INSULIN CALCULATIONS CHEAT SHEET

Note: TDD=Total daily Dose, ICR=Insulin to Carbohydrate Ratio, ISF=Insulin Sensitivity Factor, ICF=Insulin Correction Factor

Insulin Calculation	Example	How to understand
ICR: 500/TDD (basal and bolus combined)	One of your patients with type 2 diabetes is on 20 units of Toujeo (concentrated glargine) once daily and 10 units of FIASP (aspart) three times a day with each meal. The patients total daily dose is 20+10+10+10=50 so 500/50= 1 unit per 10 grams of carbohydrate	This equation assumes that an average person consumes 500 grams of carbohydrate per day. The higher the TDD the higher the insulin resistance. Higher insulin resistance means the patient needs more insulin for every carbohydrate they consume. For the CDE™ exam use this equation. In real life I don't find this equation very accurate. 500 grams of carbohydrate is equal to 33 slices of bread! Please see the two alternate ways of calculating insulin to carb ratio at the end. However you could use this as a starting point for a patients ICR.
ISF or ICF (same thing): If on rapid acting insulin: 100/TDD If on regular or fast acting insulin: 83/TDD	Your patient is on Apidra (glulisine) 20 units three times a day and Xultophy (degludec/liraglutide) 40 units/1.44mg once daily. 20+20+20+40=100 so 100/100= 1 mmol/L drop for every 1 unit of rapid insulin	These equations were originally developed by Dr Paul Davidson in Atlanta, Georgia based on his experience with treating patients with diabetes. For regular insulin he developed the 83 rule. Because the blood sugar tends to drop faster and farther on rapid acting insulins, like Humalog (lispro) and Novorapid (aspart), the 100 rule is used. These equations predict how much one unit of insulin drops blood sugar.
	Your patient is on Humulin R (regular insulin) 7 units three times a day with each meal and 20 units of Toujeo (concentrated glargine) once daily. 7+7+7+20=41. 83/41= 2 mmol/L drop for every 1 unit of regular insulin.	
Switching from BID (twice daily) basal insulin dosing to QD (once daily) basal insulin dosing = reduce dose by 20%	You have a patient who takes 50 units of NPH insulin twice daily. You switch him to Lantus (glargine) once daily. So 50+50=100 x 0.8 = 80 units of Lantus (glargine) once daily	This was originally part of the Lantus monograph. When switching to twice daily NPH to once daily Lantus, researchers usually reduced the dose by 20%. Since then, it has become a general insulin adjustment rule to reduce the dose by 20% when switching from twice daily basal insulin to once daily basal insulin. In my own experience, patients lose trust/confidence in you, if you suggest switching insulins and then they experience hypoglycemia. So, it's better to be safe than sorry

Switching from multiple daily injections to continuous subcutaneous infusion = reduce TDD by 25% then split 60/40 bolus/basal	You have a patient who is switching onto an insulin pump. Currently she is on Humalog 5 units three times a day with meals and Basaglar (glargine) 85 units once daily. So 5+5+5=85= 100 TDD. 100 x 0.75= 75 units. 75 x 0.6= 45 bolus so 45/3= 15 units bolus with each meal and 75 x 0.4= 30 units of basal NOTE: Insulin pumps only use rapid insulin	A normal pancreas secretes small amounts of insulin (monomers, the active form of insulin) continuously throughout the day. During meals, a normal pancreas will secrete large amounts of insulin in a biphasic pattern. Subcutaneous (SC) basal insulin injections do not simulate normal pancreas secretion as well as an insulin pump. After injection, basal insulin forms a depot in the SC layer of the skin where it slowly disassociates into monomers. Some of the basal insulin is degraded as it sits in the SC skin layer. Insulin pumps simulate normal pancreas secretion better by pumping small amounts of rapid acting insulin that are better absorbed and do not degrade. This results in more efficient absorption, so you need to lower the dose when switching from MDI to insulin pump.
A1c to average blood glucose= ((A1c-6) x2) + 6 = average BG in mmol/L	You have a patient who has an A1c of 10%. His average BG is: ((10-6) x 2) +6= average 14 mmol/L	There is usually a question on the exam where a patient says his A1c is X% and asks what is his average mmol/L? This is an easy formula to learn for the exam and in real life.
Basal insulin start= Start with 10 units once daily	10 units is the suggested starting dose for basal insulin starts. You can choose a lower dose if the patient is elderly or patient's body weight is normal to low	See Appendix 9 on pg S317 on the 2018 Diabetes Canada guidelines for more information
Bolus insulin start= Start with 2-4 units	Start with 2-4 units at one meal of the day. You do not need to start with all three meals. The StepWise study showed that patients get the most benefit with the first bolus dose at a meal and get less benefit with each additional bolus dose at meals.	See Appendix 9 on pg S317 on the 2018 Diabetes Canada guidelines for more information
Mixed insulin start= 5-10 units once or twice daily	Usually, people are started on 5-10 units with breakfast and supper. Remember the older regular insulin mixes need to be taken 30 minutes before meals.	See Appendix 9 on pg S317 on the 2018 Diabetes Canada guidelines for more information

Switching from Multiple Daily Injections (MDI) to Twice daily Mixed insulin. Add bolus insulin together then divide dose by 2. Add basal insulin together then divide dose by 2. Find the closest matching insulin ratio and dose twice daily.	Your patient wants less injections and wants to switch to Humalog Mix 25 twice daily. He is currently on Humalog (lispro) 40 units three times a day with meals and Levemir (detemir) 120 units in the morning. Bolus: 40+40+40=120 / 2 = 60 units twice daily Basal: 120 /2 = 60 units twice daily. So, 120 units twice daily at a 50:50 basal/bolus ratio. 100 units of Humalog Mix 25 contains 25 units of Humalog which acts as bolus and 75 units of protamine-bound Humalog which acts as basal insulin. This does not match the patient's basal bolus ratio. A better choice for this patient would be Humalog Mix 50 which contains a 50:50 bolus/basal ratio. You switch this patient to Humalog Mix 50 120 units twice daily.	Protamine is a protein that stabilizes the insulin hexamer and slows its disassociation into insulin monomers (the active form of insulin). Protamine is now synthesized but was originally extracted from fish sperm! Now you will always remember why these insulins are cloudy! Mixed insulins such as Humulin 30/70 and Novolin 30/70 (and their various combinations such as 40/60 and 50/50) are regular insulin (which acts as bolus) combined with regular insulin bound with protamine (which acts as basal). Humalog Mix 25 and Novomix 30 (and their various combinations) are combinations of rapid acting insulin (which acts as bolus) and rapid acting insulin bound to protamine (which acts as basal)
Alternate Method for ICR based on weight <u>Weight (lbs) ICR</u> <60 1:30 60-80 1:25 81-100 1:20 101-120 1:18 121-140 1:15 141-170 1:12 171-200 1:10 201-230 1:8 231-270 1:6 >270 1:5	You have a patient who is obese and weight 250lbs. He would like to start carbohydrate counting. He is on multiple daily injections for his insulin. He takes Tresiba (degludec) once daily and Humalog U-200 (concentrated lispro) three times a day. He wonders how much insulin he should take per gram of carbohydrate he consumes. Looking at the table you determine that he should take 1 unit per every 6 grams of carbohydrate he consumes.	This table assumes that as a person's weight increases, they are more insulin resistant and therefore need a more insulin to cover carbohydrates. While I have found that this theory works as a general rule, I have never found this table to be accurate enough to use in real life. I have also never seen on the exam as well.

Alternate Method for ICR based on pre and post prandial blood sugar readings. Note that the number of carbohydrates in the food is made up to fit the question.	Below is your patient's food diary and blood glucose log (carbs are examples, not exact):	You need to calculate the ICR used and then compare
	Pre-breakfast=6.8 Had 2 slices of white toast and a glass of diet coke. Took 5 units of Admelog. 2-hour PC BG= 3.9	2 white toast = 30 carbs. Diet coke = 0 carbs. Total carbs= 30/5 Admelog= 1:6 ICR. Pt went low so too much
	Pre-lunch= 5.2 Had 2 cups of salad, 2 medium apples and 3 boiled eggs. Took 2 units of Admelog. 2 hr PC BG= 7.9	Salad= 0 carbs, 2 medium apples= 32 gram of carbs, 3 boiled egg= 0 carbs. Total carbs= 30/2 Admelog= 1:16 ICR. Pt was on target after meal, so this is a good ICR
	Pre-supper= 5.8 Had a 6 oz steak, mashed potatoes, 1 cup of salad, 1 cup of boiled rice and a cup of unsweetened tea. Took 5 units of Admelog. 2 hr PC BG= 12.7	Steak=0 carbs, mashed potatoes= 57 gram, salad= 0 carbs, boiled rice= 39 gram, tea= 0 gram. Total carbs= 96 grams/5 Admelog= 1:20 ICR. Pt was above target so not enough.
		Comparing all the different ICR the patient used it seems that the 1:15 ratio is best. For more questions, please check out the free quizzes I have on my website.
Switching from AM insulin to PM insulin or vice-versa. Day 1: ½ Am and ½ PM Day 2: Desired time	A patient reports he wants to switch his evening Levemir 10 units to the morning as he sometimes forgets to take it in the evening. Day 0: 10 units evening Day 1: 5 units morning, 5 units evening Day 2: 10 units morning	I have been using this method for over a decade and I can't remember if I copied it from someone else or made it up. Regardless, I don't recall a patient having a negative experience with this method. Note that this method is not necessary for the newer basal insulins like Tresiba (degludec) and Awiqli (icodec). You could just switch the insulin time and due to the long insulin half-life, the switch won't have a significant impact on sugars.
Switching from twice daily insulin to Awiqli insulin. Take daily basal insulin and multiply by 7. Since Awiqli takes so long to reach steady state you could advise a loading dose of 150% for the first dose.	You have a patient who is on Levemir 10 units twice daily. She is tired of injecting herself and wants to reduce her number of injections. Basal insulin- 10 units twice daily = 20 units daily. Multiply 20 x 7 = 140 units weekly. As an option for the first week you could give her a loading dose of 140 units x 1.5= 210 units. You advise her to stop Levemir and the next day (week 1) to take 210 units Awiqli once weekly then afterwards take 140 units once weekly	Awiqli (icodec) is a new insulin that binds to albumin and then very slowly unbinds leading to a very long half-life. Awiqli is taken once weekly on the same day (i.e. Monday) and can be taken at any time during that day. Awiqli seems to peak around day 2-4 so when starting/adjusting the dose you may want to advise your patients to test more often during those days. The pen has 10 units increments so round down to the nearest 10. The 20% reduction from twice daily insulin to once daily insulin rule does not apply to once weekly Awiqli insulin. The recommended starting dose of Awiqli to insulin naïve patients is 70 units weekly (equivalent to about 10 units daily).

Below is an example of how to build a sliding scale for a patient. Please note that this cheat sheet gives guidelines not laws/rules. You must assess the patient and use your own clinical judgment to adjust the numbers to suit your patient. I repeat, you must use your own clinical judgement. This cheat sheet is meant to be used a guide not a set of laws/rules for insulin adjustment. If unsure, I suggest using a lower dose of insulin. In general, it is easier to use a lower dose and titrate up instead of suggesting too high of a dose and then dealing with hypoglycemia.

Bob is referred to you by the family MD as Bob's sugars are above target. Bob has been on Basaglar 35 units at bedtime for years. A few weeks ago, the family physician added Novorapid 5 units TID. Bob reports he consumes roughly the same amount of carbohydrates at each meal. Bob reports that when he is at target (4-7 mmol/L) before eating the 5 units keeps his sugars on target (4-7 mmol/L before the next meal). However, when he is above target before meals the 5 units is not enough. First, we need to calculate ISF which is 100/TDD. 35+5+5+5= 50 so 100/50 = **2**. This means 1 unit of insulin drops Bob sugars by **2** mmol/L.

Current Blood Sugar	Breakfast Insulin	Lunch Insulin	Supper Insulin
Below 3.9 mmol/L	0 units- Treat low instead	0 units- Treat low instead	0 units- Treat low instead
3.9-7 mmol/L	5 units (as Bob reports it works)	5 units (as Bob reports it works)	5 units (as Bob reports it works)
We use increments of 2 as Bob's ISF is **2** so 7.1-9 mmol/L (rounded to make the graph simple for Bob)	6 units (since Bob's ISF is **2**, we expect that the additional 1 unit above 5 unit will drop his sugars **2** mmol/L)	6 units (for example if Bob's sugars are 7.1 we expect that the extra unit will drop him to 5.1 which is on target)	6 units (for example if Bob's sugars are 9 we expect that the extra unit will drop him to 7.0 which is on target)
9.1-11 mmol/L	7 units (since Bob's ISF is **2**, we expect that the additional 2 units above 5 unit will drop his sugars **2** x 2 units = 4 mmol/L	7 units (for example if Bob's sugars are 9.1 we expect that the two extra units will drop him to 5.1 which is on target)	7 units (for example if Bob's sugars are 11 we expect that the two extra units will drop him to 7.0 which is on target)
11.1-13 mmol/L	8 units	8 units	8 units
13.1-15 mmol/L	9 units	9 units	9 units
The scale would keep going up by 2 mmol/L. However, you could put in something like "above 20 mmol/L call diabetes educator or seek medical attention"			