

Diabetic Foot: Epidemiological, Therapeutic and Evolutionary Aspects in the Department of Medicine and Endocrinology of the Hospital in Mali, Mali

Nanko Doumbia^{1,2*}, Adama Alexis Diarra³, Seydou Mariko^{2,4}, Drissa Sangare^{2,5}, Danfaga Bakary³, Nouhoum Ouologuem^{1,2}, Samaké Magara^{2,6}, Sekou Mamadou Cisse⁵, Mamady Coulibaly^{2,7}, Mahamadou Saliou^{2,8}, Bakary Dembele², Yacouba L. Diallo^{1,2}, Amadou Kone¹, Modibo Mariko¹, Bah Traore¹, Massama Konate^{1,9}, Djenebou Traore^{9,10}, Djeneba Sylla^{1,9}, Kaya Assetou Soucko^{9,10}, Assa Traore⁹

¹Department of Medicine of the Mali Hospital, Bamako, Mali

²National Center for Scientific and Technological Research (CNRST), Bamako, Mali

³Kati Reference Center, Kati, Mali

⁴Gynaecology Department of the Mali Hospital, Bamako, Mali

⁵Department of Medicine and Medical Specialty of the Fousseyni Daou Hospital, Kayes, Mali

⁶Nephrology Unit of the Fousseyni DAOU Hospital, Kayes, Mali

⁷Health and Social Affairs Department of the National Police, Bamako, Mali

⁸Internal Medicine Department of the Gabriel Toure University Hospital, Bamako, Mali

⁹Faculty of Medicine, Bamako, Mali

¹⁰Internal Medicine Service of the Point G University Hospital, Bamako, Mali

Email: *docteurdoumbia@gmail.com

How to cite this paper: Doumbia, N., Diarra, A.A., Mariko, S., Sangare, D., Bakary, D., Ouologuem, N., Magara, S., Cisse, S.M., Coulibaly, M., Saliou, M., Dembele, B., Diallo, Y.L., Kone, A., Mariko, M., Traore, B., Konate, M., Traore, D., Sylla, D., Soucko, K.A. and Traore, A. (2022) Diabetic Foot: Epidemiological, Therapeutic and Evolutionary Aspects in the Department of Medicine and Endocrinology of the Hospital in Mali, Mali. *Journal of Diabetes Mellitus*, 12, 18-27.

<https://doi.org/10.4236/jdm.2022.121003>

Received: October 10, 2021

Accepted: December 14, 2021

Published: December 17, 2021

Abstract

Introduction: The diabetic foot remains a public health problem due to its high frequency, difficult and costly management. The aim of this study was to determine the epidemiological, therapeutic and evolutionary aspects of the diabetic foot in a hospital setting in Bamako. **Methodology:** This is a retrospective, descriptive, cross-sectional and monocentric study conducted between September 1, 2011 and December 31, 2015 on diabetic patients aged 14 years and older arriving in our department with a foot infection. **Results:** We identified 94 cases of diabetic foot infection out of a total of 828 hospitalized patients, a prevalence of 11.35%. The age range 41 - 60 years represented 57 cases (60.6%), the extreme ages were 14 and 81 years. Men (38.3%), women (61.7%) with a sex ratio of 0.62%. Housewives 50%, illiterate 51 cases (54.3%), low economic standard of living 40 cases (42.6%), presence of osteitis 40 cases (42.6%), foot at stage D Grade3 28 cases (29.8%). Management was medical in 48 cases (51.1%), treatment with insulin 58 cases (61.7%), Amoxicillin +



Metronidazole used 36 cases (38.29%). Amputation was performed in 35 cases (37.2%). Deaths concerned 5 patients (9.6%) with hypoglycemia as the main cause in 4 cases. **Conclusion:** Diabetic foot is a frequent complication of diabetes. The establishment of a multidisciplinary team should contribute to the improvement of the prognosis of the diabetic foot in a management center.

Keywords

Diabetic Foot, Epidemiology, Therapeutics, Evolution, Mali Hospital

1. Introduction

According to the WHO, the number of people with diabetes worldwide has increased from 108 to 422 million over the past 30 years [1]. In Belgium, this number increased from around 300,000 to over 500,000 individuals between 2001 and 2011 [2]. Projections for 2030 are over one million [3]. In Africa, the number of diabetics was estimated at 14.2 million people in 2015 and 34.2 million are expected in 2040 [4].

The diabetic foot is defined according to the international consensus on the diabetic foot (developed by IWGDF: International Working Group on Diabetic Foot) of 2007 as any Infection, ulceration or destruction of the deep tissues of the foot associated with neuropathy and/or peripheral arterial disease of the lower limbs in diabetics [5].

These lesions in ill-balanced patients, difficult and expensive to treat most often lead to amputation, which makes this pathology a major public health problem, especially noting that every 30 seconds, a lower limb will be lost due to the diabetes [6].

Diabetic foot is a frequent and serious complication of diabetes with a very high rate of amputations of the lower limbs and often dramatic socio-economic and psychological consequences [7].

In Africa, foot injuries in diabetics are unfortunately very common. Poverty, poor hygiene and barefoot walking interact to aggravate the impact of foot injuries caused by diabetes [8]. In Mali there are few studies on diabetic foot [9] and there is an increase in the number of cases in the department. The objective of this study was to describe the epidemiological, therapeutic and evolutionary profile of the diabetic foot in a hospital setting in Mali.

2. Methodology

We conducted a retrospective, descriptive, cross-sectional study between September 1, 2011 and December 31, 2015 among diabetic patients aged 14 and over who arrived in the endocrinology/medicine department of the hospital in Mali.

Inclusion criteria:

- Study: retrospective, descriptive, transversal.

- Duration: 4 years and 3 months.
- Be 14 years old and over.
- All diabetic patients who arrive in the endocrinology department of the hospital in Mali with a foot infection.
- We collected clinical, paraclinical and therapeutic data from these patients.
- Voluntary and informed consent was given in writing before being enrolled in the study.

Non-inclusion criteria:

We excluded from our series the incomplete files as well as the other causes apart from the diabetic foot.

Information was collected from patient charts using survey forms on which diabetic foot lesions were described according to the Texas classification (see **Table 1**). The questionnaires were entered and analyzed on Excel 2007 and SPSS version 20.0 software after data verification.

3. Results

We identified 94 cases of diabetic foot out of a total of 828 hospitalized patients, *i.e.* a prevalence of 11.35%. The age range 41 - 60 years represented (60.6%), the extreme ages were 14 and 81 years (Cf. **Table 2**). Men 36 cases (38.3%), women 57 cases (60.6%) with a sex ratio of 0.62%. Housewives 47 cases 50% (see **Figure 1**). Non-educated people 51 cases (54.3%) (see **Figure 2**). The economic standard of living was considered low in 40 cases (42.6%) and sufficient in 54 (57.4%). The presence of osteitis was observed in 40 cases (42.6%). Doppler ultrasound was abnormal in 48 patients (51%) (see **Figure 3**). Cytobacteriological examination of the pus was positive in 56 cases (59.6%). Staphylococcus aureus was found in 21 samples (22.4%) (see **Table 3**). The wounds were classified as stage D Grade 3 in 28 cases (29.8%) (see **Table 4**). Fifty-nine (61.7%) and 25.5% of the

Table 1. University of Texas classification (UT).

	Grade 0 Lesion epithelialized	Grade 1 Wound superficial	Grade 2 Tendon involvement	Grade 3 Damage to the bone or joint
Stage A No infection No ischemia	0A	1A	2A	3A
Stage B Infection, but No ischemia	0B	1AB	2B	3B
Stage C No infection But ischemia	0C	1C	2C	3C
Stage D Infection and ischemia	0D	1D	2D	3D

Table 2. Age distribution of patients.

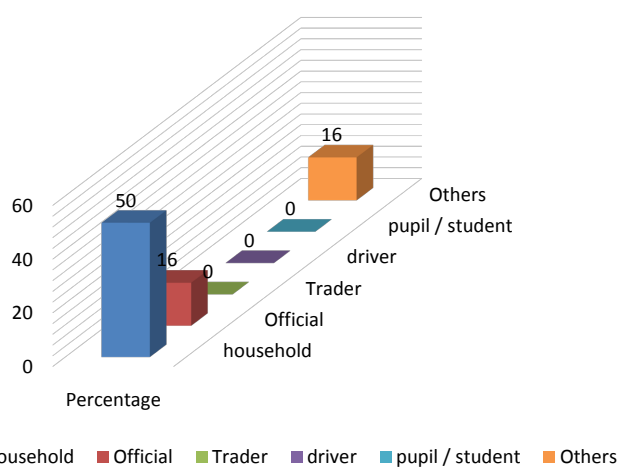
AGE (year)	Workforce	Percentage
14 - 20	1	1.06
21 - 40	7	7.98
41 - 60	57	60.6
61 - 81	28	29.79
Total	94	100

Table 3. Distribution according to the germs found in the culture.

Isolated germs	Workforce	Percentage
<i>Staphylococcus aureus</i>	21	22.34
<i>Klebseilla Pneumonioux</i>	9	9.57
<i>E. coli</i>	11	11.70
<i>Morganella morga</i>	6	6.38
<i>Protus mirabilis</i>	5	5.31
<i>Pseudomonas aeruginosa</i>	4	4.25
Sterile	37	39.36
Not done	1	1.06
Total	94	100

Table 4. Distribution of patients by Texas classification.

Grade	Wound stage			
	Stage A	Stage B	Stage C	Stage D
Grade 0	5	2	0	0
Grade 1	8	19	0	0
Grade 2	0	16	5	4
Grade 3	0	4	3	28
Total	13	41	8	32

**Figure 1.** Distribution of patients by occupation.

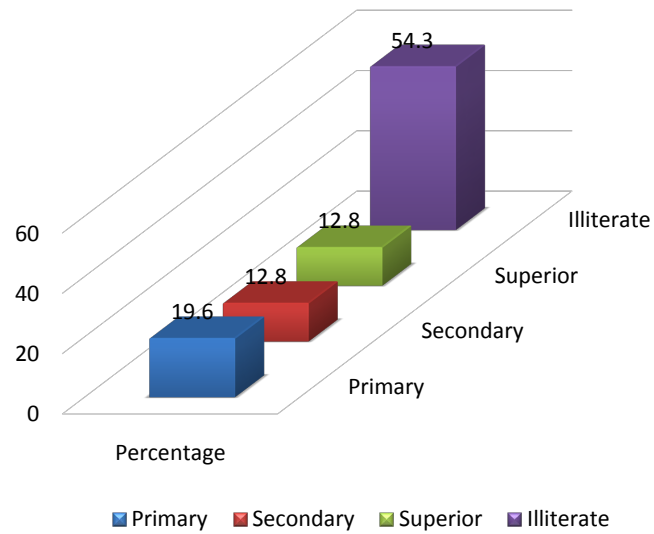


Figure 2. Distribution of patients by education level.

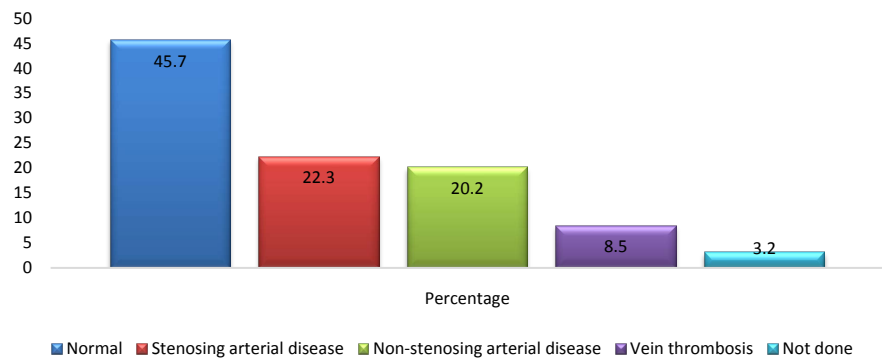


Figure 3. Distribution of patients by Doppler ultrasound findings.

patients were on insulin and oral anti-diabetic drugs respectively, while 12.8% had no anti-diabetic treatment. Medical treatment was mainly Amoxicillin + Metronidazole used in 36 cases (38.29%) and amputation was performed in 35 cases (37.2%) (Cf. **Table 5**, **Table 6**). The evolution was favorable in 85 cases (90.4%), 9.6% (5 patients) died of which the main causes were hypoglycemia in 4 cases and sepsis in 3 cases.

4. Discussion

The study included 94 cases out of a total of 828 hospitalized patients, for a prevalence of 11.35%. This hospital prevalence is close to those reported by Djim. F *et al.* [9] and Koffi D [10] respectively 16.37% and 15.29%. In Africa, it is estimated overall at 5.5% [11] and in France (ENTRED), the prevalence is 6% [12].

The 41 - 60 age group was the most represented, 60.6%, Djim. F *et al.* [9] found 59.6%. The average age was 42.66 years, other African studies: SANIR *et al.* [13], Nghario L *et al.* [14], Gueye D.D *et al.* [15], Dr Merad M S *et al.* [16], Mohaman Djibril *et al.* [17] found respectively 53 years, 54 years, 57 years, 60.5 years, 60.74 years. That reported in European literature varies between 67 years

Table 5. Distribution of patients according to the type of antibiotics used.

Antibiotics	Workforce	Percentage
Ciprofloxacin + Metronidazole	36	38.29
Amoxicillin + acid Clavilanique + Gentamicine	19	20.21
Ceftriaxone + Gentamicine	14	14.89
Fusidic acid	11	11.70
Cefotaxime	6	6.38
Imipenème	8	8.51
Total	94	100

Table 6. Distribution of patients according to surgical management.

Therapeutic gestures	Workforce	Percentage
Disarticulation of the toes	9	9.6
Transmetatarsal amputation	4	4.3
Trans-femoral amputation	2	2.1
Amputation of the lower 1/3 of the leg	9	9.6
Amputation of the middle 1/3 of the leg	5	5.3
Amputation of the upper 1/3 of the leg	6	6.4
Revascularization	1	1.1
Disarticulation of the knee	1	1.1
Not applicable	57	60.6
Total	94	100

and 73 years [18]. This age difference can be explained by the young age of onset of diabetes in African populations, but above all by poor treatment compliance by our patients. The reasons for this poor compliance are multiple: the non-acceptance of diabetes, traditional therapy, beliefs and especially poverty [19].

Women were in the majority (61.7%) against 38.3% for men with a sex ratio of 0.62%. This female predominance has been noted by some authors such as Samaké D [20]. On the other hand, the male predominance which has been studied by Dr Merad M S *et al.* [16] (sex ratio M/F 2.33) is a phenomenon confirmed by several authors. Sani *et al.* [13] found a sex ratio of 2.46; it is 2.5 for Amoussou-Guenou [21]. The generally recognized poor adherence to therapy in men explained this male predominance [22].

Housewives were the most represented in our study (50%). This same predominance was observed by Djim F *et al.* [9] 53.3%.

The majority of our patients were not educated with 54.3%. This same result was observed by Traoré D.Y [23] 55.5% and Nghario L *et al.* [14] 47%. In fact, ignorance of the diabetic status due to illiteracy has also been reported in a variable proportion in the African literature: 13.1% in Niger [24]; 27.9% in Tanzania [25].

The socio-economic level was low in 42.6%, Nghario L *et al.* [14] found a low level in 66.10% of patients. The Doppler ultrasound was abnormal in 51% of our patients. Djim F C. *et al.* [9] had 48.6% arteriopathy of the lower limbs and 20% obliteration.

The presence of germs was noted in 59.6% of samples taken from wounds. Nghario L *et al.* [14] had reported in 50% of his samples.

Among the germs isolated, staphylococcus aureus was found more in 22.4%, the same germ was the most isolated in 16.13% in Djim F C. *et al.* [9]. On the other hand, in the Aouam study [26], the most frequently found germ was *Pseudomonas aeruginosa*. A study done in India and published in 2017 found poly-microbial infections in 54% with other mono-microbial in 43%. [27]. In Morocco the bacteriological sample carried out had objectified the multisensitive Staphylococcus aureus in 28.23% [28].

According to the University of Texas classification, the foot was classified as stage D Grade 3 in (29.8%), Guèye D.D *et al.* [15] found grade 1b lesions which represented 34.0%, followed by 26.4% by grade 2d lesions and 24.5% by grade 3d lesions. Also, Dr Merad M S *et al.* [16], had found osteitis at Stage 3D in 46% of patients.

During hospitalization, insulin therapy alone was started in 61.7% of cases. This result was with Djim F *et al.* [9] in Mali with 95.7% insulin therapy and Dr L. Elazizi *et al.* [29] had performed insulin therapy in 77.20% of patients. The most widely used antibiotic therapy was the combination Ciprofloxacin + Metronidazole in 38.29% of cases, the same combination found in Djim F *et al.* [9] at 37.8%. Similarly, this antibiotic therapy was generally introduced by Dr L. Elazizi *et al.* [29] in 89.20%.

Amputation was performed in 37.2% of our patients including 24.3% in the lower 1/3 of the leg, 16.3% in the upper 1/3 of the leg and a disarticulation of the big toe in 24, 3% of cases. SANLR *et al.* [13] found amputation in 37 cases (41.1%), of which the amputation site was the foot in 23 cases (62.2%) followed by the leg in 11 cases (29, 7%) and the thigh in 3 cases. Case (8.1%), as well as authors such as Sidibé AT *et al.* [30] and Merad M S *et al.* [16] reported respectively 41.36% and 34% of amputations in their studies.

The outcome was favorable in 90.4% of cases, other favorable results have been reported by authors such as Koffi D [10] which reported 91.70% and 71% of cases in Assia EL Ouarradi [31].

We recorded a mortality rate of 9.6% during the study period. This rate was reported at Djim. F *et al.* [9], Sidibé AT *et al.* [30], Gueye D.D *et al.* [15], SANLR *et al.* [13], Djibril *et al.* [17] respectively 10.6%; 5.75%; 16.9%; 16.7%; 6.45%. Hypoglycemia in 4.3% of cases was the leading cause of death. Djim. F *et al.* [9] found that sepsis was the cause of death (60%) and for Nghario L *et al.* [14] sepsis and hyperglycemia were the main causes of death in 50% of cases.

5. Conclusion

Foot lesions are relatively frequent in our diabetic patients, and are responsible

for high mortality and morbidity. A delay in management with lesions received at advanced stages is always noted. The management of the diabetic foot must be multidisciplinary.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] OMS (Organisation mondiale de la santé) (2016) Rapport mondial sur le diabète. Organisation mondiale de la santé, Geneva.
- [2] OMS (Organisation mondiale de la santé) (2016) Rapport Belgique sur le diabète. Organisation mondiale de la santé, Geneva
- [3] Alliance Nationale des Mutualités Chrétiennes (2012) Rapport sur l'épidémiologie du diabète.
- [4] International Diabetes Federation (2015) Diabetes Atlas. 7th Edition. International Diabetes Federation, Brussels.
- [5] International Working Group in the Diabetic Foot (2007) International Consensus on the Diabetic Foot Ant Practical Guidelines on the Management and Prevention oh the Diabetic Foot. *Journal of Medical Rehabilitation: Practice and Training in Physical Medicine and Rehabilitation*, **31**, 14-21.
- [6] El Hariri, L.R. (2005) Communiqué de presse de la Fédération Mondiale du diabète Diabète: Évitions l'amputation. Doctissimo, Articles 9039. <http://www.doctissimo.fr/dossierdiabete>
- [7] Dia, A.M., Affangla, A.D., Dione, J.M., Akpo, G., Mbengue, M., Ka, M.M., *et al.* (2015) Apport de l'écho-doppler artériel des membres inférieurs dans la prise en charge du pied diabétique à l'hôpital Saint-Jean de Dieu de Thiès (Sénégal). *Pan African Medical Journal*, **22**, Article No. 193. <https://doi.org/10.11604/pamj.2015.22.193.5992>
- [8] Monabeka, H.G. and Nsakala-Kibangou, N. (2001) Aspects épidémiologiques et cliniques du pied diabétique au CHU de Brazzaville. *Bulletin de la Société de Pathologie Exotique*, **94**, 246-248.
- [9] Djim, F.C. (2014) Fréquence et prise en charge des pieds diabétiques dans le service de médecine et d'endocrinologie de l'hôpital du Mali Med. FMOS, Bamako.
- [10] Koffi, D.P. (2013) Pied diabétique dans le service d'endocrinologie -diabétologie du CHU de Yopougon, février2013, Yopougon; Colloque SERVIER-2013. [En ligne].
- [11] 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>
- [12] Richard, J.L. and Schuldiner, S. (2008) Epidémiologie du pied diabétique. *La Revue de Médecine Interne*, **29**, S222-S230. [https://doi.org/10.1016/S0248-8663\(08\)73949-3](https://doi.org/10.1016/S0248-8663(08)73949-3)
- [13] sani, R., *et al.* (2010) Le pied diabétique: Aspects épidémiologiques, cliniques et thérapeutiques à l'hôpital national de Niamey A propos de 90 cas. *Medecine D'Afrique Noire*, **57**, 172-176.
- [14] Nghario, L., *et al.* (2017) Les pieds diabétiques: Aspects épidémiologique, clinique et thérapeutique à propos de 62 cas. *Revue de chirurgie d'Afrique centrale (recac)*, **2**,

9-24.

- [15] Guèye, D.D., *et al.* (2020) Profil épidémiologique et évolutif du pied diabétique au Centre Hospitalier Régional de Saint-Louis. *Revue Africaine de Médecine Interne*, **7**, 14-18.
- [16] Merad, M.S., *et al.* (2019) Les infections du pied diabétique à la Clinique Larribère. *Congres de la société Algérienne de diabetologie (SADIAB)*, Alger, 14-16 novembre 2019, 12.
- [17] Djibril, M., *et al.* (2018) Pied diabétique: Aspects épidémiologique, diagnostique, thérapeutique et évolutif à la Clinique Médico-chirurgicale du CHU Sylvanus Olympio de Lomé. *The Pan African Medical Journal*, **30**, Article No. 4. <https://doi.org/10.11604/pamj.2018.30.4.14765>
- [18] Carpentier, B., Pradines, S., Benhamou, P.Y. and Halimi, S. (2000) Health Costs Associated with the Diabetic Foot in Developed Countries: A Plea for the Creation of Healthcare Networks. *Diabetes Metabolism*, **26**, 75-80.
- [19] Goeh-akue, E., Pio, M., Afassinou, Y., Baragou, S., Mossi, K.E., Pessinaba, S., *et al.* (2015) Apport de l'écho doppler vasculaire dans le diagnostic lésionnel du pied diabétique ouvert chez le diabétique de type 2 à Lomé. *Angéiologie*, **67**, 1-7.
- [20] Samaké, D. (2005) Etude épidémiologique des amputations consécutives aux complications du diabète dans le service de chirurgie orthopédique et traumatologique de l'Hôpital Gabriel Toure. Thèse: Med, FMOS, Bamako, N = 05M155.
- [21] Amoussou-Guenou, D., Wanvoegbe, F.A., Boko, E., Segnon-agueh, J., Agbodande, K.A., Kerekou, A., *et al.* (2015) Aspects bactériologiques des plaies et leur prise en charge chez les diabétiques à Cotonou: Étude prospective à propos de 42 cas. *Médecine d'Afrique Noire*, **62**, 241-246.
- [22] Bidingua, M., Kayembe, K. and Ditu, M. (2004) Profil clinique du pied diabétique: À propos de 63 cas suivis à la Clinique Universitaire de Kinshasa. *Congo Médical*, **3**, 1304-1311.
- [23] Traoré, D.Y. (2013) La prévalence de la neuropathie diabétique en commune I du district de Bamako. Thèse: Med, FMOS, Bamako, N = 13M203.
- [24] Edo, A.E., Edo, G.O. and Ezeani, I.U. (2013) Risk Factors Ulcer Grade and Management Outcome of Diabetic Foot Ulcers in a Tropical Tertiary Care Hospital. *Nigerian Journal of Medicine*, **54**, 59-63. <https://doi.org/10.4103/0300-1652.108900>
- [25] Chalya, P.L., Mabula, J.B., Dass, R.M., *et al.* (2011) Surgical Management of Diabetic Foot Ulcers: A Tanzania University Teaching Hospital Experience. *BMC Research Notes*, **4**, Article No. 365. <https://doi.org/10.1186/1756-0500-4-365>
- [26] Aouam, A., Sayadi, H., Sallem, O., Kechida, M. and Khochtali, I. (2018) Prise en charge des pieds diabétiques infectés: À propos de 54 cas. *Annales d'Endocrinologie*, **79**, 462. <https://doi.org/10.1016/j.ando.2018.06.984>
- [27] Saseedharan, S., Sahu, M., Chaddha, R., Pathrose, E., Bal, A., Bhalekar, P., Sekar, P. and Krishnan, P. (2018) Epidemiology of Diabetic Foot Infections in a Reference Tertiary Hospital in India. *Brazilian Journal of Microbiology*, **49**, 401-406. <https://doi.org/10.1016/j.bjm.2017.09.003>
- [28] Laidi, S., El Aziz, S. and Chadli, A. (2016) Prise en charge du pied diabétique infecté au CHU Ibn Rochd de Casablanca: À propos de 244 cas. *Annales d'Endocrinologie*, **77**, 498-528. <https://doi.org/10.1016/j.ando.2016.07.805>
- [29] Elazizi, L., Lazar, N., Mohib, A., *et al.* (2021) Pied diabétique: Aspects épidémiologique, diagnostique, thérapeutique et évolutif. *Annales d'Endocrinologie*, **82**, 492. <https://doi.org/10.1016/j.ando.2021.08.698>

- [30] Sidibé, A.T., *et al.* (2006) Pied diabétique en médecine interne de l'hôpital du Point "G". *La Revue de Médecine Interne*, **8**, 14-17.
- [31] Ouarradi, A.E.L. (2019) Pied diabétique: Profil épidémiologique thérapeutique et pronostique. Thèse No. 106, Faculté de médecine et de Pharmacie, Marrakech.