

A Multidisciplinary Approach to Managing Diabetes Complications: Integrating Internal Medicine, General Practice, Nursing, Physiotherapy, and Dentistry to Improve Patient Clinical Outcomes

Ahmed Mohammed Albalawi¹, Mohammed Abdullah Alghamdi², Sarah Mubarak Abdullah Alquaymi³, Hassan Mohammed Abdullah Thubab⁴, Ahmad Alsanie⁵, Israa Shaker Hassan Al-Sharif⁶, Rahaf Ahmed Ali Almagali⁷, Wed Morad Ahmad Attllah⁸

Abstract

Diabetes mellitus is a chronic, progressive metabolic disorder characterized by persistent hyperglycemia and multisystem involvement. The disease is associated with substantial microvascular, macrovascular, neuromuscular, and periodontal complications that significantly impair quality of life and increase healthcare expenditure. Despite advancements in pharmacotherapy, complication rates remain high, reflecting limitations in fragmented care delivery models. Contemporary evidence increasingly supports multidisciplinary, patient-centered approaches as superior frameworks for managing diabetes and its associated complications. This comprehensive literature review critically examines the integration of Internal Medicine, General Practice, Nursing, Physiotherapy, and Dentistry in the management of diabetes complications. The review synthesizes pathophysiological mechanisms, epidemiological data, discipline-specific contributions, collaborative care frameworks, economic implications, psychosocial determinants, digital health integration, and implementation challenges. Evidence demonstrates that structured multidisciplinary models significantly improve glycemic control, reduce cardiovascular events, enhance functional mobility, decrease hospitalizations, improve periodontal health, and optimize long-term patient outcomes. The findings underscore the necessity of integrated healthcare systems to address the systemic complexity of diabetes and support sustainable improvements in clinical outcomes.

Keywords: *Diabetes Mellitus, Multidisciplinary Care, Internal Medicine, General Practice, Nursing, Physiotherapy, Dentistry, Diabetes Complications, Periodontal Disease.*

Introduction

Diabetes mellitus has emerged as one of the most significant global public health challenges of the twenty-first century. According to the International Diabetes Federation, approximately 537 million adults were living with diabetes in 2021, and this number is projected to rise substantially in the coming decades (International Diabetes Federation [IDF], 2021). The chronic nature of the disease, combined with its systemic complications, imposes an enormous burden on individuals, families, and healthcare systems.

Diabetes is characterized by persistent hyperglycemia resulting from insulin deficiency, insulin resistance, or both. Chronic exposure to elevated glucose levels leads to progressive microvascular complications—including retinopathy, nephropathy, and neuropathy—and macrovascular complications such as coronary artery disease, cerebrovascular disease, and peripheral arterial disease. Additionally, diabetes contributes to musculoskeletal dysfunction, sarcopenia, impaired mobility, and periodontal disease. These complications frequently coexist and interact, amplifying morbidity and mortality.

¹ Bachelor of Physiotherapy, Armed Forces Hospital Wadi Aldawaser.

² Bachelor of Physiotherapy, Armed Forces Hospital Wadi Aldawaser

³ Technician dental assistant, Primary Health Center North Alkhars, Al-Hassa Health Cluster, Al-Hassa, Saudi Arabia

⁴ General Practice, King Fahd Central Hospital in Jazan

⁵ Internal Medicine, King Salman Hospital First Cluster, Riyadh, Saudi Arabia

⁶ Nursing, University Medical Clinic in Al-Zaher, Umm Al-Qura University, Mecca Al-Makrama, Saudi Arabia

⁷ Nursing, Khamis Mushait Hospital, Abha Maternity Hospital, Asir Cluster, Abha, Saudi Arabia

⁸ Registered Nurse, King Abdulaziz University, University Medical Services Center in Female Campus, Jeddah, Saudi Arabia

Despite pharmacological advances, including SGLT2 inhibitors and GLP-1 receptor agonists with proven cardiovascular benefits (Zinman et al., 2015; Marso et al., 2016), many patients fail to achieve durable glycemic control or optimal risk reduction. Fragmented care models that isolate disciplines limit the capacity to address the multifactorial nature of diabetes complications. Increasingly, multidisciplinary approaches integrating Internal Medicine, General Practice, Nursing, Physiotherapy, and Dentistry are recognized as essential to improve long-term outcomes (Tricco et al., 2012).

This review critically synthesizes evidence supporting multidisciplinary integration in the management of diabetes complications and evaluates its impact on clinical outcomes.

Epidemiology and Global Burden

The prevalence of diabetes continues to increase globally. The IDF (2021) reports that one in ten adults worldwide lives with diabetes. Cardiovascular disease remains the leading cause of death among individuals with diabetes, accounting for approximately half of all mortality cases (American Diabetes Association [ADA], 2023).

Diabetic nephropathy is a leading cause of end-stage renal disease, while diabetic retinopathy remains a primary cause of preventable blindness. Peripheral neuropathy significantly contributes to ulceration and lower limb amputation. Hospitalization rates among individuals with diabetes are markedly higher than among non-diabetic populations.

The economic burden is substantial. Direct medical costs include hospital admissions, dialysis, cardiovascular interventions, and long-term pharmacotherapy. Indirect costs arise from productivity loss and disability. Many complications, however, are preventable through comprehensive and coordinated care.

Pathophysiological Basis of Complications

Chronic hyperglycemia activates multiple damaging biochemical pathways. Brownlee (2005) described a unifying mechanism involving increased oxidative stress, advanced glycation end product formation, polyol pathway activation, and protein kinase C activation. These mechanisms promote endothelial dysfunction, a central contributor to both microvascular and macrovascular complications. Systemic inflammation plays a pivotal role. Elevated cytokines such as tumor necrosis factor- α and interleukin-6 contribute to insulin resistance and vascular injury. These inflammatory mediators are also implicated in periodontal tissue destruction, establishing a biological link between oral health and glycemic control (Preshaw et al., 2012). Neuropathy and musculoskeletal dysfunction arise from metabolic injury to peripheral nerves and reduced microvascular perfusion, leading to impaired sensation, balance disturbances, and functional decline. The interconnected nature of these mechanisms supports integrated management strategies.

Role of Internal Medicine

Internal Medicine occupies a central and coordinating position in the multidisciplinary management of diabetes and its systemic complications. Given the complex metabolic, cardiovascular, renal, and neurological sequelae of chronic hyperglycemia, internists are uniquely positioned to provide comprehensive risk stratification, pharmacological optimization, and longitudinal complication surveillance. Their role extends beyond glycemic regulation toward integrated cardiometabolic risk reduction and prevention of end-organ damage. Intensive glycemic control has long been recognized as a cornerstone of complication prevention. The landmark trial conducted by the UK Prospective Diabetes Study Group (1998) demonstrated that improved glycemic control significantly reduced microvascular complications, including retinopathy and nephropathy. Subsequent long-term follow-up data confirmed a “legacy effect,” whereby early metabolic optimization confers sustained vascular protection.

However, contemporary diabetes management emphasizes multifactorial intervention rather than glucose-centric treatment alone. The American Diabetes Association (2023) highlights the importance of comprehensive cardiovascular risk management, including blood pressure control, lipid modification,

antiplatelet therapy, and weight management. Internal Medicine specialists integrate these domains through individualized pharmacotherapy, often combining renin–angiotensin–aldosterone system inhibitors, statins, and antithrombotic agents to mitigate macrovascular complications. Modern glucose-lowering agents have further transformed internal medicine practice. Sodium–glucose cotransporter-2 (SGLT2) inhibitors and glucagon-like peptide-1 (GLP-1) receptor agonists provide cardiovascular and renal protection beyond glycemic lowering. In the EMPA-REG OUTCOME trial, empagliflozin significantly reduced cardiovascular mortality in individuals with type 2 diabetes and established cardiovascular disease (Zinman et al., 2015). Similarly, liraglutide demonstrated reductions in major adverse cardiovascular events in the LEADER trial (Marso et al., 2016). These findings underscore the expanding therapeutic scope of Internal Medicine toward cardioprotective endocrinology.

Internists also play a pivotal role in early identification and management of diabetic nephropathy through annual albuminuria screening and estimated glomerular filtration rate (eGFR) monitoring. Early renoprotective intervention delays progression to end-stage renal disease. Likewise, neuropathy assessment—including monofilament testing and autonomic evaluation—allows timely referral to physiotherapy and podiatric services, reducing ulceration and amputation risk.

Acute metabolic emergencies, including diabetic ketoacidosis and hyperosmolar hyperglycemic state, require rapid internal medicine intervention. Effective inpatient management and structured discharge planning reduce readmissions and improve post-acute outcomes. Thus, Internal Medicine provides the metabolic and cardiovascular backbone of multidisciplinary diabetes care, functioning as both a clinical leader and a systems integrator.

Role of General Practice

General Practice represents the frontline of diabetes detection, prevention, and long-term continuity of care. Unlike episodic specialist consultations, primary care delivers sustained patient engagement across the disease trajectory, from prediabetes identification to advanced complication management. Early detection is fundamental to reducing disease burden. Prediabetes is often asymptomatic yet strongly predictive of progression to type 2 diabetes (Tabák et al., 2012). General Practitioners (GPs) conduct opportunistic screening in high-risk populations, enabling early lifestyle intervention and pharmacologic prevention strategies.

Continuity of care has emerged as a critical determinant of improved outcomes. A large cohort analysis by Barker et al. (2017) demonstrated that stronger relational continuity in primary care was associated with significantly reduced emergency hospital admissions. Sustained therapeutic relationships enhance trust, medication adherence, and early symptom reporting, thereby preventing acute deterioration.

Primary care physicians coordinate routine complication screening, including:

- Annual retinal examinations
- Urinary albumin testing
- Comprehensive foot assessments
- Cardiovascular risk profiling

By integrating electronic health records and structured recall systems, General Practice ensures that patients do not fall through gaps in surveillance.

Additionally, GPs manage multimorbidity, which is highly prevalent among individuals with diabetes. Hypertension, obesity, dyslipidemia, depression, and chronic kidney disease frequently coexist. Holistic management reduces treatment fragmentation and therapeutic duplication. Vaccination adherence—including influenza, pneumococcal, and hepatitis B immunizations—is another critical preventive role of

primary care. Infection-related morbidity is elevated in diabetic populations; proactive immunization reduces hospitalization risk.

Importantly, General Practice serves as the gateway to multidisciplinary referral. Timely coordination with Internal Medicine, Nursing services, Physiotherapy, and Dentistry enhances comprehensive care delivery.



Figure 1. Conceptual Framework of Multidisciplinary Diabetes Care

Role of Nursing

Nursing professionals are central to patient education, behavioral modification, and self-management support—domains that directly influence long-term metabolic control. The American Diabetes Association (2023) identifies Diabetes Self-Management Education and Support (DSMES) as an evidence-based, structured intervention essential at diagnosis and during major therapeutic transitions. Meta-analytic evidence indicates that DSMES interventions significantly reduce HbA1c levels, particularly when delivered through interactive, patient-centered formats (Chrvala et al., 2016). Nurses translate complex medical recommendations into practical daily routines, empowering patients to perform glucose monitoring, insulin titration, carbohydrate counting, and symptom recognition.

Behavioral science principles underpin effective nursing interventions. Motivational interviewing techniques enhance intrinsic motivation and adherence, while structured goal-setting improves lifestyle sustainability. Education on medication timing, injection technique, and hypoglycemia prevention reduces acute complications. Nurses also conduct foot care education and routine inspection, critical for preventing ulceration. Given that peripheral neuropathy may impair protective sensation, patient instruction in daily foot surveillance is essential to amputation prevention.

Psychosocial support is another core nursing contribution. Diabetes distress, depression, and burnout negatively influence self-care behaviors. Early screening and referral mitigate these risks and improve overall treatment engagement. Through continuous patient interaction, nursing professionals serve as both educators and advocates within the multidisciplinary team.

Role of Physiotherapy

Physical inactivity is a major modifiable determinant of insulin resistance, cardiovascular disease, and functional decline. Exercise enhances skeletal muscle glucose uptake via insulin-independent pathways,

improving glycemic control and cardiometabolic fitness. A systematic review and meta-analysis by Umpierre et al. (2011) demonstrated that structured exercise training significantly reduced HbA1c levels, particularly when programs exceeded 150 minutes per week. Consistent with these findings, the World Health Organization (2020) recommends at least 150 minutes of moderate-intensity physical activity weekly for adults with chronic diseases.

Physiotherapists design individualized exercise prescriptions that account for neuropathy, cardiovascular status, musculoskeletal limitations, and obesity. Resistance training counteracts sarcopenia, which is increasingly recognized as a complication of long-standing diabetes. Improved muscle mass enhances metabolic efficiency and physical independence. Balance training and gait correction are particularly important in patients with peripheral neuropathy. Sensory deficits increase fall risk; targeted rehabilitation reduces injury incidence and preserves mobility.

Post-amputation rehabilitation further highlights the importance of physiotherapy within multidisciplinary frameworks. Early mobilization, prosthetic training, and strengthening programs facilitate reintegration into daily life and reduce long-term disability. Through functional restoration, physiotherapy addresses the mobility dimension of diabetes complications, complementing metabolic management.

Role of Dentistry

Periodontal disease is increasingly recognized as the “sixth complication” of diabetes due to its bidirectional relationship with glycemic control. Chronic hyperglycemia impairs neutrophil function, increases inflammatory cytokine production, and alters collagen metabolism, rendering periodontal tissues more susceptible to infection and destruction (Preshaw et al., 2012). Conversely, chronic periodontal inflammation contributes to systemic insulin resistance through elevated circulating inflammatory mediators. This reciprocal relationship underscores the importance of oral health within integrated diabetes management.

A Cochrane systematic review found that non-surgical periodontal therapy resulted in modest but statistically significant reductions in HbA1c at three to four months post-treatment (Simpson et al., 2015). Although the magnitude of reduction is moderate, even small improvements in HbA1c translate into meaningful reductions in complication risk. Dentists contribute to early detection of poorly controlled diabetes through recognition of xerostomia, candidiasis, delayed wound healing, and recurrent periodontal abscesses. Referral to primary care following suspicious findings facilitates earlier diagnosis.

Preventive education—including oral hygiene instruction, smoking cessation counseling, and routine scaling—reduces inflammatory burden. Integration of dental records within shared health systems enhances communication and interdisciplinary coordination. Recognition of oral-systemic health interconnections reinforces the necessity of including Dentistry within comprehensive diabetes care models.

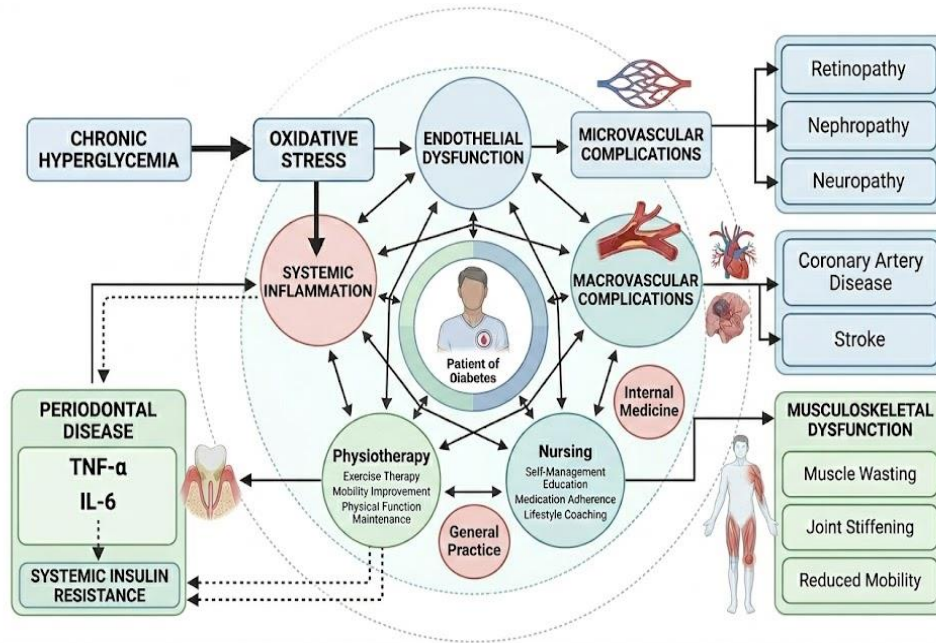


Figure 2. Pathophysiological Pathways Linking Diabetes to Multisystem Complications

Discussion

The findings synthesized in this review provide compelling evidence that multidisciplinary integration represents not merely an enhancement to diabetes care but a structural necessity. Diabetes mellitus is a chronic, multisystem disease characterized by complex interactions among hyperglycemia, oxidative stress, endothelial dysfunction, systemic inflammation, and behavioral determinants. These interconnected mechanisms generate overlapping microvascular, macrovascular, neuromuscular, and periodontal complications that cannot be effectively addressed through isolated specialty interventions. Consequently, fragmented models of care are inherently limited in their capacity to achieve durable clinical outcomes.

A central theme emerging from the literature is the inadequacy of glucose-centric management paradigms. Although intensive glycemic control reduces microvascular complications, macrovascular risk is more profoundly influenced by multifactorial cardiometabolic management (American Diabetes Association, 2023). Internal Medicine contributes advanced pharmacological strategies, including SGLT2 inhibitors and GLP-1 receptor agonists, which confer cardiovascular and renal protection beyond glycemic reduction (Zinman et al., 2015; Marso et al., 2016). However, medication efficacy is highly dependent on adherence, lifestyle behavior, and early symptom recognition—domains strongly influenced by nursing and primary care continuity. Thus, pharmacotherapy and behavioral reinforcement function synergistically rather than independently.

Continuity of care emerges as a critical structural determinant of improved outcomes. Longitudinal primary care engagement reduces hospital admissions and enhances preventive screening adherence (Barker et al., 2017). In the absence of coordinated primary care oversight, patients frequently experience delayed referrals, missed complication screening, and inconsistent follow-up. General Practice therefore operates as a stabilizing axis within multidisciplinary networks, ensuring temporal coherence in care delivery.

Table 1. Multidisciplinary Roles and Clinical Outcomes in Diabetes Management

Discipline	Core Responsibilities	Mechanism of Impact	Clinical Outcomes
Internal Medicine	Advanced pharmacotherapy, cardiovascular risk management, complication surveillance	Multifactorial cardiometabolic control	Reduced CVD events, delayed nephropathy progression

General Practice	Continuity of care, screening, referral coordination	Early detection and sustained engagement	Reduced hospital admissions, improved adherence
Nursing	DSMES, behavioral counseling, psychosocial support	Enhanced self-management capacity	Lower HbA1c, fewer acute complications
Physiotherapy	Exercise prescription, mobility rehabilitation	Improved insulin sensitivity, muscle metabolism	Reduced falls, improved functional independence
Dentistry	Periodontal therapy, infection control	Reduced systemic inflammatory burden	Improved glycemic control, reduced oral complications

The integration of nursing services further strengthens metabolic control through structured Diabetes Self-Management Education and Support (DSMES). Behavioral interventions grounded in adult learning theory and motivational interviewing significantly reduce HbA1c levels and improve medication adherence (Chrvala et al., 2016). Importantly, DSMES addresses psychosocial determinants such as diabetes distress, depression, and health literacy—factors that strongly predict long-term complication risk. Without sustained self-management competence, even the most advanced pharmacologic regimens fail to achieve optimal effectiveness.

Physiotherapy contributes a mechanistic and functional dimension often underemphasized in traditional diabetes models. Physical inactivity exacerbates insulin resistance, endothelial dysfunction, and sarcopenia. Exercise enhances skeletal muscle glucose uptake via insulin-independent pathways, improves mitochondrial efficiency, and reduces systemic inflammation (Umpierre et al., 2011). Furthermore, neuropathy-related gait abnormalities increase fall risk and subsequent hospitalization. Targeted physiotherapy mitigates these risks and preserves functional independence. By improving mobility, physiotherapy also indirectly enhances psychological well-being and self-efficacy, reinforcing behavioral adherence.

Table 2. System-Level Benefits of Multidisciplinary Integration

Outcome Domain	Impact of Integrated Care
Glycemic Control	Significant HbA1c reduction
Cardiovascular Risk	Improved BP and lipid profiles
Hospitalization	Reduced emergency admissions
Amputation Rates	Lower incidence of diabetic foot complications
Quality of Life	Enhanced physical and psychosocial well-being
Economic Impact	Long-term cost savings through complication prevention

Dentistry provides an essential but frequently overlooked component of integrated diabetes management. Periodontal inflammation contributes to systemic cytokine release, which exacerbates insulin resistance and endothelial dysfunction (Preshaw et al., 2012). Evidence demonstrates that periodontal therapy produces modest but clinically meaningful reductions in HbA1c (Simpson et al., 2015). Although the magnitude of glycemic improvement may appear moderate, even a 0.4% reduction in HbA1c is associated with significant decreases in microvascular risk. The bidirectional relationship between diabetes and periodontal disease exemplifies the necessity of expanding chronic disease management beyond traditional medical silos.

System-level analyses further support multidisciplinary integration. A meta-analysis of quality improvement strategies in diabetes demonstrated that team-based care significantly improved glycemic, blood pressure, and lipid outcomes compared with usual care (Tricco et al., 2012). These improvements were most pronounced when interventions combined patient education, clinician decision support, and organizational restructuring—indicating that structural redesign is as important as clinical expertise.

Economic evaluations provide additional justification. While multidisciplinary programs may initially require greater resource allocation—particularly in workforce expansion and electronic health infrastructure—long-term cost savings are achieved through reduced hospital admissions, fewer amputations, delayed renal replacement therapy, and decreased cardiovascular events. Prevention of a single lower-limb amputation or myocardial infarction offsets substantial healthcare expenditure. Therefore, integrated care models should be interpreted as investments in complication prevention rather than short-term cost burdens.

Despite robust evidence, implementation barriers remain substantial. Workforce shortages, particularly in primary care and specialized diabetes nursing, constrain scalability. Fragmented reimbursement systems often incentivize episodic specialist consultations over coordinated team-based management. Limited interprofessional education during professional training further impedes collaborative practice readiness. Policy reform must therefore address financing structures, shared electronic health records, and interdisciplinary training frameworks.

Conclusion

Diabetes mellitus is a chronic, progressive, multisystem disorder whose complications arise from complex interactions among metabolic dysregulation, vascular injury, inflammation, and behavioral determinants. Management strategies focused solely on glycemic reduction are insufficient to address the breadth and interconnectedness of these pathophysiological processes. This review demonstrates that structured integration of Internal Medicine, General Practice, Nursing, Physiotherapy, and Dentistry provides a comprehensive framework capable of addressing the full spectrum of diabetes-related complications.

Each discipline contributes a distinct yet complementary domain of expertise. Internal Medicine delivers advanced cardiometabolic risk reduction and complication surveillance. General Practice ensures longitudinal continuity and early detection. Nursing empowers patients through self-management education and psychosocial support. Physiotherapy preserves functional capacity and mitigates disability. Dentistry reduces chronic inflammatory burden and strengthens systemic metabolic control. The collective effect of these coordinated contributions exceeds the sum of individual interventions.

Evidence consistently indicates that multidisciplinary care improves glycemic control, reduces cardiovascular events, lowers hospitalization rates, prevents amputations, enhances mobility, and improves quality of life (Tricco et al., 2012). Moreover, economic analyses suggest that complication prevention achieved through integrated care yields long-term cost savings for healthcare systems. However, realizing these benefits requires structural commitment. Health systems must invest in shared electronic health infrastructure, interprofessional education, sustainable reimbursement models, and workforce development. Policymakers should prioritize multidisciplinary chronic disease frameworks within national health strategies, consistent with recommendations from the World Health Organization (2020).

Future research should focus on implementation science methodologies to determine optimal integration models across diverse healthcare settings. Comparative effectiveness studies evaluating different team configurations may further refine best practices. In conclusion, multidisciplinary integration is not merely advantageous but essential for addressing the escalating global burden of diabetes complications. Coordinated, patient-centered frameworks represent the most evidence-based pathway toward improving clinical outcomes, preserving functional independence, and achieving sustainable healthcare delivery in the era of chronic disease predominance.

Digital health technologies may facilitate integration. Shared registries, telemonitoring systems, and electronic referral pathways improve communication efficiency and reduce duplication of services. However, technology must complement rather than replace relational continuity. Importantly, equity considerations must be integrated into multidisciplinary frameworks. Diabetes disproportionately affects socioeconomically disadvantaged populations, who often experience limited access to coordinated services. Multidisciplinary care models must incorporate culturally competent education, community outreach, and affordability strategies to prevent widening disparities.

In synthesis, multidisciplinary diabetes management represents a systems-based response to a systems-based disease. The interdependence of metabolic, behavioral, inflammatory, and functional processes necessitates coordinated intervention across specialties. The strongest outcomes arise when integration is structured, protocol-driven, and supported by institutional policy.

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