

# The Business of Insulin Pumps in Diabetes Care: Clinical and Economic Considerations

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Insulin pumps provide one of three commercially available technologies for insulin delivery. In comparison to syringe-injected insulin and pen-injected insulin, continuous subcutaneous insulin infusion (CSII) via an insulin pump is perceived and marketed to be the most sophisticated and flexible method of providing insulin therapy.<sup>1,2</sup>

Professional and consumer information programs provided by insulin pump manufacturers in the United States have emphasized that this flexibility and sophistication may result in enhanced glycemic control and improved quality of life for insulin-requiring diabetic patients. People who use insulin pumps are said to enjoy increased discretion in daily living patterns compared to those using other forms of insulin administration. There is also a perception among at least some health care professionals and consumers that CSII can help achieve enhanced glycemic control with a reduced risk of hypoglycemic events.

These impressions have led to substantial growth in the market for insulin pumps during the two decades since their introduction. Because of its perceived sophistication and flexibility, CSII was included in the intensive therapy protocols of the Diabetes Control and Complications Trial (DCCT).<sup>3</sup>

However, CSII should not be considered without appropriate caveats. The annual costs of this therapy, including periodic replacement of pumps with “upgrades,” may be substantially higher than those of other forms of insulin administration. In at least some patient subgroups, pump use may have no positive effect on clinical status or may even worsen it.<sup>4</sup>

Because other forms of insulin administration, particularly pen injection devices, are now being advocated more widely, the evidence of clinical benefit and relative costs of these methods of insulin delivery assume greater importance, in terms of both health policy and individual treatment.

## Costs of Pump Therapy

Cost can be a formidable obstacle to CSII therapy. The most popular insulin pumps and initial supplies, including tubing, syringes, cartridges, and dressings, cost more than \$5,000 (Tables 1 and 2). The infusion set and catheters must be purchased regularly for as long as CSII is used, at an annual cost of approximately \$1,500. Most insurance companies, including Medicare and Medicaid plans, cover the cost of CSII after prospective approval.<sup>5</sup> However, patients whose plans cover 80% of the total cost may still face substantial initial and recurrent out-of-pocket expenses.

CSII therapy poses financial issues for providers, as well. Initiating this type of treatment requires a substantial investment of time and effort to assess patient suitability and to teach proper pump use. CSII also necessitates an increase in office visitation, both before and after therapy initiation, to adjust insulin dosages. Insurance coverage for these services is variable. Some providers manage to secure from health plans a

“global fee” that includes coverage of these services. Most others attempt with varying degrees of success to cover these costs by properly applying standard evaluation and management codes for office visits.

Ongoing maintenance costs of CSII therapy are not necessarily greater than those of pen-injected insulin therapy, excluding the annual amortization of the depreciation of the pump itself (see Table 2). Both forms of insulin delivery are more than twice as expensive as syringe-injected insulin therapy.

Overall, though, CSII is the most expensive option when the amortized depreciation of the pump is added into the equation. Although no clear data are available regarding how often patients upgrade their insulin pumps, our experience suggests that this change occurs approximately every 5 years. Pump upgrades are available for a discounted fee compared to the original acquisition costs. Thus, annual depreciation adds approximately \$250.00 to the yearly cost of care for CSII therapy.

## The Insulin Pump Market

The actual clinical use of insulin pumps in the United States is poorly understood. Approximately 162,000 people are registered with the major manufacturers. However, there are no data regarding how many of these patients are still actively using their pumps.

**Table 1. Initial Costs Associated With Insulin Pump Use**

Pump Manufacturer	Initial Cost of Pump and Supplies
Animas	\$5,475
Disetronic Medical Systems	\$4,995–5,495
Medtronic Minimed	\$5,495

**Table 2. Annual Costs Associated With Available Insulin Delivery Technologies**

Therapy Type	Annual Insulin Cost*	Annual Cost of Supplies**	Total Cost
Syringe-injected insulin	\$720–1,164	\$288–332	\$1,008–1,496
Pen-injected insulin	\$2,592–3960	\$336	\$2,938–4,296
CSII	\$720–1,164	\$1,554–2,160	\$2,274–4,234

\*Annual insulin cost is based on the administration of 50 units of rapid-acting insulin per day, or a monthly consumption of 1,500 units. Prices are based on retail figures accumulated in Seattle, Wash.

\*\*Annual cost of supplies reflects monthly use of 100 syringes or 100 pen needle tips or the estimated monthly cost of insulin pump infusion sets.

There is a vague notion that most people who purchase insulin pumps are Caucasian, relatively better-educated, and more affluent than the overall population of Americans with diabetes. Health care professionals who have diabetes seem to prefer CSII therapy over other forms of insulin delivery for their own treatment.<sup>6</sup>

Medtronic Minimed pumps dominate the market in the United States, whereas Disetronic pumps are predominant in other countries. Although the insulin pump market has slowed recently, total sales of pumps and related supplies are now thought to exceed \$1 billion per year.<sup>7–9</sup>

### Clinical Outcomes

Whether more sophisticated insulin delivery methods, such as pumps or pens, enhance diabetes control is not clearly understood. Although a subgroup of the DCCT's intensively treated patients were on CSII, no data showing a clear advantage of this therapy over multiple daily injections were published. DCCT researchers compared the quality of life of intensively treated subjects with that of conventionally treated subjects and noted no significant differences.<sup>10</sup> This applied to subjects using CSII as well as those using syringe-injected insulin.

A meta-review of all published experience with insulin pumps has recently been offered by Pickup and Keen.<sup>11</sup> They observed no clear evidence that CSII significantly enhanced glycemic control, but they did note data suggesting that CSII offers intense control with lower

risks of hypoglycemic events and greater dosing flexibility than syringe-injected insulin therapy.

Other studies have tended to confirm what clinicians anecdotally report on individual patients: that specific patients have very positive experiences with CSII, which lead to enhanced glycemic control and improved quality of life.<sup>12</sup> This impression is substantiated by at least one other study suggesting that results vary widely among individual patients.<sup>4</sup> Relying on the results of large-group studies to predict CSII results in individual patients may, therefore, be unwise. Although we have no reliable means of predicting whether a specific patient will substantially benefit from CSII therapy, some patients clearly do benefit.

Perhaps surprisingly, the data on pen-injected insulin are less favorable than those on insulin pumps. Jehle et al.<sup>13</sup> reported inadequacy in the suspension of NPH insulin in cartridges for pen injection. There has also been a brief report on patients experiencing acute deterioration in glycemic control when switched from syringe injections to pen injections.<sup>14</sup> However, as with CSII, Graff and McClanahan<sup>15</sup> reported better patient acceptance and fewer omissions of insulin doses with pen- versus syringe-injected insulin therapy.

### Conclusions

This perspective on the three available technologies for insulin administration suggests that pen-injected insulin therapy and CSII therapy are both associated with higher costs than is syringe-inject-

ed insulin therapy. When equipment costs are added to the cost of supplies, CSII is only slightly more expensive than pen-injected insulin therapy on an annual basis.

Data in favor of these newer forms of insulin administration are most substantial in relation to patient acceptance, flexibility of injection regimen, and reduction in omissions of scheduled doses. In contrast to widespread perceptions of CSII, which are encouraged by the marketing efforts of pump manufacturers, there is no clear evidence that CSII therapy enhances glycemic control compared to other forms of insulin therapy.

CSII does, however, appear to reduce the risks of hypoglycemia for the same level of control and, as with pens, may help more patients accept intensive insulin therapy. Because CSII lends itself to intensive management of hyperglycemia, positive public perceptions regarding insulin pumps may aid in the advocacy of strict glycemic control for people with insulin-requiring diabetes.

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## Case Study: A Woman With Type 2 Diabetes and Severe Hypertriglyceridemia Sensitive to Fat Restriction

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