Managing low glucose levels (HYPOS) with the CamAPS FX closed-loop insulin delivery system

Hypoglycaemia (hypos) occurs when glucose levels drops below 3.9 mmol/L. Hypos happen when there is more insulin than required circulating in the body (e.g. due to unplanned physical activity or when a meal bolus is given late).

Signs and symptoms are different from person to person and in different age groups, but can include:

- Feeling hungry
- Headaches
- Feeling faint
- Looking pale
- Tingling lips
- Having a cold sweat
- Shaking hands or tremors
- Difficulty concentrating
- Blurred vision
- Mood changes
- Unconsciousness

Hypo symptoms may change over time. If anyone experiences any hypo symptoms, but their current sensor glucose reading is not low, please check the blood glucose with a fingerprick test.

10 Top Tips for managing Hypos on closed-loop…

1. **Most people find that they need less hypo treatment to manage a hypo on closed-loop than they needed when using injections or standard insulin pump therapy.** Often, half of the previous hypo treatment can be enough because the closed-loop system is likely to have delivered very little or no insulin in the time leading up to the hypo in its effort to avoid it. Review the system's insulin delivery by turning the app on its side (landscape view) to help decide how best to treat the low.

2. **Use the direction arrows and alarms to help prevent hypos.** We suggest setting the low glucose alert at a level which gives enough time to review the recent insulin delivery, rate of fall and current trend arrows to help decide if any additional carbohydrate (hypo treatment) is needed and how much is required. If the closed-loop system has already shut off insulin delivery for the last 45 minutes or longer, you may be able to have a smaller amount of hypo treatment when the low alert sounds, or even none. Try not set the low glucose alert too high, which will cause lots of alarms and may result in later ignoring them, or too low so that there isn't time to act to prevent the hypo.

3. **Accurate counting of carbohydrate is essential to increase the time spent in target glucose range (TIR).** It is worth revisiting carbohydrate counting, get the scales out and weigh portions every now and again to ensure the carbohydrate counting is accurate.

4. **Check if the carbohydrate : insulin ratios are right by reviewing what happens to closed-loop insulin delivery following a meal bolus.** The best way to review is using Diasend and choosing "Comparison" and the "Day by Day" view. After a meal bolus, look to make sure the system doesn't back off so much it delivers nothing and nor does it have to dramatically increase insulin delivery after the meal-time bolus have been given. If no insulin is delivered after a meal bolus, the ratio might be too strong. If the system needs to deliver lots of insulin after the meal bolus, the ratio might be too weak.

5. **Try to give the meal bolus 10 – 15 mins before eating.** For younger children, in whom you can't guarantee will eat the full meal, use the bolus calculator to deliver a bolus to cover a percentage of the meal upfront and then give another bolus for the rest as soon as they are finished eating. The percentage that is given first is very individual and will depend on their eating speed, food preferences, meal, etc. Giving all the bolus after eating can cause delayed hypos 1-2 hours after the meal.

6. **Putting "Ease-Off" on 60-90 minutes before planned activity, running it for the duration and a and for a few hours afterwards if required can help reduce the risk of hypos.** "Ease-off" makes the algorithm less aggressive by raising the target glucose, reducing the amount of insulin delivered and even stopping insulin delivery if glucose is below 7mmol/L. You will need to experiment with the timing of when to start and stop "Ease-Off" that best suits you and the activity being done.

7. **For cardiovascular exercise (e.g. running or cycling) of high intensity or of a longer duration, "Ease-Off" alone may not be enough and some people find they may need to drizzle in additional carbohydrate during the activity.** Try to avoid carbohydrate loading before the activity as the system will increase insulin delivery to try to cover the rising glucose levels, but rather take small amounts of carbs throughout the activity. Some people find that they even need to take the system out of auto-mode and run a significantly reduced temporary basal rate, or even disconnect the insulin pump during the activity and use "Ease-Off" once re-connected.

8. **If there has been a run of hypos, try raising the personal glucose target for a few days by 1-2mmol/L, (e.g. change from 5.8mmol/L to 7.5mmol/L) until things settle down.** Then you can drop it back down. You can set a different personal glucose target at different times of the day and night. This might be especially useful when you first start using the system or change your routine, like start a new job, return to school, go on holiday, etc.

9. **Avoid "Rage" bolusing to correct an above target glucose.** If you have a high glucose level (assuming it is not due to a set failure) the system will be working hard to deliver additional insulin to get your glucose back to target. Remember that insulin will not be at its most active until approx. 1hr after being delivered. You may like to consider using "Boost" to help the system be more aggressive, but please take account of additional insulin delivered by the system before giving an additional correction bolus. This will help to avoid the inevitable hypo caused when too much insulin is given.

And finally…

10. **Hypos can still occur even when you are using closed-loop.** Using "Ease-Off", especially in relation to activity, will reduce the risk of hypos, but not completely eliminate it. If glucose levels are dropping, the closed-loop system will have already reduced its insulin delivery significantly and may have even stopped giving any insulin to try to prevent a hypo. Starting "Ease-Off" when the system has already switched off its insulin delivery will not have any effect and taking additional carbohydrate is recommended to prevent a hypo.

Don't forget to tick "hypo treatment" in the "add meal" menu on the CamAPS FX app to capture the amount of hypo treatment taken. Doing this will show the treatment on the Diasend data to help look for patterns, but also alter the system so it knows those carbohydrates are hypo treatment.