



# The COVID-19 Outbreak Negatively Affects the Delivery of Care for Patients With Diabetic Foot Ulcers

Chao Liu,<sup>1</sup> Jiaying You,<sup>1</sup> Weifen Zhu,<sup>2</sup> Yixin Chen,<sup>2</sup> Shengyun Li,<sup>1</sup> Yuefeng Zhu,<sup>3</sup> Shujuan Ji,<sup>4</sup> Ying Wang,<sup>5</sup> Hongye Li,<sup>1</sup> Lin Li,<sup>2</sup> and Shunwu Fan<sup>1</sup>

*Diabetes Care* 2020;43:e125–e126 | <https://doi.org/10.2337/dc20-1581>

Diabetic foot ulcers (DFUs) represent the most frequent diabetes-related cause for hospitalization (1). Currently, the coronavirus disease 2019 (COVID-19) pandemic is likely to pose a threat to the delivery of care, leading to some unintended consequences. We aimed to determine the impact of the COVID-19 outbreak on patients with DFUs at a multidisciplinary center in China.

In the first part of this study, an interrupted time-series design was applied to estimate the trends in hospitalization for patients with DFUs before the COVID-19 outbreak to generate the predicted value in 2020. Monthly hospitalization records from 2016 to 2019 were abstracted to fit the autoregressive integrated moving-average model. We compared the prediction with the actual values in the first trimester of 2020 to project changes in trends that were assumed to have been caused by the outbreak. This analysis showed significant reductions in January and February, as indicated by actual hospitalizations being significantly lower than the lower boundary of 95% CI of predicted values. The number of hospitalizations in March rebounded and was close to the usual level (Fig. 1).

In the second part, we concurrently collected the data of hospitalized patients with active DFUs in the first trimester of 2020 (group A) and retrospectively reviewed the charts of all patients admitted during the corresponding period of 2019 for DFU treatment (group B). Patient demographics and comorbidities were similar between groups. Twenty-three (52.3%) of 44 patients in group A suffered from severe infection on initial presentation compared with 18 (20.7%) of 87 in group B ( $P < 0.001$ ). The median time courses of delivery of care were 85 (interquartile range 66–131) days in group A and 64 (43–108) days in group B ( $P = 0.024$ ). When the time frame was stratified, there were significant differences between groups regarding the median intervals from patient-reported DFU onset to their medical visits (75 [49–120] days vs. 45 [30–90] days,  $P = 0.001$ ) and from outpatient assessment to hospital admission (3 [2–5] days vs. 7 [5–10] days,  $P < 0.001$ ). However, the durations of inpatient care were homogenous (10 [6–14] days vs. 9 [7–18] days,  $P = 0.584$ ). The major amputation rate was 11.4% in group A and 4.6% in group B ( $P = 0.162$ ). Two patients (4.5%) from group A

died, one from myocardial infarction and the other from sepsis. There was one death (1.1%,  $P = 0.261$ ) in group B due to end-stage renal disease. Of the surviving patients, no statistical significance was observed between groups in ulcer status at the 8-week follow-up.

The study was approved by the Human Research Ethics Committee of Zhejiang University School of Medicine Sir Run Run Shaw Hospital (SRRSH2020005569).

This study suggests that the COVID-19 outbreak has had serious and disruptive effects on the delivery of DFU care, in terms of considerable drops in hospitalization and extended periods in treatment. It is conceivable that fears of being infected or stigmatized with COVID-19 compromise patients' accessibility to medical services. A recent survey from Manchester, U.K., and Los Angeles, CA, revealed that more than half of patients were deterred from traditional face-to-face appointments and those admitted from clinics for inpatient DFU care were candidates for surgical interventions (2). Additionally, we witnessed fluctuating monthly hospitalizations that were concomitant with the public health emergency switch in response to COVID-19 in

<sup>1</sup>Department of Orthopedics, Zhejiang University School of Medicine Sir Run Run Shaw Hospital, Hangzhou, China

<sup>2</sup>Department of Endocrinology, Zhejiang University School of Medicine Sir Run Run Shaw Hospital, Hangzhou, China

<sup>3</sup>Department of Vascular Surgery, Zhejiang University School of Medicine Sir Run Run Shaw Hospital, Hangzhou, China

<sup>4</sup>Department of Infectious Diseases, Zhejiang University School of Medicine Sir Run Run Shaw Hospital, Hangzhou, China

<sup>5</sup>Wound and Ostomy Care Clinic, Zhejiang University School of Medicine Sir Run Run Shaw Hospital, Hangzhou, China

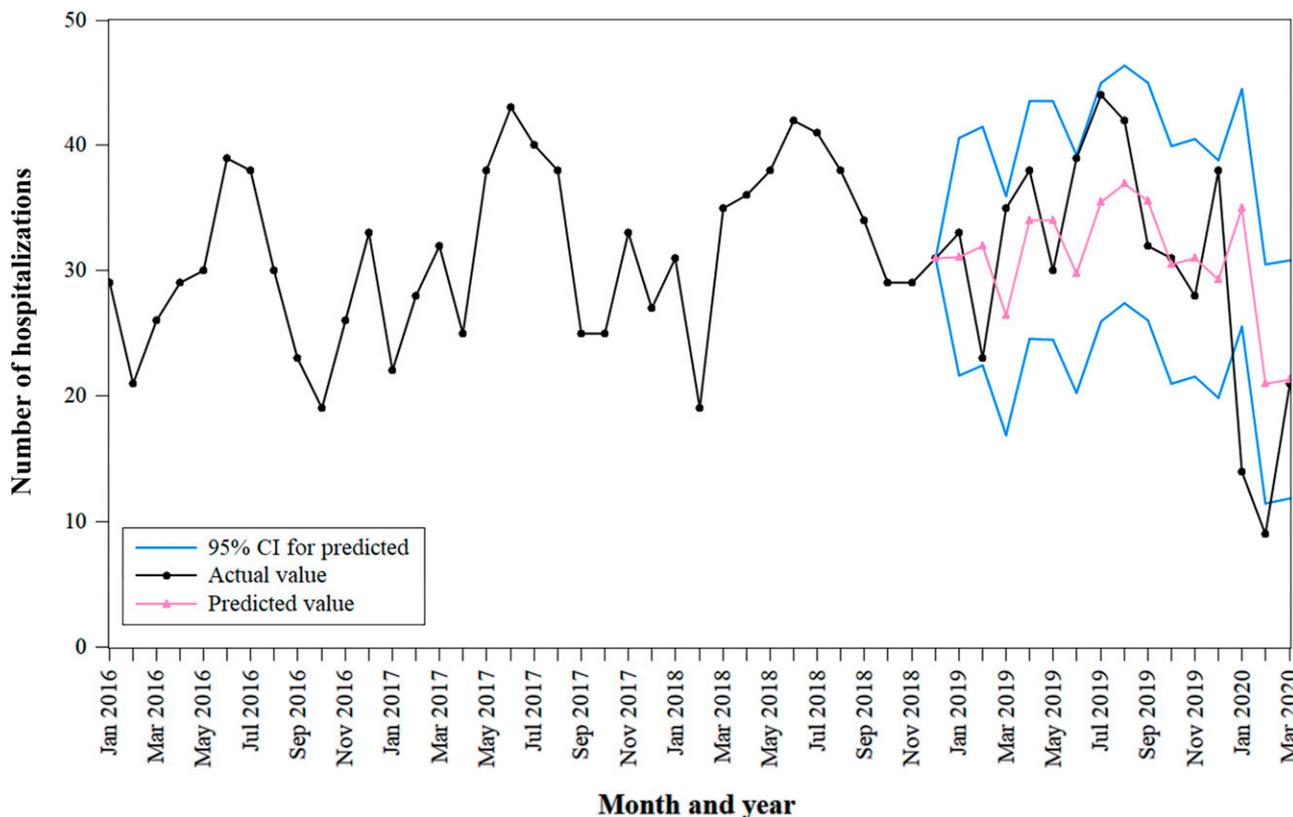
Corresponding authors: Hongye Li, [zjuyjx@zju.edu.cn](mailto:zjuyjx@zju.edu.cn), Lin Li, [3312012@zju.edu.cn](mailto:3312012@zju.edu.cn), and Shunwu Fan, [shunwu\\_fan@zju.edu.cn](mailto:shunwu_fan@zju.edu.cn)

Received 25 June 2020 and accepted 12 July 2020

This article is part of a special article collection available at <https://care.diabetesjournals.org/collection/diabetes-and-COVID19>.

C.L., J.Y., and W.Z. contributed equally to this study.

© 2020 by the American Diabetes Association. Readers may use this article as long as the work is properly cited, the use is educational and not for profit, and the work is not altered. More information is available at <https://www.diabetesjournals.org/content/license>.



**Figure 1**—Actual and predicted values of monthly hospitalizations for patients with DFUs. The numbers of inpatients with DFU episodes were 343 in 2016, 376 in 2017, 403 in 2018, and 413 in 2019. The monthly reported hospitalizations were entirely within the 95% CI for the predicted values in the year 2019. During the COVID-19 outbreak, actual hospitalizations declined in January, followed by a sharp reduction in February and a noticeable rise in March.

China. This finding indicates that causes of fears are multifactorial, mainly arising from the novelty and rapid transmission of the virus and the public health context.

During the outbreak, it is reasonable for patients to evaluate perceived risks and benefits before taking health-related actions, thus protracting the time lapse in seeking DFU care. We also found that the interval from assessment to referral shortened by 50% compared with the previous year. It is plausible that prominent decreases in attendance for nonacute conditions during an epidemic might facilitate the referral trajectory of DFUs, and patients with severe infection could take priority for admission (3).

Since substantial treatment deferrals are responsible for the progression of infection and poor prognosis, this study stresses the importance of providing optimal care during the pandemic. Currently, several advisory documents have been proposed. Rogers et al. (4) recommended prioritizing patients with critical or serious foot problems to receive timely hospital-based care, while conducting those with guarded or stable conditions through

telemedicine and in-home visits. Armstrong et al. (5) believed that telehealth-guided management has the potential to reduce resource usage and improve DFU care during the pandemic.

In summary, the COVID-19 outbreak negatively affects the delivery of DFU care. In view of the ongoing pandemic, massive efforts remain indispensable to mitigate the COVID-19 impact on patients with DFUs.

**Acknowledgments.** The authors would like to thank all front-line health care workers for their efforts during the COVID-19 pandemic. **Funding.** This study was funded by Natural Science Foundation of Zhejiang Province (no. LQ18H070001).

The funding sources for this study had no role in the study design, data collection, analyses, interpretation, or writing the manuscript.

**Duality of Interest.** No potential conflicts of interest relevant to this article were reported.

**Author Contributions.** C.L., J.Y., and W.Z. drafted the manuscript. C.L., J.Y., Y.C., and S.L. researched the literature. Y.C., S.L., Y.Z., S.J., and Y.W. collected the epidemiological and clinical data. C.L., W.Z., H.L., and L.L. contributed to the statistical analysis. J.Y., W.Z., and Y.C. contributed to the figure construction. H.L., L.L., and S.F. conceived and

supervised the study. All authors reviewed and approved the final version of the manuscript. L.L. and S.F. are the guarantors of this work and, as such, had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

## References

1. Skrepnek GH, Mills JL Sr, Lavery LA, Armstrong DG. Health care service and outcomes among an estimated 6.7 million ambulatory care diabetic foot cases in the U.S. *Diabetes Care* 2017;40:936–942
2. Shin L, Bowling FL, Armstrong DG, Boulton AJM. Saving the diabetic foot during the COVID-19 pandemic: a tale of two cities. *Diabetes Care* 2020;43:1704–1709
3. Lu TH, Chou YJ, Liou CS. Impact of SARS on healthcare utilization by disease categories: implications for delivery of healthcare services. *Health Policy* 2007;83:375–381
4. Rogers LC, Lavery LA, Joseph WS, Armstrong DG. All feet on deck—the role of podiatry during the COVID-19 pandemic: preventing hospitalizations in an overburdened healthcare system, reducing amputation and death in people with diabetes. *J Am Podiatr Med Assoc*. 25 March 2020 [Epub ahead of print]. DOI: 10.7547/20-05
5. Armstrong DG, Rowe VL, D'Huyvetter K, Sherman RA. Telehealth-guided home-based maggot debridement therapy for chronic complex wounds: peri- and post-pandemic potential. *Int Wound J*. 18 June 2020 [Epub ahead of print]. DOI: 10.1111/iwj.13425