

# DIY Artificial Pancreas Systems

## Gold Coast Build Event

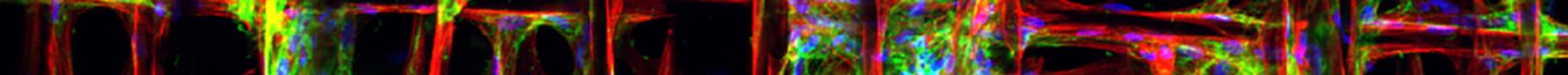


Anna Jott

anna\_jaey

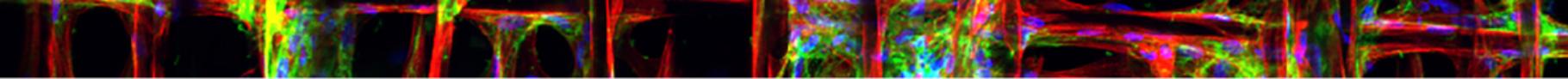
anna-jaey

October 12, 2019



## ACKNOWLEDGEMENTS

 David Burren     BionicWookiee    <https://bionicwookiee.com>



## CLOSED-LOOP SYSTEMS

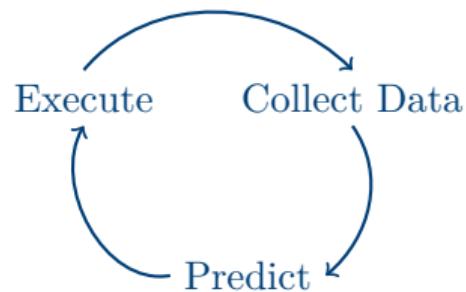
A system that **continuously collects data** (blood glucose values, pump data, carbohydrate intake), **predicts** the future BG levels, using algorithms, and **executes** the calculated changes in insulin delivery.

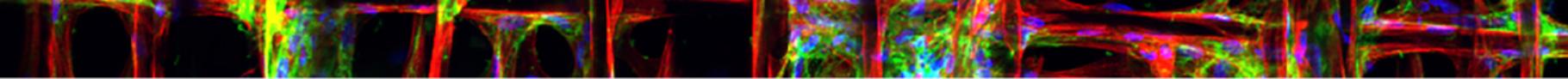
Requires:

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A system that **continuously collects data** (blood glucose values, pump data, carbohydrate intake), **predicts** the future BG levels, using algorithms, and **executes** the calculated changes in insulin delivery.  
Requires:

- Continuous Glucose Monitoring (CGM)
- A 'brain'- a.k.a. the Artificial Pancreas System
- A pump that can be monitored and controlled by the 'brain'





# DIY LOOPING

## What can it do?

- ✓ Make unemotional decisions and it is never tired
- ✓ Reduce highs and lows
- ✓ Reduce risk in decision making (AAPS & Loop IOB aware in bolus calculator)
- ✓ Make overnights plain sailing
- ✓ Allow you to relax

adapted from: @tims\_pants | <https://www.diabetetech.com>

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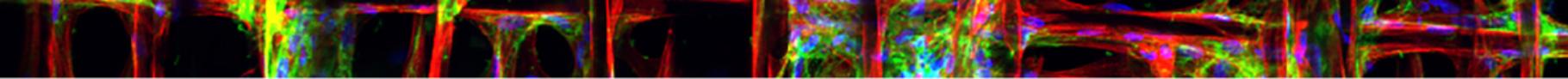
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## What can't it do?

- ✗ Keep you at target if you don't talk to it
- ✗ Give good results with bad inputs
- ✗ Learn (No AI, no set and forget)
- ✗ Magically take away diabetes (although it tries)

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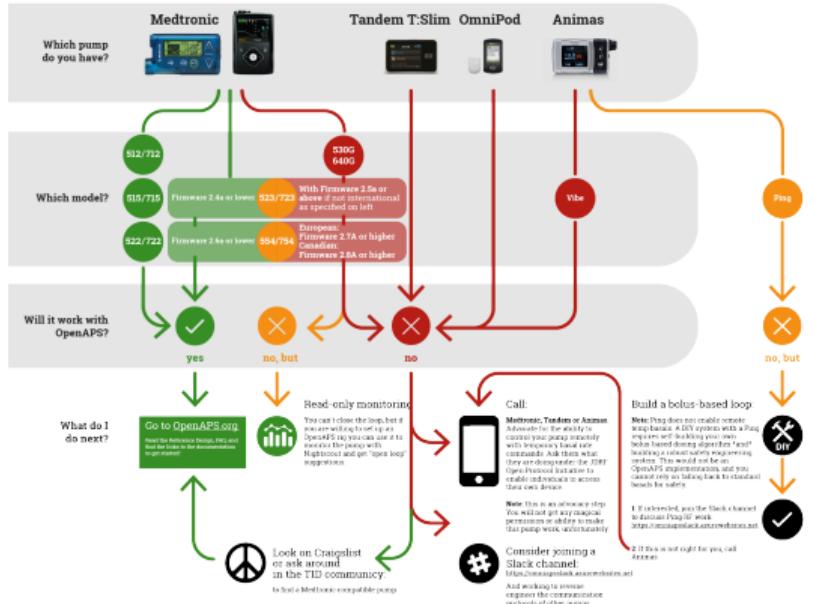
# DIY LOOPING

## What are realistic expectations?

- Effort in = Results out
- You must do it yourself; you can't just download an app
- You need to check your basal, Insulin Sensitivity Factor and Carb Ratio are reasonably accurate for best results
- Don't expect miracles, then you'll be pleasantly surprised

# OPENAPS

Can I close the loop with my pump?



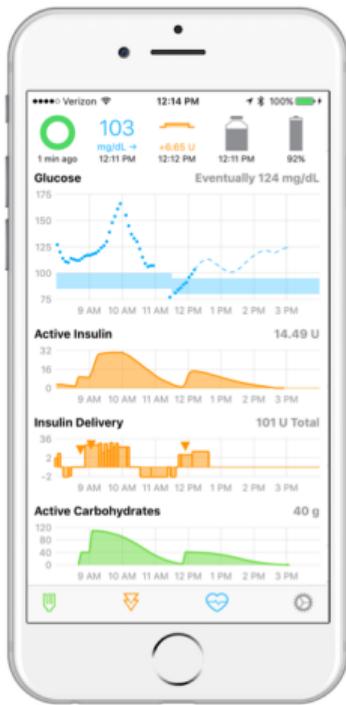
- <https://openaps.readthedocs.io>
- some old Medtronic pumps
- additional hardware: "Rig" (= 'Brain')

# ANDROIDAPS

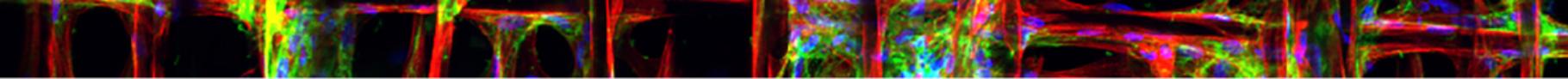


- <https://wiki.androidaps.org>
- Dana R, Dana RS, Accu Check Combo, Insight
- some old Medtronic pumps: need additional hardware "RileyLink" (Communication)
- Omnipod: need additional hardware "RileyLink" (Communication) **DEV**
- Android OS: phone, some smartwatches

# LOOP

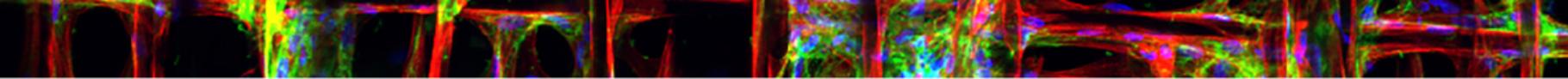


- <https://loopdocs.org>
- some old Medtronic pumps: need additional hardware "RileyLink" (Communication)
- iOS: iPhone or iPod touch



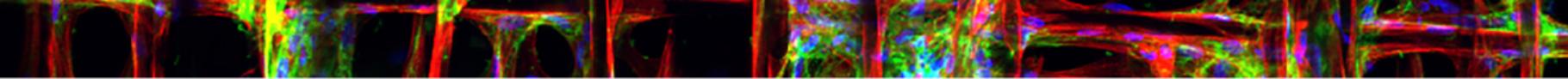
# CGM

- Dexcom G5/G6
  - Dexcom app, xDrip+, Spike
- Libre
  - MiaoMiao, Nightrider, Droplet Bluetooth adapters
  - xDrip+, Spike
- Others possible



# NIGHTSCOUT

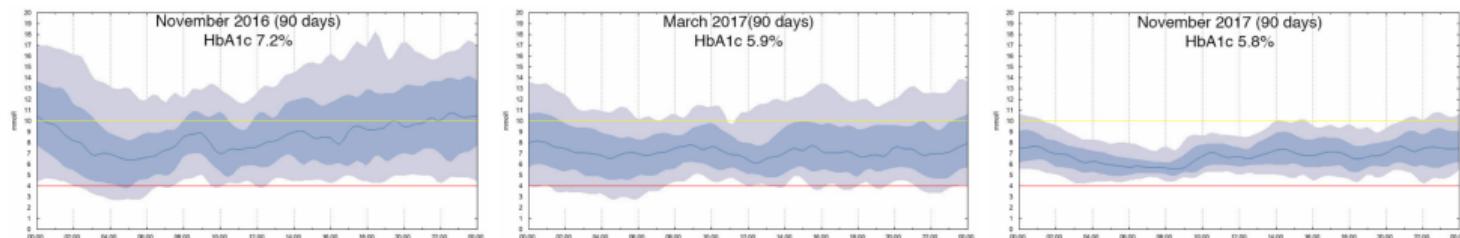
- not an app
- your website, running a Nightscout database
- updated by all 3 loop systems: **CGM in the cloud**
- viewed through web browser



# AUTOTUNE

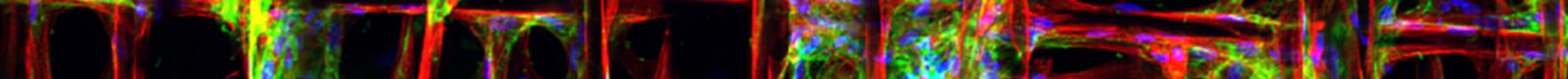
- build in OpenAPS
- can be run outside of the APS system (Nightscout)
- Nightscout database with complete records of:
  - Insulin
  - BG (CGM)
  - Carbs
- suggestions: basals, CR, ISF
- if you record ALL carbs it can take those into account
  - This includes hypo treats!
  - You can declare carbs without bolusing.
- doesn't model exercise

# HbA1c



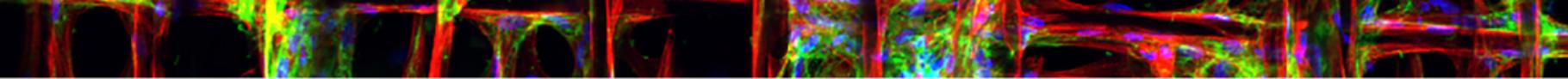
- doesn't measure variability
  - Time in Range (TIR)
  - Standard Deviation (SD)

images: David Burren



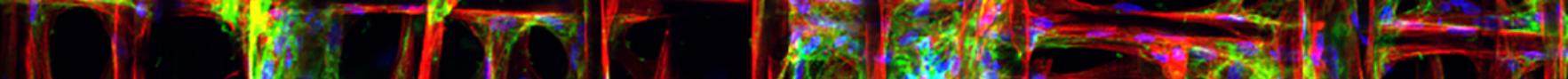
## CONCEPTS IN DIY APS/LOOP SYSTEMS

- no extended boluses → e-carbs ('future carbs'), carb absorption, temp basal rate, SuperMicroBolus (SMB)



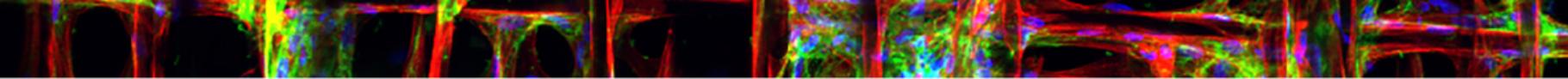
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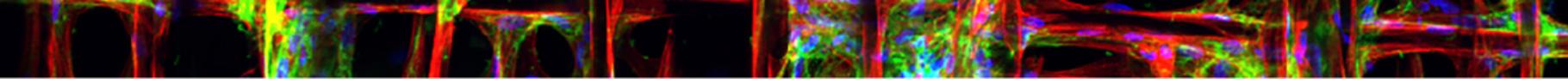
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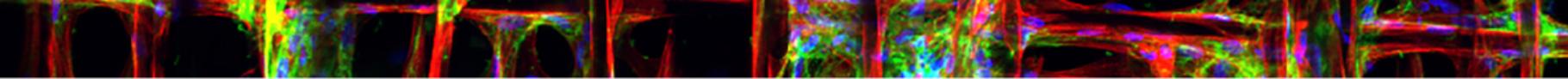


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- IOB “0” means “just programmed basal”
- DIA (duration of insulin action)

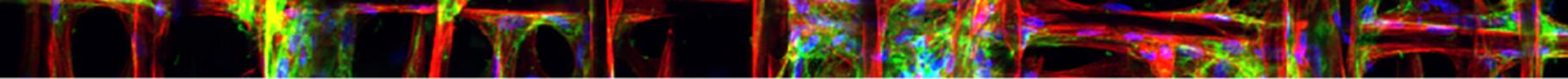
## TARGETS AND PREDICTIONS

- start with loose goals, tighten up over time
- aim at single figure or small range
  - system will aim to get you in range hours from now
  - if your “target” is 3.9-10, you’re at 12, but the forecast is that you’ll be 9.9 in 4 hours  
→ *Nothing will be done!*



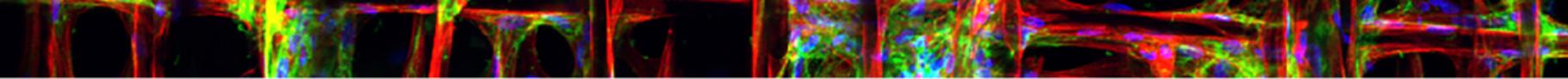
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- predictions keep changing



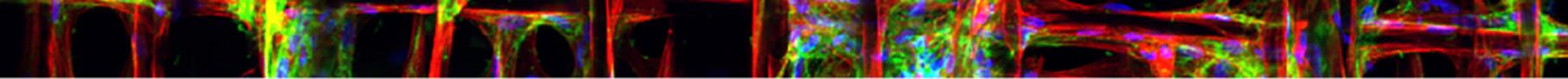
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- it's a tool
- it won't automatically fix things



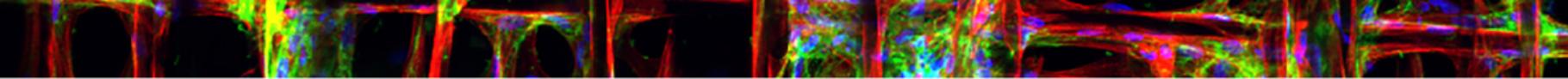
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- don't try to "run" before you learn to "jog" or even "walk"



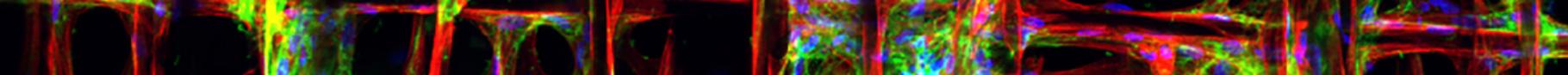
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## DIY CLOSED LOOP

- it's a tool
- it won't automatically fix things
- don't try to "run" before you learn to "jog" or even "walk"
- YOU need to tune your settings
- It makes life easier



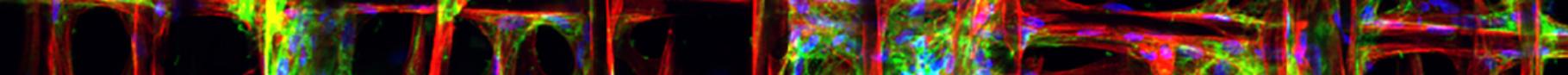
## LEARN AND UNDERSTAND

If your levels are not going the way you expect, don't just push on and hope they'll improve!

**It's a sign that something needs changing.**

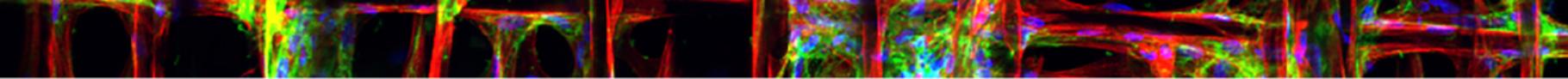
Sometimes that's settings.

Sometimes it's your behavior or assumptions.



# BUILD

- You have to do this for yourself, we can't do it for you
- We *can* show you by showing you how we did it for ourselves
- No medical advice (YOU and your doctor)



# Happy Looping