

OpenAPS

the open source artificial pancreas system

+

DIY Diabetes

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You
never
leave
the
car

Your permanent reality:

Learn to use this
really well,



and sometimes
you get to
focus on this.

It's up to you

how often you check the speedometer

how often you make adjustments

whether you drive on dangerous roads

how you drive



I'm doing my best
to drive this car

What could this car be doing
to make my drive easier?



I don't know how to hotwire a car
I don't have time to learn to hotwire a car
I don't want to damage my car



Why OpenAPS

What it's like to use OpenAPS

What OpenAPS is for

What DIY Diabetes is for

Why OpenAPS

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What OpenAPS is for

What DIY Diabetes is for

Feedback loop



Reality



Ideal

Nightscout + Dexcom



Nightscout + Medtronic



nah, not for me

Feedback loop



Reality



Ideal

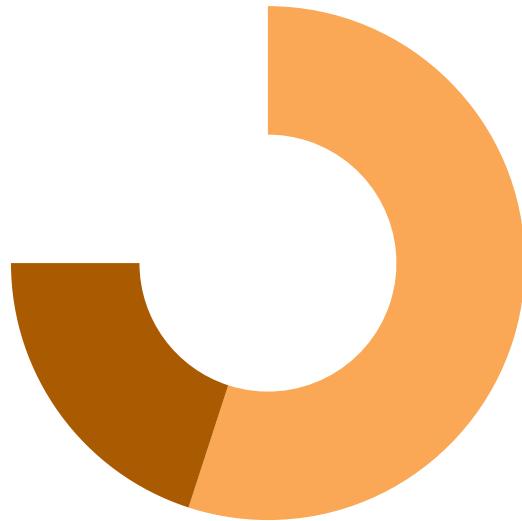


Nightscout for Medtronic *using RileyLink*

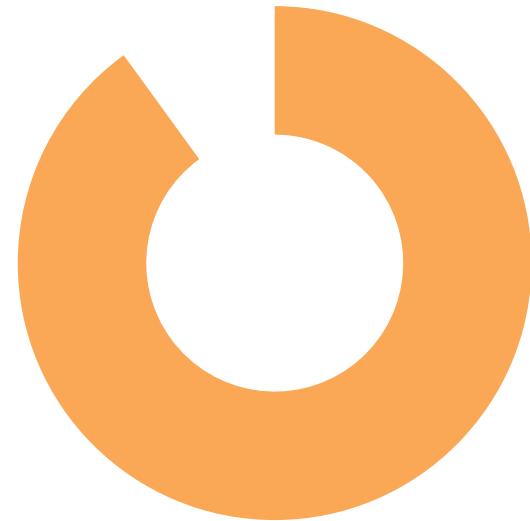


<https://github.com/ps2/rileylink>

Feedback loop



Reality



Ideal



graph of last 3 hours

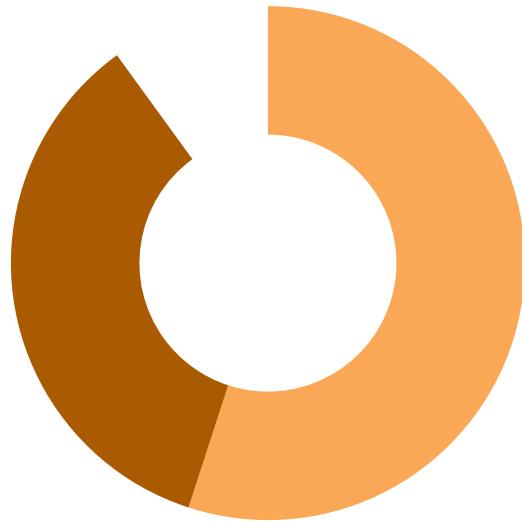


insulin on board

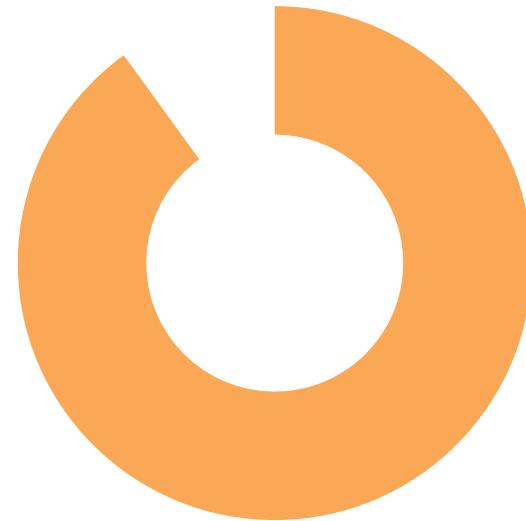


<https://github.com/mddub/nightscout-osx-menubar>
<https://github.com/mddub/urchin-cgm>

Feedback loop



Reality



Ideal

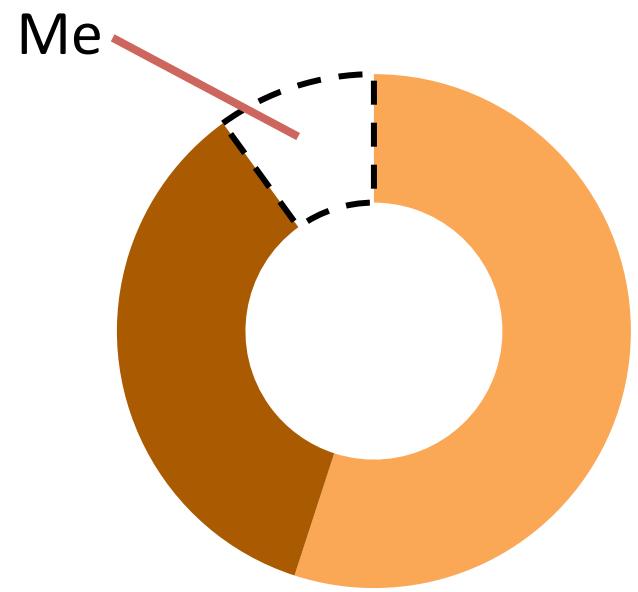
OpenAPS



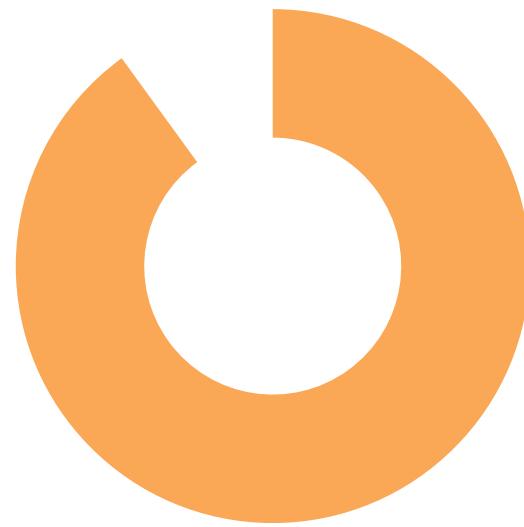
nah, not for me



Feedback loop

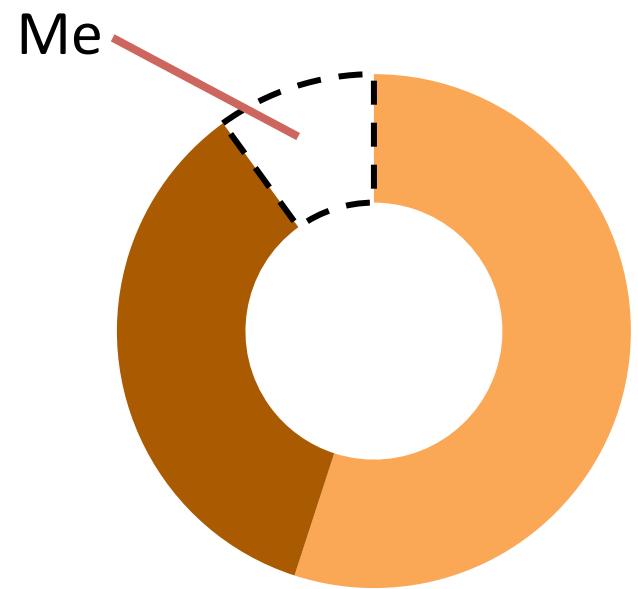


Reality

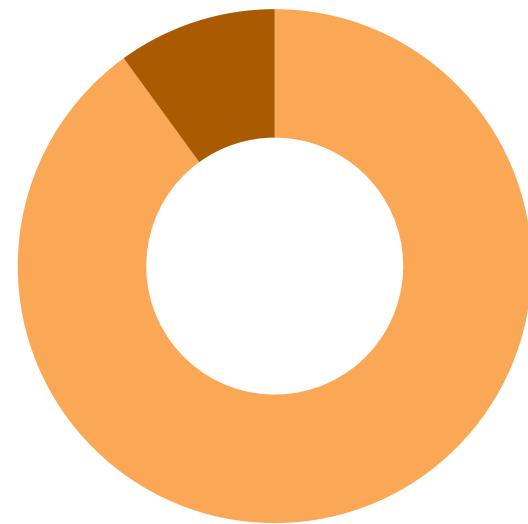


Ideal

Feedback loop



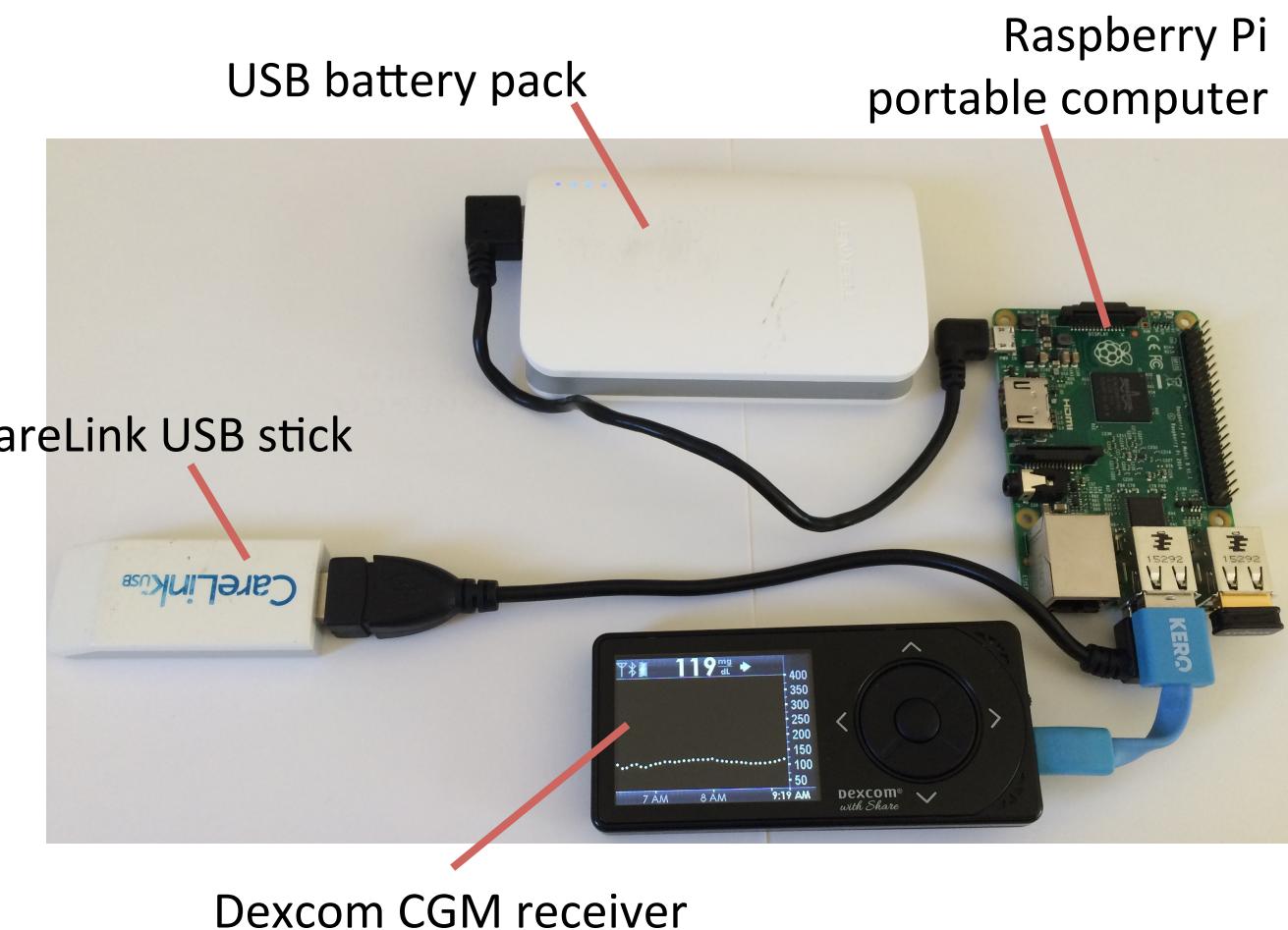
Reality



Ideal

loop (v):

to use a closed feedback loop artificial pancreas



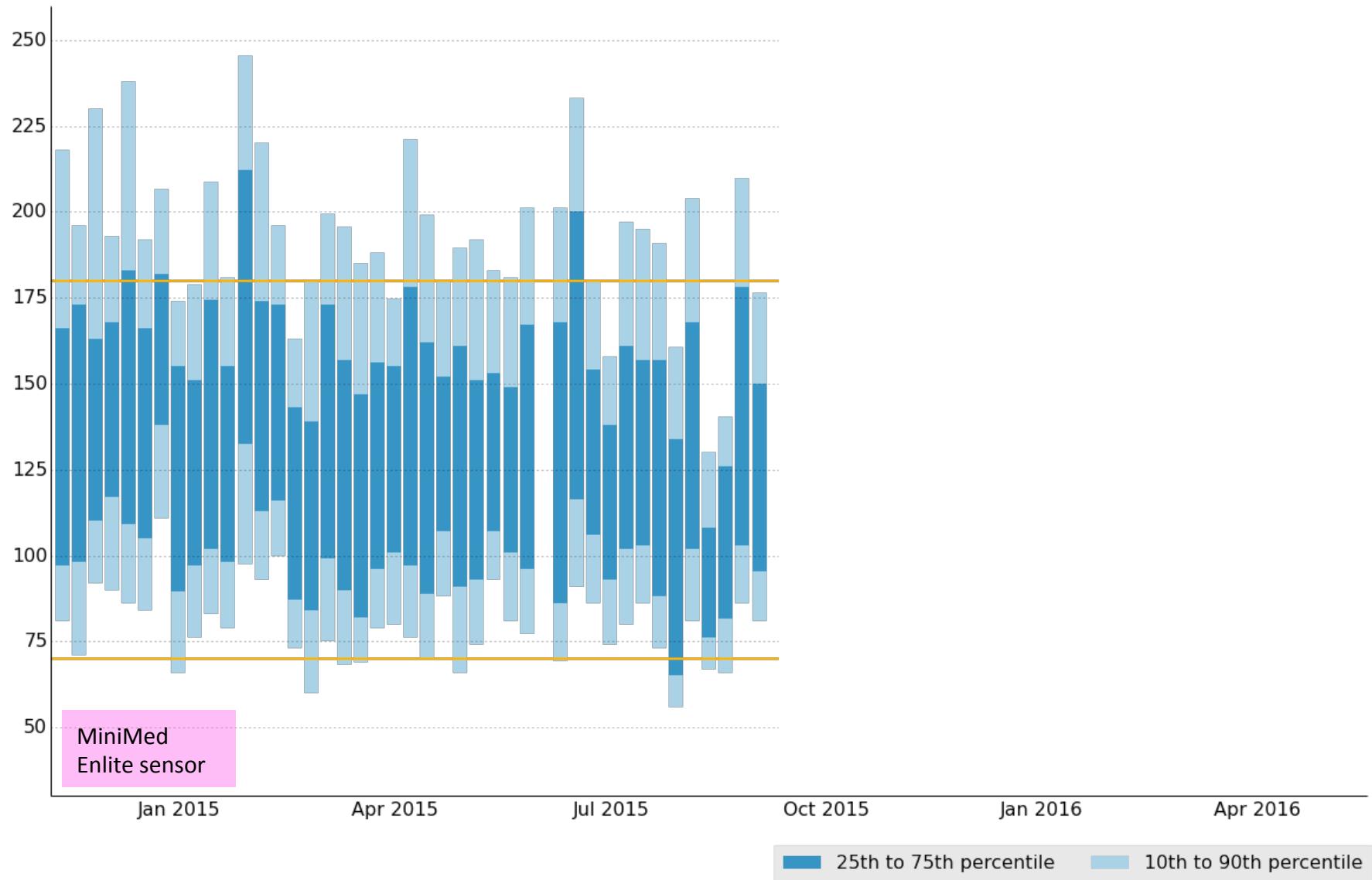
Why OpenAPS

What it's like to use OpenAPS

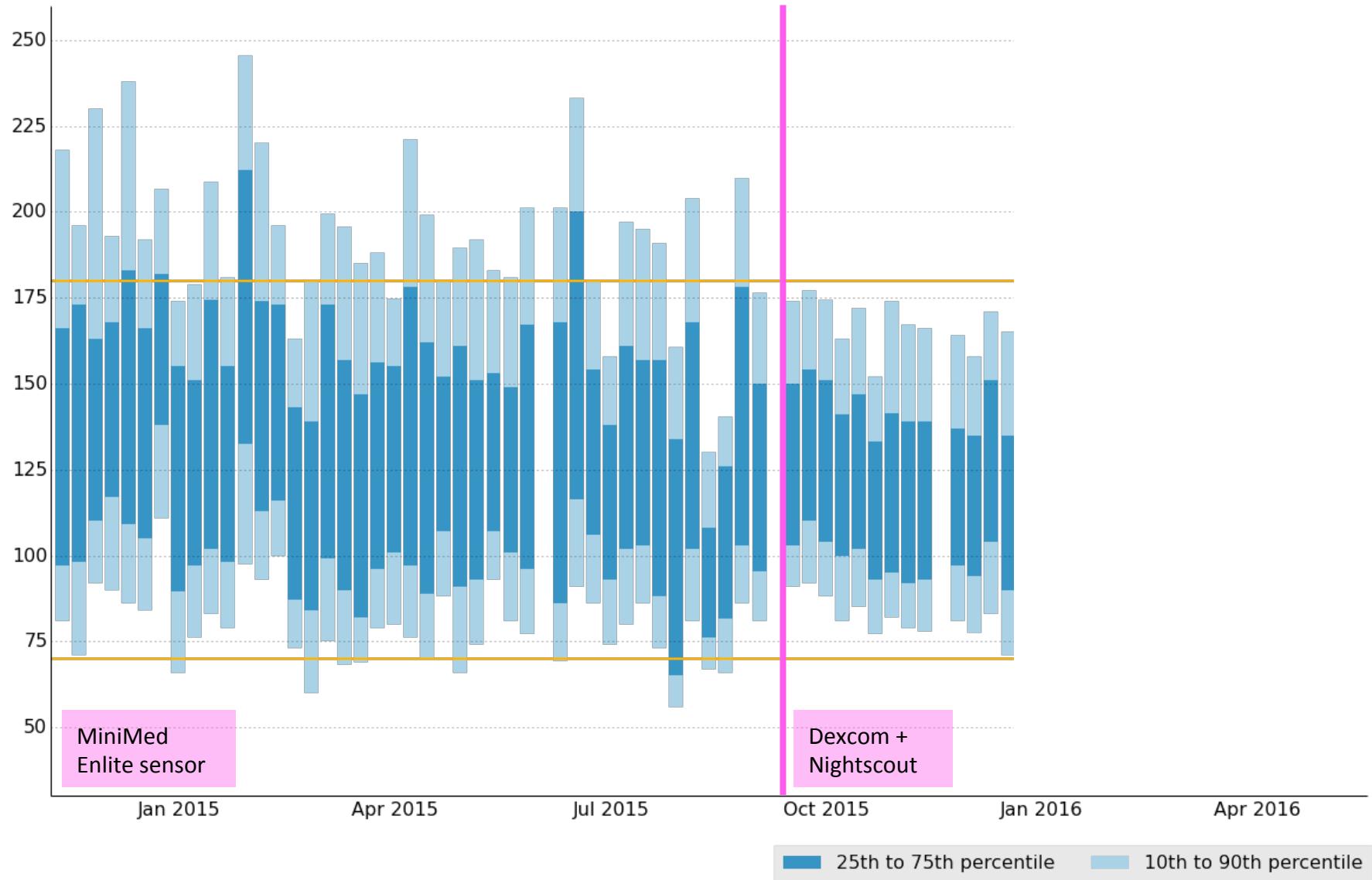
What OpenAPS is for

What DIY Diabetes is for

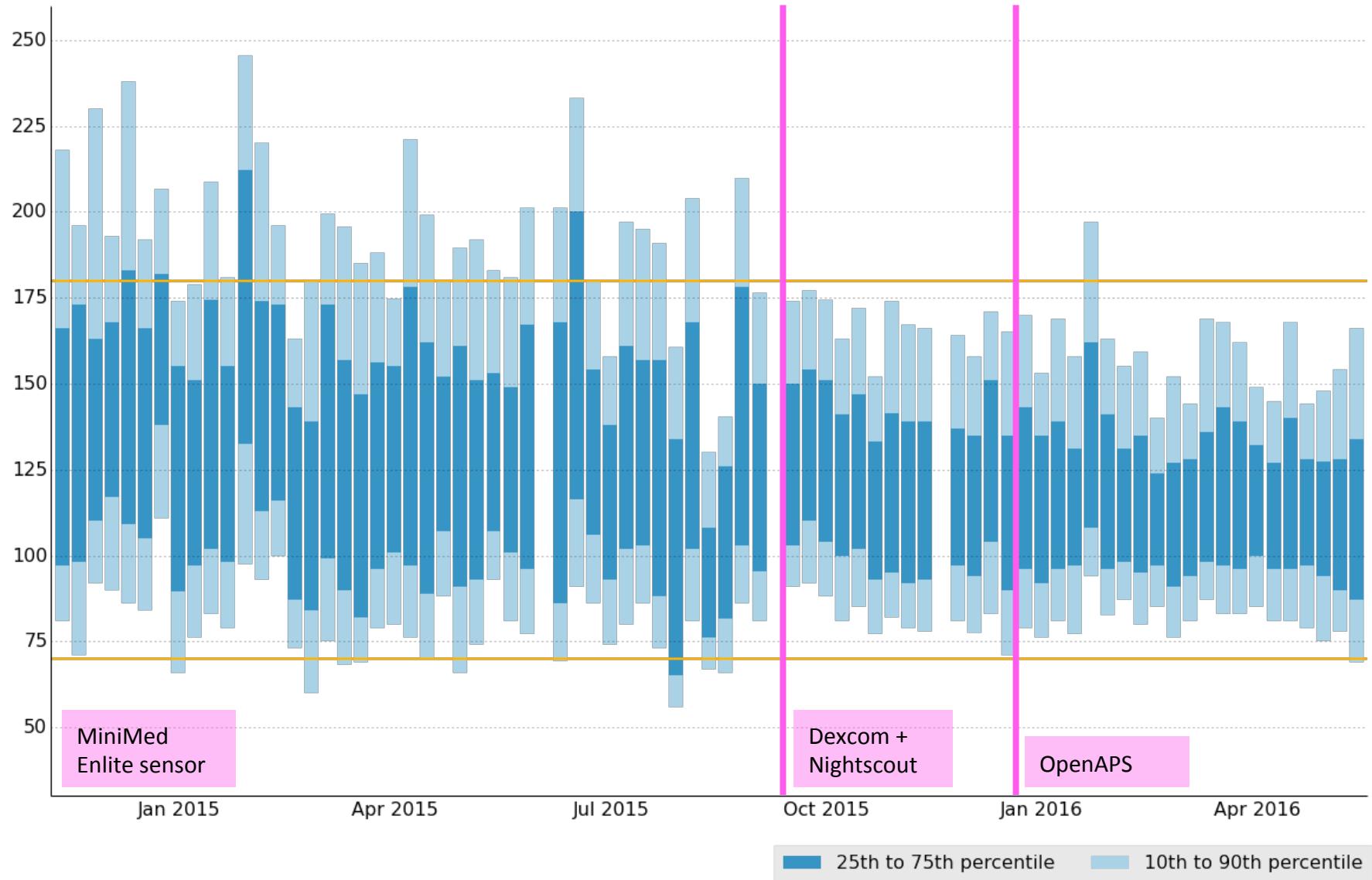
CGM distribution by week



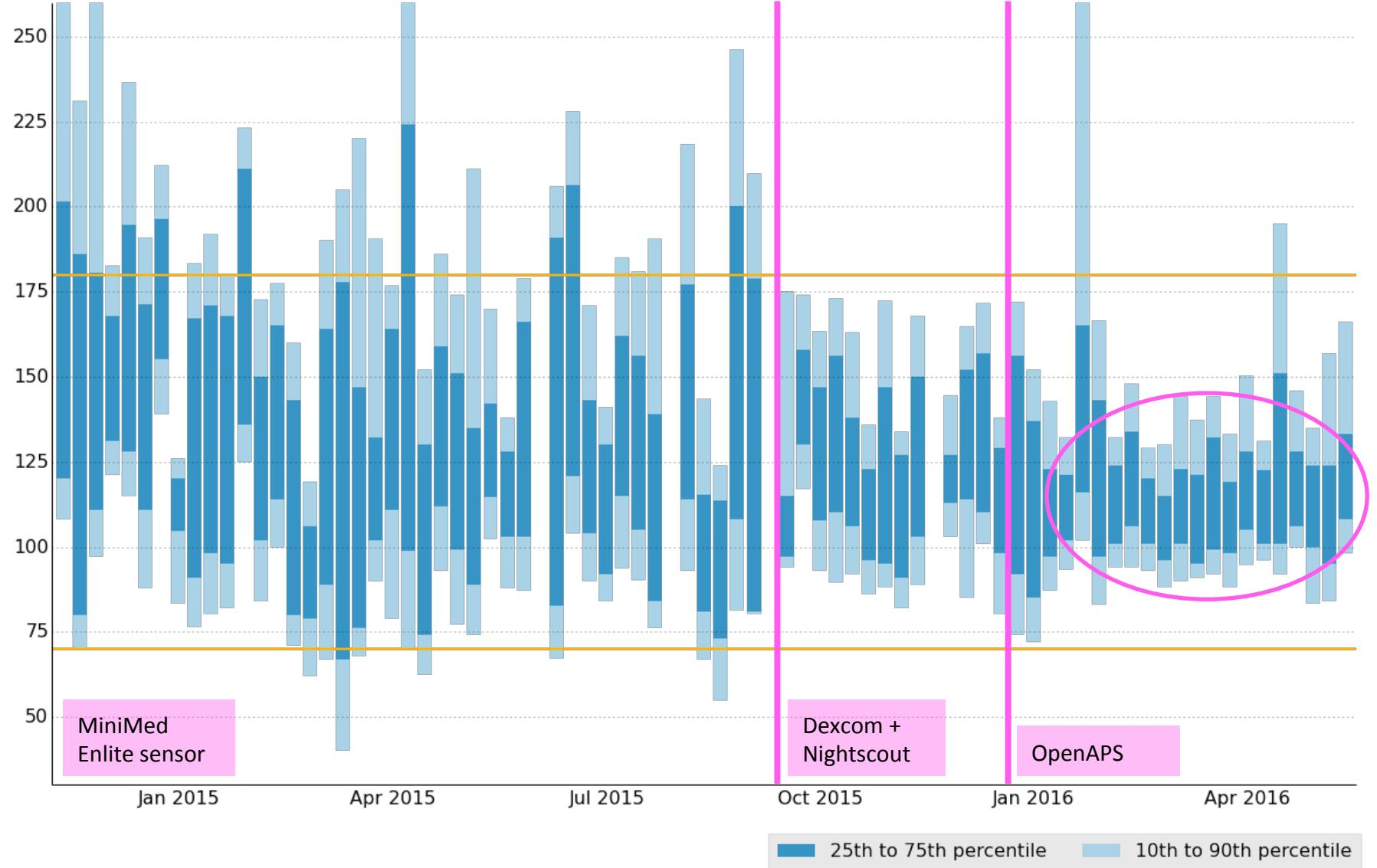
CGM distribution by week



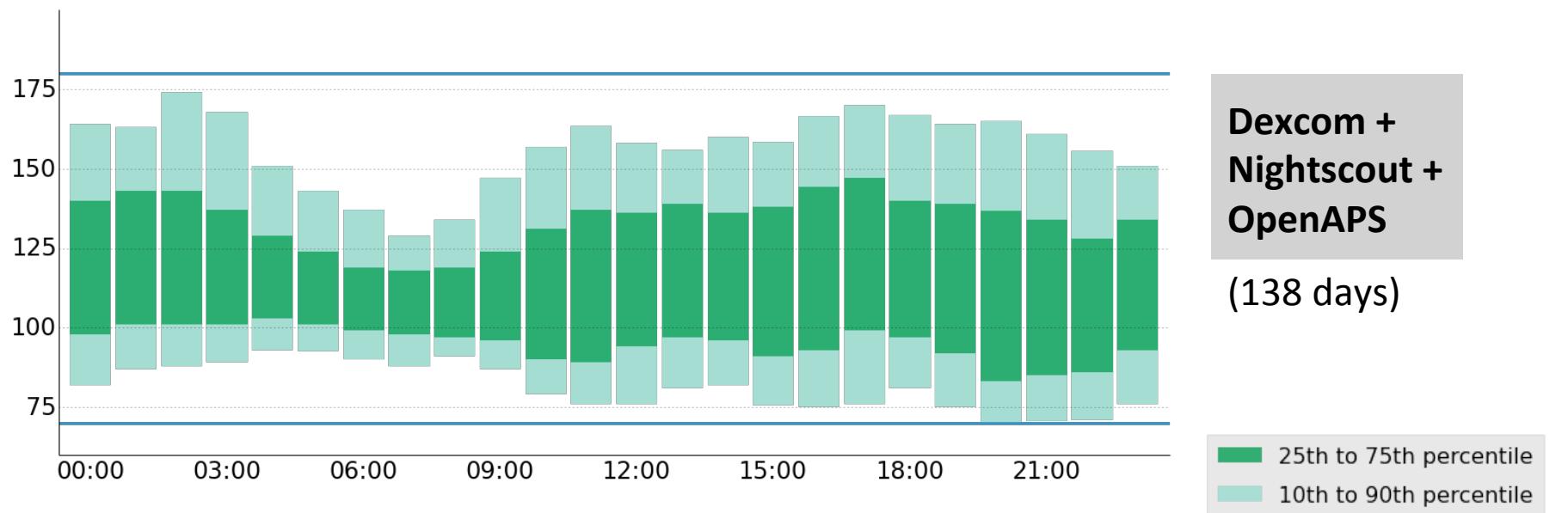
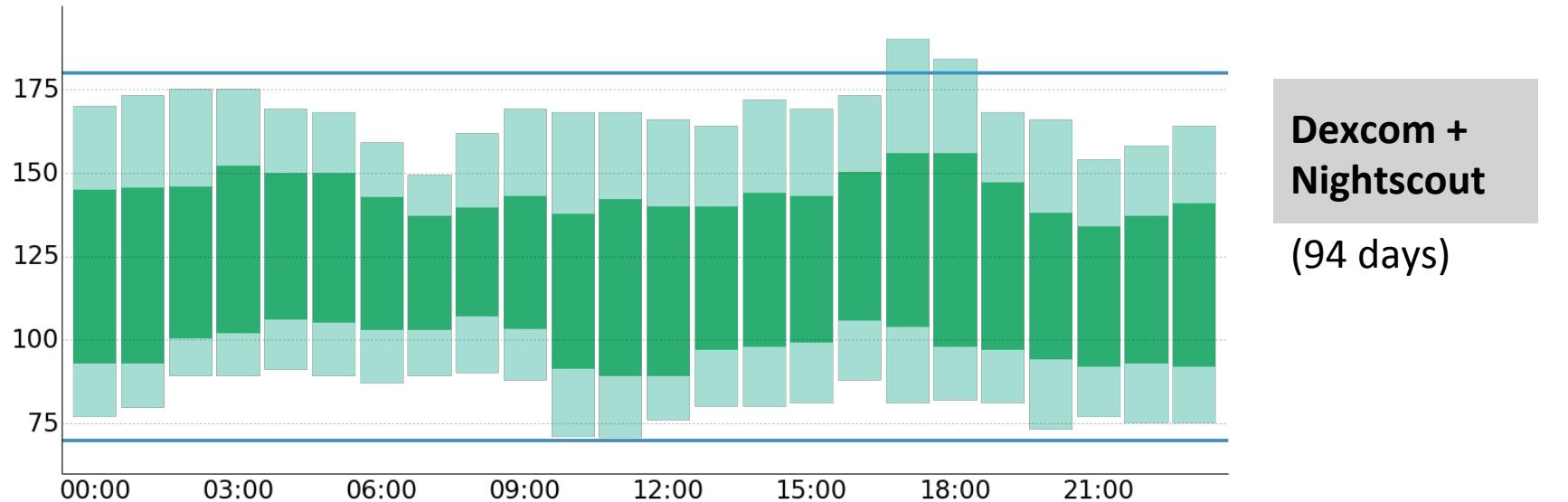
CGM distribution by week



Overnight CGM distribution by week (02:00-08:00 only)



CGM distribution by hour



Waking up



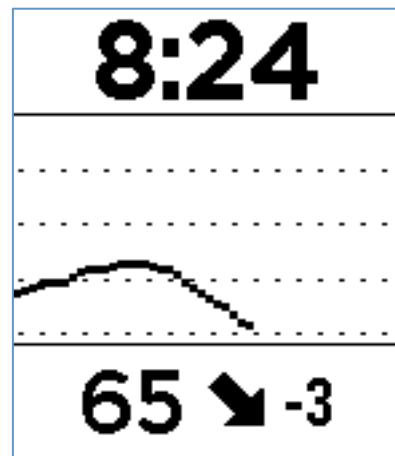
I woke up one morning, and I was like,
**“How do I feel today? What’s my day
going to be like?”**

instead of,

**“What’s my blood sugar and how can
I correct that?”**

—Sara Krugman

Making decisions



BG: 65 mg/dL

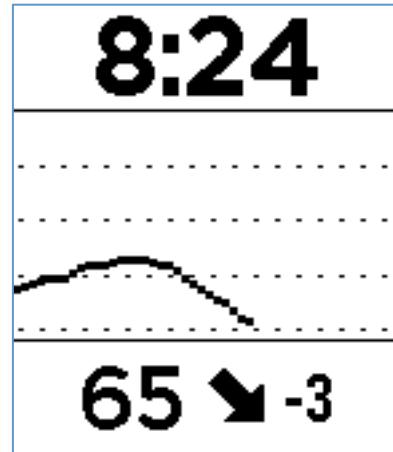
Rate of change: -3 mg/dL/5min

Deceleration: +0.5 mg/dL/(5min)²

Insulin on board: 0.3 units

Q: How many carbs right now
to land at 90 - 110 in 1.5 hours?

Making decisions

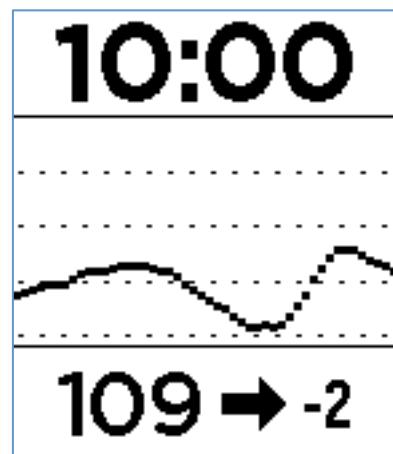


BG: 65 mg/dL

Rate of change: -3 mg/dL/5min

Deceleration: +0.5 mg/dL/(5min)²

Insulin on board: 0.3 units



Q: How many carbs right now
to land at 90 - 110 in 1.5 hours?

A: Trick question, it's f*&#ing impossible

I err on the side of over-correcting,
and let OpenAPS blunt the spike

Lower highs

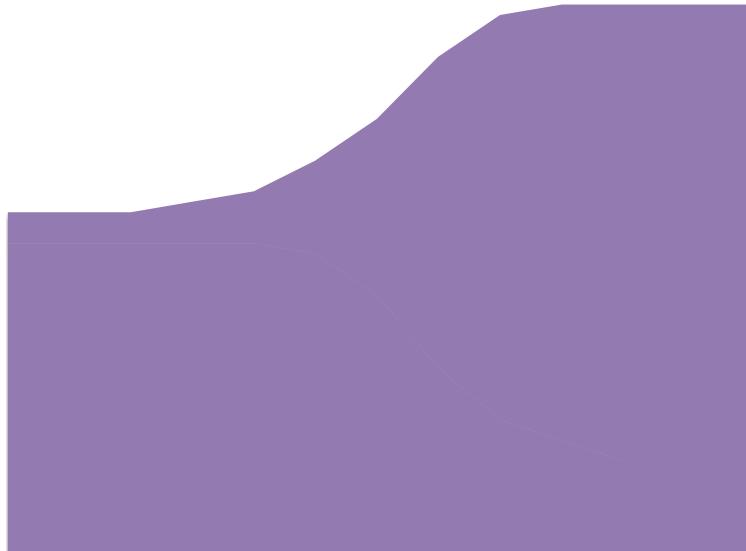
Higher lows

Building OpenAPS

- Here's some instructions
- They may not be complete
- Here's how to contribute to the instructions
- You may have issues
- Here's how to contribute your fixes

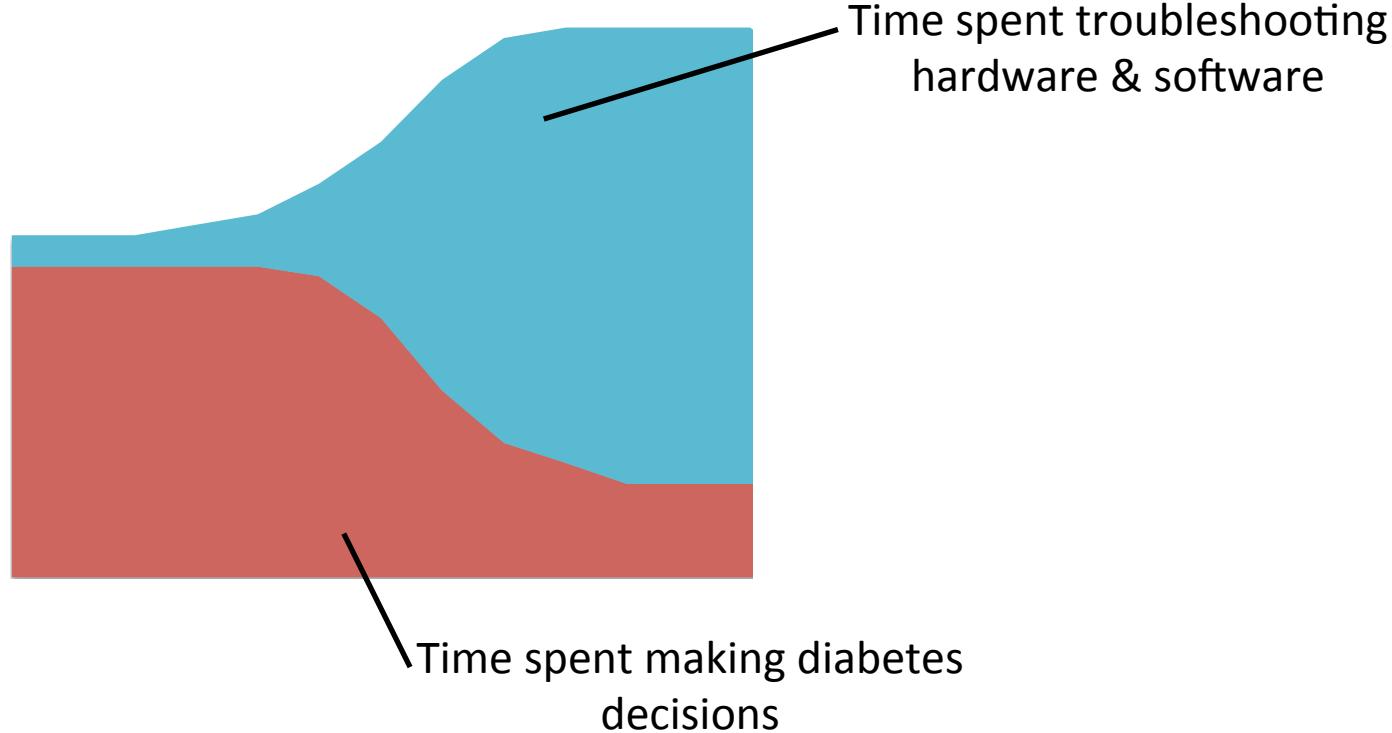
“You’re spending so much more time on your diabetes than you ever were before.”

Time spent managing diabetes



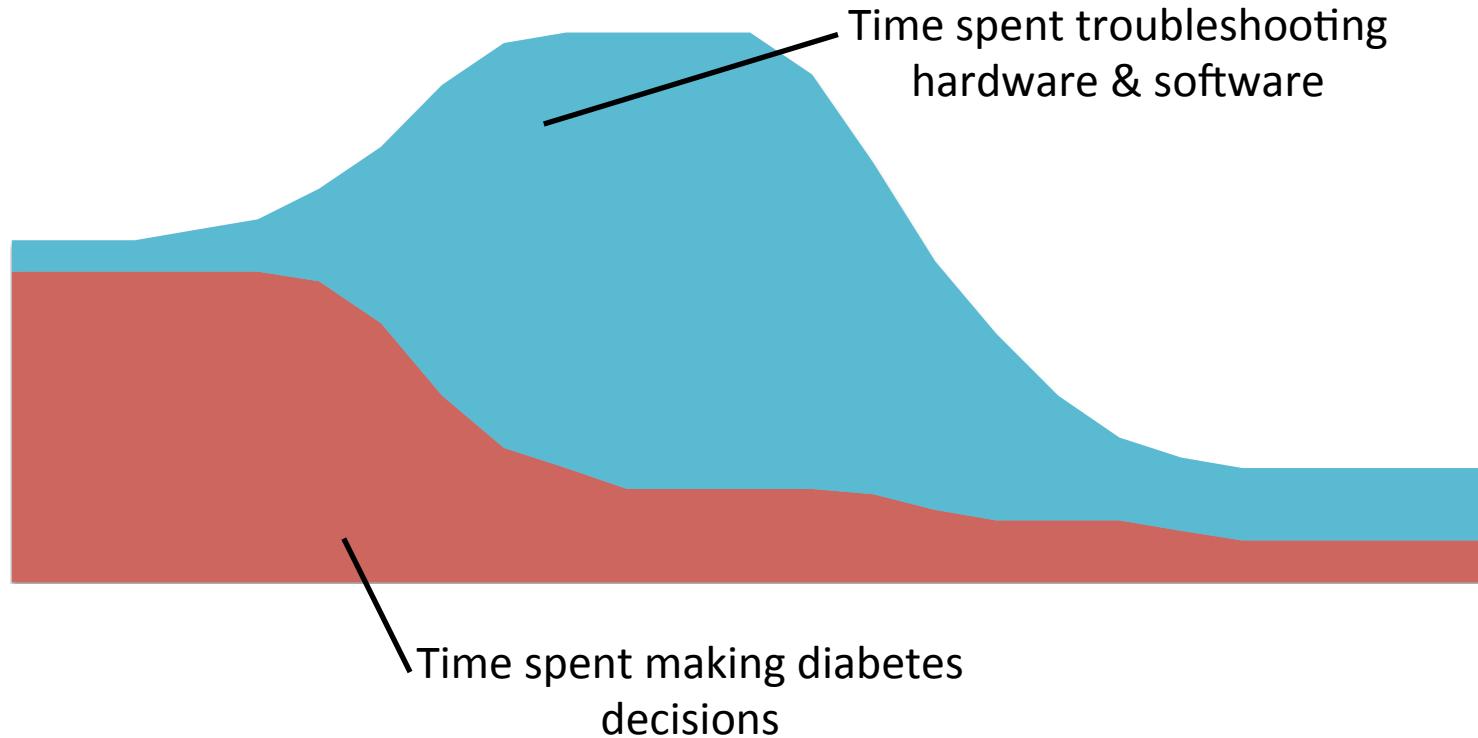
“You’re spending so much more time on your diabetes than you ever were before.”

Time spent managing diabetes



“You’re spending so much more time on your diabetes than you ever were before.”

Time spent managing diabetes



Building OpenAPS

- Now it's a few moments of monitoring per day
- You learn how it works and how it can fail
...just like your pump and CGM

Trusting OpenAPS

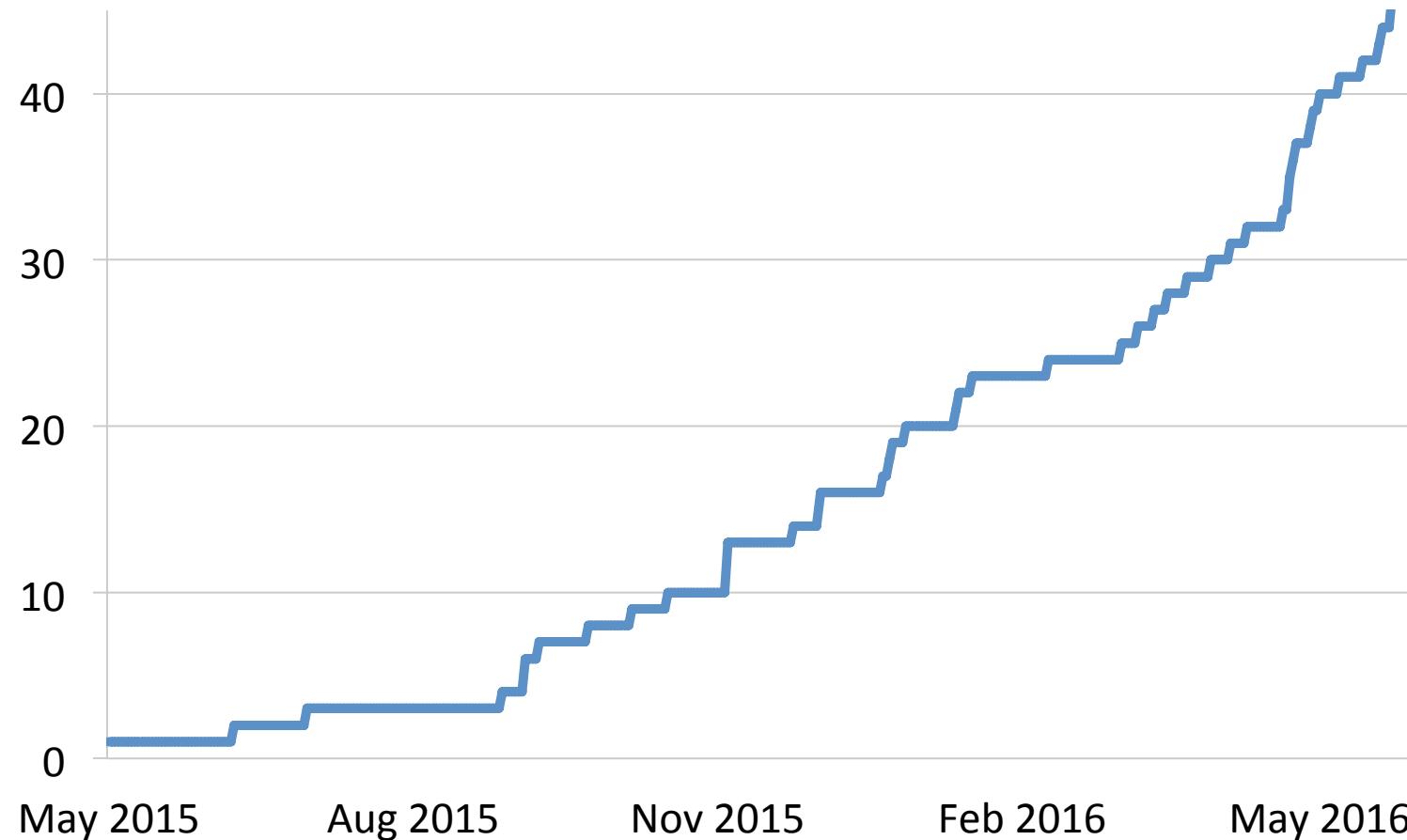
Safety is built into the design of the dosing algorithm.

- Temporary basal rates, not boluses
- Conservative limits
- Conservative adjustments
- Adjustments match what a human would do

It's open source.

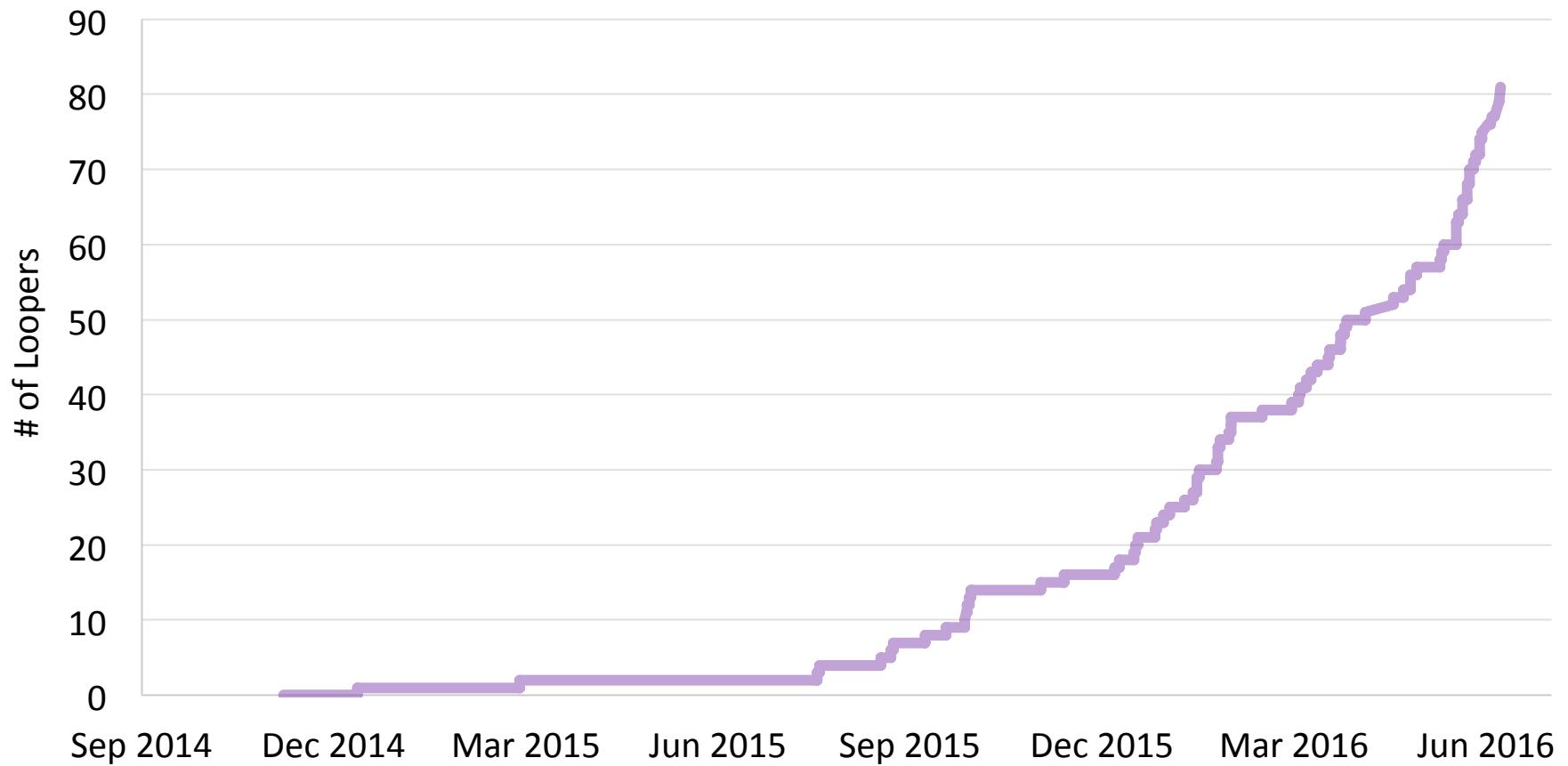
"Given enough eyeballs, all bugs are shallow."

Contributors to OpenAPS documentation



Source: GitHub

OpenAPS users



Credit: Chris Hannemann / Dana Lewis

Why OpenAPS

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What OpenAPS is for

What DIY Diabetes is for

This is a Fitbit scale



- Costs over \$100
- Proven less accurate than other scales
- Yet tens of thousands sold, because it has Wi-Fi

Fitbit data flow

Device

Wi-Fi

Cloud

Open API

Interfaces/
Applications



novel applications
unforeseen by the
device maker

Fitbit data flow

Device



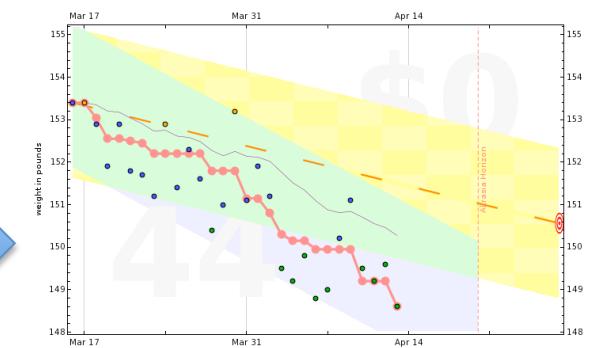
Wi-Fi

Cloud



Open API

Interfaces/
Applications



BEEMINDER

Fitbit data flow

Device

Wi-Fi

Cloud

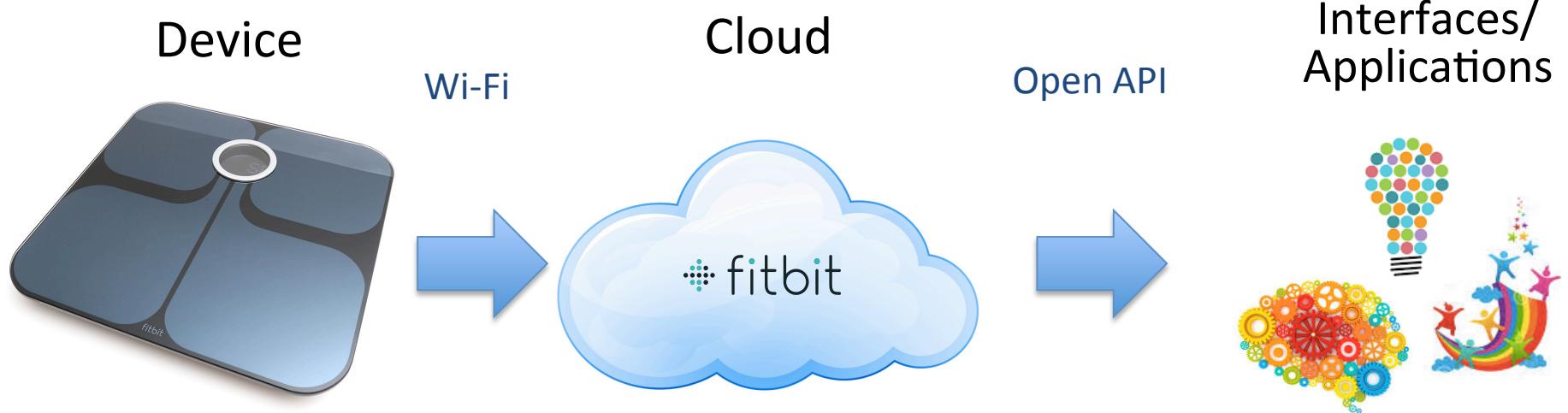
Open API

Interfaces/
Applications

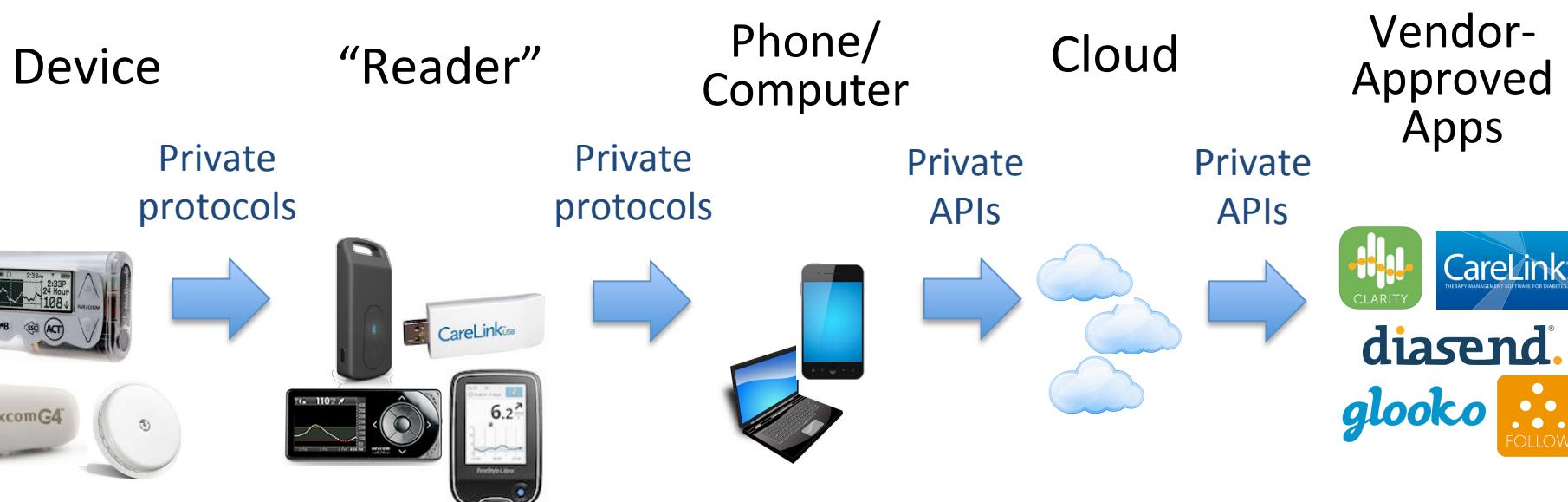
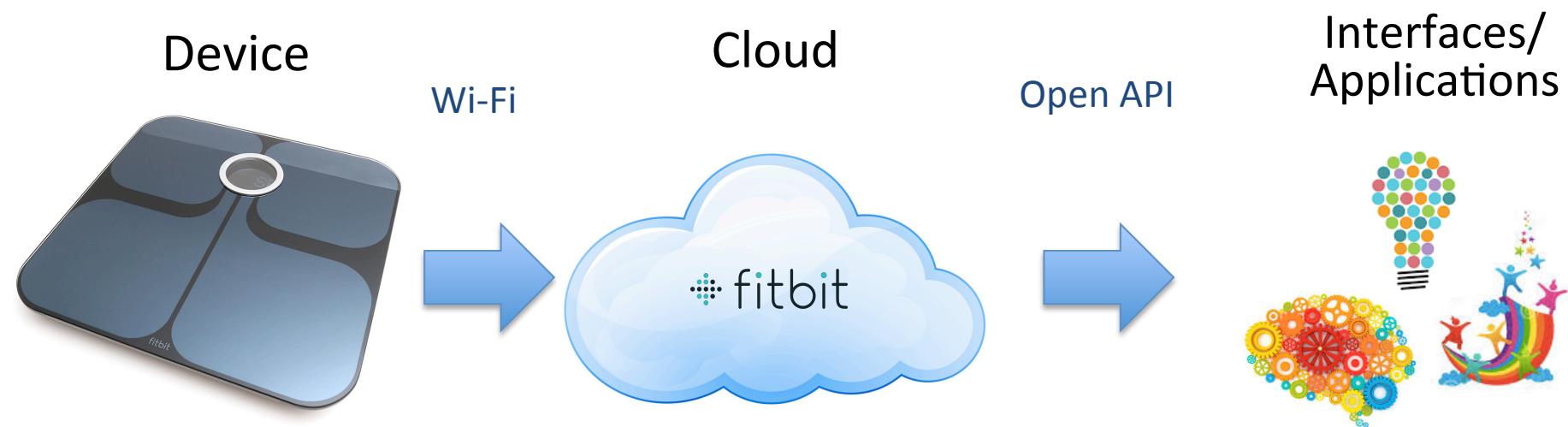


...an application which Fitbit knows it won't think of
which Fitbit will not invest in
which adds value to Fitbit's platform

Fitbit data flow



Diabetes data flow



Device “Reader” Phone/ Computer Cloud Vendor- Approved Apps

Private
protocols



“Reader”



Private
protocols

Phone/
Computer



Private
APIs



Cloud



Private
APIs



Vendor-
Approved
Apps



OpenAPS actually isn't an
artificial pancreas.

OpenAPS is an **open platform**
which enables you to build one.

Device



“Reader”



Private
protocols

Phone/
Computer



Private
protocols

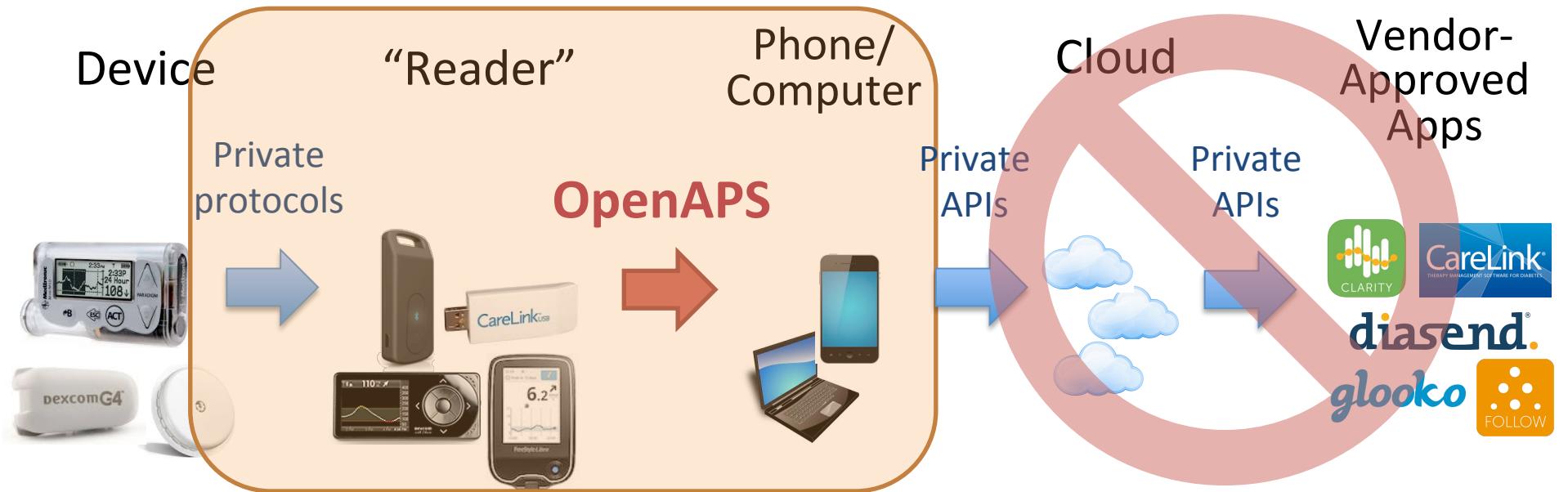
Cloud



Private
APIs

Vendor-
Approved
Apps





Device



“Reader”

Private
protocols



Phone/
Computer

OpenAPS



Private
protocols

OpenAPS

OpenAPS options: hardware



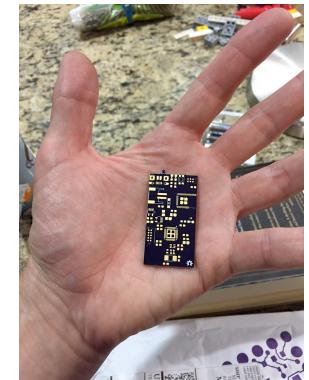
Raspberry Pi



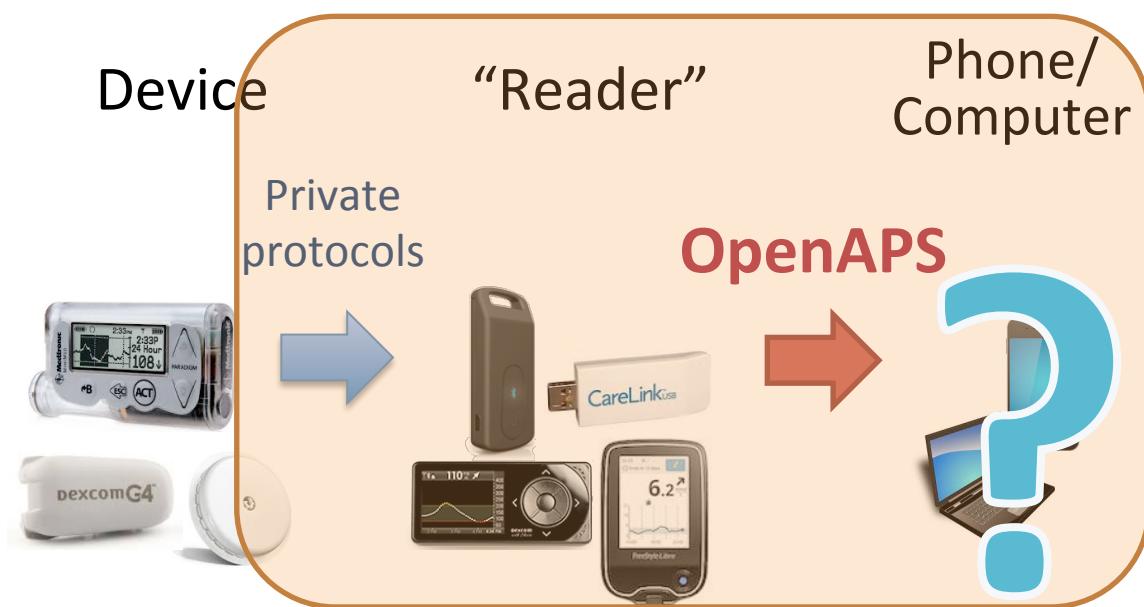
Intel Edison



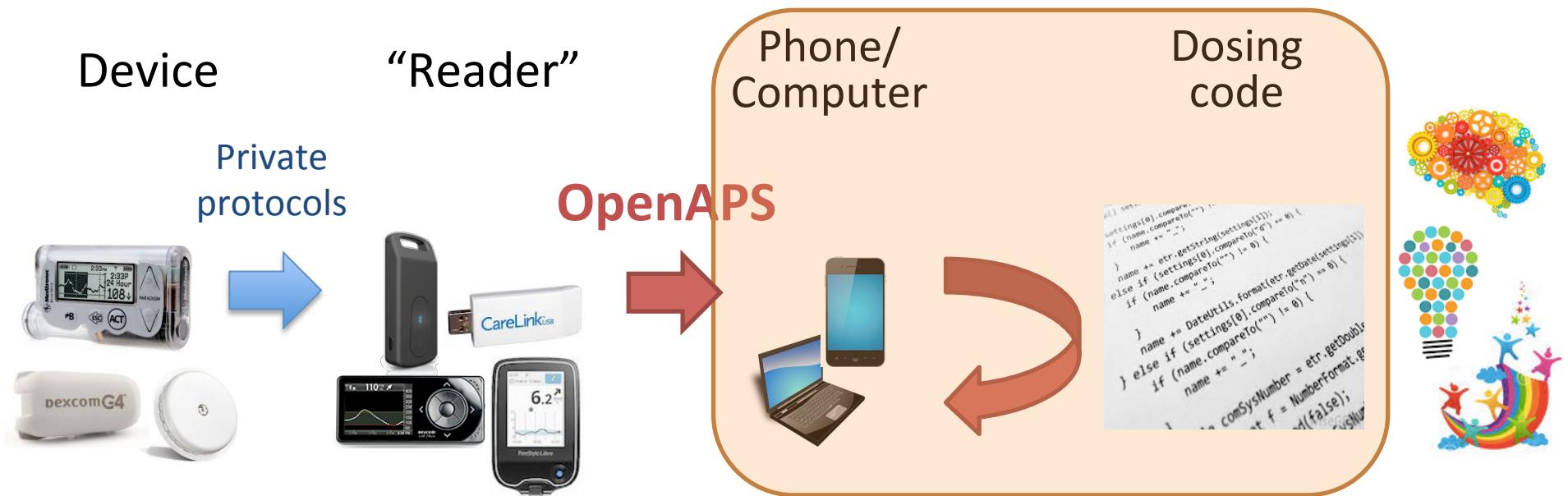
RileyLink



tinyAP



OpenAPS options: dosing algorithm



OpenAPS options: dosing algorithm



oref0



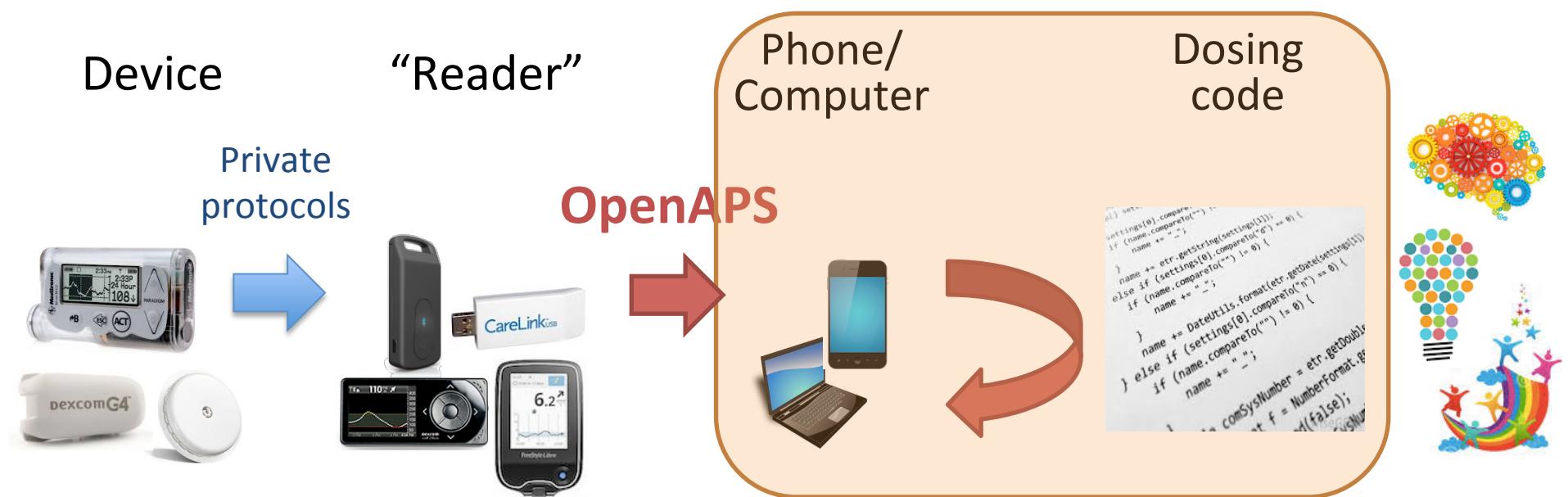
openaps-dose



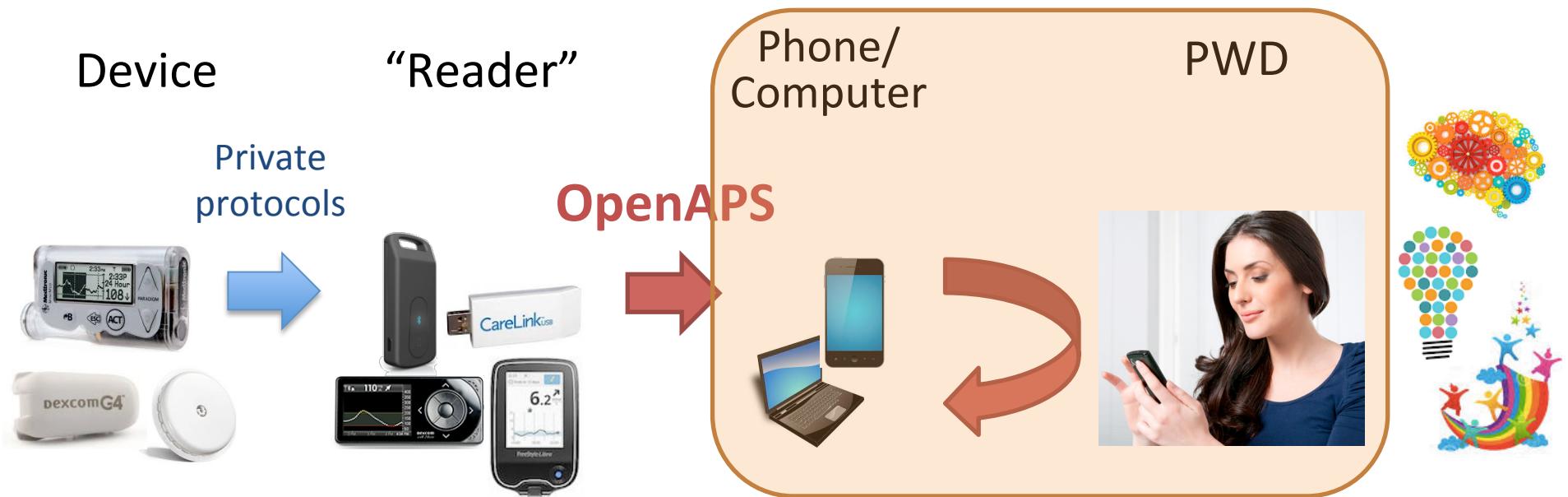
simPancreas



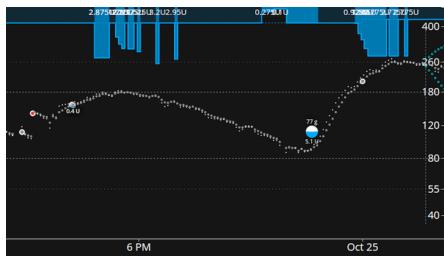
tinyAP



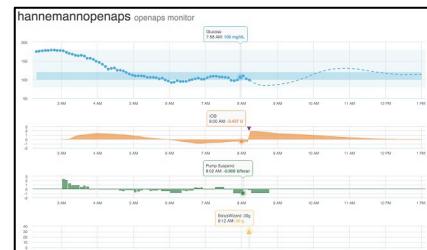
OpenAPS options: interface



OpenAPS options: interface



Nightscout



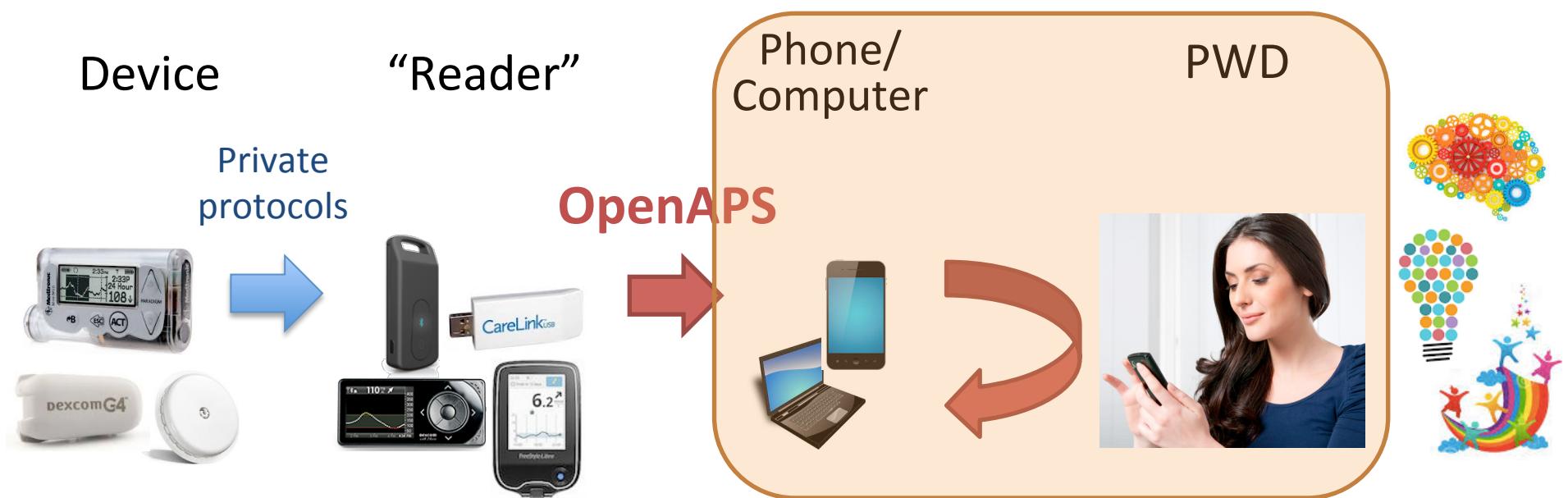
openaps-monitor



LoopKit



Urchin



OpenAPS
serves many different needs
in many different ways.

DIY Diabetes
serves many different needs
in many different ways.

Why OpenAPS

What it's like to use OpenAPS

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What DIY Diabetes is for

Device “Reader” Phone/ Computer Cloud Vendor- Approved Apps

Private
protocols



“Reader”



Private
protocols

Phone/
Computer



Private
APIs



Cloud



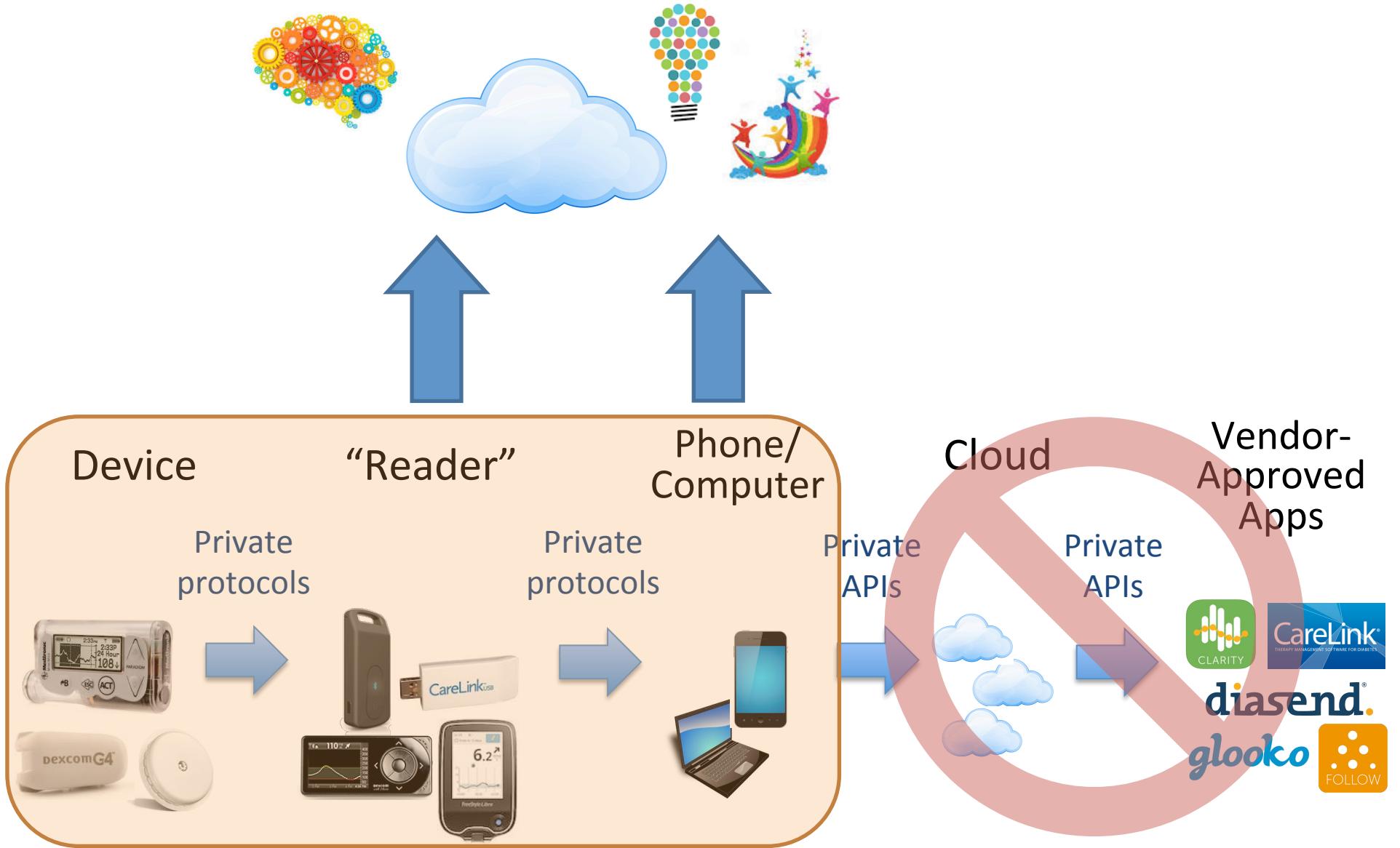
Private
APIs



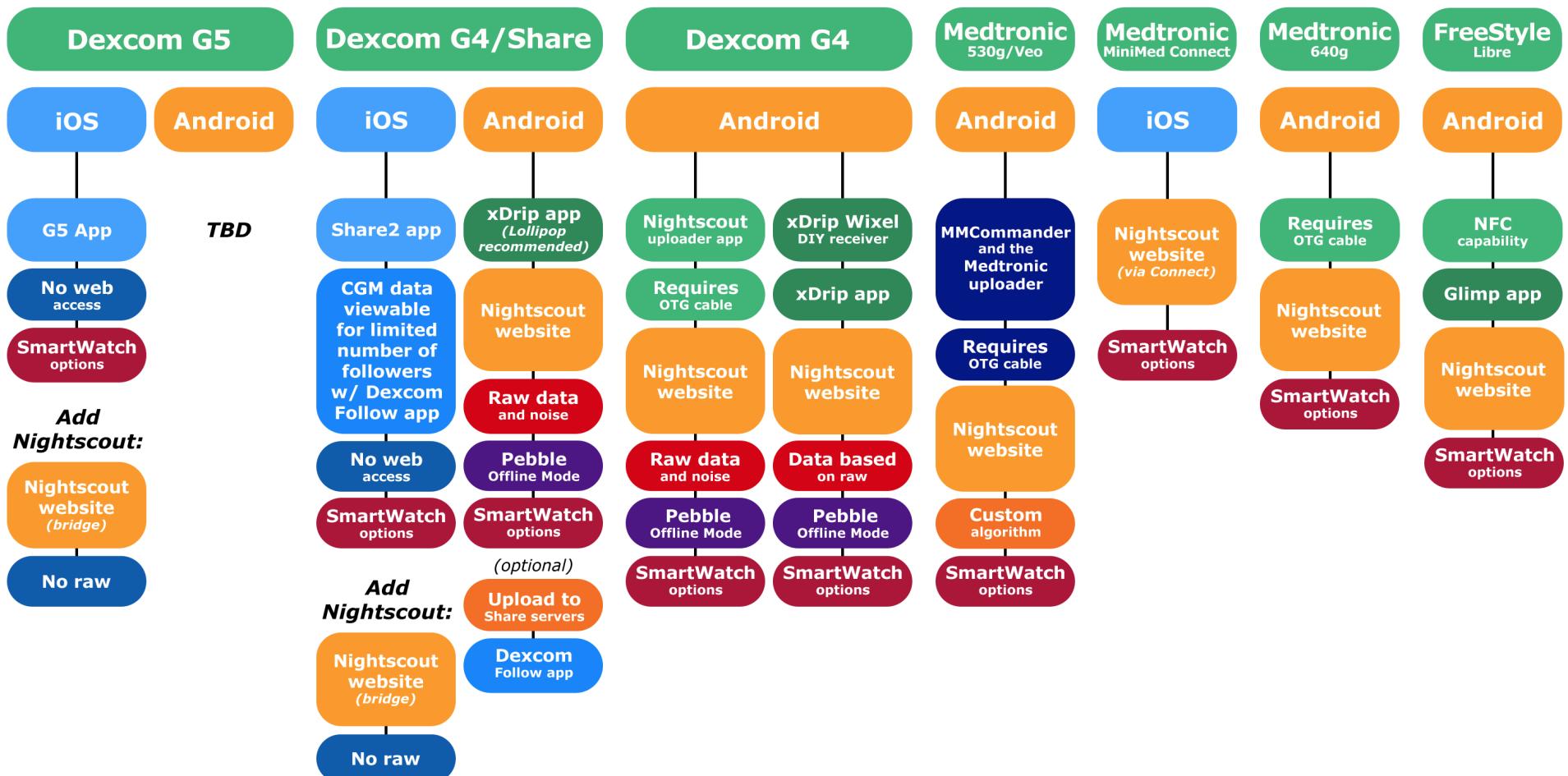
Vendor-
Approved
Apps



DIY Diabetes: opening device data



Nightscout



Freestyle Libre



Freestyle Libre



Freestyle Libre + G limp app



Freestyle Libre + LimiTTer

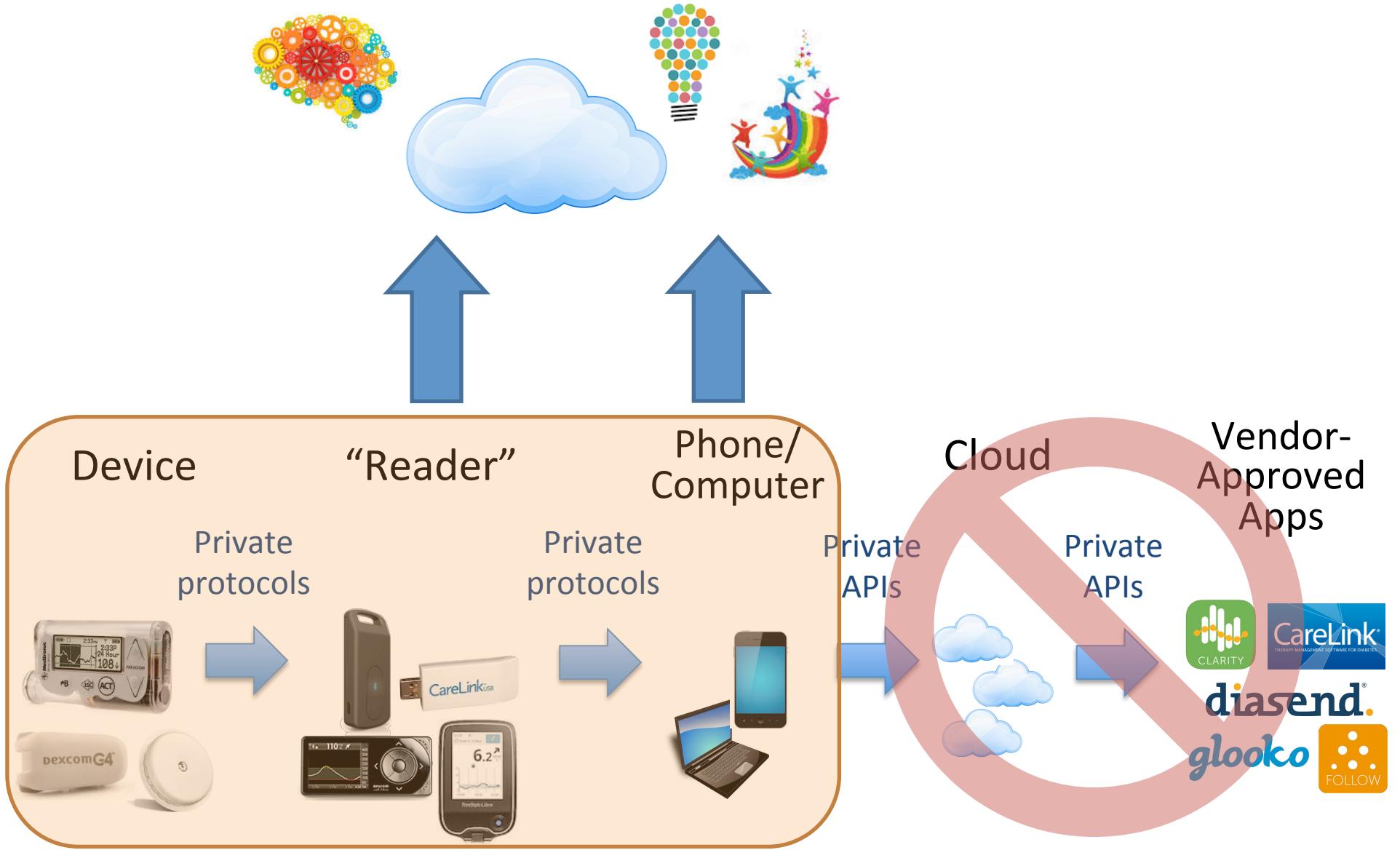


Turn the Libre into
a CGM



<http://joernl.github.io/LimiTTer/>

DIY Diabetes: opening device data



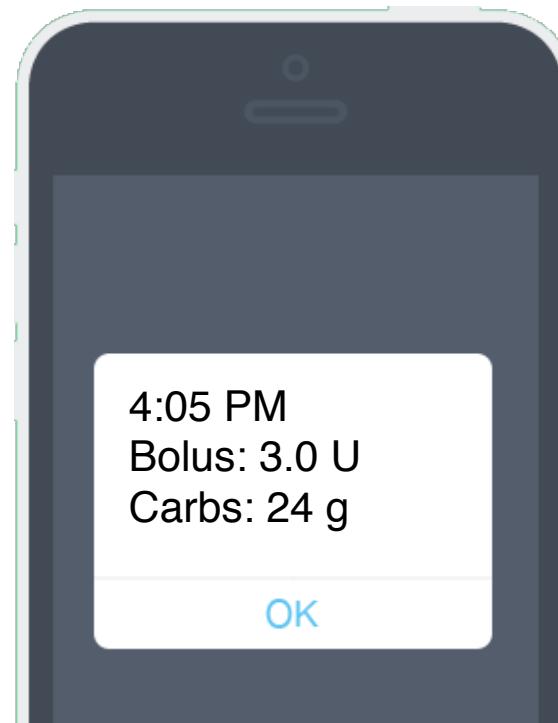
DIY Diabetes: novel interfaces



Pump push notifications



Kid boluses
at school



Parent receives push
notification

LoopKit



<https://github.com/loudnate/LoopKit>

Temporary targets

Log a Treatment

Event Type: Temporary Target

Reason: Eating Soon

Targets

Top	Activity
Bottom	Manual
	160
	120

Duration: 180

Additional Notes, Comments:

Entered By: [redacted]

Event Time: Now Other
2016-06-01 13:19

Submit Form

The screenshot shows a mobile application interface for logging a treatment. The main title is 'Log a Treatment'. The 'Event Type' is set to 'Temporary Target'. The 'Reason' is 'Eating Soon'. In the 'Targets' section, there are two rows: 'Top' and 'Bottom'. The 'Top' row has a blue background and contains the word 'Activity'. The 'Bottom' row has a white background and contains the word 'Manual'. A cursor arrow is pointing to the 'Activity' option. There are also numerical values '160' and '120' with up/down arrows next to the target rows. Below the targets, there is a 'Duration' field with the value '180'. Underneath the duration is a section for 'Additional Notes, Comments' which is currently empty. The 'Entered By' field is filled with a redacted string. At the bottom, there are 'Event Time' options: 'Now' (radio button checked) and 'Other'. The date and time shown are '2016-06-01 13:19'. At the very bottom is a large, rounded 'Submit Form' button.

<https://github.com/nightscout/cgm-remote-monitor>

Urchin



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<https://github.com/mddub/urchin-cgm>

DIY Diabetes: novel interfaces



Diabetes is already DIY.

Why OpenAPS

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What DIY Diabetes is for

...Why?





I don't know how to hotwire a car
I don't have time to learn to hotwire a car
I don't want to damage my car



I don't know how to hotwire a car
I don't have time to learn to hotwire a car
I don't want to damage my car



I don't know how to hotwire a car
I don't have time to learn to hotwire a car
I don't want to damage my car



It would transform the way I drive.

Of course you hotwire the car.



It's not about the car.

It's about the drive.

Misconception



“Diabetes”

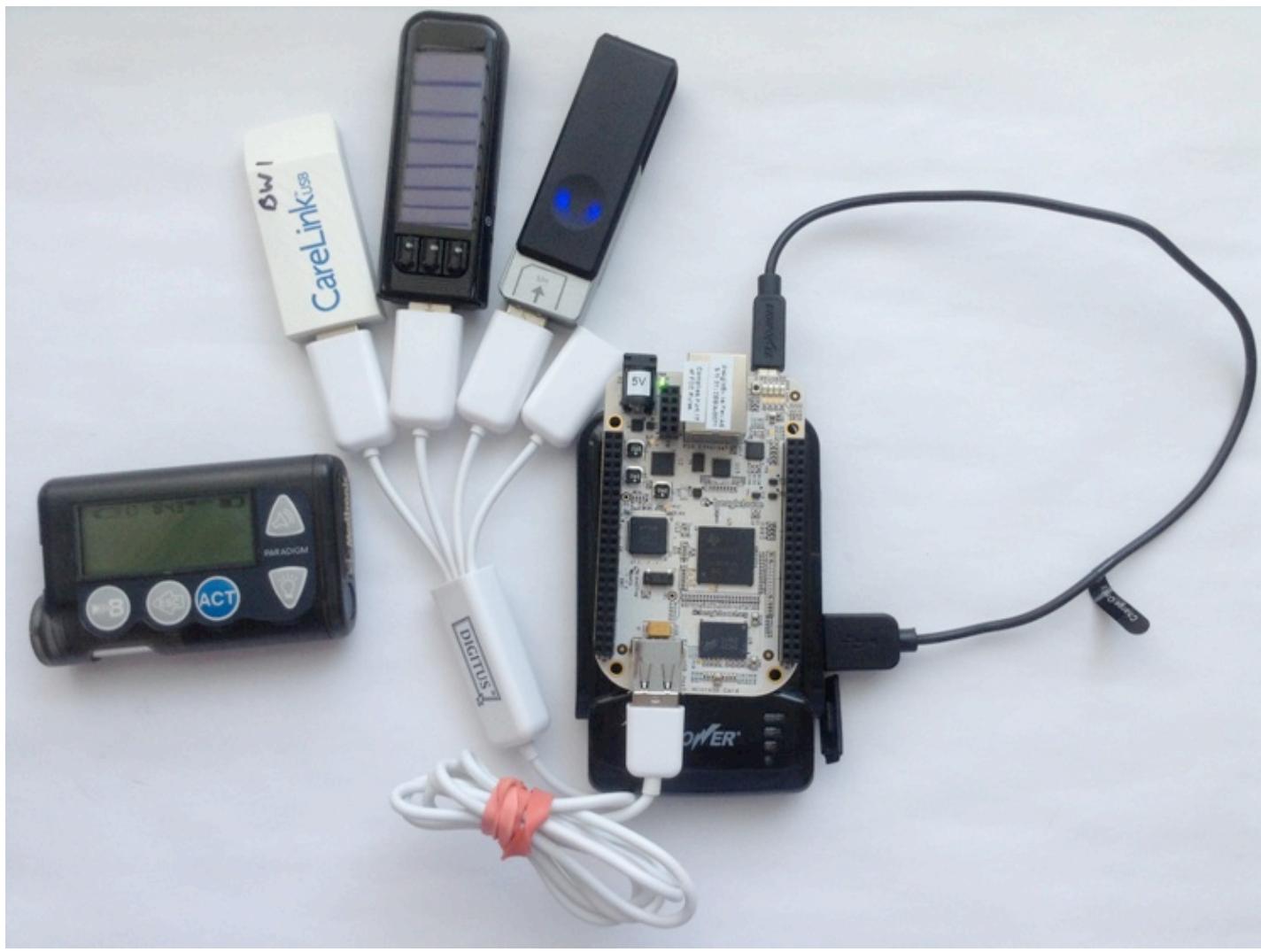


“DIY Diabetes”



It's not about the car.

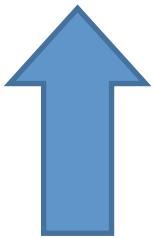
It's about the drive.



It's not about the car.

It's about the drive.







Authorized
access









#WeAreNotWaiting