JPPT | Multihospital Survey Study

Survey of Diabetes Technology in the Pediatric Inpatient Setting

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OBJECTIVE Advances in diabetes technology have led to increasing use of insulin pumps and continuous glucose monitors (CGMs) to improve the quality of life for children with diabetes. The objective of this study was to assess the percentage of hospitals that had policies regarding the use of diabetes technology in the pediatric inpatient setting and assess the content of policies to identify specific areas for improvement.

METHODS A diabetes technology survey was developed by a multidisciplinary research team, consisting of 3 domains including CGM use/policies, insulin pump use/policies, and demographics. It was distributed to the pharmacist membership of the Pediatric Pharmacy Association in August 2022. Descriptive statistics were conducted to describe current practices/policies.

RESULTS Seventeen of the 31 responding hospitals (55%) allowed CGM use in the pediatric inpatient setting with 77% (n = 13) having written policies. Primary barriers to use included lack of policy (n = 11, 79%), knowledgeable staff (n = 10, 71%), and electronic health record (EHR) integration (n = 6, 43%). More than half reported not using CGM alarms for high and low blood sugar levels (n = 10, 59%). More hospitals allowed insulin pump use (n = 29, 94%) with 97% (n = 28) reporting written policies. Less than half had specific policies for suspected pump site failure (n = 13, 46%). Only 60% reported that nurses verify insulin pump doses given.

CONCLUSION This study demonstrates there is room to improve both the existence and content of policies related to CGM and insulin pump use in hospitals.

ABBREVIATIONS CGM, continuous glucose monitor; EHR, electronic health record; EMR, electronic medical record FDA, US Food and Drug Administration; HIPAA, Health Insurance Portability and Accountability Act of 1996; PPA, Pediatric Pharmacy Association

KEYWORDS continuous glucose monitor; continuous subcutaneous insulin infusion; diabetes mellitus; hospitals; pediatric; technology

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Introduction

Diabetes is a significant chronic health concern in children. A recent study showed that in several parts of the United States, rates of both type 1 and type 2 diabetes in people 19 years of age and younger have significantly increased.[1] In studied areas, prevalence of type 1 diabetes rose from 1.48 per 1000 in 2001 to 2.15 per 1000 in 2017; the prevalence of type 2 diabetes increased from 0.34 per 1000 patients to 0.67 per 1000 within the same period.[1] Diabetes can be difficult to manage with children's day-to-day activities and can result in significant health complications if not appropriately managed. Many children use continuous subcutaneous insulin infusion devices, more commonly known as insulin pumps, as well as continuous glucose monitors (CGMs) to help manage their diabetes. These devices help improve both blood glucose control and quality of life for children with diabetes; however, their use in the pediatric inpatient setting is variable across facilities.[2,3]

Continuous glucose monitors used in the inpatient setting have shown overall accuracy when compared with standard capillary point-of-care glucose data in multiple studies using different systems including Dexcom (Dexcom, United States) and Freestyle Libre (Abbott Laboratories, United States).[4,5] Although some CGM and point-of-care paired readings may differ, these differences result in little to no change in clinical intervention.[5,6] A recent study by Li and colleagues[7] demonstrated the accuracy of CGM data in children with diabetes aged 4 months to 4 years. Additionally, participants reported positive responses to their perception of CGM use because of reduced pain and ease of use.[7] While there is evidence supporting CGM

efficacy, integration of CGM data into hospitals' electronic health record (EHR) systems remains a barrier to use.[8] Some hospitals have already begun integrating CGM data into their EHR but report limitations due to a lack of standardization and infrastructure.[9]

Insulin pumps are an increasingly common way that people with diabetes receive insulin. Continued insulin pump use in the inpatient setting has been associated with better glycemic control and fewer episodes of both hypoglycemia and hyperglycemia.[4,10–14] Currently, guidelines are in place to help clinicians in decision-making regarding whether patients should continue to use a pump once admitted.[15–17] These guidelines outline specific situations that would contraindicate pump use as well as use in special situations like diabetic ketoacidosis and perioperative periods.[15] However, general consensus is that if a patient is physically and cognitively able to use the pump and diabetes complications are not the reason for hospitalization, the patient may remain on insulin pump therapy.[4,10,14,15] While these guidelines do exist, there is widespread consensus that more prospective research needs to be done to determine best practices.[10,13,14,18] Given the increasing popularity of CGMs and insulin pumps, the primary objective of this study was to assess the number of hospitals that have policies outlining their use in the pediatric inpatient setting. The secondary objectives included collecting information related to these policies as well as identifying barriers to CGM and insulin pump use.

Methods

A survey regarding diabetes technology in the pediatric inpatient setting was developed by a multidisciplinary research team in the Department of Pediatrics at the OU-TU School of Community Medicine. The survey was created by using 2022 standard of care recommendations in addition to previous literature related to technology use in the inpatient setting[15,16] alongside the professional and personal experiences of team members, which included a certified diabetes care and education specialist pharmacist, a person with type 1 diabetes, and a pediatric endocrinologist. The clinical team members have extensive experience in both inpatient and outpatient care of children and adults who use diabetes technology. The final survey, as summarized in Supplemental Table S1, included a total of 64 potential questions spanning 3 domains including respondent demographics (14 questions), CGM use and policies (24 questions), and insulin pump use and policies (26 questions). Demographics were collected to examine whether different hospital level factors might be associated with the presence of policies. Given the content outlined in the 2022 standards of care guidelines along with the professional experiences of the 2 clinical team members, the CGM and insulin pump domains were added. The survey included multiple choice questions and open-ended items related to hospital practices regarding insulin pump and CGM use in the pediatric inpatient setting (Supplemental Table S1). Once consensus was reached among team members related to the final questions retained in the survey, it was converted to a HIPAA (Health Insurance Portability and Accountability Act of 1996)–compliant REDCap (Research Electronic Data; Vanderbilt University, Nashville, TN) database only accessible to team members.

An email was sent inviting all members of the Pediatric Pharmacy Association (PPA) to participate in an online survey regarding the use of diabetes technology. The survey was distributed via the membership database of the organization, an estimated 1109 pharmacists. The survey was sent in August 2022 followed by a reminder email 2 weeks later. The survey closed 1 month after distribution.

If respondents answered they did not allow the use of CGM, or insulin pumps, they were only asked about barriers to device usage, if they would like for policies to be shared with them from other facilities, and information about their facility. The remaining respondents who indicated they did allow for the use of these devices were asked further questions related to their practices and policies. Respondents from institutions with policies were asked if they would be willing to share de-identified versions of their policies. The study team followed up with individuals who indicated they would be willing to share their policies.

All surveys returned to the team were returned with a "complete" response status in REDCap, indicating the respondent had completed the survey. Respondents did have the option to skip over most questions and still submit their response. Required fields for basic hospital information included hospital name and other descriptive information; however, individuals could choose to not provide their emails by choosing to not share policies or ask for the policies of other hospitals. Missing data did not disqualify responses from analysis given the descriptive nature of the study. SPSS 28.0 (IBM) was used to run descriptive statistics.

Results

A total of 33 surveys were received representing 31 facilities (Table). Of those responses, 2 duplicates were removed. Respondents were from hospitals that were primarily university based (n = 17, 55%), and children's hospitals (n = 26, 84%). Of the 26 children's hospitals, only 35% (n = 9) indicated they were free-standing children's hospitals with the remaining 65% (n = 17) indicating they were children's hospitals associated with adult systems. Most respondents reported their hospitals' having a pediatric endocrinology rounding service (n = 23, 74%) and using Epic for their EHR (n = 21, 68%). Respondents were predominantly pharmacists (n = 26, 84%; see Table).

Table. Respondent Demographics

Variable	Response
Hospital type	
Children's hospital	26 (84%)
Non–children's hospital (pediatric beds but no designation)	5 (16%)
System type	
University based	17 (55%)
Private hospital	14 (45%)
Inpatient pediatric endocrinology service	
Yes	23 (74%)
No	8 (26%)
Electronic health record system	
Epic	21 (68%)
Cerner	5 (16%)
Meditech	4 (13%)
Other	1 (3%)
Respondent designation	
Physician	1 (3%)
Nurse	1 (3%)
Pharmacist	26 (84%)
Diabetes educator	3 (10%)
Health educator	0 (0%)
Other	0 (0%)

Of the 31 responses, only 17 hospitals (55%) allowed CGM use in the pediatric inpatient setting. The 14 hospitals not allowing inpatient pediatric CGM use cited lack of policy (n = 11, 79%), lack of knowledgeable staff (n = 10, 71%), and lack of EHR integration (n = 6, 43%) as barriers.

Clinical status (n = 15, 88%) was the main factor considered for CGM use, followed by the admitting diagnosis (n = 11, 65%) and caregiver availability (n = 11, 65%). Most of these hospitals reported not using CGM high and low blood sugar alarms (n = 10, 59%). Sixteen of the 17 hospitals (94%) did not supply new or replacement sensors when one was needed during an inpatient stay. Caregivers (n = 14, 82%) and patients (n = 9, 53%) were predominantly responsible for placing new sensors. All of the 17 respondents indicated that CGM data did not integrate into the EHR automatically.

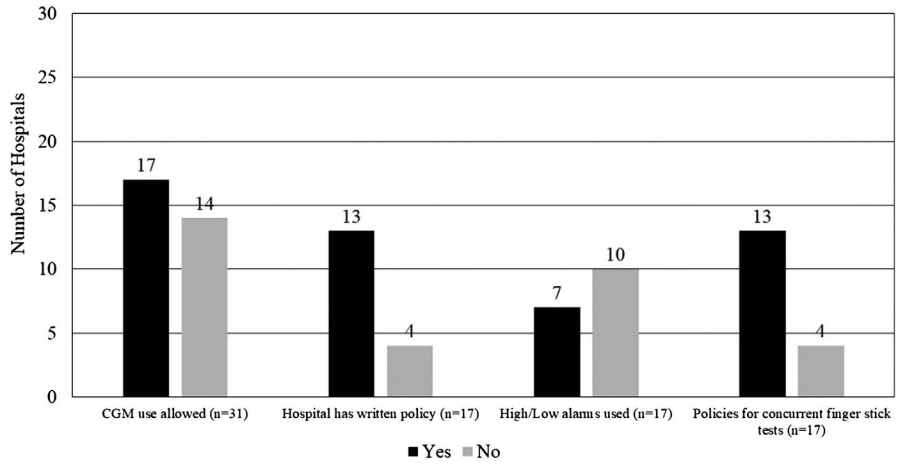
Thirteen of the 17 hospitals (77%) had policies outlining when finger stick blood glucose testing was needed for pediatric patients using CGM. These policies included routine assessment via finger stick regardless of CGM use (n = 9, 69%), symptoms inconsistent with CGM readings (n = 8, 62%), and glucose settings outside of a set range (n = 8, 62%).

Thirteen of the 17 facilities (77%) had written CGM policies (Figure 1, Supplemental Table S2).

Twenty-nine of the 31 responding hospitals (94%) reported an option for insulin pump use in the pediatric inpatient setting with 97% (n = 28) having a written policy (Figure 2, Supplemental Table S3). Barriers reported by the 2 hospitals not allowing insulin pump use included lack of knowledgeable staff (n = 2, 100%), lack of policy (n = 1, 50%), and lack of staffing (n = 1, 50%).

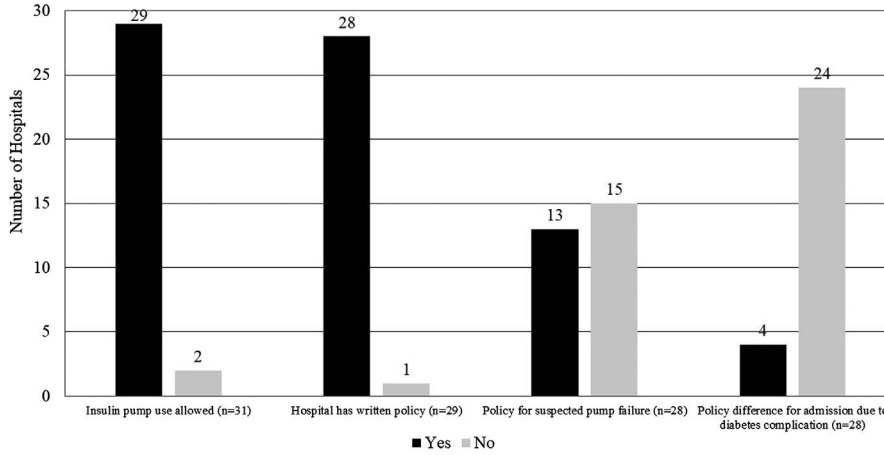
Most hospitals allowing insulin pump use reported the patient's clinical status (n = 27, 93%) as a factor considered when deciding on insulin pump use followed by caregiver availability (n = 20, 69%). The use of hybrid closed loop systems in auto mode varied, with most respondents saying their hospitals allowed it (n = 12, 41%) followed by respondents being unsure (n = 11, 38%). Verification of pump setting practices included asking the patient/family (n = 22, 76%), looking at the settings in the pump (n = 20, 69%), and contacting the endocrinologist (n = 16, 55%). Most facilities reported entering pump settings into the EHR at admission (n = 21, 72%) with very few reporting

Figure 1. CGM use in the pediatric inpatient setting.



CGM, continuous glucose monitor.

Figure 2. Insulin pump use in the pediatric inpatient setting.



the setting being entered at other times. Infusion site changes were primarily the responsibility of caregivers (n = 23, 79%), patients (n = 18, 62%), and nurses (n = 16, 55%). Documentation of infusion site changes varied across responding hospitals with most documenting in the nursing notes (n = 11, 38%) and fewer (n = 6, 21%) not documenting in the EHR at all. Verification of bolus pump doses varied, with hospitals reporting nursing verification (n = 17, 59%), patient report (n = 10, 35%), and no verification (n = 2, 7%).

Twenty-eight of the 29 hospitals (97%) that allowed insulin pump use had written policies. Overall, policies did not differ for pump use in children admitted for diabetes complications vs non-diabetes diagnoses (n = 24, 86%). Few hospitals had policies for U-200/U-500 insulin use in insulin pumps (n = 3, 11%). Less than half had specific policies for suspected pump site failure (n = 13, 46%).

Discussion

Despite the increasing use of technology in diabetes management, there is little published research on the use of CGM and insulin pumps in the inpatient setting, particularly regarding the pediatric population. The American Diabetes Association advises that individuals, both pediatric and adult, in the inpatient setting who can effectively operate their home insulin pumps and CGM regimen should be offered the option to continue use while hospitalized, provided there is adequate oversight.[16] Until recently CGMs were not approved by the US Food and Drug Administration (FDA) to be used in the inpatient setting; however, several hospitals across the United States developed strategies to allow their use during the COVID-19 pandemic to reduce provider fatigue and exposure risk.[10,17] Currently, certain hospitals have individualized protocols and requirements to determine whether a patient can continue using CGM while in the inpatient setting.[17] Additionally, in 2022 the FDA approved the Dexcom CGM for inpatient use.[19]

The findings of the current study indicate that while 94% of hospitals allowed inpatient insulin pump use, only 55% allowed CGM use. While most noted the reason for not allowing CGM use being lack of policy, 43% also reported lack of EHR integration as a barrier to CGM use. Additionally, with 59% of hospitals not using high and low blood sugar alarms in clinical decision-making, there is a gap in taking full advantage of the benefits of CGM use in the inpatient setting. This could be mitigated with further improvement in CGM data integration into the EHR and creating CGM workflow designs. To help guide workflow development, a recent report from the Diabetes Technology Society provided recommendations for implementation of this process.[20] Given the increasing number of insulin pumps that create a hybrid closed loop system that infuses basal insulin doses based on CGM data, the creation of hospital policies regarding CGM use is essential for optimized patient care.[21]

While insulin pump use in the inpatient setting is widely allowed, there are still changes that could be made to improve patient safety. Despite almost all hospital respondents allowing insulin pump use, 86% reported not having policy differences for patients who are admitted for a diabetes complication such as diabetic ketoacidosis or hyperosmolar hyperglycemic syndrome. Individuals admitted for these complications likely have altered insulin requirements, in which case using an insulin drip instead of an insulin pump may be preferred. Additionally, most hospitals reported they did not have specific policies outlining the proper management for suspected pump site failure. This was a concerning finding because pump failure can lead to extremely high blood glucose levels or even diabetic ketoacidosis if not managed appropriately.[22] There was

also a large variation in how bolus doses are verified, with a small number not verifying at all, risking a patient getting too much or too little insulin for a meal. As such, education for both physicians and support staff is vital to ensuring proper use of CGMs and insulin pumps in the inpatient setting, particularly for hospitals that do not have endocrinology rounding services.

Based on our findings, priorities for health systems include 1) ensuring policies for CGM and insulin pump use are developed and align with published recommendations; 2) developing staff education on diabetes technology and best practices; and 3) working toward electronic medical record (EMR) integration of data obtained from diabetes technology. Examples of items to include in policy documents are provided in Supplemental Table S4. For guidance in developing staff education, The Association of Diabetes Care and Education Specialists has published a professional competencies document outlining expected training and competency of various hospital personnel.[23] Finally, the Diabetes Technology Society has developed comprehensive guidance on best practices for data integration for both inpatient and outpatient settings for institutions and information technology support personnel.[20]

While our study provides new information related to the use of diabetes technology in the pediatric inpatient setting, it is not without limitations. Our results were limited by the modest number of completed survey responses, as well as the survey style design of the study, which makes it difficult to extrapolate results. Similarly, the use of a non-validated survey is another limitation. Additionally, there is a risk of human error in filling out responses. Finally, while an estimated 1109 individuals received surveys, it is not possible to calculate a true response rate. This is due to many factors including members of the PPA having a variety of roles beyond inpatient settings as well as the potential for multiple pharmacists to work at the same facility. Given these limitations, further research is needed to determine if these results are generalizable to hospitals outside of the study cohort. Future work should also involve coordination with hospital administrations to further develop and review policy as well as education for hospital staff.

Conclusion

This study demonstrates there are gaps in both the development and content of policies related to CGM and insulin pump use in hospitals. Current policies could improve by maximizing the benefit of the data received from diabetes technology by integrating into EMRs, as well as aligning with current guidelines. Additionally, as diabetes technology continues to improve and advance, it is vital that hospital policies continue to be updated to reflect these changes.

Article Information

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