

Clinical Patterns, Treatment Modalities and Outcome of Diabetic Foot Ulcers in Three Regional Hospitals in the South-West Region of Cameroon

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Abstract

Background: Diabetic foot ulcer (DFU) is one of the most devastating complications of diabetes mellitus. It has significant effects on patient morbidity and mortality and is a frequent cause of hospitalization and disability in diabetic patients. **Objective:** To describe the clinical patterns, treatment modalities and outcome of DFU in the South-west Region of Cameroon. **Method:** This was a multi-centered five-year retrospective study carried out in Three Regional Hospitals in the South-West Region of Cameroon. Data collected from patients medical records were entered into a structured pre-tested data entry form and analysed using Statistical Package for Social Sciences (SPSS) Version 26. Bivariate and multivariate logistic regressions were used to identify associated factors for mortality with a p-value < 0.05 considered statistically significant. **Results:** A total of 6760 patient records Were reviewed in the surgical departments of the three recruitment sites, 394 cases of DFU were identified (5.8% of all surgical hospitalizations) and 360 were finally retained for analysis. The most common clinical patterns were Wagner grade IV (172/360: 47.8%) and grade V (87/360: 24.2%), with about half (46.9%) located at the forefoot and (30.0%) at the hind foot. Surgery was the most frequent treatment modality with major lower limb amputations making up 48.7% of definitive treatment modalities. Over 70 patients (19.7%) developed complications, including, surgical site infections (50.7%) and pressure ulcers (26.3%).

The overall mortality rate was 20.3%. An associated hypertension ($p < 0.017$ aOR: 2.680), and the development of surgical site infections ($p < 0.001$ aOR: 12.562), were significantly associated with higher in-hospital mortality. **Conclusion:** Advanced diabetic foot ulcers (Wagner IV and V), located principally in the forefoot are very common, and are associated with high lower extremity amputations and mortality especially in patients with comorbidities like hypertension. Timely diagnosis and prompt intervention with early identification of other comorbidities might help improve outcome.

Keywords

Diabetic Foot Ulcer, Clinical Patterns, Treatment Modality, Treatment Outcome

1. Background

Diabetic foot ulcer (DFU) is one of the most common major severe and debilitating chronic complications of diabetes mellitus (DM) and consists of lesions in the deep foot tissues associated with neurological disorders like peripheral neuropathy (PN) and peripheral vascular disease (PVD) [1] [2]. It is a highly morbid consequence of long standing and poorly managed diabetes and it is one of the most common causes of hospital admissions. Over the years, its prevalence is increasing exponentially across the globe following the persistent increment of DM worldwide. It is estimated that, every thirty seconds, a lower limb or part of it is lost to amputation as a consequence of diabetes globally [1] [3]. A meta-analysis study showed about 30 million people affected with DFU globally with a prevalence of 6.3% [3] [4]. In Africa the prevalence ranges from 3.2% - 19.1%, in Cameroon 9.9% and South-West region (SWR) being 11.8% [4]-[6]. DFU is characterized by poor short- and long-term survival especially when associated with other comorbidities. Mortality in hospitalized diabetic patients with DFU is quite considerable compared to those without. Mortality due to DFU was reported to be 14% in Africa and 40.5% in a cohort of Nigerians [7]-[9]. This problem though well-known still poses a huge burden in low-income countries like Cameroon. Several studies have been carried out in Cameroon on DFU but there is paucity of data concerning the intra-hospital outcome following treatment. Hence, it is important to identify contributing factors which will predict outcome in this group of patients, thus enabling optimized management strategy and stem this tide of high DFU related mortality.

2. Materials and Methods

A multi-centered retrospective and analytic study was carried out on patients admitted in the Limbe Regional Hospital (LRH), Buea Regional Hospital Annex (BRHA) & the Kumba Regional Hospital Annex (KRHA) from January 2019 to December 2023. These hospitals are the major referral hospitals in the South-West

Region (SWR) of Cameroon and have a high influx of patients from other parts of the region. They have specialists, trained doctors and other fully experienced staff who help in patient diagnosis and management. They all have major units including a Diabetic unit headed by a Diabetologist and a surgical department having over 25 beds each. Our study involved all files of patients admitted within the study period.

After obtaining ethical clearance from the Institutional Review Board of the Faculty of Health Sciences, University of Buea (IRB FHS-UB) and administrative authorization from the Regional Delegate of Public Health (RDPH) and administrative boards of LRH, BRHA & KRHA, the ward charges of the surgical departments of these health facilities were also informed about the study and permission given to have access to patient's records.

Patient files were obtained from the archives of the LRH, BRHA and KRHA on scheduled days. Diabetic foot problems were confirmed by one of the following physician's handwritten diagnoses as: "diabetic foot", "diabetic foot ulcers", "diabetic foot infections", "diabetic foot gangrene" or a wound below the ankle in a patient diagnosed with diabetes placed under the Wagner's classification or grading system or described as superficial or deep foot infections. The data from the files were retrieved using a well-structured data collection form. We excluded files with incomplete objective data (diagnosis and precised treatment not mentioned) and files of patients who were discharged against medical advice (DAMA) and those who might have been readmitted for the same problem during the study period. A simple consecutive sampling method was used. Data was obtained on the following variables:

Socio demographic: Age, gender, occupation, religion, time of diagnosis, those on treatment or not.

Comorbidities & past history: Hypertension (HTN), HIV, Nephropathy, family history of diabetes, duration of diabetes, history of ulceration, history of surgical approach (debridement, amputation), alcohol intake, smoking.

Clinical patterns: Based on the depth of the wound and the severity, the Wagner's system of classification (Grade I to V) was used and the topography was described by the anatomical location of the ulcer (forefoot, midfoot and hindfoot) and the extent as described by the treating physician.

Treatment modalities: conservative (Insulinotherapy, Analgesics, antibiotherapy, bedside wound care) or Surgical (surgical debridement, minor or major limb amputation).

Treatment outcome: The treatment outcome was described by the presence of complications or not and in terms of survival (dead or alive).

Data Management and Analysis

The information collected was entered into electronic data collection forms created with Google Forms and double checked to avoid errors. It was later exported, processed and analyzed using Microsoft Excel 2019 and Statistical Package for So-

cial Sciences (SPSS) version 26. Frequencies and proportions were used to present categorical variables whereas continuous variables were presented in terms of mean (\pm SD) and median (IQR). Bivariate and multivariate logistic regressions were used to identify factors associated with in-hospital mortality and a p-value < 0.05 was considered statistically significant.

3. Results

A total of 6,760 hospital records of patients admitted at the surgical units of Limbe, Buea and Kumba Regional Hospitals over a five-year period (January 2019 to December 2023) were reviewed, of which 394 cases were admitted for DFU, giving a proportion of 5.8%. Thirty-four files were excluded, with 21 being discharged against medical advice (DAMA) and 13 with incomplete objective data, giving a definitive retained sample size of 360.

Of the 360 files retained 195 (54.2%) were males and 165 (45.8%) were females giving a sex ratio of 1.2:1. The ages ranged from 16 to 100 years with a mean age of 55.92 ± 15.19 years. Most represented age range was 41 - 60 years (49.2%) with majority being farmers (40.3%).

Fifty-four (15%) of them were diagnosed of diabetes on admission and 306 (85%) were aware of their diagnosis with a median duration of diagnosis of 60 (24 - 108) months. Hypertension was the most common comorbidity (49.3%), followed by HIV (16.7%) and kidney disease (9.3%) (**Table 1**).

Table 1. Socio-demographic characteristics of the retained files, N = 360.

Socio-demographic variable		Effective (n)	Percentage (%)
Gender	Male	195	54.2
	Female	165	45.8
Occupation	Farming	145	40.3
	Trader	101	28.1
	Teacher	12	3.3
	Health worker	18	5.0
	Others	84	23.3
Comorbidities	Hypertension	178	49.3
	Kidney disease	28	9.3
	History of foot ulcer	50	16.7
	History of amputation	22	7.3
	History of debridement	32	10.7
	HIV	50	16.7
	Smoking	37	12.3
	Alcohol	214	71.3
	Heart failure	11	3

With regards to the clinical patterns according to the Wagner system of classification, 172 presented with Wagner IV (47.8%) followed by Wagner V (24.2%) and anatomically the majority presented with ulcers at the forefoot (46.9%), followed by that on the hindfoot (30%) (**Table 2**).

Table 2. Clinical characteristics of diabetic foot ulcers.

Clinical characteristic		N (%)
Ulcer grade (Wagner)	2	18 (5.0)
	3	83 (23.1)
	4	172 (47.8)
	5	87 (24.2)
Anatomical Location	Forefoot	169 (46.9)
	Midfoot	83 (23.1)
	Hindfoot	108 (30)

Amongst the 360 patients, over 175 patients were managed surgically with major lower limb amputation (48.7%). 90 (51.4%) of patients had above knee amputations (AKA) and 62 patients (35.4%) had below knee amputations (BKA) (**Figure 1**). The rest were either managed by repeated surgical debridement (32.3%), bedside debridement (7%) or regular wound care (12%).

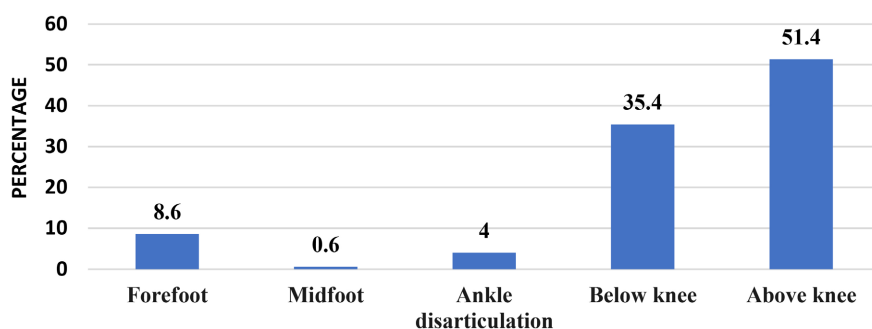


Figure 1. Level of lower limb amputation.

Over 19% of patients (n = 71) had complications following treatment with majority having surgical site infections and pressure ulcers (**Figure 2**).

132 (36.7%) of patients were hospitalized for >16 days with a median duration being 14 days. Seventy-three patients (20.3%) died during hospitalization while the rest of the patients were discharged after achieving satisfactory wound healing and clinical recovery (79.7%) (**Figure 3**).

On bivariate logistic regression analysis, factors such as age > 60 years, presence of hypertension (p = 0.013), renal disease (p = 0.002), Wagner grade > 3 (p < 0.001), and the development of SSI (p = 0.001), were significantly associated with high mortality. However, on multivariate analysis the factors that were inde-

pendently associated with higher in-hospital mortality were Hypertension and the Development of SSI (aOR 2.680, $p < 0.017$ and aOR 12.562, $p < 0.001$ respectively) (Table 3).

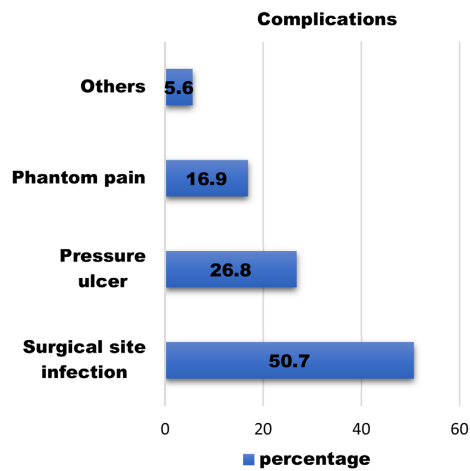


Figure 2. Complications following treatment.

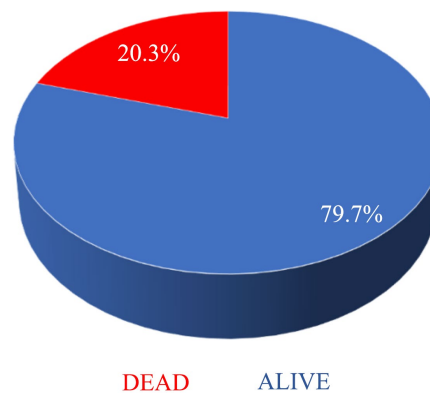


Figure 3. Survival outcome of diabetic foot ulcer.

Table 3. Multivariate analysis for independent associated factors for higher in-hospital mortality in patients with DFU.

	Alive	Dead	aOR	95% CI (lower - upper)	p value
Disease duration					
Newly diagnosed	48	6	0.225	0.086 - 0.587	0.002
<1 - 5 years	98	17	1.618	0.283 - 6.438	0.707
>5 years	141	50	1.414	0.214 - 8.800	0.009
SSI	40	31	12.562	3.250 - 48.552	<0.001
Hypertension (yes)	109	39	2.680	1.190 - 6.034	0.017

4. Discussion

In this study we had a mean age of 55.92 ± 15.19 years, similar to findings from

other studies done by Pemayun *et al.* in Indonesia, Shabbay *et al.* in Tanzania and Tamfu *et al.* in Cameroon [9]-[11].

Males were more affected than females [9] [12]-[14]. This correlates with the reported high prevalence of diabetes mellitus in males than females coupled with the fact that males are more likely involved in risky behaviors (excessive alcohol consumption, smoking, poor diet and non-compliance to diabetic foot guidelines) which predispose them to injury, including the feet, and eventually foot disease.

This is in contrast with another studies done by Kim *et al.* in Korea and Pemayun *et al.* in Indonesia which showed no gender variations as females were as much affected as males [9] [12]. The median duration of diabetes was 60 (24 - 108) months. Majority (53%) had the disease for more than five years and 15% of the patients were newly diagnosed with diabetes mellitus at presentation which was similar to the 13.1% by Edo *et al.* in Nigeria and much higher than the 8% gotten by Mutonga *et al.* in Kenya [13] [14].

4.1. Clinical Patterns

The most common clinical pattern presented in our study was Wagner IV (47.8%) followed by Wagner V (24.2%). This was similar to the 44.3% (Wagner IV) seen in a study by Edo *et al.* in Nigeria [13]. In contrast, studies by Uivaraseanu *et al.* in Oradea and Kim *et al.* in Korea had Wagner III as the most common clinical pattern [12] [15]. In any case, all these results showed that the various populations all present with foot diseases in advanced stages.

The most frequent anatomical location of occurrence was the forefoot (46.9%) which was similar to the 49% gotten by Mutonga *et al.* in Nairobi Kenya [14]. This could be explained by the following factors: Peripheral neuropathy which also is a complication of poorly controlled diabetes mellitus renders the foot less sensitive and predispose it to trauma that may go unnoticed for long. This risk is enhanced by fragile terminal vascularization in the forefoot which renders healing difficult especially in a setting of poorly controlled diabetes mellitus. On the other hand, Estrella *et al.* in Mexico showed a predominance in hind foot (heel ulcers) [16], which was the second most common site in our study.

4.2. Treatment Modalities

The various treatment modalities were grouped into conservative (Analgesics, Insulinotherapy, antibiotherapy, wound dressing, debridement) and Surgical care (Major and minor amputation). The majority (48.7%) of those with Wagner IV & V were managed surgically with major limb amputation (BKA 35.4%, AKA 51.4%). This was similar to the 48.4 % by Tamfu *et al.* in 2023 and the 48.21% by Bahebeck *et al.* [11] [17]. In contrast, Forde and collaborators in Ireland [18] had 28.6% treated by major limb amputations. This difference could be explained by their advancement in plateau technique, the availability of multidisciplinary teams including vascular surgeons and also their higher socioeconomic status with stable health insurance policies.

4.3. Outcome

In this study, 50.7% of patients with complications developed SSI, pressure ulcers (26.8%) and phantom limb pain (15.3%). This was similar to the 64% surgical site infections gotten by Fitriyaningsih *et al.* in 2025 [19]. This could be explained by vascular insufficiency which is often a complication of advanced diabetes, systemic comorbidities and immunodepression (DM, HIV, malnutrition) which render poor healing. In contrast Kooijman and collaborators reported phantom limb pain as the leading post amputation complication [20].

A mortality rate of 20.3% was recorded which was similarly seen in a study done in 2020 by Adeleye *et al.* (21.4%) in Nigeria [21]. Late presentation and high rate of complications could account for this high mortality. Foryoung *et al.* in 2018 found a much lower mortality in their study (8.6%) [22]. Factors such as an associated hypertension ($p < 0.017$ aOR: 2.680), and the development of surgical site infections ($p < 0.001$ aOR: 12.562), were significant independent predictive factors for higher mortality. This could be explained by the effect of HTN on blood vessels which impair blood flow to organs and in turn decreases the oxygen supply to tissues thereby delaying wound healing, increasing the risk of infection or sepsis which further impacts patient mortality. Furthermore, HTN is a known risk factor for cardiovascular diseases which may be lethal. The actual mortality rate in this study could be higher if those who refused surgery or got discharged against medical advice were considered.

5. Conclusion

DFU is a common chronic complication in hospitalized patients with diabetes mellitus. Its most common clinical patterns according to the Wagner Meggitt's classification system are grades IV and V, anatomically located at the forefoot. Major lower extremity amputations are the most frequent treatment modality. However, mortality remains high following treatment aggravated principally by the presence of comorbidities like hypertension and the development of surgical site infection. Hence, there is a need for comprehensive care models with trained multidisciplinary teams to increase the effectiveness in the treatment of DFUs. With early detection of diabetes mellitus, identification of comorbidities like hypertension; timely interventions and effective wound care, the burden of diabetes mellitus will be greatly mitigated, alongside its attendant complications such as diabetic foot ulcers.

Limitation

The retrospective nature of data collection meant valuable information could have been left out during recruitment. Also possible physician hand written diagnoses or misclassification and the exclusion of incompletely filled-in files and those discharged against medical advice, constitute a major setback in the generalization of our findings. Also, we did not consider the glycemia control values, presence of

peripheral arterial disease and results of microbiology analysis.

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Conflicts of Interest

The authors declare that they have no competing interests

References

- [1] (2023) World Health Organization (WHO). <https://www.who.int>
- [2] Abbas, Z.G. and Boulton, A.J.M. (2022) Diabetic Foot Ulcer Disease in African Continent: ‘From Clinical Care to Implementation’—Review of Diabetic Foot in Last 60 Years—1960 to 2020. *Diabetes Research and Clinical Practice*, **183**, Article ID: 109155. <https://doi.org/10.1016/j.diabres.2021.109155>
- [3] Google Scholar (2023) Federation: International Diabetes Atlas. https://scholar.google.com/scholar_lookup?title=International-al+diabetes+atlas&author=ID+Federation&publication_year=2017&
- [4] Zhang, P., Lu, J., Jing, Y., Tang, S., Zhu, D. and Bi, Y. (2017) Global Epidemiology of Diabetic Foot Ulceration: A Systematic Review and Meta-Analysis. *Annals of Medicine*, **49**, 106-116. <https://doi.org/10.1080/07853890.2016.1231932>
- [5] Rigato, M., Pizzol, D., Tiago, A., Putoto, G., Avogaro, A. and Fadini, G.P. (2018) Characteristics, Prevalence, and Outcomes of Diabetic Foot Ulcers in Africa. a Systemic Review and Meta-Analysis. *Diabetes Research and Clinical Practice*, **142**, 63-73. <https://doi.org/10.1016/j.diabres.2018.05.016>
- [6] Tindong, M., Palle, J.N., Nebongo, D., Aminde, L.N., Mboue-Djieka, Y., Mbarga, N.T.F., *et al.* (2018) Prevalence, Clinical Presentation, and Factors Associated with Diabetic Foot Ulcer in Two Regional Hospitals in Cameroon. *The International Journal of Lower Extremity Wounds*, **17**, 42-47. <https://doi.org/10.1177/1534734618764252>
- [7] Andrew J.M. Boulton, *et al.* (2008) Comprehensive Foot Examination and Risk Assessment: A Report of the Task Force of the Foot Care Interest Group of the American Diabetes Association, with Endorsement by the American Association of Clinical Endocrinologists. *Diabetes Care*, **31**, 1679-1685. <https://diabetesjournals.org/care/article/31/8/1679/28543/Comprehensive-Foot-Examination-and-Risk>
- [8] Armstrong, D.G., Tan, T., Boulton, A.J.M. and Bus, S.A. (2023) Diabetic Foot Ulcers. *JAMA*, **330**, 62-75. <https://doi.org/10.1001/jama.2023.10578>
- [9] Pelayun, T.G.D. and Naibaho, R.M. (2017) Clinical Profile and Outcome of Diabetic Foot Ulcer, a View from Tertiary Care Hospital in Semarang, Indonesia. *Diabetic Foot & Ankle*, **8**, Article ID: 1312974. <https://doi.org/10.1080/2000625x.2017.1312974>
- [10] Shabhay, A., Horumpende, P., Shabhay, Z., Mganga, A., Van Baal, J., Msuya, D., *et al.* (2021) Clinical Profiles of Diabetic Foot Ulcer Patients Undergoing Major Limb Amputation at a Tertiary Care Center in North-Eastern Tanzania. *BMC Surgery*, **21**, Article No. 34. <https://doi.org/10.1186/s12893-021-01051-3>
- [11] Tamfu, N.S., Gustave, T.J., Ngeh, E.N., Kwijirba, N.B. and Christopher, P.T. (2023) Indications and Complications of Lower Extremity Amputations in Two Tertiary

- Hospitals in the North West Region of Cameroon. *Pan African Medical Journal*, **44**, Article 196. <https://doi.org/10.11604/pamj.2023.44.196.34969>
- [12] Kim, S., Kim, T.H., Choi, J., Kwon, Y., Choi, D.H., Kim, K.C., *et al.* (2018) Predictors for Amputation in Patients with Diabetic Foot Wound. *Vascular Specialist International*, **34**, 109-116. <https://doi.org/10.5758/vsi.2018.34.4.109>
- [13] Edo, A., Edo, G. and Ezeani, I. (2013) Risk Factors, Ulcer Grade and Management Outcome of Diabetic Foot Ulcers in a Tropical Tertiary Care Hospital. *Nigerian Medical Journal*, **54**, 59-63. <https://doi.org/10.4103/0300-1652.108900>
- [14] Mutonga, D.M., Mureithi, M.W., Ngugi, N.N. and Otieno, F.C. (2019) Diabetic Foot Ulcers in a Kenyan Referral and Teaching Hospital: Risk Factors, Patient Characteristics and Clinical Outcomes. *Series of Endocrinology, Diabetes and Metabolism*, **1**, 41-51.
- [15] Uivaraseanu, B., Bungau, S., Tit, D.M., Fratila, O., Rus, M., Maghiar, T.A., *et al.* (2020) Clinical, Pathological and Microbiological Evaluation of Diabetic Foot Syndrome. *Medicina*, **56**, Article 380. <https://doi.org/10.3390/medicina56080380>
- [16] Cervantes-García, E. and Salazar-Schettino, P.M. (2017) Clinical and Surgical Characteristics of Infected Diabetic Foot Ulcers in a Tertiary Hospital of Mexico. *Diabetic Foot & Ankle*, **8**, Article ID: 1367210. <https://doi.org/10.1080/2000625x.2017.1367210>
- [17] Bahebeck, J., Sobgui, E., Fonfoe, L., Nonga, B.N., Mbanya, J.C. and Sosso, M. (2010) Limb-Threatening and Life-Threatening Diabetic Extremities: Clinical Patterns and Outcomes in 56 Patients. *The Journal of Foot and Ankle Surgery*, **49**, 43-46. <https://doi.org/10.1053/j.jfas.2009.08.011>
- [18] Forde, H., Wrigley, S., Casserly, S., *et al.* (2020) Five-Year Outcomes of Patients Attending a Diabetic Foot Clinic in a Tertiary Referral Centre. *Irish Journal of Medical Science*, **189**, 511-515.
- [19] Fitrianiingsih, F., Veryanti, P.R., Yunir, E., Saptaningsih, A.B. and Sauriasari, R. (2025) Factors Affecting Mortality in Diabetic Foot Ulcer Infection Patients in National Referral Hospital, Jakarta, Indonesia: 4-Year Cross-Sectional Study. *Journal of Applied Pharmaceutical Science*, **15**, 262-273. <https://doi.org/10.7324/japs.2025.209241>
- [20] Soliman, M. and Rajbhandari, S. (2013) Assessing Outcome of Diabetic Foot Ulcers and Multidisciplinary Foot Clinic. *Current Diabetes Reviews*, **9**, 397-401. <https://doi.org/10.2174/15733998113099990075>
- [21] Adeleye, O.O., Ugwu, E.T., Gezawa, I.D., Okpe, I., Ezeani, I. and Enamino, M. (2020) Predictors of Intra-Hospital Mortality in Patients with Diabetic Foot Ulcers in Nigeria: Data from the MEDFUN Study. *BMC Endocrine Disorders*, **20**, Article No. 134. <https://doi.org/10.1186/s12902-020-00614-4>
- [22] Fournier, C., Singbo, N., Morissette, N. and Thibeault, M. (2021) Outcomes of Diabetic Foot Ulcers in a Tertiary Referral Interdisciplinary Clinic: A Retrospective Canadian Study. *Canadian Journal of Diabetes*, **45**, 255-260. <https://doi.org/10.1016/j.cjcd.2020.09.004>