



Transdisciplinary Care for Adolescents With Type 1 Diabetes: Development of a Provider Cross-Discipline Training Curriculum

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Only 17% of adolescents with type 1 diabetes achieve glyce-mic control targets (1), and many are at risk for psychological concerns (e.g., depression, anxiety, and diabetes distress) (2,3), diminished quality of life (4), and the development of diabetes complications (5,6). Psychological functioning and the quality of parent-child interactions can heavily influence self-management in adolescents with type 1 diabetes and are therefore among the greatest concerns of adolescents with type 1 diabetes, their parents, and their health care providers (HCPs) (7). However, conventional models of care are ill equipped to address these issues effectively. Approximately 30% of diabetes teams do not have access to mental health providers (8), and teams with access to such professionals struggle to efficiently incorporate them into routine care (9). The increasing incidence of youths diagnosed with type 1 diabetes each year (10,11), coupled with the limited supply of pediatric endocrinologists (12) to treat these patients, exacerbates these challenges. Thus, there is a need for novel and alternative models of health care delivery for adolescents with type 1 diabetes that address behavioral and psychological barriers to diabetes management and dietary management and are more time-efficient for diabetes clinicians.

Multiple models for integrated pediatric care of type 1 diabetes exist and aim to meet American Diabetes Association (ADA) guidelines for care (13). The ADA recommends a collaborative care approach among HCPs and families, including the incorporation of shared decision-making, medical nutrition therapy, and psychosocial support during routine ambulatory care visits (13). These treatment teams may include endocrinologists, advanced practice nurses, physician

assistants, dietitians, certified diabetes care and education specialists (CDCESs), social workers, and psychologists. Multidisciplinary care, typifying much of type 1 diabetes care in the United States, engages several disciplines, but each discipline stays within its boundaries, and knowledge of other disciplines is limited. Interdisciplinary care coordinates disciplines around care and forms a unified team, but professional boundaries remain, and knowledge of other disciplines is incidental (14–16). Although these models make strides toward meeting ADA recommendations, they tend to maintain professional silos and are centered around HCP schedules, resulting in families waiting to see multiple professionals for separate visits and repeating their concerns and questions. In these models, the burden of integrating recommendations from multiple specialists also falls to the family.

In contrast to these more traditional models of integrated care, transdisciplinary care integrates multiple disciplines in a collaborative, holistic approach, forming a fully integrated team with overlapping professional boundaries (14–16). Knowledge of other disciplines is intentional and thorough (17). In transdisciplinary care, families see professionals from multiple disciplines simultaneously, and each professional is trained in the roles and approaches of the other professionals on the team. As a result, the professionals and families work together to integrate the recommendations and perspectives of all experts to develop a treatment plan. Research has supported transdisciplinary care models for the delivery of care for a variety of clinical problems, including pediatric under-nutrition (18), craniofacial surgery (19), dementia (20), and pre-maturity (21). Transdisciplinary care has the potential to

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improve patient outcomes (e.g., satisfaction with health care, quality of life, and psychosocial functioning), HCP outcomes (e.g., satisfaction and proficiency), and health care system outcomes (e.g., cost-effectiveness) (22).

Essential to transdisciplinary care models is a training component in which members of the transdisciplinary care team engage in cross-discipline clinical education (18–21). This training ensures an optimal coordinated approach to care, in which each discipline builds on the strengths of the others. For example, dietitians trained in evidence-based behavioral approaches to type 1 diabetes care can leverage this knowledge and the presence of a psychologist in the room to support families in making dietary changes. Development of a cross-discipline training curriculum for HCPs is a crucial step to developing a transdisciplinary care model for adolescents with type 1 diabetes and their families.

Bloom's Taxonomy of Educational Objectives (23) and the revised version of this taxonomy (24) are well-known frameworks for teaching in the medical field and specifically in diabetes education (25). In 2016, the American Association of Diabetes Educators (AADE) applied the revised Bloom's Taxonomy to levels of diabetes educator qualifications (26). Six hierarchical levels of learning comprise Bloom's Taxonomy and exist along a continuum of simple to complex and concrete to abstract. These include 1) remember, 2) understand, 3) apply, 4) analyze, 5) evaluate, and 6) create (23–26). Each level requires a greater degree of learning. Pediatric type 1 diabetes professionals (e.g., endocrinologists, nurse practitioners, dietitians, psychologists, and social workers) obtain within-discipline training at the highest levels of learning (levels 4–6) through graduate school programs, internships, fellowships, licensure processes, board certifications, continuing education, and other requirements for practice within their own disciplines. In contrast, expectations for cross-discipline learning are more basic and concrete (levels 1–3). Cross-discipline training aims to facilitate informed collaboration and leverage expertise across HCPs to optimize clinical care. A transdisciplinary curriculum for HCPs who care for adolescents with type 1 diabetes that is rooted in this taxonomy can guide cross-discipline learning necessary for each professional on the care team.

Current Study

We recently completed data collection for a randomized controlled trial (RCT) comparing the effect of transdisciplinary care with usual care on clinical (e.g., A1C and health care utilization) and parent-/patient-reported (e.g., treatment adherence, quality of life, and diabetes distress) outcomes. Our health care system includes two children's hospitals—

one in the Delaware Valley and one in Central Florida. At each site, we created a separate transdisciplinary care team consisting of a nurse practitioner, a dietitian, and a psychologist. All team members received the same Transdisciplinary Care Training Curriculum. The purpose of this article is to describe the development of that curriculum using the Bloom's Taxonomy and a multilevel framework similar to that used by the AADE (26), as well as the process through which our team of transdisciplinary care providers and researchers trained each other. This curriculum offers cross-discipline training for nurse practitioners, dietitians, and psychologists who specialize in pediatric type 1 diabetes care and may serve as a practical tool for diabetes care teams who are interested in providing transdisciplinary care.

Overview of the Transdisciplinary Care Training Curriculum

A team of experts in pediatric type 1 diabetes clinical care and research, including two nurse practitioners, one dietitian, and five pediatric health psychologists, developed the curriculum. This team included all of the HCPs designated to deliver transdisciplinary care as part of the RCT except for one dietitian, who had not yet been hired.

Clinical care guidelines and standards published by professional diabetes organizations guided the development of the nurse practitioner, dietitian, and psychology curricula content. The team reviewed the discipline-specific guidelines for the care of children and adolescents in the ADA's *Standards of Medical Care in Diabetes* (27) and the ADA's position statement on the psychosocial care of people with diabetes (28), current national standards for diabetes self-management education and support (29), and the International Society of Pediatric and Adolescent Diabetes's clinical practice consensus guidelines on diabetes in adolescence (30). The training curriculum content incorporated developmental factors across disciplines and addressed how adolescent development manifests in type 1 diabetes self-care. The psychology curriculum also incorporated cognitive behavioral and family systems techniques that are effective for adolescents with type 1 diabetes (e.g., communication and problem-solving skills) (31). Additionally, all team members received extensive training in motivational interviewing with parents and adolescents (32) to enhance their patient-centered communication skills. This approach ensured that the transdisciplinary care training was of a high quality and consistent with clinical guidelines and existing evidence for the medical and psychosocial care and management of adolescents with type 1 diabetes. Table 1 provides examples of specific learning domains, objectives, and topics covered by the curriculum.

Application of Bloom's Taxonomy of Educational Objectives

Transdisciplinary care involves all team members having thorough knowledge of each other's disciplines, while also respecting the individual expertise of the professionals from each discipline (in this case, nurse practitioners, dietitians, and psychologists). Because all team members achieved within-discipline learning via advanced degrees, licensure, and clinical experience (levels 4–6: analyzing, evaluating, and creating) before joining the transdisciplinary care teams, the training objectives focused on cross-discipline training, which emphasized basic knowledge, comprehension, and the ability to recognize factors that may influence each patient/family's management of type 1 diabetes (levels 1–3: remembering, understanding, and applying). Each discipline used Bloom's Taxonomy to develop broad learning domains of training and then specific learning objectives for cross-discipline teaching. For example, nurse practitioners identified a broad learning domain for type 1 diabetes psychology providers of basic diabetes management tasks, with specific cross-discipline learning objectives such as knowing the difference between short- and long-acting insulin (level 2: understanding) and calculating insulin doses (level 3: applying). Table 1 provides more examples. Next, the team members shared their discipline-

specific learning objectives with the rest of the team to review and provide input on clarity, importance, and relevance. For example, psychology team members shared psychology-specific learning objectives with the dietitians and nurse practitioners. Feedback from these cross-discipline colleagues was then incorporated into the final psychology learning domains and objectives of the training curriculum.

Delivering Training Curriculum Sessions

Team members created discipline-specific training module content (e.g., PowerPoint slides, case examples, and readings) and designed a schedule to deliver each module over the course of 11 weeks. Nearly all sessions were 2 hours in length, and, most weeks, two team members from different disciplines presented. A paid consultant with expertise in delivering motivational interviewing training in pediatric diabetes clinics presented at one 4-hour session. Because team members spanned several locations within a pediatric health system, we used video conferencing to deliver sessions and recorded each session. This afforded transdisciplinary care team members who were not present for sessions the opportunity to review the content and receive training on those topics at a later date.

TABLE 1 Domains and Objectives for Cross-Discipline Learning Examples by Discipline

	Bloom's Taxonomy Level		
	1. Remembering	2. Understanding	3. Applying
<i>Nurse practitioner teacher</i>	<i>Dietitian and psychologist learners</i>		
Basic diabetes management tasks: <ul style="list-style-type: none"> • Blood glucose checks • Calculating insulin doses • Hyperglycemia symptoms, causes, treatment 	State what an insulin-to-carbohydrate ratio is used for	Locate carbohydrates on a food nutrition label	Calculate an insulin dose for a meal
<i>Dietitian teacher</i>	<i>Nurse practitioner and psychologist learners</i>		
Introduction to carbohydrates: <ul style="list-style-type: none"> • Carbohydrate metabolism • Dietary sources of carbohydrates • Low-carbohydrate diets: evidence and pitfalls 	Recall food groups that often contain carbohydrates	Describe how carbohydrates are metabolized	List potential negative outcomes of following a very-low-carbohydrate diet
<i>Psychologist teacher</i>	<i>Nurse practitioner and dietitian learners</i>		
Family problem-solving and communication skills: <ul style="list-style-type: none"> • Role of parents in type 1 diabetes care • Negative reinforcement style • Structured problem-solving • Communication strategies 	List the steps of structured problem solving	Explain how structured problem solving helps with diabetes management	Use problem-solving steps to help families set a diabetes management goal
Motivational interviewing (MI): <ul style="list-style-type: none"> • Rationale underlying MI • Stages of change • Core components of MI • Identifying and eliciting change talk 	List different communication strategies used in MI	Discuss the rationale behind MI	Implement MI skills during role-play sessions

Team members previously achieved higher levels of Bloom's taxonomy (levels 4–6: analyzing, evaluating, and creating) within their own discipline.

Assessment of Cross-Discipline Mastery

To ensure that all transdisciplinary team members achieved cross-discipline learning objectives, they needed to demonstrate mastery at the levels of remembering, understanding, and applying. We assessed mastery through two measures: 1) the percentage of accuracy on a curriculum post-training evaluation (levels 1 and 2: remembering and understanding) and 2) demonstration of skills and techniques during the training sessions (level 3: applying) (33). After creating training modules, team members submitted one to two multiple-choice questions on their content to the senior researcher. The senior researcher compiled the questions into a 30-question post-training evaluation that assessed cross-discipline learning objectives. Team members demonstrated level 1 and level 2 mastery if they scored $\geq 80\%$ correct on the evaluation. All team members met this minimum criterion; scores ranged from 83.33 to 100.00% (mean 92.00%, SD 5.25%). Although not needed, our procedures would have allowed team members who did not score $\geq 80\%$ to review session content, ask relevant team members questions, and retake the post-training evaluation. To assess level 3 mastery through skill demonstration, each training module included case examples and problem scenarios. Team members discussed cases and worked through problem scenarios together. Skill demonstration was not formally assessed, but team members asked questions and provided constructive feedback when demonstrating skills. Because of the emphasis on patient-centered care and communication in the transdisciplinary care model, multiple training sessions focused solely on applying motivational interviewing skills using case vignettes and role-playing.

Implementing and Disseminating the Transdisciplinary Care Training Curriculum

Our team designed the training curriculum to meet the needs of our teams of nurse practitioners, dietitians, and psychologists to deliver transdisciplinary care, as well as to offer this resource to other institutions interested in creating transdisciplinary care teams for pediatric type 1 diabetes. Care teams that include medical HCPs (e.g., endocrinologists, nurse practitioners, and physician assistants), dietitians, and mental health providers with expertise in evidence-based clinical intervention (e.g., psychologists, social workers) would meet the minimum requirements to engage in this training. None of the transdisciplinary care team members were CDCESs at the time of the training; however, there is considerable overlap between the Transdisciplinary Care Training Curriculum and the CDCES competencies. Our curriculum can be easily adapted to include other practitioners (e.g., CDCESs), meet the educational needs of the training team members at other institutions, or be

delivered to those providing care to other diabetes populations (e.g., young adults with type 1 diabetes or adolescents and/or young adults with type 2 diabetes) by incorporating relevant standards of care and developmental and cultural considerations. Practitioners who are interested in developing their own cross-discipline training for diabetes clinics may obtain access to our curriculum by contacting the corresponding author.

There are several points to consider for other diabetes care teams who may be interested in adapting this curriculum. We developed the curriculum for HCPs who have achieved expertise in delivering pediatric type 1 diabetes care within their professions (e.g., medical care and mental health care). In addition, our cross-training curriculum heavily focused on the psychological aspects of type 1 diabetes care compared with the medical and nutritional aspects. One reason for this decision was that the psychologists on our transdisciplinary care teams had previously achieved some formal and experiential cross-discipline training in medical and nutritional care for type 1 diabetes. In contrast, the nurse practitioners and dietitians had not completed similar levels of cross-discipline training in psychological type 1 diabetes care. Other teams may want to consider adapting the curriculum to be more balanced across disciplines. Teams that include mental health providers with expertise in evidence-based clinical intervention for children and families but who have limited experience in working with people with diabetes may consider supplementing the curriculum for these providers with the more formalized cross-discipline training available through the Mental Health Provider Diabetes Education Program sponsored by the ADA (34).

Recording the video conference training sessions allowed new additions to the transdisciplinary team (i.e., a dietitian who was hired after we completed the live trainings and a nurse practitioner who covered for one of the transdisciplinary care nurse practitioners during parental leave) to complete the trainings. This approach can be useful in clinical settings where staff turnover can present challenges to implementing and maintaining transdisciplinary care. However, not all teams may have access to such technology and may want to consider other ways to deliver training to team members who miss live sessions.

Grant funding allowed for protected time for team members to participate in the weekly trainings and for team training from an expert in motivational interviewing for pediatric type 1 diabetes. Other teams may need to work with administrators at their centers to negotiate protected time for transdisciplinary care providers to participate in trainings or change the format of the trainings to fit their needs (e.g.,

offering two day-long trainings on a weekend). Motivational interviewing is central to the delivery of transdisciplinary care, so care teams should prioritize training in these skills from experts in the area. For teams with limited financial support, there are a number of lower-cost motivational interviewing resources (35,36).

Transdisciplinary care models may not yet be a viable option for many clinics. For institutions offering multidisciplinary or interdisciplinary type 1 diabetes care, the Transdisciplinary Care Training Curriculum is likely to be beneficial. HCPs with knowledge of the perspective and approaches to care of their colleagues from other disciplines may work with families in a more informed, holistic, and family-centered manner.

Limitations

Although the transdisciplinary care training sessions included role-playing and in vivo learning practices, cross-discipline learning undoubtedly continues when HCPs are able to apply these skills in a transdisciplinary care clinical practice and learn from experience. We did not formally assess continued cross-discipline learning or long-term skill mastery as part of the RCT. Team members were encouraged to provide each other with informal feedback after each transdisciplinary care visit, and cross-site monthly transdisciplinary care team meetings offered opportunities for peer consultation. Future studies should consider reassessment of cross-discipline knowledge to examine maintenance and incorporate booster training sessions as needed. We also did not administer a pretraining evaluation to assess baseline cross-discipline knowledge, so we could not disentangle what the transdisciplinary care team members already knew about other disciplines from their past experiences.

Although clinical and research team members collaborated in the development of the curriculum, we did not obtain formal feedback from team members about their experiences with the training or their confidence in delivering the material after the training. We also did not obtain input from adolescents and family stakeholders on the development of the curriculum, although our goal was to increase HCP knowledge of other disciplines that are crucial to providing comprehensive, family-centered type 1 diabetes care. Other teams may consider gathering this additional feedback.

Of note, we did obtain extensive qualitative feedback from adolescents with type 1 diabetes and their parents on the transdisciplinary care delivery model (i.e., seeing three HCPs at one time, HCPs training each other to work together as a team, and the involvement of a mental health professional in routine type 1 diabetes care visits). We also collected

qualitative data from transdisciplinary care providers after completion of the RCT to understand the experience of delivering type 1 diabetes care in this model.

Conclusion

Transdisciplinary care has the potential to promote the health and well-being of adolescents with type 1 diabetes through the provision of fully integrated and holistic team-based care. The Transdisciplinary Care Training Curriculum provides a guide for cross-discipline training of nurse practitioners, dietitians, and psychologists in type 1 diabetes care and management for adolescents. This curriculum has the potential to be readily adapted across diabetes clinic settings and to be applied to all populations of people with diabetes, with tailoring of the training content to appropriately capture developmental and other relevant issues and the building in of cultural considerations to ensure equity.

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DUALITY OF INTEREST

No potential conflicts of interest relevant to this article were reported.

AUTHOR CONTRIBUTIONS

J.S. Pierce, P.E., and J.P. co-developed the training curriculum and wrote the manuscript. M.A.A., K.B., and A.T. reviewed/edited the manuscript. R.W., E.O., J.S. Pendley, M.R., K.W., and T.W. co-developed the training curriculum and reviewed/edited the manuscript. S.G. reviewed the training curriculum and reviewed/edited the manuscript. J.S. Pierce is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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