Diabetes in the Shadow of Conflict: Understanding and Addressing the Crisis in Gaza

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Abstract

The conflict in Gaza has inflicted severe damage on an already fragile healthcare system, leading to significant challenges in providing adequate care for individuals, particularly those with chronic diseases like diabetes. The conflict has caused immense strain on healthcare facilities, resulting in shortages of essential supplies and medications, including insulin, and disrupting the provision of proper nutrition and medical care. This situation has led to an increase in communicable diseases and a significant impact on individuals with chronic conditions, such as diabetes.

Patients with diabetes in Gaza face numerous challenges, including the inability to access necessary medications, adhere to special diets, and receive proper surveillance and care for their condition. The lack of appropriate management can lead to a deterioration in the quality of life

and an acceleration of the disease processes, increasing the risk of complications such as cardiovascular disease, nephropathy, retinopathy, and neuropathy.

To address these challenges, short-term strategies must focus on promptly identifying diabetic patients and ensuring their continuous access to essential medications, particularly insulin. Long-term strategies should include strengthening health information systems, ensuring continuous access to medication and adequate supplies, and providing comprehensive healthcare services targeting diabetes within primary health centers. Additionally, training healthcare professionals in diabetes care, developing national emergency response plans, and fostering effective communication between governments are crucial steps in managing diabetes during crises like the conflict in Gaza.

Key words:

Gaza conflict, Diabetic patients, Diabetes, Challenges, Recommendations

Introduction

Diabetes Mellitus (DM), once considered prevalent primarily in affluent nations, has now become a pervasive global phenomenon. Presently, it afflicts 537 million adults worldwide, and projections suggest this number will increase to 783 million within the next two decades (1). The implications and complications associated with this disease are profound, affecting not only individual health but also exerting significant strain on national economies and stability. This burden is especially pronounced in underrepresented communities, including low-income and

Indigenous subgroups, where the impact is disproportionately felt (2), particularly in regions characterized by high conflict and limited access to healthcare facilities (3).

The healthcare sector in occupied territories faces significant challenges, with physicians enduring constant threats and Palestinians not guaranteed access to hospitals (4). With the global rate of undiagnosed DM at one individual for every two cases, the lack of testing centers and consistent healthcare provision exacerbates this disparity (5).

Gazans, comprising 64% of whom are descendants of refugees, find themselves on the disadvantaged side of an expanding health disparity (6). They have endured the historical trauma of forced displacement, known as "Al Nakba" (the great catastrophe), which paved the way for Israel's control over the West Bank and Gaza. This control has perpetuated further displacement and instability among the local populations. A significant ongoing issue exacerbating the broader conflict faced by Gazans is the siege imposed on Gaza in 2007, intensifying humanitarian concerns and severely restricting access to essential resources. The persistent state of war renders life and basic amenities uncertain for many (7).

The healthcare system routinely faces compromise, either directly through the destruction of medical facilities or through the withholding of medical supplies. Many life-saving devices and medications, crucial for various medical interventions, are subject to arbitrary rules, leaving many civil structures vulnerable during the war. The few remaining institutions struggle to meet the growing demand and cope with limited capabilities, heavily reliant on foreign aid, rendering them largely inadequate (7).

As the need to address the growing epidemic grows, many nations have made it a routine to allocate funding appropriately. Healthcare funding is expected to increase significantly to meet the projected surge, with global diabetes-related health expenditures estimated to reach $966 billion USD in 2021 and projected to rise to $1.054 trillion USD by 2045 (8). In countries with high GDP, funding is often barely sufficient to meet the demand for improved chronic healthcare management centers (9). Chronic conditions like DM require specialized care and high maintenance. Tackling increasing co-morbidity requires constant surveillance due to various factors (1). Sub-optimal diets play a significant role in the predictive aspects of DM (10).

The growing number of adverse health outcomes related to DM in Gaza is influenced by the lack of healthcare access due to geopolitical instability and limited resources (6). There is an apparent link between the development of DM and economic development (10), raising concerns regarding the healthcare situation in Gaza.

This review aims to delve into the complexities of this conflict's impact while also examining its limitations and challenges to propose unique recommendations.

Impact of the Conflict

The conflict in Gaza has put an enormous strain on the already stretched healthcare sector in the strip, a region with around 2.2 million residents, of which almost 1.7 million have been displaced. As of the 27th of March 2024, more than 74,000 have been injured, and 32,000 have died. The displaced population took refuge in religious centers, United Nations Relief and Works

Agency for Palestine Refugees in the Near East (UNRWA) facilities, schools, and hospitals, which has led to further degradation of healthcare services provided (11,12).

According to the World Health Organization (WHO), the conflict has led to the degradation of healthcare facilities, with only 2 out of 3 field hospitals fully functioning. Additionally, 12 out of 36 hospitals in the strip are partially functioning, and the average bed occupancy in the hospitals is approximately 327%. Furthermore, only 20 out of 82 primary healthcare facilities are functional, and 104 ambulances have been affected since the onset of the war. Fuel, electricity, food, water, medicine, and medical equipment shortages have resulted in inadequate treatment of the patient population in the Gaza Strip. These shortages have also led to a significant increase in Communicable Diseases, with more than 524,363 cases of acute respiratory infections recorded since mid-October 2023 and the number of recorded cases of diarrhea reaching 296,152 (11,13–15).

Gaza's healthcare system provides for 350,000 individuals suffering from chronic diseases, 1000 patients on hemodialysis, 50,000 pregnant women who result in 183 births per day, and 130 premature infants dependent on incubators, in addition to numerous other chronic diseases that have gone untreated (13). According to the World Health Organization (WHO), individuals suffering from long-term health conditions in Gaza are numbered to be more than 485,000 individuals with mental health disorders, 225,000 with hypertension, 45,000 with cardiovascular disease (CVD), and more than 60,000 patients suffering from DM as of the 31st of October 2023 (14).

Patients with chronic diseases in ordinary conditions face challenges in terms of access to healthcare, including the ability to acquire the medication they need, medication side effects, healthcare facilities, compliance, and the psychosocial impact of their disease conditions. More than 60,000 individuals with DM need special diets to control blood glucose levels, slow down disease progression, manage their weight, and handle the comorbidities that typically accompany DM. These diets are low in carbohydrates, sodium, saturated, and trans fats and provide large amounts of proteins, low-fat dairy, fruits, and vegetables. Considering the events in Gaza, providing such a diet consistently would be difficult due to the high prices—up to fifty times the prices before the conflict—and the lack of fresh supplies (50). The World Food Programme (WFP) had warned of the ongoing famine in the northern governorates, which, according to the warnings, was projected to occur anytime between mid-March and May 2024 (16).

Diabetic patients, like other patients with chronic diseases in Gaza, suffer from the scarcity of medications. In the United States, DM patients typically use about 5.9 different medications. Patients may require statins, Angiotensin Converting Enzyme (ACE) inhibitors, sulfonylureas, alpha-glucosidase inhibitors, and insulin, in addition to other medications needed to manage concurrent comorbidities (17). The entry of medicines, including insulin pens, into the Gaza Strip, has proven to be a difficult topic due to circumstances surrounding the matter.

A parallel can be drawn regarding the war in Ukraine. The availability of medications varies by the affected area, being worse in contested areas, which is not a privilege Gaza has as the effects of the conflict have been far-reaching. The issue of cost has emerged in Gaza, just as it has in Ukraine, alongside the logistical challenges of importing or manufacturing medications. In

Ukraine, prices of medications have increased by up to 60%. The World Health Organization (WHO) has predicted that disruptions in the supply of medications would lead to a rise in morbidity and mortality in Ukraine. Mirroring the situation, a worse outcome would be expected to occur in the Gaza Strip (18,19).

The lack of medication, appropriate diet, proper surveillance of DM complications, and circumstances conducive to adequate glycemic control would result in a deteriorating quality of life and the acceleration of disease progression, leading to DM complications. Patient noncompliance has been found to increase overall mortality in both Type 1 DM and Type 2 DM. Type 1 DM is an autoimmune disease that results in the destruction of pancreatic beta cells that release insulin (20) . On the other hand, Type 2 DM is a chronic disease that presents as a resistance to the peripheral actions of insulin or an impairment in the secretion of insulin (21) . Medication non-adherence has also been associated with worsened quality of life, poorer outcomes, increased complications, and greater resource utilization by patients (22–24).
Not only death but CVD, nephropathy, retinopathy, and neuropathy are all outcomes that may become more prevalent or be accelerated because of the lack of appropriate management systems. Bourne et al.'s systemic analysis between 1990 and 2010 concluded that blindness caused by DM-associated retinopathy accounted for 2.6% of blindness worldwide (25). With 80% of end-stage renal disease caused by either DM, hypertension, or a combi in a nation of both (25). Patients suffering from DM are 10 to 20 times more likely to undergo amputation of the lower limbs (26).

The psychological aspect of DM affecting adherence has been documented in the literature. Patients with DM tend to score lower on EQ-5D quality of life assessments than similarly aged peers, and their scores are even lower with the onset of macrovascular and microvascular complications of DM. The presence of both complications leads to even lower scores (27). DM has also been found to be highly associated with depression (28). The psychological impact of DM, leading patients to suffer from depression, stress, and anxiety, is exacerbated by the worsened circumstances in the Gaza Strip, which would lead to decreased adherence to self-care behaviors, including medication adherence (29,30).

Limitations and Challenges

Based on previous conflicts, such as the conflict with Nicaragua, it has been evident that warfare significantly impacts health and access to essential services (31)**.** It has been noted that access to medications may be constrained during conflicts due to insufficient medical supplies and logistical challenges such as limitations in shipping and electricity infrastructure. Maintaining the integrity of insulin, particularly in extreme environments with extreme temperatures, becomes challenging due to electricity shortages, which may result in the degradation and loss of potency of the medications (32). The cessation of electrical power disrupts cooling systems and refrigeration, resulting in a temperature fluctuation between 25° and 37°, leading to the loss of insulin effectiveness for short-acting, intermediate-acting, and mixed insulin (33). Furthermore, the breakdown of data systems in conflict zones poses difficulties in accurately assessing mortality and morbidity rates of diseases (34), impeding the identification of needs for managing non-communicable diseases such as DM (35). Additionally, prioritizing infectious disease

management due to concerns about transmission often results in decreased attention to the care of non-communicable diseases (35). It is well-established that specific dietary requirements and proper nutrition are crucial in managing and controlling DM. However, during times of conflict, the scarcity of food resources can profoundly affect patient outcomes (36). Moreover, the reallocation of financial resources from social services to military endeavors exacerbates the scarcity of resources such as medications and food (37). Despite increased physical activity and weight loss during wartime, no improvement in serum lipid levels has been observed. This is attributed to the limitations in antioxidant vitamins found in fruits and vegetables and the heightened levels of smoking prevalent during times of conflict (38). Additionally, poor mental health, stress, and anxiety serve as significant risk factors for the development of type 2 DM (39). The prevalence of post-traumatic stress disorder, depression, and severe emotional disorders during and after wartime exacerbates health challenges in conflict-affected areas (40). **Table 1** shows the limitations and challenges DM patients face in the conflict.

Table 1. *The limitations and challenges for DM patients through the conflict.*

Limitations and Challenges
1. Limited access to medications and medical supplies due to logistical constraints in wartime conditions (31,32)
2. Difficulty in preserving insulin due to electricity scarcity, leading to loss of insulin activity (32,33)
3. Impaired data systems hinder accurate assessment of disease mortality and morbidity, affecting non-communicable disease care (34,35)
4. Prioritization of infectious disease care reduces attention to non-communicable disease management (35)
5. Food limitations during wartime affect diabetes management outcomes (36)
6. Allocation of budget from social services to military services leads to resource constraints (37)
7. Lack of improvement in serum lipid levels during war attributed to limitations in

antioxidant vitamins and increased smoking rates (38)

8. Poor mental health, stress, and anxiety increase the risk of developing type 2 diabetes mellitus, posing challenges in conflict areas (39,40)

Recommendations

Several recommendations were made to address the proper management of DM during conflicts. They discussed both short- and long-term plans (41). In terms of short-term management, the study emphasizes the critical need for local and international healthcare systems to promptly identify diabetic patients and ensure their continuous access to essential medications (41). Notably, the study underscores the importance of identifying type 1 diabetic patients and providing them with necessary insulin. Additionally, it highlights the importance of providing suitable diabetic care for vulnerable populations such as pregnant women, the elderly, and patients with prior complications from DM, such as foot ulcers and end-stage renal disease (41). It is imperative for functioning healthcare systems in Gaza to maintain sufficient data on diabetic patients despite the challenges in obtaining such information. Developing a plan to understand the epidemiology of diabetes, including standardized tools, methods, and diagnostic tests, is deemed beneficial.

Providing adequate support to diabetic patients in ongoing crises through continuous surveillance, the use of health information systems, and planning for medical emergencies associated with diabetes is essential for the long-term management of DM and limiting complications (42). As per the "Boston Declaration," one of its four primary objectives is to

ensure universal access to insulin, essential medications, and diagnostics for managing glycemic and blood pressure levels during humanitarian crises. Issued in 2019 after a conference in Boston, this declaration aimed to address the global health and humanitarian dimensions of DM during crises. The conference deliberated on pressing issues and barriers necessitating attention, culminating in formulating a coordinated action plan. Moreover, it underscored the heightened vulnerability of individuals with type 1 DM to mortality (43). Thus, ensuring the provision of essential medications and insulin to Gaza emerges as an imperative mandate. Evidence-Based Clinical Guidelines for Diabetes Management in Crisis provide recommendations regarding glucose testing methods, glycemic goals, and the role of Electronic Medical Records (EMR) and mobile health (mHealth) technologies in clinical decision-making. Further research is needed to improve the diagnosis and treatment of DM in humanitarian crises (42). Moreover, within the framework of short-term management strategies for addressing DM amidst humanitarian crises, an essential aspect involves training humanitarian healthcare workers. This training regimen should encompass comprehensive instruction on insulin administration and managing DM-related emergencies (41). Furthermore, insights gleaned from a case study in Mali underscore the importance of equipping healthcare workers with essential resources. These include rapid-acting insulin, insulin syringes, antibiotics, dressings for foot infections, blood glucose meters, urine test strips, and intravenous fluids, particularly in conflict zones (44). Patient education is an additional critical facet emphasized in managing DM during crises. This entails focusing on key aspects such as guiding in managing medications during illness episodes and recognizing symptoms of dehydration, hypoglycemia, and Diabetic Ketoacidosis (DKA). DKA is a life-threatening complication of DM that is usually seen in type 1 DM patients rather than type 2.

DKA presents with uncontrolled hyperglycemia, metabolic acidosis, and an increase in the concentration of ketones (41,45,46). However, it is imperative to acknowledge the potential obstacles posed by language barriers, translation issues, and the complexity of medical terminology, which may impede effective communication between patients and healthcare providers. Various approaches can be employed to mitigate these challenges, including using simple and visual communication methods. Additionally, adopting mobile applications, such as Cardmedic, accessible via app stores, can facilitate communication and comprehension in healthcare settings (47). In the context of long-term management, it is imperative to ensure consistent access to indispensable medications and to guarantee that healthcare facilities are equipped with essential supplies and laboratory testing capabilities for parameters including HbA1C, total cholesterol, HDL, LDL, triglycerides, urine albumin to creatinine ratio (41). Additionally, adopting additional cost-effective approaches for the management of type 2 DM is advisable, such as the utilization of metformin, statins, and ACE inhibitors, coupled with the implementation of systematic screenings for conditions like gestational diabetes, microalbuminuria, retinopathy, and diabetic foot complications (48). Addressing the necessity for maintaining specific temperature conditions for medical equipment, the deployment of thermoelectric coolers emerges as a viable solution. Additionally, employing drones for medication transportation presents itself as a feasible option (49). These strategies collectively contribute to developing and implementing comprehensive, continuous DM care protocols. Suppose the conflict persists for an extended duration spanning several weeks or months. In that case, providing comprehensive healthcare services targeting DM, hypertension, and CVD within primary health centers is paramount (41). Additionally, there is a critical need to prioritize

training healthcare professionals (HCPs) in DM care, as this enhances local capacities and resilience. National emergency response plans should be formulated with a dedicated strategy for addressing DM care and ensuring the availability of insulin during crises Moreover, leveraging online consultations facilitated by volunteers comprising both DM and mental health specialists presents a promising avenue to alleviate the inevitable shortage in healthcare services resulting from military conflict (47). While utilizing technology, medical equipment, and specialized expertise holds significant value in achieving these recommendations, paramount importance lies in fostering effective communication between all parties involved in the conflict. This requires accommodations to ensure the safe transport of people and critical supplies to areas in need (47).

Table 2 summarizes the short- and long-term recommendations.

Table 2. *The short-term and long-term recommendations.*

Short-Term Management
1. Prioritize recognition of diabetic patients and ensure continuous access to vital medications, particularly insulin, in both local and international healthcare systems (41). 2. Provide suitable diabetic care for vulnerable populations, including pregnant women, the elderly, and patients with previous complications from diabetes (41). 3. Enhance data collection on diabetic patients and develop standardized tools and methods to understand the epidemiology of diabetes locally (41). 4. Strengthen health information systems and surveillance for epidemiological purposes and ensure sufficient medication and diagnostic supplies in healthcare centers (41,42). 5. Train humanitarian healthcare workers in insulin administration and diabetes emergencies and equip them with necessary supplies for managing diabetes in conflict zones (41,44).
Long-Term Management
1. Ensure continuous access to essential medication and supplies and conduct laboratory testing for diabetes-related parameters (41). 2. Implement cost-effective approaches such as employing metformin, statins, and ACE inhibitors, and conducting screenings for various diabetic complications (41,48). 3. Utilize thermoelectric coolers for maintaining medical equipment temperatures and consider using drones for medication transportation (49). 4. Provide comprehensive care for diabetes, hypertension, and cardiovascular diseases in primary health centers, along with culturally appropriate diabetes education for patients and families (41).

5. Incorporate strategies for diabetes care into national emergency response plans, including the provision of insulin and the development of emergency kits containing essential medications and diagnostic tools (41,50).

Conclusion

The conflict in Gaza has had a devastating impact on healthcare, particularly for individuals with chronic diseases like DM. Immediate action is needed to ensure the provision of essential medications and care for DM patients, both in the short and long term, to mitigate the worsening health outcomes caused by the conflict.

Submission statement

This work has not been submitted for publication elsewhere, and all the authors listed have approved the enclosed manuscript.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Conflict of interest

The authors declare that they do not have conflicts of interest relevant to this review.

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List of abbreviations

ACE: Angiotensin-Converting Enzyme, CVD: Cardiovascular Diseases, DKA: Diabetic Ketoacidosis, DM: Diabetes Mellitus, EMR: Electronic Medical Records, GDP: Gross Domestic Product, HCPs: Healthcare Professionals, mHealth: Mobile Health, UNRWA: United Nations Relief and Works Agency for Palestine Refugees in the Near East, USD: - United States Dollar, WHO: World Health Organization, and WFP: World Food Programme.

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