Case Study 1.2: ***Insulins suitable for FCL*** V1

Summary from:
https://www.facebook.com/download/831505605647892/What%20about%20insulin%20in%20FCL%20mode.pdf (Jiri Borek)

Method

iAPS using Dexcome g6/7, Dash, iPhone (FCL, but not using autoISF)

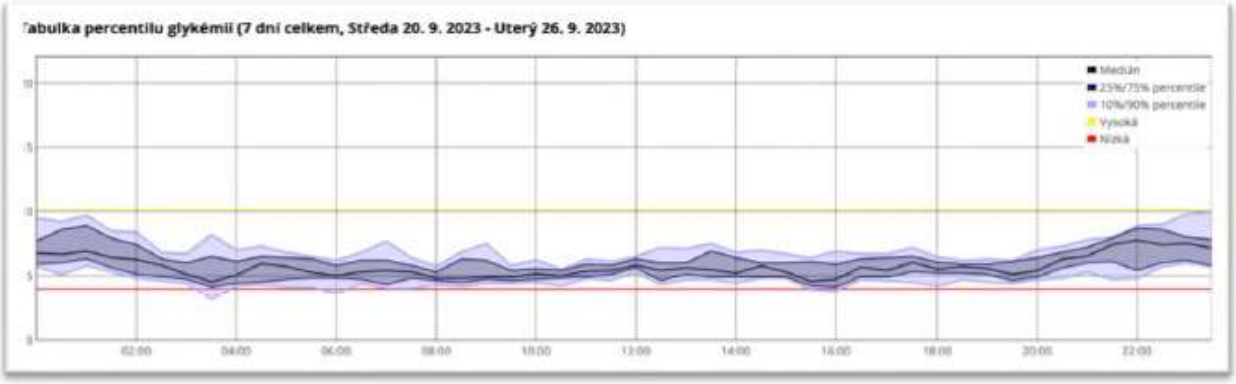
SMB+UAM FCL mode without any bolus or carb input or TT setting by the user. For one full week with a standardized sequence of meals (150 – 300 g carb/d; and no exercise after meals), the FCL performance was established for each of the 4 insulins trialled: Fiasp 100 ui, Apidra 100 ui, Humalog 200 ui, and Lyumjev 200 ui.

And what did I always start with when I changed? Safety is the foundation. So before changing the settings, I first fixed the security limits. Max IOB, Max SMB are the basics. We all want to have nice glucose levels without hyper. But always approach the limits so that the priority is not to protect from hyper, but to not give more insulin than you are able to in case of a problem and cover by finishing the carb. It's silly to put high limits, have it nice and end up in a coma when the sensor jumps! Two hours in hyper has never killed anyone, two hours somewhere alone in a coma can be fatal. Also, never make multiple changes at once while debugging the system. If something doesn't work you won't find out where the error is. Also, before you start pressing anything in the settings be sure of what you are doing. If it's not, please don't do it. Some may be puzzled by the short time to tune the system between insulin. This is due to the fact that I have already studied this system in detail and have been working with the FCL mode since 2020. My first system tune-up (AAPS back then) took maybe half a year, so don't be discouraged by setbacks. And don't bypass security especially, the stress is not worth it. After all, the whole point of FCL is just to take the stress out of dealing with DM.

Apidra

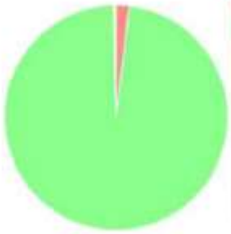
What surprised me about Apidra was the pretty quick onset. It managed the glycemia quire successfully. >But – maybe due to ist longer DIA – I had to feed (against) hypoglycemia a few times. 38 values under 3.9 mmol in 1 week (2% of all values are below range) is not terrible, but created a bit of discomfort taking away from the intended ease in FCL.

Percentil



Rozložení glykemii 3,9-10 mmol

Rozložení glykémií (7 dní celkem, Středa 20. 9. 2023 - Úterý 26. 9. 2023)

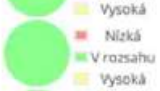


Rozsah	% záznamů	počet záznamů	Průměr	Medián	Standardní odchylka	Předpokládané HBA1c*
Nízká (<3.9):	1.9%	38	3.5	3.7	0.4	
V rozsahu:	97.8%	1967	5.8	5.7	1.2	
Vysoká (>=10.1):	0.3%	7	10.3	10.4	0.1	
Celkem:		2012	5.8	5.7	1.3	5.3%DCCT | 34IFCC

Průměrná celková denní změna	Doba měnící se glykémie (>0.27 mmol/l/5m)	Doba rychle se měnící glykémie (>0.55 mmol/l/5m)
51.07 mmol/L	14.0%	4.0%
Průměrná hodinová změna	**GVI**	**PGS**
2.13 mmol/L	1.28	2.93
Out of Range RMS		
5.42 mmol/L		

Denní statistiky 3,9-10mmol

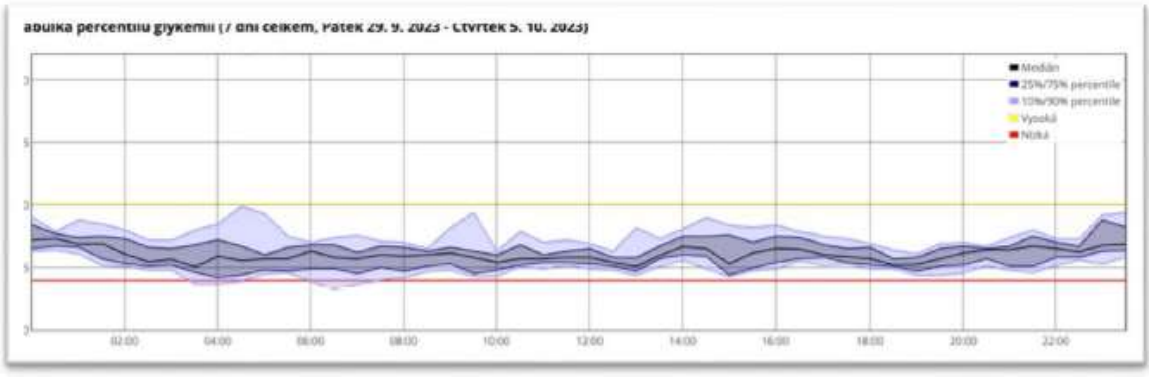
Denní statistiky

	Datum	Nízká	Normální	Vysoká	Záznamů	Min	Max	Průměr	Směrodatná odchylka	25%	Medián	75%
	Úterý 26. 9. 2023	1%	99%	0%	278	3.7	8	5.4	1.0	4.7	5.3	6.0
High carb day												
	Pondělí 25. 9. 2023	3%	97%	0%	279	3.7	9.7	6.0	1.3	5.1	5.9	6.8
	Neděle 24. 9. 2023	3%	97%	0%	277	2.2	8.5	5.5	1.1	4.7	5.4	6.2
	Sobota 23. 9. 2023	2%	98%	0%	287	2.9	9.9	6.2	1.5	5.2	5.8	6.9
	Pátek 22. 9. 2023	4%	94%	2%	288	2.4	10.7	6.0	1.5	5.0	5.8	6.7
Low carb day												
	Čtvrtek 21. 9. 2023	0%	100%	0%	286	4	8.4	5.7	1.0	4.8	5.4	6.4
	Středa 20. 9. 2023	1%	99%	0%	285	3.7	8.9	5.8	1.2	4.8	5.8	6.6

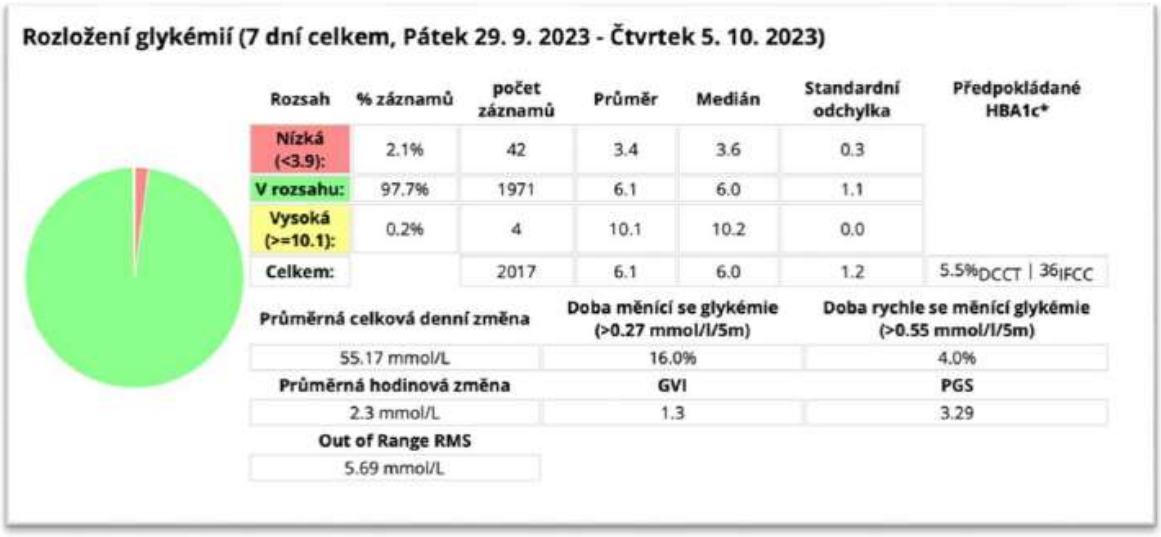
Fiasp

I observed some problems also many others have reported, like or tendency towards partial occlusions and elevated insulin need with cannula age. In FCL operation (with regular pod changes, and the typical smaller boli occurring in FCL) overall Fiasp worked well and fairly muchg replicated the good resultzs as was reported for Apidra:

Percentil



Rozložení glykemii 3,9-10 mmol

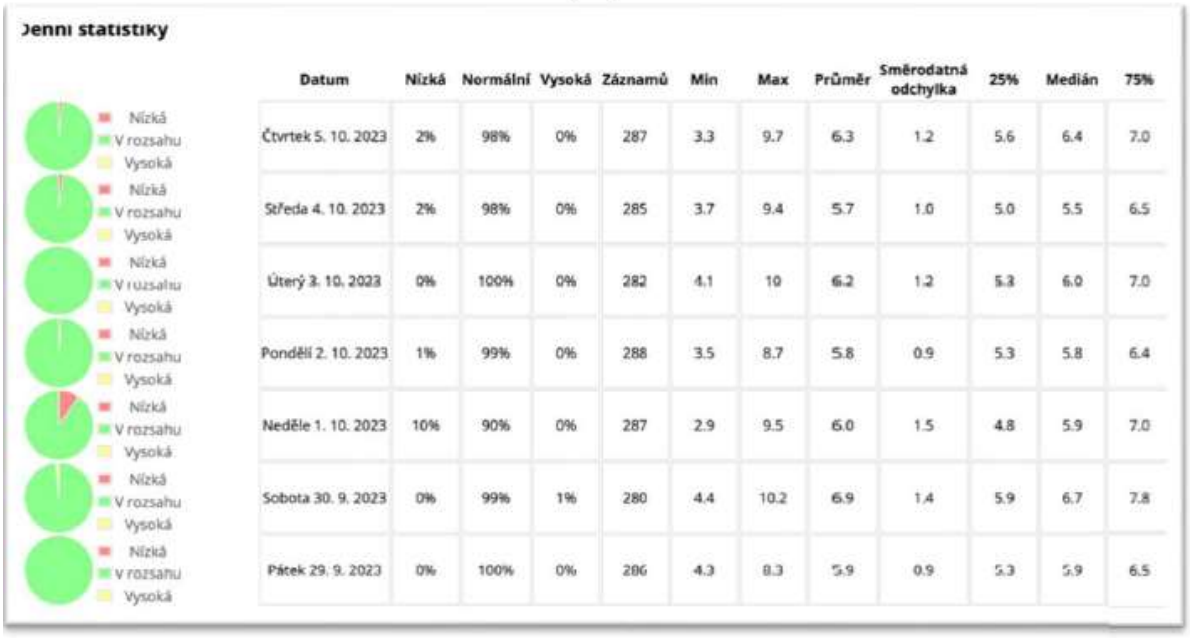


Rozložení glykémií (7 dní celkem, Pátek 29. 9. 2023 - Čtvrtek 5. 10. 2023)

Rozsah	% záznamů	počet záznamů	Průměr	Medián	Standardní odchylka	Předpokládané HBA1c*
Nízká (<3.9):	2.1%	42	3.4	3.6	0.3	
V rozsahu:	97.7%	1971	6.1	6.0	1.1	
Vysoká (>=10.1):	0.2%	4	10.1	10.2	0.0	
Celkem:		2017	6.1	6.0	1.2	5.5%DCCT | 36IFCC

Průměrná celková denní změna	Doba měnící se glykémie (>0.27 mmol/l/5m)	Doba rychle se měnící glykémie (>0.55 mmol/l/5m)
55.17 mmol/L	16.0%	4.0%
Průměrná hodinová změna	**GVI**	**PGS**
2.3 mmol/L	1.3	3.29
Out of Range RMS		
5.69 mmol/L		

Denní statistiky 3,9-10mmol



Denní statistiky

	Datum	Nízká	Normální	Vysoká	Záznamů	Min	Max	Průměr	Směrodatná odchylka	25%	Medián	75%
Nízká V rozsahu Vysoká	Čtvrtek 5. 10. 2023	2%	98%	0%	287	3.3	9.7	6.3	1.2	5.6	6.4	7.0
Nízká V rozsahu Vysoká	Středa 4. 10. 2023	2%	98%	0%	285	3.7	9.4	5.7	1.0	5.0	5.5	6.5
Nízká V rozsahu Vysoká	Úterý 3. 10. 2023	0%	100%	0%	282	4.1	10	6.2	1.2	5.3	6.0	7.0
Nízká V rozsahu Vysoká	Pondělí 2. 10. 2023	1%	99%	0%	288	3.5	8.7	5.8	0.9	5.3	5.8	6.4
Nízká V rozsahu Vysoká	Neděle 1. 10. 2023	10%	90%	0%	287	2.9	9.5	6.0	1.5	4.8	5.9	7.0
Nízká V rozsahu Vysoká	Sobota 30. 9. 2023	0%	99%	1%	280	4.4	10.2	6.9	1.4	5.9	6.7	7.8
Nízká V rozsahu Vysoká	Pátek 29. 9. 2023	0%	100%	0%	286	4.3	8.3	5.9	0.9	5.3	5.9	6.5

Humalog

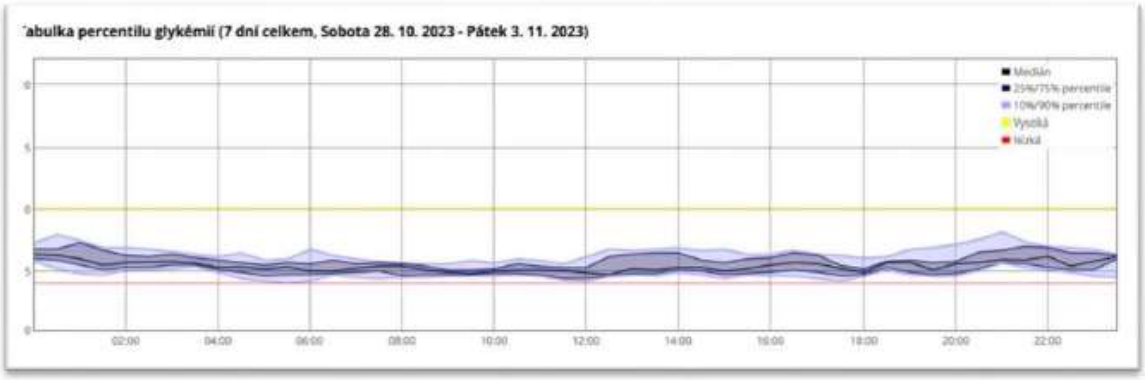
Of the tested insulins, it was the

slowest and had the longest DIA. Unfortunately, that showed. Even after 14 days, I was not happy with the settings and behavior of the system. Hyper was taking turns with hypo. So I didn't even try FCL with this insulin in the end. The 90% in TIR of 3.9-10 mmol in hybrid mode was enough warning for me not to do it. Hyper wouldn't have mattered anyway. But those hypoglycemic episodes due to his long DIA were pretty uncomfortable and long lasting.

Lyumjev

Lyumjev is the insulin with fastest onset and shortest DIA. At the 3.9-10 mmol TIR level, where I has also with Apidra and Fiasp reached ~97%TIR, the difference was less obvious…

Percentil



Rozložení glykemii 3,9-10 mmol

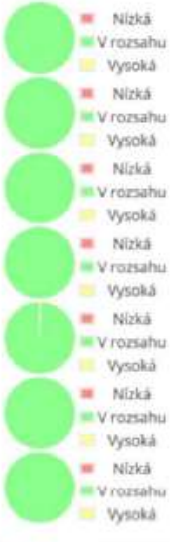
Rozložení glykémií (7 dní celkem, Sobota 28. 10. 2023 - Pátek 3. 11. 2023)

Rozsah	% záznamů	počet záznamů	Průměr	Medián	Standardní odchylka	Předpokládané HBA1c*
Nízká (<3.9):	0.0%	1	3.8	3.8	0.0	
V rozsahu:	100.0%	2015	5.5	5.4	0.8	
Vysoká (>=10.1):	0.0%	0	N/A	N/A	N/A	
Celkem:		2016	5.5	5.4	0.8	5.1%DCCT | 32IFCC

Průměrná celková denní změna	Doba měnící se glykémie (>0.27 mmol/l/5m)	Doba rychle se měnící glykémie (>0.55 mmol/l/5m)
34.15 mmol/L	7.0%	1.0%
Průměrná hodinová změna	**GVI**	**PGS**
1.42 mmol/L	1.14	0
Out of Range RMS		
5.03 mmol/L		

Denní statistiky 3,9- 10mmol

Denní statistiky



Datum	Nízká	Normální	Vysoká	Záznamů	Min	Max	Průměr	Směrodatná odchylka	25%	Medián	75%
Pátek 3. 11. 2023	0%	100%	0%	286	3.9	8.8	5.6	1.1	4.9	5.4	5.9
Čtvrtek 2. 11. 2023	0%	100%	0%	284	4.1	7.2	5.4	0.8	4.7	5.3	6.0
Středa 1. 11. 2023	0%	100%	0%	283	3.9	7.5	5.5	1.0	4.8	5.2	6.4
Úterý 31. 10. 2023	0%	100%	0%	287	4.3	7.5	5.5	0.7	5.0	5.3	5.8
Pondělí 30. 10. 2023	0%	100%	0%	287	3.8	7	5.5	0.7	5.0	5.4	6.0
Neděle 29. 10. 2023	0%	100%	0%	287	4.1	7.8	5.5	0.7	5.1	5.6	5.9
Sobota 28. 10. 2023	0%	100%	0%	287	4.2	7.4	5.6	0.8	4.9	5.6	6.3

It is very interesting that with Lyumjev I reached the lowest predicted HbA1c (5.1%), despite it coming with a vastly lower incidence of low (0,0% <3.9) values when comparing with Apidra (5.3 % HbA1c @ 1,9% <3.9) and Fiasp (5.5 % HbA1c @ 2,1% <3.9).

The superior performance of Lyumjev to control highs is responsible for this – see conclusion.

Conclusion

Lyumjev clearly is the best insulin for my FCL.

- It showed practically no tendency towards hypoglycemia.
- It controlled peaks the best.

This can be best seen when comparing %TIR (3.9 – 7.9 mmol/L)(70-142 mg/dl) between the studied insulins:

Rozsah	% záznamů	počet záznamů	Průměr	Medián
Nízká (<3.9):	1.9%	38	3.5	3.7
V rozsahu:	90.6%	1823	5.6	5.6
Vysoká (>=7.9):	7.5%	151	8.7	8.5
Celkem:		2012	5.8	5.7

Průměrná celková denní změna | Doba měnící se glykémie

Apidra

Rozsah	% záznamů	počet záznamů	Průměr	Medián
Nízká (<3.9):	2.1%	42	3.4	3.6
V rozsahu:	88.3%	1781	5.9	5.9
Vysoká (>=7.9):	9.6%	194	8.6	8.4
Celkem:		2017	6.1	6.0

Doba měnící se glykémi

Fiasp

Rozsah	% záznamů	počet záznamů	Průměr	Medián
Nízká (<3.9):	0.0%	1	3.8	3.8
V rozsahu:	99.2%	1998	5.5	5.4
Vysoká (>=7.9):	0.8%	17	8.2	8.2
Celkem:		2016	5.5	5.4

Doba měnící se glykémie

Lyumjev

Fiasp and Apidra had about 10 times as many bg values in the elevated range, above 7.9 mmol/L (142 mg/dl).
It is worth noting here again, that the researched range of meals went up to 300 g carb content (which is a „stress test“, way above my usual range). Loopers on a low carb diet might see FCL viable maybe even using Humalog (ref D. Burren - ?check?)

Besides the performance data reported above, for me this translates also in very important ways into peace of mind and quality of life as a T1D .
FCL with Lyumjev allows me to not watch myself and my diabetes but to trust the system 99.9% of the time.

The only thing I address is checking the sensor twice a day with a glucometer. Maybe an unnecessary precaution for some, but it is also necessary to realize how aggressively the FCL mode is set up to work as it should. Therefore, I would avoid it even with a lesser quality sensor and not run it immediately after starting the sensor. If you use a Dexcom G7 that hums a lot then be sure to activate the "smooth glucose value" function in the CGM tab, it can iron out those values. Without activating this function you have to think about how to adjust the loop response to the delta. It is one of the parameters that you need to be aggressive on the FCL.

Disclaimer: This is a report on testing weeks done by an experienced FCL user (FCL with AAPS or iAPS since nearly 3 years). Prior to each testing week, up to 10 days were spent to fine tune settings for the insulin in use. Effects from sickness, strenuous exercise etc. were excluded. Attention to technical system function (CGM performance, bluetooth stability, timely cannula changes to limit occlusion) was high in these testing weeks, too.