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Group Style Central Venous Catheter Education Using the GLAD Model☆

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ABSTRACT

Purpose: This study aimed to examine the impact of group-based central venous catheter education (CVC) on the knowledge, skill and comfort of caregivers, length of stay (LOS) related to initial CVC placement and 30-day return hospital visit for central line associated blood stream infections (CLABSI).
Design and Methods: This pilot study employed a pretest-posttest design comparing retrospective data collected before implementation of the group-based education (GLAD Model). Data were collected from children's caregivers before and after taking the educational class through use of the Comfort Survey, and collected though the electronic medical record. The data were analyzed using SPSS 24, repeated measures analysis of variance, and *t*-test.
Results: Pre-post difference with the Comfort Survey indicated significant increase ($M = 0.49$, $SD = 0.79$), $t(92) = 6.05$, $p = 0.001$, $d = -0.62$) for skill, knowledge and comfort for the pre- and the post 2 (1 month after) and 3 (2 months after). After GLAD Model implementation, LOS related to initial CVC placement during retrospective review declined from 29.7 days to 27.7 and 30-day return hospital visit declined from twelve to zero. Our results suggest that use of the GLAD Model educational program might be effective in improving caregiver knowledge, skill and comfort as well as LOS and 30-day return hospital visit.
Conclusion: This study suggests that group-based, education with use of the GLAD Model should to be considered as an effective educational intervention in providing caregivers CVC education. This may help care for their child at home while enhancing their hospital experience and decreasing unplanned hospital visits.

Introduction

Though caregiver education is critical to achieving optimal patient outcomes after discharge, certain factors can adversely influence its accomplishment during a hospital stay. In particular, bedside nurses who act as primary educators may encounter various barriers in creating supportive educational experiences for adult learners. A specific teaching barrier might include insecurity in teaching the content needed for safe care at home, which may cause inconsistent messaging and practices amongst various providers. Additionally, time for teaching the patient and family is frequently interrupted by hospital activities, reducing the ability to absorb knowledge and skills. The sheer amount of new material to be learned can itself be a detriment too. Solan et al. (2015) claimed the amount of information families receive related to their child's diagnoses, medications, or follow-up appointments can be so overwhelming that it can affect patient adherence to important practices, reduce comfort, and reduce the effectiveness of post-discharge care. The stress of being in the hospital can reduce health literacy comprehension, and limit overall understanding of new information, especially complex medical information. As a result, caregivers (parents and guardians) have a challenging time understanding how to safely care for their child at home. Misunderstanding medical cares can lead to a longer stay in the hospital or lead to returning for an unexpected visit or admission.

The importance of caregiver education has been recognized. In 2005, the American Academy of Pediatrics called for "high-intensity" hospital discharge care coordination, for children with medical complexity and technology assistance (American Academy of Pediatrics, 2005). Yet since 2005, hospital discharge has not evolved to meet the demands of an increasingly medically complex pediatric inpatient population (Russell & Simon, 2014). This represents a significant gap in care quality and lost opportunities for improvement in quality of life, as well as cost savings, for these children and caregivers.

Extending group instruction was considered as a path toward improved caregiver training. Evidence supports that group well-visits improved the likelihood that caregivers will be more engaged, acquire needed skills and use appropriate safety practices related to medical

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care at home (Glascoe & Trimm, 2014). Some hospitals across the nation have implemented educational programs that offer health education in a structured, standardized way. However, a survey conducted by the researcher of a national electronic distribution list of health care educators found most hospitals do not offer group-based educational classes for central venous catheter (CVC) care.

Review of Literature

There is abundant literature toward the development of best practices of adult learning. Recently, concepts including continual feedback, multi-modal technology use, productive interactions, scenario learning, and teach-back have been suggested for individual focus (Office of Disease Prevention and Health Promotion, 2017; Rothman et al., 2009; Teaching Excellence in Adult Literacy [TEAL], 2011). However, there is scarce literature on group learning as an effective method of teaching caregivers how to provide care to their child in the home, when complex medical technologies are involved. Even within this limited literature, best methods are debated.

Caregivers may become quickly overwhelmed by new medical cares they must complete. Children requiring medical technology assistance are clinically heterogeneous with variability in underlying conditions, types of technology used, and hours per day of use (Heaton, Noyes, Sloper, & Shah, 2005). The most common medical technologies support enteral nutrition (e.g. nasogastric tubes and gastrostomy tubes), respiratory care (e.g. tracheostomy and ventilators), and intravenous infusions (e.g. CVCs) (Feudtner et al., 2005). Children requiring these medically complex treatments have higher rates of 30-day readmissions (Berry et al., 2011; Coller et al., 2014; Hain et al., 2013; Kun, Edwards, Ward, & Keens, 2012; Mallory et al., 2017). Studies show that caregivers facing these types of technologies may not be sufficiently prepared for the transition from hospital to home (Heaton et al., 2005; Kirk & Glendinning, 2004; Sawin et al., 2017).

Caregiver education appears to be a critical element toward home care success. Evidence shows appropriate caregiver education is crucial to supporting the transitional care competencies for caregivers of children with medical complexities and new treatment technologies. Enhancing caregiver skill and knowledge in technical aspects of their child's care is supported in the literature as an important strategy to reducing hospitalizations in medically complex children (Coller et al., 2017). Weiss et al. (2017) found that the way nurses teach, and not the amount of content, was strongly correlated to caregiver perceptions and nursing assessments of discharge readiness. In this study, an increase in discharge readiness was associated with a decrease in likelihood of readmission (Weiss et al., 2017). A multi-centered study by Mallory et al. (2017) found that implementation of a discharge bundle, which included use of teach-back prior to hospital discharge, did not reduce readmission rates overall, in the subset of technology-supported children. This suggested that a more targeted approach is needed to effectively educate caregivers of children going home with medical technologies. For example, Rinke et al. (2013) developed a CVC maintenance bundle for ambulatory pediatric oncology patients which led to fewer central line–associated bloodstream infections (CLABSIs). The bundle included caregiver assessment, evaluating problems at home and CVC education needs, yet it did not specifically describe educational interventions to address those needs.

The method of bedside education by nurses is problematic. Nurses take on the primary role of providing cares in the hospital, however, children with medical complexities may need continued medical care at home. In the home environment, caregivers become the sole caretaker, providing all medical cares, often without easy access to medical support or supplies. Essential caregiver education is commonly provided by the nurse in a mostly non-structured, highly variable educational model. Caregiver education is usually introduced ad-hoc at the bedside, between required nursing tasks. The development of high quality, complex care education is therefore critical for the well-being, safety and health of the child prior to leaving the hospital.

A literature review suggested the potential benefits of developing effective group style education, prior to bringing home a child with medically complex needs. Group education has been proven effective in pediatric settings for asthma and primary care (Glascoe & Trimm, 2014; Tolomeo, 2009). However, this approach has not been widely studied in regards to CVC teaching. According to Sheff, Park, Neagle, and Oreskovic (2017) peer-to-peer support prompts additional information sharing, immediate connection, vocalized experiences, and an early sense of camaraderie. Group style education is becoming a common way to effectively and efficiently teach many caregivers while providing peer support, which has previously been seldom available during an admission.

Implementation of the Group Learning and Development (GLAD) Model

Owing to its success in training caregivers in related medical fields, group education was considered a viable method for CVC instruction as well. The researcher initially demonstrated a successful model of group education for CVC teaching in an oncology inpatient unit, limited to oncology caregivers. It was considered that this class could be of benefit to caregivers of children with CVCs in other hospital units and clinics, by expanding accessible and standardized teaching to support caregivers using best practice teaching methodologies. Moreover, changes to the oncology group instruction were also deemed desirable, owing to the notion that ideally, education should be started throughout the admission, rather than at discharge (Solan et al., 2015).

Consequently, the Group Learning and Development (GLAD) Model was created by the researcher. It was adapted from previously proven successful methods from the oncology CVC class, with enhanced educational materials and teaching methods to align with adult learning practices. Additionally, the GLAD Model accommodated six caregivers per class, available four times a week, whereas the oncology CVC class had a maximum of three caregivers per class, available three times a week. This allowed for an additional fifteen caregivers to attend each week. Enhancements to the GLAD Model class included short, focused videos (shown in the class and accessible at home), multi-use laminated cheat sheets for quick skill recollection, and a handbook with clear content and photos.

The decision to transition from individualized bedside teaching to the GLAD Model stemmed from merging Imogene King's Conceptual System with health literacy tools for teaching and peer support. King's methodology was intended to improve understanding of CVC cares by allowing caregivers to take on their new role of medical caretaker, in an environment supporting their educational needs and understanding (Fawcett, 2005; Rothman et al., 2009). It was considered essential for the GLAD Model to educate caregivers in an intentional, comprehendible manner, with health literacy and its multiple aspects in mind. Using teach-back and educational technologies have been proven to enhance knowledge and satisfaction of the adult learner (Gysels & Higginson, 2007; Rothman et al., 2009).

Because the educational program is structured with time set goals and conducted using evidence-based methods, it supports King's Conceptual System (Fawcett, 2005), where various structures allow one to obtain information dependent on the emotional state and learning readiness of the learner. King further explained that it is significant to receive education on new information, and for communication between caregivers and health educators to set goals prior and during their educational process (Fawcett, 2005). The GLAD Model incorporated this best practice by providing achievable goals and supportive efforts, in a peer setting. Educating caregivers about complex technologies can be time consuming, however multi-modal techniques in addition to repetitive practice were incorporated in the model to promote caregiver engagement needed to learn new skills (Glascoe & Trimm, 2014).

Purpose of the Study

The purpose of this study was to examine the impact of the GLAD Model on several outcomes, including (1) caregiver skill, knowledge and comfort caring for the CVC, (2) hospital length of stay (LOS), and (3) 30-day return hospital visit (readmission or emergency room visit) for CLABSI. The researcher hypothesized that participation in the GLAD Model classes would increase participants comfort in caring for their child's CVC, decrease LOS related to initial CVC placement, and decrease 30-day return hospital visit related to CLABSI.

Methodology

Design and Sample

This pilot study analyzed pretest-posttest outcomes following educational transition of CVC care from traditional bedside nurse education to the GLAD Model. Outcome measures were: (1) caregiver reported skill, knowledge and comfort related to gained understanding with use of the GLAD Model (2) LOS related to initial placement of CVC, (3) return hospital visit within 30 days of discharge related to CLABSI.

Retrospective data collected from April 2015 to May 2016 included: (1) type of CVC, (2) return hospital visit within 30 days of discharge after CVC placement, (3) positive blood culture within 30 days of CVC placement, (4) average LOS in the hospital (inpatient and outpatient) with placement of a new CVC. The same data was compared after implementation of the GLAD Model from May 2016 to November 2016. All data collection was stored in a secure, non-linking RedCap data base.

Participants ($n = 105$) were enrolled by provider referral, as identified caregivers of patients needing CVC care at home. Participants were from all areas of the hospital (NICU, Oncology, Cardiology, GI, surgical/medical, etc.) and from both inpatient and outpatient settings. Eligible participants included caregivers of patients birth through 18 years old with a tunneled or non-tunneled CVC, and the imminent need to learn how to care for their child's new CVC at home. Exclusion criteria included caregivers of patients with implanted ports who did not need to learn CVC care and those that did not want to complete the demographic or data collection forms. Participation in the study was not required to participate in the class.

Colorado Medical Institutional Review Board (COMIRB) reviewed the study. This study had minimal risk and those that did not want to participate still received the class. Caregivers that did not want to or could not take the class were provided with standard teaching (bedside nurse education). All subject data collection was de-identified. Consent was obtained through the Informational Sheet provided to all participants before the class.

Operational Definition

In this paper and the study it describes, particular terms are employed as shown in Table 2, and defined as follows. The term "complete CVC education" was the goal for each participant, and was considered to be their knowledge and understanding of emergency care, when to call the doctor, ability to flush the CVC, perform cap changes, dressing changes and patient bathing. The achievement of complete CVC education was an assessment based on appropriate response to teach-back questions during the class, as well as return demonstration on skills acquired. A combination of nursing documentation of class completion, and participant self-report card completion, was used to verify total participation in the CVC class. When completing the Comfort Survey, we defined "skill" of the participant as being able to successfully and accurately flush the CVC, change the cap and dressing and wrap the CVC for bathing. Similarly, "knowledge" was defined as the ability to recognize emergent signs, understanding the rationales of cares, the ability to perform processes for decreasing CLABSI, and overall CVC understanding. Finally, "comfort" was defined for the participant as having developed confidence providing CVC cares (Table 1) without additional assistance in the home environment.

Data Collection

In May of 2016, the GLAD Model was launched for CVC education to all caregivers in the freestanding academic pediatric hospital where CVC oncology classes existed. Group style classes were taught by twelve specially trained registered nurses. Either nurses taught alone or with one additional proctoring nurse. Nurses completed specialized educational training to better understand adult learning principles and use of positive reinforcement, teach-back and return demonstration to ensure a successful and standardized educational program.

The GLAD Model program was developed over time in a collaborative manner. The curriculum was developed by a nationally certified clinical nurse specialist with proficiency in health literacy. Content was modified by continual caregiver feedback and some caregivers' previous experiences of CVC care problems in the home. The class included extensive explanation of CVC tasks, such as flushing, cap change, dressing change and wrapping for bathing, emergency indications, and when to call the doctor. In addition, the class provided real-life scenarios, positive reinforcement, a multitude of educational learning techniques for adult learners, and a structure providing peer support for participants. Classes included explaining the rationale of cares, in addition to the skill itself. Also to set a cooperative environment, teach-back and the curriculum were outlined in the beginning of the class. Furthermore, there was a focus in the class to allow the learner to make recommendations of class content and evaluate their own learning (TEAL, 2011).

The GLAD Model used multi-modal methods including teach-back, demonstration, short videos, handouts, hands-on practice and verbal explanation, as outlined in Table 1. Classes were held in a centralized location, away from the inpatient units, in a quiet room, four times a week, at various days and times to accommodate the different schedules of caregivers. Children, either patients or sibling, were not allowed in the class, to promote a minimally distracting and supportive environment. There was a maximum of six caregivers per class, with limitations of two caregivers per patient to accommodate multiple families. Classes were two hours long, capturing all CVC curriculum (Table 1).

After the class, participants completed a self-assessment report card. The intent of this was to for the inpatient bedside nurse, or outpatient clinic nurse, to review during follow-up after class completion. This evaluation prompted the bedside or clinic nurse to provide reinforced education in acknowledgement of their participation in the class. Inpatient caregivers were instructed to practice skills on their child with the assistance of their bedside nurse prior to discharge to reinforce education provided during the class. Nurses, both inpatient and outpatient, had access to educational materials and videos to ensure understanding of class content for reinforcement.

Table 1
Curriculum.

General information	What is a CVC, indications for a CVC, hand hygiene, patient activity, tips for covering the line, supplies (company providing them and storage).
Emergency care/when to call the doctor	What is a CLABSI (central line associated bloodstream infection), how CLABSI is treated, how to reduce a CLABSI, signs of CLABSI infection.
Showering and bathing	How to wrap the CVC, frequency of bathing, what to do if the dressing gets wet.
Flushing the CVC	How to flush the CVC, when to flush it, why flushing is needed, what happens when you cannot flush the line, type and amount of fluid needed for flushing.
Changing the cap	How to change the cap using clean technique, when to change the cap, why changing the cap is needed, what to do if you find the line without a cap on it.
Changing the dressing	How to change the dressing using sterile technique, when to change the dressing, why changing the dressing is needed.

Data from participants were collected using the Comfort Survey, shown in Table 2. The Comfort Survey, created by the researcher, recorded self-assessment of skills, knowledge, and comfort. It was internally validated by the team providing the education and caregivers of children with a CVC. This was necessary as there were no other validated surveys that adequately measured desired outcomes in a quantitative way.

The Comfort Survey asked participants to rate their level of competence using a Likert-scale with adjacent ratings. The ratings included: (1) I need the class again; (2) I need reinforced education; (3) I don't need more education; (4) I can teach someone. Participants circled which answer best reflected their ability.

The Comfort Survey was administered to all participants as a pretest prior to the CVC class (pre). The same survey was then given immediately after the class (post 1); 1 month after the class (post 2) and 2 months after the class (post 3). Participants had fifteen minutes in a quiet environment to complete both pre- and post 1- survey information. Post-surveys 2 and 3 were delivered via mail or secure RedCap email based on participant preference before the class. In addition to the Comfort Survey, participants completed a demographic survey (Table 3a) with pen and paper prior to the class.

Data Analysis

The Comfort Survey (Table 2), Demographic (Table 3b), and Experience Measures (Table 4) data were analyzed using SPSS 24. First, pre-post differences for each survey factor and experience measures were examined for all caregivers combined using a paired-samples *t*-test. Second, pre-post differences for each survey question were examined discretely, while controlling for the demographic variables using MANCOVA. Finally, survey categories and pre-post differences were analyzed based on Experience Measures.

Results

A repeated measures MANOVA (rMANOVA) were conducted to test time on comfort scores. Significant and moderate positive intercorrelations between skill, knowledge and comfort at T0, T2, and T3 were found ($p < 0.01$) and all pairs of variable's associations had correlations of <0.65. Results supports the use of the MANOVA test related to variables with moderate strength correlations. Bonferroni correction was conducted for Type 1 error and because sample sizes in each group were different, the Games-Howell procedure was used to determine whether there was any statistical differences between the groups.

The results of rMANOVA showed significant differences in the total comfort scores across the four-time points, however no significant multi-variate effects were found on IVs: socioeconomic, disease characteristics, or CVC characteristics, except for time with the CVC ($F = 4.13$ [2, 84], $p = 0.032$). Next, a series of univariate ANOVAs yielded following results: for comfort scores, the difference between groups was significant after 1 month, but not at the baseline with the immediate (T1) timepoint.

From the Comfort Survey results, skill and comfort level scores had higher results after 3 months than those at 1 month. Results indicated a significant increase ($M = 0.49$, $SD = 0.79$), $t(92) = 6.05$, $p = 0.001$, $d = -0.62$) for a total comfort score for the pre- and the post 2 (1 month after) and pre- with post 3 (2 months after). No significant differences were found between the pre and the post 1 (immediately after the class).

When analyzing the pre-post difference for each survey factor based on time with a CVC and previous CVC education while controlling for the demographic variables, only the time with the CVC proved significantly different ($F = 4.13$[2, 84], $p = 0.032$). Finally, the results indicated no statistically significant differences for any specific demographic variable.

Additional univariate testing showed LOS related to initial CVC placement went from an average 29.7 days during the retrospective data review to 27.7 days during the 6-month trial with the implementation of the GLAD Model. Additionally, there were twelve 30-day return hospital visit related to CLABSI during the retrospective timeframe compared to zero after implementation of the GLAD Model.

Discussion

The researcher found caregivers had positive perceptions of group CVC education with use of the GLAD Model. The GLAD Model method of education provided an opportunity for caregivers to obtain structured, standardized and efficient education that supported the cares needed for their child at home. The researcher concluded there is benefit of the GLAD Model to enhance patient outcomes. Providing education in a learning environment, away from distractions of the bedside and using supportive methodology enhanced caregiver skill, knowledge, and comfort. Knowledge gained in the class, enhanced the caregiver's quality of cares provided in the home and decreased unexpected time spent in the hospital or the emergency room. Findings indicated that LOS with initial CVC placement decreased as caregivers obtained timely education prior to day of discharge, providing a more organized transition to home. Moreover, this program has demonstrated potential in reducing educational cost and challenges by combining caregivers into group class settings.

Caregivers often have a challenging time coping with demands of caring for their child, in addition to learning new skills of caring for a CVC. Edwards, Wood, Davies, and Edwards (2012) found the complexity, amount and timing of learning information can be stressful when dealing with the stressors of medical complexities. Caregivers may struggle to acquire knowledge and skills needed to care for a CVC while in the hospital environment due to high emotional stress, constant distraction, interruption and noise levels. Caregivers require education in a supportive and structured manner to adequately learn the cares needed for the health of their child. They should understand their child's complex medical device and how to safely care for it outside of the hospital setting, without immediate access and support from the medical team.

In most hospital settings, education is performed by the bedside nurse. Nurses may exhibit wide variations in understanding health literacy and adult learning methods to meet the educational needs of the caregiver. Additionally, nurses may be uncomfortable teaching the needed content required for CVC care in the home, which may be different than care practices in the hospital. Home supplies provided to caregivers often vary from supplies used to practice with in the hospital setting. Furthermore, there may also be deviation amongst bedside teaching practices and techniques.

Table 2
Comfort survey.

	Skills Flushing the line, changing the cap, changing the dressing	Knowledge Flushing the line, changing the cap, changing the dressing	Comfort Flushing the line, changing the cap, changing the dressing	How do you feel with central line care? *Free text*
1	I need the class again	I need the class again	I need the class again	
2	I need reinforced education	I need reinforced education	I need reinforced education	
3	I don't need more education	I don't need more education	I don't need more education	
4	I can teach someone	I can teach someone	I can teach someone	

Table 3a
Demographic data collection.

Your name (parent/guardian):_____
Email or Mailing Address: _____
Age:____
Gender: Female Male
Marital Status: Single Married Common Law Divorced Separated Widowed
Education (circle highest): Elementary Junior High School High School Some College
Associate Degree Bachelor's Degree Post-Baccalaureate Other_____
Number of Children: _____
Number of hospital stays related to line: _____
Did you receive education on this line before coming to the class: Yes No
If yes, from who?: _____
How long has your child had the line: <7 days 1–2 weeks 2–4 weeks 1–3 months

Other challenges in educational practice may be related to nurse familiarity of the topic. Experienced nurses that care for CVCs daily may feel more at ease teaching a topic they fully understand; however, others may support a patient population that infrequently cares for them. Level of comfort, understanding and confidence of teaching CVC content may lead to ineffective and inefficient caregiver education. The variety of nursing competencies in education may result in distrust, confusion or frustration of caregivers from inconsistent messaging amongst providers.

During a time study conducted by the research team, observations of bedside CVC teaching appeared more fragmented compared to the GLAD Model class. One nurse would provide one task, another nurse would provide a couple more tasks, and the caregiver would seem to lose interest in the content. Incomplete education may contribute to the percentage of caregivers that did not perceive they had any education at all prior to taking the GLAD Model class. Caregivers may have mistaken bedside education for narrating cares since it may not have provided a sense of completeness or follow through. The GLAD Model class reviewed all content and rationales to CVC care in a smooth and structured manner, so that no curriculum was overseen. Additionally, the researcher found time of complete bedside education was up to two times longer than the same curriculum in the GLAD Model class. Complete curriculum of CVC care took upwards of four hours as gathering supplies, educational material and overcoming distractions often interrupted a smooth educational process.

Table 3b
Demographics.

Demographics	% or mean	Range or N
n = 105		
Age	M 39.8 years	R14–71
Gender	71.42%	75 female
	28.57%	30 male
Number of children in the home		
1 child at home	54%	56.7
2–3 children at home	30%	31.5
>3 children at home	31%	32.55
Parent education level		
HS diploma/GED	16%	16.8
Some college	27.80%	29.19
Bachelor's degree	36%	37.8
Post-graduate	17%	17.85
Marital status		
Single	10.20%	10.71
Married	66.70%	70.04
Divorced/separated	16.70%	17.54
Number of line related hospitalizations at time of class		
0	28%	30
1	51.40%	54
2–4	<1	10
5–8	<1	5

Conclusion

The study concluded that caregivers benefited from the GLAD Model because it increased their skills, knowledge, and comfort of CVC care. The GLAD Model promoted proactive education and discharge planning to ensure caregivers attended prior to discharge. Early education allowed caregivers to have additional time to practice caring for their child's CVC while in the hospital, with guided support from their bedside nurse.

Caregivers had no hesitation abiding by the environmental requests of the classes, with efforts to promote a less distracted environment. Additionally, having a group style class emphasized CVC care is important, so much so that the hospital supported the continuation of the classes with effort and resources.

Similar to the benefits of peer groups, caregivers had the opportunity to support each other in a classroom setting, which is not always available with one-on-one or bedside education. Peer support may provide a sense of normalcy around this new, complex medical understanding. While receiving needed CVC education, caregivers were able to collaborate, encourage and learn together. Due to the strict timeframe of class curriculum, there were minimal opportunities to steer off topic and curriculum was always completed.

Limitations

The researcher identified a few limitations of the study. This study was a pilot for a given group of caregivers over a 6-month timeframe and randomization was not used. None of the caregivers were knowledgeable about the topic taught in the class, thus avoiding one type of selection bias. The lack of randomization still made external validity challenging, as does the small sample size. Additional limitations included that the Comfort Survey was created by the investigator, as was the GLAD Model. As with any measure of success, the use of a single pilot study may legitimately raise issues of both validity and reliability. Nevertheless, the findings are considered an important foundation for future studies using the GLAD Model.

Table 4
Experience measures.

Experience	% or mean	Range/N
n = 105		
Line in place before class		
<7 days	59.30%	62.26
1 week	11.00%	11.55
2–4 weeks	7.40%	7.77
1–3 months	10.20%	10.71
Previous education	36.10%	37.9
From inpatient nurse	33.10%	34.75

Implications for Future Research

The pilot data assessing the GLAD Model educational methodology can be the foundation for future studies, including longitudinal studies, following patients and caregivers throughout their CVC care journey. Telehealth education may capture home care discrepancies including incomplete supplies or challenges in cares at home, which could reinforce teaching in a realistic setting.

The GLAD Model components of peer support and a focused environment, away from the bedside, may lead to enhances in caregiver understanding of content. Future application of the GLAD Model may be applied to alter current educational practices such as bedside or one-to-one education. By doing so, the environment and group style education may demonstrate cost effectiveness, standardization of education protocols, and productivity.

Expansion of the GLAD Model to other medical technologies in addition to CVC care may further support the value of using the GLAD Model. Additional topics can include tracheostomy, ventilator care, nasogastric tubes, gastric tubes and other complex medical technologies needing caregiver education and support in the home. In addition, the GLAD Model may be implemented to educational programs within hospital settings, including substituting existing CVC teaching programs. Adaptation of the GLAD Model would further enhance the trial's proven effectiveness.

Expanding this research to other pediatric hospitals could be very beneficial. The GLAD Model has the potential of enhancing discharge readiness by decreasing LOS and decreasing unexpected hospital visits related to challenges caregivers may have when providing CVC care in the home. Furthermore, it encouraged caregivers to understand educational requirements in a model created for adult learners while supporting each other and learning the necessities to provide safe care to their child.

CRediT Author Statement

Beth Hicks: Conceptualization, Investigation, Methodology, Data curation, Validation, Supervision, Writing-Original data preparation.

Rhonda Knapp-Clevenger: Data curation, Supervision, Writing-Original draft preparation, Formal Analysis.

Mark Brittan: Writing-Original draft preparation.

References

American Academy of Pediatrics: Council on Children with Disabilities (2005). Care coordination in the medical home: Integrating health and related systems of care for children with special health care needs. *Pediatrics*, *116*(5), 1238–1244.

Berry, J. G., Agrawal, R., Kuo, D. Z., Cohen, E., Risko, W., Hall, M., ... Srivastava, R. (2011). Characteristics of hospitalizations for patients who use a structured clinical care program for children with medical complexity. *Journal of Pediatrics*, *159*(2), 284–290.

Coller, R. J., Nelson, B. B., Klitzner, T. S., Saenz, A., Shekelle, P. G., Lerner, C. F., & Chung, P. J. (2017). Strategies to reduce hospitalizations of children with medical complexity through complex care: Expert perspectives. *Academy of Pediatrics*, *17*(4), 381–388.

Coller, R. J., Nelson, B. B., Sklansky, D. J., Saenz, A. A., Klitzner, T. S., Lerner, ... Chung, P. J. (2014). Preventing hospitalizations in children with medical complexity: A systematic review. *Pediatrics*, *134*(6), 1–20.

Edwards, M., Wood, F., Davies, M., & Edwards, A. (2012). The development of health literacy in patients with long-term health condition: The health literacy pathway model. *BMC Public Health*, *12*(130), 1–15.

Fawcett, J. (2005). *Contemporary nursing knowledge: Analysis and evaluation of nursing models and theories* (2nd ed.). Philadelphia, PA: F.A. Davis Company.

Feudtner, C., Villareale, N. L., Morray, B., Sharp, V., Hays, R. M., & Neff, J. M. (2005). Technology-dependency among patients discharged from a children's hospital: A retrospective cohort study. *BMC Pediatrics*, *5*(8).

Glascoe, F. P., & Trimm, F. (2014). Brief approaches to developmental-behavioral promotion in primary care: Updates on methods and technology. *Pediatrics*, *133*(5), 884–897.

Gysels, M., & Higginson, I. J. (2007). Interactive technologies and videotapes for patient education in cancer care: Systematic review and meta-analysis of randomized trials. *Supportive Care in Cancer*, *15*(1), 7–20.

Hain, P. D., Gay, J. C., Berutti, T. W., Whitney, G. M., Wang, W., & Saville, B. R. (2013). Preventability of early readmissions at a children's hospital. *Pediatrics*, *131*(1), 171–181.

Heaton, J., Noyes, J., Sloper, P., & Shah, R. (2005). Families' experiences of caring for technology-dependent children: A temporal perspective. *Health & Social Care in the Community*, *13*(5), 441–450.

Kirk, S., & Glendinning, C. (2004). Developing services to support parents caring for a technology-dependent child at home. *Child: Care, Health and Development*, *30*(3), 209–218.

Kun, S. S., Edwards, J. D., Ward, S. L., & Keens, T. G. (2012). Hospital readmissions for newly discharged pediatric home mechanical ventilation patients. *Pediatric Pulmonology*, *47*(4), 409–414.

Mallory, L. A., Osorio, S. N., Prato, B. S., DiPace, J., Schmutter, L., Soung, P., ... Cooperberg, D. (2017). Project IMPACT pilot report: Feasibility of implementing a hospital-to-home transition bundle. *Pediatrics*, *139*(3), 1–12.

Office of Disease Prevention and Health Promotion (2017). *Health communication and health information technology. Washington, DC.*

Rinke, M. L., Bundy, D. G., Chen, A. R., Milstone, A. M., Colantuoni, E., Pehar, M., ... Miller, M. R. (2013). Central line maintenance bundles and CLABSIs in ambulatory oncology patients. *Pediatrics*, *132*(5), 1–10.

Rothman, R. L., Yin, H. S., Mulvaney, S., Co, J. P. T., Homer, C., & Lannon, C. (2009). Health literacy and quality: Focus on chronic illness care and patient safety. *Pediatrics*, *124*(3), 315–326.

Russell, C. J., & Simon, T. D. (2014). Care of children with medical complexity in the hospital setting. *Pediatric Annals*, *43*, 157–162.

Sawin, K. J., Weiss, M. E., Johnson, N., Gralton, K., Malin, S., Klingbeil, C., ... Schiffman, R. F. (2017). Development of a self-management theory-guided discharge intervention for parents of hospitalized children. *Journal of Nursing Scholarship*, *49*(2), 202–213.

Sheff, A., Park, E. R., Neagle, M., & Oreskovic, N. M. (2017). *The patient perspective: Utilizing focus groups to inform care coordination for high-risk Medicaid populations. 10.* (pp. 1–9). BioMed Central, 1–9 (315).

Solan, L. G., Beck, A. F., Brunswick, S. A., Sauers, H. S., Wade-Murphy, S., Simmons, J. M., ... Sherman, S. N. (2015). *Pediatrics*, *136*(6), 1539–1549.

Teaching Excellence in Adult Literacy (2011). *Adult learning theories.* American Institute of Research, 1–4.

Tolomeo, C. (2009). Group asthma education in a pediatric inpatient setting. *Journal of Pediatric Nursing*, *24*(6), 468–473.

Weiss, M. E., Sawin, K. J., Gralton, K., Johnson, N., Kilingbeil, C., Lerret, S., ... Schiffman, R. (2017). Discharge teaching, readiness for discharge, and post-discharge outcomes in parents of hospitalized children. *Journal of Pediatric Nursing*, *34*, 58–64.