hacking type one diabetes

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Goal:

Find people to work on diabetes-related software and hardware problems

This session:

- Some background (diabetes, current treatment)
- Continous Glucose Monitoring
  (what, how, hack value)
- OpenAPS - the artificial pancreas

⚠ WARNING ⚠

- Know what you're doing
- Don't trust technology
- Double-check your data
- Do not mess with other peoples health!

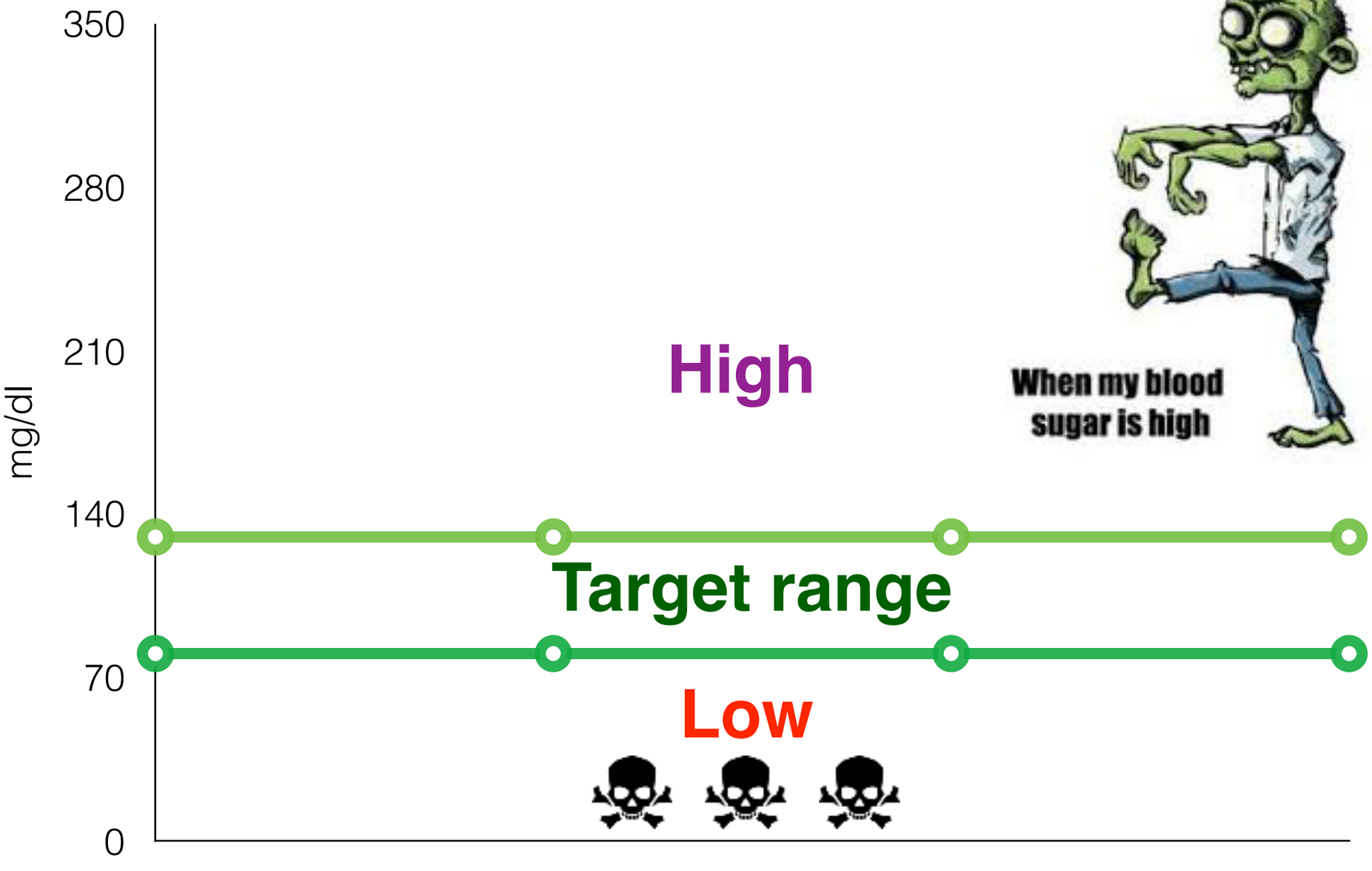
Diabetes…
"I know what you're talking about"
(maybe not?)

- Type 2: Insuline resistance. *Might* be managed with lifestyle change.

- Type 1: Auto immune disease. Pancreas stopped making insulin. *Requires* insulin injections to control blood glucose levels.

- 7% of adults have diabetes. 10% of these T1D. (There might be 84 T1D attending 33C3.)

Type 1 Therapy: Manage BGL



High Maintenance

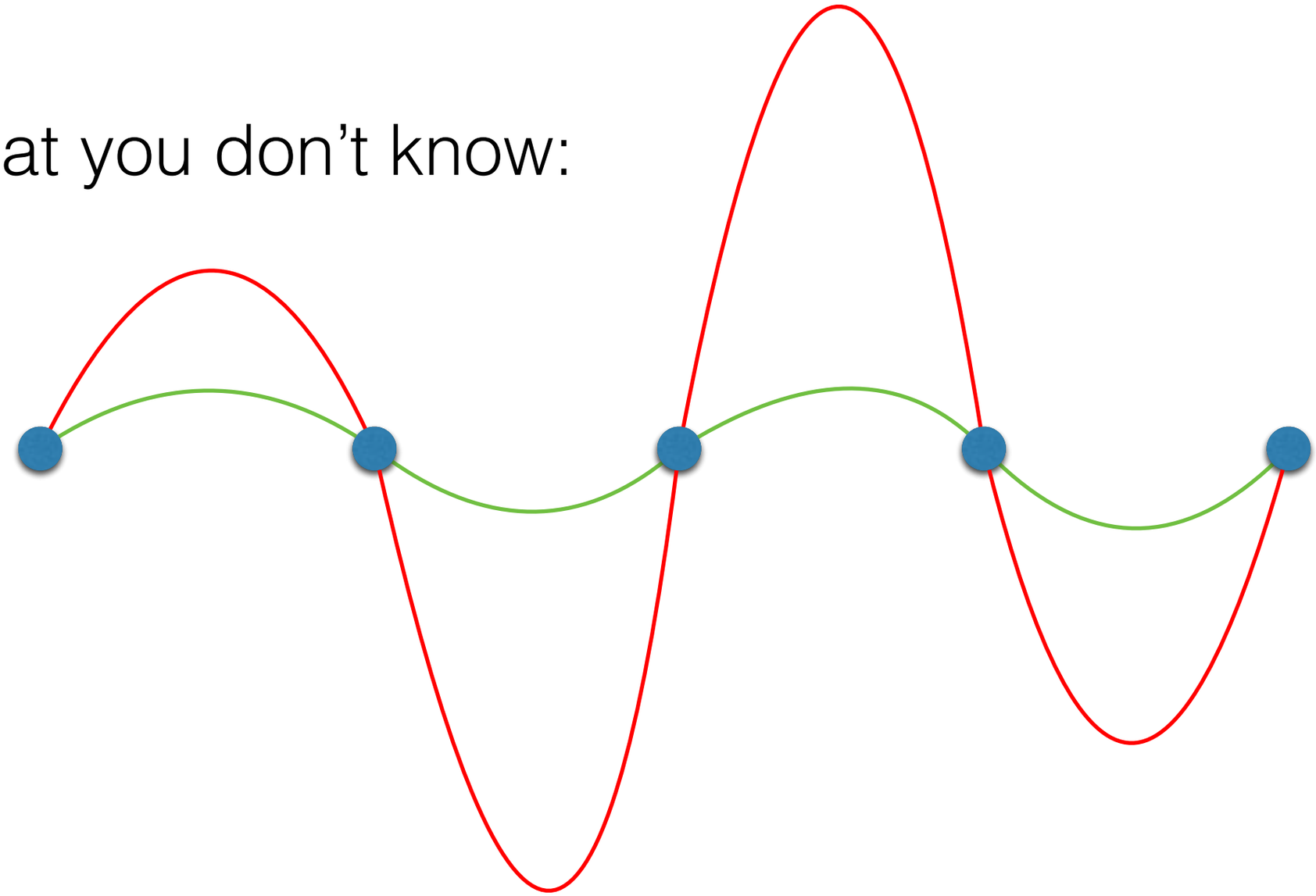
- Multiple blood glucose checks (morning, night, meals, …) —> 5-10 / day
- Multiple insulin injections to control blood glucose levels —> 4-8 / day
- Insulin pumps are available
- Calculating, counting, estimating all the parameters: Current BGL, BGL trend, insulin sensitivity, carbohydrates, physical activity, sickness, …

Blood glucose check:

What you see:

Blood glucose check:

What you don’t know:



Enter Continous Glucose Monitoring (CGM)

Measurement every 3-5 minutes —> Σ480/day

★ Trend information! Alerts! ★

Components:

1. Sensor: tiny wire measuring glucose level
2. Transmitter: sending data
3. Receiver: analysing + displaying data

Continous Glucose Monitoring: Issues

- measured value: t+15min
- sensor reliability decreasing over time
- regular calibrations necessary
- my data should be freely accessible - everywhere and in realtime! (no, USB + Windows Tool is not a solution…)

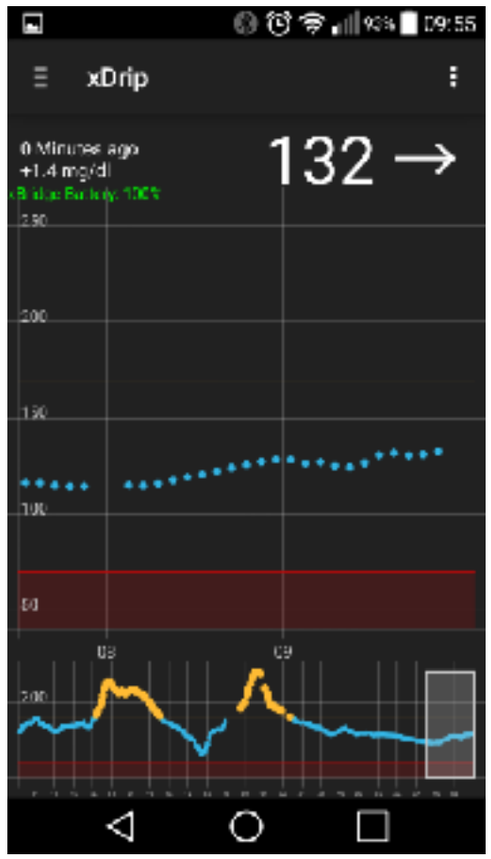
Dexcom

- G4 Sensor + Transmitter: 2.4Ghz -> Receiver
  - Sensor: 1 week / 80 €
  - Transmitter: 6-12 months / 300 €
- G5: Bluetooth LE
  - reduces transmitter life time
  - reliability (?)

Freestyle Libre

- “Flash Glucose monitoring” (data pulled from sensor)
- Sensor lasts up to 14 days
- great: some health insurances pay the costs
- not so great: the glue
- no alerts!

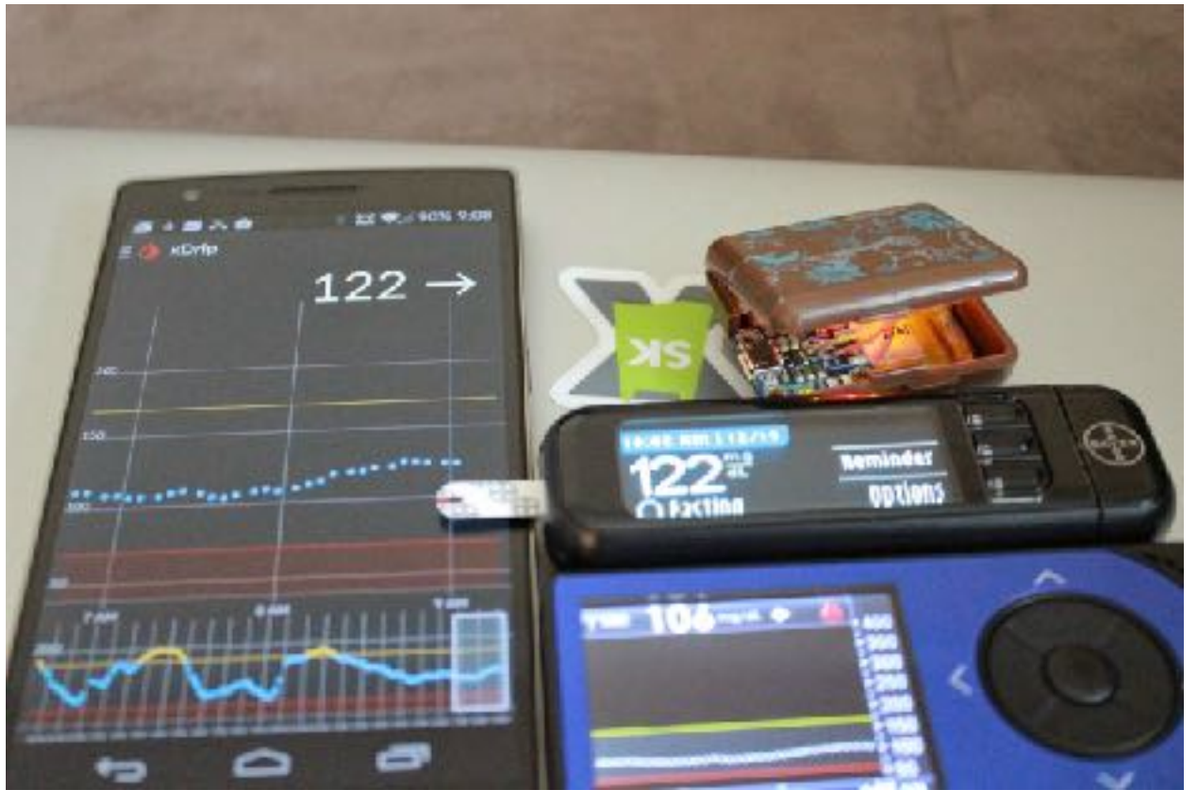
What has been done?



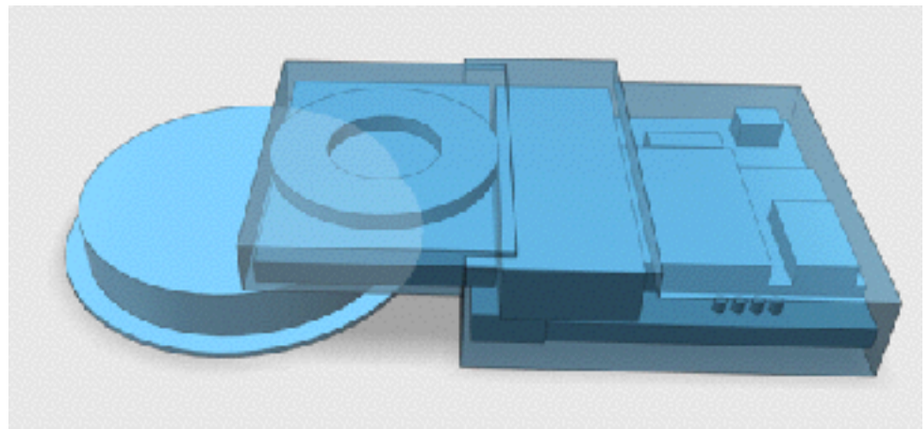
NIGHTSCOUT
#WeAreNotWaiting

What has been done?

- xDrip: open algorithm to analyse Dexcom data
- Dexcom g4 + xDripKit + Android = $PROFIT
- “CGM in the Cloud” - data + alerts for other people (PARENTS, Partners)
- xDrip + Pebble (RIP) = <3 <3 <3

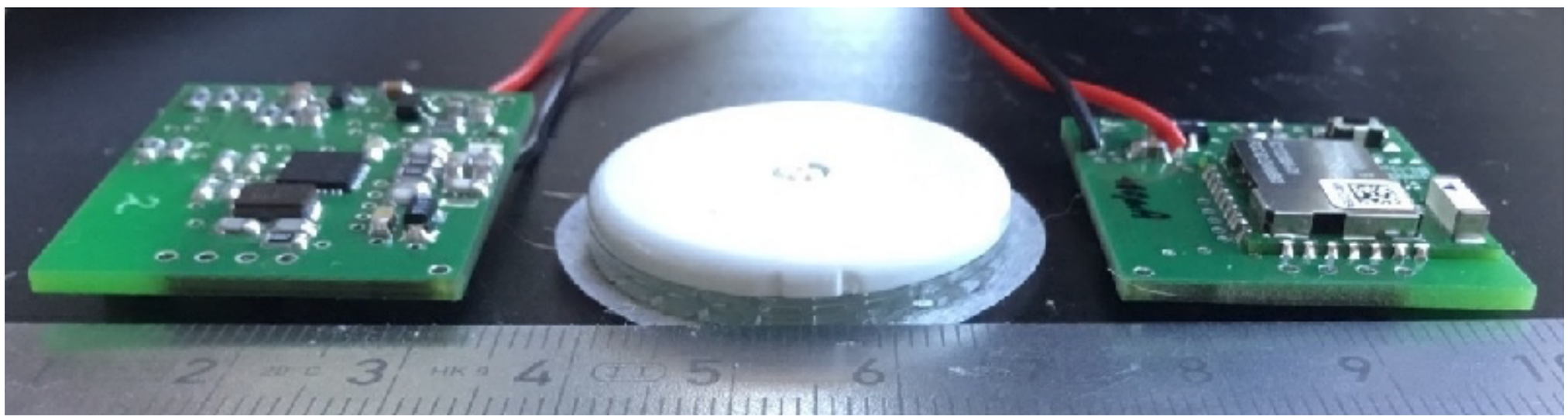


What has been done?
Freestyle Libre



- BlueReader by Sandra Keßler: NFC->Bluetooth LE bridge
  https://www.startnext.com/bluereader

- automatic alerts via xDrip



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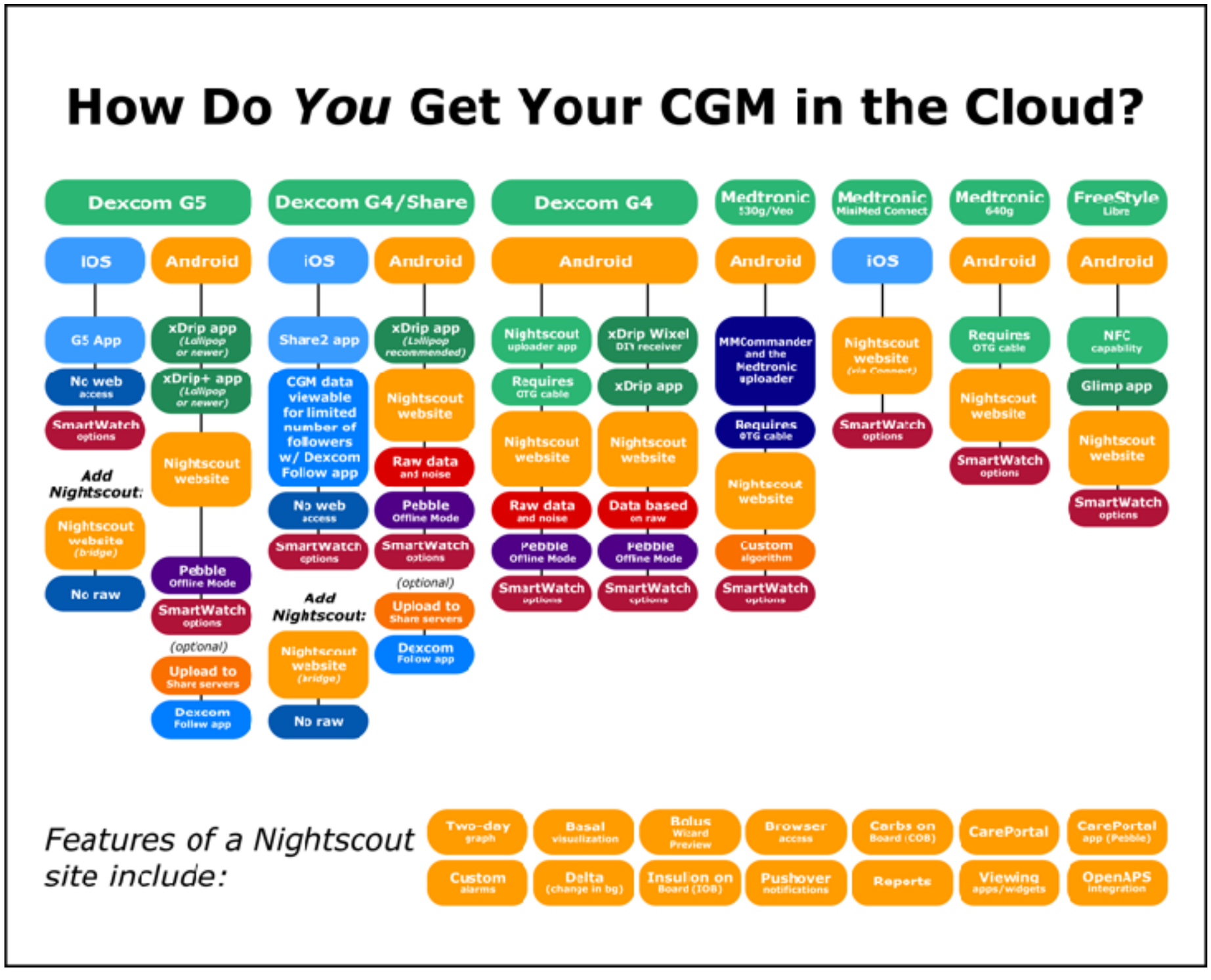


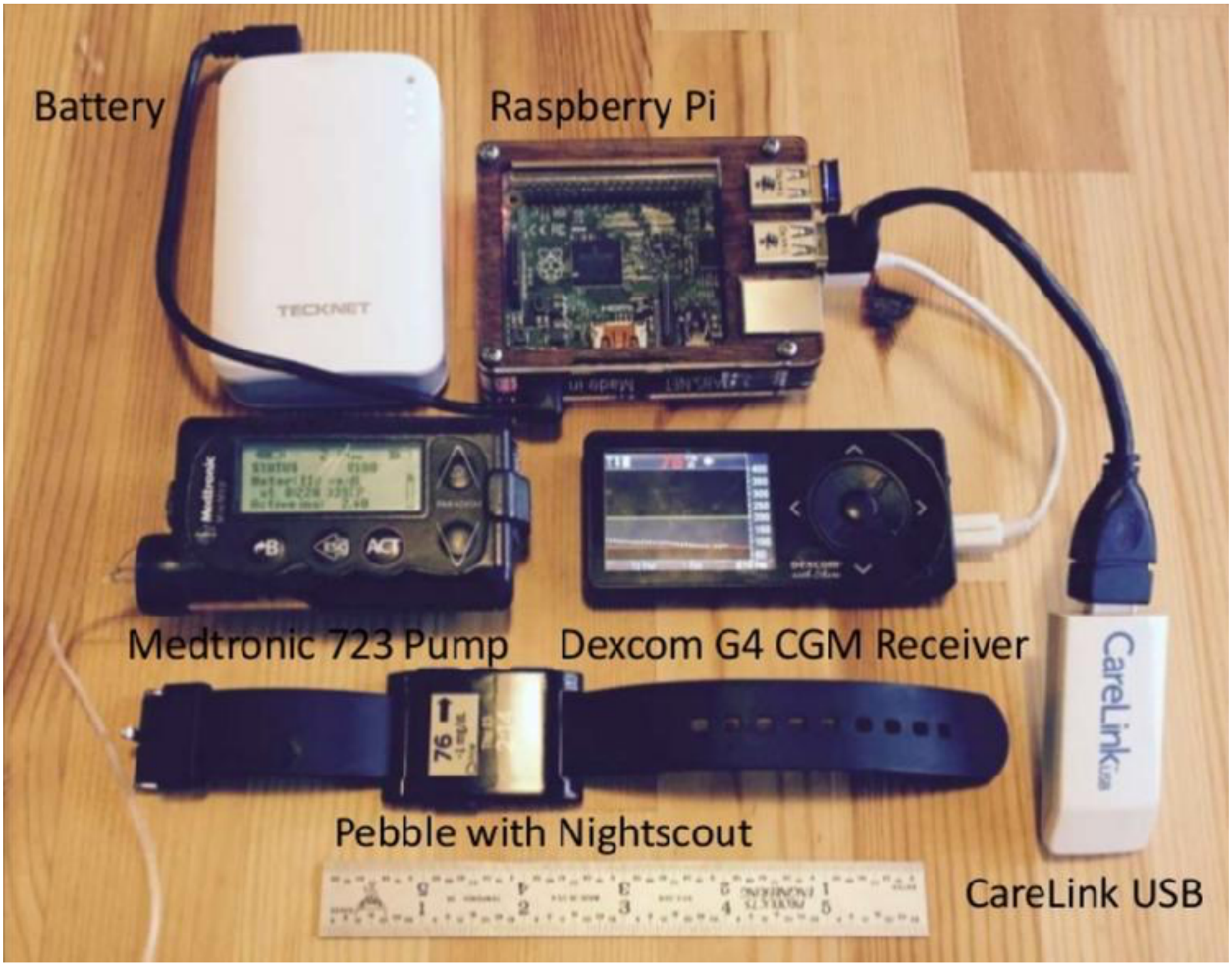
Issues

- too many devices to carry, power management is hard
- mobile phone (~1 day), another mobile phone (~1 day), xDrip (~2 days), Smart Watch (1-7 days), Commercial CGM receiver as Backup, Powerbank…

The next step….

- We know the blood sugar level
- there are pumps to dispense insulin

Open Artificial Pancreas System (OpenAPS)

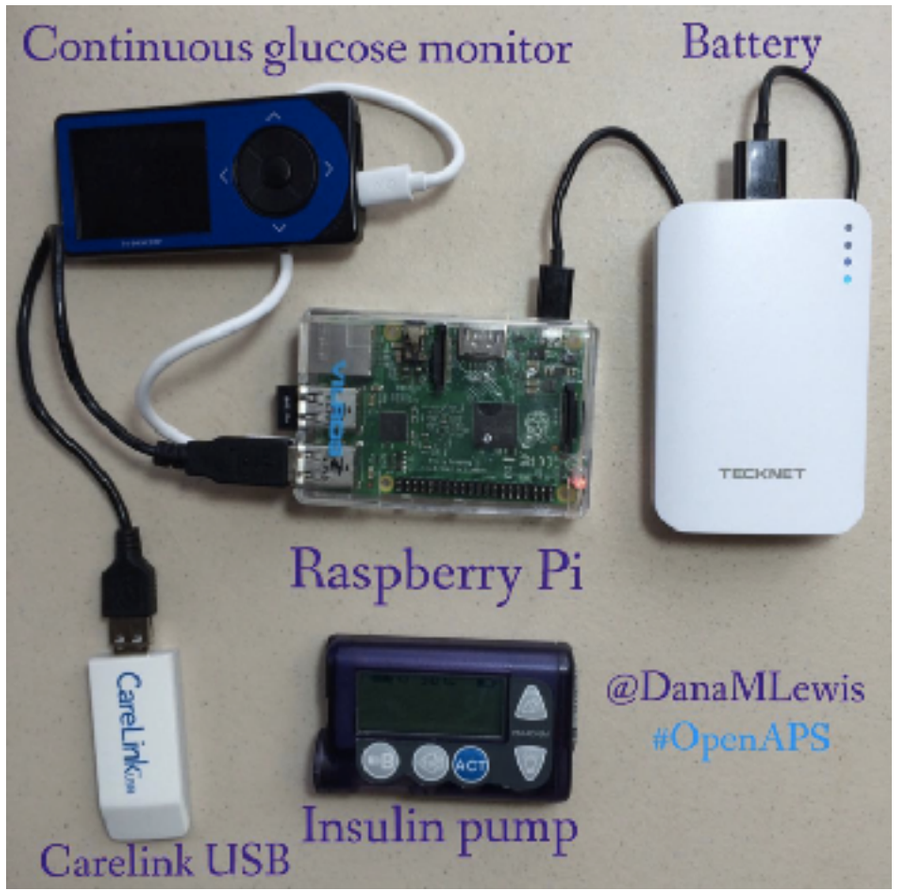


Closed Loop in Action

[Ali Mazaheri]

OpenAPS

- Dana M. Lewis + Scott Leibrand, http://openaps.org
- CGM + insulin pump + X = Closed Loop
- only possible with old medtronic insulin pumps
- new firmware locks wireless access



Hacking opportunities

- extract old Medtronic firmware, flash onto new Medtronics pumps

- xDrip App on iOS (and Apple Watch). Let's build a free iOS App (BLE)

- German problem: coverage by health insurance. Insurance "owns" the pump.

- Let's build our own pump. It's just a pump, isn't it?

Questions / discussion

- $YOUR_IDEA_HERE

- Contact: @nahoernsiemal / @dysternis