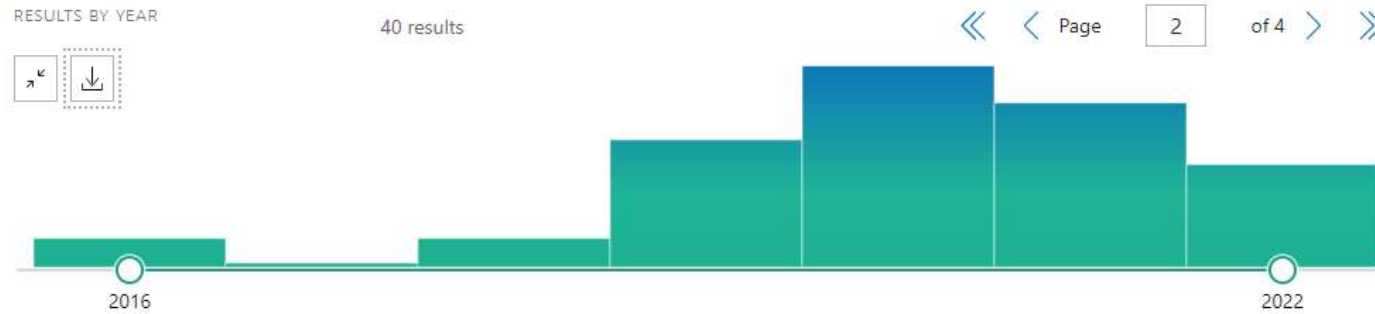
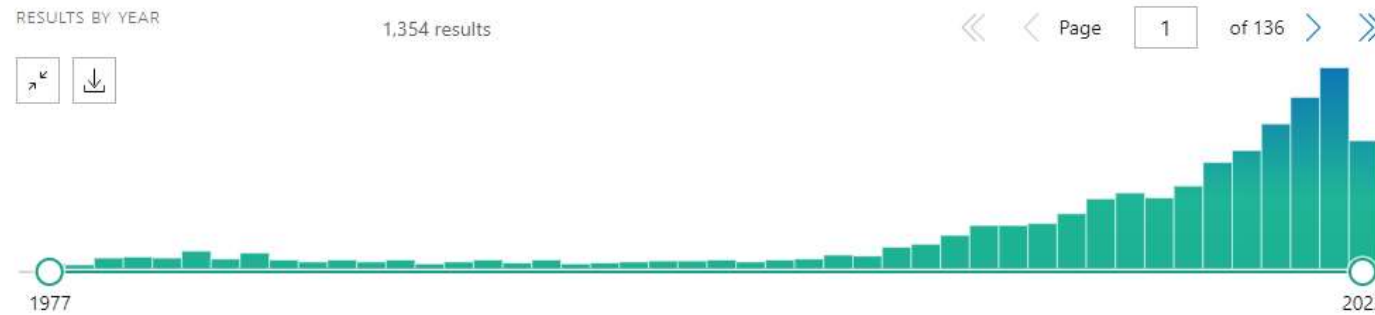


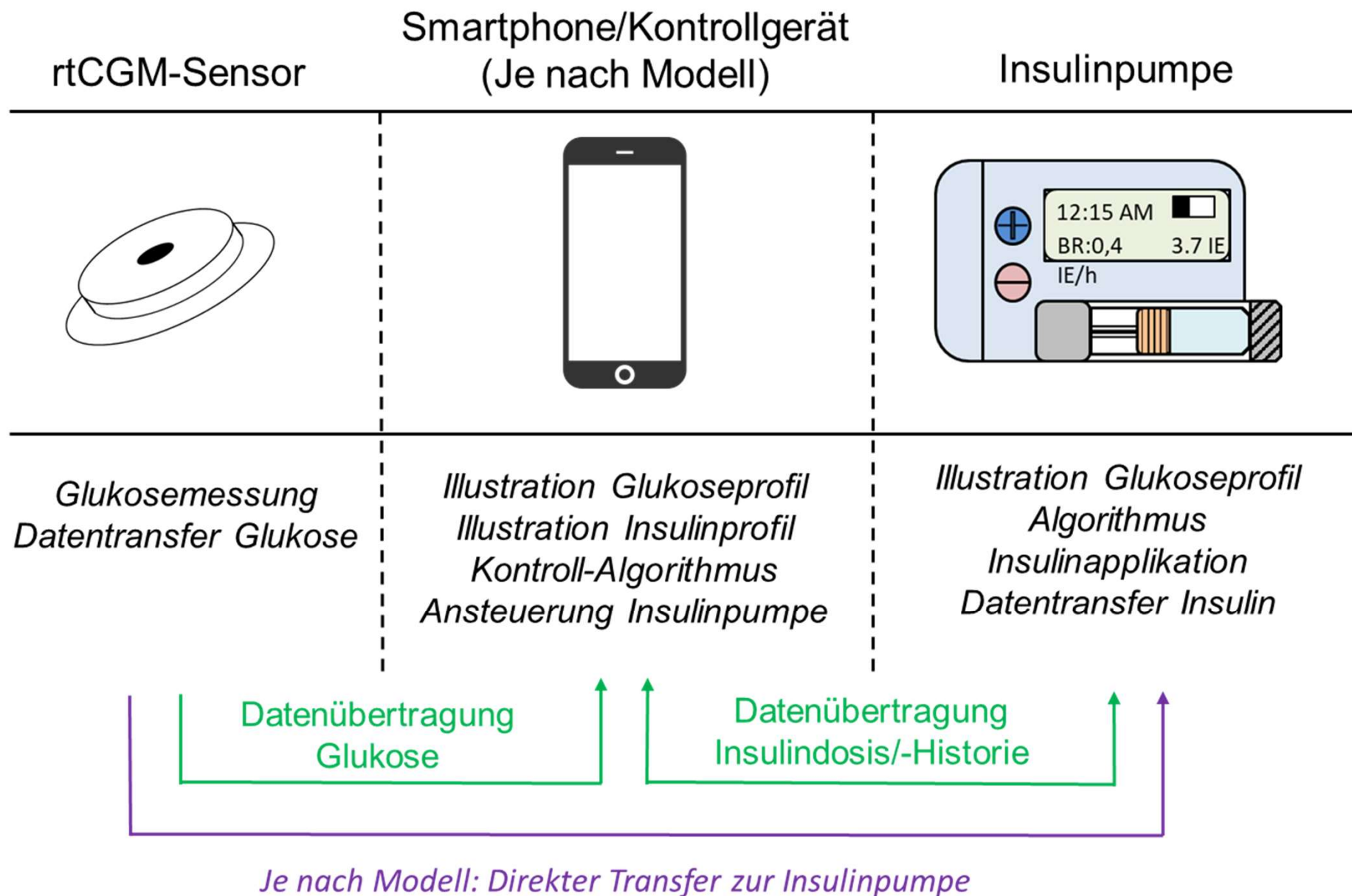
Suchwort: *[open source] + [artificial pancreas system]*



Suchwort: *[artificial pancreas system]*



(hybrid) closed loop Systeme – generell



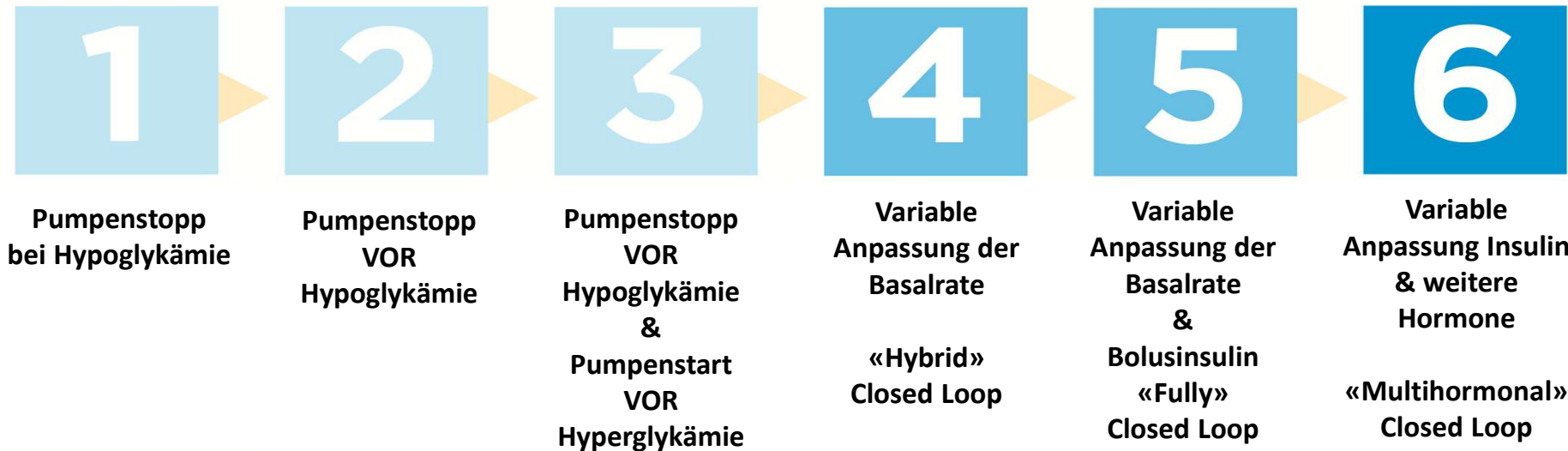
Closed Loop Systeme – Eine Erfolgsgeschichte



First Generation

Second Generation

Third Generation



DIY - Closed Loop Systeme – Meilensteine der Entwicklung

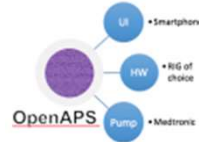
2011



2013



2014



2015



2016

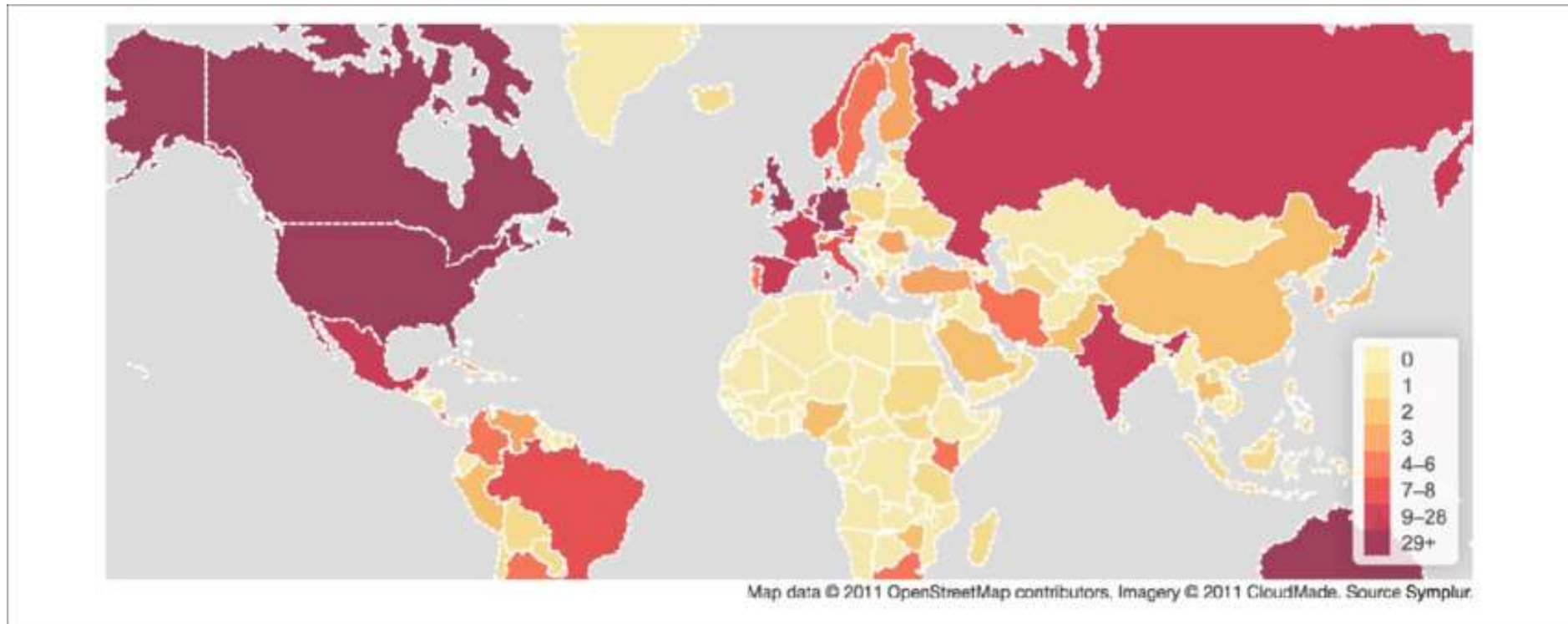


The collage features a portrait of a man, a smartphone displaying the Nightscout app with a glucose reading of 146, a white hardware device, and a screenshot of the AndroidAPS app interface. The app interface shows a glucose reading of 89, insulin dose of 4.75 U, and carbohydrate count of 66 g. It also displays a graph of glucose levels over time and various control settings.

Fakten



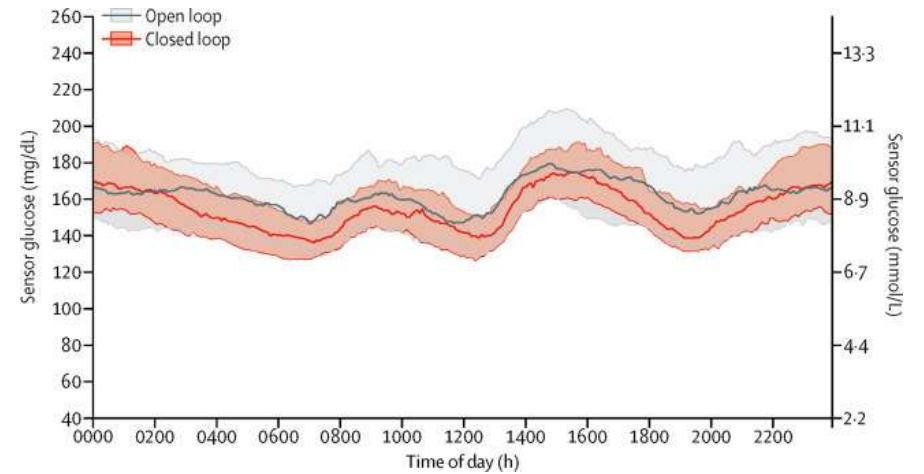
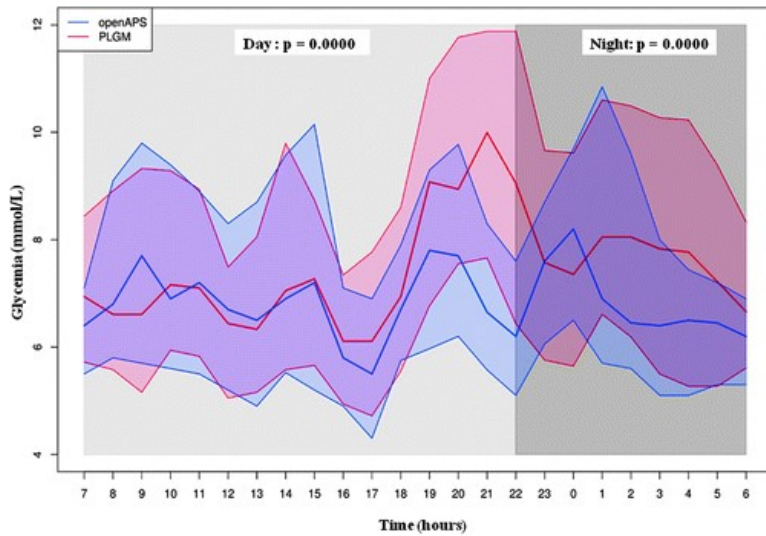
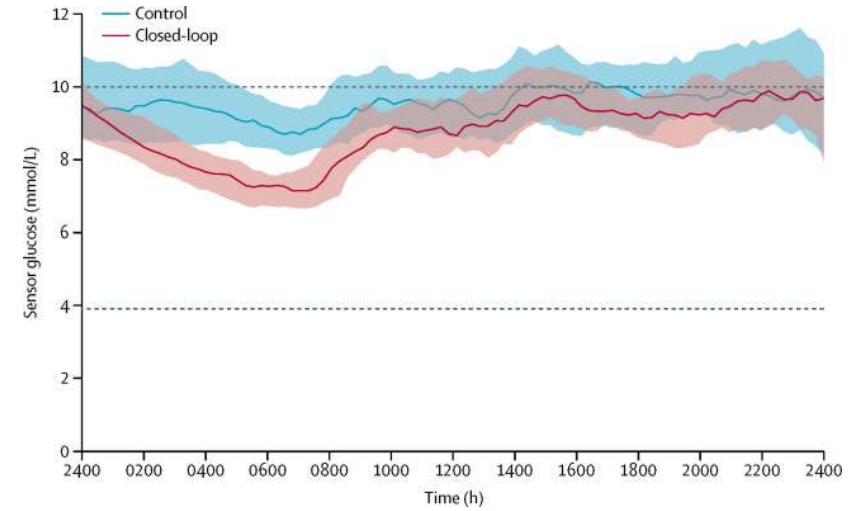
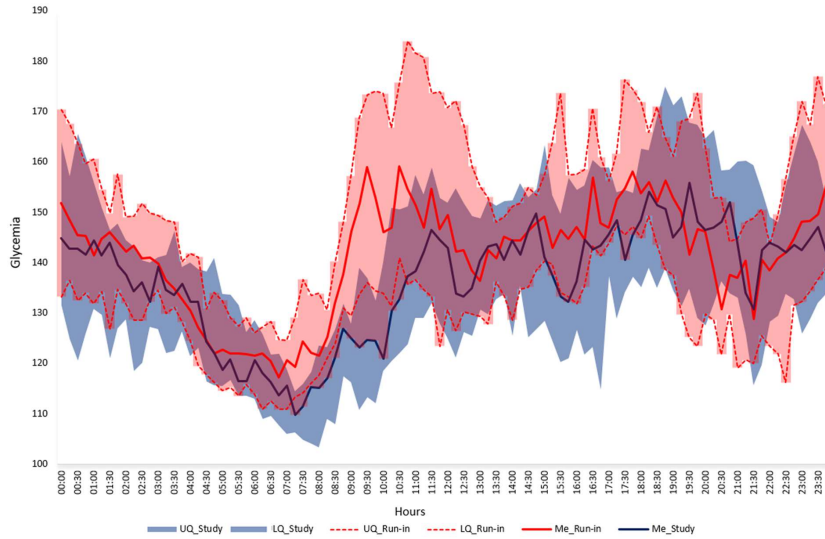
Weltweite #OpenAPS Twitter-User:innen



«Schweizer Looper» 40 Mitglieder

Ca. 2 DIYAPS-Nutzer:innen pro Diabeteszentrum in Deutschland/Österreich

Das können DIYAP Systeme



<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0248965v>

<https://www.liebertpub.com/doi/10.1089/dia.2018.0214>

<https://www.sciencedirect.com/science/article/pii/S2589750019300032>

<https://www.thelancet.com/journals/lancet/article/PIIS0140-6736%2818%2931947-0/fulltext>

Das können DIYAP Systeme



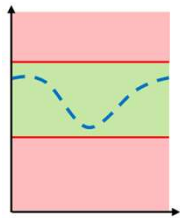
Leistung



Sicherheit



Nutzerberichte



TIR ↑
Hypo ↓
Hyper ↑



Handyempfang
Einzelne
Hardwareprobleme



Besserer Schlaf
Weniger Disstress



Verbessertes
eHbA1c

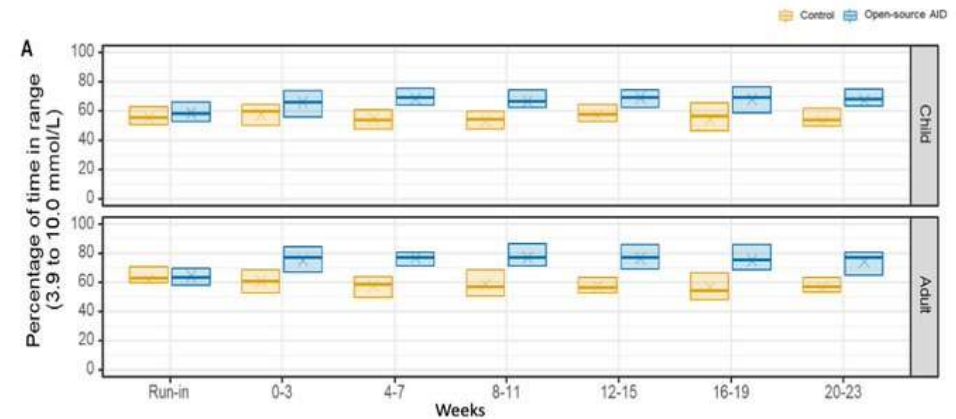
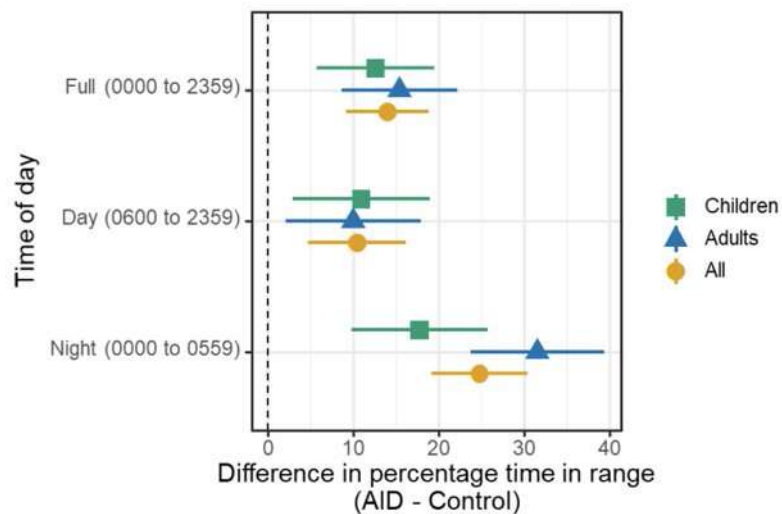
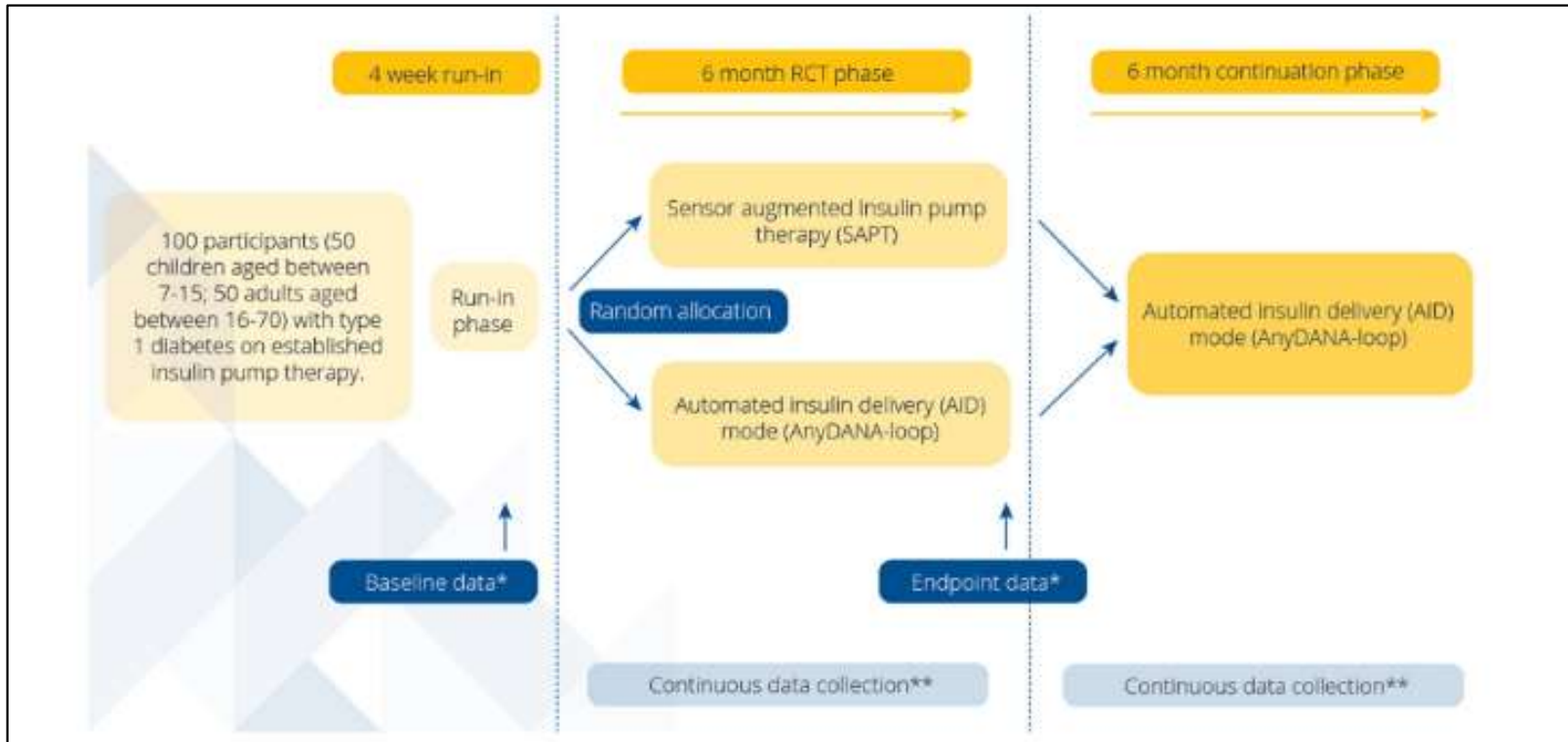


Mehr Katheter-
Verstopfungen



Beschaffungs-
Probleme

Das können DIYAP Systeme. CREATE Trial



The effect was immediate and sustained

Fragen



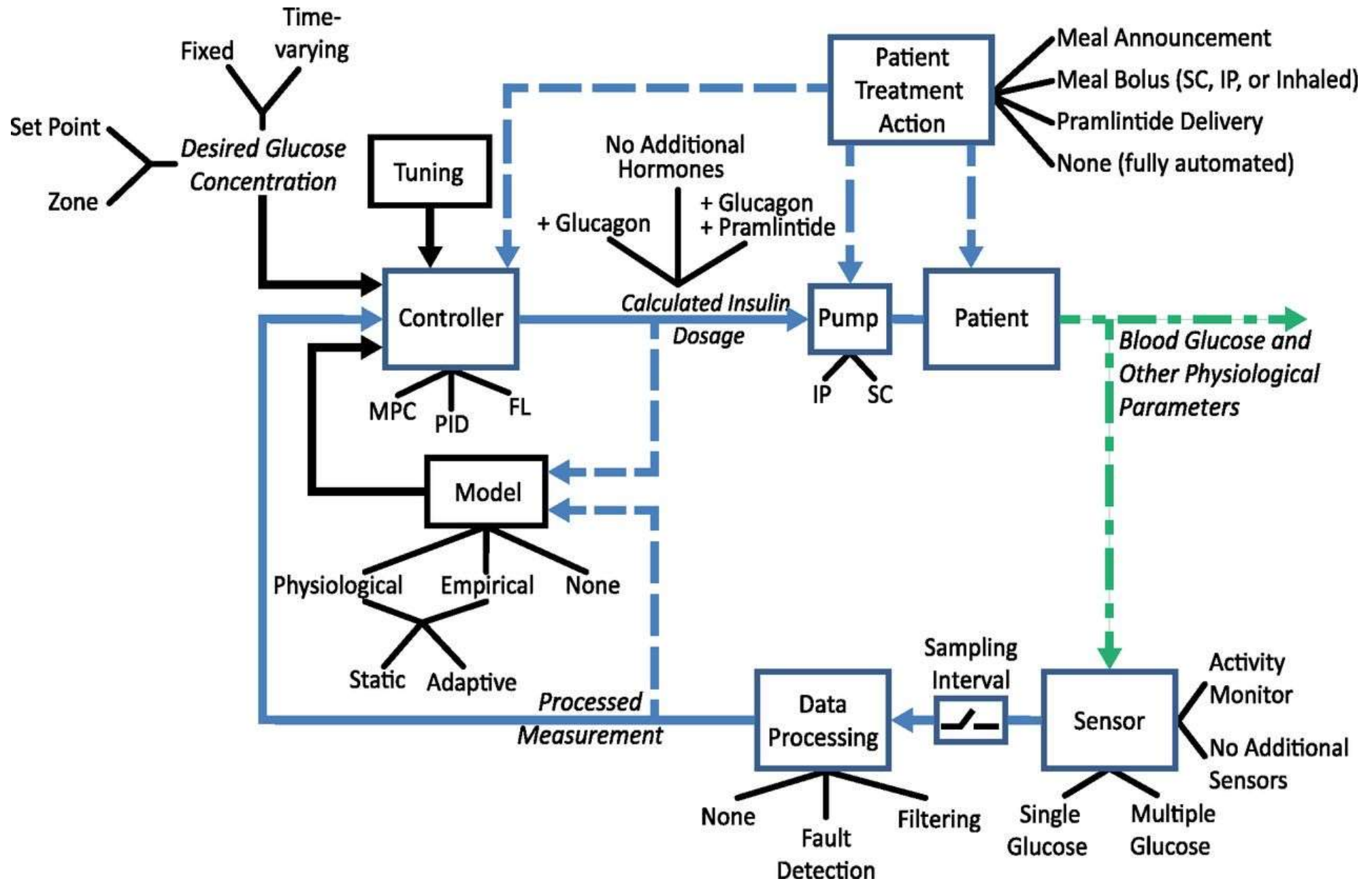
Studiendesigns

[15] (USA and Europe)	209 caregivers in a cross-sectional analysis
[16] (Germany) 2019	A case report of a 49-year-old male with T1DM ⁴ completing half-marathon
[32] (Australia) (2018)	68 respondents in a cross-sectional analysis
[34] (Germany) 2019	A case report of a 57-year-old male with T1DM underwent acute cholecystectomy
[41] (USA) 2016	18 adults in a cross-sectional analysis
[42] (USA)2019	328 participants in a qualitative netnography analysis
[43] (UK) 2019	Perspectives of 2 adults with T1DM and 1 caregiver
[44] (Switzerland, USA)2019	80 adults in a retrospective CGM⁵ record analysis
[44] (Switzerland, USA) 2019	A subcohort analysis of 34 adults changing from SAP ⁶ to OpenAPS
[53] (Czech Republic) 2018	23 adolescents followed up for 3 days in a ski camp
[59] (Italy and Czech Republic) 2019	In silico trials of AndroidAPS algorithms
[32] (Australia) 2018	68 respondents in a cross-sectional analysis

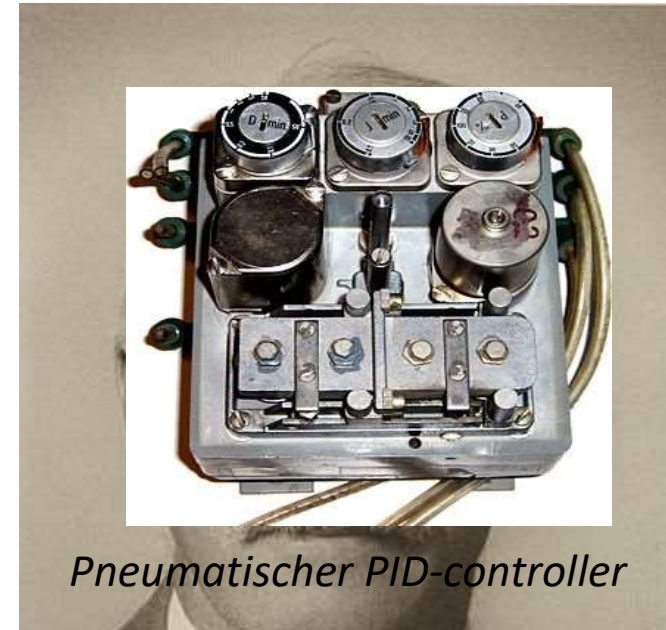
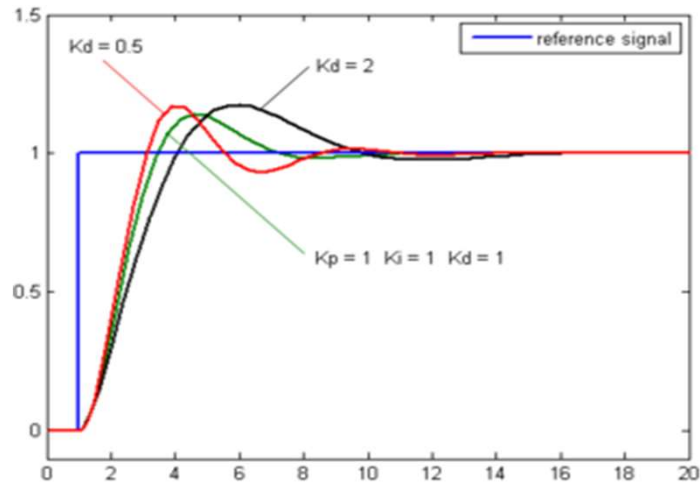


Alte Geräte...

(hybrid) closed loop Systeme – wie gut und wie funktioniert der Algorithmus eigentlich?

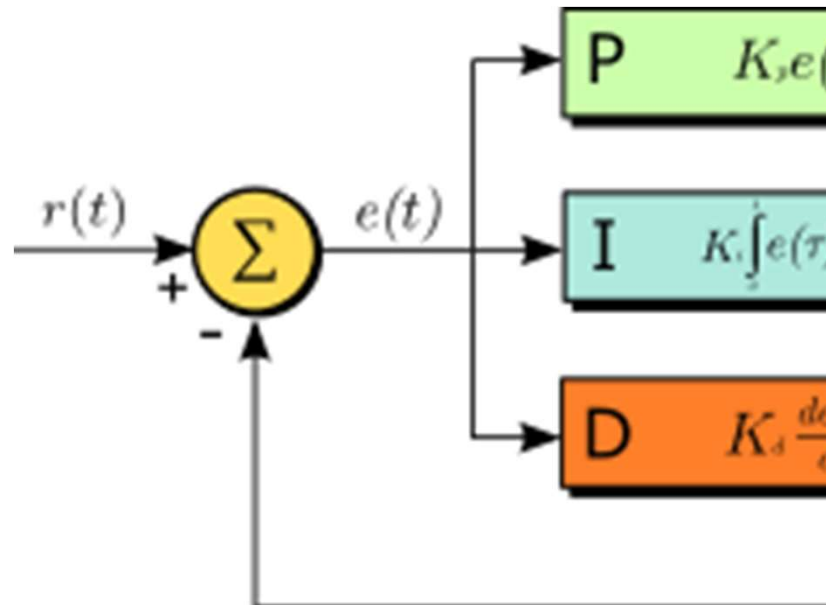


Kontrollalgorithmen und Glukosemodelle – Kernstücke des closed loop systems



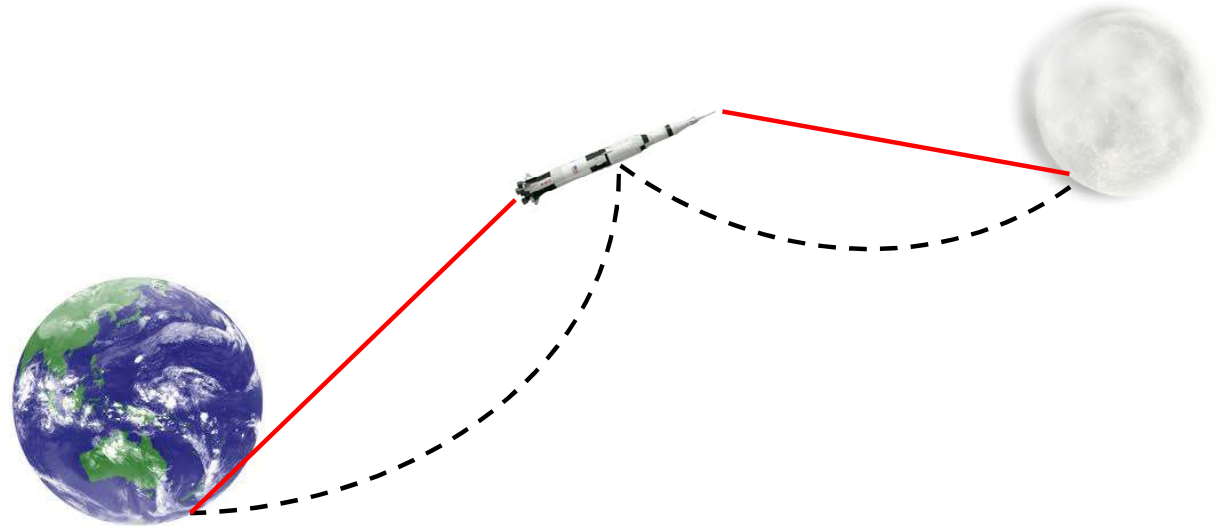
Pneumatischer PID-controller

«Proportional integral derivate»
Kontrollalgorithmus



USS New Mexico, 1925

Margaret Hamilton, Teamleiterin der «AGC Computer Software» für Apollo 11, 1961



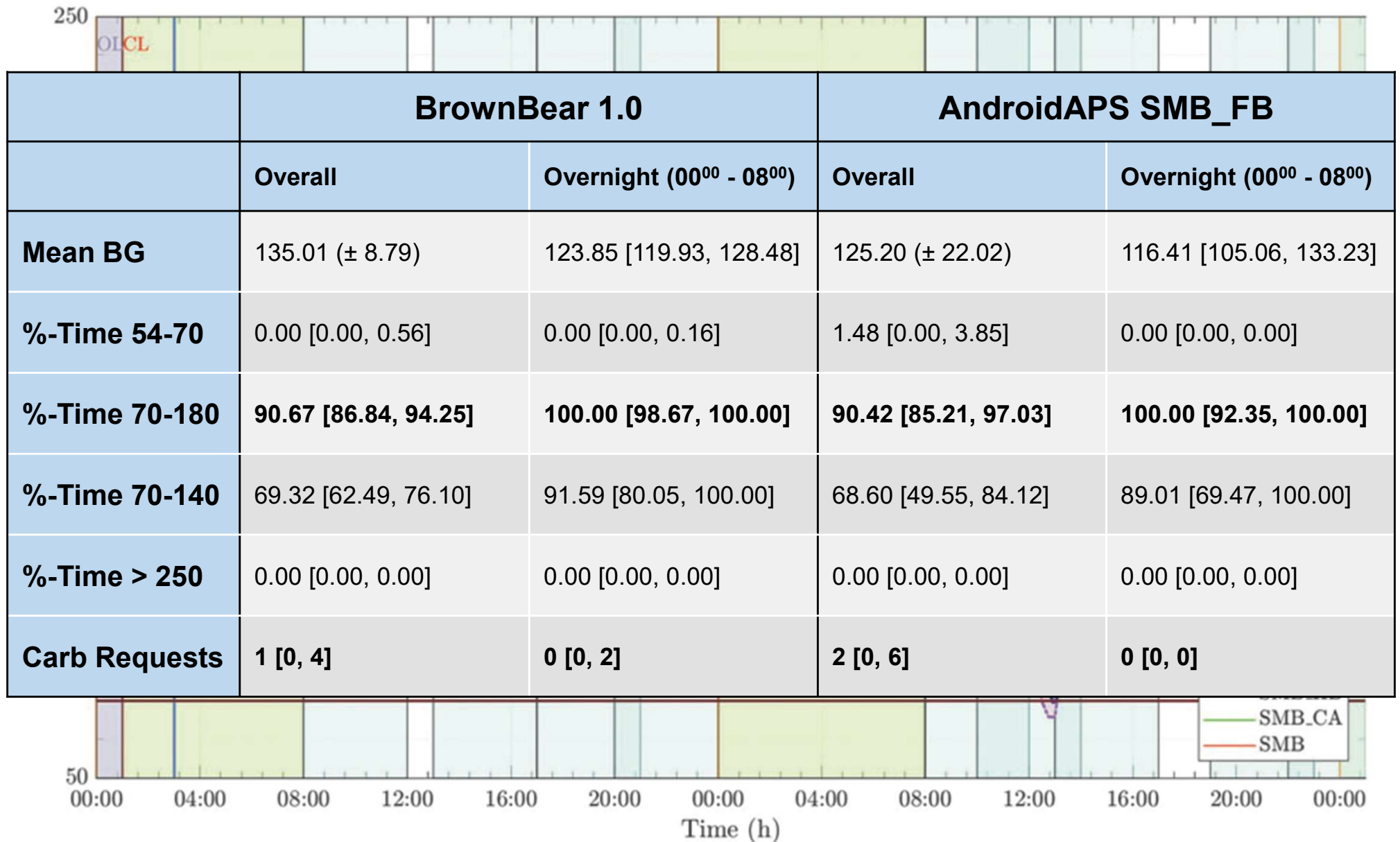
Reading an AGC Program

line	label	opcode	address	comments
0184	P63SPOT3	CA	BIT6	IS THE LR ANTENNA IN POSITION 1 YET
0185		EXTEND		
0186		RAND	CHAN33	
0187		EXTEND		
0188		BZF	P63SPOT4	BRANCH IF ANTENNA ALREADY IN POSITION 1
0189		CAF	CODE500	ASTRONAUT: PLEASE CRANK THE
0190		TC	BANKCALL	SILLY THING AROUND
0191		CAADR	GOPERF1	
0192		TCF	GOTOP00H	TERMINATE
0193		TCF	P63SPOT3	PROCEED SEE IF HE'S LYING
0194	P63SPOT4	TC	BANKCALL	ENTER INITIALIZE LANDING RADAR
0195		CAADR	SETPOS1	
0196		TC	POSTJUMP	OFF TO SEE THE WIZARD...
0197		CAADR	BURNBABY	

```

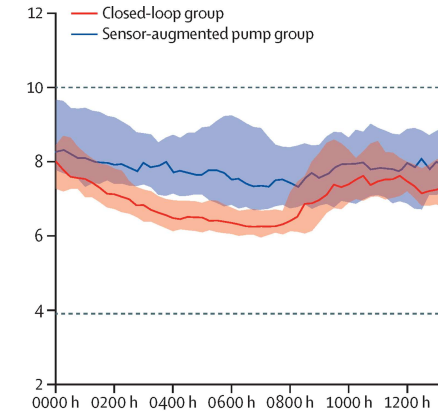
graph TD
    Start(( )) --> Antenna{Antenna in position 1?}
    Antenna -- Yes --> Radar[Initialize landing radar]
    Radar --> Burn[Goto BURNBABY]
    Antenna -- No --> Ask[Ask astronaut to deploy it]
    Ask --> Response{Astronaut response?}
    Response -- Enter --> Radar
    Response -- Proceed --> P00H[Goto program P00H]
    Response -- Terminate --> P00H
    
```

Beispiel «Brownbear»-Algorithmus

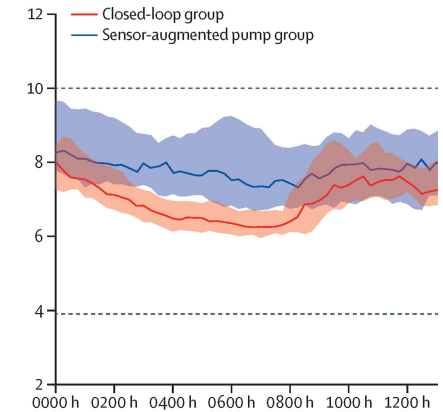


Vorteil von «open source» Algorithmen

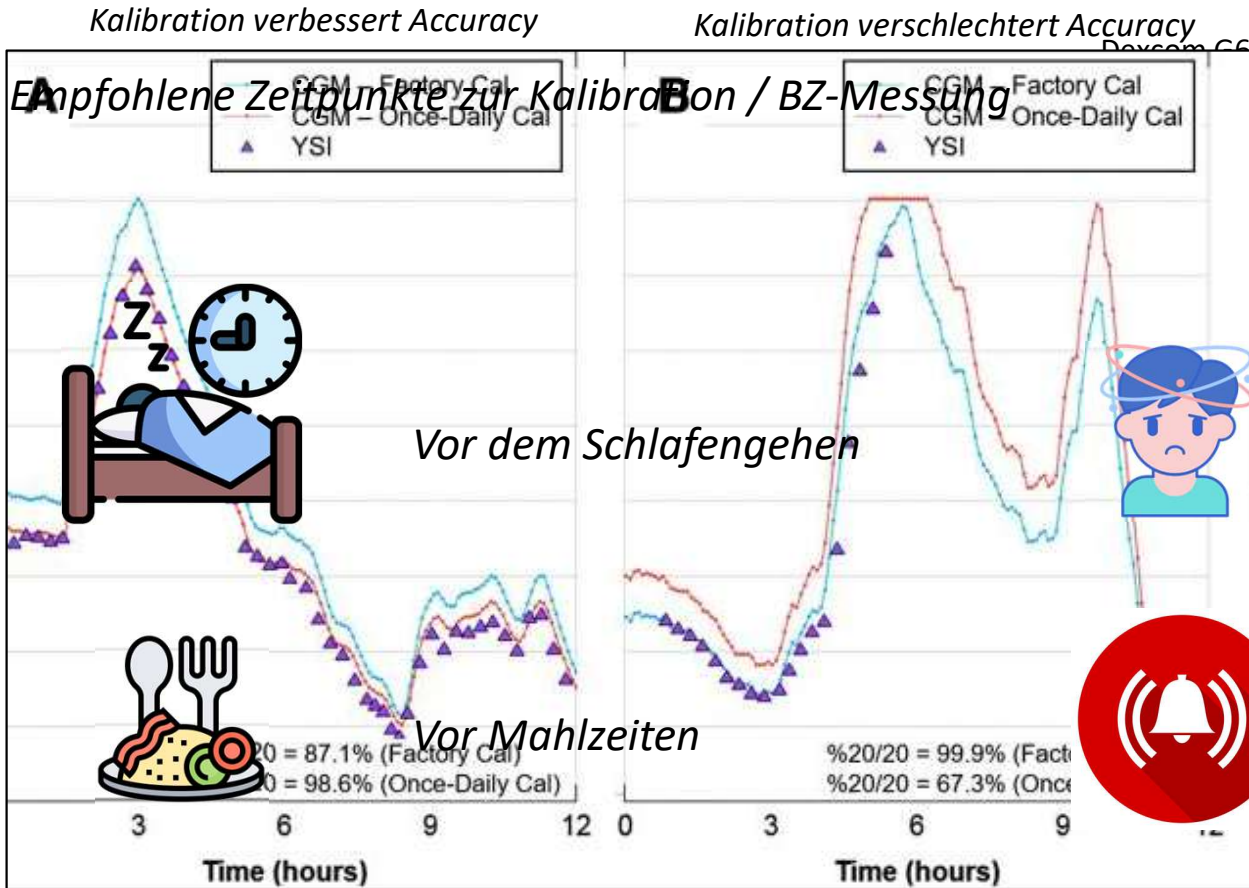
Kommerzielle Systeme



Open Source Systeme



«Common problems» aller Closed-Loop Systeme Sensoren und Kalibration



Freestyle Libre 3 Guardian Connect Eversense

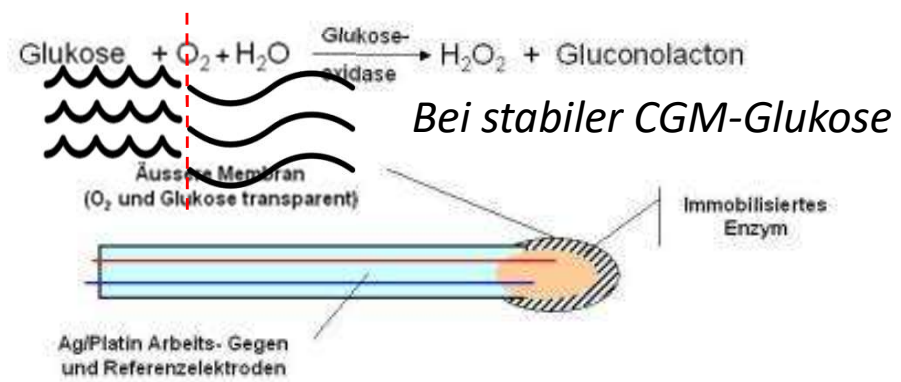
Sensor Error
 Temporary issue. Wait up to 3 hours.
 [Help]

Kalibration notwendig/möglich?
 You will not receive alerts, alarms, or sensor glucose readings.

Bei Symptomen: 9.7% unmöglich, notwendig, notwendig

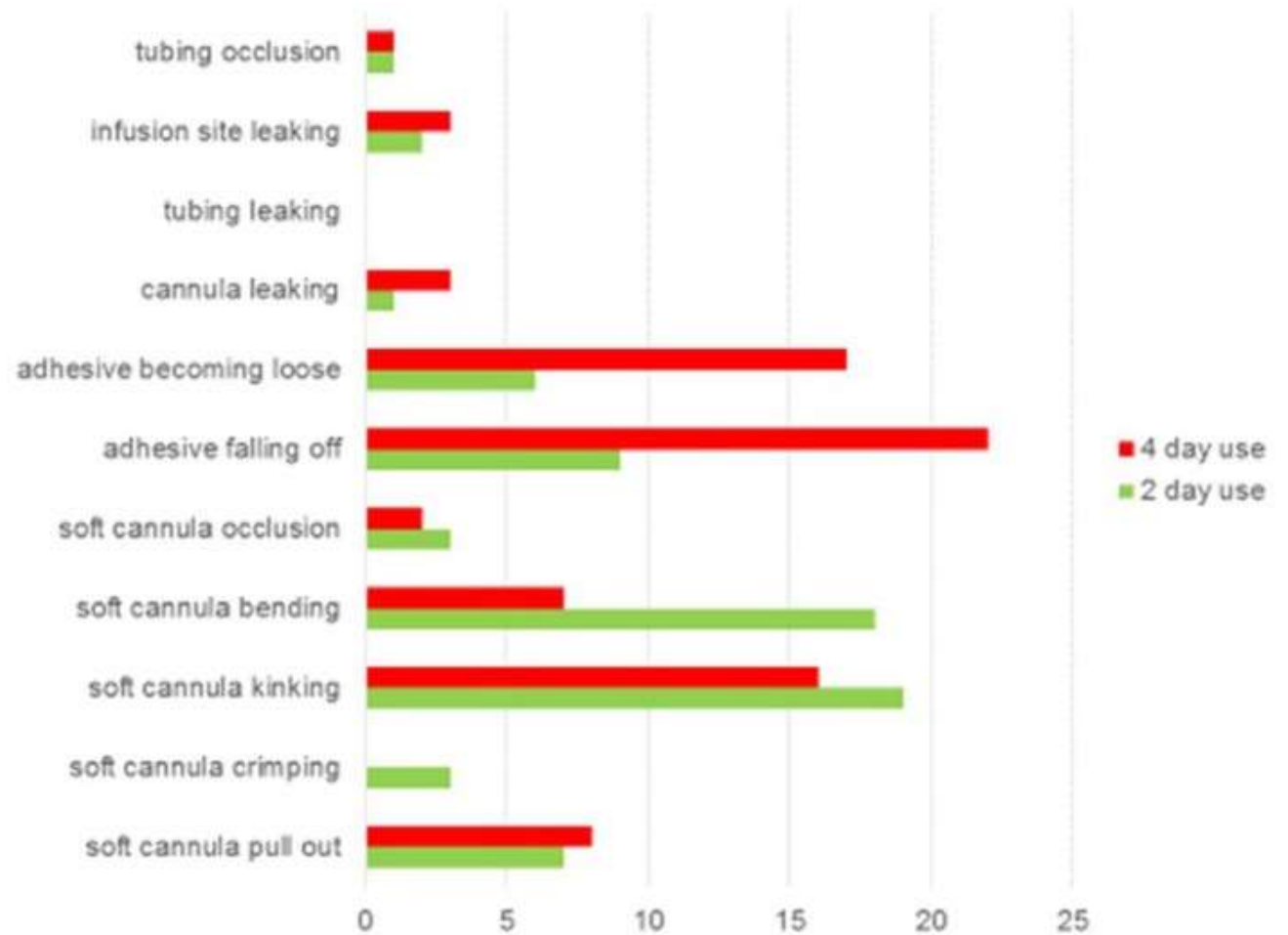
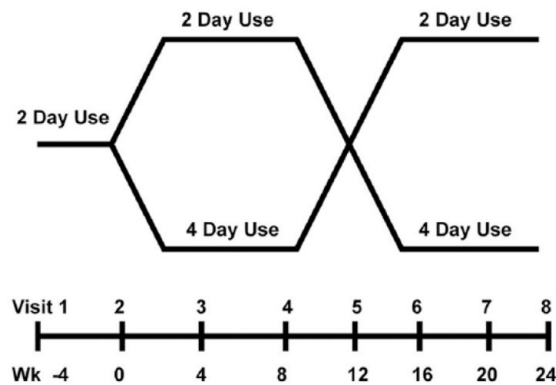
Bei Meldung durch das System

Events Settings



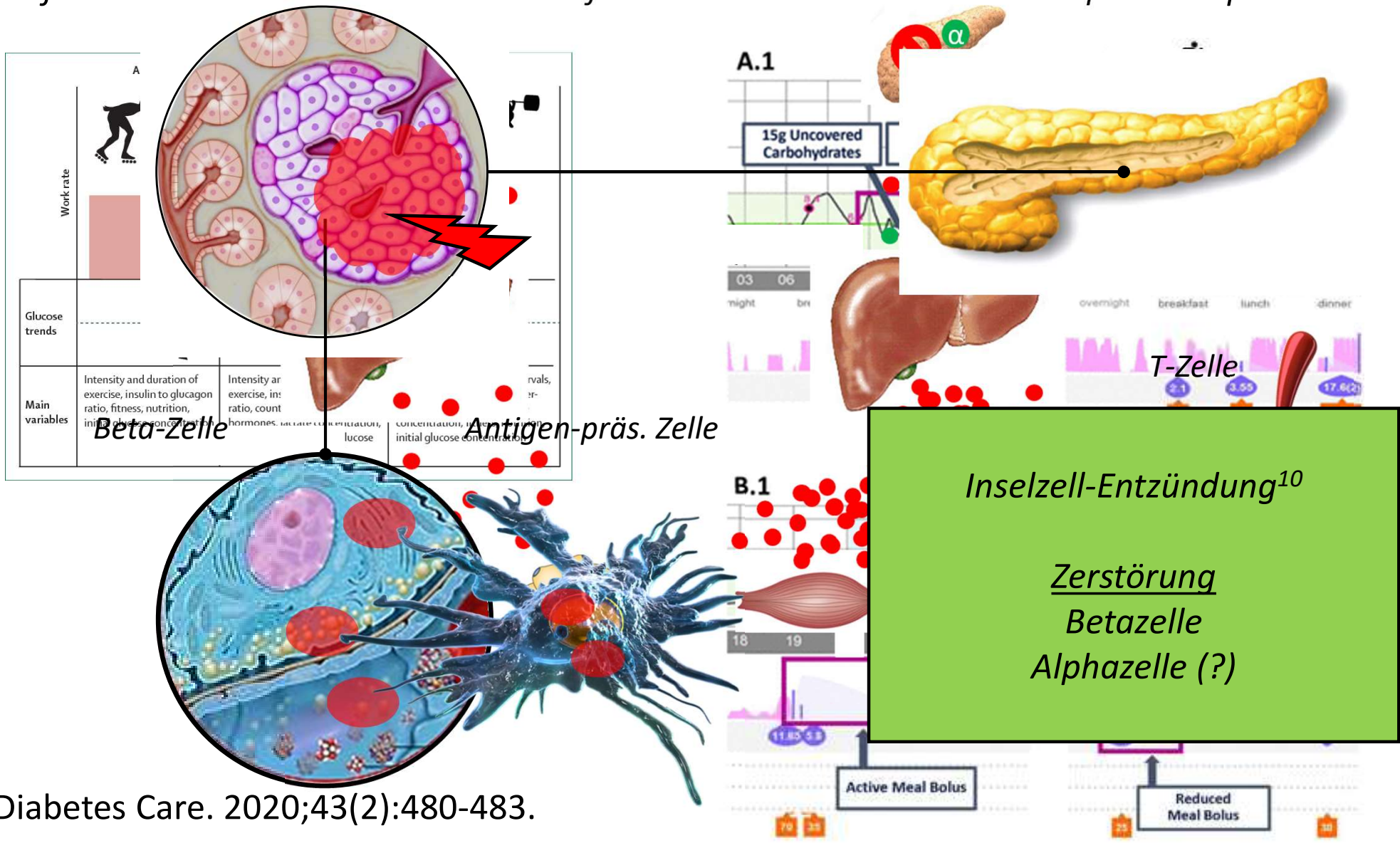
BZ-Wert innerhalb 5 Minuten eingeben
 Zw. 2 Kalibrationen mind. 15 Minuten

Katheterset-Probleme



«Common problems» aller Closed-Loop Systeme – Einflüsse auf den Insulinbedarf

Insulin zur falschen Zeit am falschen Ort
 Fehlende Hormonantwort auf Hypoglykämie
 Einfluss von Sport auf den Insulinbedarf
 Auch mit Closed-Loop: vorausplanen!



Diabetes Care. 2020;43(2):480-483.



Diabeloop-System

Selbstlernender Algorithmus

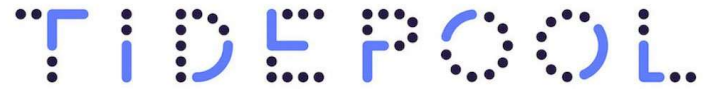
In der Entwicklung enger Austausch mit der DIYAPS community
Patient:innen-orientierte Entwicklung
«Public patient involvement»

«Zen»-Modus



Leichte Erhöhung der Zielwerte (Autofahren,
Training, Prüfungen, etc...)
Keine Erhöhung der Zeit in Hyperglykämie

Fragen – wird DIYAPS irgendwann als Behandlung anerkannt?



open-source Plattform für Diabetesdaten

 Medtronic 670G Mac, Windows	 Dexcom G6 Mac, Windows	 Insulet Omnipod DASH Mac, Windows	 Tandem t:slim X2 Mac, Windows	 Abbott FreeStyle Libre (Reader) Mac, Windows	 Tandem t:slim Mac, Windows	 Tandem t:slim G4 Mac, Windows	 Tandem t:flex Mac, Windows	 Abbott FreeStyle Libre (LibreView) Mac, Windows	 Abbott FreeStyle Libre 2 (LibreView) Mac, Windows
 Dexcom G5 Mac, Windows	 Insulet Omnipod Mac, Windows	 Dexcom G4 Mac, Windows	 Medtronic 640G Mac, Windows	 Medtronic 630G Mac, Windows	 Abbott FreeStyle Libre 2 Pro (LibreView) Mac, Windows	 Abbott FreeStyle Libre 3 (LibreView) Mac, Windows	 MicroTech Equil Mac, Windows	 Ascensia (Bayer) Contour Next Link 2.4 Mac, Windows	 Ascensia (Bayer) Contour Next Link Mac, Windows
 Medtronic 530G Mac, Windows	 Medtronic 754 Mac, Windows	 Medtronic 554 Mac, Windows	 Medtronic 723 Mac, Windows	 Medtronic 523 Mac, Windows	 Ascensia (Bayer) Contour Next One Mac, Windows	 Ascensia (Bayer) Contour Next USB Mac, Windows	 Ascensia (Bayer) Contour USB Mac, Windows	 Ascensia (Bayer) Contour Next Mac, Windows	 Ascensia (Bayer) Contour Next EZ Mac, Windows
 Abbott FreeStyle Libre Pro (Reader)	 Medtronic Guardian Sensor (from pump)	 Medtronic Enlite Sensor (from pump)	 Animas Ping Mac, Windows	 Animas Vibe Mac, Windows	 Ascensia (Bayer) Contour Link Mac, Windows	 Ascensia (Bayer) Contour Mac, Windows	 Ascensia (Bayer) Contour Plus Mac, Windows	 Ascensia (Bayer) Contour Plus One Mac, Windows	 Abbott FreeStyle Freedom Lite

Unklarheiten

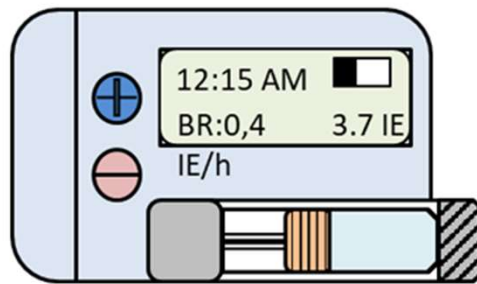


Unklarheiten – wird DIYAPS irgendwann als Behandlung erstattet?



TIDEPOOL

Eingereichter FDA-Antrag



Alte Insulinpumpen...



Open-source automated insulin delivery: international consensus statement and practical guidance for health-care professionals

Katarina Braune, Rayhan A Lal*, Lenka Petruželková, Gary Scheiner, Per Winterdijk, Signe Schmidt, Linda Raimond, Korey K Hood, Michael C Riddell, Timothy C Skinner, Klemens Raile, Sufyan Hussain on behalf of the OPEN International Healthcare Professional Network and OPEN Legal Advisory Group†*

Unklarheiten – sind (DIY)APS für alle die beste Lösung?



Patient*Innen

Kohlenhydrat-Schätzung

Korrektur Hypo + Hyper

Bolus-Timing

Vorbereitung Sport

Instanthaltung

«Alarm-burden»

«Device-burden»



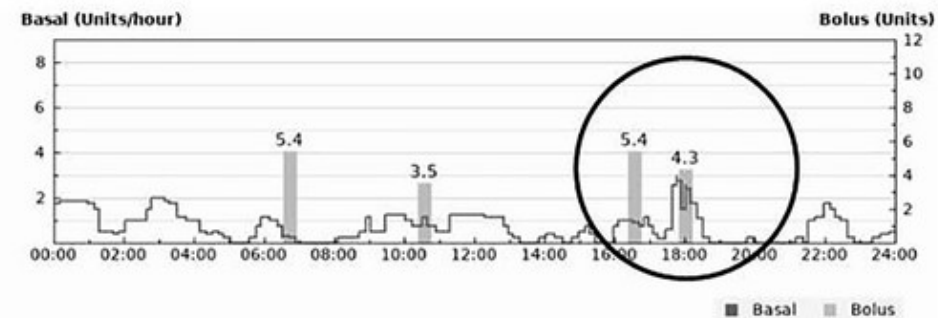
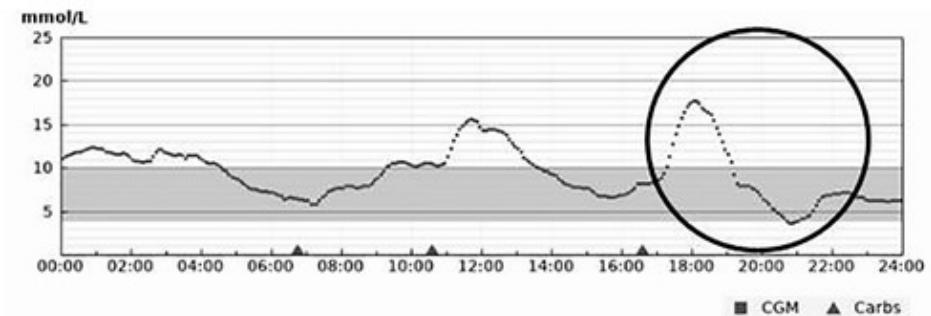
Expert*Innen

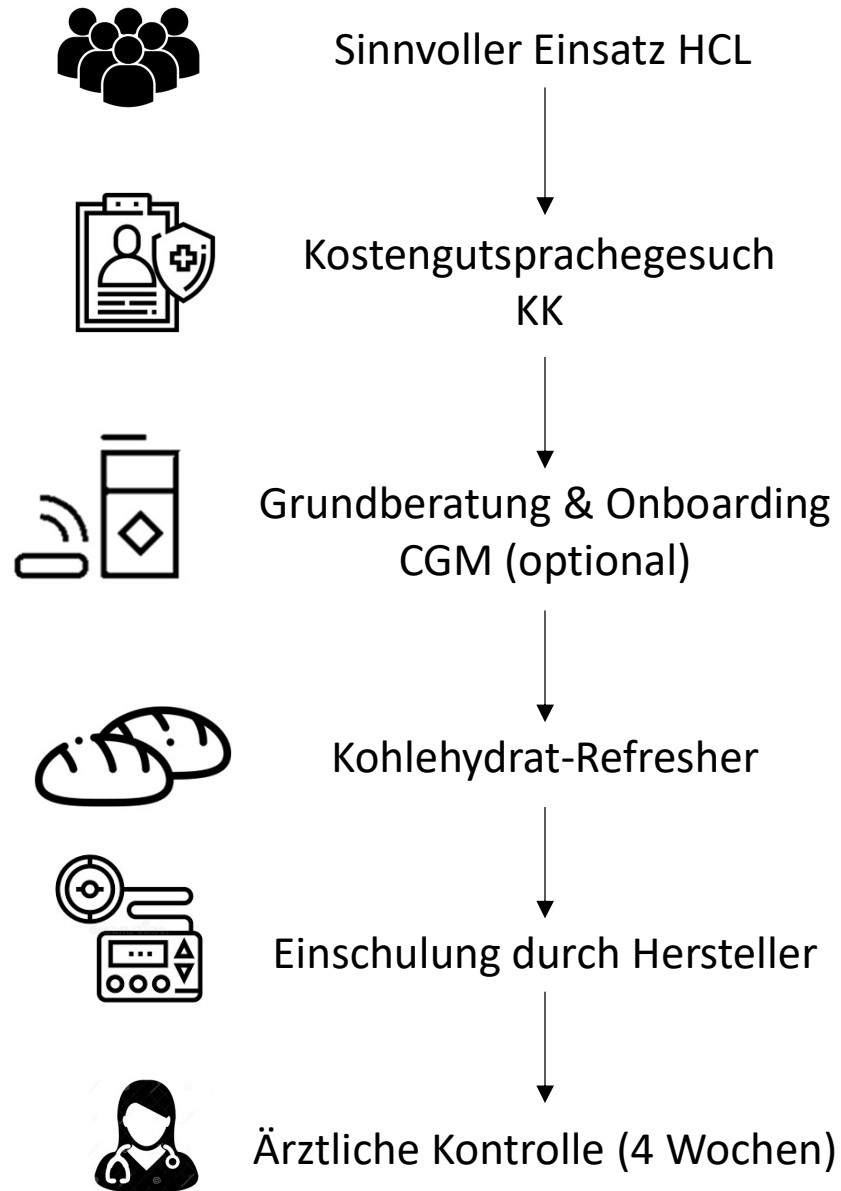
Software-Vielfalt

Interoperabilität

Zeitdruck

Fehleridentifikation





Die wohl wichtigste Tatsache...



DIYAPS – eine Erfolgsgeschichte in Sachen Kommunikation

- Beschleunigung Nutzerorientierter Technik
- Patient:innen = Expert:Innen
- Förderung standardisierter Schnittstellen
- Nutzerorientierte Studien

