

Infection Comorbidity Among Individuals Living with Type 2 Diabetes Mellitus in Bayelsa State Nigeria: Narrative Review of Epidemiology, Health Promotion and Primary Healthcare Concepts

Ogbara CN^{1,2*}, Ofili CC¹ and Nwose EU^{1,3}

¹Department of Public & Community Health, Novena University, Nigeria

²Ministry of Health, Environmental. Bayelsa State Government, Nigeria

³School of Health & Medical Sciences, University of Southern Queensland, Australia

***Corresponding author:** Ogbara CN, Department of Public & Community Health, Novena University, Ogume, Nigeria

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ABSTRACT

Background: Type 2 diabetes mellitus is commonly associated with infectious disease complications. Primary healthcare services including health promotion is one of the preventive medicine options.

Objective: The objective of literature review is to establish what is already known, and the gap in knowledge and practice (KAP), with a view to substantiating research needs.

Design: Narrative review of concepts.

Outcome: The Alma Ata concept is a major program in primary healthcare service. However, the low-mid-income countries have yet to equip their facilities for expected quality services. The healthcare providers and users also have their behavioural change wheel factors that need to be addressed. Microbial infections in diabetes are quite varied but there is established model for quality management at the primary healthcare level.

Conclusion: Understanding the concepts of primary healthcare services, the Alma Ata declarations, and the current limitations in low-mid-income countries require all stakeholders. Knowledge of the model of care for immunocompromised individuals is imperative. Promotion of behavioural change wheel for both healthcare providers and users is imperative to achieve quality primary healthcare services to improve the lives of affected individuals living with T2DM.

Keywords: Alma Ata; Diabetes Foot Ulcer (DFU); Immunocompromised; Health Promotion; Primary Healthcare

Introduction – Overview of Infection in Diabetes

Diabetes mellitus (DM) can be said to be a clinical syndrome associated with deficiency of insulin secretion. It is known as one of the largest emerging threats to human existence in the 21st century [1]. In 2007, it was reported that 246 million individuals were living with diabetes in the world, and it estimated that by this year, 2025, the number will increase to 380 million [2]. In addition to the compli-

cations of the disease, DM is known to be associated with reduced response of T cells, neutrophil function, and disorders of humoral immunity. The disease increases the susceptibility of patients to infections [1]. People living with type 2 diabetes mellitus (T2DM) are at higher risk of infection, it is however, unknown if the risk is similarly observed in people with prediabetes [3,4]. According to Caporossi, et al. [5], T2DM is a chronic metabolic disorder which is characterized

by hyperglycemia. It is a major global health concern, affecting over 400 million people worldwide. T2DM is associated with a number of complications, including cardiovascular disease, neuropathy, retinopathy, and nephropathy [1].

Evaluating Infections Among T2DM

Evaluating infections among individuals living with T2DM is crucial due to the increased susceptibility of these individuals to infections [6]. Diabetes mellitus, particularly T2DM, has been associated with impaired immune function, making individuals more prone to infections. Individuals with T2DM have an increased risk of infections due to several factors, including hyperglycemia, impaired immune function, and micro-vascular complications. Hyperglycemia compromises the immune response by impairing neutrophil function and reducing the effectiveness of macrophages [7,8]. Persistent high blood glucose levels create a favorable environment for microbial growth and compromise the body's ability to combat infections. To assess the risk and impact of infections in individuals with T2DM, various evaluation methods can be employed. They include clinical assessment and laboratory investigation [6].

Clinical Assessment: Clinical evaluation involves monitoring signs and symptoms of infections, such as fever, wound healing, and localized signs of infection. Regular clinical check-ups can help identify and address infections promptly.

Laboratory Investigations: Laboratory tests, including full blood count, C-reactive protein (CRP), and blood cultures, can provide objective measures of infection severity and guide appropriate interventions.

Pathophysiology of Infections in T2DM

Infections in T2DM constitute a significant public health concern, as individuals with this condition are more prone to developing infection due to impaired immune function. The pathophysiology of infection in T2DM is complex and multifactorial. Hyperglycemia, which is a hallmark of T2DM, impairs the function of immune cells, such as neutrophil and macrophages, making it difficult for the body to fight off infections. Chronic inflammation and oxidative stress are common in T2DM, and they can further impair immune function and increase the risk of infections [9,10]. In patients with T2DM, insulin resistance and abnormal insulin secretion leads to hyperglycemia. Some studies have also shown that metabolic disturbance like T2DM, increase the risk of cognitive decline and Alzheimer dementia, as Alzheimer dementia is also a risk factor for T2DM [11]. The impaired immune

functions in T2DM can lead to a range of infections, including urinary tract infections, pneumonia, and skin and soft tissue infections [6,8]. These infections can be severe and life threatening and may require hospitalization and aggressive treatment. Infections can exacerbate hyperglycemia and worsen diabetes control, creating a vicious cycle of infection and hyperglycemia. In addition, to impaired immune function, other factors can contribute to increased risk of infections in T2DM, including poor wound healing, neuropathy, and cardiovascular disease. These factors can increase risk of infection by providing a portal of entry for pathogens and impairing the body's ability to fight infections [12,13].

Conceptual Framework of Infections in Patients with Type 2 Diabetes Mellitus

Overviews: The Infectious Disease Society of America (IDSA) provides a model conceptual framework for understanding and managing infectious diseases in immunocompromised patients [14]. The model articulated the concepts of recognition and preventive measures (Figure 1). The report from Germany on healthcare workers' hand hygiene practices adds to the concept, especially in diabetes foot ulcer (DFU) management [15], and this is further supported by recommendations "on infection prevention and control for immunocompromised individuals in health care facilities" (Commission for Hospital Hygiene and Infection Prevention (KRINKO), [16]). This is because their immune systems are not able to fight off infections as effectively as the immune systems of healthy people [17]. The type and severity of infection in an immunocompromised host depends on the degree of immunosuppression and the type of infectious agent. The management of infectious diseases in Immunocompromised hosts requires a multidisciplinary approach. This includes prevention, diagnosis, treatment, and supportive care. The IDSA Model is a useful tool for clinicians who care for immunocompromised patients. It can help them identify patients at risk for infection, to choose the appropriate diagnostic tests and treatments, and to provide supportive care. The IDSA model or risk can be divided into two main components. Predisposing factors: These are the factors that make a person immuno-compromised. They can be divided into two categories (Intrinsic and Extrinsic factors). Intrinsic factors: These are factors that are present at birth or develop over time, such as immunodeficiency diseases, cancer, and chronic kidney disease. Extrinsic factors: These are factors that are introduced from outside the body, such as medications, radiation therapy, and chemotherapy. Infectious agents: These are the organisms that cause infection and are quite varied (Figure 2).

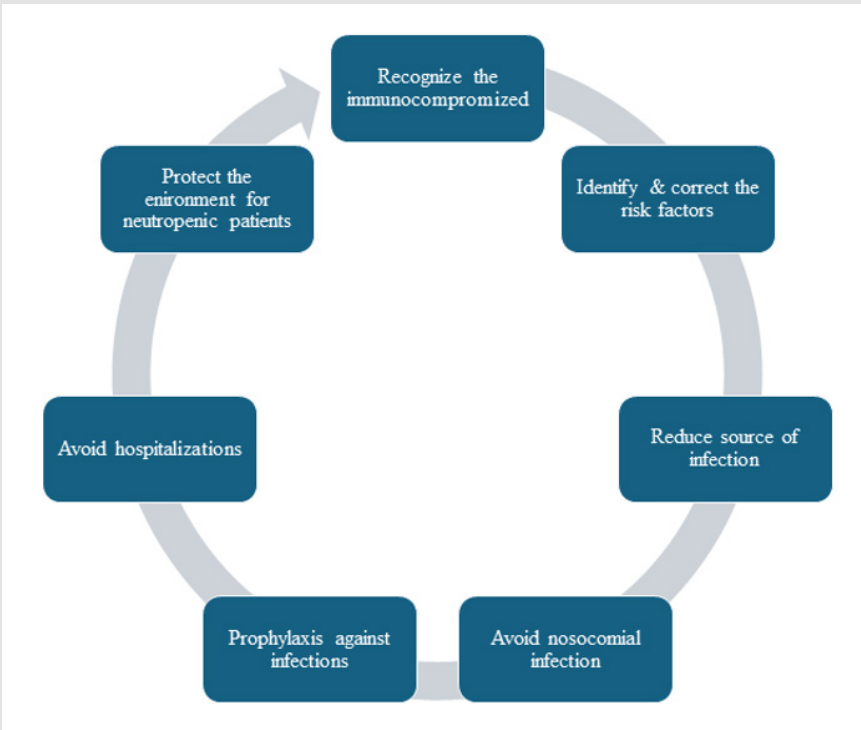


Figure 1: Conceptual model of care for immunocompromised individuals (Risi, et al. [14]).



Figure 2: Microbial infections associated with diabetes.

Bacteria: These are single-celled organisms that can cause a variety of infections, such as pneumonia, meningitis, and urinary tract infections. **Viruses:** These are tiny particles that contain genetic material. They can cause a variety of infections, such as the common cold, influenza, and HIV/AIDS.

Fungi: These are eukaryotic organisms that can cause a variety of infections such as athlete's foot, ringworm, and thrush. **Parasites:** These are organisms that live in or on other organisms and feed-off them. They can cause a variety of infections, such as malaria, giardia, and lice [17].

Host Factors: These are the factors that determine how an immunocompromised host will respond to an infection. They can be divided into two categories – general and specific. General host factors are those that affect the overall health of the host, such as nutritional status, hydration status, and underlying medical conditions. Specific host factors are those that are specific to the type of infection, such as the presence of antibodies and the ability of immune cells to function. The IDSA Model is a dynamic model, which means that it can be adapted to fit the specific needs of each patient. For example, the model can be

used to develop treatment plans for patients with different types of immunosuppression and different types of infections. The IDSA Model is a valuable tool for clinicians who care for immune-compromised patients. It can help them to provide the best possible care for these patients and to improve their outcomes [17].

Epidemiology Concepts of T2DM

T2DM is a growing global health concern, with an estimated 462 million adults living with the disease worldwide, and this number is expected to increase to 578 million by 2030. The prevalence of T2DM varies widely across different countries and regions, with the highest rate found in the low-and middle-income countries, particularly South Asia and the Middle East [18]. Individuals with T2DM are more susceptible to infections due to several risk factors. Such factors include the duration of diabetes, age of the disease, comorbidities and lifestyle (Figure 3). Among the co-morbidities, peripheral artery disease (PAD) and its associated risk factors including lifestyle and nutritional are paramount [19]. Recent report from northern Nigeria has affirmed age and PAD as well as neuropathies as determinant risk factors of diabetes infection leading to amputation [20].



Figure 3: Epidemiological determinant risk factors of diabetes infection.

Health Promotion Concepts in T2DM

Health promotion is the process of helping individuals or people to have and increase control over health and to improve general wellbeing. Health promotion is a crucial function of public health which implies different strategies to promote health and longevity [12]. In other words, health promotion is the development of individuals, group, institution, community and the application of systematic means to improve the health knowledge, attitudes, skills and behavior of people. Health promotion is to create supportive environment that encourages healthy behavior, creating safe and accessible place for physical activities, promote healthy eating option in schools, working environment, by creating environment that supports healthy lifestyle which individuals are more likely to accept and maintain [21]. In the conceptual perspective, it is important to characterize disease prevention as that primary aspect to look at within the health care system and health promotion. Services depend on the intersectional actions of the social determinants of health. Health promotion normally addresses behavioral risk factors such as dietary, physical inactivity, injury prevention, drug abuse control, health related behavior related to any disease situation, tobacco use, alcohol control and sexual health amongst others [12]. In a study carried out in Nigeria, on health promotion intervention in type 2 diabetes mellitus shows that the most common health intervention in T2DM are initiatives

targeting health care professionals. The target was mainly to increase the relationship in terms of collaborations between healthcare stakeholders [22]. The management of Diabetes mellitus is not an easy process but challenging for both clinicians and patients. This can only be achieved by proper management of diet, medication, and good knowledge about illness. Healthcare practitioners encourage lifestyle change; adjust medication doses interpret the blood glucose levels and behavioral change to ensure that patients understand the treatment and their condition. The importance of health promotion and education among strategies clinicians often use to create awareness for patients and the engagement can be through media etc to ensure positive outcome on patients. Keeping to medication or adherence to medication is also an important component of diabetes management [23]. In Nigeria, the Federal ministry of health has collaborated with World Health Organization to launch stop diabetes initiative program. The program was purposed “to bring in different stakeholders to collaborate and prevent the increasing prevalence of diabetes in Nigeria. The program was meant to enhance primary healthcare services in the prevention and control of diabetes as stated in the National policy and strategic plan action to prevent and stop the control of non-communicable diseases” [24]. Indeed, the concept of health promotion involves some strategic process of control for complications (Figure 4), including infection prevention, among individuals living with T2DM.

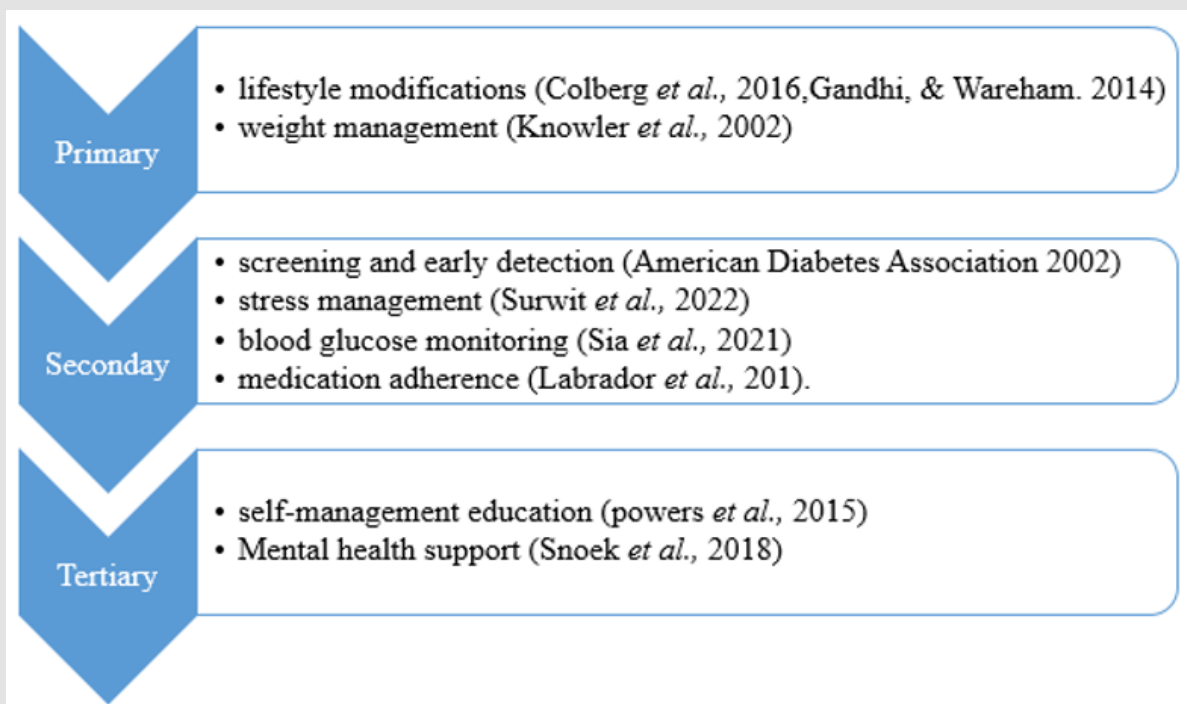


Figure 4: Three stepwise level of strategies.

Primary Healthcare Concept on Infections in Patients with T2DM

The concept of primary healthcare was advanced in a paper submitted to the executive board of WHO in January 1975. This was in the form of seven principles followed by the Alma Ata Declaration in 1978 at the international conference in Alma-Ata, Kazakhstan. The Alma Ata put health equity as a policy agenda being the first time and afterward, primary healthcare became a full concept with the goal of Health For All [25,26]. The Alma Ata declaration is an important healthcare program that has practical relevance with T2DM [27,28]. However, it is known that the primary healthcare systems in the low-mid-income countries are not well equipped to provide quality care for chronic diseases such as diabetes [29]. For instance, behavioral change wheel concept in diabetes self-management is relevant in primary healthcare service for DFU [30].

Foot Care: Foot infections are a common and serious complication of T2DM, and in severe cases, can lead to death [31], and amputation [20,32-34]. While good foot care constitutes preventive management against infections, T2DM can damage nerves and blood vessels leading to diabetic neuropathy and DFU. The management of DFU has

improved in developed countries, but not in low-mid-income countries [35]; and this non-improvement is attributable to high cost of healthcare being beyond the affordability of poor patients [36]. Further, lack of knowledge is considered a major factor militating against self-management in DFU [35]; but there is credible evidence of patients belief and refusal to accept medical care being a factor [37].

Prompt Treatment of Infection: Prompt treatment of infections is crucial for preventing complications and improving outcomes in T2DM patients [38,39]. Prompt treatment of infections in T2DM patients is essential for several reasons, amongst which are preventive complications, improve glycemic control, enhance wound healing and reduce hospitalization. The principle of prompt treatment includes early diagnosis, appropriate antibiotics, and adequate duration of therapy, glycemic control and supportive care [40]. Primary healthcare concepts play a crucial role in the management of T2DM (Figure 5). Effective primary healthcare for T2DM can lead to an improvement in outcome, reduce the disease complications, and ensure good quality of life. However, while knowledge of intervention for comorbidities in diabetes is available [41], the factor of individual physicians and/or practices remains a concern [42], as well as other determinants of quality of services [43,44].

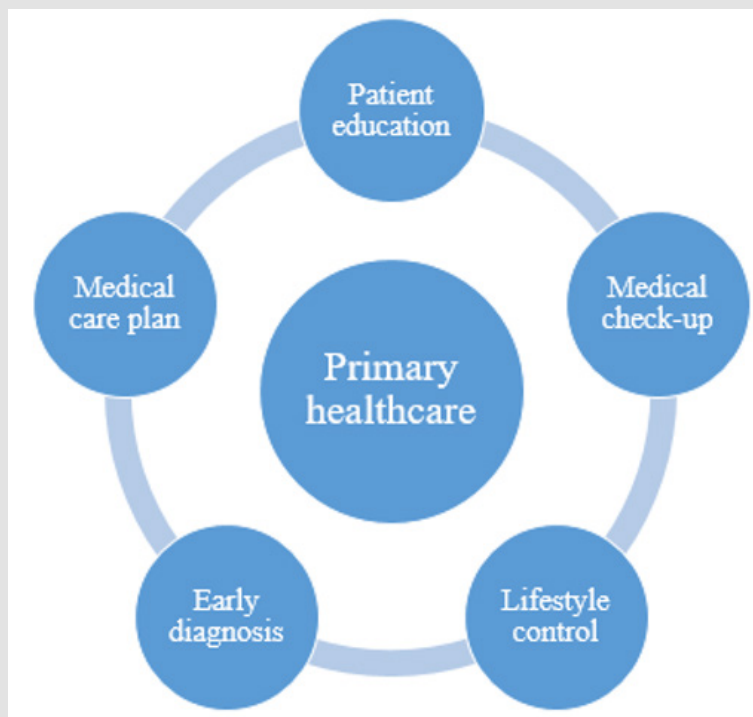


Figure 5: Primary healthcare concept in diabetes care.

Summary

The pandemic situation of T2DM requires more attention at the national level with policies that ensure quality primary healthcare services at the community level. T2DM is a complex, multifaceted disease requiring a comprehensive and multidisciplinary approach. By understanding the concepts of primary healthcare services, and Alma Ata in particular, key players need to be developed in all facets of care including promotion of behavioural change wheel for both healthcare providers and users. By implementing quality primary healthcare services, i.e. education, preventive and treatment strategies, the burden of T2DM and DFU can be managed to improve the lives of affected individuals.

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