



RESEARCH: CARE DELIVERY

Impact of the COVID-19 Epidemic on hospitalization for diabetic foot ulcers during lockdown: A French nationwide population-based study

Anne-Sophie Mariet^{1,2,3,4} | Eric Benzenine^{1,2,3,4} | Benjamin Bouillet^{5,6}  | Bruno Vergès^{5,6} | Catherine Quantin^{1,2,3,4} | Jean-Michel Petit^{5,6} 

¹Biostatistics and Bioinformatics (DIM), Dijon University Hospital, Dijon, France

²University of Burgundy and Franche-Comte, Dijon, France

³INSERM, CIC 1432, Dijon, France

⁴Clinical Investigation Center, Clinical Epidemiology/Clinical Trials Unit, Dijon University Hospital, Dijon, France

⁵INSERM Unit, LNC-UMR 1231, University of Burgundy, Dijon, France

⁶Department of Endocrinology, Diabetes and Metabolic Disorders, Dijon University Hospital, Dijon, France

Correspondence

Jean-Michel Petit, Service de diabétologie, Centre Hospitalier Universitaire François Mitterrand - BP 77908, 21079 Dijon Cedex, France.
Email: jean-michel.petit@chu-dijon.fr

Abstract

Aims/hypothesis: The aim of this study was to examine the impact of the COVID-19 epidemic on the hospitalization rates for diabetic foot ulcer (DFU), osteomyelitis and lower limb revascularization procedure in people with DFU.

Methods: This nationwide retrospective cohort study included hospital data on all people hospitalized in France for diabetes in weeks 2–43 in 2020, including the COVID-19 lockdown period, compared to same period in 2019.

Results: The number of hospitalizations for DFU decreased significantly in weeks 12–19 (during the lockdown) ($p < 10^{-4}$). Hospitalization for foot osteomyelitis also decreased significantly in weeks 12–19 ($p < 10^{-4}$). The trend was the same for lower limb amputations and revascularizations associated with DFU or amputation.

Conclusions/interpretation: The marked drop in hospitalization rates for DFU, osteomyelitis and lower limb revascularization procedures in people with DFU observed in France during the lockdown period suggests that COVID-19 was a barrier to DFU care, and may illustrate the combined deleterious effects of hospital overload and changes in health-related behaviour.

KEY WORDS

diabetes foot ulcers, osteomyelitis, COVID-19, lockdown, hospital data, diabetes complications, lower limb amputations

What is already known about this subject?

- The spread of coronavirus disease 2019 (COVID-19) has led to significant disruption of health services. Management of diabetes care was deeply impacted during the lockdown.
- We lack reliable data regarding the impact of COVID-19 outbreak on diabetes management.

The aim of this study was therefore to examine the impact of the COVID-19 crisis on the hospitalization rates for diabetic foot ulcers (DFU), osteomyelitis and lower limb revascularization procedures in people with DFU.

What this study has found?

- We observed a marked drop in hospitalization rates for DFU, osteomyelitis and lower limb revascularization procedures in France during the lockdown period, suggesting that COVID-19 was a barrier to DFU care.

What are the clinical implications of the study?

- Given the potential deleterious medical consequences of under-hospitalization of patients with DFU, it is crucial to maintain an efficient care pathway for people with diabetes during health emergencies such as the COVID-19 crisis.

1 | INTRODUCTION

The spread of coronavirus disease 2019 (COVID-19) has induced a significant disruption of health services. In France, the management of diabetes care was deeply impacted in the first lockdown period, during which the population was strictly required to stay at home. The only accepted reasons for going out were for work (when teleworking was impossible), to do essential food shopping, to travel for health reasons, to assist vulnerable people and for individual physical activity or to take out a pet (limited to one hour per day). In some hospitals heavily impacted by the outbreak, diabetes departments were suspended and their staff redeployed to provide care to people with COVID-19. It is now known that people with diabetes have significantly increased COVID-19 severity and mortality.^{1,2} They also have COVID-19-specific issues related to their condition, and they were found to have poorer psychosocial health as a result of the COVID-19 crisis.³ During this period, there is also a fear of exposure in hospital environments because of the possibility of SARS-COV-2 contamination. The COVID-19 pandemic has thus made the management of diabetic foot ulcer (DFU), which is already complex, even more difficult.⁴ It has particularly affected the referral of patients to specialist diabetic foot teams, which is needed to avoid severe complications such as lower extremity amputation.⁵

We lack reliable data regarding the impact of the COVID-19 outbreak on diabetes management. However, there is a risk that the pandemic could have a negative impact on DFU management. For this reason, it seemed relevant to evaluate whether COVID-19 and the associated lockdown influenced hospitalization for diabetes complications. The aim of this study was therefore to examine the impact of the COVID-19 crisis on the hospitalization rates for DFU, osteomyelitis and lower limb revascularization procedures in people with DFU.

2 | RESEARCH DESIGN AND METHODS**2.1 | Hospitalization data**

Hospitalization data were extracted from the French National Hospital Discharge database (PMSI-MCO) (*Programme de*

Médicalisation des Systèmes d'Information en Médecine, Chirurgie, Obstétrique et Odontologie), which collects the medical records of all patients discharged from public and private hospitals in France. Diagnoses are recorded by physicians during the hospital stay and are coded according to the 10th Edition of the International Classification of Diseases (ICD-10). All procedures performed during the hospitalization are coded following the French Common Classification of Medical Procedures (CCAM). Hospitalizations included possible hospital transfers. All the data are compiled on a national level.

The principle of this nationwide historical cohort study was to examine the hospital data of all patients hospitalized for diabetes in France in 2019 and 2020. People with diabetes were identified on discharge abstracts with the ICD-10 codes E10 to E14 as the main, related or associated diagnoses.

2.2 | Outcomes

The main outcome of interest was hospitalization for DFU (infection, ulceration or destruction of tissues of the foot associated with neuropathy and/or peripheral artery disease in the lower extremity of a person with [a history of] diabetes mellitus) identified with at least one main, related or associated diagnosis codes (I70.21, L97 and S91) (Supplementary Table S1). Hospitalizations for foot osteomyelitis (infection of the bone, with involvement of the bone marrow) were identified with the relevant codes (M8607, M8617, M86.27, M86.37, M86.47, M86.57, M86.67, M86.87 and M86.97) (Supplementary Table S1). Lower limb amputations and revascularizations (associated with DFU, foot osteomyelitis or amputation) were identified with the relevant CCAM codes. Lower limb revascularizations associated with DFU, foot osteomyelitis or amputation included open vascular surgery and endovascular surgery. Lower limb amputation included minor amputation (any resection through or distal to the ankle) and major amputation (any resection proximal to the ankle).

2.3 | Statistical analysis

The number of stays per week was described for each outcome for weeks 2–43 in 2020 and in 2019. Three periods

were identified: before the lockdown (weeks 2–11), during the lockdown (weeks 12–19) and after the lockdown (weeks 20–43). In 2019, week 2 started on January 7, week 12 on March 18, week 20 on May 13 and week 44 on October 28. In 2020, week 2 started on January 6, week 12 on March 16, week 20 on May 11 and week 44 on October 26. For these three periods, we compared the proportion of hospitalizations for each outcome among French diabetics (3,300,000 individuals) in 2020 and in 2019 using a Pearson Chi-squared test. Analyses were performed with SAS 9.4 software for Windows (The SAS Institute). The tests were two-sided, and p values <0.05 were considered significant.

2.4 | Ethics

Data from the French hospital database were provided by the French national agency for the management of hospitalization data (*Agence Technique de l'Information sur l'Hospitalisation* [ATIH] no 2015-111111-47-33). The present study was approved by the French Institute of Health Data and by the French data protection authority, which did not require informed consent for the use of registry data.

3 | RESULTS

Diabetic patients hospitalized for one of the events of interest were on average 73.8 years old (standard deviation [SD]

12.4 years), 64% were men and 4.4% had type 1 diabetes. The number of hospitalizations for DFU (respective proportion of hospitalizations among French diabetics) before the lockdown (in weeks 2–11) increased significantly in 2020 compared to the same period in 2019 (17,420 [resp. 0.53%] vs 16,295 [0.49%], $p < 10^{-4}$) (Table 1). However, during the lockdown (in weeks 12–19), hospitalizations decreased drastically by 25.2% compared to the same period in 2019 (9,589 [0.29%] vs 12,825 [0.39%], $p < 10^{-4}$). After lockdown (in weeks 20–43), the number of hospitalizations for DFU was significantly higher in 2020 compared to the same period in 2019 (39,119 [1.19%] vs 36,513 [1.11%], $p < 10^{-4}$). For hospitalization for foot osteomyelitis, we observed no variation before the lockdown ($p = 0.94$), but a significant decrease during the lockdown (1,767 [0.05%] vs 2,294 [0.07%], $p < 10^{-4}$) and after the lockdown (6,740 [0.20%] vs 7,179 [0.22%], $p = 0.0002$), compared to the same periods in 2019 (Figure 1). The trend was the same for lower limb amputations and revascularizations associated with DFU, foot osteomyelitis or amputation.

4 | DISCUSSION

In this analysis of data covering all hospitalizations for people with type 1 and type 2 diabetes in France, we found a marked reduction in hospital admissions for DFU and osteomyelitis between the period directly before and during the lockdown in France. The impact of the COVID-19 outbreak

TABLE 1 Hospitalizations for diabetic foot ulcers, foot osteomyelitis, lower limb amputations and revascularizations among people with diabetes in 2020 versus 2019, before, during and after the lockdown in France

Hospitalization for:	Lockdown	2019		2020		p^*
		n	%	n	%	
Diabetic foot ulcer (DFU)	Weeks 2–11 ^a	16295	0.49	17420	0.53	$<10^{-4}$
	Weeks 12–19 ^b	12825	0.39	9589	0.29	$<10^{-4}$
	Weeks 20–43 ^c	36513	1.11	39119	1.19	$<10^{-4}$
Foot osteomyelitis	Weeks 2–11 ^a	2990	0.09	2984	0.09	0.94
	Weeks 12–19 ^b	2294	0.07	1767	0.05	$<10^{-4}$
	Weeks 20–43 ^c	7179	0.22	6740	0.20	0.0002
Lower limb amputation	Weeks 2–11 ^a	3071	0.09	3009	0.09	0.43
	Weeks 12–19 ^b	2425	0.07	2164	0.06	$<10^{-4}$
	Weeks 20–43 ^c	6984	0.21	6432	0.19	$<10^{-4}$
Lower limb revascularization associated with DFU, foot osteomyelitis or amputation	Weeks 2–11 ^a	2688	0.08	2656	0.08	0.66
	Weeks 12–19 ^b	2050	0.06	1803	0.05	$<10^{-4}$
	Weeks 20–43 ^c	5402	0.16	5150	0.16	0.014

Aweeks 2–11 = before the lockdown in 2020.

Bweeks 12–19 = during the lockdown in 2020.

Cweeks 20–43 = after the lockdown in 2020.

* p value of the Chi² test. For these three periods, we compared the proportion of hospitalizations for each outcome among French people with diabetes (3,300,000 persons) in 2020 and in 2019 using a Pearson Chi-squared test.

on the management of DFU in people with diabetes is complex, relatively unknown and probably multifactorial. People with diabetes were forced to reduce their daily activities during the first COVID-19 lockdown, which was potentially helpful for off-loading the diabetic foot and speeding up the healing rates of neuropathic ulcers.⁶ On the other hand, during this period, there was a decrease in the referral of patients with DFU to specialist diabetic foot teams for several reasons. First, the fear of exposure to the coronavirus in hospital environment may have led patients to refuse medical evaluation at the hospital. Second, diabetes staff were often redeployed to COVID-19 units, which resulted in a decrease in the availability of care for the management of diabetic ulcers. Third, the COVID-19 outbreak led to the suspension of most routine clinical work seeing as all healthcare resources were mobilized to fight the pandemic. During the lockdown, it was difficult to maintain a high standard of care for patients with DFU.⁴ On the contrary, in theory, the lockdown could have helped patients to reduce their daily activities thus giving DFUs a chance to heal.⁶

A recent study found an association between lower extremity arterial thromboses and SARS-CoV-2 infection.⁷ There is a growing evidence that coagulopathy or vasculopathy in COVID-19 patients is probably the main reason for the increase in leg amputations in patients with COVID-19.^{7,8} Even though the increase in leg amputations in patients with COVID-19 in this study was not focused on people with diabetes, we can assume that these patients were also heavily affected by this complication of SARS-CoV-2 infection. However, our data did not show an increase in lower limb amputation. On the contrary, we detected a reduction in foot amputation during the lockdown period. Similarly, we observed a reduction in lower limb revascularization procedures for people with DFU during this period. In patients with DFU that fail to heal because of reduced blood supply, the benefit of revascularization to help wound healing and limb salvage outweighs the risks of acquiring a COVID-19 infection. The

drop in hospitalization rates for lower limb revascularization during this period suggests that the Covid-19 crisis led to a decrease in the availability of standard of care for the management of diabetic ulcers.

It has been shown that patients with DFU who were referred for specialist care by a general practitioner more than 52 days after ulcer onset had a 58% decreased healing rate compared to patients who were referred earlier.⁹ The reduction in the number of hospitalizations for DFU observed here could negatively impact healing and therefore increase the risk of lower limb amputation. A longer survey period will be needed to determine whether a corresponding phenomenon will be observed at some point after the end of lockdown. In any case, our results demonstrate the need to develop new care pathways for DFU during the context of a health crisis or lockdown. Recently, the International Diabetic Foot Care Group and D-Foot International developed a COVID-19 fast-track pathway for DFUs, aiming to reduce late referral for patients requiring early evaluation from specialized diabetic foot units and to avoid hospital admission for stable clinical cases.¹⁰ Similarly, the development of teleconsultations using physician-to-patient and physician-to-home nurse telemedicine could improve DFU management during this type of crisis.¹¹

Several limitations must be acknowledged. First, this is a simple descriptive retrospective and observational study. Access times to hospital were not analysed. Another limitation is that the PMSI inpatient database was developed with accelerated transmission of data from March 2020 on the request of the government according to the decree of April 21, and these data are therefore pending consolidation.

The present study has several strengths. First, we analysed data on a national level, covering the 3,300,000 French diabetics who were put under the same complete lockdown. Data were obtained for all cases managed in French public and private hospitals before, during and after the lockdown, and any potential seasonal effect was limited by using the previous year as a historical control.

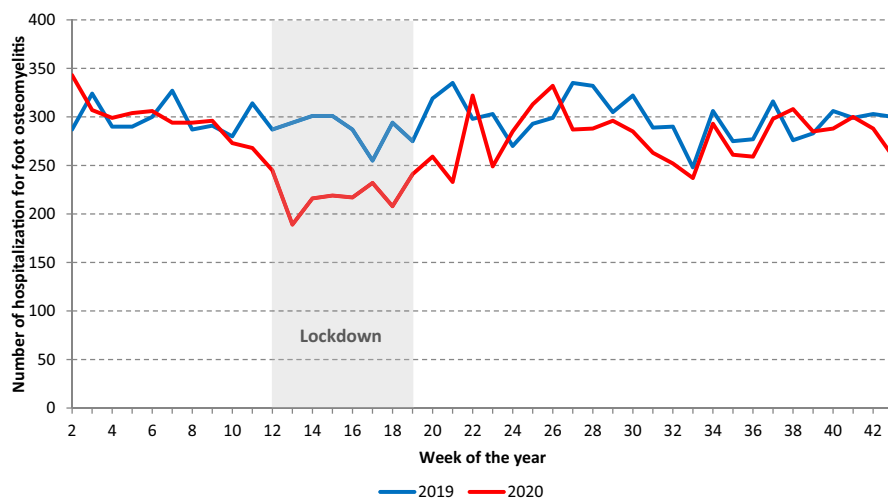


FIGURE 1 Hospitalizations for foot osteomyelitis among people with diabetes in 2020 versus 2019, before, during and after the lockdown in France

In conclusion, the marked drop in hospitalization rates for DFU, osteomyelitis and lower limb revascularization procedures observed in France during the lockdown period suggests that COVID-19 was a barrier for DFU care, illustrating the potential combined deleterious effects of hospital overload and changes in health-related behaviour. Given the potential medical consequences when patients with DFU do not seek appropriate care, the maintenance of an efficient care pathway for people with diabetes appears to be crucial in the context of a health crisis or lockdown.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

AUTHORS’ CONTRIBUTIONS

JMP, ASM and CQ conceptualized and designed the study, interpreted the data and wrote the paper. ASM, EB and CQ realized the analyses. EB, BV and BB participated in the interpretation of the results and reviewed and revised the manuscript drafts. JMP accepts responsibility for the paper as published. All authors have approved the final manuscript to be published.

ORCID

Benjamin Bouillet  <https://orcid.org/0000-0002-4317-6714>

Jean-Michel Petit  <https://orcid.org/0000-0002-1809-2455>

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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