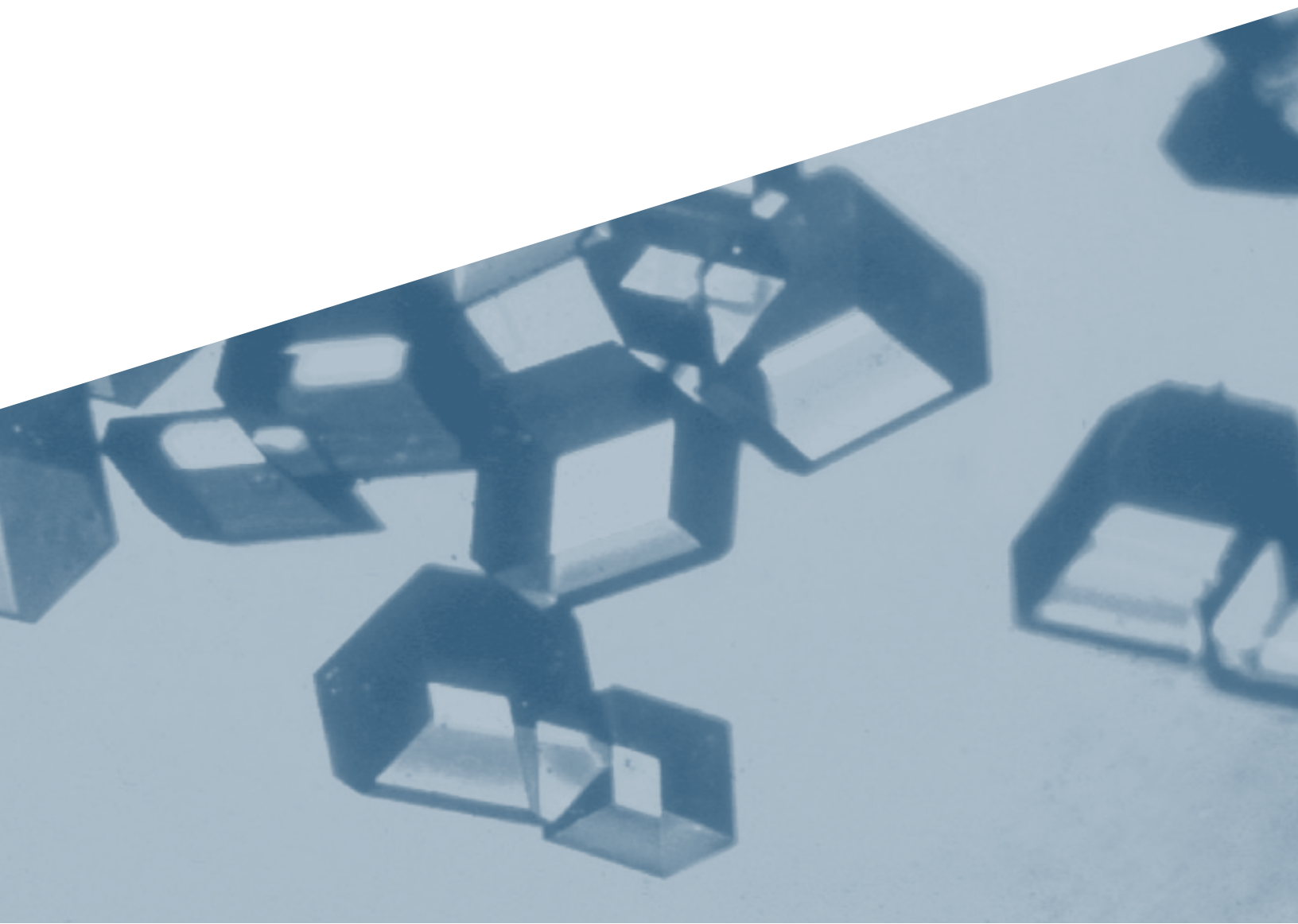


GOAL IV

PREVENT OR REDUCE
HYPOGLYCEMIA
IN TYPE 1 DIABETES



Hypoglycemia—perhaps the most distressing, acute complication of type 1 diabetes—is caused by excessive treatment with insulin relative to food intake and physical activity. This condition, which is also referred to as an “insulin reaction,” occurs when an overdose of insulin in the blood causes glucose to fall dangerously far below a minimal level necessary to fuel the body’s activities. Even with newer forms of insulin that may decrease the risk, hypoglycemia remains an extremely serious concern. The potential for hypoglycemic episodes has limited the use of intensive insulin therapy protocols that are known to reduce the risk of longer-term diabetic complications, such as eye and kidney disease. The immediate effects of hypoglycemia can be severe. They include potential changes in cardiovascular and central nervous system function, cognitive impairment, increased risk for unintentional injury, coma, and, in a minority of cases, death. Reducing the impact of hypoglycemia on patients with type 1 diabetes would profoundly improve their quality-of-life.

Normally, the brain senses hypoglycemia and initiates a compensating cascade of signals—“counter-regulation”—to elevate blood glucose levels. However, in diabetic individuals who experience repeated episodes of hypoglycemia, the brain fails to respond—a condition known as counter-regulatory failure. Some individuals are also at risk for a second condition, hypoglycemia unawareness, in which they have difficulty recognizing the symptoms of hypoglycemia and are, therefore, more vulnerable to adverse outcomes. At present, no treatment options are available for patients suffering from hypoglycemia unawareness other than: 1) more frequent blood glucose monitoring, or 2) relaxation of insulin therapy, which can lead to more long-term complications.

The widespread implementation of reliable, accurate, and relatively user-friendly self-monitoring glucose devices and portable insulin pumps has transformed the management of type 1 diabetes in the past two decades. Because many of these systems still require painful finger-sticks and injections to measure glucose and deliver insulin, the development of non-invasive, continuous-monitoring technologies is critical. In addition, designing a “closed-loop” delivery system or “artificial pancreas”—made by combining the glucose sensor and insulin pump—is the next important step in achieving tight glucose control, until islet or beta cell replacement therapy becomes a viable option for type 1 diabetic individuals.

The Special Statutory Funding Program for Type 1 Diabetes Research has opened up critical new research avenues on hypoglycemia and glucose monitoring. From basic studies on the neuronal mechanisms that induce hypoglycemia to clinical research to improve and validate technologies that measure blood glucose levels, the initiatives supported by the special statutory funds should lead to novel technologies and therapies to ease the daily management of type 1 diabetes.

Photo

Insulin crystals.

MAJOR RESEARCH CONSORTIUM AND RESOURCES

With the marked increase in special statutory funds that became available in FY 2001, a large-scale trial network and research solicitations were launched in FY 2001 and FY 2002. Brief descriptions of the research efforts and expected outcomes of initiatives supported in whole or in part by the special funds are presented below. More detailed scientific plans are available in Appendix 3.

DirecNet: A Network To Test Glucose Sensors in Children with Type 1 Diabetes (RFA HD01-009)

Hypoglycemia had been the major limitation to the implementation of intensive glycemic control, which has been proven to dramatically reduce the development of eye, kidney and nerve disease in adults and adolescents with type 1 diabetes. Intensive therapy has not been systematically evaluated in type 1 diabetic children younger than 13 years of age, who may be at increased risk of hypoglycemia. DirecNet will assess glycemic control and the incidence, magnitude and duration of hypoglycemia in children with type 1 diabetes. It will also measure glucose levels in children without diabetes for the purpose of defining the normal range of blood sugar in children. The network will examine the use of continuous glucose sensing technology, which has not yet been tested in children, to determine its value in improving metabolic control and reducing the risk of hypoglycemia in young children. This network of five clinical centers and a coordinating center, which is supported by the NICHD and NIDDK, began in FY 2001 and is expected to continue through 2006.

Standardization Program To Improve the Measurement of Blood Glucose by Portable Monitoring Systems

People with diabetes and their health care providers rely on the results reported by portable blood glucose monitoring systems to make treatment decisions. Improper treatment can occur if results are not accurate. It is important that performance be comparable among the many different systems that are available. This project was launched by the CDC to evaluate the variability among blood glucose monitoring systems and to develop a standardization program to normalize results among these systems.

Investigator-Initiated Research (RFA DK01-031, EB01-002, NS02-008)

Hypoglycemia and hypoglycemia unawareness significantly impair the quality-of-life of diabetic patients, yet many gaps remain in our understanding of the neurological mechanisms underlying these conditions. Research solicitations were issued to support basic and clinical studies on hypoglycemic complications. These research efforts should lead to new targets or strategies for therapeutic interventions designed to protect patients from these acute complications. Grant applications were also solicited for research on new glucose sensing or insulin delivery technologies to improve the management of this disease. The 15 grants awarded in FY 2002 through these three research solicitations will help to advance our understanding of hypoglycemia and should provide the basis for future treatments.

HIGHLIGHTS OF SCIENTIFIC DISCOVERIES

Many significant scientific advances have emerged from investigator-initiated research that began in the early years of the special statutory funding program. Highlights of these discoveries are provided here. More extensive discussion of initiatives and their research progress can be found in Appendix 3. Some grants or programs supported by the early initiatives are still in progress and the full impact of these projects on detecting and preventing hypoglycemia may not be realized for several years. It is premature to assess accomplishments of the newly formed trial network or investigator-initiated research grants awarded in FY 2001 or FY 2002.

Advanced Glucose-Sensing Technology

- ▶ Researchers developed a method to use glucose binding proteins as reagent-less glucose sensors. Eventually, such sensors could be incorporated into implantable sensor devices that serve as a component of an artificial pancreas in conjunction with insulin delivery systems. A U.S. patent has been issued for the invention of this technology.
- ▶ A continuous glucose monitoring system has been designed that is capable of acquiring data at a near-continuous rate, with a storage capacity of 2 months. This sensor and analysis system can provide a warning to diabetic patients who might not otherwise be able



Management of type 1 diabetes requires multiple, painful finger sticks to measure glucose levels in the blood, combined with either insulin injections or the use of an insulin pump. Even the most vigilant patients may at times experience difficulties maintaining their glucose within normal levels. The Special Statutory Funding Program for Type 1 Diabetes Research supports research on new glucose sensing and insulin delivery technologies to ease the daily burden and improve the treatment of type 1 diabetes.

(Photo Credit: National Diabetes Education Program)

to detect falling glucose levels—telling them to eat immediately to prevent hypoglycemic coma.

- ▶ Investigators developed novel, fluorescence-based glucose sensing systems, including a chemical compound that fluoresces when it binds to glucose. A highly selective optical device detects these changes without interference from related substances present in blood. The research also demonstrated the power of computer-based design in the development of a glucose-selective sensor.

Optimizing Glucose Measurement

- ▶ Investigators have made progress on the application of ultrasound to enhance skin permeability. A vacuum is applied to the site of enhanced skin permeability, a small amount of interstitial fluid between skin cells is removed, and glucose present in this fluid can be measured. This technology has the potential to provide a painless, non-invasive, and convenient method of glucose monitoring for type 1 diabetes.
- ▶ A key issue in developing minimally or non-invasive glucose monitors is understanding the relationship between glucose levels in interstitial fluids and blood. Several studies of interstitial glucose indicate that, despite a short time lag, measurements made just beneath the skin will likely be good indicators of blood sugar.

EXTERNAL EVALUATION

This section provides commentary from leading scientific experts within the diabetes research community who assessed the accomplishments of the special statutory funding program and from researchers who participated in the use of the special funds. A complete description of the evaluation process and the use of evaluative data regarding the special funding program is available in the Assessment chapter and Appendix 2.

Advisory Panel

A panel of scientific and lay experts on type 1 diabetes research convened at the NIH in May 2002 to review the use of the special statutory funds. Comments from the advisory panel regarding hypoglycemia-related initiatives established by the special funding program include:

- ▶ The panel members were pleased with the NIH's responsiveness to a meeting held in 2000 that identified a need for scientific investigation at the interface of neuroscience and diabetes. Such research is critical to understanding hypoglycemia and its impact on diabetic patient care.
- ▶ The advisors applauded the NIH for stimulating basic neuroscience research related to hypoglycemia, as well as initiating trials to develop and validate glucose sensors as a way of detecting and preventing hypoglycemia. Further, the NIH was commended for using the special statutory funds to support research validating the utility in children of glucose sensing devices that have received FDA approval.
- ▶ The panel enthusiastically supported the research partnership initiatives of the special funding program (*see Goal VI*) and suggested that such initiatives be fully exploited for the purpose of recruiting neuroscientists to diabetes research.

Extramural Grantees

Principal investigators who received grants or grant supplements related to understanding, preventing, and treating hypoglycemia responded to a survey asking, in part, about the value of this grant or funding source. Representative remarks include:

- ▶ “When discussing hypoglycemia unawareness with my nursing colleagues, I found that many of them had never heard of this condition. As I am presently preparing the results of my research for publication, I also published an article on hypoglycemia unawareness [for a provider audience]...to increase awareness of this problem in nurses engaged in generalist nursing practice.”



Children with type 1 diabetes can participate in sports activities as long as their glucose levels are closely monitored. Exercise, food intake, and insulin treatments must be carefully balanced to avoid episodes of dangerously low blood sugar (hypoglycemia). The DirecNet consortium is testing the use of continuous glucose monitoring technology for improving the management of diabetes in children younger than 13 years.

- ▶ “I have worked in enzymology for 40 years. This grant was the first that caused me to use my expertise with immobilized enzymes in the area of diabetes.”
- ▶ “This R21 [pilot] grant allowed us to start a new research direction, which would otherwise be impossible. This is one research project that has blossomed into a major research direction in my group with current total NIH funding of over \$2.3 million.”
- ▶ “As evidenced by the long list of publications and our current grant support from the NIH, it is apparent that the R21 grant played a critical role in allowing us to initiate a very promising research direction. Without the R21 grant, such a promising idea would have no chance of being tested and developed to the current stage that is making a tremendous impact in the field. I strongly urge the NIH and NIDDK to periodically issue PAs [Program Announcements] in support of innovative research ideas that lack the necessary preliminary results to get funded by the traditional R01 mechanism. Such support will help develop truly innovative ideas.”
- ▶ “The funding level for this project was much appreciated because previous NIDDK funding did not allow us to proceed rapidly in the development of the sensor, the hardware and software related to data acquisition and interpretation of data, and finally the physiological studies connected to glucose kinetics and sensor biocompatibility.”
- ▶ “This grant had a great impact—it allowed us to pursue an active research program in implantable glucose sensor development.”

Symptoms of hypoglycemia include:

- ▶ hunger
- ▶ nervousness or shakiness
- ▶ perspiration
- ▶ dizziness or light-headedness
- ▶ sleepiness
- ▶ confusion
- ▶ difficulty speaking
- ▶ feeling anxious or weak
- ▶ convulsions
- ▶ changes in behavior

Hypoglycemia can also happen during sleep.

Patients might:

- ▶ cry out or have nightmares
- ▶ find that pajamas or sheets are damp from perspiration
- ▶ feel tired, irritable, or confused upon awakening.

(Source: National Diabetes Information Clearinghouse)

MULTICENTER RESEARCH NETWORK TO TEST GLUCOSE SENSORS IN CHILDREN WITH TYPE 1 DIABETES



Dr. William Tamborlane, Chief of Pediatric Endocrinology at the Yale University School of Medicine, shown here with a young patient, leads the DirecNet research consortium. DirecNet studies the regulation of blood glucose levels in children with or without type 1 diabetes and the use of continuous glucose sensing devices for diabetes management in children.

(Photo Credit: Yale University School of Medicine)

The Diabetes Research in Children Network (DirecNet) is a group of five leading academic medical centers that are also leaders in the treatment of type 1 diabetes in children. Supported in part through the Special Statutory Funding Program for Type 1 Diabetes Research, DirecNet is a nationwide group of focused investigators, whose mission is to learn how best to use continuous, around-the-clock measurement of blood glucose (sugar) and thus, ultimately to improve the management of type 1 diabetes in children. The five participating centers are located at Yale University, Stanford University, the University of Iowa, Nemours Children's Clinic in Jacksonville, Florida, and the University of Colorado Health Sciences Center.

Dr. William Tamborlane is the Principal Investigator at the Yale Center and also serves as the Chair of the DirecNet's Steering Committee. Dr. Tamborlane and the other investigators are very enthusiastic to participate in the DirecNet because it is addressing a problem that they deal with on a daily basis in their clinical practices. Dr. Tamborlane previously participated in an important NIH-funded clinical trial investigating the benefits of strict blood sugar control in preventing complications in type 1 diabetes patients. This trial, known as the Diabetes Control and Complications Trial (DCCT), showed that intensively treated patients with strict blood sugar control had a reduced incidence of microvascular diabetic complications, specifically, eye, kidney,

and nerve disease compared to poorly controlled patients on conventional treatment. After the DCCT ended, both trial groups received intensive glucose treatment. Yet, several years later, the original intensive treatment group continued to exhibit a lower rate of onset and progression of complications than the original conventional treatment group. Thus, the DCCT and its follow-up study clearly demonstrate the long-term benefits of careful glucose control.

Although Dr. Tamborlane and his colleagues are eager to apply this knowledge to the treatment of diabetic children, he points out that: "A key piece of information is still missing: even with three or four blood tests a day, patients and clinicians often don't realize how high the glucose level can go after a meal. Another barrier to the application of strict blood sugar control in children is that it can frequently increase the incidence of dangerous low blood sugar episodes (hypoglycemia). Hypoglycemic episodes often occur in the night, and may not cause any symptoms. That's why everyone is excited about the potential usefulness of the new continuous glucose sensors as a better way to monitor glucose profiles in youth with type 1 diabetes."

The DirecNet will test the accuracy of glucose sensors in both diabetic and non-diabetic children, as compared to frequent in-patient measures of blood sugar. Researchers will be comparing two glucose sensors that are currently available. They will also compare the sensors' accuracy in younger children versus adolescents, to determine if the accuracy is similar in different age groups. This trial will not only test current sensors, but it will help to define normal blood glucose ranges in non-diabetic children and establish a rigorous protocol for testing new sensors as they are developed.

The DirecNet also plans to conduct a large, prospective, randomized clinical trial to determine whether the use of a glucose monitor in conjunction with traditional fingerstick blood glucose measurement is more effective than the fingerstick method alone in managing blood glucose levels. The children will be evaluated in an out-patient setting as they go about their normal routines over a 6-month period. In addition, the study will permit investigators to evaluate the effectiveness of current blood glucose management strategies in children with type 1 diabetes, including carbohydrate counting, and the impact of afternoon exercise on nighttime episodes of hypoglycemia.

The initial inpatient study for both diabetic patients and normal subjects has already been completed. The outpatient study is currently in the planning phase. Members of the DirecNet plan to pool their respective data on glucose sensors to identify common themes or trends reported with their use. Data pooling may also enable the researchers to determine if there is a difference in sensor efficacy between those with newly-diagnosed versus long-term type 1 diabetes. Participants hope that this new DirecNet will prove to be an invaluable way to test glucose sensors and glucose management strategies in a broad cross-section of U.S. patients with type 1 diabetes.

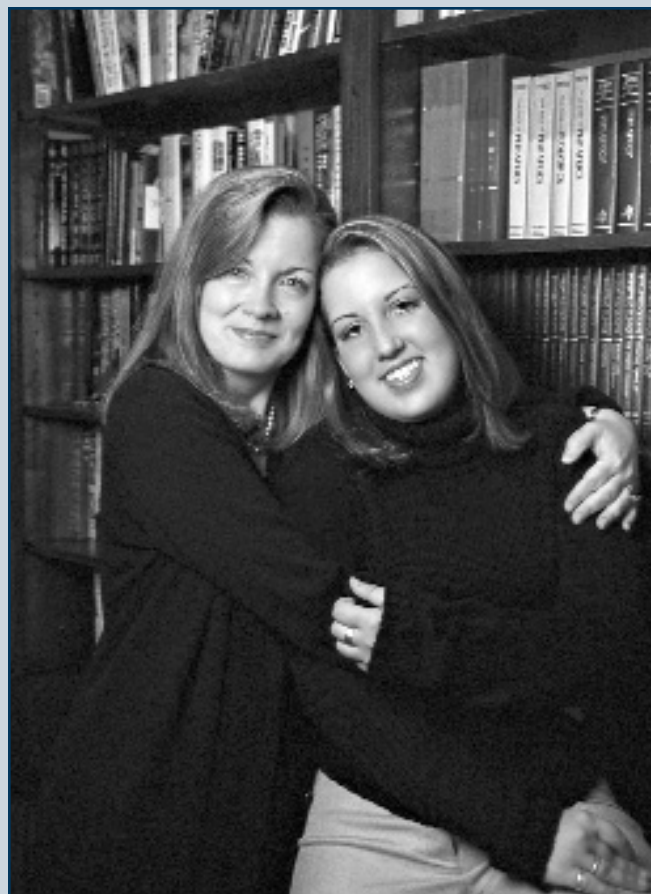
Dr. Tamborlane points out that: "Until now, the main barrier to development of an artificial pancreas has been our inability to measure blood glucose around the clock. By overcoming this barrier, glucose sensors may provide an exciting leap forward towards a possible 'cure' for type 1 diabetes—providing patients with a device capable of monitoring blood sugar and administering insulin in response to the body's specific needs at any given point in time."

PATIENT PROFILE: Michelle Puczynski

Hypoglycemia in Diabetes, from Infancy to Adulthood

Michelle Puczynski, who was diagnosed with type 1 diabetes at 11 months old, experienced several hypoglycemic seizures at a very young age. These seizures occurred even though Michelle had the best medical specialists. Moreover, her mother was a certified diabetes educator at the time, and her dad is a pediatrician. “We knew what we were doing,” Michelle’s mother, Sandra Puczynski, said, “but our daughter seemed particularly vulnerable to hypoglycemic episodes.” Hypoglycemia, or low blood sugar, can be life-threatening. It occurs when blood levels of glucose drop too low to fuel the body’s activity. Sandra said that when Michelle was younger, she and her husband were awakened on several occasions during the night to “distressing” sounds coming from Michelle’s bedroom. The Puczynskis usually found Michelle non-responsive and in a stroke-like condition called hemi-paresis, in which Michelle’s arms and legs were limp and half her body had lost movement. “The condition is temporary, but frightening to witness,” said Sandra, who admittedly became a self-described “hypervigilant” parent immediately after Michelle was diagnosed with type 1 diabetes. “My husband and I anticipated Michelle’s every need... we felt we couldn’t leave her in anyone else’s care.”

Fortunately for Michelle, her family, and the many others who suffer from type 1 diabetes, research has helped them to achieve careful control of blood sugar that reduces hypoglycemic episodes. The advent of insulin pumps, better medications and more effective ways of testing blood sugar, as well as a better understanding of the roles played by diet and exercise, have gone a long way to helping patients like Michelle control their blood sugar. Yet despite these new tools and her own motivation and intelligence, control of Michelle’s blood sugar remains a challenge.



Michelle Puczynski (right), with her mother Sandy (left). Michelle was diagnosed with type 1 diabetes before she was a year old. With the help of her family, Michelle has learned to manage her diabetes and carefully control her blood sugar levels. Research has shown that diligent glucose control reduces the risk of long-term diabetic complications, including eye, nerve, and kidney disease.

(Photo Credit: Juvenile Diabetes Research Foundation International)

“I know that the only way they will ever find a cure for diabetes is through research. I closely follow all reports in the newspaper or on television about scientific discoveries and possible cures. I worry that it is getting too late for me.”
— *Written by Michelle when she was 15 years old.*

Today, at age 18, in college and away from home for the first time, Michelle is an independent young woman making the adjustment to living with type 1 diabetes on her own. "I've really got to take care of myself," Michelle said. "I don't have my mom around to pay attention to how my insulin is working, or to make sure I test my blood sugar, stick to my diet, and continue to exercise. It's all up to me now."

Living with Hypoglycemia

Because she was only 11 months old at the time, Michelle doesn't remember anything about having been diagnosed with type 1 diabetes. "I don't know any other way to live my life," she said. However, she does have clear memories of the times her mother would wake her in the middle of the night and say, "Michelle, it's boopie time." Boopie was a word her mother made up that indicated it was time for Michelle to test her blood sugar. "I was about 4 years old, I guess," says Michelle. "I still remember the lancet looking so big and so scary." Little did Michelle realize then that her parents were as frightened as she. "When Michelle was diagnosed with diabetes, my husband and I were both shocked and sad," says Sandra. "We didn't know anyone that young with the disease."

Like many parents of young children with diabetes, the Puczynskis trained themselves to get up during the night to check on Michelle, a pattern they found very hard to break over the years. "When Michelle was a baby and would cry, we never knew if it was related to her diabetes or whether she was just hungry," said Sandra. "And every time I pricked her little fingers or heel to check her blood sugar, I always felt like I was inflicting pain on my infant child." But for Sandra the hypoglycemic episodes were the worst.

Whenever Michelle went into a hypoglycemia-induced seizure, the Puczynskis would swiftly inject her with glucagon, a hormone that quickly eases the symptoms of low blood sugar by causing the release of a burst of glucose into the blood. Then, they would stay by Michelle's side for hours, checking her blood sugar every 20 minutes or so until the levels were in an acceptable range. "These were extremely frightening times," said Sandra. But over the years, she added, things have gotten much better. Michelle was 12 when she had her last hypoglycemic seizure. "I attribute this good fortune to better medications (Michelle began taking humalog, a synthetic human insulin, in 1997) and to the insulin pump, which has been an enormous breakthrough in meeting the changes in daily insulin requirements." Nevertheless, Michelle must still remain constantly vigilant.

Making the Transition to Adulthood

Now that she's living away from home for the first time, Michelle is finding the transition a bit scary, but manageable. "I had no idea what it would be like when I left home... not to have my mom around to remind me to test myself or to take my insulin. The first few days at college I was really freaked out, but I'm pretty comfortable with it now," she said. She knows that a hypoglycemic episode can be brought on by taking too much medication, missing or delaying a meal, eating too little food for the amount of insulin taken, exercising too strenuously, drinking alcohol, or any combination of these factors. Michelle has come too far not to stay diligent.

PATIENT PROFILE: Michelle Puczynski (CONTINUED)

“If I could send one message to other kids with type 1 diabetes,” Michelle said, “it would be to monitor your blood sugar closely, no matter how hard or frustrating it gets. It can get tiring to listen 24/7 to your parents and others ask if you’ve tested yourself or if you’re feeling okay, but they’re right. If you’re diligent about your diabetes when you’re young, you’ll be happier later in life.”

“Now that I’m in college, the one thing I’d love to do more than anything else is to sleep until two in the afternoon,” Michelle said. Instead, she gets up each morning at 8:00 a.m., takes a shower, tests her blood sugar, calculates how much insulin she requires, and takes her insulin, which is a process she repeats several times a day. Then she heads across campus for breakfast, which she needs to eat every morning. “Every time I eat a meal, I need to test myself,” said Michelle. “I’d love not to have to do that.” But she knows that she must, or else she puts herself at great risk for complications related to diabetes. “I know if I stay diligent, it will pay off as I get older.”

Symptoms of Hypoglycemia

A person with hypoglycemia may feel weak, drowsy, confused, hungry, and dizzy. Paleness, headache, irritability, trembling, sweating, rapid heart beat, and a cold, clammy feeling are also signs of low blood sugar. In severe cases, a person can lose consciousness and even lapse into a life-threatening coma.

Sandra admitted that she too underwent separation trauma when Michelle went off to college. “As a teenager, Michelle would often say to me, ‘You don’t know what I’m going through with this disease,’” said Sandra. “But our main

message to her was always: ‘Be the best that you can be, regardless of the fact that you have diabetes.’” Michelle has obviously taken that message to heart. Not only is she adapting well to being away at college, but Michelle also leads an active social life, plays volleyball for her dorm floor, is a member of the school’s snowboarding team, loves the outdoors, and is an advocate for others who have diabetes. “I try to live life to the fullest,” she said. “There’s nothing to hold back for.”

“There is a tremendous lack of understanding about this disease on the part of the general public,” said Sandra. “Very few school personnel, for example, are prepared to manage a hypoglycemic episode. That’s why parents of children with diabetes need to be advocates for their children every step of the way.”

Both Michelle and her mom have testified in Washington on behalf of people with diabetes, and the need for further research. They are particularly heartened by the recent increase in funding to study the hypoglycemia component of the disease, with a focus on how to prevent hypoglycemic episodes as well as manage them. In addition, Michelle has written letters to Members of Congress and the Juvenile Diabetes Research Foundation International, and has been interviewed about diabetes on local radio and TV several times. “I worry about the many children with diabetes in America whose families cannot provide them with the care and support that mine did for me,” Michelle says. “My mom and dad are the greatest people in the world. I don’t know what I would have done without them.” And her mom and dad feel the same about Michelle.

WHY WE NEED A CURE *

Monday night I had the opportunity to attend the Tampa Bay Bucs – Pittsburgh Steelers football game. I was the medical chaperone for seven children with type 1 diabetes. These kids ranged in age from 8 to 12 years old. Their parents had to drop them off at the stadium and you could feel the apprehension, as they realized that their kids would be with people they did not know for the next 5 hours. Julie Robertson, the Executive Director of our Tampa Bay JDRF, had gotten tickets for them on the front row in the end zone, and we were in our seats an hour before the game.

I spend most of my time working with adult type 2 diabetes patients and yet these parents had entrusted their children to me for the entire evening.

Six of the children had pumps and one used insulin injections.

After we sat down, I took my son up to get something to eat. No sooner than getting to the food stand, I got a frantic call from Julie. One of the girls had a glucose level of 58 mg/dl and Julie had no idea how many glucose tablets to give her. I had to run back down to the seats and help them.

Fifteen minutes later three of the girls wanted to eat, so I had all of them check their glucose and we headed up to get some food.

We got the food and then had to figure the bolus dose. Two girls thought their ratio was 12 to 1 and the third had no idea as her mother does it. We made a couple of phone calls and we were able to take care of the bolus dose. I made a decision to only give half the bolus before they ate and then the rest if they finished their food. One of the girls asked me why and I explained it as best I could.

I then took the two boys up, one got a diet coke only and the other had an order of nachos and a sprite. I asked him about checking his glucose and he said "my parents gave me some Humalog before I left and told me to eat and I would be okay."



David Joffe is a pharmacist and Certified Diabetes Educator. Six years ago he became involved with JDRF and is currently Vice President of the Tampa Bay Chapter. David is Editor-in-Chief of a free online newsletter* for medical professionals. In addition, he manages diabetes patients, trains new insulin pump patients, and practices pharmacy in Madeira Beach, FL.

As the game progressed, I found myself watching the kids more than the game. About half way through the second quarter I saw one of the girls shivering and a quick check of her glucose gave a 287 reading. She had shared a large order of fries with a friend and thought she had only eaten 15 carbs, but the order itself was over 100 carbs. We gave her a couple units of insulin and her glucose started dropping.

This continued all through the game and I couldn't begin to tell you what happened on the field. All I know was that I was constantly looking at those seven kids and wondering who I should check next.

When the game was over we had to take the kids back to the drop-off spot. By the time one of the kids was picked up, we had to give her a couple of glucose tablets to raise her level.

My son and I walked back to the car with Julie, and the discussion focused on how hard it was to pay attention to the game while watching these kids and my son added, "imagine how hard this is for their parents as they have to do it every day."

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