

Diabetes Medications and Devices

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Objectives

Recognize	Recognize the stress of chronic disease
Identify	Identify common diabetes management technology
Discuss	Discuss emergent risks and side effects of diabetes medications

Medication adherence

- When is the last time you had to take medications?
- Was it long term or short term?
- How well do you think you "complied" with the medications?
- What were factors that played into this?

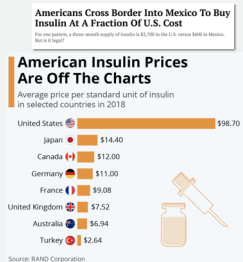
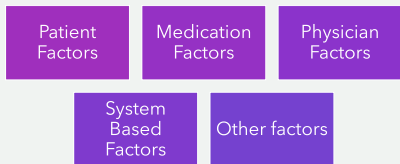
Medication adherence

Primary Medication Non Adherence - defined by not renewing prescriptions on monthly basis as expected.

HTN, DM, osteoporosis, Asthma, HLD 10-25% doses missed

Schizophrenia 41% doses missed

Medication adherence factors



Diabetes patients turn to underground insulin networks as Covid-19 exposes limits of copay caps

What can we do?

Understand	Understand our patients face major challenges
Inquire	Ask what makes it difficult to access or take meds
Clarify	Ask patients about their pharmacy and ability to pay
Collaborate	Work closely with our pharmacist to figure out availability

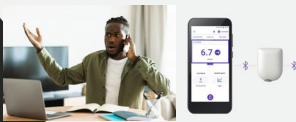


- Shame
- Self doubt
- Isolation
- Frustration
- Disbelief
- Stress
- Grit/resilience
- Determination
- Stress
- Acceptance



- Acceptance
- Relief
- Weight gain
- Frustration
- Stress
- Patience
- Self care
- Understanding

Health care providers and insurance companies can be incredibly challenging to work with



Text 1: "I tried to buy insulin about it and she said ICP was for prevention... I got ICP and some covering doctor responded saying only one covered ICP... I'm not sure if I need a doctor too. So I just prescribed it to myself."

Text 2: "I've been struggling with pump sites falling and my DKA going into the 300s repeatedly. Having to go back and forth to shots, I'm tired. I literally thought I was going to end up in the hospital with DKA. I need a little bit of backup something here."

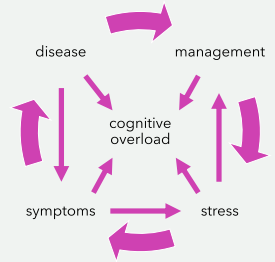
Text 3: "Damn that's amazing! Might have to look more seriously into trying that, seems like lots of people the comments with success too. Wonder if any have gone on out there to help get it covered... I imagine it might be an insurance issue!"

Text 4: "Last, I was looking at alternatives to typical insulin (I'm not even gonna tell you how much I've done that but even looked into people making DIY insulin and insulin suspension kits), and looks like the insulin analogs are completely stable for at least 2 years... and if you can get your hands on some, good backup."

Text 5: "Haha yes. We just watched this movie Grand Budapest which is what drove me down the rabbit hole. Not sure if you've seen it, but that movie is intense af."

Text 6: "Really good tho"

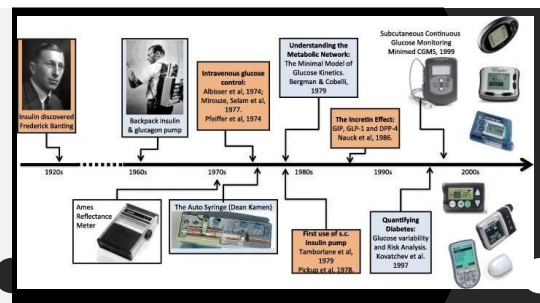
Burden of chronic disease



Chronic disease takeaways

- It is hard to have a (chronic) disease
- It is hard to navigate the healthcare system
- Don't judge your patients
- Think about how you can help them with navigating the system and getting medications

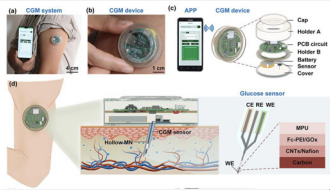
Evolution of diabetes technology



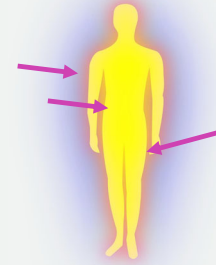
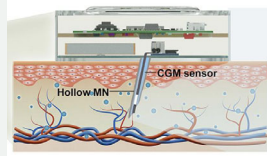
Diabetes technology in the ED

- 48% of people with T1DM use a CGM
- 50% in white patients, 18% in Black patients
- 57% of privately insured patients, 33% of publicly insured patients
- 30-60% of people with T1DM use an insulin pump

Continuous Glucose monitors

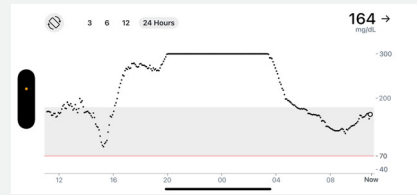
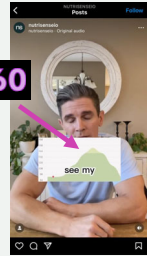
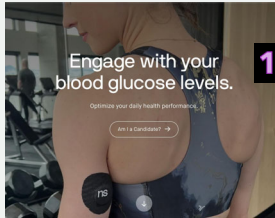


Continuous Glucose monitors



Eligibility?

- People who use insulin multiple times daily
- People with hypoglycemic episodes
- Elderly patients
- Patients with disabilities
- People who use a pump



Model	FreeStyle Libre Pro	FreeStyle Libre	FreeStyle Libre 2	FreeStyle Libre 3
Year of FDA Approval	2016	2017	2018	2022
MARD	12.3%	12%	9.5%	7.5%
Wear Length Time	14 days	14 days	14 days	14 days
Warm Up Time	1 hour	1 hour	1 hour	1 hour
Repeated Calibrations Needed	None	None	None	None
Measures Glucose	Every 15 minutes	Every 15 minutes	Every 1 minute	Every 1 minute
Wireless Data Sharing	N/A	20 people	20 people	20 people
Transmitter Duration	14 days	14 days	14 days	14 days
Interference With	Hydroxyurea	N/A	Vitamin C Aspirin	N/A

Model	Short Term Sensor (STS)	Dexcom SEVEN PLUS	Dexcom G4	Dexcom G5	Dexcom G6	Dexcom G6 Pro	Dexcom G7
Year of FDA Approval	2008	2007	2012	2015	2019	2019	Not Approved
MARD	26%	16%	13%	9%	9%	9%	5.1% in am, 5.1% in afternoon
Wear Length Time	3 days	7 days	10 days	10 days	10 days	10.5 days	10.5 days
Warm Up Time	2 hours	2 hours	2 hours	2 hours	2 hours	2 hours	27 minutes
Repeated Calibrations Needed	None	None	None	None	None	None	None
Measures Glucose	Every 5 minutes	Every 5 minutes	Every 5 minutes	Every 5 minutes	Every 5 minutes	Every 5 minutes	Every 5 minutes
Wireless Data Sharing	N/A	N/A	5 people	10 people	N/A	N/A	10 people
Alerts	Only for hypoglycemia	Yes	Yes	Yes	Yes	Yes	Yes
Transmitter Duration	6 months	3 months	3 months	1 month	10 days	10 days	10 days
Interference With	Aspirin Vitamin C	Acetaminophen	Acetaminophen Hydroxyurea	Hydroxyurea	Ascorbic Acid Salicylic Acid	Unknown	Unknown
Pump Integration	N/A	Tandem	Tandem OmniPod	N/A	Unknown	Unknown	Unknown

Model	Dexcom Implantable Sensor	Eversense	Eversense XL	Eversense EX
Year of FDA Approval	Not approved by FDA	2018	Not approved by FDA	2022
MARD	16-25%	11.2%	11.6%	8.5%
Wear Length Time	3 months	90 days	180 days	180 days
Warm Up Time	N/A	24 hours	24 hours	24 hours
Repeated Calibrations Needed	None	Every 12 hours	2 calibrations per day for the first 21 days of wear. Then, every 24 hours.	None
Measures Glucose	Every 5 minutes	Every 5 minutes	Every 5 minutes	Every 5 minutes
Wireless Data Sharing	N/A	Yes	5 people	5 people
Transmitter Duration	51-68 days	3 months	Tetracycline	6 months
Interference With	N/A	N/A	Tetracycline Mannitol	N/A
Pump Integration	N/A	N/A	N/A	N/A



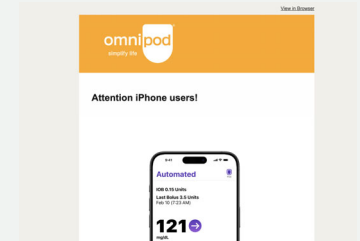
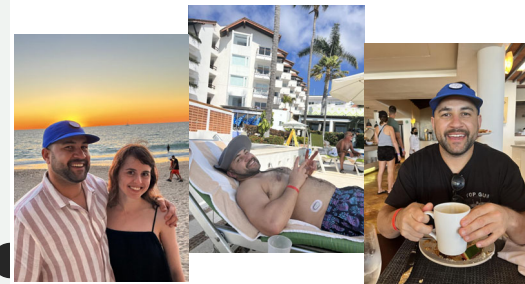
CGM Considerations

- CGMs can be inaccurate
- Skin irritation is common
- Beware of meds/conditions that interfere with readings

CGM Considerations

- Look for a CGM if a patient is hypoglycemic
- Let the patient leave the CGM on
- Some are not compatible with MRI
- Check to see if your hospital allows you to document CGM readings
- Consult endocrine if you are concerned

Insulin Pumps



We're excited to share that the highly anticipated **OmniPod® 5** App for iPhone is expected to be on the App store in mid-October. In the coming weeks we'll provide helpful resources to get started on iPhone control with Devoom OS.

The **OmniPod 5** App for iPhone will first be compatible with **iOS 17**. Please note that iPhone 16 models will not be available with the **OmniPod 5** App until it is fully compatible with **iOS 18**.

Managing operating system updates by phone manufacturers is not unique to Insulet or **OmniPod 5**. We test an early version of the software to make sure it is accessible to use with the **OmniPod 5** App and complete testing once Apple releases the final operating system.

Apple is releasing **iOS 18** as soon as next week. If you plan to use the **OmniPod 5** App on a compatible iPhone* once available, we recommend remaining on **iOS 17** and turning off your automatic updates to avoid updating to **iOS 18**.

To turn off automatic updates on your iPhone:
Settings > General > Software Updates > Automatic Updates (toggle off).

Model	Medtronic 670G 770G	Medtronic 760G	Insulin Libre X2 Basal IQ	Insulin Libre X2 Control IQ	OmniPod
FDA Approval	2017/2020	Not yet approved	2018	2020	2022
CGM level	Guardian 3	Guardian 3 or 4			GE
Auto-Mode	After 48 hours	Immediately			
Basal adjusted	Every 2-6 days	Based on previous basal program			With each and change
Target Range (mg/dL)	120, 150, 110 or 130	N/A	112.5-160	110, 120, 130, 140 or 150	
Correction Target (mg/dL)	Fixed at 100	Fixed at 120	N/A	Fixed at 110	Flexible
Modified Parameters	ICR, DIA	ICR, DIA	ICR, DIA, Basal-Rate	ICR, ICR, DIA	
Fixed Parameters	Basal Rate, ICR	Basal Rate, ICR	DIA & 4 Hours	DIA & 4 Hours, Correction Target	Basal rate
Exercise Mode (mg/dL)	Temporary Target (150)	Exercise Mode (150)	N/A	Exercise Mode (140-160)	Activity Mode (150)
More needs (mg/dL)	N/A	N/A	N/A	Stale Mode (112.5-120)	N/A
Additional Features (mg/dL)	Recommended Basal, Auto-Basal	Auto-Basal	N/A	Extended Basal, Insulin Delivery	N/A
Upload program	CloudLink		i-Connect		Glucose

Table 1. Pharmacokinetic Profiles of Insulin Therapies

Insulin type	Onset	Peak	Duration
Long-acting			
Detemir (Levemir)	3 to 4 hours	6 to 8 hours	6 to 23 hours
Glargine (Lantus)	90 minutes	None	24 hours
Intermediate-acting			
NPH (Humulin N)	1 to 2 hours	4 to 10 hours	14 or more hours
Short-acting			
Aspart (Novolog)			
Glulisine (Apidra)			
Lispro (Humalog)			
Regular			
Mixed*			
NPH/rapid or aspart	15 to 30 minutes	Dual	14 to 24 hours
NPH/regular	30 to 60 minutes	Dual	14 to 24 hours

*—NPH/regular: Humulin 70/30, Novolin 70/30, Humulin 50/50; NPH/rapid or aspart: Humalog 75/25, Novolog 70/30, Humalog 50/50. Adapted with permission from Endotext.org. Insulin pharmacology, types of regimens and adjustments. <http://www.endotext.org/diabetes/diabetes17/diabetes/ame17.htm>. Accessed December 6, 2019.

Initiating and Managing pumps

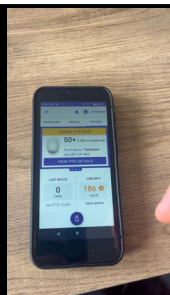
Education before starting on a pump

Data shared with endocrinologist

Program created with basal insulin expectation

Insulin/carb ratio determined

Patients learn how to use the pump over time



Pump Safety

Activity/Exercise feature

Maximum basal rate

Shut off feature

Short acting insulin only

Hypoglycemia alerts from phone/controller

Pump issues

Incorrect settings

Empty reservoir

Kinked/broken tube

Insulin is heat sensitive

Skin irritation

Pump is gone (adhesive issue)

Disconnection from sensor

Pump Considerations

- In hypoglycemia, remove the pump
- In hyperglycemia consider that the reservoir is empty, kinked or disconnected tube, kinked cannula
- Patients have a high risk of DKA after pump is removed
- If admitting, consult endocrinology
- Not all pumps are compatible with MRI

Diabetes tech Summary

CGM and pumps are more commonplace

Ask patients about their technology, they likely have a lot of knowledge

Leave CGMs in place

Remove pumps in hypoglycemia

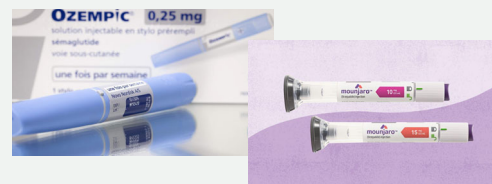
Patients are at high risk of DKA when pumps are removed

Consult endocrinology with questions

Diabetes Med Case 1

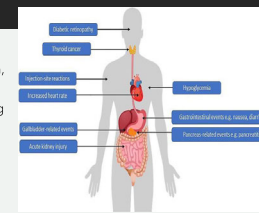
A healthy 36 y/o man presents with nausea, abdominal cramping and vomiting. He has no fevers, urinary symptoms, history of abdominal surgeries. His vitals are normal and his exam is unremarkable. He recently reached out to PlushCare and was started on semaglutide for weight loss. It turns out that he accidentally took about 10x the dose.

GLP 1 Receptor Agonists



GLP1 Receptor Agonists

- Once weekly shots or daily pill
- Increase insulin, decrease glucagon, delay gastric emptying
- Potentially increase satiety, reducing weight and calorie intake
- "quieting of food noise"
- Possible CV and renal protection
- Main side effects: **nausea, vomiting, diarrhea, abdominal pain**



Sedation, Aspiration, and the Risk of GLP-1 Agonists

September 03, 2024

Open Read
Patients on GLP-1 agonists might be at risk of delayed gastric emptying, which has significant implications for procedural sedation and endotracheal intubation.

Source
Use of Glucagon-like Peptide-1 Receptors and Increased Risk of Procedural Sedation and Endotracheal Intubation in the Emergency Department. Ann Emerg Med 2024 Aug;84(2):226-227. DOI: 10.1016/j.annemergmed.2024.03.007. PMID: 39032988.

GLP-1 medications for weight loss could reshape the food industry

Morgan Stanley Research analysts estimate that around 7% of the U.S. population will be using GLP-1 drugs by 2035. When 24 million people change their eating habits, it's inevitable that the market will see some changes, too.

Those analysts project that manufacturers of confectioneries, baked goods, and salty snacks will be among the first casualties of widespread GLP-1 usage for weight loss. Overall consumption of these products could drop by as much as 3% by 2035—but demand for "weight-loss management foods" like protein shakes and meal replacements will likely rise in response.

The beverage industry will also likely see losses. More than 60% of patients taking GLP-1 drugs drink fewer sugary drinks and less alcohol. Around one in four gave up alcohol entirely, while one in five stopped drinking sugary drinks. This could lead to a 2% drop in nationwide alcohol consumption.

GLP1 Receptor Agonist Adverse Event Treatment

Most effects go away over time

Supportive care

Monitor for hypoglycemia - maximum effect likely 6-24 hours after injection

Case outcome

Toxicology/Poison Control consulted. Patient was treated with Zofran, Compazine and 3 Liters of fluid. Abdominal pain, nausea and vomiting persisted so they were given droperidol 2.5 mg and stayed in the observation unit overnight with good outcome. Patient never had hypoglycemia.



Diabetes Med Case 2

A 63 year old transwoman with type 2 diabetes presents with chest pain. They recently had a long flight and they have pleuritic chest pain. On exam their HR is 104, BP is normal. EKG neg acute. Trop is 0.07. You want to order a CT pulmonary angiogram but see they are on metformin and your departmental policy states "patients must hold metformin for 24 hours after contrast".

Metformin Can Be Safely Used in Patients Exposed to Contrast Media: A Systematic Review and Meta-Analysis

Hua Qiao,^a Yimin Lu,^{b,*} Bao Xu,^c Zhining Liu,^d Jinqi Zhao,^e Daxin Meng,^f Shanghai He,^g and Jin Huang^g

* Author information • Article notes • Copyright and License information • Disclaimer

Conclusion

Metformin can be safely used in patients with moderate renal impairment (eGFR ≥ 30 mL/min/1.73 m²) during CM exposure.

Diabetes Med Case 3

60 year old woman with history of DM1 presents after 2 days of feeling unwell with some nausea and vomiting. ROS reveals dysuria. She recently started a new medication she cannot recall. Exam notable for dehydration. Vitals notable for low grade temp and tachycardia.

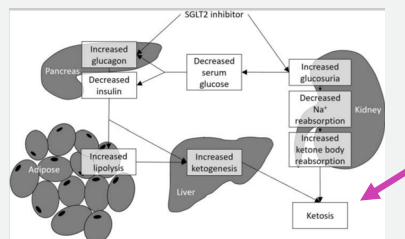
Labs show: pH 7.23, Anion gap 18 (nl < 12), Serum Glucose 174

Euglycemic DKA and SGLT2 Inhibitors

- Acidosis and Ketosis with glucose <250
- Pregnancy, stimulant use, infection, fasting, chronic liver disease, glycogen storage disease
- SGLT2 inhibitors
- 0.2% in DM2 9.4% in DM1
- Usually happens within the first 2 months
- Precipitants: Infections, stimulant use, dehydration, discontinuation of insulin

Table 1. Available SGLT2 inhibitor preparations.

Medication	Dose (mg)	Frequency
Dapagliflozin	5; 10	Once daily
Dapagliflozin/metformin	5/850; 5/1000	Twice daily, with food
Dapagliflozin/saxagliptin	10/5	Once daily
Canagliflozin	100; 300	Once daily, before first meal of day
Canagliflozin/metformin	300/850; 50/1000; 150/850; 150/1000	Twice daily, with food
Empagliflozin	10; 25	Once daily
Empagliflozin/metformin	5/850; 5/1000; 12.5/850; 12.5/1000	Twice daily, with food
Empagliflozin/linagliptin	10/5; 25/5	Once daily
Ertugliflozin	5; 15	Once daily



Case resolution

- Patient treated with IV fluids with dextrose, insulin drip, UTI treated. She improved and was discharged home 2 days later.
- Treat these patients as you would DKA, consult endocrinology.

The SQUID protocol (subcutaneous insulin in diabetic ketoacidosis): Impacts on ED operational metrics

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DISCUSSION

In this study, we found that a SQ fast-acting insulin protocol is an excellent option for MTM-severity DKA patients in the ED, reducing EDLOS and holding the potential for reductions in ICU admissions for MTM DKA. We observed excellent performance on our metric for fidelity to the protocol and had equivalent safety compared to a traditional insulin infusion pathway. Our project was met with a high degree of enthusiasm by ED providers and by the inpatient teams, leading to a forthcoming expansion of the SQUID protocol to a general medical floor and liberalization of criteria to include more complex patients. We anticipate this will result in a greater impact on reducing ICU admissions for DKA. This study adds to literature demonstrating efficacy of SQ insulin for this purpose and suggests that this might be a useful strategy for patient throughput in facilities where lack of ICU or intermediate care bed availability result in patient delays and prolonged EDLOS.

Diabetes medication takeaways

GLP1 agonists are popular, watch for n/v

Metformin is safe to continue using in patients getting contrast studies with GFR >30

SGLT2 inhibitors (flozins) predispose people to euglycemic DKA

Consider subcutaneous insulin treatment of DKA

Thank you

