

When Joslin nurse and patient **Katey Welty, R.N.**, was first diagnosed with diabetes in 1997, her grandfather handed her *The Joslin Guide to Diabetes* and said, “This will save your life.” Welty attributes her good health to the critical information learned through the Joslin publication.

# Primed for the **PUMP**

by Elizabeth Gilbert

For an active person like Welty, however, taking insulin by injection required she schedule her days around her diabetes, limiting her activities. The solution? Two years after her diagnosis, Welty began insulin pump therapy, which allows her to manage her diabetes without affecting her free-spirited lifestyle.

Crediting superior leadership and expertise, Welty steered not only her diabetes care, but also her career path toward Joslin’s diabetes programs, including pump management. Howard A. Wolpert, M.D., Director of Joslin’s Insulin Pump Program, has established Joslin as the largest center for adult insulin pump therapy in the world. The rate of “pumpers” at Joslin is 33 percent of type 1 diabetes patients (about 1,300 patients), while the national average is only about 15 to 20 percent.

## **PUMP Freedom**

The pump is a device worn on the body (usually on the stomach) that delivers insulin through a catheter attached to a needle inserted under the skin. The size of a pager, the pump attempts to mimic the activity of a healthy pancreas, but the

patient still plays a role—programming the amount of insulin to inject, or how many carbohydrates eaten. The biggest difference between injection therapy and pump therapy is the continuous stream, or basal rate, of insulin administered by the pump. Patients can match their body’s insulin needs without eating food—keeping blood glucose levels stable between meals and overnight. This allows patients like Welty to sleep in or eat a late lunch without fear of “going low.”

Insulin glargine injection and other long-acting insulins are meant to function similarly; however, the pump is more precise and functions in real time. This increased precision with insulin delivery is why pump users are at a lower risk for hypoglycemia (low blood glucose) than their counterparts on injection therapy.

< Joslin pump patient and nurse Katey Welty, R.N., (left) with Joslin Nutrition Educator Roslyn Grant, M.S., R.D., L.D.N., C.D.E.

## AN UPCOMING REVOLUTION

Another tool that could change the landscape of diabetes management is continuous glucose monitoring (CGM). This tool shows an entire day's worth of a patient's blood glucose peaks and valleys, instead of a single snapshot of blood glucose levels. Much like a pump, CGM devices are the size of a pager and require some penetration through the skin to extract blood to determine glucose levels. In the future, however, implantable and non-invasive devices will be available.

"CGM is a more comprehensive picture of a patient's glucose control. When patients experience blood glucose highs and lows, this technology allows them to adjust insulin delivery accordingly, controlling their blood glucose more precisely and reducing their risk for complications," says Dr. Wolpert.

"When it is available for patient home use (likely within the next five years)," adds Dr. Wolpert, "the introduction of CGM will mark a paradigm shift in diabetes management as significant as the commercial launch of finger pricking in the 1970s, which led to the intensive therapy revolution."

But Dr. Wolpert adds: "With these devices, you're not taking an actual reading of blood glucose—there's a lag time for the glucose level to travel from the blood to the tissue where the sensor is."

Also coming in the future is diabetes management software integrated into a pump, and a hybrid tool that integrates the pump and CGM in one external unit. Several companies are developing "real-time" sensors that would monitor glucose continuously and sound an alarm if it falls outside a set range.

Additional technologies in the pipeline include pumps surgically implanted under the skin, and alternative ways to measure blood glucose using radio, energy and light waves. Furthermore, wireless technology will be leveraged and pumps will be controlled remotely from a personal digital assistant. One company has already linked the pump to a food library where the user can access nutrition information.

"Integrating diabetes management software and real-time CGM has the potential to revolutionize the management of type 1 diabetes—it would move us closer to the automatic glucose management provided by the pancreas in healthy people," says Dr. Wolpert. "However, several major hurdles need to be overcome before an implanted closed loop system for long-term diabetes management will be feasible."

With control over her background insulin delivery, Welty has the flexibility to go to the gym or play tennis simply by taking off her pump or reducing her basal rate, cutting her need to eat on a rigid schedule.

"With a pump, a person can adjust their insulin delivery around exercise with much more precision, so they can use exercise more effectively as a tool to burn calories to maintain or lose weight," says Dr. Wolpert, who is editor of *Smart Pumping*, pub-

lished by the American Diabetes Association. "The principal of insulin therapy has changed—patients take insulin to cover their food, instead of eating to cover their insulin."

In addition to the basal rate of insulin, patients set the pump to administer a "booster" dose of insulin, or "bolus," before meals. Unlike injection therapy, the pump can accommodate varied diets and foods, such as a high-fat diet. Because high-fat foods can cause



insulin resistance, the user can set the pump to spread out the insulin over time—with injection therapy this is not possible.

### PUMP's Pros...and Cons

Although Dr. Wolpert agrees "pumps give patients more flexibility in their daily lives," he adds, "users need to be motivated." Before using the pump, patients need to understand the relationship of food, exercise and insulin to blood glucose levels, the action profiles of insulin, advanced carbohydrate counting, how to calculate bolus doses, and basic troubleshooting of glucose levels while on the pump.

Welty is the ideal pump patient, having taken the time to be trained properly and to find the right basal and bolus rates—she now even trains patients in pump use. "Some people have the idea before they get a pump that they can just put it on and it will do all the work for them. This is not the case. Pump patients need to be aware of their diabetes and how the pump works for proper diabetes management."

"For many patients, a real draw to the pump is the lower risk for hypoglycemia," says Dr. Wolpert. But he cautions: "The pump is a great tool, but it is not a miracle device that will give you perfect glucose control," says Dr. Wolpert, who is an advisor to many in industry and the diabetes community on how to introduce new technologies



PHOTO: MICHAEL J. MALONEY

“THE PRINCIPAL OF INSULIN THERAPY HAS CHANGED—  
PATIENTS TAKE INSULIN TO COVER THEIR FOOD, INSTEAD  
OF EATING TO COVER THEIR INSULIN.”

— HOWARD WOLPERT, M.D., DIRECTOR OF JOSLIN'S INSULIN PUMP PROGRAM

into diabetes care. Although the pump decreases risk of hypoglycemia, any interruption of insulin delivery by the pump quickly leads to an increase in blood glucose levels, which can cause ketoacidosis.

The most significant disadvantage, however, is the expense: the average price of a pump is about \$5,000, and it costs an additional \$1,500 per year for disposables, such as infusion sets, syringes and batteries. Insurance coverage varies state to state.

Unfortunately, many companies only view the high short-term costs and not the long-term savings due to a reduction in diabetes complications.

#### **PUMPs Are Personal**

So, with more advantages than disadvantages, why wouldn't most people with type 1 diabetes use the pump? “Pump use is a personal preference. To some, it can act as an outward symbol to the world that you

have diabetes, almost like a badge,” explains Dr. Wolpert. “For people who have a lot of problems with hypoglycemia, the pump is really worthwhile, but for others who can achieve as good control on injection therapy, changing their routine isn't worth it.”

Wearing a pump is less of an issue now because it is common to see pagers and cell phones on a belt, which appear similar. Yet the biggest deterrent to pump use remains psychosocial/body image issues, which affect both men and women equally. Although there might not be a gender gap, there is a generational gap. As Dr. Wolpert explains, “Teenagers begin pump therapy in high school when it's hip to be wearing a pump. But when they go off to college, wearing a pump can feel stigmatizing. However, when young adults are more conscious of the future and ready to make sacrifices, their interest in the pump is renewed.”

“I did not want to go on a pump at first because I was worried that it would look bad, or that it would be a problem to wear it 24/7, but once I gave it a try I would not trade it in for anything,” says Welty. “As a patient and a nurse, I recognize the value of this tool, but I wouldn't say it is for everyone. The patient needs to be ready to put the time in to make the necessary adjustments.”

Pumps are primarily suitable for people with type 1 diabetes, or insulin-dependent diabetes, but there are some type 2 diabetes cases where it may be applicable. However, as Dr. Wolpert notes, it may not be the best solution. “Even when type 2 diabetes patients reach the stage where their beta cells have lost function, for most people the key issue in terms of maintaining good glucose control is being careful about what they eat—better precision with insulin delivery isn't necessarily the answer.”

Before other new diabetes management tools go commercial, physician-researchers like Dr. Wolpert are testing their effectiveness. Dr. Wolpert and colleagues are beginning a multi-center study of 100 patients this summer in which one half will wear a conventional pump and use a finger stick glucose monitor, while the other group will wear a pump and continuous glucose monitor.

Along with technology development, creating educational materials, such as interactive software and Web-based tools, is essential, Dr. Wolpert notes. “We need an educational infrastructure to ensure that patients have the diabetes self-management skills needed to reap the benefits of this technology.”

Meanwhile, Welty offers her patients good advice an established way (citing *The Joslin Guide to Diabetes*), a more modern way (a pump training manual) and her own suggestions from life experience.

*Elizabeth Gilbert is a writer in Joslin's Communications office.*

## **INSULIN PUMP PROGRAMS AT JOSLIN**

**PUMPING: IS IT RIGHT FOR YOU?** – Pros and cons of pumps

**PUMP ASSESSMENT: ARE YOU READY?** – Individual pump assessment

**PUMPING FOUNDATIONS** – Pump users, basic hands-on training

**PUMP START** – One-on-one course during which the pump is inserted

**PUMP LOGIC** – Provides continuous blood glucose sensor monitoring and self-management techniques for the pump