FEATURE ARTICLE

Institutional Barriers to the Successful Implementation of Telemedicine for Type 1 Diabetes Care

Joyce M. Lee,[1] Emma Ospelt,[2] Nudrat Noor,[2] Ann Mungmode,[2] Osagie Ebekozien,[2,3] Meenal Gupta,[4] Faisal S. Malik,[4] Naomi R. Fogel,[5] Siham Accacha,[6] Susan Hsieh,[7] Meredith Wilkes,[8] Anna Neyman,[9] and Francesco Vendrame,[10] on behalf of the T1D Exchange Quality Improvement Collaborative

The aim of this study was to describe rates of telemedicine use 18 months after the start of the coronavirus disease 2019 pandemic and to assess the institutional barriers to its implementation for type 1 diabetes care across centers of the T1D Exchange Quality Improvement Collaborative. Observational electronic health record data capturing telemedicine rates from 15 U.S. centers between September 2020 and September 2021 and a survey of 33 centers capturing telemedicine rates and key components of telemedicine were analyzed. A capacity score was developed and summed to a total capacity score and compared with overall telemedicine rates across centers. Telemedicine visits decreased by 17.4% from September 2020 to September 2021. Generally, it was observed that the lower the average telemedicine capacity score, the lower the rate of telemedicine visits. Despite a decline in the utilization of telemedicine 18 months after the start of the pandemic, visit rates were still 20% higher than in the pre-pandemic period. However, there is a need to improve structural components to ensure telemedicine capacity and robust telemedicine utilization.

The coronavirus disease 2019 (COVID-19) pandemic was instrumental for rapidly accelerating the widespread adoption of telemedicine visits in the U.S. health care delivery system. We previously reported on telemedicine adoption for 13 centers participating in the T1D Exchange Quality Improvement (T1DX-QI) Collaborative, capturing a baseline telemedicine rate of 1% of all visits before the pandemic and a peak rate of 95.2% of all visits by April 2020, which settled to a rate of 45% by August 2020 (1). There are many uncertainties regarding the future of telemedicine because of a number of barriers, including insurance coverage, implementation barriers, and provider and patient preferences. We therefore sought to capture telemedicine utilization rates for type 1 diabetes centers 18 months beyond the start of the pandemic and describe barriers to its long-term sustainability.

Research Design and Methods

The T1DX-QI Collaborative is a multicenter quality improvement collaborative focused on improving outcomes for patients with type 1 diabetes and has performed ongoing work in the area of telemedicine adoption since the start of the pandemic in March 2020. We assessed overall telemedicine rates (visits that occurred using video-conferencing software in lieu of a medical visit) for centers through electronic health record (EHR) data and clinic surveys. For at least 15 centers (12 pediatric and 3 adult care clinics) who had EHR data, we captured the overall proportion of total visits conducted as telemedicine encounters and calculated the percent change in monthly telemedicine rates from the start of the pandemic through September 2021. In addition, a center-level survey was administered from September to November 2021 and was completed by 33 centers (inclusive of the 15 centers with EHR data), which reported telemedicine rates,

[1]Susan B. Meister Child Health Evaluation and Research Center, C.S Mott Children's Hospital Ann Arbor, MI; [2]T1D Exchange, Boston, MA; [3]University of Mississippi School of Population Health, Jackson, MS; [4]Seattle Children's Hospital, University of Washington, Seattle, WA; [5]Ann & Robert Lurie Children's Hospital, Chicago, IL; [6]School of Medicine NYU Long Island Mineola, NY; [7]Cook Children's Hospital Fort Worth, TX; [8]Icahn School of Medicine at Mt. Sinai New York, NY; [9]Indiana University School of Medicine, Riley Children's Hospital, Indianapolis, IN; [10]University of Miami Miller School of Medicine, Miami, FL

Corresponding author: Emma Ospelt, eospelt@t1dexchange.org

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telemedicine goals, and key drivers for supporting telemedicine in the clinical delivery system.

We generated and assigned a capacity score to each center based on the following survey responses, which we identified as key components for supporting a telemedicine visits: having a defined telemedicine workflow (yes = 1, no = 0), having staff support assigned to telemedicine visits as for regular clinic visits (yes = 1, no = 0), having support for uploading data to the EHR that did not require providers' involvement (automated EHR uploading or staff uploading = 1, provider uploading = 0), and having an institutional telemedicine goal regarding the proportion of visits seen via telemedicine (yes = 1, no = 0). We calculated a total capacity score by adding scores for all four capacity elements.

Finally, we compared center-level capacity scores by overall telemedicine rates across centers. Because of the limited number of centers, we elected not to perform statistical analyses, but rather provided summary statistics. This study was approved by Western Institutional Review Board, and participating clinics also obtained their own approvals per institutional policy.

Results

For all centers that contributed data from the EHR, the combined monthly rate of telemedicine visits was 37.6% (n = 2,294) in September 2020, and this rate decreased to 20.2% (n = 1,180) by September 2021, which represents an overall decline of 48.5%. Figure 1 shows the monthly proportion of telemedicine visits, the monthly number of telemedicine visits, and the overall percent change in telemedicine visits for each center. All centers except for one experienced a consistent decline in telemedicine visits over the period. Despite this consistent decline, telemedicine rates varied widely among centers, ranging from 2.9 to 63.6%.

Of the 33 centers surveyed, 24 were pediatric and 9 were adult care providers. The majority of centers reported conducting 11–25% of visits as telemedicine encounters in the fall of 2021, with a greater proportion of centers performing more (≥26%) than fewer (0–10%) (Figure 2*A*). Figures 2*B*–2*E* show that the majority of centers had a workflow, support for data uploading, and a telemedicine goal, but a minority had assigned staff dedicated to telemedicine. Only 12% of

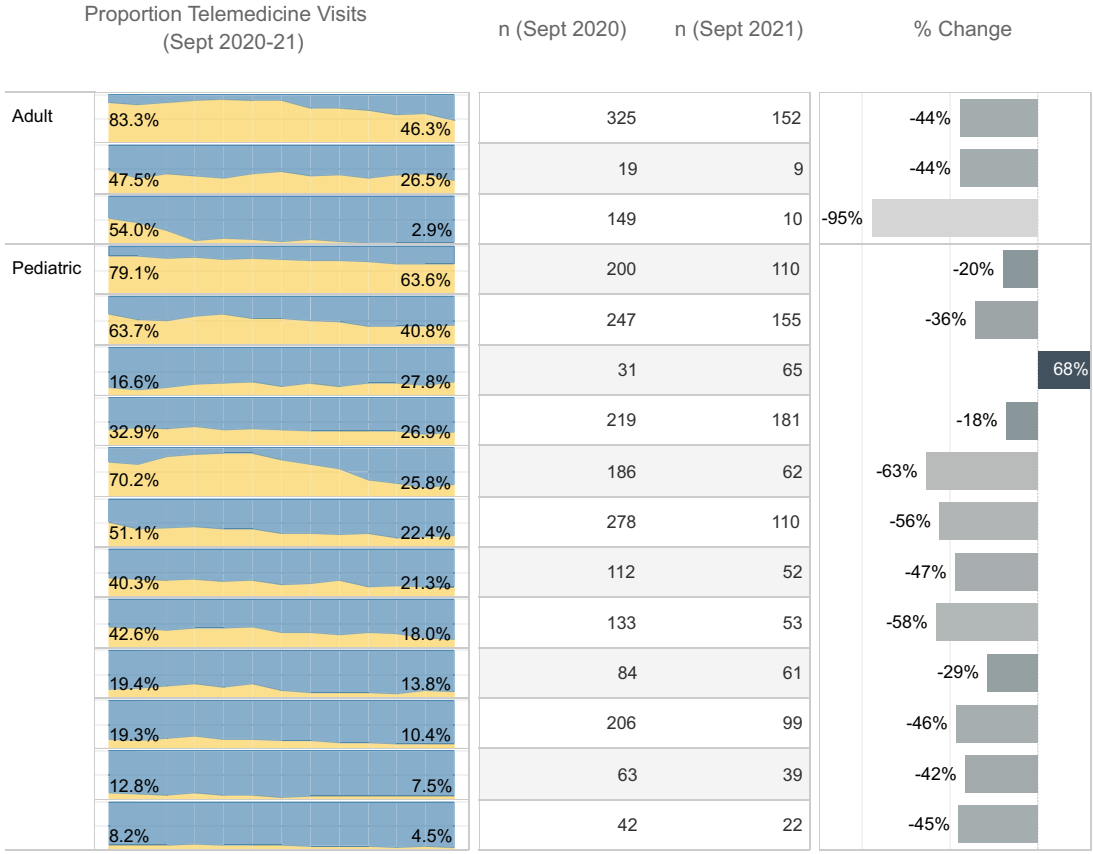

FIGURE 1 Proportion, number, and percent change in telemedicine visits between September 2020 and September 2021 for 15 centers that contributed monthly visit data.

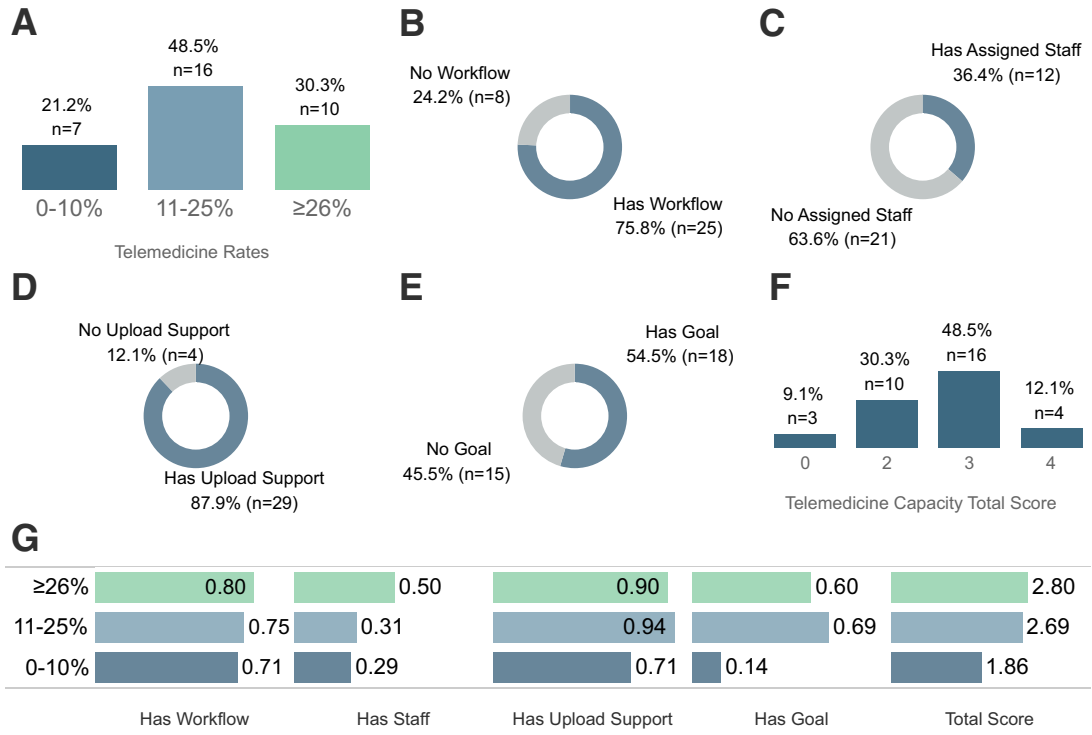

FIGURE 2 Findings from the telemedicine utilization and capacity analysis. Proportion of centers by percentage of telemedicine visits performed in September 2021 (*A*). Proportion of clinics with telemedicine capacity components: has a telemedicine workflow (*B*), has assigned staff for telemedicine (*C*), has staff/automated support for data uploading to the EHR (*D*), and has a telemedicine goal (*E*). Proportion of centers by total telemedicine capacity score (*F*). Average capacity score for each of the components by percentage of telemedicine visits performed (*G*).

centers reported having all four capacity components, but a majority of centers had a telemedicine capacity score of at least two components (Figure 2*F*). Figure *2G* shows the average individual and total telemedicine capacity scores according to the telemedicine rates reported by the centers. Generally, the lower the average score was, the lower the rate of telemedicine was, although a statistical test was not conducted.

Table 1 shows the breakdown of telemedicine rates and telemedicine capacity components by pediatric and adult care centers based on survey responses. The majority of centers provided institutional support for participation of multidisciplinary providers in clinics for both adult and pediatric centers, although the deployment of these individuals differed by clinic type; in pediatric clinics, the interaction of these providers was mixed, integrated with the provider telemedicine visit, or occurring separately, but the majority of adult clinics did not have integrated visits.

Centers did report a number of barriers impeding the sustainability of telemedicine over the long term, including limited Internet access for patients (94%); health disparities, including poverty, geographical isolation, and limited access to services as assessed by the provider (91%); limited access to patient data (88%); limited access to laboratory test results (64%); reimbursement issues (48%); and licensing laws (42%). Other reported barriers included patients not having the required technology and patient preferences.

Discussion

This is one of the first studies to describe telemedicine rates for individuals with type 1 diabetes for a large and geographically diverse sample of endocrinology centers up to 18 months after the start of the COVID-19 pandemic. Given the initial near-total adoption of telemedicine during the peak of the pandemic (95.2%), it was expected that rates would drop significantly as patients would likely seek in-person care after a long period of only virtual contact with their providers and care teams. Our data show a telemedicine rate of 20% by September 2021, which is higher than the pre-pandemic level of <1% (1). However, our capacity analysis shows that key institutional barriers remained for many centers, even 18 months after the start of the pandemic, and these barriers affect the long-term sustainability of telemedicine.

TABLE 1 Telemedicine Rates and Capacity Components by Pediatric and Adult Care Centers From Survey Responses

Survey Question	Adult Clinics (n = 9)	Pediatric Clinics (n = 33)
Percentage of diabetes visits currently conducted via telemedicine		
0–10	1 (13)	5 (21)
11–25	4 (50)	12 (50)
26–50	2 (25)	7 (29)
>50	1 (13)	0 (0)
Clinic has a protocol or workflow for pre-visit preparation for telemedicine visit, contacting patients, and obtaining the data download for the visit ahead of time		
Yes	6 (67)	18 (75)
No	3 (33)	6 (25)
Staff member that is partially or entirely dedicated to the telemedicine process just as in a clinic		
Yes	3 (33)	9 (38)
No	6 (67)	15 (63)
After a patient uploads data into the device platform, what is the workflow for the data uploads to the EHR?		
Data are integrated into the EHR automatically from the device platform	0 (0)	3 (13)
Clinic staff/administrators document device data into the EHR	9 (100)	21 (88)
Provider uploads device data into the EHR	3 (33)	8 (33)
Clinic has specified a goal on the proportion of patients seen by Clinic has specified a goal on the proportion of patients seen by telemedicine		
Yes, and we met the goal	0 (0)	1 (4)
Yes, and we made progress but didn't meet the goal	0 (0)	1 (4)
No, we did not set a goal	3 (33)	12 (50)
The goal has changed over the course of the COVID-19 pandemic	6 (67)	10 (42)
Device training via telemedicine		
Virtual pump training	7 (78)	17 (71)
Virtual continuous glucose monitoring training	7 (78)	18 (75)
No virtual training offered	2 (22)	4 (17)

	Adult Clinics		Pediatric Clinics	
	Yes; Part of Provider Video Visit	Yes; Separate From Provider Video Visit	Yes; Part of Provider Video Visit	Yes; Separate From Provider Video Visit
Institutional support for multidisciplinary providers in conducting telemedicine visits				
Certified diabetes educator	0 (0)	7 (78)	7 (29)	14 (58)
Registered dietitian	0 (0)	8 (89)]	7 (29)	16 (67)
Registered nurse	1 (11)	4 (44)	7 (29)	6 (25)
Social worker	0 (0)	4 (44)	8 (33)	8 (33)

Data are n (%).

Given that only four of 33 centers (12%) reported having all four capacity elements, it is clear that more work is needed to improve the operational capacity of centers to perform telemedicine. Only a minority of centers reported having staff partially or fully dedicated to telemedicine. When patients are seen for in-person clinic visits, a medical assistant typically prepares them for the visits by navigating their entry into a room, capturing their vital signs, reviewing medications, and downloading data from their diabetes devices. However, this type of support is not provided for telemedicine visits in many centers. If providers run late or patients have difficulty connecting to

a virtual visit or downloading data, both must navigate these obstacles independently, which can lead to delays, lower the quality telemedicine visits because of a lack of access to diabetes data, and incur financial costs because of missed or canceled visits. Health care staffing models have traditionally been constructed to support in-person care; new models of operational staffing to directly support telemedicine will be critical for the ultimate sustainment of telemedicine activities.

When we first reported telemedicine statistics for the T1D-QI Collaborative for September 2020, just one of the 21 centers (<5%) assessed had automated integration of data downloading into the EHR. As of the fall of 2021, just three centers (~10%) reported having automated downloading, which is an improvement, but still represents only a minority of centers and speaks to the significant technical challenges of integrating diabetes device data into the EHR. In 2020, in 43% of centers, providers were either solely (10%) or partially (33%) responsible for capturing data downloads, but, by 2021, in 36% of centers, providers were either solely (3%) or partially (33%) responsible for this task. Access to diabetes data are the linchpin of telemedicine; therefore, technology to support the integration of data into the EHR and improved telemedicine workflows supporting providers and patients are crucial.

We are unaware of other studies that have captured telemedicine rates for diabetes care in a such a large and comprehensive sample of centers for up to 18 months post-pandemic, nor are we aware of studies that have used EHR data to capture longitudinal monthly statistics on telemedicine rates in a cohort of centers. The majority of centers are located in urban settings. The COVID-19 Healthcare Coalition evaluated telemedicine trends between January 2019 and March 2021 using health care claims and reported a decline in the proportion of individuals with diabetes who participated in telemedicine from 27% in the second quarter of 2020 to 13% by March 2021 (2) We recognize that the end date of the current study was still relatively early in the pandemic, and this study did not focus on diabetes centers who see a large population of individuals with type 2 diabetes. Additional studies of telemedicine adoption reported on rates during the early stages of the pandemic (3), were single-center studies (4), focused on populations outside of the United States (5), or simply described the characteristics of telemedicine users without providing specificity to the center-level components of diabetes-related telemedicine care (6).

Because this was a center-level analysis, we could not assess key patient-level barriers to telemedicine such as lack of insurance coverage for telemedicine visits, lack of access to the Internet, lack of access to the online patient portal, lack of access to diabetes devices, or inability to download diabetes data as potential factors that may affect overall telemedicine rates. Furthermore, we did not examine providers' and patients' preferences regarding telemedicine, which are also important factors. Haynes et al. (6) surveyed a small sample of patients (n = 53) at a single center who had an in-person rather than a telemedicine visit during the start of the pandemic, which may have been a biased sample in that the study was targeted to individuals without a telemedicine visit. Still, individuals and families identified a variety of factors, including the belief that in-person care was of higher quality than care using telemedicine, lack of familiarity with technology, and a lack of smartphone access. Conversely, Crossen et al. (7) surveyed a panel of patients in the T1D Exchange patient registry and online community regarding their experiences with and opinions about telemedicine care during the pandemic. More than 60% of the 2,235 individuals who responded had used telemedicine; of these individuals, 62% felt telemedicine care was as effective as or was more effective than in-person care, and >80% wished to use telemedicine into the future. However, notably, the most common reason for not using telemedicine was that the providers were not offering it (49%), which indicates the need for further research focused on providers' preferences and/or clinic resources for telemedicine. Additionally, Tanenbaum et al. (8) found telehealth to be used successfully for diabetes technology onboarding, and parents reported that they believed telehealth should be an option for all families.

Conclusion

Telemedicine rates for type 1 diabetes care decreased substantially from 2020 to 2021 across all participating centers but were still higher than in the pre-pandemic period. Centers with higher rates of telemedicine had a higher average number of center-level capacity components, suggesting the need for improved structural components to ensure telemedicine capacity and sustainment of telemedicine utilization.

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DUALITY OF INTEREST

J.M.L. is on the GoodRx medical advisory board and a consultant for Tandem. O.E. is a Health Equity Advisory Board member for Medtronic Diabetes. F.V. is a consultant for Eli Lilly. No other potential conflicts of interest relevant to this article were reported.

AUTHOR CONTRIBUTIONS

J.M.L. wrote the manuscript and researched data. J.M.L., E.O., and N.N. analyzed the data and reviewed/edited the manuscript. A.M., O.E., M.G., F.S.M., N.R.F., S.A., S.H., M.W., A.N., and F.V. contributed to the discussion and reviewed/edited the manuscript. J.M.L., O.E., and F.V. conceptualized the study. E.O. is the guarantor of this work and, as such, had access to all of the data and take responsibility for the integrity of the data and the accuracy of the data analysis.

PRIOR PRESENTATION

Portions of the content of this article previously presented in abstract form at the American Diabetes Association's 82nd Scientific Sessions in New Orleans, LA, 3–7 June 2022.

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