Diabetes Technology: Practical Tips for Supporting Students with Diabetes in School

Daniel DeSalvo, MD February 2024

PEDIATRIC DIABETES & ENDOCRINOLOGY



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2024 Virtual Diabetes Management Conference for School Nurses

Provided by Texas Children's Hospital

NURSING CONTINUING PROFESSIONAL DEVELOPMENT

Texas Children's Hospital is approved with distinction as a provider of nursing continuing professional development (NCPD) by the Texas Nurses Association, an accredited approver by the American Nurses Credentialing Center's Commission on Accreditation.

REQUIREMENTS FOR SUCCESSFUL COMPLETION

To receive contact hours for this nursing continuing professional development activity, the participant must:

- Register for the continuing professional development activity
- Attend at least one session of the professional development activity
- Complete the pre-conference survey
- Complete the post-conference survey online

Print your contact hour "Certificate of Successful Completion" once you have completed the post-conference survey online .

LEARNING OUTCOME

As a result of this professional development activity, 90 % of attendees will be able to name one concept learned on the post conference survey as it relates to care of the child with diabetes as well as attendees will demonstrate increased knowledge as evidenced by an increase in scores on the post conference survey when compared to the pre-conference survey.

RELEVANT FINANCIAL RELATIONSHIPS

Explanation: a relevant financial relationships occurs when an individual has an opportunity to affect or impact educational content with which he or she may have a relationship with an ineligible company or a potentially biasing relationship of a financial nature. All planners and presenters/authors/content reviewers must disclose the presence or absence of a relevant financial relationship relative to this activity. All potential relationships are mitigated prior to the planning, implementation, or evaluation of the continuing education activity. All activity planning committee members and presenters/authors/content reviewers have had their relevant financial relationships assessed, identified and mitigated by Activity Director & the nurse planner.

The activity's Nurse Planner has determined that no one who has the ability to control the content of this nursing continuing professional development activity – planning committee members and presenters/authors/content reviewers – has a relevant financial relationship.

MY DISCLOSURES

Funding sources:

Grants/research support	FDA Pediatric Device Consortium, NIH/NIDDK, National Science Foundation, Helmsley Charitable Trust, Insulet
Consulting/advisory board:	Dexcom, Insulet
Other/Patents:	D3 hypoglycemia prediction algorithm

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OBJECTIVES:

Following the conclusion of this activity, participants will be better able to:

- Support students with diabetes who utilize CGM and/or insulin pump in school
- Identify and address barriers to diabetes technology in the school setting

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MANAGING DIABETES IS CHALLENGING!

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Factors That Affect BG

Food	Biological
↑↑ 1. Carbohydrate quantity	↑ 20. Insufficient sleep
→ ↑ 2. Carbohydrate type	↑ 21. Stress and illness
→↑ 3. Fat	22. Recent hypoglycemia
→ ↑ 4. Protein	→↑ 23. During-sleep blood sugars
→↑ 5. Caffeine	1 24. Dawn phenomenon
↓↑ 6. Alcohol	↑ 25. Infusion set issues
↓ ↑ 7. Meal timing	↑ 26. Scar tissue and
↑ 8. Dehydration	lipodystrophy
? 9. Personal microbiome	↓↓ 27. Intramuscular insulin delivery
Medication	↑ 28. Allergies
→↓ 10. Medication dose	↑ 29. A higher glucose level
↓ ↑ 11. Medication timing	↓ ↑ 30. Periods (menstruation)
↓ ↑ 12. Medication interactions	↑↑ 31. Puberty
↑↑ 13. Steroid administration	↓ 32. Celiac disease
↑ 14. Niacin (Vitamin B3)	↑ 33. Smoking
Activity	Environmental
→ ↓ 15. Light exercise	↑ 34. Expired insulin
↓ ↑ 16. High-intensity and	↑ 35. Inaccurate BG reading
moderate exercise	↓ ↑ 36. Outside temperature
→ ↓ 17. Level of fitness/training	↑ 37. Sunburn
↓↑ 18. Time of day	? 38. Altitude
↓ ↑ 19. Food and insulin timing	Behavioral & Decision Making
	↓ 39. Frequency of glucose checks
1. 771	↓↑ 40. Default options and choices
dialribe	↓↑ 41. Decision-making biases
ulailibu	↓↑ 42. Family relationships and social pressures

Credit: Adam Brown. *diatribe,* Feb 2018

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Baylor College of Medicine Hilliard et al. Curr Diabetes Rep. 2015

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REVIEW OF GLUCOSE MONITORING

Traditional "fingerstick" glucose testing



Fingersticks Alone



 Continuous glucose monitoring (CGM)



Ref: Berget C, et al. The Use of Technology in Managing Diabetes in Youth Part 1—Continuous Glucose Monitoring, NASN Sch Nurse. 2020



CGM – CURRENTLY AVAILABLE SYSTEMS



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DEXCOM G6







Sensor + Algorithm

Factory calibrated 10 Day Session Acetaminophen blocking

Applicator

Push Button Sensor Applicator

Transmitter

BLE - 20 Foot Range 3 Month Life



Apps

Dexcom G6 App Urgent Low Soon Alert Remote Monitoring Clarity

Ref: https://www.dexcom.com





DEXCOM G7



Ref: https://www.dexcom.com

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MEDTRONIC GUARDIAN 3, 4



Ref: https://www.medtronicdiabetes.com/products/guardian-connect-continuous-glucose-monitoring-system



ABBOTT FREESTYLE LIBRE 1, 2, 3

- Libre: Flash Glucose Monitor (FGM) / Intermittently scan CGM (isCGM)
- Libre 2: isCGM w/ optional, real-time alarms
- Libre 3: real-time CGM



Ref: https://www.freestyleprovider.abbott



PERSONALIZING DIABETES CARE: GLYCEMIC OUTCOMES BEYOND A1C



Credit: Adam Brown, diaTribe Foundation.

https://diatribe.org/BeyondA1c



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Î F FROM RESEARCH TO PRACTICE



Beyond A1C: A Practical Approach to Interpreting and Optimizing Continuous Glucose Data in Youth

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Despite significant pharmacological and technological advances in the treatment of type 1 diabetes, the majority of youth in the United States do not meet the American Diabetes Association's recommended A1C goal. Understanding and managing glycemic variability is important in children and adolescents. Because A1C provides an incomplete picture of day-to-day glycemic fluctuations, continuous glucose monitoring (CGM)-derived metrics are a promising addition to address glycemic management challenges in youth with diabetes. In this article, we discuss how to develop practical strategies to optimize the use of CGM in the pediatric population, interpret the valuable data it provides, and develop personalized and actionable treatment goals.



Ref: Al-Gadi I et al. Diabetes Spectrum. 2021 May; 34(2):139-148.







Standard Continuous Glucose Monitoring (CGM) Report



Learn more at diabetes.org | 1-800-DIABETES (1-800-342-2383)

Supported in part by Time in Range[™]-a diabetes technology initiative of the American Diabetes Association (ADA)[®]

Ref: https://professional.diabetes.org



Safe at School®: Guidance for the Use of Continuous Glucose Monitoring in the School Setting

- DMMP is key!
- Low / high alerts
- Meal bolus, activity



 *Remote Monitoring: school nurse, trained staff, and/or parents (requires clear communication plan)

*The school nurse and 504 team, including the parent/guardian, should discuss each student's needs and determine if remote monitoring is necessary based on the DMMP/provider's orders.

Ref: www.diabetes.org/safeatschool



TREND ARROWS (DMMP)

"Goal should be to manage diabetes needs while also promoting student well-being and minimizing interruptions in the school day."

TREATMENT OF HYPOGLYCEMIA UTILIZING CGM: SCHOOL AGE

		<70	70-100	101-120	121-150	
CGM	\rightarrow		OBSERVE	OBSERVE	OBSERVE	\rightarrow
SYMBOLS	К	FOLLOW RULE	Check BG Give 5 GM	OBSERVE	OBSERVE	ĸ
	\checkmark	OF 15	Check BG Give 5 GM	Check BG Give 5 GM	OBSERVE	\downarrow
	$\checkmark \checkmark$		Check BG Give 10 GM	Check BG Give 10 GM	Check BG Give 5 GM	$\checkmark \checkmark$

*BG = BLOOD GLUCOSE (BLOOD SUGAR)

*GM = GRAMS

Ref: www.diabetes.org/safeatschool



SUPPORTING STUDENTS ON CGM

- Avoid overreacting to highs and lows
- CGM as learning tool



Ref: Stephen Ponder, MD. Sugar Surfing: How to manage type 1 diabetes in a modern world. 2015



CGM SUPPLIES IN SCHOOL

- If CGM falls off, school nurse can help place the pieces in sealable plastic bag to be sent home
- Use back-up meter as needed
- Student's DMMP may allow student to replace a new sensor

Type 1 Diabetes Rescue Boxes for Back to School



Tips and Tricks from Parents

Ref: www.diabetes.org/safeatschool

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Ref: https://something2offer.com/type-1-diabetes-rescue-boxes-for-back-to-school/

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INSULIN PUMP TECHNOLOGY LANDSCAPE





Ref: Kadish. Am J Med Electronics. 1964

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INSULIN REGIMEN – ACT LIKE A PANCREAS

- GOAL: mimic the function of the pancreas with basal and bolus insulin
 - Basal: insulin required in fasting in order to cover glucose released by liver
 - Bolus: insulin required to cover carbohydrates or to correct a high blood glucose

Goal range: 70-180 mg/dl





INSULIN REGIMEN WITH PUMP



Texas Children's*

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BOLUS CALCULATOR

- Enter carbs (grams) and/or glucose level and pump will calculate bolus dose
 - Keeps track of insulin onboard (IOB)



Image credit: www.tandemdiabetes.com



CLOSED-LOOP, AUTOMATED INSULIN DELIVERY (AID)



- AID systems sense changes in glucose (via CGM) and adjust insulin delivery in pump via control algorithm
 - Still need to enter carbs to bolus before eating

Ref: Boughton C and Hovorka R. Diabetologia, 2021



AID SYSTEM IN ACTION

Sep 2, 2021



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AID SYSTEMS \rightarrow INCREASE TIME-IN-RANGE

Control-IQ Pivotal Trial Data (N=168, age 14-71y with T1D)



Trifecta w/ HCL: 1) lower A1c, 2) more TIR, 3) less hypoglycemia

Ref: Brown SA et al. N Engl J Med. 2019



GREAT WAY TO START THE DAY!



Image: Omnipod 5 Pivotal trial participant

5-020-001	ACR
0.00 U	
\rightarrow	121 mg/dL
~	CGM 07:09 AM
5-020-002	LAG
0.00 U	
\rightarrow	119 mg/dL
·	CGM 07:16 AM
5-020-003	GRH
0.00 U	
\rightarrow	104 mg/dL
/	CGM 07:13 AM
5-020-004	AGH
0.00 U	
\rightarrow	104 mg/dL
/	CGM 07:10 AM
5-020-005	KMD
0.00 U	
\rightarrow	97 mg/dL
<i>·</i>	CGM 07:16 AM
5-020-006	TDB
0.00 U	
\rightarrow	108 mg/dL
/	CGM 07:12 AM

5-020-007	JJB
0.00 U	
\rightarrow	113 mg/dL
·	CGM 07:14 AM
5-020-008	LWM
0.00 U	
\rightarrow	101 mg/dL
·	CGM 07:13 AM
5-020-009	MCS
3.59 U	
	119 ma/dL
\rightarrow	CGM 07:13 AM
5-020-010	ARH
0.21 U	
	99 ma/dl
\rightarrow	CGM 07:11 AM
	00m 07.11 Au
5-020-012	IMM
0.00 U	
7	106 mg/dl
/	CGM 07:16 AM
	COM 07.10 AM

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IMPACT OF AID SYSTEMS TO CHILDREN AND CAREGIVERS

<u>Pros</u>

- Burden of care lifted to large degree
- Improved control (♥A1c,
 ↑TIR, ♥hypo)
- Less nighttime worry
- Great start to the day

<u>Cons</u>

- Not a cure
- Still have to wear devices
- Not yet fully automated
- Cost, coverage, and access issues

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PANTHER Program's CARES Framework

standardizes and streamlines key points for clinicians.

How does the algorithm calculate insulin delivery?

Which components of insulin delivery are automated (e.g. basal suspensions, basal modulation, high glucose corrections, food boluses, etc.)?

Which pump settings can be adjusted when using AID*?

Which parameters can be adjusted to influence insulin delivery during automation (e.g. carbohydrate ratios, insulin action time, basal rates, sensitivity factors)?

Which parameters are fixed?

R Revert

A Adjust

C Calculate

When will the system **revert** from AID* to Manual Mode / no automation?

E Educate

S | Sensor/ Share What are the key **education** points for the advanced diabetes device (e.g. essential training, tips & tricks, best practices, etc.)?

How does the user optimize time using the automated features?

Where can users and clinicians find additional education?

What are relevant **sensor** characteristics for each device (e.g. calibration and therapeutic blood glucose requirements, duration of sensor wear, etc.)?

What are the system capabilities for remote monitoring and cloud-based data **sharing**?



Ref: Messer et al. Diabetes Technol Ther. 2019

www.pantherprogram.org

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TANDEM T:SLIM X2 W/ CONTROL-IQ

- Tandem t:slim X2 pump
- Control-IQ algorithm
- CGM options:
 - Dexcom G6, G7
 - Libre 2 Plus



180 -	🗞 🚺 Delivers	Delivers an automatic correction bolus if sensor glucose is predicted to be above 180 mg/dL
160 -	Increases 🚯	Increases basal insulin delivery if sensor glucose is predicted to be above 160 mg/dL
112 5 -	B Maintains	Maintains active Personal Profile settings
70	In Decreases	Decreases basal insulin delivery if sensor glucose is predicted to be below 112.5 mg/dL
mg/dL	🗞 🖸 Stops	Stops basal insulin delivery if sensor glucose is predicted to be below 70 mg/dL

Ref: www.tandemdiabetes.com

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CONTROL-IQ ALGORITHM



Image credit: www.tandemdiabetes.com

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MEDTRONIC MINIMED 780G

MiniMed 780G pump with Guardian 4 CGM with *SmartGaurd* algorithm

- Flexible target 100, 120, or 150
- Meal detection technology w/ auto bolus
- 7-day extended infusion set



Ref: https://www.medtronicdiabetes.com



MINIMED 780G SMARTGUARD TECHNOLOGY



Ref: https://www.medtronicdiabetes.com

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OMNIPOD

- Tubeless, waterproof POD holds up to 200 units
- PDM: controller for commanding bolus, temp basal, changing settings

OMNIPOD EROS/CLASSIC

OMNIPOD DASH





Ref: https://www.omnipod.com/hcp



OMNIPOD 5 AID SYSTEM

Tubeless Pod w/ integrated control algorithm



- Wearable tubeless, insulin-filled Pod communicates directly with Dexcom G6 sensor (continuous glucose monitor)
- Algorithm is built into the Pod automated insulin delivery can continue without the handheld controller nearby
- Omnipod 5 App is used to start and stop Automated Mode, deliver boluses, view data, and change settings
- Customizable glucose targets from 110-150 mg/dL in 10 mg/dL increments, adjustable by time of day
- Activity feature for times of reduced insulin needs, such as exercise

Ref: https://www.omnipod.com/hcp

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OMNIPOD 5 AUTOMATED MODE



Ref: https://www.omnipod.com/hcp

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BETA BIONICS - ILET BIONIC PANCREAS

- Only parameter required is weight (kg)
- No bolus or basal settings
- 3 target options: usual, lower, higher
 - Sleep target
- Meal announcement: "usual", "more than usual", "less than usual"



Ref: https://www.betabionics.com/hcp

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ILET ALGORITHM

- Basal modulation
- Auto correction
- Meal-announcement



Ref: https://www.betabionics.com/hcp

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DIY LOOP

The Loop app is an open-source DIY iPhone app with AID algorithm





Ref: https://loopkit.github.io/loopdocs/

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TIDEPOOL LOOP







Tidepool Loop is not cleared for use in the US or outside of the US. Displayed is a conceptual rendering of a product in development.

Ref: https://www.tidepool.org/tidepool-loop

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INSULIN PUMP IN THE SCHOOL SETTING

- School nurse and/or designated staff should be trained on pump
- Ensure pump supplies are available
- Back-up plan for "pump failure" in DMMP



This checklist was designed for school nurses who provide care for students with diabetes on insulin pumps. The school nurse and/or designated school employees should be trained to perform the skills listed below. As always, diabetes management needs should be individualized according to each student's Diabetes Medical Management Plan (diabetes.org/dnmp) or provider orders.

How to give a food bolus □ How to give a correction bolus □ How to give a combined food + correction bolus □ How to review the bolus history How to do a temporary basal How to suspend pump How to change a battery or charge a pump The number for technical support: The number for medical support: When to check for ketones When to call for medical intervention Plan for pump or site failure Optional features that may need reviewed if being utilized: How to use the remote meter How to lock and unlock the device How to calibrate with sensor integration



Ref: www.diabetes.org/safeatschool

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PRECAUTIONARY AREAS WITH INSULIN PUMPS



"Pump failure" resulting in hyperglycemia, ketosis and/or DKA if insulin infusion is interrupted

*Occlusion/infusion set failure



Lipohypertrophy if infusion sites are not properly rotated



Infusion site reactions (rash/skin irritation) or infections

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TREATING "PUMP FAILURE"

- Use the mnemonic KISS.
- K Check for <u>Ketones</u> for unexplained, prolonged hyperglycemia
 - I Give insulin by <u>Injection</u> (using an insulin pen or
 - syringe not through the pump)
 - S Change the infusion Set
 - **S** Follow blood <u>**Sugar**</u> closely



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PUMP & CGM WITH PHYSICAL ACTIVITY

CGMs and insulin pumps can help students with T1D participate safely in PE, sports, and school sponsored events

Table 1. Quick Tips for Using CGM/Pumps With Physical Activity

Have a plan for monitoring sensor glucose levels preexercise, during exercise, and postexercise

Set CGM predictive alerts

Have diabetes supplies including fast acting sugar, blood glucose meter, tape to reinforce CGM sensor/pump infusion site

Adjust basal insulin on pump per DMMP (usually preexercise)

If student disconnects from pump during exercise, keep pump safe and available. Will need to reconnect in at least 2 hours.

Maintain hydration (support CGM sensor reading)

If student's symptoms do not match CGM readings or the glucose levels are rapidly changing-check blood glucose levels by finger stick.

Continue to monitor glucose levels postexercise, up to 24hrs depending on degree of exercise

Note. CGM = continuous glucose monitoring; DMMP = Diabetes Medical Management Plan.

Ref: Wycoff L, et al. The Use of Technology in Managing Diabetes in Youth Part 3—Integration Into the School Setting, NASN Sch Nurse. 2020







Interviews with 40 school nurses (elementary and middle schools) revealed 4 major themes:

- 1. School nurses desire more training on diabetes devices
- 2. Enthusiastic about devices but concerns about implementation
- 3. Collaboration between school nurses and clinicians varies widely
- 4. Barriers to integrating devices into school setting

Ref: March CA et al. Pediatric Diabetes. 2020



BARRIERS TO DIABETES TECH IN SCHOOL

School nurses perceived barriers to integrating diabetes tech in the school setting:



Ref: March CA et al. Pediatric Diabetes. 2020



INSULIN PUMP RESOURCES FOR SCHOOL NURSES

Seek out training to update your skills and gain knowledge about diabetes technology

able 2.	Insulin Pump Resources for School Nurses
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Helping the student with diabetes succeed: A guide for school personnel: https://www.niddk.nih.gov/health-information/professionals/clinicaltools-patient management/diabetes/helping-student-diabetes-succeed-guide-school-personnel

ADA school nurse pump training skills checklist (https://www.diabetes.org/sites/default/files/2019-11/school-nurse-pump-training.pdf)

The Minimed 670G system school nurse guide (https://s3.amazonaws.com/medtronic-hcp/MiniMed-670G-System-School-Nurse-Guide.pdf)

Medtronic 670G: Information for school nurses (1-page guide; http://www.coloradokidswithdiabetes.org/wp-content/uploads/2013/07/ Medtronic-670G-School-RN-Final.pdf)

T:Slim X2 Insulin Pump: Information for School Nurses (1-page guide comparing Basal IQ and Control IQ; http://www.coloradokidswithdiabetes. org/nurse-files/)

Insulet Omnipod Education Resources (https://www.myomnipod.com/podder-support/resources-troubleshooting/caregiver-guide)

Tandem Control IQ: Link to Control-IQ online training for healthcare professionals (https://cloud.scorm.com/sc/InvitationConfirmEmail? publicInvitationId=78da4159-4546-4152a53e494d203c86e2&mkt_tok=eyJpljoiWkRGaU1tVTBPV1kwWVdFMylsInQi0iJFSkhGaU x0VFVxV0h5NUNxVTFLbTUyWFo3S3d3b1FpTm10WjFiK3F3Z3hNT21rYnJ2enZVXC9zSWRqQ0NFXC9DQWtBVXVYRHdlbjdCWUNTMGZ5N3Q xdWI5WUgraWpXZmRoeTVsZIg1NEErTUhqRzdvK1I4ZTI2M2IIMG1sekw4WEICIn0%3D)

Ref: Berget C, et al. The Use of Technology in Managing Diabetes in Youth Part 2—Insulin Pump Technologies, NASN Sch Nurse. 2020

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ADDITIONAL REFERENCES

- ADA Training Resources for Schools: <u>https://diabetes.org/advocacy/safe-at-school-state-laws/training-resources-school-staff</u>
- ADA Safe At School's Helping the Student with Diabetes Succeed: A Guide for School Personnel, 2020.
- ADA Safe At School's *Recommendations for use of continuous glucose monitoring in the school setting*, Sep 2023.
- Berget C and Wykoff L. Use of Technology in Managing Diabetes in Youth, NASN School Nurse, March 2020.
 - Part 1 Continuous Glucose Monitoring: Information and Tips for the School Nurse
 - Part 2– Insulin Pump Technologies: Information and Tips for the School Nurse
 - Part 3– Special Considerations: Integration Into the School Setting
- March CA, et al. Modern diabetes devices in the school setting: Perspectives from school nurses. *Pediatric Diabetes*, August 2020.







COMMENTS/QUESTIONS?