Promotive and preventive strategies strengthened by pharmacists at both the individual and community levels can significantly reduce the risk of disease progression. Therefore, metabolic syndrome must be viewed not merely as an individual clinical problem, but as a global public health challenge. Therefore, interdisciplinary collaboration supported by regulations, technology, and ongoing education is a crucial prerequisite for efforts to reduce complications and improve the quality of life of the wider community

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