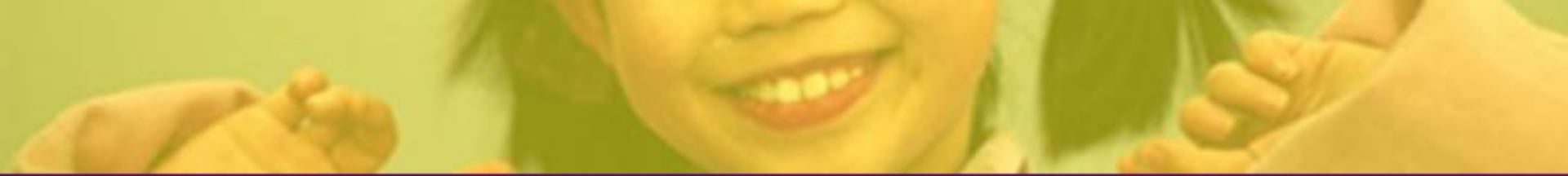


A young child with light-colored hair is shown in profile, blowing bubbles. The child is smiling and looking upwards. The background is a soft, greenish-yellow color with many bubbles of various sizes floating around. The overall mood is happy and carefree.

Adjusting Insulin Pump Settings with Confidence

Mary Wright, RN, CDE, NP



**We have come
a long way...**

Current Insulin Pumps

Animas



Omnipod



Medtronic MiniMed





Objectives:

- Review what, when, and how much insulin to adjust
- Account for different food types & changes in activity:
Combo/dual wave & temporary basal rates
- Explore other advanced tools to help with adjustment
- Review causes of BG problems other than settings
- Review basal/bolus testing
- Review sample pump reports/logs
- Other: your questions, concerns



Basic Method: WHAT

What setting do you change?

If the problem is...

- **1-4 hours after a meal:** change the **carb ratio**
- **After you do a correction dose:** change **sensitivity factor**
- **When you don't eat for 4+ hours:** change the **basal**
- **Overnight or when you wake up:** change **overnight basal***

* Don't forget to look at bed settings and bed blood sugar though too. Test 2-3 hours after bed snack to see if the problem could be not enough carb coverage for bed snack. Test at 2-3am for more info.



Basic Method: TIME

What times do you set your carb ratios & sensitivity?

Just set times to the widest range of time your child (or you) might eat each meal/snack.

Example:

- BREAKFAST 5-9am
- AM SNACK from 9am-11am
- LUNCH 11am-2pm
- PM SNACK 2-4pm
- DINNER 4-8pm
- BED SNACK 8pm-12am.



Basic Method: TIME

What about basals?

Typically we change the basal about 2 hours* before we start seeing the BG problem. In this example increase basal 12-4pm

No food eaten or insulin given between tests here:

12pm BG 100	2pm BG 152	4pm BG 201	6pm BG 199
12pm BG 84	2pm BG 197	4pm BG 223	6pm BG 235

*Varies by clinic, clarify with your diabetes team



Basic Method: AMOUNT

Amount to adjust: Carb Ratios

- **Carb ratios under 10:** make 1-2 point changes
- **Carb ratios 10-20:** make 2-3 point changes
- **Carb ratios 21-30:** make 3-5 point changes
- **Carb ratios 31-50:** make 5-10 point changes
- **Carb ratios over 50:** make 10-20 point changes



Basic Method: AMOUNT

Amount to adjust: Sensitivity

- **Sensitivity under 30:** make 3-5 point changes
- **Sensitivity 30-60:** make 5-10 point changes
- **Sensitivity 61-100:** make 10-15 point changes
- **Sensitivity over 100:** make 25 point changes



Basic Method: AMOUNT

Amount to adjust: Basal

Basal over 1 u/hr: make 0.1-0.2 u/hr changes.

Basal 0.5-1 u/hr: make 0.05-0.1 u/hr changes

Basal under 0.5 u/hr: make 0.025-0.05 u/hr changes



Pump Log Review

Use “basic” method guidelines to suggest changes to pump settings on example reports.

	7A	8A	9A	10A	11A	12P	1P	2P	3P	4P	5P	6P	7P	8P	9P	10P	11P	12/1A	2/4A	4/6A	
BG				321							300				222						
Carbs	●					●															
Bolus	●					●															

	7A	8A	9A	10A	11A	12P	1P	2P	3P	4P	5P	6P	7P	8P	9P	10P	11P	12/1A	2/4A	4/6A	
BG				401								62									
Carbs	●					●															
Bolus	●					●															

	7A	8A	9A	10A	11A	12P	1P	2P	3P	4P	5P	6P	7P	8P	9P	10P	11P	12/1A	2/4A	4/6A	
BG	195			297		162															
Carbs	●					●															
Bolus	●					●															

	7A	8A	9A	10A	11A	12P	1P	2P	3P	4P	5P	6P	7P	8P	9P	10P	11P	12/1A	2/4A	4/6A	
BG				201								401			183						
Carbs	●					●															
Bolus	●					●															

Pizza Dinner

	7A	8A	9A	10A	11A	12P	1P	2P	3P	4P	5P	6P	7P	8P	9P	10P	11P	12/1A	2/4A	4/6A	
BG	219			309								181			254						
Carbs	●					●															
Bolus	●					●															

	7A	8A	9A	10A	11A	12P	1P	2P	3P	4P	5P	6P	7P	8P	9P	10P	11P	12/1A	2/4A	4/6A	
BG																					
Carbs	●			●		●															
Bolus	●			●		●															

Notes: 1250 Total insulin =
 BASAL 150 = 150

00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00

	217			166					221	46		96			169			379		58	111		
Tue 8/7	0.5U		1.5U					70g 8U	2.55U	20g 2U		30g 1.65U	130g 0U 7.5U				1.3U	3.65U 1.25U 1.75U	50g	0.75U	65 88 10g		
Wed 8/8								1.5U	2.5U			99 130g 7.2U						331	75g 1.5U 4U	25g 1.25U	159	108 34g 1.7U	160 40g 1.6U
Thu 8/9								236	236m	60		207	155g 3.05U 5.55U	95g 4.75U	40g 1.6U 2U	55g 2.75U			180 80g 2.36U 1.3U			151 95g 2.2U 1.6U	109
Fri 8/10								270				89 125g 6U 1.65U	59						50g 2.5U	60g 3U 1.25U	85g 4.25U	77	
Sat 8/11								282		160		212		293	290m				223	15g 2.2U	145g 4.5U 2.75U	231	227
Sun 8/12								317					84						188 188m	336	25g 1.5U	25g 1.25U	387 388
Mon 8/13								310				63m							211	55g 4U 1.5U	0.75U 2.75U	55g 2.75U	312
Tue 8/14			316						256									239	25g 1.25U 0.4U 3.75U	75g 0.4U	50g 2.5U	25g 0.5U	366

< 70 mg/dl
> 180 mg/dl
 m tagged values were typed in manually by the patient
 Suspend Resume Temp. basal Pump alarm Fill Cannula Prime



Minimed

- Carelink Personal can use Logbook Diary
- Easiest to circle the BG readings since they are hard to differentiate from other numbers
- Can circle in-target readings in green, high readings in red, low readings in blue to easily identify patterns
- On next slide, the asterisk means they bolused for carbs (if eaten) & BG (if high) per pump recommendation. The log is modeled after Logbook Diary report
- Note the dates go from most current AT TOP


Date	12-6am	Break.	Lunch	Dinner	Evening
3/9/12		6am: 286 (43 carbs)*	1pm: 199 (70 carbs*)	3pm 129 50 carbs* 6:45pm 118 95 carbs*	8pm 237 45 carbs* 10pm 186 (no correction or carbs)
3/8/12		9am 218 (30 carbs*)	11:30am: 226* , (100 carbs) 1pm 200*	5:45pm 235 75 carbs* 7pm 141 68 carbs*	9pm 120
3/7/12		8:14am 227 (67 carbs*) 10am 266*	12pm 121 50 carbs* 3pm 167	5pm 154 18 carbs* 7pm 245 83 carbs*	9:30pm 147 10:45pm 192* with correction
3/6/12	1:42am 382*	6:55am 318 (61 carbs*)	12pm 529? 3pm 474*	4pm 105 7pm 78 112 carbs*	10pm 175 , no correction



FOOD:

High carb but low in fat, protein, & fiber:

- Example foods: rice, bread, sushi rolls, cereal, yogurt
- 1-2 hours after eating the blood sugar can really spike! Sometimes it spikes over 200 points, and then normalizes by 3-4 hours after eating.



You know it's a food spike not a pump setting problem when...

If the BG is much higher 1-2 hours after a meal, but without a correction goes back to normal by 3-4 hours later, you know you got the correct amount of insulin for your carbs but the timing was off. The meal hit your system before the insulin did.



Preventing food spikes:

- Take at least part of the bolus 15-20 minutes before eating.
- Eat non-carb foods first.
- If the BG is high, give 20-30 minutes before eating.
- Add protein, healthy fat, and fiber to meals. Cut back on processed, refined, white foods.
- Consider more insulin for carbs (lower carb ratio number) and less insulin for basal if you are seeing major spikes but getting lows by 3-4 hours after eating.
- Consider Super Bolus for “spiky” foods



Super Bolus

Step 1: At meal time set a temp basal of 50% x 3 hours

Step 2: Enter BG & carbs to pump, follow pump recommendation but add to the bolus the insulin you will be missing over the next 3 hours.

Example: If basal is 1 u/hr then you will miss 0.5 unit/hr over 3hrs = 1.5 units over the 3 hour temp basal. So if the pump recommends a 5 unit bolus, give 5 (recommended bolus) + 1.5 (amount of basal you will miss over 3 hours) = 6.5 unit bolus for that meal

More info: See “Strike the Spike 2”:

<http://www.diabetesselfmanagement.com/articles/high-blood-glucose/strike-the-spike-ii/all/>



Less Spiky Breakfast Ideas

- Non-traditional breakfast foods (beans + cheese on whole-wheat tortilla with salsa, chicken, turkey, turkey burgers, tofu, fish, nuts, cheese, left-overs, etc.).
- Eggs with toast* or bagel thin*
- Eggs with potatoes (diced with veggies is best but can do hash-brown style too)
- Eggs with avocado and/or veggies (egg scramble with chopped mushroom, squash, etc.)
- Toast* or bagel thin* + olive oil drizzled +/- avocado +/- tomato
- Bagel thin* with cream cheese +/- tomato
- English muffin pizzas: English muffin* + tomato sauce + cheese +/- veggies +/- canadian bacon
- Egg Sandwich: Cook egg any way you like and place it on toast/bagel thin/English muffin* with cheese slice +/- veggies +/- canadian bacon
- Steel-cut oatmeal vs regular or instant oatmeal

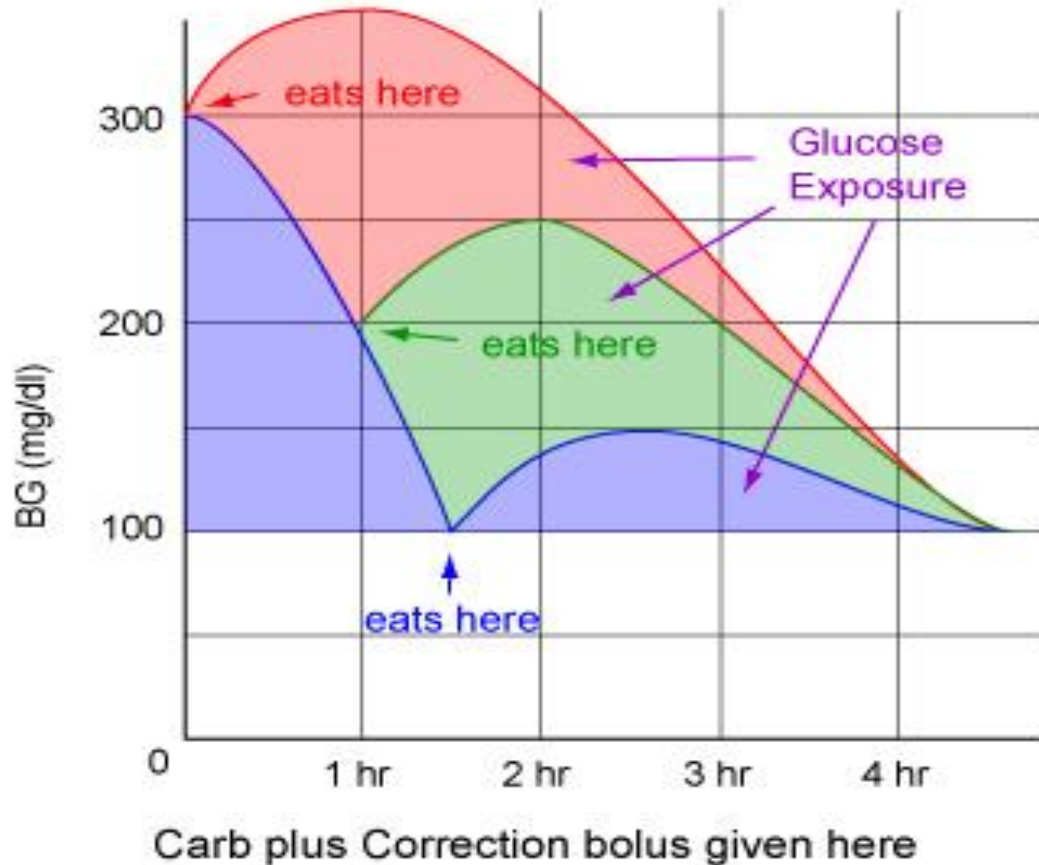
Less Spiky Breakfast Ideas

- Healthier pizza: Take crusty bread*, spread it with 3 tablespoons of low-fat ricotta, and add tomatoes. Finish with a drizzle of olive oil (about 1 teaspoon) and a little salt and pepper.
- Wraps & Breakfast burritos: tortilla* +/- cheese +/- veggies +/- salsa +/- egg +/- canadian bacon (stuff with cheese or meet or veggie combo)
- Waffles/pancakes/french toast (homemade whole wheat are best, you can freeze a batch of homemade for future use) +/- fruit +/- sugar-free syrup
- Sliced fruit with cheese and/or nuts (applesauce with string cheese or sliced apples/pears/berries/plums/etc with sliced Manchego cheese or Cheddar cheese)
- Toast* with drizzled olive oil +/- flavored chicken or turkey sausage
- Peanut butter or Almond butter on whole wheat toast/English Muffin/Bagel/Waffle*
- Fruit + nuts + greek yogurt
- Greek yogurt

*Whole-wheat bread/bagel/eng muffin is best, especially sprouted wheat. Sourdough & less processed breads are good too. Whole wheat or corn tortillas are best.

Benefits of Pre-meal Insulin

When a BG is high before a meal, how soon a person eats determines their exposure to glucose





Other meal types?

High fiber & protein

- Example foods: chicken and brown rice, high fiber bread with peanut butter, nuts
- These typically may cause a small spike in blood sugar (maybe 25-50 points) 1-2 hours after eating and normalize blood sugar by 2-4 hours after the meal.
- Usually the timing of these meals matches nicely with insulin timing to prevent big spikes.



The dreaded high fat & carb meals:

- Example foods: pizza, Chinese food, most restaurant meals
- Best to eat these only as a treat every once in awhile
- Typically do not raise blood sugar levels as much at first, but might cause slowly increasing blood sugars 2-8 hours after eating.



How to handle high fat meals:

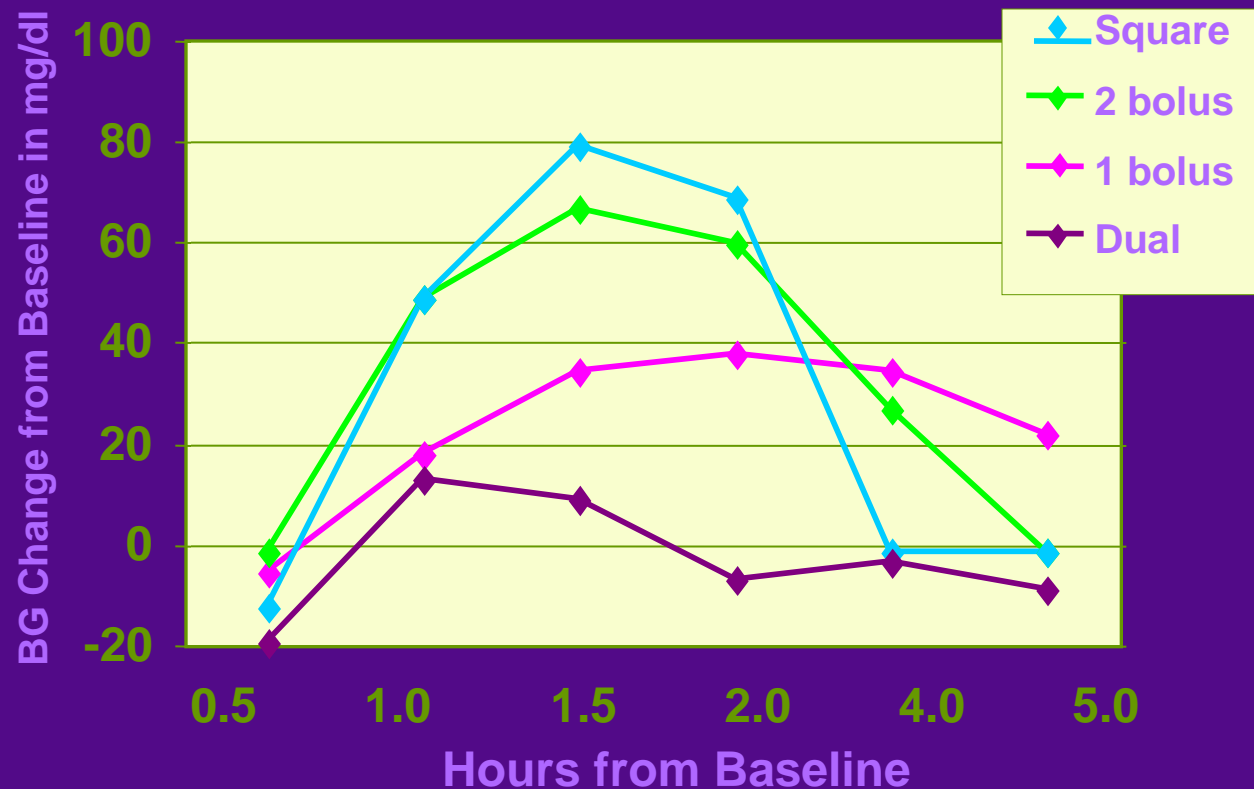
- Try dual-wave/combo bolus
- Most diabetes clinics start with 50-70% up front and the remaining percentage of bolus given over 2-3 hours.
- It takes some trial & error to get the percentage and total time correct. Test BG frequently for 6-8 hours after a high fat meal & track carefully so you can adjust settings.



Adjusting Dual/Combo:

- Use worksheets provided.
- If BG is normal 1-2 hours after eating but is high 4-8 hours after eating: need more insulin stretched out over a longer period of time.
- If BG is high 1-2 hours after eating but is normal 4-8 hours later, need more insulin up front.
- With high fat meals, you might notice you need to give more insulin for corrections in the 2-8 hours following a high fat meal. Start with small increases and again trial and error to see how much extra insulin (if any) you might need.

Which Bolus is Best for High Carb and High Fat Meal?





Adjusting around exercise/activity level?

- Temp basal
- Exercise snacks



If activity is causing lows...

- You have several choices for managing exercise related hypoglycemia
 - Use Temporary Basal Rate to decrease insulin doses prior to activity
 - Reduce bolus if exercising soon after a bolus
 - Disconnect from pump during exercise (if not more than 1 ½ hours)
 - Eat or drink 10-30 grams fast acting carbs just prior to activity



Temporary Basal Feature

- Temporary basal temporarily increases/decreases basal rates for a specific length of time.
- Temporary basal overrides normal basal rates during the duration of the temporary basal.
- The temporary basal rate does not repeat
- Duration of temporary basal can be set for ½ hour up to 24 hours
- This feature can be canceled at any time



Temp basals are helpful for:

- Exercise (ex: 12-24 hour temp basal of 60-90% with activity)
- Illness
- Offset insulin on board (ex: 1 hr 0%)
- Short-term problems that cause highs or lows (long travel day, etc.).
- Percentage option is nice because it will automatically change as your basal changes throughout the day.



Beyond the basics:

- Basal & bolus testing: the best way to adjust your pump settings & the only way to really know which settings need adjustment.
- Good to do a few times per year, especially after major changes to routine schedule (new exercise routine, eating pattern, school vs summer, etc.)
- Use worksheets to track:
- <https://pumpschool.minimed.com/512/6010.tpl>
- <http://www.animas.com/sites/default/files/pdf/Workbook.pdf> (starting on page 48)



Fine Tuning Basal Rates

Always start with basal testing first, then move on to bolus testing.

The correct basal rate will keep your blood glucose from going up or down by more than 30 mg/dl when you are not eating, taking a bolus, or exercising.



Example: Overnight Basal Test

- ◆ Do not eat carbs after dinner.
- ◆ Test BG at bed 3-4 hours after your last bolus of insulin.
- ◆ If the bed blood sugar is in the target range recommended by your clinic for bed (usually around 100 to 150/180), then you can do the test.
- ◆ **SKIP BED SNACK** (at least skip all carbs)!
- ◆ Check BG overnight (usually 2-3am) & then pre-breakfast.
If you sleep in, test BG around 7am then continue to sleep and test when you wake up.



What do I do with the results?

If BG stayed within 30 points of starting bed BG, then no changes are needed. If BG \uparrow or \downarrow by 30 or more points, adjust the basal rate up or down about 2-3* hours before the rise/fall in BG starts. Use worksheets provided.

Basal over 1 u/hr: make 0.1-0.2 u/hr changes.

Basal 0.5-1 u/hr: make 0.05-0.1 u/hr changes

Basal under 0.5 u/hr: make 0.025-0.05 u/hr changes

*Varies by clinic, discuss with your diabetes team



My basal rates are correct! What's next?

- Carb counting refresher – measuring, reading labels, RD appt
- Test your carbohydrate to insulin ratio for each meal (see meal bolus worksheet)
- Test your insulin sensitivity (see correction bolus worksheet)
- Try using a combo/dual bolus for high fat meals & temp basals for changes in activity



Testing your carbohydrate ratio:

1. Test blood sugar before eating a low fat meal
2. Proceed with test if pre-meal BG is in target range (usually about 70-150). Test blood glucose 2 and 4 hours after the meal
3. Don't eat any other carbs in the 4 hour "test" time & don't correct a high BG at the 2 hour mark.



What to do with results?

- The carb ratio is correct if the BG 4 hours after eating is also in the target range & very similar to starting BG.
- Change your carb ratio if you are below or above target 4 hours after the meal.
- If the 2 hour reading is much higher than the pre-meal & 4 hour reading, you are spiking (try super bolus, giving insulin more lead time before eating, etc.)
- If BG is low 3-4 hours after the meal, the carb ratio is too strong. Make the carb ratio a larger number.
- If BG is still high 3-4 hours after meal, the carb ratio is too weak. Make the carb ratio a smaller number.



Carb ratios under 10: make 1-2 point changes

Carb ratios 10-20: make 2-3 point changes

Carb ratios 21-30: make 3-5 point changes

Carb ratios 31-50: make 5-10 point changes

Carb ratios over 50: make 10-20 point changes



Testing sensitivity factor:

- The sensitivity tells you how much 1 unit of insulin affects your blood sugar
- If your sensitivity is 1:50, that means 1 unit of insulin drops your BG 50 points
- See Correction Bolus Worksheet
 - When BG is high, take correction bolus (do not eat!)
 - Check BG 2 & 4 hours after correction.
 - Did you get to target range 3-4 hours after correction bolus?



What to do with results?

- If BG is in target range 3-4 hours after correcting a high, the sensitivity factor (ISF) is correct.
- If BG is low 3-4 hours after correcting, the ISF is too strong. Make the ISF a larger number.
- If BG is still high 3-4 hours after correcting, the ISF is too weak. Make the ISF a smaller number.



- **Sensitivity under 30:** make 3-5 point changes
- **Sensitivity 30-60:** make 5-10 point changes
- **Sensitivity 61-100:** make 10-15 point changes
- **Sensitivity over 100:** make 25 point changes



Advanced Adjustment Tools: 1800/450 rules & % Basal

- 1800 divided by TDD = estimate of sensitivity
- 450 divided by TDD = estimate of carb ratio
- 35-45% *= about how much we expect of your TDD** to be going to basal

*This varies by clinic, discuss with your team

**TDD = Total daily dose of insulin.



Finding TDD & % basal: Minimed

- Go to Utilities → Daily Totals → Daily Average → Activate Button → Change the number you see to “7” → Hit the down arrow
- Hit the down arrow until you see at the top of the screen “AVG INSULIN”. Write down the numbers for:
- AVG INSULIN (this is the total amount of insulin delivered in 24 hours, on average, over the past 7 days). This is also called Total Daily Dose (TDD)
- Basal (the second number, which is a percentage)



Finding TDD & % basal: Animas

You can go directly to your pump under “history” to find the average total daily dose. You can also find the average daily insulin delivered by uploading the pump. Then go to “logs” and TDD log. Percentage basal: go to “reports” then choose the top report to generate (“Insulin & BG Distribution Report Overview”).



Don't forget to rule out tech issues that cause BG problems:

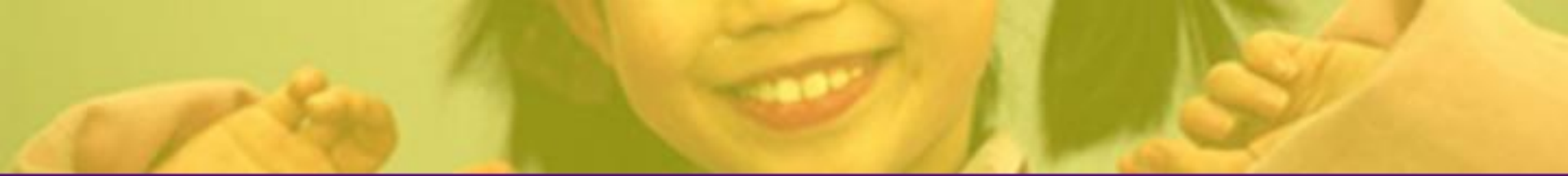
- Rule out pump issues & site failures as cause of blood sugar problems!!! Check very carefully that the time is set correctly, with the correct AM/PM.
- Check that times & numbers for basals, carb ratios, and sensitivities are correct.
- Check bolus history to confirm delivered.
- Change set and inject if “no delivery”/”occlusion” alarm
- If you suspect a pump problem: Call Minimed or Animas, your pump company and diabetes clinic.



Consider non-tech causes of highs & lows:

- Stress/adrenalin
- Illness
 - Stomach bug
- Caffeine
- Weight lifting-non aerobic
- Infusion set in overused area
- Hormones
- Hot tub
- Hot weather/cold weather
- Shopping
- Exercising
- Guessing for BG and carbs
- Drugs/medicine
- Missed boluses



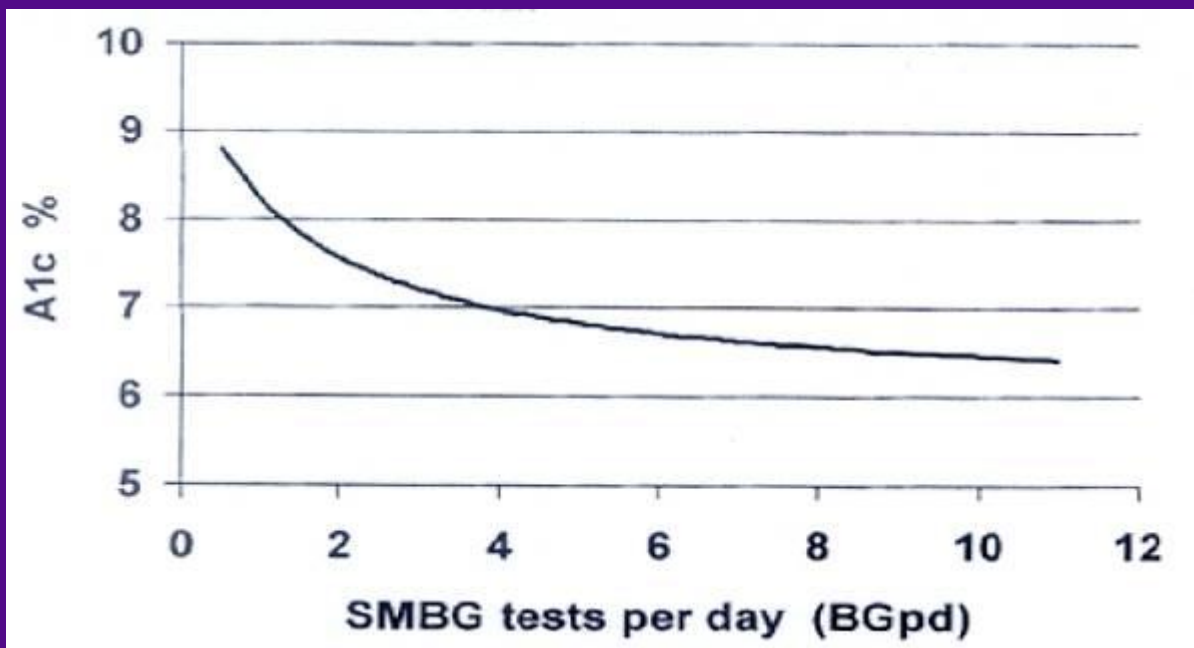


Other factors contributing to BG probs:

- Missed boluses (big increase in A1C)
- Not replacing insulin when off the pump for sports
- Waiting until a set fails to change it
- Not using Carelink/Diasend or reviewing logs periodically
- Not testing BG enough



More testing = better A1C



Frequency of testing

378 pump (pre-smart) users Paul Davidson et al: Diabetes



Downloading your pump:

- **MINIMED:** Comes with USB, need to go to www.carelink.minimed.com & create an account. If you have any trouble with this, call 1-800-MINIMED.
- **ANIMAS:** Go to www.animas.com. Go to products tab & click on “diasend uploader” then “get diasend” & follow instructions. For assistance call 1-877-937-7867. When prompted, enter the clinic ID (obtain from your diabetes team)



Additional Resources

- Pumping Insulin by John Walsh
- Understanding Pumps and Glucose Sensors by Peter Chase MD:
www.barbaradaviscenter.org & click on “online books & teaching slides” to see a free, online version
- www.insulin-pumpers.org
- http://www.diabetesnet.com/diabetes_presentations/index.php#walsh

Questions?

