

# A Pediatric Resident Diabetes Curriculum Targeting Different Learning Styles

Ellen Goldman, EdD, Kyle Shah, MHA, Larrie Greenberg, MD, and Fran R. Cogen, MD, CDE

Diabetes-related medical errors can lead to excessive morbidity, complications, disability, and even death.<sup>1</sup> In the inpatient setting, errors involving insulin therapy have been associated with 33% of deaths that occurred within 48 hours of a medical error.<sup>2</sup> There is accumulating evidence that insulin errors can be reduced with increased clinical supervision, along with educational curriculums.<sup>3</sup>

During the past decade, the endocrinology and diabetes division at Children's National Medical Center (CNMC) in Washington, D.C., implemented a diabetes care pathway to help guide physicians in diabetes management.<sup>4</sup> Pathway education was provided to residents via delivery of three 1-hour lectures during the traditional resident core lecture series.

Despite transmittal of this information, there continued to be a significant number of diabetes-related errors. Based on analysis, they fell into four categories: insulin dosing and timing, choice of intravenous fluids after pediatric intensive care unit (PICU) transfer, miscommunication between health care professionals, and discharge planning.

Pedagogies were altered to embrace a more learner-centered approach that addresses differences in learning styles and requires active engagement on the part of the residents. As a result of this new curriculum, diabetes-related errors decreased significantly.<sup>5</sup> This article discusses the curriculum that was developed, focusing on the variety of teaching approaches and their relationship to various styles of learning.

## Methods of Curriculum Development

### Curriculum development process

The diabetes program director (author FRC) hypothesized that creating a learner-centered curriculum could decrease residents' pathway errors. She received the approval of the director of resident education to go forward with curricular development.

Following the general process used in higher education,<sup>6</sup> curriculum development by the diabetes program director occurred over a 6-month period with the guidance of authors EG and LG, who serve as education specialists at George Washington University in Washington, D.C. The established goal of the curriculum was to decrease inpatient diabetes-related errors. A literature review was conducted. Several studies with internal medicine residents showed an improvement in their knowledge of inpatient diabetes management, but the effect on patient care was unknown.<sup>7</sup> There was, however, no literature specifically related to diabetes care in children's hospitals.

Based on current practices in the treatment of children with diabetes, the curricular content developed at CNMC includes the types of diabetes, disease pathophysiology, patient presentation, pathways and patient management strategies, insulin calculations, and common pathway errors. The learning objectives are to 1) prescribe appropriate fluid management and insulin therapy for newly diagnosed patients with diabetes, 2) identify the types of diabetes and treat patients appro-

priately based on their presentation, and 3) use the diabetes pathway to avoid common errors and improve patient safety. Teaching strategies used include self-paced lecture, cases, discussions, and small-group work (further described below). To determine the effectiveness of the curriculum, errors in the four categories were documented by the CNMC's "web-envision" incident reporting process before and after the curricular intervention.

### Applicable learning theory

Kolb's experiential learning theory of growth and development<sup>8</sup> suggests that learning moves in a circular fashion from experience (concrete experience) to reflection (reflective observation), to generalization (abstract conceptualization), and finally to application (active experimentation). Kolb has generalized these steps to many learning situations, including problem-solving such as that required in the care of children with diabetes. In problem-solving, the steps of the learning cycle are as follows: identify problems, select a problem, consider alternative solutions, evaluate consequences of solutions, select a solution, execute the solution, choose a model or goal, compare with reality, and, finally, start over again if necessary. This application to problem-solving makes Kolb's theory appropriate to the development of a learning-centered diabetes curriculum.

According to Kolb, each learner has a learning style that favors certain components of the learning cycle. Thus, to engage all learners, faculty must use teaching strategies that appeal to the learning style related to each part of the learning cycle. There are four learning styles, each with its own notable characteristics: "Divergers," who favor experience and reflection and particularly enjoy engagement and discussion that exposes many different points of view; "Assimilators," who favor reflection and conceptualization and use theories, guides, flow charts, and checklists to develop their understanding of material; "Convergers," who favor conceptualization and active experimentation

and enjoy applying material to solve problems and devise plans; and "Accommodators," who favor active experimentation and experience and prefer immediate immersion into activity and self-assessment.

Kolb developed a Learning Style Inventory<sup>9</sup> that allows individuals to identify their learning style, which is a personal preference. He suggested that everyone needs to develop all styles to fully benefit from their learning opportunities.

### Resulting Curriculum

#### Curriculum description

Four modules were developed and taught by the diabetes program director, a physician who is also a certified diabetes educator.

#### *Diabetes toolkit for principles and management of diabetes.*

This consists of a 1-hour self-study PowerPoint presentation with a case involving a hospitalized patient with diabetes. The presentation is posted on Blackboard (an Internet-based education software program) 1 month before the face-to-face meeting and includes all aspects of diabetes management (i.e., insulin calculations, guides, and flow sheets). Residents are asked to anonymously submit assessment and management strategies for the simulated patient with symptomatic descriptions and personal and family history. Feedback is provided to the residents; comments on their engagement and suggestions for improvement are solicited. An appendix of reference information is also available.

#### *Diabetes pathway and pitfalls.*

This 1-hour face-to-face module begins with a PowerPoint presentation by the diabetes program director documenting the hospital's diabetes pathways in the emergency department, PICU, and general medical floors. Based on documentation of historical errors, possible pitfalls that occur in the pathway are included. This is followed by an interactive discussion, prompted by questions from both residents and educators regarding sources of the typical errors and appropriate actions to reduce these miscues.

*Diabetes potpourri.* The chief residents collect residents' questions about the management of hospitalized patients with diabetes 1 week before this face-to-face session. The diabetes program director randomly chooses questions and facilitates a 1-hour discussion. Residents are asked for their responses before answers are revealed, encouraging engagement in the learning process. Discussion points generally include variations in patient presentation, unique management by caregivers and the related implications, insulin dosage, timing with respect to meals, and care plan.

*Diabetes case presentation embedded with errors.* This 1-hour face-to-face module involves residents working in small groups facilitated by the diabetes program director and pediatric chief resident. The case presentation used in Module 1 is presented with errors discussed in Modules 2 and 3. Residents are asked to identify all errors in the case and indicate how to correct the errors and prevent future errors.

### Adaptation of the curriculum to learning styles

Figure 1 illustrates how faculty oriented the modules to different learning styles, accommodating learning styles not generally addressed by traditional didactic teaching.

In Module 1, Assimilators are engaged by theoretical descriptions of the pathophysiology of diabetes, insulin regimens, and the American Diabetes Association clinical guidelines to manage patients. This does not mean that residents with other learning styles are not interested in this material. It means that Assimilators have a preference for material provided in the form of theories and guidelines.

In Module 2, Accommodators are engaged with the discussion of the actual errors experienced and actions to be taken to avoid these errors in the future. The pathway presentation appeals to Assimilators. Preferences of other learning styles are addressed by case discussion (Divergers) and treatment plan development (Convergers).

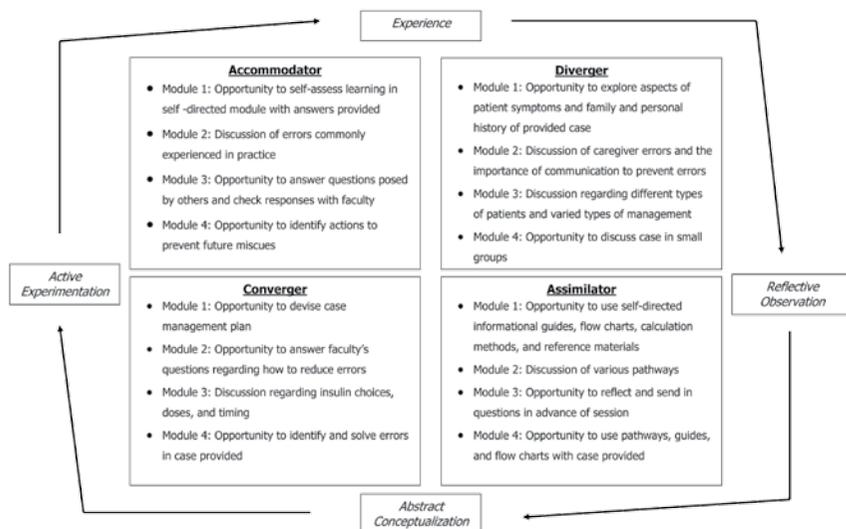


Figure 1. Application of Kolb's Learning Styles to the development of a pediatric resident diabetes curriculum. Each box shows which aspects of the curriculum appeal to each learning style. Exterior boxes show the process of learning according to Kolb.

In Module 3, Convergers are engaged in the discussion regarding decision-making about the patient's management. The discussion relating to different types of patients is appealing to Divergers.

In Module 4, Divergers are engaged in the small-group activity and hearing the views of others. Of particular interest to Convergers in this module is the incorporation of all previous learning and its application to improve patient care.

It should be noted that curriculum developers did not attempt to assess residents' learning styles, but rather designed the curricular intervention to engage all learning styles. In other settings, where there is a small, consistent group of learners, establishment of their styles could aid the selection of teaching strategies. For particularly difficult material, faculty could match the strategy to residents' learning style preferences. For easier material, residents could be encouraged to engage in activities preferred by the opposites to their learning style preferences to enhance their development as learners.<sup>8</sup>

### Feedback and impact

Resident feedback is formally obtained at the conclusion of Module 1, informally during Modules 2 and 3, and again formally at the conclusion of Module 4. Comments have

indicated a high level of satisfaction and learning, particularly with the initial self-directed module and the various forms of learner engagement and application of material in the subsequent three modules. The curriculum was effective in reducing residents' diabetes-related errors by > 50% and generating a 2.4-fold decrease in the number of errors per inpatient days, thus contributing to safer and more efficient patient care.<sup>5</sup> A detailed article documenting the results is currently being prepared for publication elsewhere.

### Lessons Learned

In developing and implementing the curriculum, the following lessons were learned.

- Faculty need to question their own teaching methods and not just assume that problems are with the learners. The impetus for this curricular intervention was based on the same number of residents' errors, year after year, as the same material was offered during the core resident lecture series. The diabetes program director reflected that the problem was not with the learners, but rather with the teaching methods employed. In using traditional, teacher-centered lecturing, faculty were not engaging residents, who were not learning the content or,

more importantly, applying it to patient care.

- Faculty members need to identify and understand their own learning style. We tend to teach how we prefer to learn. To illustrate this point, the diabetes program director completed the *Kolb Learning Style Inventory*<sup>9</sup> and discovered that her preferred learning style was balanced with a preference toward converging and assimilating. This lent itself toward traditional lecture (appealing to Assimilators) and descriptions of how to apply the material (partially appealing to Convergers). Teaching methods that could engage the other two learning styles were absent, and, generally, there was a lack of variety in how material was presented.
- Faculty should ensure that during each session, they address all learning styles. The application of Figure 1 for every session is required to ensure teaching methods that are targeted to each style of learning.
- In the ideal world, residents should be required to attend every session to maximize the impact on patient care. We found this difficult because residents can be assigned to other areas of the hospital or at other hospital rotations. Thus, the curriculum may need to be delivered several times during the year to include all resident trainees.

### Conclusions

We have described a curriculum shown to be effective in reducing residents' diabetes-related errors. The use of teaching methods that engage learners and consider all styles of learning was crucial to the success of the curriculum.

Future curricular development in diabetes-related education should consider similar approaches. This applies not only to residents, but to professional education for all health care disciplines—nursing, pharmacists, dietitians, and others—as well as to patients and family members. The investment of time is more than that required to give a lecture, but is well worth the payoff of reduced

medical errors and improved patient care.

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*Ellen Goldman, EdD, is the director of the Master Teacher Leadership*

*Development Program and an assistant professor at George Washington University School of Education and Human Development in Washington, D.C. Kyle Shah, MHA, is the program coordinator for the Children's Academy of Pediatric Educators at Children's National Medical Center in Washington, D.C. Larrie Greenberg, MD, is a clinical professor in pediatrics and an internal consultant for faculty development at George Washington University School of Medicine in Washington, D.C. Fran R. Cogen, MD, CDE, is the director of the Childhood and Adolescent Diabetes Program and an associate professor of pediatrics in the Department of Endocrinology and Diabetes at the Children's National Medical Center in Washington, D.C.*