

# Selecting Children and Adolescents for Insulin Pump Therapy: Medical and Behavioral Considerations

Fran R. Cogen, MD, CDE; Randi Streisand, PhD; and Seema Sarin, BA

The use of continuous insulin therapy via a subcutaneously implanted catheter connected to an external pump is being used increasingly in the management of childhood type 1 diabetes. This form of intensive diabetes management places multiple demands on young patients to achieve near-normal blood glucose levels. Therefore,

appropriate selection of pediatric candidates for pump therapy is critical to achieving successful outcomes.

Although few empirical data are available on readiness evaluations conducted with pump candidates, clinical data suggest several factors important in the consideration of these individuals, including age, med-

ical history, and psychosocial functioning. The focus of this case presentation is to describe key factors for health care professionals to consider in transitioning children and adolescents to the insulin pump, based on our pediatric pump program at Children's National Medical Center in Washington, D.C.

## Case Presentation

S.P., is a 10-year-old boy with a 3-year history of type 1 diabetes. In May 2000, while on three insulin injections per day, he requested insulin pump therapy in order to increase lifestyle flexibility. His height was at the 90–95th percentile, and his weight was at greater than the 75th percentile. His hemoglobin A<sub>1c</sub> (A1C)

concentration was 6.9%. His anticipated pump start was set to coincide with his tenth birthday.

As a requirement of our program, S.P. was asked to learn carbohydrate counting and to obtain psychological consultation per our center's protocol. After psychological and nutritional evaluations, there were concerns relat-

ed to untreated anxiety with obsessive-compulsive tendencies as well as the need for additional carbohydrate counting practice. We therefore delayed his pump start for 5 months and asked S.P. and his family to seek additional psychological counseling and nutritional support to increase the likelihood of pump success.

## Discussion

### Medical and Behavioral Considerations

Insulin pump therapy provides a more physiologically precise manner of delivering insulin compared to self-injections with less variable insulin absorption and a better match between insulin and food intake. In addition to receiving continuous insulin, pump users give themselves boluses of insulin based on the carbohydrate content of their meals and their current blood glucose levels.

Insulin pump therapy requires additional education, which markedly expands patients' diabetes knowledge base. Because of the demands of insulin pump initiation and therapy during the first few weeks of pump use, many patients in our practice have noted similarities between pump initiation and initial diabetes

education and training. There are, however, significant differences in these two learning processes. Pump therapy is usually accompanied by a sense of excitement, greater lifestyle control, and the anticipation of improved quality of life. This is in contrast to the sense of despair, uncertainty, and anticipation of diminished quality of life that usually surround an initial diagnosis. This underscores the pump's benefits.

Despite these benefits, not all children and adolescents are able to manage their diabetes with a pump. In order to reap the complete benefits of continuous subcutaneous insulin infusion, sustained adherence to the prescribed diabetes regimen is required. Many children—adolescents in particular—have difficulty adhering to key aspects of their diabetes self-care regi-

men, including testing their blood glucose levels and maintaining a proper diet.<sup>1–4</sup> It is therefore imperative to identify pump candidates who have the greatest likelihood of succeeding with this form of therapy and to help those who are most interested in using the pump gain access to this technology.

Research suggests that patient selection guidelines similar to those for adults should be implemented for safe and effective insulin pump therapy in children.<sup>2–4</sup> However, because insulin pump therapy has only recently become a popular therapy for children, data are limited on the specific evaluation protocol that should be followed when starting young patients on pump therapy.

### General Considerations

The American Diabetes Association's

criteria to determine the benefit of pump therapy for children and adults include: 1) motivated attitude, 2) willingness to work with the health care team, 3) ability to demonstrate understanding of the technology and correct usage of the pump, and 4) ability to learn how to manage pump-specific information in an effective way and translate it into programming the pump.<sup>5</sup>

Some have argued that children as young as 10–12 years old have the cognitive and technical skills necessary to operate an insulin pump effectively and independently.<sup>2</sup> By the age of 10–12, it is believed<sup>2</sup> that most children can be safe even at school with procedures including insertion and programming of the pump, counting carbohydrates, understanding nutritional principles, and correcting a blood glucose level outside of the target range. However, others<sup>6</sup> have suggested that adults rather than adolescents are better candidates for the pump because they are more likely to achieve the most beneficial effects of insulin pump treatment. Thus, there are no universally accepted age guidelines for initiating pump therapy for children and adolescents or methods by which to predict which pump candidates are most likely to be successful.

Limited data also exist regarding other variables important for pump starts in children and adolescents. Although there have been several investigations of health and psychosocial outcomes for children and adolescents using insulin pumps,<sup>4</sup> data on pump candidate selection and prediction of success are unavailable. Kaufman and colleagues<sup>4</sup> followed 83 children, ages 9–17 years, who were placed on insulin pump therapy for up to 5 years. Neither the age of the child, duration of diabetes, nor pre-pump metabolic control significantly related to outcome measures. Overall, patients reported satisfaction with the pump, and insulin usage was reduced by an average 20% from pre-pump dosages. Despite these positive health outcomes, the descriptive nature of the study did not allow for drawing conclusions about which candidates were most likely to benefit from pump use. Another study examining predictors of who continued with pump therapy

found that individuals in poorer metabolic control were more likely to discontinue pump therapy,<sup>7</sup> further highlighting the importance of screening individuals before pump initiation.

### Criteria for Initiating Pump Therapy

At our center, discussion regarding the potential use of an insulin pump usually arises during patients' routine 3-month follow-up visits for diabetes management. Typically, patients initiate questions about the insulin pump and its use. Increasing lifestyle flexibility is often their primary interest. On occasion, physicians will initiate a discussion of the pump as a way to improve a patient's A1C concentration, especially if the child is already on intensive therapy.

If a child and family express further interest in the pump after a discussion in the office, they are given handouts of our pump objectives and criteria and a list of companies that manufacture pumps (Table 1). After seeing a demonstration of the different pumps, the family and physician decide whether to pursue pump therapy. If that decision is affirmative, a date is set because there is a waiting list of several months for prospective pump patients, as is true at other large centers.

Much additional work transpires between the time a family or physician begins to pursue pump therapy and the date of the actual pump start.

This includes training in carbohydrate counting, continuing to test blood glucose four times daily, taking at least three injections a day, working with insurance companies, and learning the mechanics of the pump. The final pre-start step is a saline trial.

### Demographics and Medical Factors Used to Determine Candidacy

#### Age

Based on review of the literature and the cognitive and emotional development of children, we have determined that pump candidates must be at least 10 years old. Although successful pump initiation and therapy have been noted in younger patients,<sup>8,9</sup> we believe that pump candidates will achieve the most in terms of medical and lifestyle success if they are at least 10 years old. We are also assured of the children's own desire for pump therapy and of their ability for self-care.

#### Health Care Coverage

One potential limitation of our program is that adequate insurance coverage is necessary in order for patients to afford the pump and supplies. We ask our candidates to immediately notify their insurance carrier after they have chosen a pump supplier. In this way, the supplier and the diabetes team can work together to ensure completion of all of the documenta-

**Table 1. Criteria for Initiating Insulin Pump Therapy**

#### Age and Medical Requirements

- At least 10 years of age
- 3–6 months of intensive insulin therapy, including three or more shots per day. Most candidates use a sliding scale of regular or lispro insulin.
- 3–6 months of monitoring and recording blood glucose levels at least four times per day
- Ability to give abdominal injections (no fear of needles)
- Diabetes identification
- Ability to make small adjustments in treatment regimen appropriately between visits
- Evidence of diabetes team contact in emergency situations
- Adequate insurance coverage

#### Psychosocial Requirements

- Psychologist visit to assess pump readiness
- Child/adolescent responsibility for the majority of diabetes self-care

#### Nutritional Requirements

- Dietitian visit
- 3–6 months of carbohydrate counting

tion required for insurance coverage of the pump and supplies in time for the scheduled pump initiation. At present, we do not have a program for acquiring pumps for uninsured patients.

### Medical Regimen

All pump candidates at our center must have 3–6 months of intensive insulin therapy, including three or more insulin shots per day. We ask our patients to begin intensive insulin therapy in order to ensure dedication to their diabetes care regimen. It is our premise that increased attention to diabetes care will reinforce future successful pump habits. When patients use a sliding scale for regular or lispro insulin, they must check and record their blood glucose level at least four times a day. We ask children to follow this more complex regimen for 3–6 months in preparation for the intensive record keeping required at pump start and in the days following pump initiation to allow frequent basal rate and bolus adjustments. If a child or family is unwilling to record blood glucose levels at least four times a day before pump initiation, then concerns are addressed regarding the pump candidate's ability to perform the necessary tasks.

We also expect that the family and pump candidate will have the ability to make small, appropriate adjustments in the treatment regimen between visits<sup>5</sup> and will demonstrate sound judgment regarding contact of the diabetes team in emergency situations. Possessing these skills demonstrates an understanding of insulin and its effects.<sup>4</sup> It is also expected that families provide and maintain diabetes identification for their child's safety.

### Psychological Factors

Families interested in beginning pump therapy are scheduled to meet with our team psychologist to further assess behavioral aspects of pump readiness and to discuss the psychosocial adjustment to this form of insulin treatment. Our team strongly believes that children themselves, as well as their parents, must desire the insulin pump. We suspect that pump candidates' success stems from their own

desire for this mode of therapy as well as their parents' wishes. Children who really do not wish to have pump therapy will sabotage their success.

We also believe that it is imperative for children and adolescents to already be doing the majority of diabetes self-care independently. Equally important, however, is that the family must remain involved in care,<sup>10,11</sup> suggesting the need for a delicate balance of responsibility between independence and continued parental involvement. Clearly, the ability to give abdominal injections and a lack of needle phobia are also of major importance to successful insulin pump therapy.<sup>10</sup>

### Role of the Psychologist

The role of behavioral psychologists in pediatric diabetes care has been well-described<sup>12</sup> and has been noted to be critically important to diabetes management.<sup>13</sup> The complex behavioral treatment regimen that often accompanies diabetes must be strictly followed in order to promote better glycemic control and positive health outcomes. In our diabetes team, the psychologist assists children and families in their adjustment to diabetes and its treatment by 1) assessing and discussing conflicting feelings, beliefs, and attitudes about diabetes that could compromise overall health and well-being; 2) promoting adherence to prescribed nutrition monitoring, exercise, blood glucose testing, and insulin injection regimens through the implementation of behavior modification treatment plans; 3) managing the stress of living with diabetes through behavioral counseling; and 4) providing adjunct individual therapy and family therapy when indicated.

### Psychological Consultation

We believe that many patients with well-controlled diabetes can experience a smooth transition to pump therapy provided that multiple domains of functioning are assessed, and we seek to ensure that this goal is attained. The aims of our diabetes team in working with the psychologist during the pre-pump time period are to 1) identify patients who are most likely to succeed with the pump and respond to those who self-identify as pump candidates; 2) alert the diabetes

team to specific behavioral concerns and issues that may need to be addressed before starting the pump; 3) confidentially assess the child and family's commitment to pursuing pump therapy; 4) assist the family in preparing for pump transition and management; and 5) conduct research on the behavioral functioning, quality of life, and supportive care needs of pump candidates and recipients. For youngsters who do not yet appear ready to initiate pump therapy but who have expressed a strong desire to do so, ongoing support and monitoring from a psychologist is often helpful to remediate aspects of self-care that have proven difficult to master and to identify possible facilitators of pump success.

### Nutritional Factors

Carbohydrate counting is an essential tool in both the management of diabetes and successful pump therapy because insulin boluses are based on carbohydrates consumed at each meal or snack. Before initiation of the insulin pump, candidates are asked to obtain a carbohydrate prescription for meals and snacks through consultation with a dietitian and to count carbohydrates routinely. We prefer children and families to have at least 3 months of experience with carbohydrate counting. In this way, we are better able to develop carbohydrate-to-insulin ratios.

By the time our candidates are ready to begin pump therapy, they are expected to be counting carbohydrates consistently throughout the day. In some cases, candidates may already be using intermittent insulin injections to match their carbohydrate intake.

### Initiating Pump Therapy

On the day of pump initiation, the candidates (we start 1–2 patients at a time) are asked to report to our outpatient site to spend ~3 h discussing pump issues with the physician, pump company nurse, and other personnel that may include our certified diabetes educator and psychologist. Calculations of basal rate, carbohydrate-to-insulin ratios, and sensitivity factor are conducted individually, and each candidate is started on the pump. The company nurse discusses

mechanics of the pump and, with the physician, outlines applications (i.e., problem solving with exercise, specific meals, and illness.)

Daily telephone contact between the family and medical team is maintained for several weeks following initiation to review blood glucose levels and make appropriate adjustments. Children are seen in a follow-up visit 1 month after pump initiation.

### Conclusions

Insulin pump therapy is a labor-intensive process for candidates, their families, and the diabetes team. We believe that it is worth the effort if candidates are successful in learning to accurately apply the principles of pump management. In order to ensure the greatest chances for success, an accurate pre-selection process must be employed. Other factors important to long-term success include the ongoing support, management, and interplay between patients, families, and the diabetes team.

After his consultation with diabetes team members and subsequent recommended follow-up treatment (carbohydrate counting instruction and anxiety management), our patient, S.P., was successfully started on the insulin pump. At 3 months after initiation, his A1C remained stable at 7.6%. No major issues have surfaced since, and he and his family report that he is doing extremely well.

### References

- <sup>1</sup>Cornwell S, Macdonald MJ: Use of the insulin pump in children: symposium on diabetes mellitus in children. *Prim Care* 10:723-750, 1983
- <sup>2</sup>Wysocki T, Wayne W: Childhood diabetes and the family. *Pract Diabetol* 11:29-32, 1992
- <sup>3</sup>Boland E, Ahern J, Grey M: A primer on the use of insulin pumps in adolescents. *Diabetes Educ* 24:78-86, 1998
- <sup>4</sup>Kaufman FR, Halvorson M, Fisher L, Pitukcheewanont P: Insulin pump therapy in type 1 pediatric patients. *J Pediatr Endocrinol Metab* 12 (Suppl. 3):759-764, 1999
- <sup>5</sup>American Diabetes Association: Insulin infusion pump therapy. In *Intensive Diabetes Management*. 2nd ed. Farkas-Hirsch R, ed. Alexandria, Va., American Diabetes Association, 1998, p. 99-120
- <sup>6</sup>Giordano BP, Klingensmith GJ, Rainwater NG, McCabe E, Boucher LA: Insulin pumps and adolescents: a compatible combination (Abstract)? *Diabetes* 32:38A, 1983
- <sup>7</sup>Floyd JC Jr, Cornell RG, Jacober SJ, Griffith LE, Funnell MM, Wolf LL, Wolf FM: A prospective study identifying risk factors for discontinuance of insulin pump therapy. *Diabetes Care* 16:1470-1478, 1993
- <sup>8</sup>Brink SJ, Stewart C: Insulin pump treatment in insulin-dependent diabetes mellitus. *JAMA* 255:617-621, 1986
- <sup>9</sup>de Beaufort CE, Houtzagers CMGJ, Bruining GJ, Aarsen RSR, den Boer NC, Grose WFA, van Strik R, de Visser JJ: Continuous subcutaneous insulin infusion versus conventional injection therapy in newly diagnosed diabetic children: two-year follow-up of a randomized, prospective trial. *Diabet Med* 6:766-771, 1989
- <sup>10</sup>The DCCT Research Group: The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin dependent diabetes mellitus. *N Engl J*

*Med* 329:977-986, 1993

<sup>11</sup>Anderson B, Ho J, Brackett J, Finkelstein D, Laffel L: Parental involvement in diabetes management tasks: relationships to blood glucose monitoring adherence and metabolic control in young adolescents with insulin-dependent diabetes mellitus. *J Pediatr* 130:257-265, 1997

<sup>12</sup>Johnson SB: Insulin-dependent diabetes mellitus in childhood. In *Handbook of Pediatric Psychology*. 2nd ed. Roberts MC, ed. New York, Guilford Press, 1995, p. 263-285

<sup>13</sup>Harris MA, Lustman PJ: The psychologist in diabetes care. *Clin Diabetes* 16:91-93, 1998

### Acknowledgments

We would like to thank our colleagues in the Department of Endocrinology and Metabolism for their assistance with this article and their contributions to our program. We also appreciate the efforts of Natalie Bellini, RN, CDE, CPT, for her invaluable contributions. Perhaps most importantly, we thank the families at our center for their continued participation in our clinical and research efforts.

*Fran R. Cogen, MD, CDE, is an assistant professor of pediatrics in the Department of Endocrinology and Metabolism, and Randi Streisand, PhD, is an assistant professor of psychiatry and pediatrics in the Department of Psychology at Children's National Medical Center in Washington, D.C. Seema Sarin, BA, is a fourth-year medical student at the George Washington University School of Medicine in Washington, D.C.*

Liberty Medical Supply  
2/c

page 76

Lifescan Induo  
4/c

page 77