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The Intersection of Herbal Medicine and Public Health Policy in Diabetes Management

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ABSTRACT

Diabetes mellitus (DM), particularly Type 2 diabetes mellitus (T2DM), continues to pose a global public health crisis due to its rising prevalence, associated complications, and treatment costs. While modern pharmacological interventions dominate current diabetes management strategies, herbal medicine has re-emerged as a potentially complementary or alternative approach, especially in resource-constrained settings and among culturally diverse populations. This paper examines the intersection of herbal medicine and public health policy in the context of diabetes care. It examines the historical and contemporary use of herbal treatments, evaluates regulatory and policy frameworks in the United States and other contexts, and highlights cultural perspectives and research gaps. By analyzing challenges in integrating herbal medicine into formal healthcare systems, ranging from safety concerns to lack of standardization, this study advocates for collaborative frameworks that include both herbal practitioners and biomedical health professionals. The paper concludes by emphasizing the need for policy reforms, inclusive research, and culturally competent care to ensure equitable, safe, and effective diabetes management strategies for all populations.

Keywords**:** Herbal medicine; diabetes mellitus; Type 2 diabetes; public health policy; traditional medicine; integrative healthcare; regulatory frameworks.

INTRODUCTION

Diabetes mellitus (DM) is one of the most serious public health problems in the world. In 2015, the prevalence of diabetes was estimated at 415 million adults (20–79 years) worldwide, including 29.1 million Americans aged 18 years or older (9.3%). It is estimated that the number of adults living with diabetes will increase to 642 million in 2040. Diabetes and its sequelae impose an enormous health burden; direct medical costs for treating and managing diabetes in the US are projected to exceed $245 billion annually, resulting in additional indirect costs of $69 billion for disability, loss of productivity, and premature mortality. Under the pressure of rising treatment costs, there is a strong public demand for safety, efficacy, and cost-effectiveness of diabetes management strategies. T2DM is a metabolic disorder that is characterized by chronic hyperglycemia and is caused by a combination of insulin resistance and inadequate insulin secretion. The T2DM management algorithm recommends individualized strategies designed to effectively reduce glycemia while considering patient-specific values and treatment-related factors. In general, there are two broad strategies for the management of T2DM: traditional modern medicine (TMM) and Chinese medicine (TCM). TMM has been thoroughly researched and comprises both pharmacologic and lifestyle interventions. The TMM algorithm similarly empowers health care providers and patients at different levels with a range of therapeutic options. However, multiple agents are frequently needed to achieve target glycemia. Because of drug costs, the burden of diabetes management expenses incurred by individuals with T2DM in the US has escalated, impacting adherence to prescribed treatment. In contrast, the herbal supplements or dietary supplements commonly perceived as a viable alternative to prescription medications are largely unregulated as marketed products in the US. The great majority of these products are largely lacking scientific evidence of the safety and efficacy

of the advertised claims. Meanwhile, any potential health benefits can accompany widely varying ingredient concentrations, rigorous product-quality issues, or adverse herb-drug interactions [1, 2].

Overview of Herbal Medicine

Herbal medicine utilizes plants intended for medicinal purposes to create products or pharmacopeia of compounds containing active ingredients. Use of herbal medicine for preventive, curative, or palliative purposes that exceed food or medicinal use is termed herbal drugs or phytopharmaceuticals. Medicinal use of herbal medicine in the treatment and prevention of diseases, including diabetes, has a long history compared to conventional medicine. The word herb generally refers to non-woody plants or parts, but it can also apply to roots, bark, seeds, and flower parts. Commonly used medicinal plants can be divided into two major groups, angiosperms and gymnosperms. Plants are the main source of medicines that are used worldwide. An adequately designed system for herbal medicines in diabetes is lacking. Diabetes mellitus is a major public health concern worldwide. There are 415 million individuals (8.8% of the total global adult population) currently living with diabetes, and this number is expected to rise to nearly 642 million by 2040. Diabetes is a chronic metabolic disorder characterized by persistent hyperglycemia or uncontrolled diabetes that can cause serious complications, including kidney disease, vision loss, and cardiovascular disease. Overall, an estimated 300 billion dollars in annual medical costs are incurred as a result of diabetes in the US, and are projected to increase to an alarming 580 billion dollars by 2030. Preventive management of diabetes consists of dietary restrictions, exercise, and maintaining a healthy body weight. Oral medicines are usually prescribed for diabetes not controlled via the aforementioned lifestyle modifications. In case of sustained risk for acute complications such as vaginal candidiasis, ketoacidosis, or hyperglycemic hyperosmolar state, exogenous insulin is prescribed. Many combinations and prolonged actions of these medicines are available and custom-made to meet an individual's drug profile [3, 4].

Public Health Policy Framework

An assortment of State and Federal policies form the framework of diabetes management in the US, which focuses primarily on the healthcare infrastructure. These public health policies and their implications will be assessed in the context of Type II diabetes prevention interventions. The lack of synergistic cooperation between herbal medicine proponents and policy-makers has led to unequal access for patients seeking cheaper, less invasive alternatives to treatment. The adoption of herbal medicine in present policies is thwarted by a myriad of reasons, including the non-inclusion of herbal medicine under the rubric of diabetes management, lack of funding for further development studies, and misconceptions that have reduced the efficacy of herbal medicine. Public health policies to manage diabetes encompass a variety of components, ranging from screening, surveillance, and education to development and distribution schemes. The added benefit of diversifying any of these components with a herbal medicine perspective would be to ensure equal access to safe and effective modes of management [5, 6].

The Role of Herbal Medicine in Diabetes

Diabetes is a chronic metabolic disorder characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. The diabetes prevalence is predicted to double to about 366 million by the year 2030. Diabetes is the leading cause of nontraumatic lower limb amputations, blindness, and end-stage renal disease. It poses a large economic burden on health systems and societies as a whole. Permanent loss of metabolic control can lead to acute fatal complications such as diabetic ketoacidosis and coma due to an increase in blood glucose. The damage to blood vessels can lead to macrovascular complications such as myocardial infarction, stroke, coronary artery disease, and peripheral vascular disease. Different categories of antidiabetic medications, such as biguanides, sulphonylureas, alpha-glucosidase inhibitors, thiazolidinediones, amylin analogs, and incretin analogs, are available for managing diabetes. The discovery of new classes such as GLP-1 receptor agonists and DPP-4 inhibitors has prolonged the utility of insulin. The preventive effects of some antidiabetic medications in the development of cardiovascular and renal complications associated with diabetes mellitus have also been proven. Nevertheless, the long-term treatment with antidiabetic drugs leads to unwanted side effects, resulting in an increase in the rate of morbidity and death. This treatment gap leads to the tremendous demand for efficacious and safe agents at a cheaper cost. Diabetes is not a new disease, and it has been known for ages. Traditional healers have been using herbal remedies to treat diabetes, and several newly formulated herbal remedies are claimed to reduce blood glucose levels and control diabetes. It has garnered much interest among diabetic patients. However, the selection of the herbs depends on several factors such as availability, affordability, safety profile, comorbidities, and the stage of diabetes. Diabetes care is still a big problem in a developing country like Nigeria, particularly among rural dwellers.

Moreover, the diabetes drug cost after treatment complications is expected to be higher than 5% of the total annual cost of living [7, 8].

Current Public Health Policies on Diabetes

Public policy attitudes about diabetes health promotion in Canada and the United States were assessed. The attitude statements and the allied responses were analyzed by country and respondent demographics, and contextual variables to explore differences in groups. Diabetes afflicted people were also interviewed to share their food and health beliefs, including the degree of skepticism of public health messages. The demographic and contextual variables were also explored in regards to possible influences on health beliefs and skepticism. From the formative research with affected people, three beliefs emerged: culturally-rooted food has essential health-giving properties; softened authentic cultures imperil food beliefs and more-general health; education and research reflect the dominant status quo of Western knowledge and culture. More skeptically viewed participants expressed dislike or mistrust of public health people and messages, media, and some industry, science, and food company messages. However, they thought public health research was important, and key informants in Montréal also acknowledged it in shaping food knowledge-sharing. In the sense of broader beliefs, skepticism about diabetes control and prevention messages was evident across public policy respondents, extending to skepticism about public health people, policy actions, certain foods, food companies, industry product claims, social media, and transnational corporations/companies. Privacy protection of actionable messaging and messengers was an issue. Key informants expressed narrower skepticism about the involvement of lifeworld-addressing, anthropological consultation in connection with public health research framing and design [9, 10].

Integration of Herbal Medicine into Public Health

This paper discusses the need for herbal medicine to be recognized as part of Kenya's national public health policy. Healthcare systems in developing nations are under pressure from the escalating costs of conventional treatments as patient populations expand. The continual effectiveness of pharmaceutical medications for chronic lifestyle diseases is brought into question as local ethnomedical traditions develop among growing client bases. A strong case can be made for adapting important herbal formulations for diabetes mellitus and recognizing their continued availability within public primary healthcare systems. Well-studied medicinal plants can resecure effective ethnomedicines for underserved populations. Two illustrative cases indicate that primary healthcare pharmacists can safely dispense such herbal products based on comparative safety profiles. Ethnomedical drugs are currently of interest in discovering new leads for drug development. New medications and herbal medicines are compared to target diabetes mellitus risk factors. Herbal products are being increasingly used against this widespread chronic illness despite unclear actions and safety problems. Acquaintance with contemporary management principles is fundamental for the realization of public health aspirations, people's well-being, and quality issues. It calls for verification of transactive knowledge management, continually to minimize complications of illness under culture-based tenets of existence – a prime motive of practice. To harmonize herbal trade across groups, the localizers' concerns need to be addressed. A bottom-up approach can relieve herbal use concerns through verification of the compatibility of traditional and modern scientific tenets of bioactivity. This will make effective herbal wisdom available in a usable form for critical health accommodation and address concerns about possible negative implications of herbal products on healthcare and public awareness standards [11, 12].

Regulatory Framework for Herbal Products

Distribution of herbal products may require rigorous requirements, including assessments for safe use in specific target populations. The shortcomings of regulatory frameworks around the world limit consumer understanding of the safety information available regarding herbal products. Regulatory frameworks also limit.. Herbal medicine is promoted as a safe alternative to pharmaceuticals and potential for self-medication. There is a risk of potential danger in over-the-counter herbal products. Marketed over-the-counter herbal products may not contain validated safety information for use in diabetes. Safety information provided with these herbal remedies may be incomplete. Assess the availability and completeness of safety information provided with OTC herbal products for use in diabetes. The presence of commercially available products for diabetes was evaluated in a recent cross-sectional study on herbal products. The experiment used criterion-based sampling for acquiring products. There is an increase in over-the-counter (OTC) herbal products for use in diabetes mellitus. Content validity regarding the risk of use, directions for use, adverse events, dose, contraindications, and interactions of OTC herbal products intended for use in diabetes. There is a risk of potential danger in OTC herbal products. There is a lack of knowledge regarding the safe use. Safety information provided with commercially available over-the-

counter (OTC) herbal products may be incomplete. There is a lack of knowledge regarding the overdose of commercial herbal products. The commercial herbal products marketed for use in diabetes contain important safety information. The raw herbal material, manufacturing considerations, and quality assurance may be more pertinent. There exists valid data on the safe use of herbal extracts. The bioavailability and optimal content of single active principles may not be known. Most herbal products marketed in industrialized countries are derived from complex mixtures. In Western countries, safety studies may have been scanty and expensive. For safety studies in retrospective meta-analyses of herb-induced liver injury, costs may be prohibitive. The recent focus on quality control of single herb extracts is likely to have limited impact on quality control of complex herbal products [13, 14].

Cultural Considerations in Herbal Medicine

African immigrants suffer from diabetes at a higher prevalence than other immigrant groups. Yet, some African populations have a lower incidence of diabetes, and management is often through traditional medicine, which has not been investigated in-depth in the US, especially regarding herbal supplements. Though other ethnicities have been studied, African culture has often been left out of investigations into the prevalence of diabetes management strategies. In the US, the adoption of over-the-counter medication from all parts of the world has increased, yet few studies have considered how this relates to diabetes management strategies for African populations new to America. African Traditional Medicine (ATM) has not only management strategies for diabetes, but culturally-embedded formulations of ATM herbal supplements might not have been investigated for safety, regulatory scrutiny, or evidence of efficacy. Exploiting this gap in diabetes management research, syntheses of the Pima community's (American Indian Tribe) T2DM management strategies, the history of diabetes in the Pima community, and studies of ATM practices for management of T2DM will widen the awareness of T2DM management options and augment its management in the African immigrant community. Grounded and culturally-relevant questions guide the inquiry: RQ1 - What practices for the management of T2DM does the Pima community employ? RQ2 - What ATM strategies do Africans in America employ to manage T2DM? RQ3 - How do ATM formulations/treatments relate to organic regulatory scrutiny, and the E.P.A. and F.D.A.'s investigations for safety? RQ4 - Which ATM management options are being studied through E.U. and 0 U.S.D.D. trials for efficacy? Compounding a dearth of literature, T2DM prevalence in African immigrants and the historically racialized interactions with Western medicine render this issue timely and necessary. Insights into ATM practices with diabetes management will intensify the praiseworthy efforts of the American diabetes Association and World Health Organization to address T2DM on a worldwide scale [15, 16].

Collaboration between Herbal Practitioners and Health Authorities

Collaboration between herbal practitioners and health authorities is essential for safe herbal medicine use in diabetes management and understanding patients' experiences. This partnership fosters adherence to guidelines encouraging cooperation among healthcare planners, authorities, and herbal practitioners. Such collaboration aids comprehension of regulations and timely sharing of herb-related information while enabling health authorities to access practitioners' expertise. Herbal medicine experts can join relevant committees to guide the development of herbal medicine-related guidelines, including health claims and access restrictions. Local practitioners and researchers can support investigations into herbal fraud, harmful substances, and adverse reactions, with successful mechanisms already in place in various countries. Engaging herbal practitioners in dialogue can enhance safety messaging, as health education is more effective when developed collaboratively. Public consultations serve to educate and address local concerns. Established herbal societies can facilitate communication with practitioners, and compliant herbal practitioners can receive training to improve herb quality control and patient assistance. Their involvement can enhance public health education programs by optimizing timing and channels for messages. Understanding local experiences with diabetes and herbal medicine can be enriched through collaboration with practitioners, boosting response rates and credibility in research. Training in focus groups and interviews can further improve data collection. Herbal practitioners can recommend suitable participants and contact methods. Sharing participant feedback with health authorities fosters credibility, aiding in the understanding of local perceptions and guiding health education efforts. Strengthening communication ensures that patients receive accurate, empowering information for safer herbal medicine use. Research evaluating patients' experiences will foster trust and dialogue between practitioners and health authorities [17, 18].

Research Gaps and Future Directions

Research on herbal medicine, public health policy, and diabetes in the USA is limited, focusing mainly on herbal use for disease prevention and management. The existing studies have not examined the implications of herbal medicine for health policy, creating a significant gap. Understanding how traditional practices intersect with the biomedical model reveals challenges and opportunities for integrating such complementary practices into public health policy, potentially improving health outcomes in diabetes. The integration of herbal medicine into health policy for diabetes remains largely unexplored. Future research should gather insights from herbal practitioners and public health policymakers on integration possibilities and challenges. These insights can help create a nuanced policy framework that addresses the diabetes epidemic through training traditional practitioners for interaction and regulating herbal products for safety and efficacy. There is a pressing need for exploratory research on herbal medicine's role in diabetes across different national contexts. Rigorous qualitative and ethnographic studies can reveal insights into herbal medicine's contributions to diabetes management within broader societal dynamics. Well-designed studies are necessary to uncover the context, mechanisms, and impacts of herbal medicine use in diabetes care. Without a comprehensive understanding of traditional medicine practices, production, regulation, and their ties to governance and power dynamics, efforts to reform public health policy to integrate herbal medicine for diabetes may falter [19, 20].

Patient Perspectives on Herbal Medicine

Around 90% of herbal medicine is recognized by doctors, though many lack sufficient information on its usage. Both patients and physicians underutilize this knowledge, and while most patients accept herbal medicine, 85% do not disclose its use to their doctors, creating a gap that could lead to treatment failures and placebo effects for diabetic patients. Given the popularity of herbal remedies like garlic and cinnamon, awareness among diabetic patients about these treatments is crucial, and physicians should prioritize this knowledge in their practice. Understanding the effectiveness and integration of herbal medicines into modern health care is vital for their acceptance. Herbal medicines are often affordable, locally sourced, and preferred by some patients, complicating the transition to conventional biomedical practices. With the increasing acceptance of alternative treatments, it is essential to reconcile scientific evidence with these practices. Herbal medicines vary widely based on culture and type, necessitating a thorough understanding of users' perceptions and experiences to create effective interventions. The long-standing history of herbal medications shows a rising interest in scientifically validating their therapeutic actions, particularly in the Western world [21, 22].

Economic Considerations in Herbal Medicine Use

Worldwide, the prevalence of type 2 diabetes mellitus (T2DM) and management costs have risen significantly. In 1980, 108 million adults aged 20–79 were diagnosed; by 2014, this increased to 422 million, with roughly 30% undiagnosed. In the US, direct costs associated with diabetes reached an estimated $5 billion in 2012. The introduction of insulin and oral hypoglycemic agents has mitigated some diabetes complications, yet the outlook for T2DM management costs is concerning, especially in the US. Reports indicate a rise in prescription drug costs, leading to increased interest in cost-effective alternatives. Herbal supplements, a popular adjunctive treatment, are largely unregulated and often lack scientific backing. The FDA does not evaluate these products before market release, raising concerns about contamination and adulteration. While the usage of herbal supplements remains steady at 20-30% in the US, there has been a notable rise in those aimed at chronic disease management. Herbal preparations are often marketed as “natural” and are readily available in various retail outlets. Additionally, the US has a significant market for both pharmaceuticals and herbal remedies, particularly among immigrants from regions with high diabetes prevalence and a history of herbal medicine use, such as China, Southeast Asia, India, Africa, and the Caribbean, potentially offering valuable insights into T2DM epidemiology and treatment options [23, 24].

Education and Training for Healthcare Providers

Coordination can be enhanced between public health stakeholders and herbalist organizations. A pilot study in Kenya consulted herbalists for Type 2 Diabetes Mellitus (T2DM) management, demonstrating that simple training improved their skills, but further education is necessary. Areas for discussion include collaboration for training, compounding regulations for herbal practitioners, and health information dissemination. Engaging professional organizations ethically while improving enrollment and retention of herbalists in training programs is crucial. Practitioner education could take place at a tertiary level, where most herbalist organization memberships occur. A National Agency for Public Health could assist

by developing educational resources for future disease prevention policies beyond diabetes. Integrating education with public health databases and financial support could enhance program implementation and serve as a model. Most public health stakeholders have experience in education and training, indicating a need for continued support in enhancing product knowledge and regulatory frameworks for herbal consumption. Effective legislation and regulations are vital to avoid public health risks stemming from inadequate practices. Identifying gaps in systems and advocating for comprehensive legislation could address the needs of all stakeholders. Additionally, developing standards for herbal diets regarding weight management is necessary. A bi-annual workshop to discuss consumption, products, practices, and research state improvements is recommended. Focusing on stakeholder recommendations during working group discussions can facilitate a conducive regulatory environment. Building relationships through diabetic management education, training, and legislative recommendations can bridge differing stakeholder views and approaches [25-29].

Global Case Studies of Herbal Medicine in Diabetes

Prevalence of Diabetes and the Use of Traditional Chinese Medicine (TCM) Among Patients: The prevalence of type 2 diabetes mellitus (T2DM) and its management costs globally continues to rise, with predictions indicating this trend will persist. In the US, rising prescription drug expenses are prompting interest in cost-effective alternatives. From 2001 to 2007, diabetic medication costs surged by 69.3%, but the number of patients using these medications grew only 13.6%. Herbal supplements, often unregulated and lacking scientific backing, are one such alternative. Approximately 52% of US adults use herbal supplements, rising to 75% among those with chronic illnesses like type II diabetes. In Eastern nations, particularly China, there is a long-standing tradition of herbal medicine for diabetes prevention and treatment, with some plant-based remedies showing antihyperglycemic effects. The US has seen a rise in herbal supplement imports and an increase in the Asian population, particularly Chinese, who are at high risk for diabetes. However, information on TCM usage in T2DM management is limited. This review outlines T2DM management strategies in traditional modern medicine (TMM) and TCM, followed by identifying commonly used TCM herbal preparations in the US. Diabetes, Complications, and Current Treatment Options: Diabetes rates worldwide are escalating and are projected to double from approximately 171 million today to 366 million by 2030. Untreated diabetes can result in serious complications like diabetic ketoacidosis, coma, and vascular issues, leading to multi-organ failure and death. A range of antidiabetic medications exists, such as biguanides and insulin analogues, yet the demand for affordable, effective treatments is growing due to long-term side effects. Asian countries offer a wealth of medicinal plants that may provide new diabetes treatments, and traditional healing practices using plants are documented even in Western nations. Many herbs are claimed to have hypoglycemic properties, leading to increased interest among diabetic patients in alternative remedies [30-33].

CONCLUSION

The integration of herbal medicine into public health policy represents both a challenge and an opportunity in the global effort to manage Type 2 diabetes. Despite its widespread cultural acceptance and historical use, herbal medicine remains under-regulated and undervalued in mainstream diabetes care frameworks. Regulatory inconsistencies, safety concerns, and a lack of robust scientific validation continue to limit its broader adoption. However, recognizing herbal medicine's role in culturally competent care, especially among underserved populations, could enrich diabetes prevention and treatment strategies. Strengthening collaboration between health authorities and herbal practitioners, standardizing herbal product quality, and conducting inclusive, interdisciplinary research are essential steps forward. Public health policy must evolve to acknowledge and responsibly integrate traditional knowledge systems, ensuring that diabetes management becomes more equitable, accessible, and responsive to the needs of diverse populations.

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