Automated insulin delivery in Type 1 diabetes

The Experience To Date
Medical Perspective – the Private System

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Talk outline

- **The nature of private practice**
- **The Patients**
- **The Clinicians and Staff**
- **The Devices**
- **The Risks**
- **The Funding**


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Private Practices can be very heterogeneous

- **Urban vs Rural**
  Metropolitan vs Outer Metropolitan vs Regional vs Rural

- **Clinician work arrangement**
  Part time vs Full time
  Private alone vs Public + Private

- **Allied health**
  On-site vs off-site
  Casual vs highly connected

- **Commitment: time and financial**

Patient

- **Profile characteristics**
  Higher education, SES, numeracy skills
  technologically savvy
  results driven

- **Referral ‘pressure’**
  ‘I selected you’ or ‘you were selected for me’ !

- **Skill set expectation**

Clinician - Endocrinologist

Provision for skills acquisition to deliver optimal care

Plan for enhanced training

Local closed loop expert team (public hospital)

Local allied health experts

Conferences

New insulin pump workshops (e.g. Australian Diabetes Society)

Device company (representatives, dinner meetings, workshops, webinars)

Evidence for enhanced training

Consider display (certificate, website)

Accreditation for enhanced training?

Clinician - Endocrinologist

Provision for infrastructure to deliver optimal care

Technology setup:

computer software, device upload, remote access (VPN)

Allied Heath team: Diabetes Educator/Nurse practitioner, Dietitian

Secretarial staff briefed

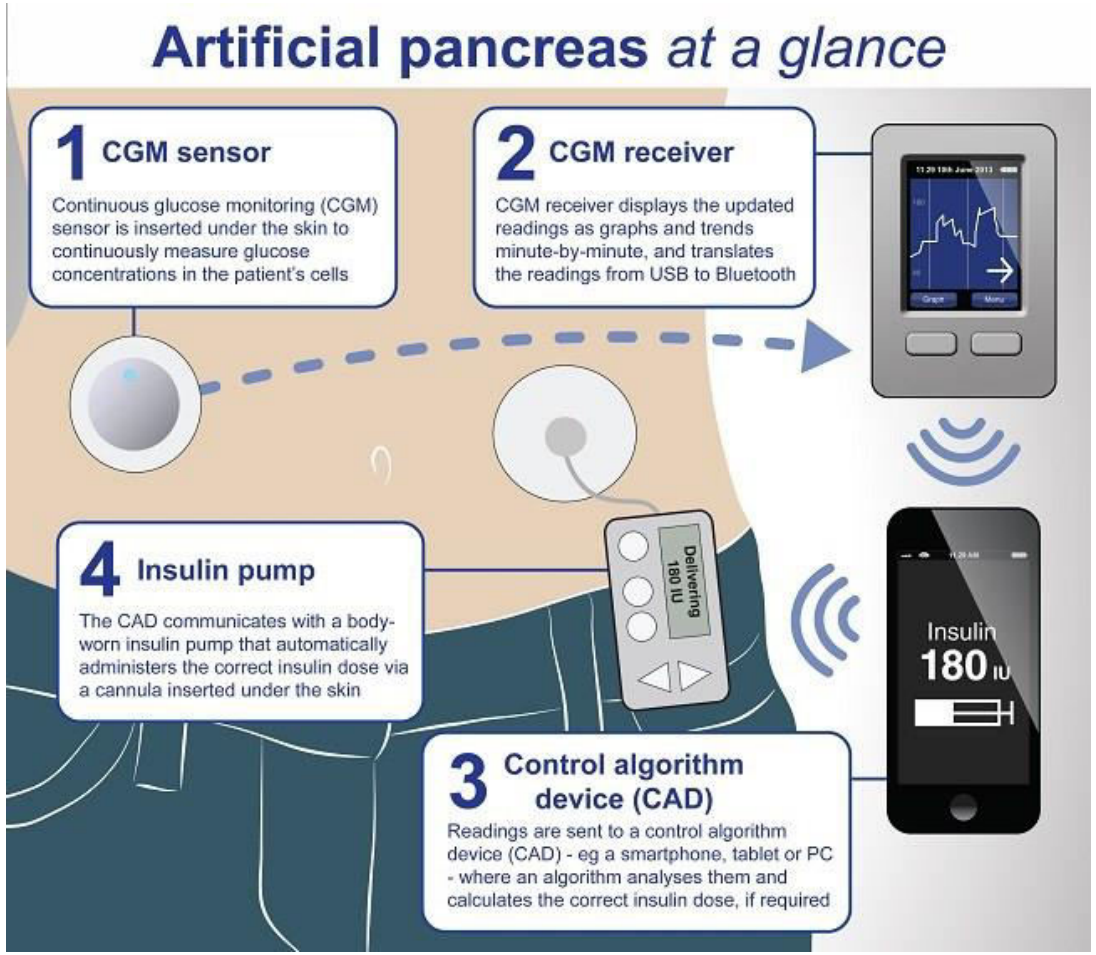
Device company assistance

Web or written resources

The ‘3 As’ of private practice still apply to insulin pump practice in private!

- Availability
- Affability
- Ability

Device variety: Automated insulin pumps



Medtronic 670G

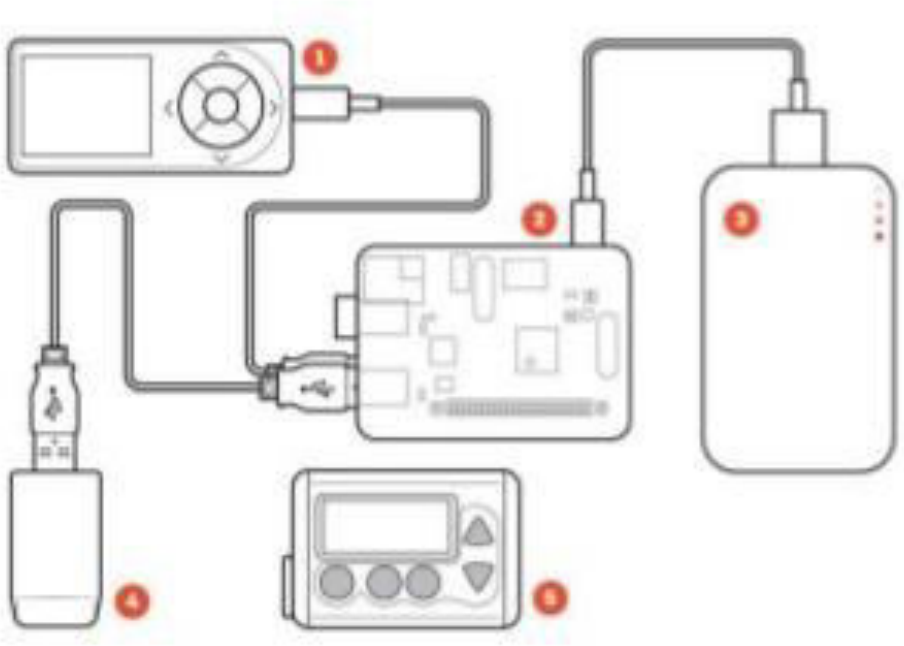
AMSL T-slim X2

omnipod HORIZON
AUTOMATED GLUCOSE CONTROL

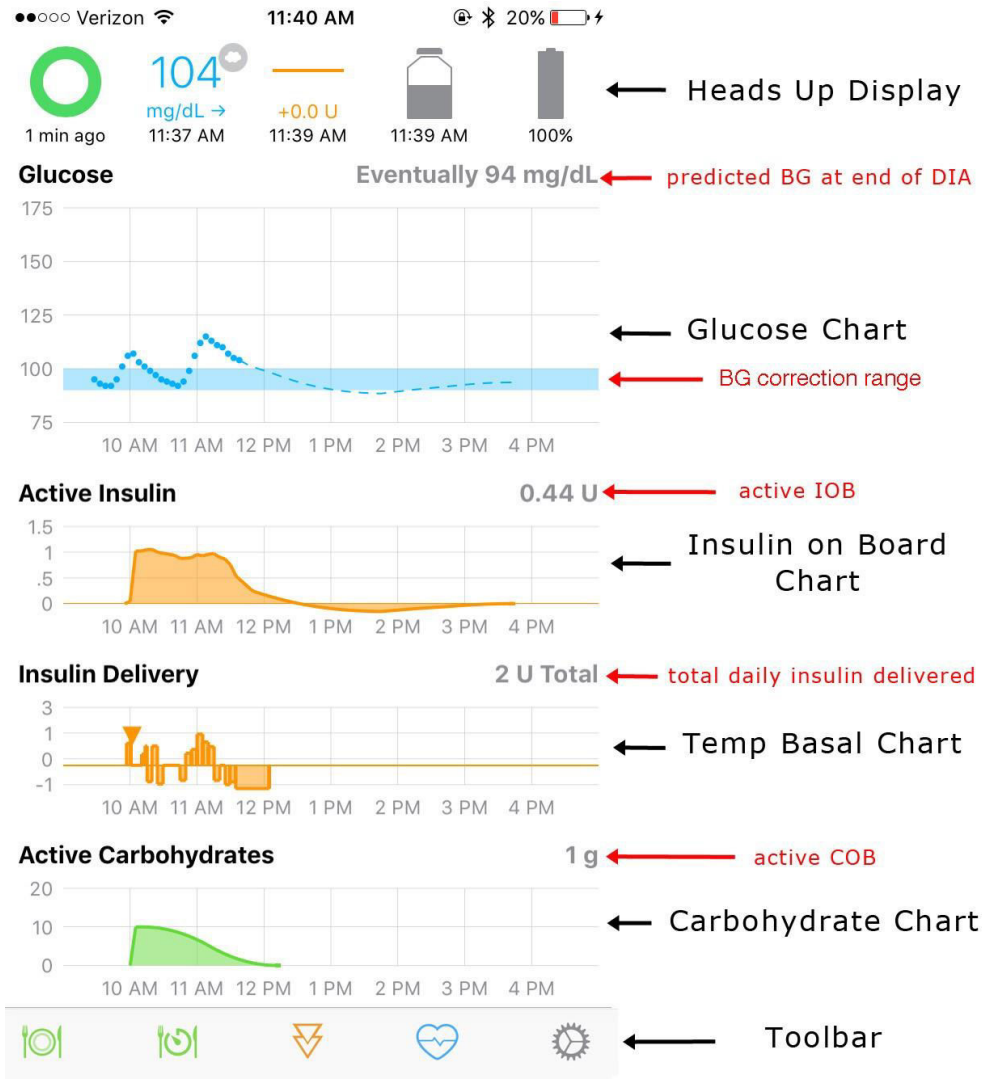
Omnipod horizon

Islet

Components of open source DIY automated insulin delivery



1. Continuous glucose monitor
2. Small computer (“controller”)
3. Battery
4. Radio stick (“translator”)
5. Insulin pump



Automated insulin delivery devices: comparison

	Medtronic 670G	Open-source DIY closed loop	Future: T-Slim X2 Omnipod et al
Device	Colour screen	Monochrome	Colour
Sensor	iPro2	Dexcom	Dexcom
Algorithm	Closed source no bolus	Multiple Open source bolus Open source no bolus	
Software	Carelink	Variable	Diasend
Data upload **Clinician friendly**	++	±	+
Patient tech savviness	Moderate	High	Moderate
Risk	Less RCT Evidence Formal road testing	Higher	

Automotive industry parallels

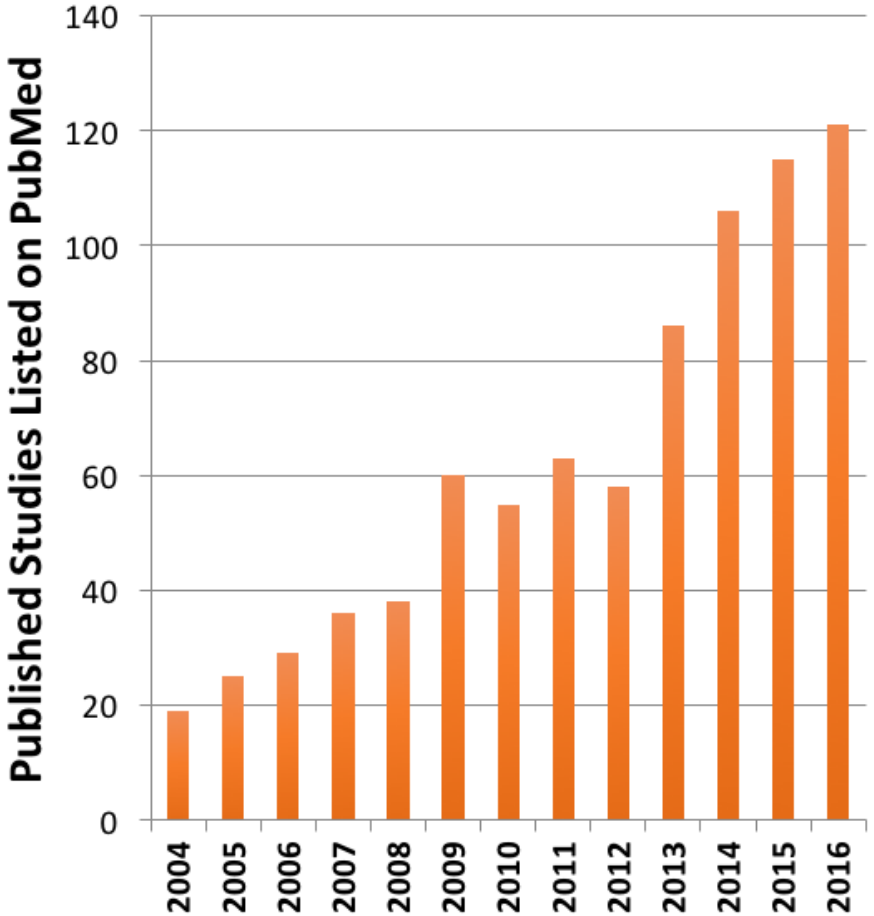
Manual

Auto

Driverless

A machine for every person and situation

Automated insulin delivery research is accelerating: multiple devices reported in the literature



Automated insulin delivery research is accelerating: very little EBM for open-source DIY pumps

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Real-World Use of Open Source Artificial Pancreas Systems

Dana Lewis[1], Scott Leibrand[1], and the #OpenAPS Community

Keywords
artificial pancreas, APS, OpenAPS, #WeAreNotWaiting, closed loop, DIY diabetes technology

Patient-designed and -driven research on hybrid closed loop was presented with outcomes on par with traditional closed loop studies at American Diabetes Association Scientific Sessions.

The #OpenAPS community (as of July 2016) consists of more than 100 individuals worldwide who self-built hybrid closed loop systems by pairing small computing hardware, open source software (OpenAPS), and existing diabetes devices (continuous glucose monitors [CGMs] and older insulin pumps). The community has used these systems in the real world for more than 250 000 hours at the time of this letter to the editor.

OpenAPS has been far safer than standard pump/CGM therapy, as measured by duration of hypoglycemia and hyperglycemia, with no reports of severe hypo- or hyperglycemic events. It has allowed patients and caregivers remarkable improvements in quality of life due to increased time in range, uninterrupted sleep, and peace of mind. OpenAPS users (18 respondents of the first 40 users, 67% male, 61% adults, median 27 years old, 15 years with diabetes, 10 years on pump, 3 years on CGM) were surveyed on quantitative and qualitative measures of their experience using their self-built artificial pancreas systems (APSs). While using OpenAPS, self-reported median HbA1c dropped from 7.1% to 6.2%, and median percent time in range (80-180 mg/dL) increased from 58% to 81%. All but one respondent reported some improvement in sleep quality, and 56% reported a large improvement. Users cautioned that APS cannot be considered a "technological cure," but were extremely satisfied with the "life-changing" improvements associated with using an APS. These experiences are instructive for what patients can expect from commercial APS when they become available, and can help health care providers be prepared to set patients' expectations properly.

pleasant surprise at the comparability of results between the 2 systems.

The number of patients interested in directly improving diabetes technology is growing, and the scientific community should be challenging itself to find new ways to engage patients as researchers and designers, rather than solely as passive recipients of care. We challenge readers to find ways to engage patients in the design and at every stage of your research and product development, including in immediate sharing of results from research, and encouraging submission of patient-designed research to journals and for presentation at academic and scientific conferences. The patient community has valuable insight, data, and experiences that can help everyone (device manufacturers, health care providers, and patients) to build better tools to better manage life with diabetes.

Abbreviations

AP, artificial pancreas; APS, artificial pancreas system; CGM, continuous glucose monitor; OpenAPS, open source artificial pancreas system.

Acknowledgments

OpenAPS would not be possible without years of work by Ben West and dozens of other contributors to the open source, DIY "#WeAreNotWaiting" diabetes community. Thanks to each and every person who has contributed. Thank you to the dozens of #OpenAPS community "loopers" who have donated their data and experiences of living with DIY closed loops.

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The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Pre and post observational study
n=18

HbA1c: 7.1% to 6.2%
TIR (4.4-10mmol/L): 51% to 81%

Risk management

- **Technological pitfalls**

  670G – CGM

  algorithm limitations for marked acute hyperglycaemia with steroids & illness (relevant hospitalisation)

  DIY – transmitter, CGM, algorithm

- **Documentation**

  Detailed, Ensuring all relevant parties cc'ed,

  need for standardised report?

- **Contact allied health team and pump experts/researchers**

Commitment

- Professional training
- Time: in (often double consult time) and outside consult
- Financial: MBS 14221 pump download
- Recognition that these are very different devices which now present unique opportunities and challenges
- Clinician ‘agility and flexibility’ (applies to most technology in medicine)
- TEAMWORK

Thank you – comments welcome

TEAMWORK

‘Talent wins games, but teamwork and intelligence win championships’ *Michael Jordan*

‘Alone we can do so little, together we can do so much’ *Helen Keller*

‘As iron sharpens iron, so one person sharpens another‘ *Proverbs 27:17*