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Research Article

Pharmacist-Led Medication Counseling and Its Effect on Treatment Adherence in Patients with Chronic Diseases

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Abstract:

Pharmacist-led medication counseling represents a critical intervention in chronic disease management, directly addressing the pervasive challenge of medication non-adherence. By transitioning from a dispensing role to a patient-centered practice, pharmacists conduct structured, tailored consultations that assess individual barriers, educate on proper medication use, and employ behavioral strategies to empower patients. This evidence-based approach, grounded in theories like the Health Belief Model and Motivational Interviewing, systematically improves treatment adherence across conditions such as hypertension, diabetes, and asthma. Enhanced adherence subsequently leads to superior clinical outcomes, reduced complications, and more efficient healthcare utilization. Ultimately, integrating pharmacists as proactive counselors within the care team is essential for optimizing long-term therapeutic success and public health in the era of chronic diseases.

1. Introduction

The twenty-first century is marked by a profound epidemiological transition, where chronic non-communicable diseases (NCDs) have ascended to become the leading cause of mortality and morbidity worldwide. Conditions such as hypertension, diabetes mellitus, dyslipidemia, cardiovascular diseases, asthma, chronic obstructive pulmonary disease (COPD), and mental health disorders like depression, constitute a significant portion of the global disease burden. These conditions are characterized by their prolonged duration, generally slow progression, and the necessity for continuous medical management and therapeutic intervention over years, if not a lifetime. The World Health Organization (WHO) consistently highlights that NCDs are responsible for over 70% of all deaths globally, with a disproportionate impact on low- and middle-income countries undergoing rapid urbanization and lifestyle changes [1]. The economic ramifications are equally staggering, encompassing direct medical costs, such as hospitalizations and medication, and indirect costs from lost productivity and disability, placing an unsustainable strain on healthcare systems internationally [2].

At the core of effective chronic disease management lies a deceptively simple yet persistently elusive goal: patient adherence to prescribed pharmacotherapeutic regimens. Adherence, defined as the extent to which a patient's behavior—taking medication, following a diet, or executing lifestyle changes—corresponds with agreed recommendations from a healthcare provider, is the critical bridge between medical prescription and desired clinical outcome. Non-adherence to medication for chronic diseases is a pervasive and complex problem of monumental scale. Studies across various disease states and regions suggest that approximately 50% of patients with chronic illnesses do not take their medications as prescribed [3]. This phenomenon translates into a cascade of negative consequences, often referred to as the "adherence gap." Poor adherence leads to suboptimal disease control, increased incidence of disease complications, more frequent hospital admissions and emergency department visits, reduced quality of life, and, ultimately, higher rates of premature mortality. From a systemic perspective, it represents a massive waste of healthcare resources, with billions spent on medications that yield no clinical benefit due to incorrect or discontinued use [4].

The etiology of non-adherence is multifactorial, seldom stemming from a single cause but rather from a complex interplay of patient-related, therapy-related, condition-related, healthcare system-related, and socioeconomic factors. Patient-related barriers include lack of understanding about the disease and the purpose of treatment, forgetfulness, psychological factors such as depression or denial, and practical issues like cost or difficulty with complex regimens. Therapy-related barriers encompass side effects, the complexity of dosing schedules, and the perceived or real inefficacy of the medication. The very nature of chronic diseases—often asymptomatic in early stages or requiring treatment for invisible, long-term risks—further undermines motivation, a concept known as "clinical inertia" on the part of the patient. Furthermore, the traditional model of healthcare, characterized by brief physician consultations, fragmented care, and poor provider-patient communication, exacerbates the problem by failing to adequately address these barriers [5].

In response to this multifaceted challenge, the role of the healthcare professional is undergoing a significant paradigm shift. The focus is expanding from a purely product-centered model—dispensing medications—to a patient-centered model that emphasizes cognitive services, education, and long-term therapeutic partnerships. Within this evolving landscape, the pharmacist has emerged as a uniquely accessible and qualified healthcare

professional poised to play a pivotal role. Pharmacists are the most accessible healthcare providers in many communities, with frequent patient touchpoints that offer unparalleled opportunities for intervention [6].

This evolution has given rise to the practice of pharmacist-led medication counseling, a structured, patient-centric communication process that extends far beyond the simple provision of instructions. It is a comprehensive service involving the assessment of the patient's understanding and relationship with their medications, the provision of tailored education, the identification and resolution of medication-related problems (MRPs), and the empowerment of the patient to take an active role in their own care. Pharmacist-led counseling is not a one-time event at the point of dispensing but an ongoing, iterative process that can occur in various settings: community pharmacies, hospital discharge transitions, outpatient clinics, and through dedicated chronic disease management programs [7].

The potential impact of this intervention is substantial. By systematically addressing knowledge deficits, simplifying regimens in collaboration with prescribers, managing side effects, employing adherence aids, and fostering a supportive, trusting relationship, pharmacists can directly target the root causes of non-adherence. Therefore, investigating the effect of pharmacist-led medication counseling on treatment adherence in patients with chronic diseases is not merely an academic exercise; it is an urgent inquiry into a scalable, practical strategy to improve individual patient outcomes and enhance the efficiency and effectiveness of entire healthcare systems [8].

2. Understanding Adherence Through Behavioral Lenses

Effective interventions must be grounded in a robust understanding of why behaviors, such as medication-taking, occur or fail to occur. Pharmacist-led counseling is most potent when it consciously applies theories from health psychology and behavioral science. One of the most influential models is the Health Belief Model (HBM). The HBM posits that a patient's likelihood of engaging in a health-promoting behavior depends on their perception of susceptibility to a health threat, the perceived severity of that threat, the perceived benefits of the recommended action, and the perceived barriers to taking that action. Cues to action, such as symptoms or advice from a provider, can trigger the behavior. A pharmacist employing the HBM in counseling would not simply state, "Take this for your blood pressure." Instead, they would explore and address perceptions: "How concerned are you about the risks of uncontrolled high blood pressure like stroke or heart attack? Do you feel this medication can effectively reduce that risk for you? What might make it difficult for you to take it every day?" By calibrating perceived threats, amplifying benefits, and collaboratively reducing barriers, the pharmacist can foster intrinsic motivation for adherence [9].

Another critical framework is the Transtheoretical Model (TTM), or Stages of Change model, which recognizes that behavioral change is a process, not an event. Patients move through pre-contemplation, contemplation, preparation, action, and maintenance stages, with potential for relapse. A one-size-fits-all counseling approach is ineffective. A patient in pre-contemplation who does not believe they have a problem requires a different strategy (raising awareness, exploring ambivalence) than a patient in action who is struggling with side effects (problem-solving, reinforcement). A skilled pharmacist assesses the patient's stage and tailors the interaction accordingly, providing the right support at the right time to facilitate progression towards sustained maintenance of adherence [10].

Furthermore, the concept of Self-Efficacy, central to Albert Bandura's Social Cognitive Theory, is paramount. Self-efficacy is an individual's belief in their capability to execute behaviors necessary to produce specific performance attainments. In chronic disease management, it is the patient's confidence that they can remember to take their pills, manage a complex regimen, or cope with side effects. Low self-efficacy is a strong predictor of non-adherence. Pharmacist-led counseling directly builds self-efficacy through mastery experiences (e.g., teaching a patient to use an inhaler correctly), verbal persuasion (providing encouragement and positive feedback), and modeling (demonstrating behaviors). By strengthening the patient's belief in their own ability to manage their therapy, the pharmacist empowers lasting self-management [11]. These theoretical underpinnings transform counseling from simple information transfer to a strategic, psychologically-informed intervention aimed at modifying the determinants of behavior.

3. The Evolving Role of the Pharmacist: From Dispenser to Counselor and Care Manager

The professional identity of the pharmacist has undergone a radical transformation over recent decades, driven by the complexities of modern pharmacotherapy and the recognized shortcomings of traditional care models. Historically, the pharmacist's primary function was logistical and

technical: to accurately and safely supply prescribed medications. This role, while vital, was largely product-oriented. The contemporary paradigm mandates a shift towards patient-oriented care, where the medication is a tool to achieve a health outcome, not the end product itself. This shift is formally encapsulated in the philosophy of Pharmaceutical Care, defined as the responsible provision of drug therapy for the purpose of achieving definite outcomes that improve a patient's quality of life. These outcomes include curing disease, eliminating or reducing symptoms, arresting or slowing a disease process, and preventing disease or symptoms [12].

Within this framework, medication counseling is a fundamental activity, but it is part of a larger suite of cognitive services. The pharmacist's responsibilities now encompass medication therapy management (MTM), a distinct service or group of services that optimize therapeutic outcomes. MTM includes comprehensive medication reviews, the creation of personalized medication records, the development of medication-related action plans, intervention and referral for identified drug therapy problems, and documentation and follow-up. Medication counseling is the communicative engine that drives this process. It is the means through which the pharmacist gathers information (e.g., about adherence, side effects, and practical barriers), provides education, and negotiates plans with the patient [13].

This expanded role is increasingly recognized and formalized in healthcare policy and funding models in many countries. Collaborative Drug Therapy Management (CDTM) agreements allow pharmacists, under protocol with physicians, to initiate, modify, or monitor drug therapy. In such models, counseling is seamlessly integrated with clinical decision-making. For example, a pharmacist managing a patient with diabetes under a CDTM protocol would not only counsel on the proper use of insulin but also titrate the dose based on glucose logs reviewed during the counseling session. This integration positions the pharmacist as a essential member of the interprofessional healthcare team, uniquely bridging the gap between the prescribing decision and the patient's everyday life with their medications [14].

4. Evidence Base: Impact Across Major Chronic Disease States

A substantial and growing body of research, including randomized controlled trials (RCTs), systematic reviews, and meta-analyses, provides robust evidence for the positive impact of pharmacist-led interventions on adherence and clinical outcomes across a spectrum of chronic diseases.

In cardiovascular diseases, the evidence is particularly strong. Hypertension, a condition often asymptomatic yet requiring lifelong treatment, is highly susceptible to non-adherence. Multiple studies demonstrate that interventions by pharmacists—through repeated counseling, home blood pressure monitoring support, and simplified dosing—significantly improve medication possession ratios (MPR) and adherence scores. Crucially, these improvements consistently translate into statistically significant and clinically meaningful reductions in both systolic and diastolic blood pressure compared to usual care [15, 16]. Similarly, in heart failure management, pharmacist-led counseling as part of multidisciplinary teams has been shown to improve adherence to complex regimens involving diuretics, ACE inhibitors, and beta-blockers. This leads to reduced rates of hospitalization for heart failure exacerbations and improved quality-of-life metrics, as patients better understand the purpose of each medication and the importance of daily weights and sodium restriction [17].

In diabetes mellitus, a condition demanding intricate self-management, pharmacist interventions are highly effective. Counseling that focuses on proper insulin administration technique, the timing of oral medications, sick-day rules, and the interplay between medication, diet, and exercise directly addresses common knowledge gaps. Studies consistently report that such interventions lead to improved adherence, better glycemic control as measured by reduced HbA1c levels, and enhanced patient self-efficacy in diabetes management. Pharmacists in ambulatory care clinics often use counseling sessions to review glucose diaries, identify patterns, and make therapeutic recommendations to the prescribing physician, creating a powerful feedback loop [18, 19].

For chronic respiratory diseases like asthma and COPD, where inhaler technique is a critical determinant of drug delivery and efficacy, pharmacist counseling plays a unique and vital role. Research indicates that a majority of patients use their inhalers incorrectly, severely compromising treatment effectiveness. Pharmacist-led education, involving physical demonstration, "teach-back" methods (where the patient demonstrates the technique), and regular reassessment, dramatically improves technique accuracy. This improvement correlates strongly with better disease control, reduced rescue medication use, fewer exacerbations, and improved lung function parameters. The pharmacist's ability to assess and

correct technique at multiple encounters is a key advantage over sporadic physician visits [20, 21].

Mental health disorders, such as depression and schizophrenia, present profound adherence challenges due to stigma, the nature of the illness (e.g., apathy, anosognosia), and medication side effects. Pharmacist interventions in this domain often involve a strong emphasis on side-effect management, motivational interviewing to address ambivalence, and fostering a trusting, non-judgmental therapeutic alliance. Evidence shows that pharmacist counseling as part of collaborative care models can improve adherence to antidepressants and antipsychotics, leading to better symptom control and reduced relapse rates [22]. Furthermore, in conditions like HIV/AIDS, where near-perfect adherence is required to prevent viral resistance, intensive pharmacist counseling and adherence support are considered standard of care and have been integral to treatment success [23].

5. Components of Effective Pharmacist-Led Medication Counseling

Not all counseling is equally effective. Research and clinical practice guidelines delineate key components that characterize high-impact, patient-centered counseling. The process is iterative and can be conceptualized in phases: Assessment, Education and Goal-Setting, and Follow-up and Monitoring.

The initial **Assessment** phase is diagnostic. It moves beyond the prescription to understand the patient's lived experience. This involves employing open-ended questions and active listening to explore health beliefs (utilizing the HBM), assess health literacy and comprehension, identify practical barriers (cost, access, regimen complexity), evaluate adherence patterns without judgment (e.g., "Many people find it hard to remember their morning pill; has that ever happened to you?"), and screen for untreated side effects or therapeutic failures. For devices like inhalers or injectables, a physical assessment of technique is mandatory. This comprehensive assessment identifies the specific, individualized determinants of non-adherence for that patient [24, 25].

The **Education and Goal-Setting** phase is collaborative and tailored. Information is provided in clear, simple language, avoiding medical jargon. The "teach-back" or "show-me" method is a critical tool to confirm understanding, where the patient explains or demonstrates what they have learned. Education covers the purpose of each medication (naming it and linking it to a symptom or risk), dosing schedule, expected benefits, potential side effects and their management, and practical strategies (e.g., pill organizers, linking medication to daily routines, refill reminders). Crucially, the pharmacist and patient collaboratively set small, achievable, short-term goals (e.g., "This week, let's focus on taking the blue pill with breakfast every day"). This fosters a sense of partnership and ownership. Motivational interviewing techniques, which explore and resolve ambivalence by eliciting the patient's own reasons for change, are highly effective in this phase [26, 27].

The **Follow-up and Monitoring** phase is what sustains change. Effective counseling is not a single encounter. Scheduled follow-up, whether in person, by telephone, or via digital platforms, allows the pharmacist to monitor progress toward goals, reassess adherence and technique, troubleshoot new problems, provide ongoing encouragement, and reinforce positive behaviors. This continuity of care is essential for managing chronic conditions and preventing relapse into non-adherent patterns. Documentation of the counseling provided, the patient's goals, identified problems, and plans in the patient's health record is essential for continuity of care within the healthcare team and for evaluating the impact of the service [28].

6. Challenges and Barriers to Implementation

Despite the compelling evidence, widespread implementation of comprehensive pharmacist-led counseling faces significant hurdles. A primary barrier is the **Economic and Reimbursement** model. In many healthcare systems, particularly in community pharmacy, the pharmacist's revenue is predominantly tied to the product dispensed, not the cognitive service provided. Conducting a 15-20 minute counseling session represents an opportunity cost with no direct financial compensation, creating a powerful disincentive. The sustainability of these services depends on the development of viable payment models, such as direct billing codes for MTM services, value-based contracting, or integration into capitated payment systems [29].

Workflow and Time Constraints in busy practice settings are a major practical challenge. High prescription volume, staffing limitations, and administrative burdens can make it difficult to allocate uninterrupted time for meaningful counseling. This necessitates workflow redesign, the effective use of pharmacy technicians in technical dispensing roles, and the prioritization of counseling for high-risk patients or those with new therapies [30].

Variability in **Pharmacist Training and Confidence** also exists. While all pharmacists

receive education in communication, advanced skills in motivational interviewing, behavioral change theory application, and specific chronic disease management require additional postgraduate training and continuous professional development. Building confidence in these areas is crucial for consistent, high-quality service delivery [31].

Finally, **Interprofessional Dynamics and Collaboration** can be a barrier. Some physicians and other healthcare providers may be unaware of the pharmacist's clinical capabilities or may perceive counseling as an intrusion. Successful integration requires proactive communication, clear definition of roles within collaborative practice agreements, and demonstration of value through shared patient outcomes and effective problem-solving. Building strong, trusting interprofessional relationships is foundational [32].

7. Future Directions

The future of pharmacist-led counseling is poised for further integration and innovation. **Technological Integration** offers tremendous potential. Telepharmacy and video consultations can extend reach to remote or homebound patients. Mobile health (mHealth) applications, SMS reminders, and smart pill bottles with adherence sensors can provide tools for patients and data for pharmacists to monitor and intervene. However, technology should augment, not replace, the essential human connection and personalized support that defines effective counseling [33].

The expansion of **Pharmacist Prescribing Authority and CDTM**, as seen in an increasing number of jurisdictions, will deepen the integration of counseling with clinical management. A pharmacist who can independently initiate or adjust therapy for minor ailments or stable chronic conditions can provide a more seamless and efficient continuum of care, with counseling as the central interactive component [34].

Research must also move beyond simply proving efficacy to defining **Optimal Intervention Models**. Future studies should investigate the cost-effectiveness of counseling services, the specific combinations of techniques (e.g., teach-back plus motivational interviewing) that yield the greatest impact, and the characteristics of patients who benefit most, allowing for targeted resource allocation. Longitudinal studies are needed to understand the sustainability of adherence gains over many years [35].

8. Conclusion:

In conclusion, the management of chronic diseases represents one of the defining healthcare challenges of our time, and medication non-adherence is a critical fault line undermining therapeutic success. Pharmacist-led medication counseling, grounded in behavioral theory and executed as a core component of pharmaceutical care, represents a powerful, evidence-based, and scalable strategy to address this problem. By transitioning from a dispensing role to that of a counselor, educator, and care manager, the pharmacist engages with the patient at the crucial intersection where prescription meets practice. Through personalized assessment, collaborative goal-setting, and sustained follow-up, pharmacists empower patients, optimize medication use, and improve clinical outcomes across a wide range of chronic conditions. Overcoming the implementation barriers related to reimbursement, workflow, training, and collaboration is essential to fully realizing this potential. As healthcare systems globally strive for greater value—better outcomes at sustainable cost—integrating and funding the pharmacist's counseling expertise is not merely an option but a necessity for building more effective, patient-centered, and resilient models of chronic disease care. The evidence clearly indicates that when pharmacists are empowered to counsel, patients are empowered to adhere, and health systems move closer to achieving the full promise of pharmacotherapy in the chronic disease era.

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References

[1] Levin A, Stevens PE, Bilous RW, et al.; Kidney Disease: Improving Global Outcomes (KDIGO)

CKD Work Group. KDIGO 2012 clinical practice guideline for the evaluation and management of chronic kidney disease. Kidney Int Suppl. 2013;3(1):1–150.

[2] Luyckx VA, Tuttle KR, Garcia-Garcia G, et al. Reducing major risk factors for chronic kidney disease. Kidney Int. 2017;7(2):71–87.

[3] Tesfaye WH, McKercher C, Peterson GM, et al. Medication adherence, burden and health-related quality of life in adults with predialysis chronic kidney disease: a prospective cohort study. Int J Environ Res Public Health. 2020;17(1):371.

[4] Parvez MK, Rishi V. Herb-drug interactions and hepatotoxicity. Curr Drug Metab. 2019;20(4):275–282.

[5] Cockwell P, Fisher LA. The global burden of chronic kidney disease. Lancet. 2020;395(10225):662–664.

[6] Anderson LJ, Nuckols TK, Coles C, et al. A systematic overview of systematic reviews evaluating medication adherence interventions. Am J Health Syst Pharm. 2020;77(2):138–147.

[7] Ljung R, Lu Y, Lagergren J. High concomitant use of interacting drugs and low use of gastroprotective drugs among NSAID users in an unselected elderly population: a nationwide register-based study. Drugs Aging. 2011;28(6):469–476.

[8] Kimura H, Tanaka K, Saito H, et al. Association of polypharmacy with kidney disease progression in adults with CKD. Clin J Am Soc Nephrol. 2021;16(12):1797–1804.

[9] Kovesdy CP. Epidemiology of chronic kidney disease: an update 2022. Kidney Int Suppl. 2022;12(1):7–11.

[10] Tangkiatkumjai M, Walker DM, Praditpornsilpa K, Boardman H. Association between medication adherence and clinical outcomes in patients with chronic kidney disease: a prospective cohort study. Clin Exp Nephrol. 2017;21(3):504–512.

[11] Rashid R, Chang C, Niu F, et al. Evaluation of a pharmacist-managed nonsteroidal anti-inflammatory drugs deprescribing program in an integrated health care system. J Manag Care Spec Pharm. 2020;26(7):918–924.

[12] Zhang X, Donnan PT, Bell S, Guthrie B. Non-steroidal anti-inflammatory drug induced acute kidney injury in the community dwelling general population and people with chronic kidney disease: systematic review and meta-analysis. BMC Nephrol. 2017;18(1):256.

[13] Kripalani S, Risser J, Gatti ME, Jacobson TA. Development and evaluation of the Adherence to Refills and Medications Scale (ARMS) among low-literacy patients with chronic disease. Value Health. 2009;12(1):118–123.

[14] Hayward S, Hole B, Denholm R, et al. International prescribing patterns and polypharmacy in older people with advanced chronic kidney disease: results from the European Quality study. Nephrol Dial Transplant. 2021;36(3):503–511.

[15] van Berlo-van de Laar IRF, Sluiter HE, Riet EV, Taxis K, Jansman FGA. Pharmacist-led medication reviews in pre-dialysis and dialysis patients. Res Social Adm Pharm. 2020;16(12):1718–1723.

[16] Schmidt IM, Hubner S, Nadal J, et al. Patterns of medication use and the burden of polypharmacy in patients with chronic kidney disease: the German chronic kidney disease study. Clin Kidney J. 2019;12(5):663–672.

[17] Shivaprasad S, Mateti UV, Shenoy P, Shastry CS, Dharmagadda S. Clinical pharmacists' scope of knowledge for medication therapy management in chronic kidney disease patients. Pharm Educ. 2021;21(1):781–788.

[18] Pai AB. Keeping kidneys safe: the pharmacist's role in NSAID avoidance in high-risk patients. J Am Pharm Assoc. 2015;55(1):e15–23; quiz e24–5.

[19] Griffin BR, Wendt L, Vaughan-Sarrazin M, et al. Nephrotoxin exposure and acute kidney injury in adults. Clin J Am Soc Nephrol. 2023;18(2):163–172.

[20] Al Raiisi F, Stewart D, Fernandez-Llimos F, Salgado TM, Mohamed MF, Cunningham S. Clinical pharmacy practice in the care of chronic kidney disease patients: a systematic review. Int J Clin Pharm. 2019;41(3):630–666.

[21] de Boer IH, Khunti K, Sadusky T, et al. Diabetes management in chronic kidney disease: a consensus report by the American Diabetes Association (ADA) and kidney disease: improving global outcomes (KDIGO). Diabetes Care. 2022;45(12):3075–3090.

[22] United States Renal Data System. USRDS annual data report: epidemiology of kidney disease in the United States; 2022. Available from: https://adr.usrds.org/2022. Accessed August 6, 2023.

[23] Cedillo-Couvert EA, Ricardo AC, Chen J, et al. Self-reported medication adherence and CKD progression. Kidney Int Rep. 2018;3(3):645–651.

[24] Wehling M. Non-steroidal anti-inflammatory drug use in chronic pain conditions with special emphasis on the elderly and patients with relevant comorbidities: management and mitigation of risks and adverse effects. Eur J Clin Pharmacol. 2014;70(10):1159–1172.

[25] Roumeliotis N, Sniderman J, Adams-Webber T, et al. Effect of electronic prescribing strategies on medication error and harm in hospital: a systematic review and meta-analysis. J Gen Intern Med. 2019;34(10):2210–2223.

[26] Britza SM, Byard RW, Musgrave IF. Traditional Chinese medicine-associated nephrotoxicity and the importance of herbal interactions–An overview. Pharmacol Res Mod Chin Med. 2022;3:100099.

[27] van Oosten MJ, Logtenberg SJ, Hemmelder MH, et al. Polypharmacy and medication use in patients with chronic kidney disease with and without kidney replacement therapy compared to matched controls. Clin Kidney J. 2021;14(12):2497–2523.

[28] Khokhar A, Khan YH, Mallhi TH, et al. Effectiveness of pharmacist intervention model for chronic kidney disease patients; a prospective comparative study. Int J Clin Pharm. 2020;42(2):625–634.

[29] Seager JM, Hawkey CJ. ABC of the upper gastrointestinal tract: indigestion and non-steroidal anti-inflammatory drugs. BMJ. 2001;323(7323):1236–1239.

[30] Cypes IN, Prohaska ES, Melton BL. Pharmacist impact on medication dosing and billable coding accuracy in outpatients with chronic kidney disease. J Am Pharm Assoc. 2021;61(2):e153–e158.

[31] Tesfaye WH, Erku D, Mekonnen A, et al. Medication non-adherence in chronic kidney disease: a mixed-methods review and synthesis using the theoretical domains framework and the behavioural change wheel. J Nephrol. 2021;34(4):1091–1125.

[32] Santoro A, Perrone V, Giacomini E, Sangiorgi D, Alessandrini D, Degli Esposti L. Association between hyperkalemia, RAASi non-adherence and outcomes in chronic kidney disease. J Nephrol. 2022;35(2):463–472.

[33] Schutze A, Hohmann C, Haubitz M, Radziwill R, Benohr P. Medicines optimization for patients with chronic kidney disease in the outpatient setting: the role of the clinical pharmacist. Int J Pharm Pract. 2021;29(6):587–597.

[34] Lin MY, Chang MY, Wu PY, et al. Multidisciplinary care program in pre-end-stage kidney disease from 2010 to 2018 in Taiwan. J Formos Med Assoc. 2022;121 Suppl 1:S64–S72.

[35] Macedo E, Bihorac A, Siew ED, et al. Quality of care after AKI development in the hospital: consensus from the 22nd Acute Disease Quality Initiative (ADQI) conference. Eur J Intern Med. 2020;80:45–53.