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Telemedicine care coordination and visit frequency in pediatric patients with type 1 diabetes in Oregon

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ABSTRACT

Introduction: Children with type 1 diabetes require close monitoring with visits every 3–4 months. COVID-19-induced telemedicine expansion may alleviate the challenge of high visit frequency that children with type 1 diabetes face. However, telemedicine's impact on access to care may be limited if patients lack adequate support for telemedicine. The purpose of this study was to evaluate the impact of telemedicine care coordination services on visit frequency in an urban medical center without care coordination services versus a rural outreach program with established care coordination services serviced by the same providers.

Methods: We evaluated EHR data from 790 children receiving care between July 2018 and December 2021 at a single academic center in Oregon. We estimated differences in likelihood of adequately timed monitoring care over time by patient care coordination services status using Generalized Estimating Equations.

Results: Just prior to telemedicine expansion, patients receiving care coordination services were 25.6 % less likely to receive adequately timed monitoring care (95 % CI: 51.6 %, 114 %). Following telemedicine expansion, likelihood of adequately timed monitoring care increased from 28.8 % to 58.2 % among those receiving care coordination services and decreased from 38.7 % to 22.0 % among those not receiving care coordination services; increases in adequately timed monitoring care were 3.55 times greater in patients receiving care coordination services relative to those not (95 % CI: 2.10, 6.01).

Discussion: For pediatric patients with type 1 diabetes, telemedicine care coordination may be an important factor for increasing visit adherence and may increase the number of patients meeting goal visit frequency beyond levels seen prior to widespread telemedicine availability.

Introduction

Poorly managed pediatric type 1 diabetes (T1D) can easily place children at risk of acutely life-threatening hypoglycemia and ketoacidosis, as well as significant morbidity and mortality due to sequelae of chronic hyperglycemia. To avoid these complications, the American Diabetes Association currently recommends quarterly visits with a Pediatric Endocrinology specialist for all children with the diagnosis of type 1 diabetes [1]. Though this recommendation is in the interest of the patients' health, this high visit frequency places a large burden on patients and their caregivers. Telemedicine is one option to decrease barriers to healthcare access, and the rapid expansion of telemedicine during the COVID-19 pandemic presented a novel opportunity to evaluate the feasibility and effectiveness of telemedicine for management of many pediatric chronic diseases, including T1D.

As with any new healthcare technology, telemedicine requires thoughtful planning and evaluation to ensure it is implemented in a safe, equitable, and effective manner. There are many factors that impact the successful implementation of telemedicine including patient and provider familiarity with technology, clinic willingness to adopt new workflows, staff support, and access to equipment and broadband. The purpose of this study was to evaluate how one factor, telemedicine care coordination services, may influence the successful implementation of telemedicine. Specifically, we evaluated the impact of telemedicine care coordination on visit frequency for pediatric patients with T1D at a single academic center in Oregon.

Abbreviations: T1D, type 1 diabetes; TE, telemedicine expansion; CCS, care coordination services; ATMC, adequately timed monitoring care.

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Study environment background

Most Oregonian pediatric subspecialty clinics are located in the state's largest city, Portland. This impairs access to care for many patients across the state who may live greater than five hours away from the nearest specialist. Pediatric Diabetes practice at Oregon Health & Science University (OHSU) is based in Portland at the Harold Schnitzer Diabetes Health Center (HSDHC). The practice also serves patients throughout the state of Oregon. In addition to a regional network of in-person outreach clinics throughout the state, the Pediatric Endocrine Division at OHSU started offering telehealth services for its diabetes patients in 2014 through three regional hubs in Eugene, Medford and Klamath Falls. These outreach clinics are staffed by Portland-based providers who have dedicated time slots throughout the year to see these patients via telehealth appointments, with the provider remaining in Portland and the patients utilizing telehealth at the OHSU-managed outreach clinics.

Care coordination services (CCS) in the outreach clinics is provided by a RN/CDCES (Registered Nurse/ Certified Diabetes Care and Education Specialist) advanced practice nurse, who supports both in-person and telehealth clinics in those locations. The care coordinator schedules and confirms attendance of the visits by telephone calls. For virtual visits in particular, the care coordinator calls the patient 15 min before their scheduled visit and reviews their management and intercurrent medical history. The care coordinator helps with device downloads and makes sure data are in the chart for providers to discuss at the visit. They order lab work and ensure that it is received in timely manner. Other barriers to care are addressed individually, in collaboration with other members of the diabetes team who might be at different locations, including scheduling virtual visits with a CDCES or psychologist who are located at the Portland-based clinic.

HSDHC in Portland did not offer telehealth services to its patients until April 2020, when all diabetes care visits for patients at all sites were transitioned to virtual visits conducted at patients' residences due to the COVID- 19 pandemic. These visits were enabled by EPIC MyChart functionality via ZOOM.

Limited in-person clinic availability returned for both outreach and HSDHC clinics in Fall 2020, but virtual visits continued to comprise more than 50 % of all visits until early 2022 due to the ongoing state of limited operations at the institution. Outreach site telehealth visits returned Fall 2020, and the telemedicine portion of the outreach visits comprised of a mix of virtual at-home visits and telehealth in-clinic visits comparable to those administered pre-pandemic. In-person visit scheduling at the outreach clinic sites returned to pre- pandemic levels in late 2020–early 2021.

Throughout this time, care coordination in the outreach clinics was administered by the same outreach care coordinator, while the visits at HSDHC were managed separately by the existing Center staff. Due to ongoing staffing challenges, patient scheduling could not be assured as reliably at the HSDHC site as it was in the outreach division where there was a consistent practice of care coordination and a smaller population size.

Study objectives

The objective of this study was to assess the impact of CCS on access to care for pediatric patients with T1D before and after the COVID-19-induced telemedicine expansion (TE). We compared the proportion of patients meeting goal visit frequency between those who received regular CCS at one outreach clinic to those who did not receive regular CCS at the HSDHC site both before and after TE. Goal visit frequency, which is defined as quarterly visits in Diabetes Clinic, was chosen as an outcome given its inclusion in guideline recommendations of multiple professional societies, including the American Diabetes Association [1]. We chose the particular outreach site (Medford outreach clinic) to analyze as the population followed there received care almost exclusively at that site, unlike our other outreach sites where patients receive care interchangeably in outreach and in Portland, so the comparisons of outcomes might not be accurate. We hypothesized that for those who regularly received CCS, the proportion of patients meeting goal visit frequency did not change during the pandemic compared to the 2 years prior. We further hypothesized that, at the end of the study time period in 2021, a higher proportion of patients receiving CCS would meet goal visit frequency compared to patients who did not receive CCS.

Materials & methods

Study design & population

This historical cohort study leveraged health record data from children with T1D. An interrupted time series (ITS) approach was used to assess pre-post COVID-19 pandemic changes in the likelihood of meeting goal visit frequency. Briefly, electronic health record data from OHSU were queried to identify all pediatric outpatient visits with any department physician or Advanced Practice Providers and with an E10 (Type 1 Diabetes Mellitus) ICD-10 billing code. Of the 806 unique patients with one or more visit between April 1, 2018 and December 31, 2021, analyses were restricted to 790 patients (N = 5015 encounters) on Medicaid or private insurance who had at least two visits with a department pediatric endocrinology provider in the pre-TE time period (4/1/2018–3/31/2020) and at least one visit in the post-TE time period (4/1/2020–12/31/2021).

Measures

Independent variable

The independent variable was time since TE in quarters (three-month units). Given that the study period included quarters both pre- and post-TE, values ranged from 7 quarters pre-TE to 7 quarters post-TE.

Dependent variable

The time-varying dependent variable was whether the patient received adequately timed monitoring care (ATMC) in a given quarter, defined as another in-person, video telemedicine, or audio telemedicine visit within 120 days of that quarter's visit.

Covariates

Receipt of care coordination services (CCS) was our effect measure modifier of interest. Patients were coded as having or not having CCS based on the clinic in which the visit occurred (see Section 1.1). Confounders were identified using a directed acyclic graph [2] created to reflect our assumed causal model and included patient age (continuous years) and insurance type at time of visit (Medicaid, Private).

Additional descriptive variables

Some variables presented in the descriptive analysis do not meet the definition of a confounder. The following variables were appraised descriptively to provide context but were not included in the multivariable model: location of patient's residence (rural or urban defined by matching patient zip code at time of visit to 2010 Rural Urban Commuting Area codes with codes >7.0 considered rural and those <=7.0 considered rural [3]), distance from patient's residence to clinic (<100 miles, ≥100 miles), and visit type (office, video, telephone).

Analytic approach

All analysis was completed in STATA 17. We first examined the distribution of patient sociodemographic and visit characteristics by CCS and TE status. We estimated Relative Risks (RR) and 95 % Confidence Interval (CI) for the association between time and ATMC both before and after the start of the pandemic using generalized estimating

equations with Poisson distribution and robust standard errors. All confounders were included in the fully adjusted model. We evaluated effect measure modification by including an interaction term for CCS. Finally, we estimated the marginal probability of ATMC in each quarter to facilitate interpretability of the relative risk of interaction terms.

Results

Patient visit characteristics

General descriptive analysis is shown in Table 1. Compared to patients for whom CCS was not available, those receiving CCS were younger on average, more likely to have Medicaid insurance, more likely to live less than 100 miles away from clinic and were the only group engaging in video visits prior to TE (43.4 % of visits in CCS group vs. 0 % of visits in no CCS group). Following TE, video telehealth visits increased for both groups (81.7 % in CCS group, 55.8 % of visits in no CCS group).

Prevalence of ATMC

Prior to TE, the prevalence of ATMC was highest for those in the CCS group (54.8 % vs. 44.6 % for no CCS group; Table 1). While the prevalence of ATMC decreased for both groups in the post TE period, the prevalence of ATMC continued to be highest among those in the CCS group (42.0 % vs. 31.3 %).

Table 1
Characteristics of OHSU pediatric endocrinology patients with T1D by those who did not or did receive care coordination services, subdivided by the time periods of pre-telemedicine expansion (4/1/2018–3/31/2020) and post-telemedicine expansion (4/1/2020–12/31/2021).

		No Care Coordination Available		**Care Coordination Available**	
	Time Period	Pre-TE	Post-TE	Pre-TE	Post-TE
	Total number of visits, n	1,816	2,558	210	431
Characteristic					
Patient Age in Years at time of visit, mean (sd)		12.5 (4.1)	13.8 (4.2)	11.3 (3.8)	12.3 (4.0)
Insurance type at time of visit, n (%)					
	Private	1,018 (56.1)	1,444 (56.5)	93 (44.3)	203 (47.1)
	Medicaid	798 (43.9)	1,114 (43.6)	117 (55.7)	228 (52.9)
Residence at time of visit, n (%)					
	Urban	1,986 (92.8)	2,401 (93.9)	203 (96.7)	413 (95.8)
	Rural	130 (7.2)	157 (6.1)	7 (3.3)	18 (4.2)
Distance from Clinic at time of visit, n (%)					
	< 100 miles	1,413 (77.8)	1,942 (75.9)	203 (96.7)	359 (83.3)
	>= 100 miles	403 (22.2)	616 (24.1)	7 (3.3)	72 (16.7)
Visit Type, n (%)					
	Office Visit	1,816 (100)	857 (33.5)	119 (56.7)	64 (14.9)
	Video Telehealth	0 (0)	1,428 (55.8))	91 (43.3)	352 (81.7)
	Telephone Telehealth	0 (0)	273 (10.7)	0 (0)	15 (3.5)
Visits < 120 days from last visit (ATMC), % (sd)		44.6 (0.5)	31.3 (0.5)	54.8 (0.5)	42.0 (0.5)

Heterogeneity in the impact of telemedicine on ATMC by care coordination status

Fig. 1 displays estimated trends in ATMC by CCS status as predicted from multivariable modified Poisson modeling. Just prior to TE, patients receiving CCS were 25.6 % less likely to receive ATMC compared to those who did not receive CCS (95 % CI: 51.6 %, 114 %). Amongst those who received CCS, the percentage of visits meeting ATMC increased from 28.8 % (95 % CI: 17.0 %, 40.6 %) in January–March 2020, just prior to TE, to 58.2 % (95 % CI: 41.1 %, 75.4 %) by the end of 2021. In contrast, amongst those who did not receive CCS, the percentage of visits meeting ATMC decreased from 38.7 % (95 % CI 33.8 %, 43.7 %) just prior to TE in January–March 2020 to 22.0 % (95 % CI: 17.2 %, 26.9 %) by the end of 2021 (Fig. 1). After TE and at the end of the study period, increases in ATMC were 3.55 times greater in patients receiving CCS relative to those not (95 % CI: 2.10, 6.01).

Discussion

By the end of the study time period from July 2018 – December 2021, the proportion of pediatric T1D patients achieving adequately timed monitoring care with a pediatric endocrinologist increased amongst those who received telemedicine CCS but decreased amongst those who did not receive telemedicine CCS. Furthermore, at the end of the study period, patients receiving CCS in the outreach site had adequately timed monitoring care significantly more frequently than those not receiving CCS in the HSDHC site serviced by the same providers. This finding is in alignment with our hypothesis. This difference is meaningful because, just prior to the expansion of telemedicine, the patients seen in the outreach site were less likely to achieve goal monitoring frequency than the patients seen in the HSDHC site, though this prior difference was not statistically significant. The explanation for this initial discrepancy may be that the number of patients requesting follow up in our Medford outreach site often exceeded the available capacity, so their visits tended to be spaced out a bit further than for the patients seen in Portland site. Those who received CCS post-TE included an increased proportion of individuals living >100 miles from clinic, suggesting that telemedicine combined with CCS can help a traditionally underserved population obtain appropriately timed cared. Overall, our findings suggest that telemedicine in combination with dedicated care coordination services may increase the number of patients achieving goal T1D monitoring.

This study compared the services rendered by the same team of providers at two different locations, with only difference being availability of care coordination services as described above. Thus, we implore that its results objectively outline the benefit of care coordination and could be applicable to other healthcare settings. We speculate that increased pre-appointment outreach and technology assistance provided by CCS were particularly impactful for increases in ATMC, as missed appointments and technology challenges are anecdotally the biggest barriers providers report with telemedicine.

Limitations to our study include the fact that the patient population receiving CCS at the outreach site was much smaller than the population who did not receive CCS at the HSDHC site. Furthermore, the outreach site had some telehealth structure in place prior to TE, so both patients and the care coordination staff may have had more familiarity, comfort, and knowledge about utilizing telemedicine. While there was a larger support staff at the HSDHC site, there was also greater turnover amongst staff at this site throughout the *peri*-pandemic period, which likely made coordination of both telemedicine and in-person visits challenging. Finally, the intervention itself is limited by the ability to find and adequately compensate qualified care coordinators.

Literature after TE has shown that telemedicine is a desirable option

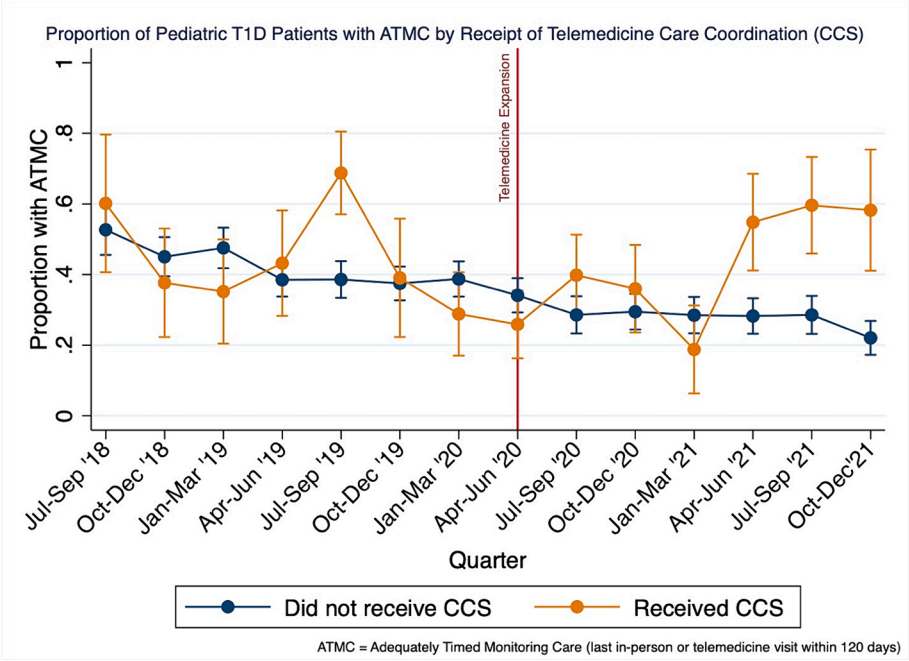

Fig. 1. Trend of the proportion of pediatric T1D patients in Oregon meeting adequately timed monitoring care (ATMC) before and after telemedicine expansion by receipt of care coordination services.

for many pediatric patients and their caregivers [4]. Despite being a desired option, we have previously shown that, following widespread telemedicine expansion, the overall pediatric T1D population at our site was less frequently meeting goal monitoring frequency compared to prior to telemedicine expansion [5]. In support of this finding, several studies have outlined the challenges that telemedicine poses to patients with T1D and their providers, the most common being the need for staff training and extensive preparation ahead of the visit. In the case of T1D patients, this includes preparing device downloads through systems and databases that are not integrated with the EMRs [6,7]. As a solution to such barriers, some practices have concentrated on the importance of team-based care for the integration of telemedicine. Sinksy et al. [8] describe their positive experiences with incorporating "advanced team-based care" with nurses and medical assistants in telemedicine office visits and encourage against reversion to a "doctor-does-it-all" approach.

The current study provides data to affirm the value of such team-based approaches to diabetes care. We found that staff-driven telemedicine care coordination may be a crucial factor to reduce telemedicine barriers, thus allowing successful implementation of telemedicine for underserved pediatric patients with T1D who could most benefit from this rapid advancement in healthcare delivery.

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CRediT authorship contribution statement

Emily S. Mitchell: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Sarah Andrea:** Writing – review & editing, Validation, Supervision, Software, Methodology, Formal analysis. **Ines Guttmann-Bauman:** Writing – review & editing, Supervision, Resources, Methodology, Funding acquisition, Data curation, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Sarah Andrea reports a relationship with Eli Lilly and Company that includes: funding grants. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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