PEDIATRIC TRACK

DIABETES TECHNOLOGIES

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DISCLOSURES

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OUTLINE

- Background
- Currently available technology
  - Glucose Monitoring
  - Insulin Delivery
- Future Developments
  - Glucose Monitoring
  - Insulin Delivery
- Summary
- Questions & Answers
BACKGROUND

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Progress in Diabetes Care

Discovery of insulin, 1920s
First portable glucose monitors, 1970s
DCCT 1993
Continuous glucose monitoring, 2000s
Artificial Pancreas/HCL

NPH insulin, 1930s
Biologic insulin, 1980s
Rapid-acting/basal insulin, 1990s
Ultra rapid insulin

FUTURE?
ARTIFICIAL PANCREAS
What is an “artificial pancreas?”

3. CGM
1. Insulin Pump
2. Rapid Acting Insulin ± Glucagon

4. Insulin Dosing Algorithm(s)
5. ± Communication Device

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Why do we need the artificial pancreas?

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CURRENT T1D CONTROL IN THE UNITED STATES

Despite >20 years of knowledge of the importance of tight control, patients are still poorly controlled.

- Evidence from the Type 1 Diabetes Exchange Registry from 2015 (Miller, Diabetes Care).
- Average A1c by age group is too high everywhere and much too high in adolescents.

SEVERE HYPOGLYCEMIA AND A1C

- DCCT (intensive therapy):
  62 per 100 pt-ys
  A1C (6.5 yr): 9.0% → 7.2%

- JDRF CGM (adults, 1 subject excluded):
  20.0 per 100 pt-ys
  A1C (6 mo): 7.5% → 7.1%

- STAR 3 SAP (all ages):
  13.3 per 100 pt-ys
  A1C (1 yr): 8.3% → 7.5%

- T1D Exchange (US data)

Garg et al. ATTD. Barcelona 2012.
BURDEN V BENEFIT

CURRENTLY AVAILABLE TECHNOLOGY

- Glucose Monitoring
- Insulin Delivery/ Artificial Pancreas
CURRENTLY AVAILABLE TECHNOLOGY

- Glucose Monitoring

GLUCOSE MONITORING

Progress over the last 50 years
- Urine glucose
- Fingerstick blood glucose
  - Improvements in accuracy and technique
  - Limitations: fingersticks, frequency, rate of change
- Interstitial fluid monitoring
  - Continuous glucose monitoring (CGM)
  - Flash glucose
CONTINUOUS GLUCOSE MONITORS

- Continuous Glucose Monitors provide increasingly accurate real-time glucose values to assist with diabetes decision making.

- Sample interstitial fluid glucose and give filtered blood glucose value which is generally within 8-12% of the serum glucose with an 4-10 minute lag-time.

CONTINUOUS GLUCOSE MONITORS

- Studies show CGM use lowers HbA1c by 0.5% with decreased hypoglycemia.

- Greater benefit seen in people who wear the sensor 6 or more days per week.

- Early CGM Studies showed overall use is only about 10% of pediatric patients with high rates of discontinuation (~40% within 1 year).

- More recent (2017) evidence shows rates of use at 50% among younger children and older adults with rates around 20% among adolescents.
CURRENTLY AVAILABLE TECHNOLOGY

- Medtronic Guardian Connect
  - Approved for age 14 years and over
  - Requires Apple device (iPhone)
  - Sensor: 7-day use, calibration 2/day
  - Allows sharing
  - Sugar IQ app – identifies trends

CURRENTLY AVAILABLE TECHNOLOGY

- Dexcom G6
  - FDA approved for pediatric & adult use in 2018
  - Factory calibration
  - 10-day use
  - Receiver or phone/ watch display
  - Share/follow apps
  - Integration with Tandem pump

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CURRENTLY AVAILABLE TECHNOLOGY

- Abbott Freestyle Libre
- “flash” glucose monitoring
- No calibration
- Up to 14-day use
- No high/low alarms

NOT APPROVED FOR PEDIATRIC USE (under age 18 yrs)

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CURRENTLY AVAILABLE TECHNOLOGY

NOT APPROVED FOR PEDIATRIC USE (under age 18 yrs)

- Senseonics Eversense
  - Requires in-office procedure to implant sensor
  - 3-month sensor
  - Requires calibration (2/day)
  - High/low alarms on phone, vibration of sensor
  - Removable transmitter

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CURRENTLY AVAILABLE TECHNOLOGY

- Insulin Delivery

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INSULIN DELIVERY

MiniMed™ 670G insulin pump with SmartGuard™ technology.

Guardian™ Sensor 3 glucose sensor and Guardian™ Link 3 transmitter.

CONTOUR®NEXT LINK blood glucose meter for calibrations.
**MEDTRONIC 670G: MODES**

- Manual mode
- Pump mode
- Sensor Augmented Pump
- Hybrid Closed Loop/Auto mode

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**INSULIN DELIVERY**

- Tandem t:slim X2 with BASAL IQ
- Use with Dexcom G6 CGM
- Predicted low glucose suspend
- Decreases risk for hypoglycemia

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INSULIN DELIVERY

- Omnipod (Insulet)
  - DASH rolling out in 2019
    - (selected areas/ insurance coverage)
  - Bluetooth enabled, wifi-compatible
  - Calorie King database
  - Display/ View apps to share info
  - iPhone widget allows CGM and pump views

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INSULIN DELIVERY

- InPen (Companion Medical)
  - Bluetooth enabled pen
  - Phone app with “smart diabetes management tool”
  - Dose calculator for injections
  - Reports with data not found in meter alone

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Future Developments

• Glucose Monitoring
• Insulin Delivery

• WARNING! NOT FDA APPROVED FOR USE
• ALL INFORMATION PRESENTED IS PUBLICLY AVAILABLE

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Future Developments

• Glucose Monitoring
  • Studies in progress for pediatric use of Freestyle Libre
  • Next generation CGM from Dexcom, Medtronic
  • Increased interaction with “apps”

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Future Developments

- Control IQ
  - Tandem X2, Dexcom G6
  - U Virginia/Kovatchev algorithm
  - Trials at 7 sites completed spring 2019 (including BDC)

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Future Developments

- Medtronic
  - Bluetooth
  - 670G for age 2-6 yrs submitted for FDA review
  - Advanced Hybrid Closed Loop (integrate new algorithm)

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Future Developments

- Omnipod Horizon
  - Trials in progress for hybrid closed loop
  - MPC algorithm

Future Developments

- Bionic Pancreas bihormonal systems
- Trials in progress
  - Pilot at BDC in summer 2018 - insulin only Gen 3 iLet
  - Plans for future insulin only, bihormonal (insulin/glucagon) trials

https://www.betabionics.com/

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Future Developments

- **Tidepool Loop**
  - Loop algorithm
  - Partnership with Tidepool, Insulet
  - Under development

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Future Developments

- **Other Systems**
  - Several academic groups working on algorithms
  - Insulin only
  - Bihormonal systems
SUMMARY

Diabetes control in general remains suboptimal for most pediatric and adult patients
New diabetes technology offers hope!
More developments coming
• With research, better tools are on the way!
• Future technology will reduce burden and increase benefit

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