ORIGINAL ARTICLE

Use of a continuous glucose monitoring device: Perceptions of nursing staff

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ABSTRACT

Objective: Wearable continuous glucose monitoring (CGM) devices, when included in the plan of care for patients in inpatient settings, provides real time blood glucose data. This allows treatment to be proactive and timely. Implementation of these devices alters nursing care. The objective of this study was to describe the perceived barriers and facilitators, from the perspective of direct care providers in an inpatient clinical setting, when the plan of care includes a CGM device.
Methods: Guided by a review of the literature and anecdotal data, a 20 item Likert-scaled survey was developed. Once study approval was secured an invitational email was sent to the password protected emails of all potential participants. Frequency and descriptive analyses were used to analyze the responses.
Results: Survey data from 31 direct care providers describe a positive experience specific to the education and resources available. The addition of a CGM device into the plan of care is not perceived to be an additional burden for the provider.
Conclusions: Pre-implementation, appropriate education and exposure to the device is critical for providing confidence and trust. The availability of ongoing support ensures that care is enhanced when a CGM device is included in the plan of care.

Key Words: Continuous glucose monitor device, Remote glucose monitoring, Direct care provider, Survey data, Competency

1. INTRODUCTION

Technological advances for patients with diabetes include the availability of wearable continuous glucose monitoring devices (CGM).[1] These devices provide real-time glucose data which allow healthcare professionals to initiate proactive and timely clinical interventions specific to glycemic management. Dexcom,[2] a CGM device, was initially developed and approved for outpatient use by the U.S. Food and Drug Administration (FDA) office in 1999.[3] As a result of the COVID-19 pandemic, on April 1, 2020, the FDA removed its objections toward the use CGM systems in inpatient settings.[4] Within these clinical settings, CGM systems support insulin administration, reduce point of care (POC) glucose monitoring, and alleviate the need for repetitive POC peripheral glucose testing.[5] The present system, Dexcom G7, has the ability to transmit results once paired to a Remote Glucose Monitoring device (RGM). This provides a mechanism for health data to be assessed without disturbing the patient while reducing exposure to body fluids for the care provider.[5]

The World Health Organization (WHO)[6] defines diabetes as a chronic disease that results when either the pancreas fails to produce sufficient insulin or when the body fails to effectively process the insulin it produces. Hyperglycemia

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and/or hypoglycemia, are the terms used to describe scenarios when blood glucose levels are abnormal and frequent consequences of uncontrolled diabetes. Either condition is a clinical indicator the diabetes is not controlled. When blood glucose levels are uncontrolled, serious, dire, and progressive damage is done to many of the body's physiological systems. Lipton and associates[7] and Pasquel and colleagues[8] have correlated a higher risk for hospitalization, worse clinical outcomes, and mortality among people with diabetes. These risks are a direct effect of periods of hyperglycemia or hypoglycemia. Summarizing their review of the literature specific to the use of CGM devices in inpatient clinical settings, Gothong et al.[9] conclude that "the use of inpatient CGM confers numerous benefits with minimal risks" (p. 8).

The introduction of any new device into a clinical healthcare setting alters established routines and requires changes in the provision of care. Clinical guidelines were developed by Galindo and colleagues[10] which include 77 expert-approved clinical recommendations that support the use of CGM devices. Results from an expert-opinion roundtable discussion document the potential for CGM devices to improve the quality of patient care.[11] Yet, the participants in this roundtable discussion recognize that cost and successful adoption of these devices are important variables that impede implementation. Accuracy of a CGM device when used in an inpatient setting was explored by Baker et al.[12] These results determined that there was a 1-to-3-unit variation of insulin dosage recommendations when comparing real-time monitoring to that obtained by the CGM. Clinical use of a CGM device was determined to be feasible, with minimal risks to patients. Results from the review article by Avari et al.[13] identified healthcare provider unfamiliarity as a barrier toward implementation. The care providers for those responsible for the intervention must be knowledgeable, skillful, and competent for the device to have utility. Staff education was provided by clinical pharmacists, clinical nurse educators, and peer-to-peer among the nursing staff. These activities allowed "super-users" to be identified. These individuals were available when a new CGM device was applied and checked the nurse's competency and comfort in using the device. A specific skills check list was not developed, allowing for flexibility in the hands on education and the ability to meet the educational needs of all. While cost is certainly a consideration in any health treatment decision, the inclusion of a device that the user is unfamiliar with, uncomfortable with, or fails to trust is unsafe practice. The purpose of this survey design study was to assess and describe the perceptions of direct care providers in a non-intensive acute care setting, when a CGM device is part of the plan of care. This data should be considered before and after CGM devices are included in the plan of care.

2. METHODS

All study activities were reviewed by the Institutional Review Committee at the study site prior to any study activity. Study participation was limited to nursing personnel (Registered Nurses [RNs], Licensed Practical Nurses [LPNs], and Unlicensed Assistive Personnel [UAPs]) who provide direct care to inpatients whose plan of care included the use of a CGM device. While any UAP will not have responsibility for medical management, they are a direct care provider. As such, monitoring by a CGM device may impact care. This information was desired for its potential impact on workload. Guided by a review of the literature and anecdotal data, a 20-item site-specific survey was developed. Once developed, face validity for the site-specific survey was secured through feedback from members of the Nursing Research and Innovations Committee. This provided a peer review of each item, from clinical experts. All recommendations were included in the final survey. These items allowed each participant to describe their perceptions related to the education received, the resources available, and their personal competency. Seventeen items used 5-point (strongly agree [5], agree [4], neutral [3], disagree [2], and strongly disagree [1]) Likert-type responses to describe their experiences when a CGM device is included in the plan of care. The content of two of the survey items was purposefully vague. The item that queried the CGM device to additional health-related stress among family members did not operationalize health-related stress. This was done so that verbal (persistently asking questions and the need for clarification) and non-verbal (pacing or stress-related behavior such as wring hands or checking the monitors) could be included. The item that explored the need to coordinate activities did not include clinical examples. This was in response to the variation of possible activities – from none to a series of multidisciplinary interventions ranging from physical therapy/occupational therapy to dialysis and radiological scans. Due to the variation in the number of respondents per item, results are presented using percentile calculations.

Recruitment was done using an invitational email which was electronically sent by the Vice President and Chief Nursing Officer to all nursing personnel. Participation was voluntary and implicit upon submission of a completed survey. All study activities were web-based and used the password protected organizational email provided to all employees. The first item on the survey, which queried about providing care to a patient with a CGM device, was used to ensure study eligibility. If the response to this item was "no," the person was thanked for their time and study access was denied. Minimal

demographic data were collected and used only to describe the study population.

Data were collected over a one-month timeframe, with a reminder email sent half-way through the data collection interval. Once the study time frame was concluded, the study survey site was closed and all data were transferred to a study specific SPSS file, cleaned, and double checked for accuracy prior to any analyses.

2.1 Data collection

The study site was accessed by 88 respondents. A response of "no" was indicated by 57 of these individuals, rendering them ineligible for study participation. The remaining 31 respondents indicated providing care to a patient whose plan of care included a CGM device and encompassed the study population. Among the 20 Likert-scored response items, there were 8 incidences of missing data. Calculating 20 items with 5 possible responses there is a total of 100 data points. This calculates to 8.0% pieces of missing data, a number that should not affect the reliability of the results. Since descriptive/frequency analyses were planned to be used in the analyses, there was no rationale to use computed mean scores to substitute for the missing data.

2.2 Data analysis

Descriptive statistics were used to describe the study population. Responses categories were collapsed within the age item, the level of education item, and the years of experience item. This was done in response to a category receiving one response, making it potentially possible to identify a specific participant while retaining confidentiality of the responses. These are presented in Table 1. Frequency calculations were used to describe the experiences of the study population. These are displayed in Table 2.

2.3 Ethics approval

The activities described in this article were reviewed by the Institutional Review Committee and determined to meet exempt criteria status.[14] In addition to this review, the study proposal and survey items were reviewed, and suggestions made by members of the Nursing Research and Innovations Council were considered when formatting the research. No personal identifying information was collected. All data were maintained, and analyses performed on password protected computers.

3. RESULTS

Demographically, the participants in this study were primarily (58%) RNs with 1-5 years of experience. (41.9%) The majority (58%) reported having earned a bachelor's degree and worked on the day shift (61%). There were study participants from all age ranges (under 25 years to 60 years and older), yet slightly more than one-half (54.8%) of the participants reported being under the age of 40 years. Table 1 displays the results of the demographic items.

Table 1. The study population demographically

Variable	Response	Percent of responses
Age	Under 25 years	20%
	25-30 years	16.7%
	31-35 years	10%
	36-40 years	10%
	41-45 years	16.7%
	45-50 years	6.6%
	51-55 years	10%
	Over 56 years	10%
Position	Registered Nurse	66.5%
	Unlicensed Assistive Personnel (Tech/PCT/CNA)	33.5%
Years of experience	Less than 1-5 years	43.4%
	6-10 years	16.6%
	11-15 years	23.3%
	More than 16 years	16.6%
Level of education	High school	17.3%
	Associate degree	6.8%
	Diploma	10.4%
	Bachelor degree or higher	65.5%
Shift worked	Days	65.5%
	Mixed or variable	10.3%
	Nights	24.2%

Table 2. Survey responses results

Survey responses results			Survey responses results		
Provided care to a patient in the previous 30 days when a hospital- issued CGM device was in place	Never	37.1%	CMG directed care lightens my workload	Strongly disagree	4%
	Infrequently	11.1%		Disagree	8%
	Sometimes	33.3%		Neutral	24%
	Often	14.8%		Agree	24%
	Every shift	3.7%		Strongly agree	80%
Competency in providing care using a CGM device	Not at all	3.7%	CGM-directed care identified alterations in the patient's glucose level, improving care by allowing proactive treatment to be provide	Neutral	8%
	Slightly	14.8%		Agree	56%
	Somewhat	22.2%		Strongly agree	36%
	Competent	55.6%			
	Expert	3.7%			
The education received on the device was appropriate	Not at all	3.7%	The CGM sensor insertion is easy and quick	Neutral	24%
	Slightly	29.6%		Agree	40%
	Appropriate	66.7%		Strongly agree	36%
The resources available on the use of the device are useful	Disagree	7.4%	CGM provides too much information	Strongly disagree	20%
	Slightly agree	22.3%		Disagree	56%
	Agree	70.3%		Neutral	24%
CGM directed care assures me that the care I provide is timely and accurate	Neutral	12%	CGM direct care results in over management	Strongly disagree	16%
	Agree	68%		Disagree	40%
	Strongly agree	20%		Neutral	36%
				Agree	8%
CGM directed care is evidenced based	Neutral	16%	Documenting CGM directed care into the EMR is too cumbersome	Strongly disagree	8%
	Agree	68%		Disagree	40%
	Strongly agree	16%		Neutral	44%
				Agree	8%
I trust the data provided by the CGM	Disagree	4%	Paring the CGM to the receivers requires too much time	Strongly disagree	8%
	Neutral	16%		Disagree	40%
	Agree	60%		Neutral	44%
	Strongly agree	20%		Agree	8%
CGM directed care is of value to me and my patients	Disagree	4%	CGM direct care results in additional health-related stress for the patient/family	Strongly disagree	16.7%
	Neutral	4%		Disagree	50%
	Agree	52%		Neutral	20.8%
	Strongly agree	40%		Agree	12.5%
CGM direct care improves the patient's quality of sleep	Strongly disagree	4%	CGM directed care requires coordination of all interventions	Strongly disagree	4%
	Disagree	4%		Disagree	12%
	Neutral	24%		Neutral	40%
	Agree	24%		Agree	40%
	Strongly agree	44%		Strongly agree	4%
CGM direct care assures that the care I provide is appropriate	Neutral	8%	CGM alarms engage only when glucose is really high or really low, making the device not really useful	Strongly disagree	24%
	Agree	56%		Disagree	52%
	Strongly agree	36%		Neutral	24%
I believe the data provided by the CGM is accurate	Disagree	4%			
	Neutral	16%			
	Agree	56%			
	Strongly agree	24%			

Slightly more than half of the study population (51.8%) reported providing care to a patient with a CGM device occurred sometimes, often, or every shift. Slightly less than 50% of the study population (59.3%) described their competency in providing care using a CGM device as competent or expert. Responses to the remaining items provided in Table 2, demonstrate positive experiences surrounding the educational processes provided and availability of resources

related to the CGM device. The items assessing the value of care, the appropriateness of the care, and the ability to provide proactive treatment are enhanced when a CGM device is present. These three items received the highest rankings, with 92% of the study population agreeing or strongly agreeing. The accuracy of the device and the data provided were perceived as positive, lending to the care provided, guided by the CGM device data, was evidenced based. The impact of care than includes a CGM device moderately improved the quality of sleep for the patient (68%), lightened the workload for the provider (60%), and did not result in additional stress for family members (66.7%). While slightly more than half of the participants (56%) perceived the CGM device as resulting in over management, 78% responded that the results obtained by a CGM device were useful (78%). Inserting the sensor was perceived as quick and easy (76%), while pairing the device or documenting the care were perceived as requiring too much time (48%). Response variability is demonstrated in the item that assessed the need to coordinate all interventions. While there is a trend toward agreeing with the statement (44% of the study population agree or strongly agree), 16% of the participants strongly disagreed or disagreed with the statement, and 40% of the study population report feeling neutral to the item's content.

4. Discussion

The use of a CGM device is becoming standard practice in inpatient acute care settings. While these devices have direct outcome benefits, they do alter present care delivery policies. The implementation of any medical device, without appropriate education for the healthcare professional who is intended to use it, is a gap that results in poor patient outcomes and personnel dissatisfaction. Comfort and a feeling of competency are necessary for trust in the data provided by the device to occur. Unfamiliarity with a new device is one barrier, inadequate education and/or support will also inhibit applicability. Presently, CGM devices are infrequently included in inpatient plans of care, thus much of the nursing staff are unfamiliar with the devices Avari and associates[13] recommend "Upskilling of hospital staff is required for clinical and allied health care professionals, particularly in the acute setting, to understand and identify between insulin delivery systems and glucose monitoring systems" (p. 620). The results of this study document positive outcomes when education and support are provided. It seems reasonable to conclude that care outcome would also improve. These responses reflect the newness of the device and a hesitancy to formulate an opinion when exposure has been limited. Repeating the survey once the use of GCM devices become standard practice may yield definitive opinions.

4.1 Clinical implications

Positive clinical implications associated with the use of a CGM device are many. They enhance the quality of care provided, the need to secure blood for testing is decreased, and patient assessment can be done without interrupting the patient.[8, 10] For care providers, data is available in real-time, alarms are available that provide alerts when values are abnormal, and there is a decrease in exposure to blood.[11] Yet adequate education and ongoing support for questions and troubleshooting are necessary to ensure successful adaptation. The results of this study demonstrate the effect education and resources have.

4.2 Limitations

Activities for this project were completed within one clinical setting. The COVID-19 pandemic was underway during each step of this activity. While it is not posited that this had any impact on the project, the pandemic has impacted the ability to provide healthcare that may have influenced this project. Implementation of our assessment tool should be done with caution, and only after site-specific data supports its use.

5. Conclusion

The results of this single-site survey-design study describe, and highlight, the perceptions of direct care providers specific to the inclusion of a CGM device as part of the plan of care. As the users of the device, the clinical competency of these individuals will impact implementation and reliance on the device. Ongoing educational sessions that provide opportunities to upskill clinical competency, together with ongoing clinical support during the implementation period are necessary for success.

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Authors contributions

Ms. Smith was responsible for the study design, data collection, and manuscript writing. Ms. Peacock, Ms. Thomassy, and Dr. Ward-Smith assisted with various activities. These contributions of individuals are acknowledged.

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DATA SHARING STATEMENT
No additional data are available.

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CONFLICTS OF INTEREST DISCLOSURE
The authors declare they have no conflicts of interest.

REFERENCES
[1] Avari P, Reddy M, Oliver N. Is it possible to constantly and accurately monitor blood sugar levels, in people with Type 1 diabetes, with a discrete device (non-invasive or invasive)? Diabet Med. 2020; 37(4): 532-544. https://doi.org/10.1111/dme.13942 PMid: 30803028.

[2] Dexcom. G7. (n.d.). Available from: https://www.dexcom.com/en-us(n.d.)

[3] Food and Drug Administration (FDA). 2016. Dexcom: Executive Summary. Available from: https://www.fda.gov/media/98967

[4] Dexcom. 2020. Use of Dexcom continuous glucose monitoring systems in the hospital. Available from: https://www.dexcom.com/en-us/hospitalfacts

[5] Food and Drug Administration (FDA). 2020. FDA authorizes the first interoperable continuous glucose monitoring device. Available from: https://www.fda.gov/news-events/press-announcements/fda-authorizes-first-fully-interoperable-continuous-glucose-monitoring-system-streamlines-review

[6] World Health Organization. 2023. Diabetes. Available from: https://www.who.int/news-room/fact-sheets/detail/diabetes

[7] Lipton JA, Barendse RJ, Van Domburg RT, et al. Hyperglycemia at admission and during hospital stay are independent risk factors for mortality in high risk cardiac patients admitted to an intensive cardiac care unit. Eur Heart J Acute Cardiovasc Care. 2013; 2(4): 306-313. PMid: 24338289. https://doi.org/10.1177/2048872613489304

[8] Pasquel FJ, Lansang MC, Dhatariya K, et al. Management of diabetes and hyperglycaemia in the hospital. Lancet Diabetes Endocrinol. 2021; 9(3): 174-188. PMid: 33515493. https://doi.org/10.1016/S2213-8587(20)30381-8

[9] Gothong C, Singh L G, Satyarengga M, et al. Continuous glucose monitoring in the hospital: an update in the era of COVID-19. Current Opinion in Endocrinology, Diabetes, and Obesity. 2022; 29(1): 1-9. PMid: 34845159. https://doi.org/10.1097/MED.0000000000000693

[10] Galindo RJ, Umpierrez GE, Rushakoff RJ, et al. Continuous glucose monitors and automated insulin dosing systems in the hospital consensus guideline. J Diabetes Sci Technol. 2020; 14(6): 1035-1064. PMid: 32985262. https://doi.org/10.1177/1932296820954163

[11] Wallia A, Umpierrez GE, Nasraway SA, et al. Round Table Discussion on Inpatient Use of Continuous Glucose Monitoring at the International Hospital Diabetes Meeting. Journal of Diabetes Science and Technology. 2016; 10(5): 1174-1181. PMid: 27286715. https://doi.org/10.1177/1932296816656380

[12] Baker M, Musselman ME, Rogers R, et al. Practical implementation of remote continuous glucose monitoring in hospitalized patients with diabetes. American Journal of Health-System Pharmacy. 2022; 79(6): 452-458. PMid: 34849550. https://doi.org/10.1093/ajhp/zxab456

[13] Avari P, Lumb A, Flanagan D, et al. Continuous Glucose Monitoring Within Hospital: A Scoping Review and Summary of Guidelines from the Joint British Diabetes Societies for Inpatient Care. Journal of Diabetes Science and Technology. 2023; 17(3): 611-624. PMid: 36444418. https://doi.org/10.1177/19322968221137338

[14] U.S. Department of Health and Human Services (HHS). Exemptions. 2018. Available from: https://www.hhs.gov/ohrp/regulations-and-policy/regulations/45-cfr-46/common-rule-subpart-a-46104/index.html