

Get Pumped

Patch Or Line Pump – Which Works Best?



Take Control Of Your Diabetes
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View slides at www.diabetesnet.com/presentations/

Disclosure

Karmeen Kulkarni, MS, RD, BC-ADM, CDE

- Employed by Abbott Diabetes Care, a division of Abbott Laboratories

Disclosure

John Walsh, PA

- Book sales – all pump companies
 - Advisory Boards – Tandem Diabetes, Unomedical, Spring, Halozyme
 - Consultant – Bayer, Roche, BD, Abbott, Tandem Diabetes, Medingo, Spring
 - Speakers Bureau – Tandem Diabetes
 - Sub-Investigator – Glaxo Smith Kline, Animus, Sanofi-Aventis, Bayer, Bidel, Dexcom, Novo Nordisk
 - Pump Trainer – all pumps
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What We'll Cover

- New Line Pumps
 - New Patch Pumps
 - Line Blurs Between Line and Patch
 - Pump–CGM Combos
 - Developments Toward The Closed Loop
 - The Ideal Pump
-

The Ideal Pump Styling



- I-Phone, a la Steve Jobs
 - Color hi-res touch screen
 - Rounded corners
 - Individualized colors & cases
-

Patch Versus Line Pumps

Line Pump

- Small infusion set size
= more site options
- Easy to detach for
showering, sports
- Variety of needle and
tubing lengths
- Infusion set can loosen,
leak, be knocked off

Patch Pump

- Worn on body
 - No external tubing in
some
 - Shorter infusion line
 - Some require
controller to bolus
 - Patch can loosen,
leak, be knocked off
-

New Line Pumps



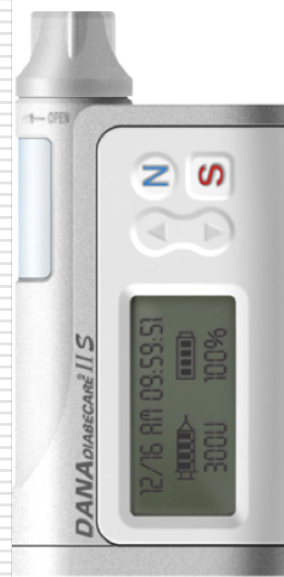
Tandem t:slim



CellNOVO



Asante Pearl



Dana Diabecare II-SG



D-Medical Spring

Pumps – Asante Pearl



- Uses a prefilled pen cartridge
- Modular design
- 3.88" x 1.72" x 0.75"
- Luer lock infusion sets
- Alarms gradually get louder
- Built-in flashlight
- Pay as you go pricing

FDA and CE approved

New Pressure Pumps



- Precise delivery – up to 1000ths of a unit
- Simpler “motor”, no gears, no stiction
- Less weight
- No dose change from gravity or on airplanes
- Clinical verification needed

Pressure Pump – D-Medical Spring



- One moving part – a spring generates pressure for 300 unit reservoir – no motor, no gears
- Reusable hardware & screen
- Simple, low cost, small, very light
- Accurate insulin delivery
- Old school styling

Submitted for FDA and CE approval

Pressure-MicroPulse Pump-Tandem t:slim



Tandem t:slim

I-Phone style, color hi-res touch screen, easy to use

Thin 300 u reservoir

- Small solenoid generates pressure – isolated micro-delivery chamber delivers 0.001 to 0.03u per pulse
- All dose settings on one page
- Fast USB download: PC, MAC
- No airplane/gravity problems
- Fast trumpet curve

Submitted for FDA and CE approval

Wax Motor – CellNovo Pump



- Small wax cube is heated to deliver 0.05 u volumes of insulin
 - ☐ 10 u bolus = 200 pulse cycles – Are boluses slow?
 - ☐ Performance in heat/cold?
- Data sent to internet or phone
- Connects to short infusion set
- 2 rechargeable pumps



CE approved in Europe

New Patch Pumps



Valeritas V-Go



Omnipod



Calibra



Roche/Medingo Solo



Debiotech Jewel

Others: Medtronic, Medsolve, Altea

Patch Pump – Valeritas V-Go



- Simple design for Type 2 & some Type 1 diabetes
- 1 u bolus button on pump
- No controller
- Preset basal rates
- No bolus calculator or BOB tracking

FDA approved

Patch Pump – Roche Medingo Solo



- Precise dispensing screw
- Manual auto-inserter
- 200 units, 1 oz
- Bolus button on pump
- Color screen control
- Accurate bolus calculations

FDA approved, submitted for CE approval

Patch Pump – Debiotech JewelPump



- Tiny micro-electro-mechanical (MEMs) silicon motor
 - Nanotechnology motor can be mass produced
 - Modular, 0.75 oz, 0.02 u delivery
 - 450 u insulin bladder makes pump relatively large
 - Unlicensed, ?cost
-

Future Patch Pumps



Future Modular Patch Pumps

	Advantages	Disadvantages
Bolus button	Allows bolus when controller is forgotten	No BOB tracking
Modular design	Green, easy to detach for 3 Ss, less \$	Some extra assembly steps
Better BOB handling	Better protection against insulin stacking	None
More data in controller	Better data access and clinical care	None

Line Blurs Between Patch & Line Pumps

- Small line pumps can attach to skin like a patch
 - Remote lets line pumps hide
 - Patch pumps vary:
 - Autoinserted infusion set
 - Infusion set within a separate base
 - Infusion line to nearby infusion set
-

Patch Or Line?



Modular Patch



Patch With Line



Line Acts Like Patch

Remote Controls For Line/Patch Pumps

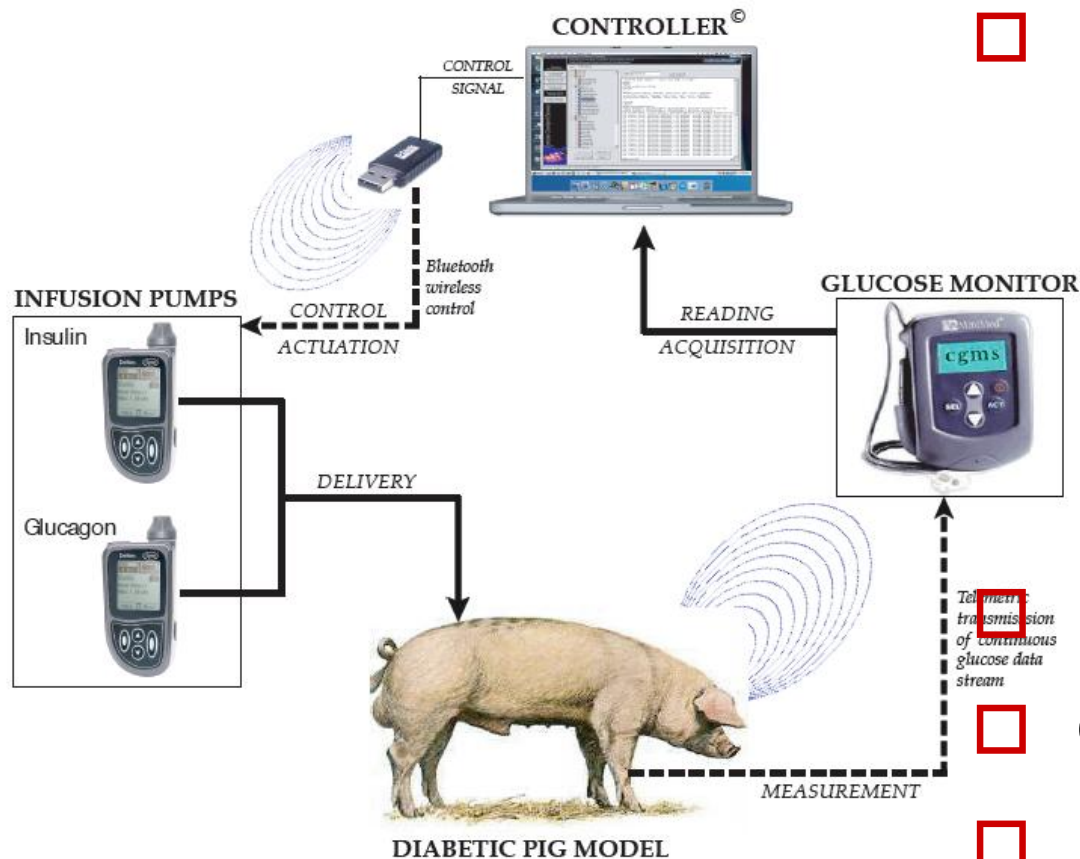


- Allows line pump to stay hidden
- BG meter and CGM readout
- Gives boluses
- Phone access
- Maintains dosing history



Some remotes must be present to bolus

How Long To A Closed Loop?



☐ Needed:

- Faster insulin
- Better CGM accuracy
- Sensor redundancy
- Less sensor lag time

☐ Dual delivery with glucagon

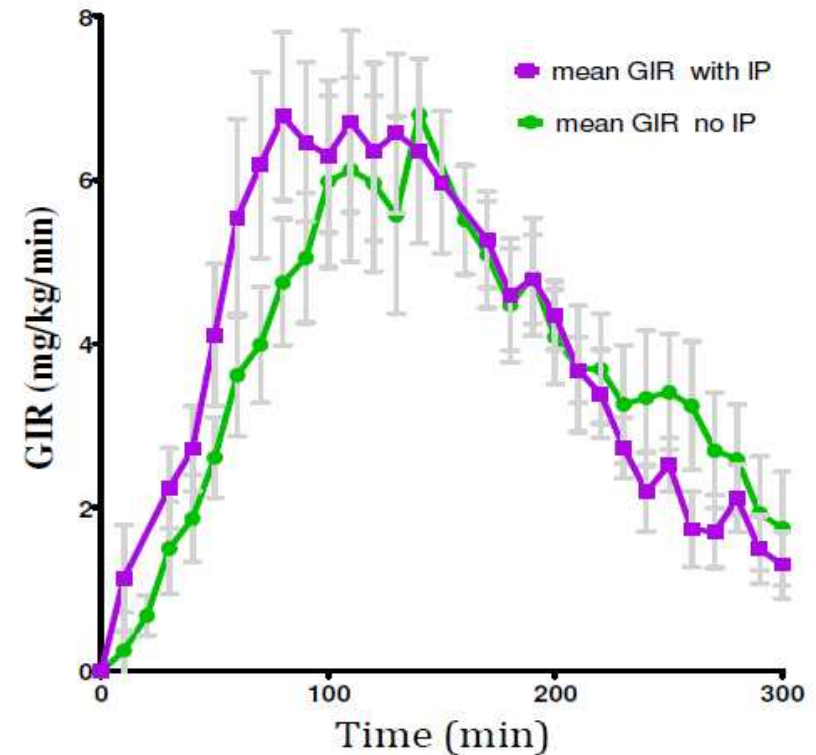
☐ Glucose control algorithms

☐ Failsafe hardware/infusion sets

The Ideal Pump

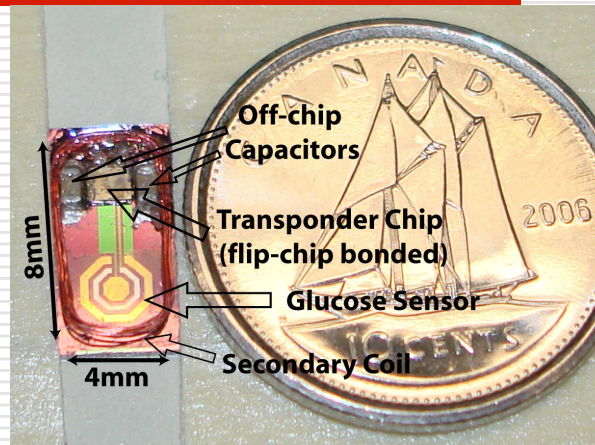
Speedy Insulin

- Super Bolus
- Warm the infusion site
 - InsuPatch by InsuLine
- Faster insulins
 - Novo Nordisk
 - Bodel
- Speed up insulin absorption
 - Halozyme
- 1.5 mm intradermal microneedles
 - BD



The Ideal Pump

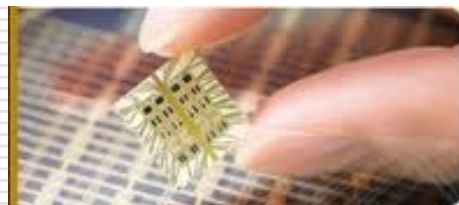
A Long-Lasting Implanted CGM



- Few disposables
- Minor surgery
- Funded as rental?



Sensors For
Medicine



MicroCHIPS Illume



GlySens

CGM – Implanted Fluorescent



Molecules fluoresce & change color as glucose rises or falls

- Small size, low power, low cost, long life, great accuracy
- Dual fluorescent chambers for low and high BGs

From Y. J. Heo et al: Institute of Industrial Science at the University of Tokyo

CGM – Raman Spectroscopy



C8 Medisensors

- Reads light reflected off glucose
- First non-invasive monitor that may have reasonable accuracy
- No calibration – set at factory
- No consumables
- Continuous or intermittent use
- Needs more battery power: 2 rechargeable external batteries

Early Closed Loops



Medtronic Veo

- 3 day sensor
- Low glucose suspend – basal off 2 hrs, on 1 hr, off 2



Animas Vibe

- 7-day Dexcom G4 sensor
- Closed loop studies underway with JDRF, Dexcom, BD, Afrezza

Veo available in Europe since 2009, approved for clinical studies in US

Closing Session & Raffle – 4:30pm Ballroom 6



***Winning With Diabetes
Natalie Strand, MD
2010 Winner of
Amazing Race***



Your opinion counts: Please fill out the 'Conference Questionnaire' on page 103 & 104 of your program guide

The Ideal Pump

Safety

- No device deaths, rare hospitalizations
- No infusion set failures, rare occlusions
- Precise dosing, no hidden insulin stacking, no over-delivery on airplane flights (1.0 to 1.4 u) ¹
- Monitor for hardware, software, & consistent dose errors
- Leak detection
- No easy to remove reservoirs (overdose risk)

Eliminate all unneeded sources for dose errors!

¹ BR King, et al: Diabetes Care September 2011 vol. 34 no. 9 1932-1933

The Ideal Pump

Safe Infusion



Avg. BG for 396 pumps in 6 hr period before a set change was **200.8** compared to **170.8** mg/dl for same period 24 hrs later. ¹
(Over 6,400 BGs in each 6 hr time slot.)

Large, high profile pods/sets more likely to be knocked off, especially on active kids or teens, when an adult is toting a child, etc.



Low profile metal sets are safest for infants, children, & pregnancy with adhesive over site & line anchored with tape.

No loose, leaky, detached, occluded sets

¹ Unpublished data from Actual Pump Practices Study by Walsh, Roberts, Bailey

The Ideal Pump

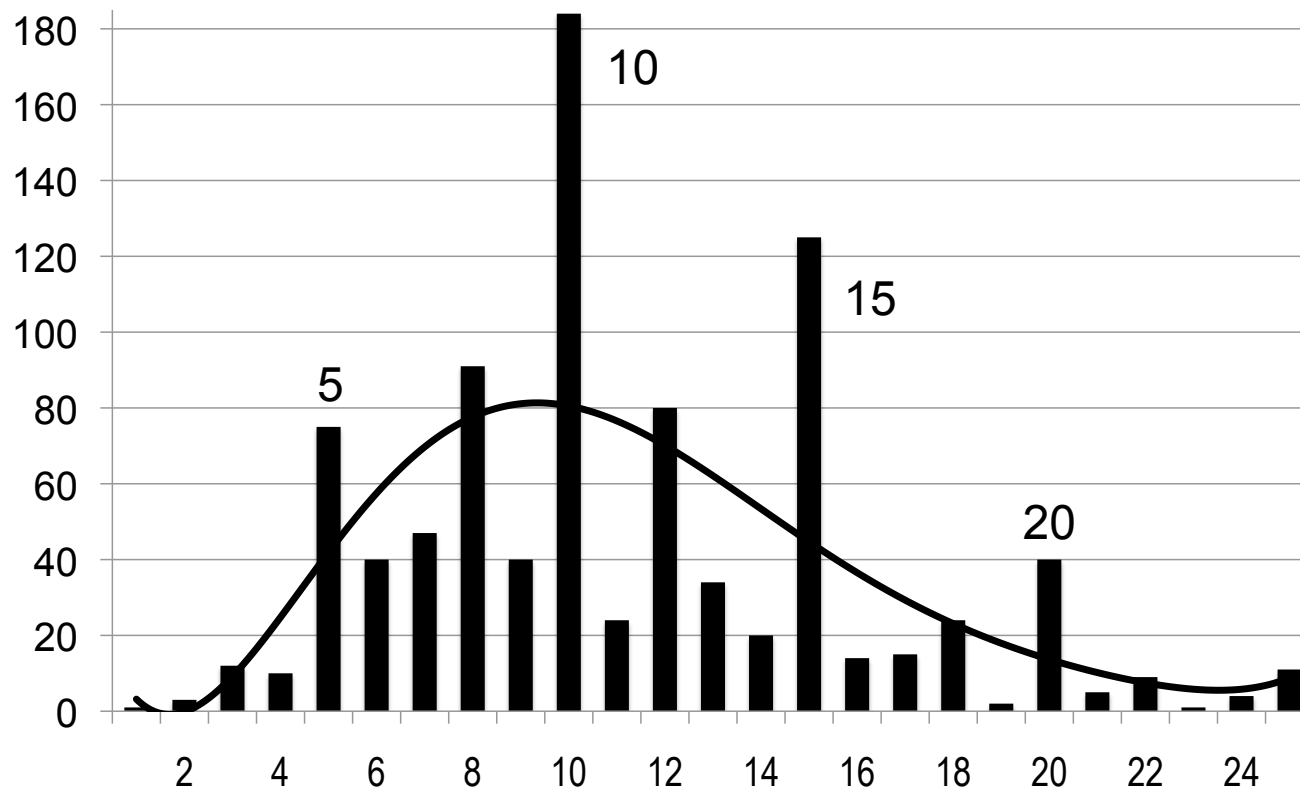
Show Glucose Outcomes

- Monitor basal and bolus errors → “What you’re doing is not working!”
 - Avg TDD vs Avg BG – the major BG controller
 - Estimate impact on BG when a setting is changed
 - Basal/Carb Bolus Balance, Corr. bolus % of TDD
 - Avg BG, SD, number of tests
 - Frequency/time <50, <65, >140, >200, >300
-

The Ideal Pump

Use Formulas For Accurate Settings

9.1 Carb Factor Settings Found In 899 Pumps



APP Study:

CarbF settings found in 899 pumps during software upgrade in 2007

Note use of easy numbers for easy math: 5, 10, 15, 20

J Walsh, R Roberts, T Bailey:
J Diabetes Sci Technol, 4:
1174-1181, 2010

Settings do not match true need → **Use formulas for pump settings**

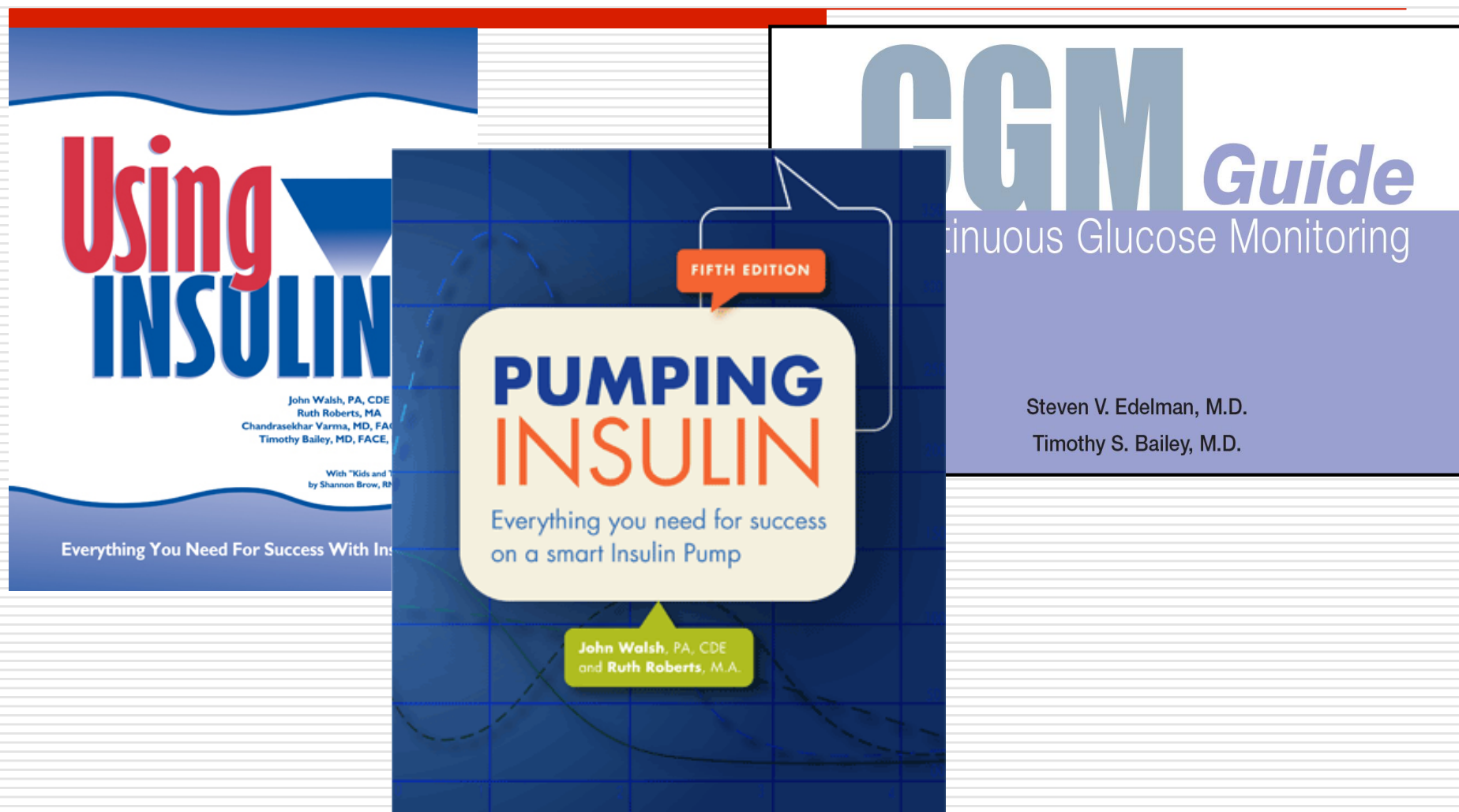
The Ideal Pump

Future Pump Features

- Show How A Setting Change Will Impact TDD & BG
- Temp Basal + Bolus Doses
- Meal Size Boluses
- Excess BOB Alert (bolusing without BG but ++BOB)
- * ■ Low BG Predictor Using Meter (HypoManager)
- * ■ Exercise/Activity Compensator
- * ■ Infusion Set Monitor – Leak Detector
- Automated Bolus and Basal Testing

* Underway

Still The Best Way To Learn



Slides at www.diabetesnet.com/diabetes-resources/diabetes-presentations

Books at www.diabetesnet.com/dmall/ or 800-988-4772