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Videoconference based training on diabetes technology for school nurses and staff: Pilot study

Chelsea F. Zimmerman, MD [a], Katelin L. Bowater, MSH, RDN/LD, CDCES [b], Maureen R. Revels, MSN, RN, CDCES [b], Janine E. Sanchez, MD [c], Victoria I. Gordon, BS [d], Janey G. Adams, BS [a], Rebecca O. Oyetoro, BS [a,*], Anastasia Albanese-O'Neill, PhD, APRN, CDCES [a]

[a] University of Florida, Division of Pediatric Endocrinology, USA
[b] Northeast Florida Pediatric Diabetes Center at Wolfson Children's Hospital, USA
[c] University of Miami, Division of Pediatric Endocrinology, USA
[d] Kansas City University of Medicine and Biosciences, USA

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ABSTRACT

Purpose: Children with diabetes spend a significant portion of time at school and in school-related activities and rely on school nurses for diabetes management support. Diabetes technologies are rapidly evolving, and there are no standardized competencies or training programs for school personnel providing diabetes care.
Design and methods: A virtual diabetes education program was provided to school nurses and staff in 3 Florida school districts. Program feasibility was measured by attendance; acceptability was measured with a usability survey; and efficacy was measured by participants' improvements in scores on pre- and post-training knowledge assessments. Descriptive statistics were generated and improvements in knowledge were evaluated via *t*-test. *P*-values <0.05 were considered significant.
Results: Pilot survey data ($n = 91$) revealed high demand for diabetes technology and basic management education among school nurses and staff. Eighty-eight school personnel from 64 schools attended the training, with 67 participants completing the demographic survey and at least one of the pre- and post-training assessments. Post-test scores demonstrated mean + 10.6% absolute improvement on the diabetes technology subscale, +11.5% on the basic management subscale, and + 10.9% on the ketone management subscale, all $p < 0.001$. Fifty-three participants completed the usability survey with 92% reporting they benefitted from training.
Conclusions: Virtual training is feasible and acceptable for delivering diabetes technology education to large numbers of school personnel. Study results demonstrate improved diabetes knowledge.
Practice implications: Establishing a standardized training program on diabetes technology for school personnel can optimize diabetes care in the school setting.

Introduction

There are >244,000 children and adolescents in the United States with diabetes, who spend the majority of their waking hours at school or in childcare (Centers for Disease Control and Prevention (CDC), 2021; American Diabetes Association Professional Practice Committee et al., 2022; Jackson et al., 2015; Kise et al., 2017). The American Diabetes Association's (ADA) position statement on diabetes management in schools describes the importance of optimal diabetes care during the school day to prevent immediate complications from hypo- or hyperglycemia and to prevent long-term complications from suboptimal diabetes control (Jackson et al., 2015). The International Society for Pediatric and Adolescent Diabetes (ISPAD) 2018 guidelines and the American Association of Diabetes Educators (AADE) 2019 guidelines both advise that schools are responsible for providing adequate training to school personnel and should make "reasonable adjustments," including support with insulin administration, management of hypo- and hyperglycemia, and understanding of diabetes technology, to ensure students with diabetes can receive optimal diabetes care which will enable them to fully participate in educational and extracurricular activities (American Association of Diabetes Educators, 2019; Bratina et al., 2018). Due to a number of individual characteristics, including age, duration of diabetes and confidence with self-management, some children will require more supervision and support than others (Jackson et al.,

* Corresponding author at: Division of Pediatric Endocrinology, University of Florida, 1699 SW 16th Avenue, Gainesville, FL 32608, USA.
E-mail address: becca.toro01@ufl.edu (R.O. Oyetoro).

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2015; Wood, 2013). School personnel are essential to ensure the safety of these children (Jackson et al., 2015; Pansier & Schulz, 2015; Siminerio et al., 2014); however, there are currently no standardized competencies or training programs for school personnel providing diabetes care at school and childcare. Schools determine requirements for training which is often inconsistent and not comprehensive. Moreover, while the American Academy of Pediatrics (AAP) recommends each school have a school nurse, this is often not achieved, leaving a variety of other school personnel, often with no medical training, to provide medical care for students (Council on School Health, 2016; Driscoll et al., 2015; Hellems & Clarke, 2007; Nabors et al., 2005; Olympia et al., 2005).

School personnel, parents, and children with diabetes alike recognize barriers to providing optimal care in schools. These most commonly include difficulty coordinating with students' healthcare providers, decreased access to necessary supplies, lack of training regarding diabetes management, lack of availability of school nurses, and lack of updated training for newer diabetes technologies and treatments (de Cássia Sparapani et al., 2017; Driscoll et al., 2015; Fisher, 2006; Jacquez et al., 2008; Kise et al., 2017; Marks et al., 2013; Marks et al., 2018; Nabors et al., 2005; Pansier & Schulz, 2015). Evidence also shows that school personnel report higher self-efficacy when they perceive they have more support and resources at their disposal (Fisher, 2006), further highlighting the importance of school personnel and healthcare provider partnerships (Jackson et al., 2015). Deficiencies can be ameliorated by the teams collaborating to streamline school policies and trainings to allow for more efficient and effective care while at school (Hopkins & Hughes, 2016).

Diabetes technologies are now more widely used and are rapidly advancing leading to a widening knowledge deficit for school nurses and staff (Foster et al., 2019; Jackson et al., 2015). Enhanced diabetes technologies can contribute to improved diabetes control, decreased complications, and improved quality of life but these effects are limited if they are not utilized optimally in the school setting (Eiland et al., 2019; Marks et al., 2013). The ADA therefore recommends providing training to school nurses and the staff who will be providing medical care in their absence to address these various concerns (Driscoll et al., 2015; Gutzweiler et al., 2020; Jackson et al., 2015).

School personnel knowledge and confidence regarding diabetes management improves when delivered traditionally (in person) as well as via an online platform (Siminerio & Koerbel, 2000; Radjenovic & Wallace, 2001; Nichols & Norris, 2002; Bachman & Hsueh, 2008; Smith et al., 2012; Lahti et al., 2014; Breneman et al., 2015; Taha et al., 2018; Rhodes et al., 2019; Shimasaki et al., 2021). Benefits of utilizing technology to present education include delivering training to a large number of participants synchronously regardless of location, flexible scheduling, avoiding high cost and travel, and allowing for social distancing which has become increasingly important given the ongoing COVID-19 pandemic (Lahti et al., 2014; Rhodes et al., 2019). Previous studies, however, did not assess knowledge improvements with objective measures and some were more tailored toward updates in diabetes management and did not address emerging diabetes technologies.

The purpose of our study was to develop a videoconference-based school nurse training program based on the self-identified diabetes knowledge needs of school nurses and staff who care for children with diabetes evaluate the program's preliminary feasibility, acceptability, and efficacy.

Research design and methods

Study design and methods

Approval for all phases of the study was obtained from the university's institutional review board and participants provided informed consent to participate. A survey was developed to obtain information on the self-identified learning needs of school nurses and staff who provide diabetes care in the school setting. The survey included 11 closed- and open-ended questions and was distributed via email. Anonymous responses were collected via Qualtrics. Survey content included the respondent's role in the school, previous diabetes management training, confidence in diabetes care skills, and desired future training regarding diabetes management. Data were exported from Qualtrics and analyzed in IBM SPSS Statistics. The survey was distributed from August to October 2019.

Based on the survey results and informed by clinical guidelines, a training program was designed directed toward school personnel's educational needs identified in the survey. The team consisted of members of three pediatric endocrinology teams at diabetes centers in Florida and included pediatric endocrinologists, an Advanced Practice Registered Nurse (APRN), two registered dieticians, two registered nurses, and 5 certified diabetes care and education specialists (CDCES). Current clinical guidelines and evidence, the diabetes education curriculum from the three diabetes centers, and resources available on https://t1dtoolkit.org, a website that includes diabetes education videos co-produced and reviewed by the American Diabetes Association were utilized to inform the content. Three training modules were developed: Diabetes Technology, Basic Diabetes Management, and Hyperglycemia and Ketone Management. The first module covered diabetes technology and provided an overview of how to use FDA-approved insulin pumps and automated insulin delivery systems, continuous glucose monitors as well as appropriate use, and strategies to recognize and address device malfunctions. The basic diabetes management module included information on symptoms and treatment of mild, moderate, and severe hypoglycemia, carbohydrate counting, insulin dose calculation and administration, and Diabetes Medical Management Plans. The final module focused on recognizing and treating hyperglycemia and ketones. General recommendations were also provided regarding when to contact student families and/or clinical care teams. Participants were directed to https://t1dtoolkit.org for continued education.

Sample and setting

School staff who provided direct care for students with diabetes were included in the virtual school nurse training pilot study. Access to a computer or device with internet connectivity and the ability to understand English were also requirements for participation.

Procedure and data collection

Flyers advertising the training session were distributed via email by the clinic teams to district nurse managers at the three school districts. The district nurses distributed them to school nurses and staff. Attendance was not mandatory. The session was delivered virtually via Zoom for over 2 h by three CDCES from the three diabetes centers in Florida (University of Florida, University of Miami, and Wolfsons Children's) who have professional relationships with the three school districts chosen for the pilot (Alachua, Palm Beach, and St. Johns counties). All participants took part in the same training session. After completion of the training session and assessments, participants were divided into three break-out groups by school district to meet with their local CDCES for 15 min for questions/answers with their local CDCES.

Measures

Feasibility was assessed by program attendance. The program was determined to be feasible if 10% of schools in the three respective districts were represented at the training session. Efficacy was assessed by pre- and post-training diabetes knowledge surveys using a validated assessment tool, Knowledge Assessment of Type 1 Diabetes (KAT-1) (Albanese-O'Neill et al., 2019). The KAT-1 has 11 subscales that assess diabetes basic diabetes knowledge and management, hypo- and

hyperglycemia, diabetes technology, supplies and insurance, activity, complications, pathophysiology, ketones and sick days, diabetes at school, and nutrition. The diabetes technology (18 questions), basic management (13 questions), and ketone management (11 questions) subscales were utilized in the study. Participants who consented to participate in the evaluation were provided with a link to each subscale prior to beginning each respective educational module and then again at the completion of the training session. Acceptability was measured using a satisfaction and usability survey that was designed for the study and included seven questions using a five-point Likert scale. Participants entered a unique identifier each time a subscale and/or survey was completed.

Statistical analysis

Scores were excluded for participants who did not complete both the pre- and post-training assessment for a specific subscale. Descriptive statistics were generated in IBM SPSS Statistics. Improvements in pre- and post-training scores were compared using a *t*-test. A *p*-value of <0.05 was considered significant.

Results

Exploratory phase

In total, 91 complete survey responses were recorded in the needs assessment survey. All respondents reported providing direct care to students with diabetes; 71% ($n = 65$) were school nurses and 29% ($n = 20$) were teachers, clinic assistants, or other school staff. School settings included elementary school 47% ($n = 43$); middle school 19% ($n = 17$); high school 15% ($n = 14$); and multiple school grades 19% (n = 17). Ninety-six percent ($n = 87$) reported confidence in their ability to provide care for children with diabetes, with 88% ($n = 80$) reporting they had received training in diabetes care. Of those who received training, 5 did so only in nursing school and 2 were trained exclusively by the parent of a student with diabetes. Of the diabetes competencies assessed, school nurses/staff reported high levels of confidence in basic diabetes management tasks; however, 11% ($n = 10$) reported lack of confidence with glucagon administration and calculating insulin doses. Confidence levels with diabetes technology were low, with 51% ($n = 46$) reporting training needs for insulin pumps, 44% ($n = 40$) for continuous glucose monitors, and 63% ($n = 57$) on automated insulin delivery systems (Fig. 1). The majority of respondents preferred future training be provided in a group setting with other school nurses; however, due to the COVID-19 pandemic, this was not feasible.

Pilot study phase

In the second phase of the study, 88 school nurses and other staff attended the videoconference-based training session and represented 64 (26%) of the total schools ($n = 249$) from the three school districts that participated in the pilot feasibility study. Sixty-seven school nurses and staff consented to participate in the research study component by completing the pre- and post-training KAT-1 diabetes technology, basic management, and ketone management subscales as well as a usability and satisfaction survey. Among study participants, 78% ($n = 52$) were school nurses. Six percent (n = 4) worked in a preschool setting, 34% ($n = 23$) in an elementary school, 12% ($n = 8$) in a middle school, 15% (n = 10) in a combined K-8 school, 16% ($n = 11$) in a high school, 8% (n = 5) in all grade levels, 6% (n = 4) in administration or at the district level, and 3% (n = 2) did not report their school setting. Sixty-seven percent ($n = 45$) reported they had previously received training (Table 1).

Data analyses revealed an overall improvement on all knowledge scales. Participants improved a mean absolute +10.6% on the diabetes technology subscale $n = 41$ (pretest = 66.1%, posttest = 76.6%, $p < 0.001$); a mean + 11.5% (75.4%, 86.9% $p < 0.001$) on the basic management subscale $n = 53$; and + 10.9% (79.1%, 90.0%, $p < 0.001$) on the sick days and ketone management subscale $n = 54$. This demonstrates an overall improvement of +10% (74.0%, 84.0%, $p < 0.001$, $n = 41$). Raw scores and percentages are included in Table 2.

Usability and satisfaction survey results (n = 53) revealed that 92.5% of respondents ($n = 49$) reported they benefited from the training; 83.0% of respondents ($n = 44$) agreed the training addressed their learning needs; 88.7% ($n = 47$) reported they would attend a subsequent training session; and 88.7% (n = 47) felt more confident in managing diabetes. Feedback provided also revealed participants appreciated the smaller discussion groups at the conclusion of the training session.

Discussion

Students spend much of their waking time in school or childcare, and school nurses and staff are crucial to ensuring the safety of children with diabetes in schools (Jackson et al., 2015). Appropriate diabetes care in school contributes to the overall improved management of diabetes (Pansier & Schulz, 2015; Smith et al., 2019). Studies have shown improvements in HbA1c and quality of life in students whose school nurses participated in a training program (Pansier & Schulz, 2015). Despite these findings and the recommendations in clinical guidelines around diabetes management in schools, there are currently no specified training requirements or a standardized curriculum to meet the educational needs of school nurses and staff nationally or in Florida. Other states do have more comprehensive and more updated standards of care with specific recommendations regarding diabetes technology utilization (Patrick & Wyckoff, 2018) which our clinic references when caring for school-aged children with diabetes, and fortunately, the state of Florida is currently revising and updating their school guidelines.

On average, students with chronic medical conditions miss significantly more school than children without healthcare needs which can lead to lower academic performance and decreased quality of life (Hopkins & Gallo, 2012; Kise et al., 2017; Pansier & Schulz, 2015; Schwartz et al., 2010). Parents also miss more work to either help with diabetes management at school functions or to care for the child at home (Driscoll et al., 2015). Consistent with the aforementioned studies, children who feel more supported at school have improved diabetes outcomes as evidenced by lower HbA1c (Lehmkuhl & Nabors, 2008). Providing adequate training for school personnel can alleviate some of these concerns, as staff will be more prepared to address routine concerns surrounding diabetes such as hyperglycemia, ketonuria, hypoglycemia, and diabetes technology failures.

Diabetes management and technologies are rapidly evolving, and school personnel can benefit from ongoing and updated training. Participants in our study demonstrated statistically significant improvement in all subscales based on scores on a validated knowledge assessment pre- and post-training. While the initial study results revealed most respondents preferred to complete training in a group setting with other school nurses, this is not feasible in a state the size of Florida, and not possible during the COVID-19 pandemic. Our study confirms previous research documenting both that virtual training is an effective means of providing education (Bachman & Hsueh, 2008; Lahti et al., 2014; Radjenovic & Wallace, 2001; Rhodes et al., 2019; Taha et al., 2018) and that knowledge and confidence improve after receiving education (Breneman et al., 2015; Siminerio & Koerbel, 2000; Smith et al., 2012; Taha et al., 2018). This is the first study in the academic literature that provided virtual diabetes education to school nurses and staff across all grade levels and objectively assessed an increase in knowledge.

The training was repeated in April 2021 and expanded to seven Florida counties. Future research opportunities include continued expansion and maintaining an updated training curriculum that will be reviewed by physicians and CDCES with the diabetes centers and will

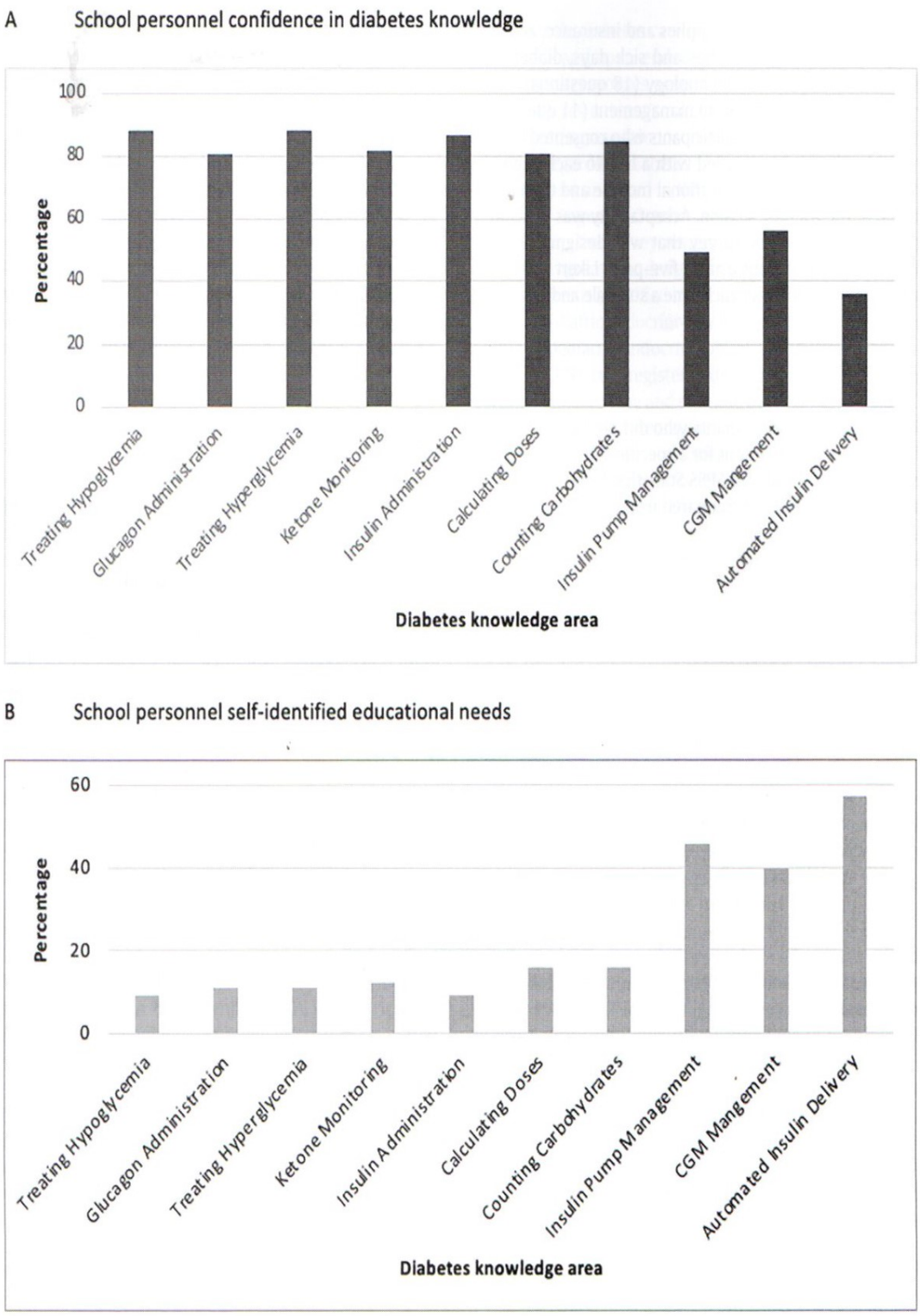

Fig. 1. Areas of confidence and educational needs of school personnel caring for children with diabetes.
Note. The percent of school staff who stated they were confident in specific diabetes knowledge areas (x-axis) are shown in 1A. The percent of school staff who stated they had self-identified education needs in this same diabetes knowledge area (x-axis) are shown in 1B.

be delivered annually to school staff caring for students with diabetes. Education needs will be continually assessed to keep training focused on pertinent topics. Psychosocial aspects of diabetes care should be considered for inclusion in future training programs. Subsequent virtual sessions will be recorded to increase availability to allow for more widespread distribution of material and to allow participants to review the concepts again at a later time. Providing continuing education units (CEU) would further incentivize participation. Measuring outcomes such as school nurse and staff confidence with diabetes management concepts before and after training as well as HbA1c, quality of life, and missed school time for children in schools with a nurse who attended training compared with those in schools without a nurse who participated would demonstrate how benefits from our program can translate to the clinical setting.

Practice implications

Virtual training provided the additional benefits of allowing collaboration between leading diabetes centers, a standardized curriculum to be distributed across counties, CDCES to efficiently deliver training, and school staff to participate conveniently from their place of work during typical business hours. The virtual program was formatted to

Table 1
Demographics of participants who completed pre- and post-training assessments.

Baseline characteristic	N	%
Total N	67	100
School County		
Alachua	22	32.8
Palm Beach	12	17.9
St. Johns	22	32.8
Not Reported	11	16.4
School Position		
School Nurse	52	77.6
Health Director	4	6.0
Teacher or Substitute	2	3.0
Not Reported	9	13.4
School Level		
Preschool	4	6
Elementary School	23	34.3
Middle School	8	11.9
K-8	10	14.9
High School	11	16.4
All Grades (Nurse)	5	7.5
Administrator/District	4	6
Not Reported	2	3
Previous Training		
Yes	45	67.2
No	11	16.4
Not Reported	11	16.4
Most Recent Training		
This Year	22	32.8
Last Year	20	29.9
>2 Years	2	3.0
Not Reported	23	34.3

preserve time for valuable personal discussions between school nurses and staff and the CDCES. These interactions were well received as evidenced by our satisfaction and usability survey results as well as in the feedback received from participants. Given the logistical burden of training school nurses in person, and the increased acceptance of virtual education and training revealed during the COVID-19 pandemic, future research should explore the efficacy and acceptability of virtual school nurse training to expand reach and access not only in type 1 diabetes but other chronic childhood diseases.

Limitations

Limitations of this study include having a small sample size, and the convenience sample that included nurses and staff from 3 school districts in Florida may not be representative of the entire state population. Participation in the pre- and post-training assessments was optional and not all participants completed the knowledge assessment. Those who did not participate in either the training or the knowledge assessments may have had lower scores. The scope and quality of previous diabetes training were not assessed. While most participants were school nurses, there may be even more benefits when providing this training to other school personnel with subsequent training sessions. Further research will be required to evaluate if an increase in knowledge translates into improved care in the school setting. These issues will be addressed by expanding training sessions.

Table 2
Pre- and post-training knowledge assessment of type 1 diabetes (KAT-1) raw scores.

	n	*Pre*		*Post*		*p*
		M	*SD*	*M*	*SD*	
Basic Management[a]	53	9.77	2.20	11.28	1.49	<0.001
Ketone Management[b]	54	8.67	1.91	9.93	1.04	<0.001
Diabetes Technology[c]	41	11.93	2.69	13.83	2.30	<0.001
Overall[d]	41	31.05	4.71	35.30	3.76	<0.001

Note.
[a] Out of 13 questions.
[b] Out of 11 questions.
[c] Out of 18 questions.
[d] Out of 42 questions.

Conclusion

Our study provides evidence that virtual diabetes education training in a group setting is a feasible, acceptable, and efficacious tool for delivering educational material to a large number of school nurses and personnel as demonstrated by significant improvement in post-training assessment scores and high satisfaction ratings in our population. Future directions include determining and implementing improvements to the training curriculum and expanding the training to include a larger number of counties in Florida.

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CRediT authorship contribution statement

Chelsea F. Zimmerman: Conceptualization, Methodology, Validation, Data curation, Formal analysis, Writing – original draft, Visualization. **Katelin L. Bowater:** Writing – review & editing. **Maureen R. Revels:** Writing – review & editing. **Janine E. Sanchez:** Writing – review & editing. **Victoria I. Gordon:** Writing – review & editing. **Janey G. Adams:** Software, Data curation, Writing – review & editing. **Rebecca O. Oyetoro:** Data curation, Writing – review & editing. **Anastasia Albanese-ONeill:** Conceptualization, Methodology, Software, Formal analysis, Resources, Writing – review & editing, Supervision.

Declaration of Competing Interest

The authors 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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