Insulin pump therapy is a new method of delivering insulin for people with type 1 diabetes. Joan Everett describes the principles of how it works and discusses the pros and cons of its use. The recent guidelines from the National Institute for Clinical Excellence (2003) are summarised with a case history to illustrate the clinical and practical benefits of insulin pump therapy.

**KEY WORDS**

Type 1 diabetes  
Insulin pump therapy  
NICE guidelines

**REFERENCES**


**What is an insulin pump?** An insulin pump is a small, portable, insulin delivery device. It delivers short-acting insulin continuously via the subcutaneous route (Fig 1). An infusion catheter connects the pump to the patient and this has to be changed every 2–3 days.

The recommended insulin for pumps is a fast-acting insulin analogue. Studies have demonstrated improved metabolic control with less hypoglycaemia when using an analogue compared to regular insulin (Colquitt et al, 2003; Hanaire-Broulin et al, 2000). The human insulin analogues have a faster onset and shorter duration of action than soluble insulin (British Medical Association and Royal Pharmaceutical Society of Great Britain, 2004).

**Insulin delivery** Insulin can be delivered in two ways when a pump is used:

● Basal rate insulin is delivered continuously. The pump can be preprogrammed to deliver a different rate each hour but usually patients have 3–5 different rates in a 24-hour period. The dose is worked out according to the individual’s needs and can be changed if necessary;  
● Bolus insulin is given with meals and snacks containing carbohydrates, and can also be used to correct high blood-glucose values.

**Advantages of insulin pump therapy**

● Mimics physiological insulin secretion with continuous insulin available 24 hours a day.  
● Pump users can lead a more flexible lifestyle by eating when and what they want. This means they often feel less guilty about sweet foods and skipping meals (Linkeschova et al, 2002).  
● The DCCT Research Group (1993) showed that as people’s diabetes control improved, the frequency of severe hypoglycaemia rose. The number of episodes of hypoglycaemia are reduced with pump therapy. Hypoglycaemic episodes occur more slowly at a higher blood-glucose level and are easier to treat.  
● The longer a person has diabetes, the more likely they are to lose some early warning symptoms of hypoglycaemia. These symptoms return in most people using pump therapy.  
● Many people with type 1 diabetes experience a rise in blood-glucose levels early in the morning. Basal rates can be increased around this time according to the individual’s requirements.  
● The infusion set only needs replacing every three days.  
● Insulin pump therapy improves quality of life by reducing the impact of diabetes. People feel better, have more energy and are more in control of their diabetes (Bruttomesco et al, 2002).

**Disadvantages of insulin pump therapy**

● There is risk of infection at the insertion site. If patients fail to change the site at least every three days, this risk is increased.  
● There is a potential risk of DKA due to insufficient circulating insulin. This can be caused by pump failure, disconnection of the cannula, or poor absorption from the site. DKA can be fatal and patients require education to prevent it. All patients who use pumps are taught to test their blood four times a day and to check their urine or blood for ketones (early warning signs of DKA) if their blood-glucose level is above 14mmol/L. Additional insulin can be given with an insulin pen or syringe if ketones are detected.

**BOX 1. BENEFITS OF USING INSULIN PUMPS**

● All studies demonstrate a small but significant improvement in long-term metabolic control (Weissberg-Benchell et al, 2003; DeVries et al, 2002)  
● Reduction of severe hypoglycaemia (low blood glucose) (Bolde et al, 1999; Bolde et al, 1996)  
● Fewer fluctuations in glycaemic control (Kunt, 2003)  
● Complications stabilise (Aragona et al, 2003)  
● Improved quality of life – patients report improved well-being, and more freedom and flexibility (Bruttomesco et al, 2002; Linkeschova et al, 2002)
Many people dislike being attached to and reliant on a device all the time (Weissberg-Benchell et al, 2003). However, after a few weeks the advantages of pump therapy usually outweigh this concern.

- The cost of a pump is £2,300 and it is guaranteed for at least four years. The consumables (catheters, reservoirs, and batteries) cost about £1,000 a year.
- Insulin pump therapy is not suitable for all patients.

**National Institute for Clinical Excellence guidelines**  NICE (2003) appraised the evidence of insulin pump therapy. It concluded that continuous subcutaneous insulin infusion (CSII or insulin pump therapy) is recommended as an option for people with type 1 diabetes provided that:

- Multiple doses of insulin (MDI) including glargine (a new 24-hour long-acting analogue insulin) have failed;
- Patients receiving the treatment have the commitment and competence to use the therapy effectively;
- Insulin pump therapy is initiated by a specialist team consisting of a physician with a special interest in pump therapy, a diabetes nurse specialist and a dietician specialising in diabetes.

**Failure of MDI therapy**  This is considered to have failed for patients if they cannot maintain HbA1c (glycosylated haemoglobin) below 7.5 per cent without disabling hypoglycaemia occurring. The patient experiences this problem despite a high level of self-care. Disabling hypoglycaemia means the repeated and unpredictable occurrence of hypoglycaemia, which requires third-party assistance. This recurrent problem results in continuing anxiety and has a major adverse effect on quality of life.

These recommendations also apply to children, adolescents and pregnant women for whom MDI therapy is deemed to have failed. NICE does not recommend CSII for people with type 2 diabetes who need insulin therapy.

**Patient criteria**  Patients who are considered for insulin pump therapy must be motivated to improve their diabetes control and have realistic expectations. They will need to learn a new way of managing their diabetes that involves monitoring their blood-glucose levels four times a day and making decisions based on these readings.

**Case study**  Ken Horton was diagnosed with type 1 diabetes 14 years ago when he was 29. He felt restricted in his work as a nightclub owner and his personal life was also affected. He was determined that diabetes was not going to take over his life so most of the time he ignored it. Attendance at a diabetes clinic was sporadic.

Mr Horton became a more regular clinic attender in 2002 because he had not been well for a long time. He had several infections, erectile dysfunction and loss of nerve sensation. He tested his blood-glucose level infrequently because it ranged from 2–25mmol/L and he felt there was little he could do to improve the situation.

His HbA1c was 11 per cent (normal range 4–6.5 per cent). He was seen regularly in the clinic and began to use insulin aspart. He was changed to glargine when it became available. Initially his HbA1c improved from 11.4 per cent to 10.3 per cent to 9.1 per cent but slowly returned to 12 per cent.

In August 2002 Mr Horton stood on a nail, resulting in a puncture wound on his left foot and a plantar ulcer that healed by February 2003. By March 2003 he had an infected ulcer on his right foot and in June his halluc (big toe) was amputated. His HbA1c was 12 per cent and his blood-glucose levels were still varying from 2–20mmol/L. He had lost his warning symptoms of hypoglycaemia.

Insulin pump therapy was discussed with Mr Horton and he was keen to proceed. This was started just after his surgery. He immediately felt much better due to his blood-glucose levels being more consistent. He felt he was in greater control of his diabetes because warning signs for hypoglycaemia had returned and his quality of life improved. When he visited the clinic in September, his HbA1c had fallen to 8.2 per cent, his wound had healed, and his glycaemic control was much better.

**Conclusion**  Insulin pump therapy is slowly being accepted as a treatment option for some patients with type 1 diabetes. There are proven clinical benefits but the most important effect is improved quality of life.