Stepping up: a pharmacist's role in managing diabetes and foot ulcers

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Abstract

Diabetes mellitus (DM) is a significant global health problem, with over 537 million adults affected in 2021. A crucial complication of DM is diabetic foot ulcers (DFUs), which result from nerve damage and impaired circulation, leading to loss of function and high medical costs. The role of pharmacists in managing diabetes and DFUs has evolved from strictly dispensing medication to being healthcare providers that are actively involved in patient education on glycaemic control, wound care strategies, and promotion of medication adherence. Treatment of DFUs is mainly focused on maintaining a moist wound environment, preventing infection and pressure offloading. This article highlights the essential role of pharmacists in a multidisciplinary healthcare team to enhance patient outcomes by applying their expertise to reduce diabetes-related complications such as DFUs.

Keywords: diabetes mellitus, diabetic foot ulcers, diabetic foot ulcer treatment, diabetes management, pharmacist interventions

https://doi.org/10.36303/SAPJ.1000

Diabetes mellitus: a global health concern

Diabetes mellitus (DM) is one of the leading non-communicable diseases and significantly contributes to early mortality and disability.[1,2] It has emerged as one of the most rapidly escalating global health crises of the 21st century, responsible for an estimated 6.7 million deaths in 2021. According to the International Diabetes Federation, there were approximately 537 million adults between the ages of 20 and 79 living with diabetes worldwide in 2021 (representing 1 in 10 people).[3] Projections indicate that by 2030, the number of individuals with diabetes will increase to 643 million, and by 2045, it will reach 784 million, translating to approximately 1 in 8 people.[3] This escalating trend has substantial economic repercussions globally due to increased healthcare costs and loss of productivity, with low- to middle-income countries bearing the greatest burden, as they house the majority of affected individuals.[1,3]

Diabetes is a chronic condition marked by either a lack of insulin, resistance to its effects, or a combination of both.[4] This disruption in insulin function leads to improper regulation of carbohydrate, fat, and protein metabolism, resulting in abnormally high blood glucose levels, often exceeding the normal range of 3.5–5.5 mmol/L.[1,4,5] Individuals living with diabetes often exhibit symptoms such as excessive urination (polyuria), increased thirst (polydipsia), increased appetite (polyphagia), and unintended weight loss.[6,7] The three primary categories of the disease are Type 1, Type 2 and gestational diabetes.[1,8]

Type 1 diabetes mellitus

Type 1 DM is defined by a significant or complete absence of insulin production, leading to elevated blood sugar levels due to an autoimmune attack on the insulin-producing beta cells of the pancreas.[4,8,9] While the precise cause remains unclear, it is believed to stem from a combination of genetic predisposition and environmental factors.[1,8] Previously known as juvenile-onset diabetes due to its diagnosis primarily in children and adolescents, there has been a noticeable rise in cases among adults as well.[7,10] Managing the condition requires daily insulin therapy to maintain blood glucose levels within a healthy range.[10] However, some individuals may not exhibit symptoms initially, leading to delays in diagnosis and an increased risk of complications.[11,12]

Type 2 diabetes mellitus

Type 2 DM is the most common form of the disease, accounting for approximately 90–95% of all diagnosed cases.[7,13] Individuals diagnosed with Type 2 DM experience insulin resistance, which can occur due to insufficient insulin production or the body's target cells failing to respond effectively to insulin.[4,14] Consequently, individuals with Type 2 DM experience chronically elevated blood glucose levels.[7] The symptoms of Type 2 DM are usually milder than Type 1 DM and develop more gradually, which often results in delayed diagnosis, as the symptoms may go unnoticed for several years.[5,7,15] Due to this slow progression, many Type 2 DM patients are already at an increased risk of microvascular and macrovascular complications by the time they are diagnosed.[7] While Type 2 DM is most frequently associated with adults, it is increasingly being observed in younger populations due to the rising incidence of childhood obesity, a major risk factor in the development of insulin resistance.[2,4] Additional risk factors include a sedentary lifestyle, advancing age, a history of gestational diabetes, and a strong genetic predisposition.[7] The cornerstone of managing Type 2 DM involves lifestyle modifications, such as adopting a healthy diet and regular physical activity to encourage weight loss, which is critical as obesity plays a significant role in insulin resistance.[16] If these measures fail to adequately control blood sugar levels, pharmacological interventions are introduced.[4,16]

Gestational diabetes mellitus

Gestational diabetes mellitus (GDM) is a form of diabetes that develops during pregnancy when blood glucose levels exceed the normal range but are not high enough to be classified as diabetes.[17] This can lead to complications for both the mother and baby during pregnancy and at delivery. While GDM typically resolves after childbirth,[1] it poses a heightened risk of Type 2 DM in the future for both the mother and her child.[4,17]

Considering that DM is a complex disease resulting from the interplay of various factors,[18] community pharmacists can significantly contribute to the care of patients living with diabetes by providing education on diabetes progression, medications, and lifestyle modifications, as well as monitoring glycaemic control.[19] Their involvement helps in the effective management of the condition and facilitates the early detection of potential complications, ultimately improving prognosis, quality of life, and reducing overall healthcare costs.[20,21]

Role of pharmacists in diabetes management

The role of community pharmacists in the management of diabetes has evolved from simply dispensing medication to actively managing and following up on patients.[22] Community pharmacists contribute to identifying medication-related issues and recommending modifications to treatment plans for doctors to consider.[22] Pharmacists manage diabetic patients through telephonic follow-ups, on-site visits, or management of patients from a central location.[23] Although a majority of these services exist within primary healthcare facilities, pharmacists can provide these services in a community or retail setting.[23] Pharmacist-led educational interventions in patients living with diabetes include self-management with an emphasis on healthy eating, exercise, self-monitoring, problem-solving, and reduction of risks such as smoking.[23,24] Importantly, pharmacist-led medication programmes have been demonstrated to be instrumental in the management of glycaemic control.[24]

In the treatment of diabetes, the primary goal for most patients should be to keep their HbA1c level at or below 7% and self-monitored plasma glucose, fasting or pre-prandial levels between 4–7 mmol/L and postprandial levels between 5–10 mmol/L.[25] In patients with a recent diagnosis, safely achieving an HbA1c level of 6.5% or lower can help prevent the onset of retinopathy, nephropathy and neuropathy.[25] However, for older patients and those with multiple health conditions, severe vascular issues, advanced chronic kidney disease, or frequent severe hypoglycaemia, an HbA1c range of 7.1–8.5% is considered appropriate.[25]

Insulin replacement therapy and continuous glucose monitoring (CGM) are typically recommended for individuals with Type 1 DM.[26] For GDM, lifestyle modifications and CGM are recommended prior to initiation of pharmacotherapy.[27] In isolated cases, insulin is provided to manage glycaemic control in individuals with GDM.[27] In addition to lifestyle modifications, metformin is recommended as the first-line treatment for Type 2 DM, except when contraindicated.[25,28] When combined with metformin most drugs for Type 2 DM are effective in the reduction of HbA1c levels. A summary of pharmacotherapy for Type 2 DM recommended in 2017 by the Society of Endocrinology, Metabolism and Diabetes of South Africa is shown in Table I. The clinical response to these drugs varies, with some patients exhibiting favourable outcomes and others demonstrating no therapeutic response.[25] Therefore, the optimal drug selection should be individualised in different Type 2 DM patients. Pharmacists are able to provide recommendations on patient-tailored treatment regimens based on dosing, potential adverse reactions, drug adherence, safety, efficacy, tolerability, and affordability.[23,29]

The use of pharmacotherapy and other interventions to maintain glycaemic control is important, as uncontrolled blood glucose levels can lead to complications over time. Therefore, in addition to assisting in optimising glycaemic control, pharmacist-led interventions can aid in the monitoring and reduction of complications associated with diabetes.[30] While monitoring of early signs of complications associated with diabetes is primarily the responsibility of physicians and specialists, pharmacists can advise patients to self-monitor and report any abnormalities.[31] When such abnormalities are reported, pharmacists could provide over-the-counter medication for symptomatic relief, and refer the patients to a specialist for a comprehensive examination.

Despite interventions aimed at optimising glycaemic control and monitoring of early symptoms, diabetic complications can still emerge due to the complexity of the disease, genetic factors and

Table I: Recommended pharmacotherapy options for Type 2 diabetes mellitus management in South Africa[25]

Therapy level	Preferred options	Alternative options	Notes
Monotherapy	Metformin XR	Gliclazide MR, DPP4i, SGLT2i, GLP-1a, Pioglitazone, Insulin	If HbA1c target is not reached, intensify to dual therapy.
Dual Therapy	Metformin XR + Gliclazide MR	Pioglitazone, SGLT2i, DPP4i, GLP-1a, Insulin	Consider dual therapy if HbA1c > 9% at diagnosis. Adjust based on response.
Triple Therapy	Metformin XR + Gliclazide MR + GLP-1a	SGLT2i, Insulin (basal), Pioglitazone, DPP4i	Add Insulin or GLP-1a in cases of inadequate control on dual therapy.
Complex Therapy	Metformin XR + basal insulin	GLP-1a or additional oral therapy	Insulin should be titrated and supported by education and CGM.

Metformin XR- extended-release metformin, Gliclazide MR- modified-release sulfonylurea, DPP4i- Dipeptidyl peptidase-4 inhibitor, SGLT2i- Sodium/glucose cotransporter-2 inhibitor, GLP-1a- Glucagon-like peptide-1 receptor agonist, CGM- continuous glucose monitoring.

associated comorbidities.[32] These complications often progress without noticeable symptoms until they reach a more advanced stage.[33] This highlights the necessity of continuous screening and vigilant care in preventing the impact of long-term complications associated with diabetes.

Complications associated with diabetes mellitus

Complications associated with DM can be categorised as either microvascular or macrovascular.[12,21] Microvascular complications affect small blood vessels and can result in conditions such as diabetic retinopathy, which may cause blindness, diabetic nephropathy, potentially leading to kidney failure, and diabetic neuropathy, which can cause nerve damage, leading to pain, loss of sensation, and a heightened risk of infections, particularly in the feet. In contrast, macrovascular complications impact larger blood vessels, significantly increasing the risk of cardiovascular diseases, such as coronary artery disease, which can lead to heart attacks, cerebrovascular disease, contributing to strokes, and peripheral artery disease, which can impair circulation to the limbs.[34] These complications cause considerable psychological and physical distress for both patients and caregivers, while also placing a substantial burden on healthcare systems.[20,21,34] Among these, peripheral neuropathy is one of the most common complications, with a lifetime prevalence of approximately 50% in people living with diabetes, making it a leading cause of disability due to foot ulceration and amputation.[35,36]

Diabetic foot ulcers (DFUs) and their relevance

Diabetic foot ulcers (DFUs) are among the most severe and costly complications of diabetes. They are primarily caused by neuropathy and ischaemia resulting from angiopathy and hyperglycaemia-induced metabolic changes.[37,38] Peripheral neuropathy, which affects approximately 50% of people living with diabetes, leads to a loss of sensation in the extremities, making patients unaware of minor injuries caused by pressure, bruises, or cuts. These injuries can progress into poorly healing ulcers.[39-41] Additionally, vascular changes can disrupt circulation to the sole of the foot, increasing the risk of developing peripheral arterial disease (PAD), which is marked by narrowing or blockage of lower-limb arteries.[42,43] Microbial infections can further complicate DFUs, ranging from mild cellulitis to severe gangrene, which may necessitate amputation.[44]

These DFUs significantly reduce patients' quality of life and are costly to treat if not managed promptly and effectively.[20,21] To minimise costs and improve patient outcomes, including efficient wound healing and closure, it is crucial to manage DFUs promptly through comprehensive assessment and a timely multidisciplinary treatment approach.[45,46]

Therapeutic management of DFUs

Pharmacists are ideally placed to recommend effective pharmacotherapy for DFUs. They can offer guidance on antibiotic use in line with clinical guidelines and support patients with medication adherence and foot inspections. Additionally, they can advise on suitable dressings and topical treatments, ensuring that both diabetes management and ulcer care are properly addressed.[47] Management strategies for wound care in DFUs should involve maintenance of a moist wound environment, infection control, debridement of devitalised tissue, wound area pressure relief and regular follow-up monitoring.[45,48,49]

Table II: A guide to dressing choice for moisture control in wounds

Dressing type	Moisture control	Characteristics and advantages
Alginate[51,53-56]	Heavily exuding wounds	• Capable of absorbing up to 20 times their weight in fluid • Form a gel-like substance when in contact with exudate • Can be used on infected wounds (antimicrobial alginate formulations are available)
Hydro-conductive[51,57,58]	Heavily exuding wounds	• Draws exudate away from the wound surface • Removes toxic components such as slough, wound debris and bacteria that compromise wound healing • Suitable for chronic wounds
Foam[51,59-61]	Moderately to heavily exuding wounds	• Highly absorbent, waterproof, non-adherent and non-occlusive • Can be used under compression • Can be used in infected wounds if combined with antimicrobial agents as they are impermeable to bacteria
Hydrocolloids[51,62-65]	Low to moderately exuding wounds	• Create a gel-like environment upon contact with wound exudate, establishing a moist wound interface • De-slough necrotic wounds • Not recommended for infected wounds
Gauze[51,60]	Low to moderately exuding wounds	• Comes in woven and non-woven forms, can be impregnated with various products, such as petrolatum, iodides, and antimicrobials • Woven form not recommended as a primary dressing (fibres can dry out and stick to wound bed) • Can be used on draining, necrotic, and infected wounds, wounds requiring debridement or packing, wounds with tunnels, tracts, or dead space • Inexpensive and easily accessible
Hydrogel[51,53,62]	Dry low exuding wounds	• Rehydrate the wound bed and reduce pain • Promote autolytic debridement • Can be used with topical medications on infected wounds • Does not damage granulation tissue

Wound moisture balance

The maintenance of moisture balance is essential for successful wound healing. This can be achieved by using appropriate dressings, which should be selected based on the specific characteristics of the wound. The ideal dressing should create a moist environment, absorb excess exudate, prevent maceration of surrounding tissue and form a protective barrier to exclude bacteria.[45,50,51] The choice of dressing can significantly impact wound healing by promoting or hindering the process. Table II offers a brief summary of dressings available for moisture control in wounds. A detailed description of these dressings can be found in other published works by the authors.[45,51,52]

Infection control

DFUs are often secondarily infected by staphylococci, streptococci, coliforms, and anaerobic bacteria, leading to complications such as cellulitis, abscesses, gangrene and osteomyelitis.[28] Pharmacists play a vital role in managing diabetic foot infections (DFIs) by recommending appropriate pharmacotherapy, providing direction for antibiotic use in accordance with clinical guidelines, and supporting patients with medication adherence. In addition, they assist with wound care by recommending suitable dressings and topical treatments. Table III provides a summary of antimicrobial agents available as dressings or topical treatments which are recommended for infected DFUs. A more detailed description of these dressings can be found in previously published work by the authors.[51]

To effectively assess infection severity, pharmacists must be able to recognise key signs such as purulence, warmth, erythema, swelling, tenderness, and systemic symptoms like fever or chills. Superficial wound infections can be treated with topical antimicrobials, however, once cellulitis is present systemic antibiotics will be required.[49] According to the South African Standard Treatment Guidelines (STGs) and Essential Medicines List (EML), amoxicillin/clavulanic acid is recommended as the first-line systemic treatment for DFUs.[28]

Wounds which are necrotic or severely infected with biofilm formation may require debridement. This can be achieved by surgical, hydrosurgical, sharp, mechanical, autolytic techniques or maggot therapy. Debridement may also be used to eliminate eschar, surface layers, damaged matrix and thick calluses surrounding the ulcers.[45,49-52] The pharmacist may advise the patient to consult their doctor or wound care specialist to debride the wound or may be required to dispense dressings which facilitate debridement in order to aid healing processes.

Pressure offloading

Offloading is a crucial component in the management of DFUs, as it helps reduce pressure on the affected area, promoting healing and preventing further complications.[75] Pharmacists can assess the patient's specific needs and recommend appropriate offloading devices based on the ulcer's location and severity. When treating DFUs with poor circulation around the ulcer, compression stockings or pressure bandages should be used alongside appropriate wound dressings.[76] Additionally, off-loading strategies must be implemented to reduce abnormal pressure. Offloading can be achieved through various methods, such as total contact casting (considered the gold standard), shoe modifications, the use of insoles or sponge devices, wedge-sole shoes, moonboots, or crutches. Ensuring proper footwear size and seamless hosiery is also important for DFU prevention.[45,49]

Advanced wound care

The management of DFUs has evolved with the introduction of newer therapies such as negative-pressure wound therapy (NPWT), hyperbaric oxygen therapy (HBOT), topical growth factors, bioengineered skin equivalents, adipose tissue-derived stem cells, bone marrow-derived stem cells, and platelet-rich

Table III: Antimicrobial agents recommended for diabetic foot ulcers

Antimicrobial agent	Characteristics	Benefits
Silver dressings[51,66,67]	Contain ionic silver for immediate and controlled release to inhibit pathogen growth, especially of antibiotic-resistant strains.	• Available in various formulations: transparent film, hydrocolloids, hydrogels, foams, alginates, hydrofibers, and composites • Cost-effective • Creates moist wound dressing interface
Iodine[51,66,68]	Povidone iodine ointment/impregnated sheet or as a cadexomer iodine paste/flat sheet which has broad spectrum antimicrobial activity.	• Highly effective against bacterial, protozoal and fungal infections • Removes biofilm • Promotes autolytic debridement
Honey[51,53,69,70]	Biological wound dressings containing honey with broad spectrum antimicrobial activity and multiple bioactive properties that work together to accelerate the healing process.	• Reduce wound odour • Autolytic debridement properties • Moist wound healing interface
Polyhexamethylene biguanide (PHMB)[51,71-73]	Dressings infused with the antiseptic agent PHMB, available in gel disks or foam form, effective against both bacterial and fungal infections	• Have a sustained effect • Effective against drug resistant wound pathogens
Chlorhexidine[51,74]	Paraffin tulle coated with chlorhexidine antiseptic agent effective against a broad range of gram positive and negative bacteria	• Can be used on small, superficial moderately infected wounds

plasma.[52,75] While these treatments show promise in enhancing healing outcomes, a significant portion of the data comes from small randomised controlled trials and require further research to establish standardised protocols and clarify their long-term efficacy and safety profiles.[75]

Collaborative care approach

An interprofessional team approach, involving the patient, wound care specialists, and various healthcare providers, typically leads to the best outcomes for managing DFUs.[45,77] Successful multidisciplinary teams, particularly those addressing glycaemic control, wound management, vascular disease, and infection, are linked to a reduced risk of major amputations in patients with severe DFUs.[78] Continuous monitoring and regular reassessment of the patient and the ulcer are essential to adjust treatment as needed. Prompt referrals and clear communication within the team help prevent complications, and ongoing follow-up after healing is crucial to prevent recurrence of the ulcer.[45] The role of a community pharmacist within a multidisciplinary team for treating DFUs is multifaceted, encompassing screening, medication management, patient education, interprofessional collaboration, monitoring, and community outreach.[20,79] By leveraging their expertise, pharmacists contribute significantly to improving patient outcomes and reducing the risk of complications associated with DFUs. Their involvement not only enhances the quality of care but also supports the overall goal of minimising amputations and improving the quality of life for individuals living with diabetes.[80,81]

Conclusion

Pharmacists are key players in the multidisciplinary management of diabetes and its associated complications such as DFUs. The pharmacist's role has expanded from dispensing medications to actively managing patient care and providing ongoing follow-up. In addition to ensuring the safe use of medications, they can offer screening services, counsel patients on the importance of blood sugar control, advise on lifestyle modifications, and explain risk factors associated with DFUs.[19] The pharmacist's role within the multidisciplinary healthcare team is essential and should not be underestimated. Thus, it is essential for pharmacists to continuously educate themselves on the disease and its related complications to ensure they deliver the highest quality care to patients.

Conflict of interest

The authors have no conflict of interest to declare.

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