The What, How, Why & Who of Insulin Pumps

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Topics

- WHAT is an insulin pump
- HOW a pump works
- WHY use a pump
- WHO should use a pump
- Pharmac criteria for funded pumps
WHAT
is an insulin pump?
All began back in the 1970s...
Also known as
CSII
Continuous Subcutaneous Insulin Infusion

NOW
WHAT is an insulin pump?

- Small computerised device
- Delivers rapid-acting insulin only
- Delivers insulin 24 hours/day
- in precise amounts (down to 0.025 unit)
- Pre-programme variable delivery rates
- Provides potential to mimic insulin release from healthy pancreas
Pump & “Consumables”

Insulin Pump

Infusion set tubing

Cannula: small tube goes into fat under skin (often in stomach). Held in place with the white adhesive patch.

Disconnect here to take pump off.
Pump user fills cartridge/resevoir with insulin for 3 days (1.8, 2 or 3 ml cartridge/resevoir) and inserts into pump.

Infusion set (line/tubing) - delivers insulin from cartridge/resevoir to cannula.

Cartridge/resevoir and insulin changed by pump user every 3 days.

Cannula infuses insulin into subcutaneous tissue.
Cannula changed by user every 3 days.
Cannula options

 Angled teflon cannula
  • Good for lean people
  • Good for active people
  • Anchors better than 90 degree cannula

 Straight-in 90 degree teflon
  • Easy to insert
  • Good for hard-to-reach sites
  • but “easy in, easy out”

 Straight-in 90 degree metal
  • Won’t kink
  • Good for hard-to-reach sites
  • Alternative to teflon
Manual insertion vs inserting device
Site options
WHAT can a pump do?
Endogenous release of Insulin in person without diabetes

BOLUS secretion – “spurt” of insulin release in response to food
BASAL secretion – constant background insulin to control BG when not eating
- prevents liver release of glucose
Mimicking normal basal bolus release with Multiple Daily Injections

Rapid-acting insulin mimicking endogenous bolus insulin

Long-acting insulin mimicking endogenous basal insulin
Pump has best technology to date to mimic normal basal bolus release

Rapid-acting insulin matching individual insulin requirements via a pump
HOW does a pump mimic basal bolus release of insulin?
HOW the pump delivers basal insulin

- Continuous delivery of rapid-acting insulin 24hrs/day
- Replaces long-acting insulin (eg. Lantus)
- Hourly rate programmed into pump
- 1/20th of hourly rate delivered every 3 mins
- Rate can be varied according to individual requirements
- This mimics normal pancreatic release of basal insulin
Basal Insulin Requirements Can Vary

Perriello, 1991
How the pump delivers BOLUS insulin

- “key in” dose of insulin to - match the carbs (CHO)
  - &/or to ‘correct’ a high BG

Food BOLUS

- calculated using insulin to carb ratio (I:CHO)
  
eg. 1:10 means 1 unit insulin to 10g of CHO

Correction BOLUS

- calculated using Insulin Sensitivity Factor (ISF)
  
eg. ISF 3 means 1 unit insulin drop BG by ~ 3 mmol/L

CARBOHYDRATE COUNTING key to successful pumping
Carb Counting Example

- Flossy’s lunchtime I:CHO is 1:8

- Flossy’s lunch:
  - 2 toast (30g)
  - ½ can spaghetti (20g)
  - cheese (0g)
  - 1 pottle yoghurt (20g)
  - 1 apple (14g)

TOTAL: 84g

84g ÷ 8 = 10.5

☞ Flossy takes 10.5 unit bolus for lunch
Correcting high BGs on a PUMP

To correct high BG on pump:

\[ \text{Current BG} - \text{correction target BG} \]
\[ \text{ISF} \]

eg. Flossy’s BG 3 hrs after lunch is 14.7
Her ISF is 3 and her correction target BG is 7

\[ \text{Current BG 14.7} - \text{target BG 7} = 2.56 \text{ units} \]
\[ \text{ISF 3} \]
From manual to automatic

- Initially Pump-user calculates I:CHO & ISF manually
- Once I:CHO and ISF programmed into the pump:
  - Pump-user enters amount of carbs &/or BG into pump – pump calculates bolus dose
  - Pump accounts for insulin bolus that is still active
  - Pump-user can increase, decrease, or stop insulin delivery as situations demand
- Pumps have continuous glucose monitoring (CGM) capability
However...

- The pump is a tool – only as good as the pt’s ability to use it

- Pumper needs to learn to “think like a pancreas”

- Accurate basal and bolus doses determined through frequent BG testing and recording and analyzing recordsheets

- Requires motivation, perseverance, good record keeping

- Willingness to work closely with diabetes team
Why use a pump?
The PROs

- Can improve BG control
  - improve hypo awareness
  - prevent / reduce / reverse complications
- Improve quality of life
- Greater lifestyle flexibility
  - skip or delay meals
  - exercise
- Very helpful for children and adults on very small insulin doses
- Has potential to mimic insulin release from a healthy pancreas
The CONS

- Steep learning curve: weeks to months
- Attached to pump 24hrs/day
- Risk of site infections
- Increase risk of DKA
- Frequent BG monitoring, recording & analyzing recordsheets
- NOT suitable for all Type 1s
- Improved BG control NOT guaranteed – can do just as badly on pump!
Pump Myths

- Not an artificial pancreas
- Does not eliminate need to test BG levels
- Does not know how much insulin is needed
- Does not know when the user’s insulin requirements change eg. exercise or stress
WHO
is suitable / eligible for a Pharmac funded pump?
PRE REQUISITES:

- Type 1 diabetes > 6 months
- on basal bolus insulin regimen via injections for ≥ 6/12
- carbohydrate counting
- under the care of a diabetes MDT
Pharmac CRITERIA:

If meet pre-requisites and suitable for pump, Diabetes Consultant or NP applies to PHARMAC under one of these criteria:

1. **HbA1c**
   Pump will improve HbA1c by at least 10mmol/mol (1%)

Or

2. **Recurrent Severe Hypoglycaemia**
   Pump expected to significantly reduce the number of severe hypos

Or

3. **Other**
   eg. hypo unawareness or dawn phenomena
Special Authority (SA)

- if approved – patient issued with SA number for pump consumables

- initial SA valid for 9 months, then every 2 years

- PHARMAC renew SA if patient meets criteria
  - 3 post-pump HbA1cs are $\leq 10$mmol/L than pre-pump Hba1cs
  - or $\geq 50\%$ reduction in severe hypos

- Entitles patient to prescription for 3 mnth supply of consumables
  - Can be written by GPs
The ideal pump candidate

- Motivated
- Realistic goals
- Intellectual ability to operate the pump
- Test & record BGs frequently
- Ability to analyze recordsheets
- Carbohydrate Counting
Patients who do well on pumps

- Somewhat obsessive
- Tech savvy
- Can think like a pancreas
- Proficient with carb counting
- Ability to analyze and troubleshoot
- Ability to self manage
Patients who don’t do well on pumps

- False or unrealistic expectations of a pump
- Don’t monitor BG levels
- Poor understanding of diabetes and insulin
- Not carb counting
- Lack formal pump education
- Lack support
Pharmac Funded Pump Brands

Animas

Medtronic
Tips for working with Pumpers in Primary Care

- Patient should be self-managing pump
- Refer back to secondary care if frequent hypos or high HbA1c or pump-related problems
- Check sites for lipohypertrophy
- Remind patient to:
  - Carry a back-up kit
  - Have a Back-up Plan
  - Record expiry date of Special Authority
Back-up Plan

- Pump failure can happen any time
- Civil emergency can happen any time
- Need to **be prepared** to convert back to MDI

**To Convert back to MDI:**
- Long-acting insulin dose will be:
  - = current **total daily basal dose**
  - = or pre-pump Lantus dose

- Rapid-acting insulin dose will be:
  - = current **I:CHO & ISF ratios**
  - = or pre-pump ratios
Back-up Kit

- Short acting insulin
- syringe / pen
- cartridge & infusion set
- Cleansing agent
- Ketone meter & test strips
- Long acting insulin (if away overnight)
- Spare batteries for pump & BG meter
- Up-to-date list of total daily basal dose and ratios
Key points

- Pump is a great tool - but not artificial intelligence or artificial pancreas!
- Can provide greater flexibility of diet & lifestyle
- Can improve glycaemic control
- Not suitable for all Type 1 patients
- Requires hard work, commitment, IQ
- Pharmac criteria for initial funding:
  1. HbA1c
  2. Severe Hypos
  3. Other
- Pt must demonstrate benefit to receive ongoing funding
Any Questions?