

The Increasing Incidence of Type 2 Diabetes: Current Trends, Screening and Referral



Amanda Perkins, C.P.N.P., M.P.H., C.D.C.E.S.
Endocrinology, Children's National Hospital

Brynn Marks, M.D., M.S.H.P.Ed.
Endocrinology, Children's National Hospital

A few notes about today's Grand Rounds

- All lines are muted throughout the presentation.
- Please use the Q&A to ask questions or make comments.
- We will be recording the session.
- Today's recording and materials will be posted to the PHN website 3 business days following the presentation:

<https://pediatrichealthnetwork.org/>

Speakers



**Amanda Perkins C.P.N.P.,
M.P.H., C.D.C.E.S.**



**Brynn Marks M.D.,
M.S.H.P.Ed.**

Disclosures:

Perkins: None

Marks:

- Investigator initiated research funding from the Dexcom & Tandem Diabetes Care, Inc.
- JDRF Community Board Member

Pediatric Health Network



Objectives for Today's talk

- Compare various presentations of new onset Type 2 diabetes (T2DM).
- Examine trends in obesity and T2DM in adolescents.
- Discuss the changes in incidence, severity and disparities in T2DM presentation at CNH.
- Explain the process for T2DM screening, follow up and referral.
- Develop practices that address disparities in T2DM diagnosis and outcomes.

Case Study - KJ

Chief Complaint:

“Not feeling well x 9 days. Headaches, dizziness, and feeling of dehydration. Vomiting x 2 days.”

Case Study - KJ

- **HPI:**
 - 13-year-old AA female
 - Nausea x 4d
 - Headache and dry-heaving since yesterday
- **Allergies:** NKDA
- **PMH:** obesity, mild, intermittent asthma
- **Medications:** albuterol inhaler PRN, multivitamin
- **Family History:** GDM in mom, T2DM in multiple maternal family members
- **Social History:** lives with mom and 3-year-old sister, 7th grade, virtual school during COVID

Case Study - KJ

- Not feeling better by Wed, advised to come to office
- **Physical exam**
 - **VITAL SIGNS:** T: 37.9 °C HR: 135 RR: 16 BP: 123/69 SpO₂: 98% WT: 84.5 kg (86.3kg in ED 3 months prior)
 - **General:** Obese, alert, NAD
 - **Skin:** + Acanthosis to neck
 - **Resp:** Slow, exaggerated deep breaths with fruity odor
 - **Neuro:** Alert and oriented
 - **Puberty:** Tanner 4
- More questioning → polydipsia, polyuria x 1 week

POLL: What would you do?

1. Prescribe Zofran and send home
2. Fax over endo referral
3. Send to lab for A1c which will result tomorrow
4. Send to ER

Case Study - KJ

- Not feeling better by Wed, advised to come to office
- More questioning → polydipsia, polyuria x 1 week
- **Physical exam**
 - **VITAL SIGNS:** T: 37.9 °C HR: 135 RR: 16 BP: 123/69 SpO2: 98% WT: 84.5 kg (86.3kg in ED 3 months prior)
 - **General:** Obese, alert, NAD
 - **Skin:** + acanthosis to neck
 - **Resp:** Slow, exaggerated deep breaths with fruity odor
 - **Neuro:** alert and oriented
 - **Puberty:** Tanner 4

POC urine showed 3+ glucose

Case Study - KJ

Initial lab results in the ED:

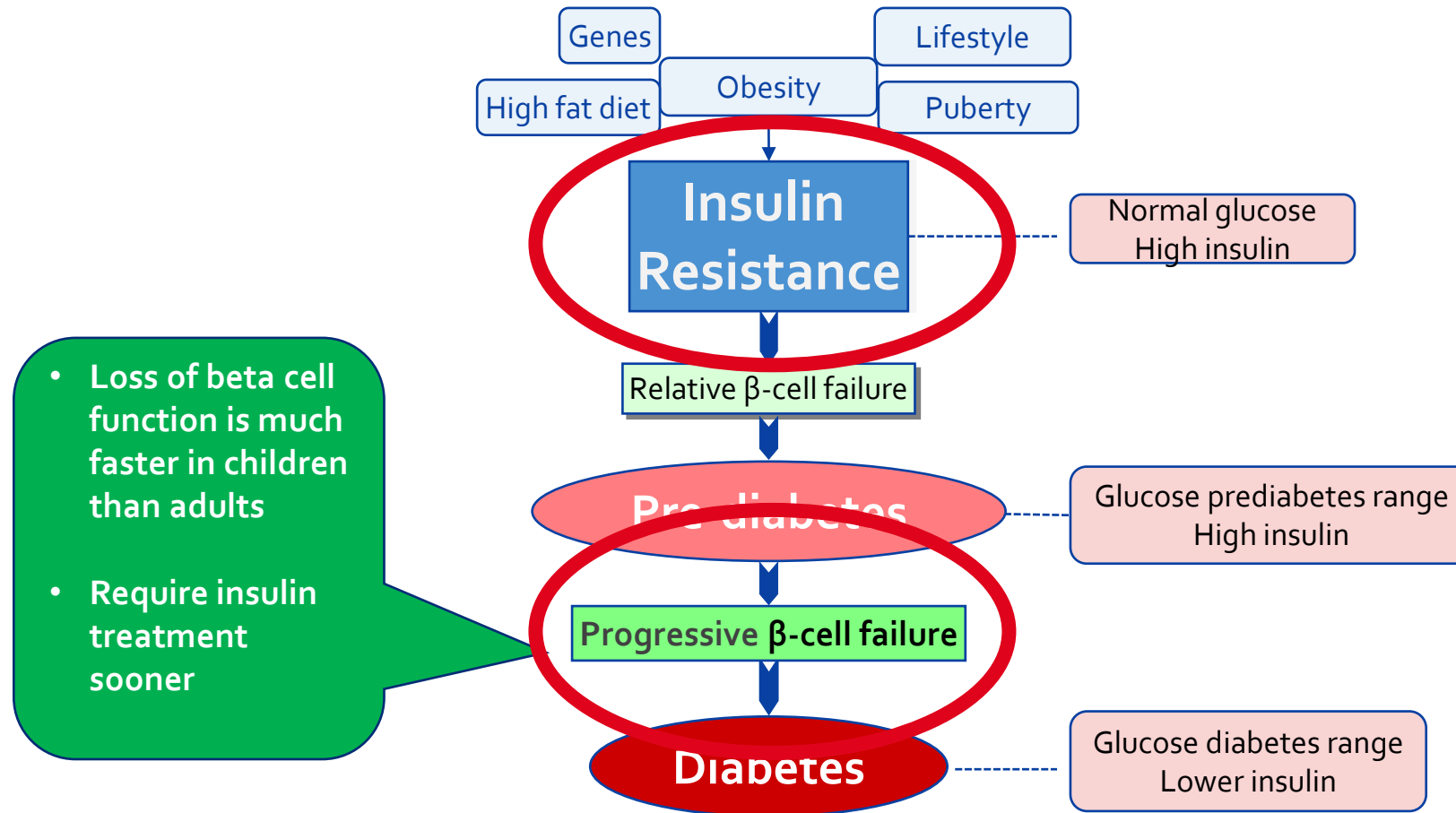
- Glucose: 788 mg/dl
- CO₂: <5 mmol/L
- pH: 7.093
- A1c: 10.2%
- Urine ketones large

You make the diagnosis

Criteria for Diagnosis of Prediabetes and Diabetes ADA Position Statement 2020

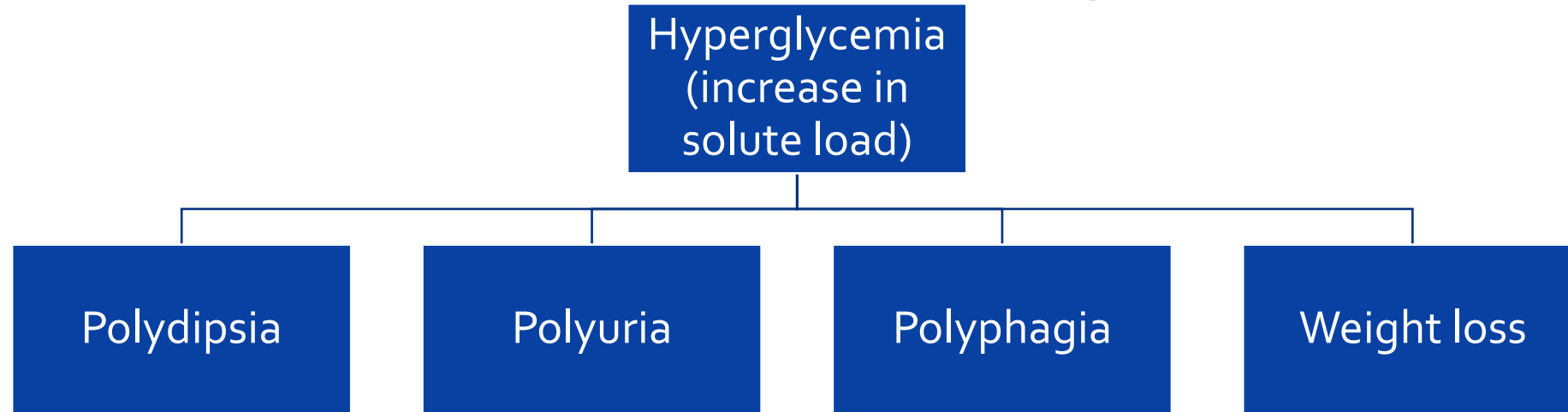
Test	Pre-Diabetes		Diabetes
	Impaired fasting glucose (IFG)	Impaired glucose tolerance (IGT)	
Fasting Glucose	100-125 mg/dl		≥126 mg/dl
2-hr OGTT		140-199 mg/dl	≥200 mg/dl
Random Glucose			>200 mg/dl plus symptoms
HbA1C	5.7-6.4%		≥6.5%

Pathophysiology



Pathophysiology

What are the symptoms of hyperglycemia?



What other concerning symptoms does our patient have?

Dehydration
Slow breathing, fruity odor to breath
Abdominal pain, N/V

Case Study - KJ

Initial lab results in the ED:

- Glucose: 788 mg/dl
- • Na: 140 (corrected 151)
- • CO₂: <5 mmol/L
- pH: 7.093
- • Serum Osm: 326 mmol/kg
- A1c: 10.2%
- Urine ketones large
- COVID negative
- Diabetes antibodies sent and pending

You make the diagnosis

	DKA			Hyperosmolar DKA	Hyperglycemic Hyperosmolar State
	Mild	Moderate	Severe		
Plasma glucose (mg/dL)	> 200	> 200	> 200	> 600	> 600
Venous pH	> 7.3	< 7.2	< 7.1	≤ 7.25	> 7.25
Serum HCO ₃ ⁻	< 15	< 10	< 5	≤ 15	> 15
Urine Ketones	Mod/ Lg	Mod/ Lg	Mod/ Lg	Mod/ Lg	Small or Less
Serum Ketones (mmol/L)	≥ 3	≥ 3	≥ 3	≥ 3	< 3
Effective Sospm	Varies	Varies	Varies	> 330	> 330

Wait... can Type 2 present in DKA?

YES!

SEARCH 2009-2012

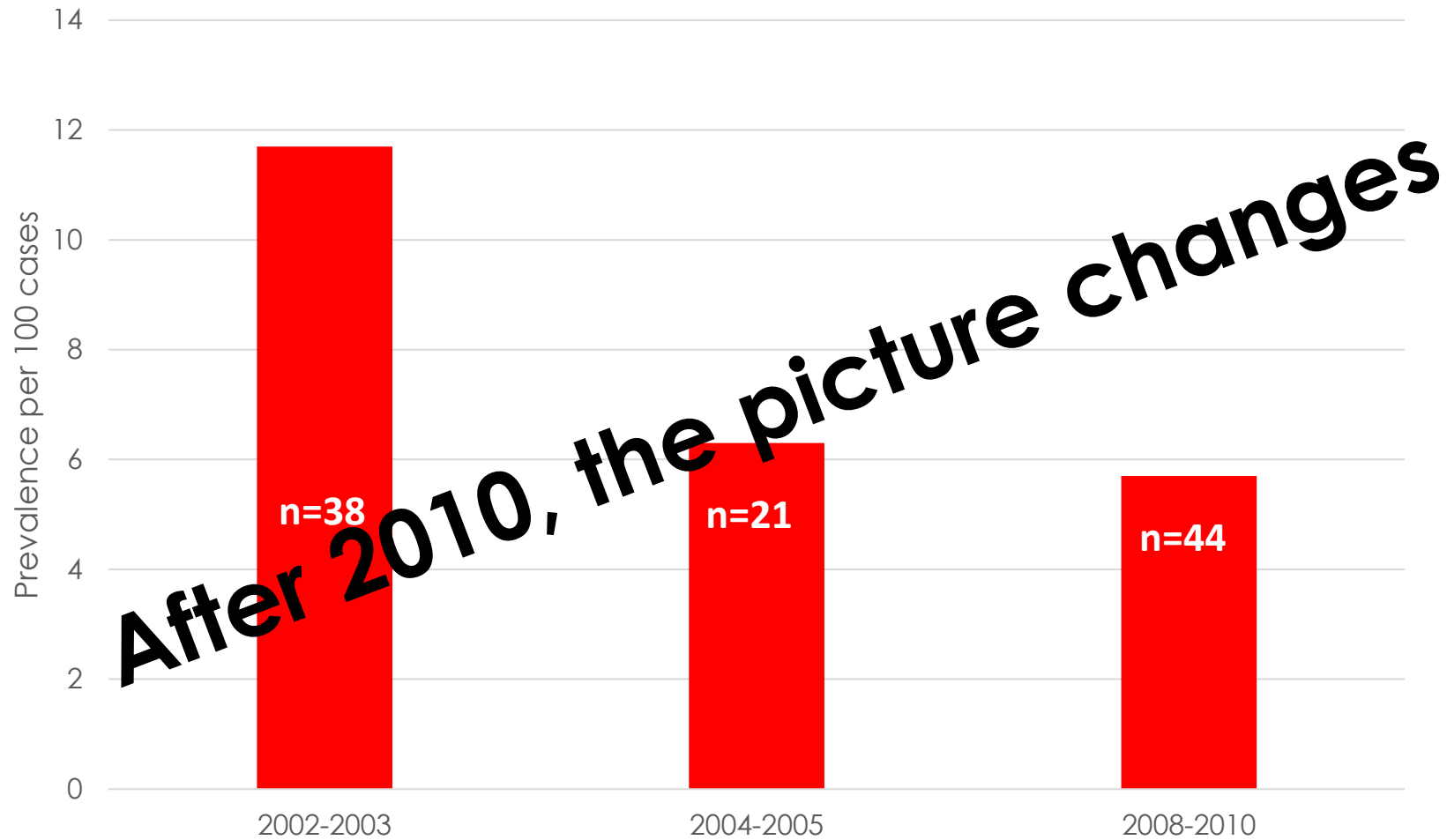
- DKA prevalence at diagnosis of T2DM: 5.5%
- Higher prevalence was significantly associated with younger age at diagnosis, minority race/ethnicity, male gender.

Can also present with **Hyperosmolar Hyperglycemic State (HHS)** or mixed picture: ~ 3.7% frequency.

Dabelea, Dana, et al. "Trends in the prevalence of ketoacidosis at diabetes diagnosis: the SEARCH for diabetes in youth study." *Pediatrics* 133.4 (2014): e938-e945.

Fourtner, Shannon H., Stuart A. Weinzier, and Lorraine E. Levitt Katz. "Hyperglycemic hyperosmolar non-ketotic syndrome in children with type 2 diabetes." *Pediatric diabetes* 6.3 (2005): 129-135.

Prevalence of DKA at T2 Diagnosis: 2002-2010



Case Study - KJ

Clinical Course:

- NS bolus, insulin drip initiated at 0.1u/kg/h
- Transferred to PICU
- By MN (12h later) bicarb improved to 16
- Transferred to floor on endo service

Initial Management of Type 2 diabetes

- Insulin drip if in DKA
- Begin insulin injections if A1c >10%
- Metformin if LFTs WNL

Case Study - KJ

Clinical Course:

- Transitioned to SQ insulin injections next morning
- Diabetes teaching completed
- Metformin initiated at discharge
- Diabetes antibodies negative
- Able to wean off insulin over next month
- 1 month follow up A1c 8.2%

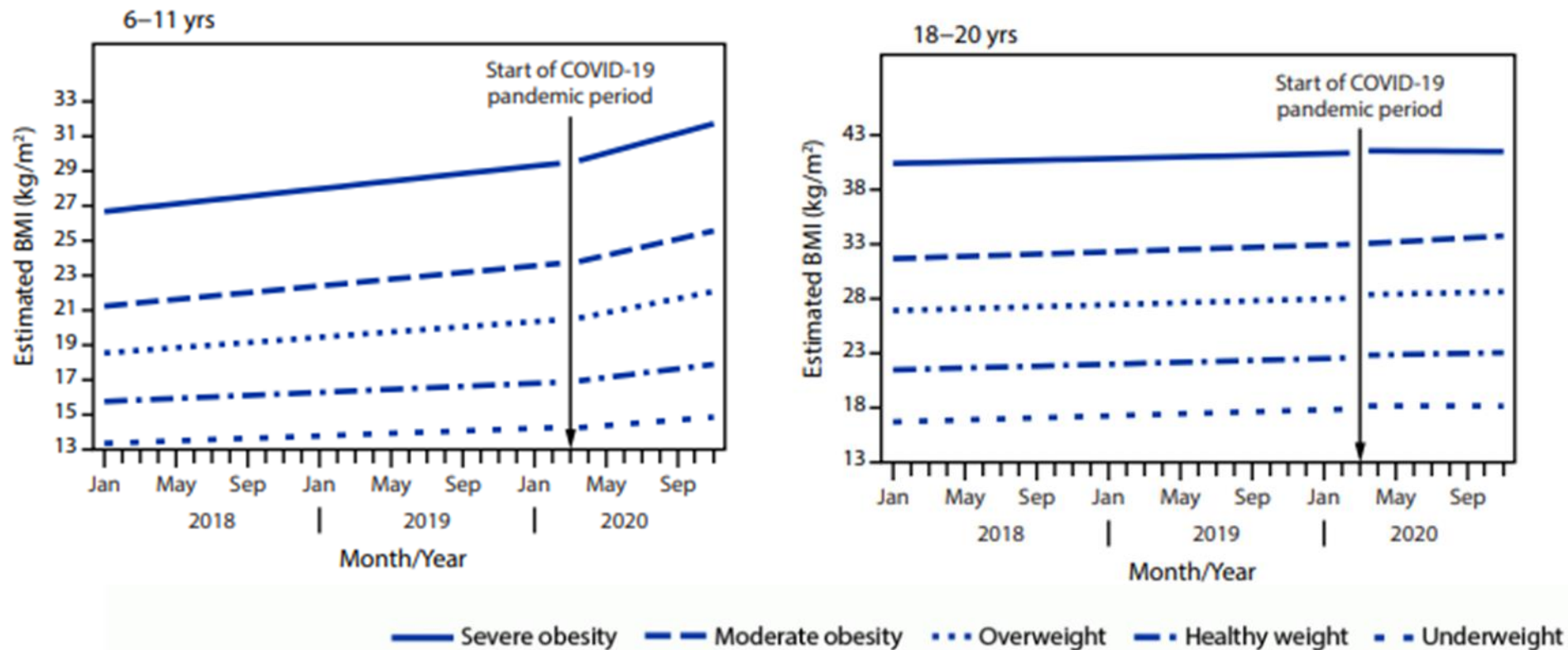
Case Study - KJ

Missed opportunities for intervention:

- Asymptomatic screening given risk factors
- Polydipsia and polyuria
- Tele-health appointment

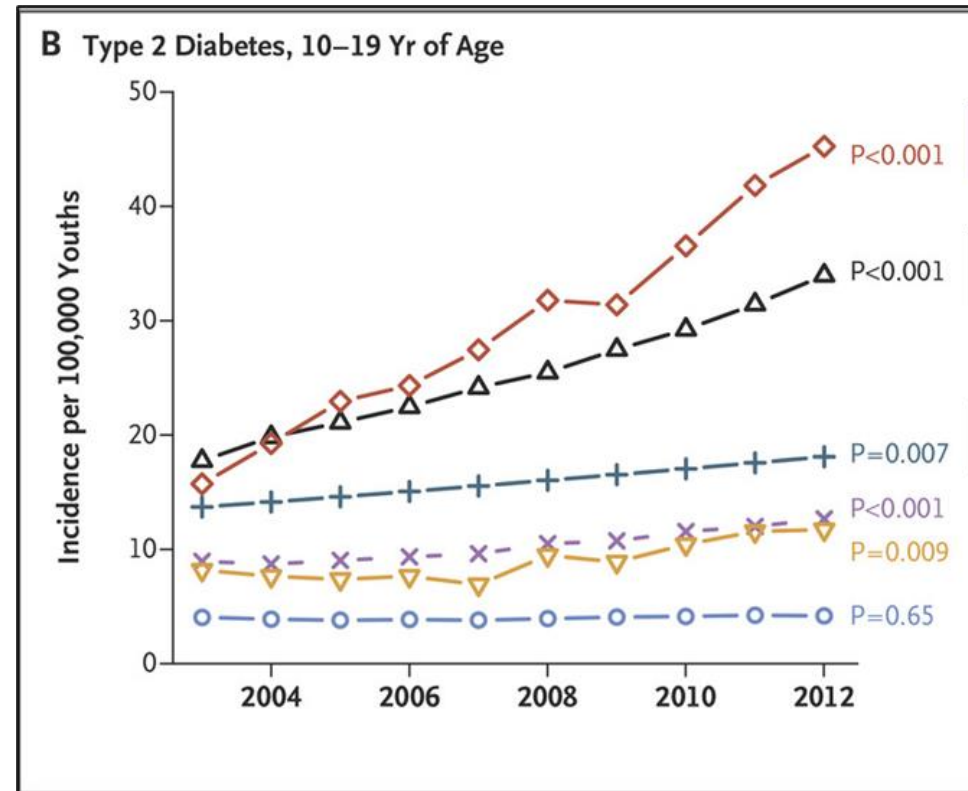
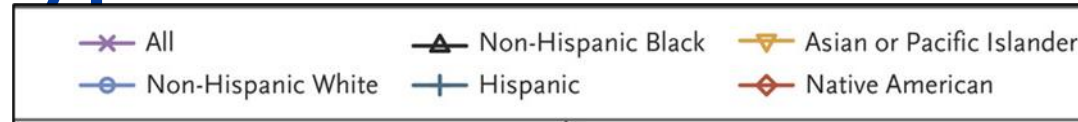
Trends in obesity

FIGURE. Estimated body mass index before and during the COVID-19 pandemic, by initial body mass index category, stratified by age group — IQVIA Ambulatory Electronic Medical Records Database, United States, January 2018–November 2020



Abbreviation: BMI = body mass index.

Trends in Type 2: 2002-2012



Increase of
4.8% per year

NA

NHB

LATINX

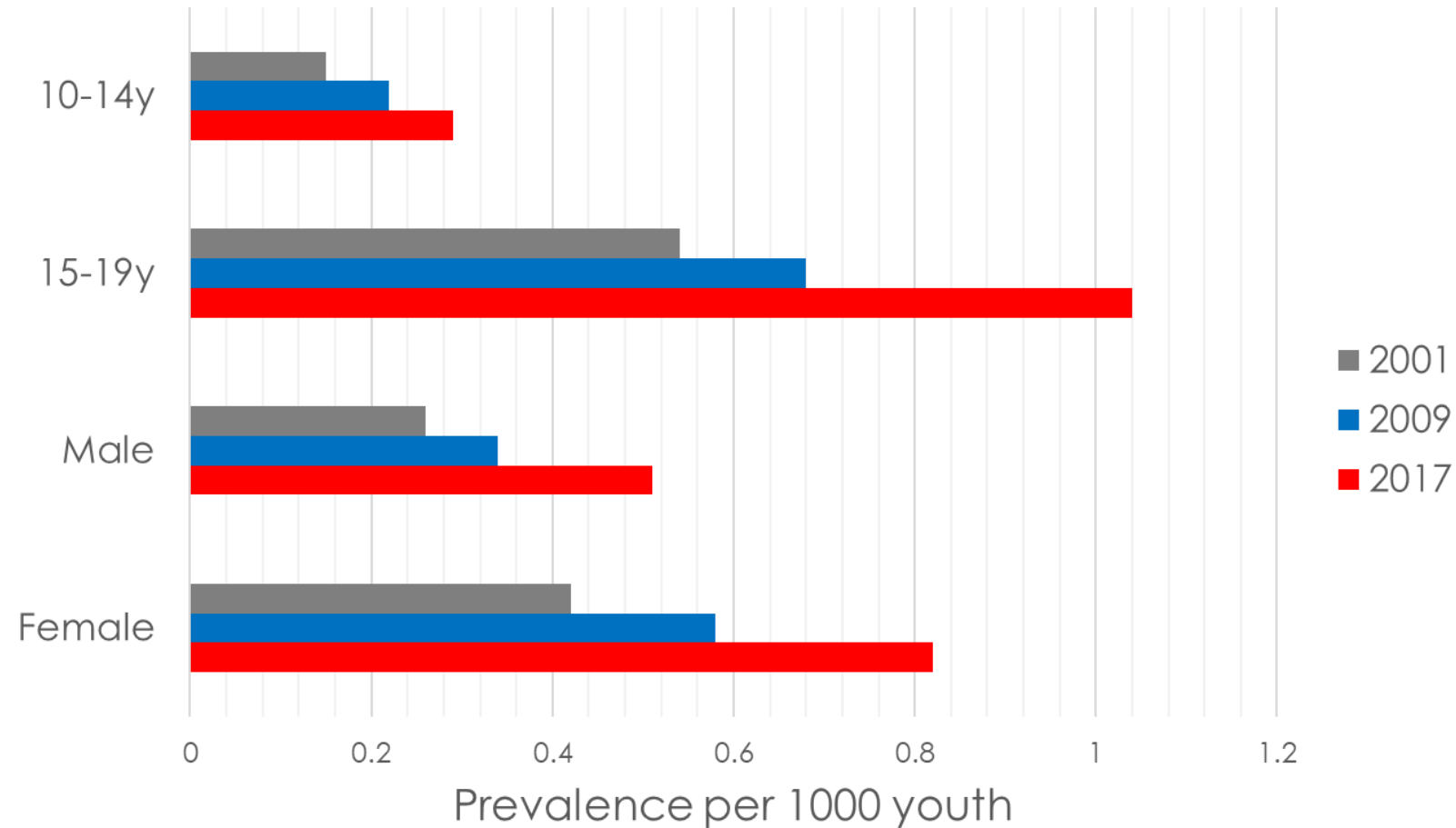
More than 4-fold increase
projected by 2050

Trends in Type 2: 2001-2017

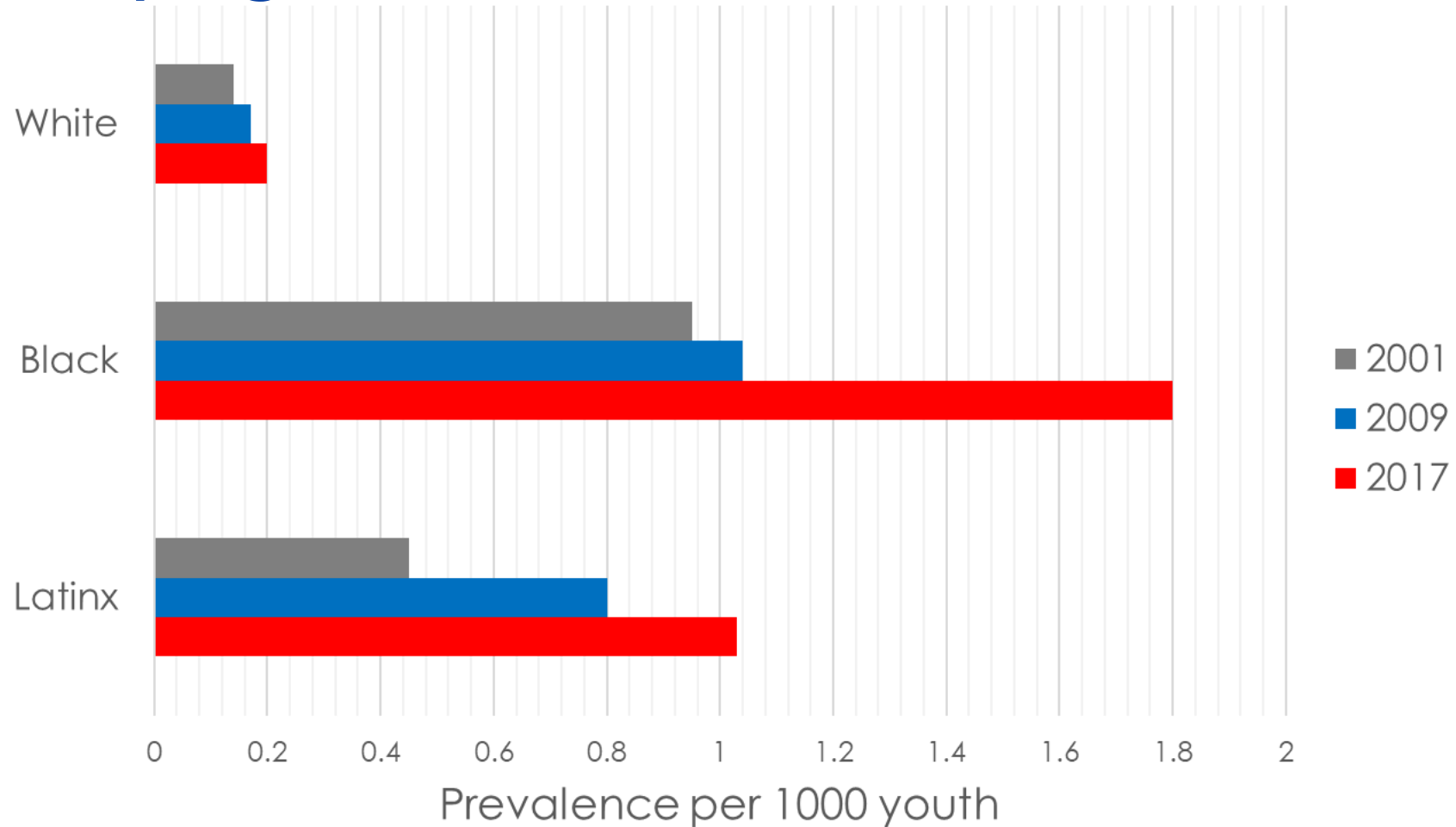
- 95.3% relative increase in prevalence of T2 over 16 years
- Greatest absolute increases were observed among non-Hispanic Black and Latinx youths

Lawrence JM, Divers J, Isom S, Saydah S, Imperatore G, Pihoker C, Marcovina SM, Mayer-Davis EJ, Hamman RF, Dolan L, Dabelea D, Pettitt DJ, Liese AD; SEARCH for Diabetes in Youth Study Group. Trends in Prevalence of Type 1 and Type 2 Diabetes in Children and Adolescents in the US, 2001-2017. JAMA. 2021 Aug 24;326(8):717-727. doi: 10.1001/jama.2021.11165. PMID: 34427600; PMCID: PMC8385600.

Estimated Prevalence of Type 2 Diabetes by Race and Ethnicity, Age, and Sex for 2001, 2009, and 2017



Estimated Prevalence of Type 2 Diabetes by Race and Ethnicity, Age, and Sex for 2001, 2009, and 2017

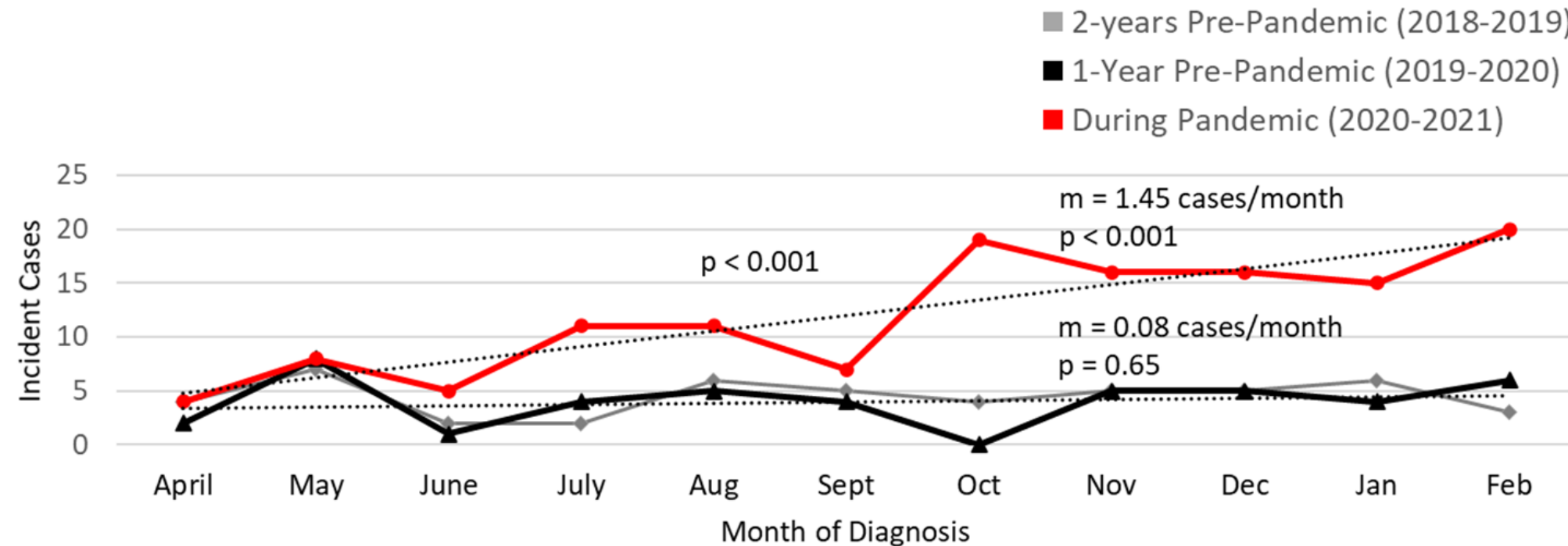


What have we seen with T2DM at CNH during the pandemic?

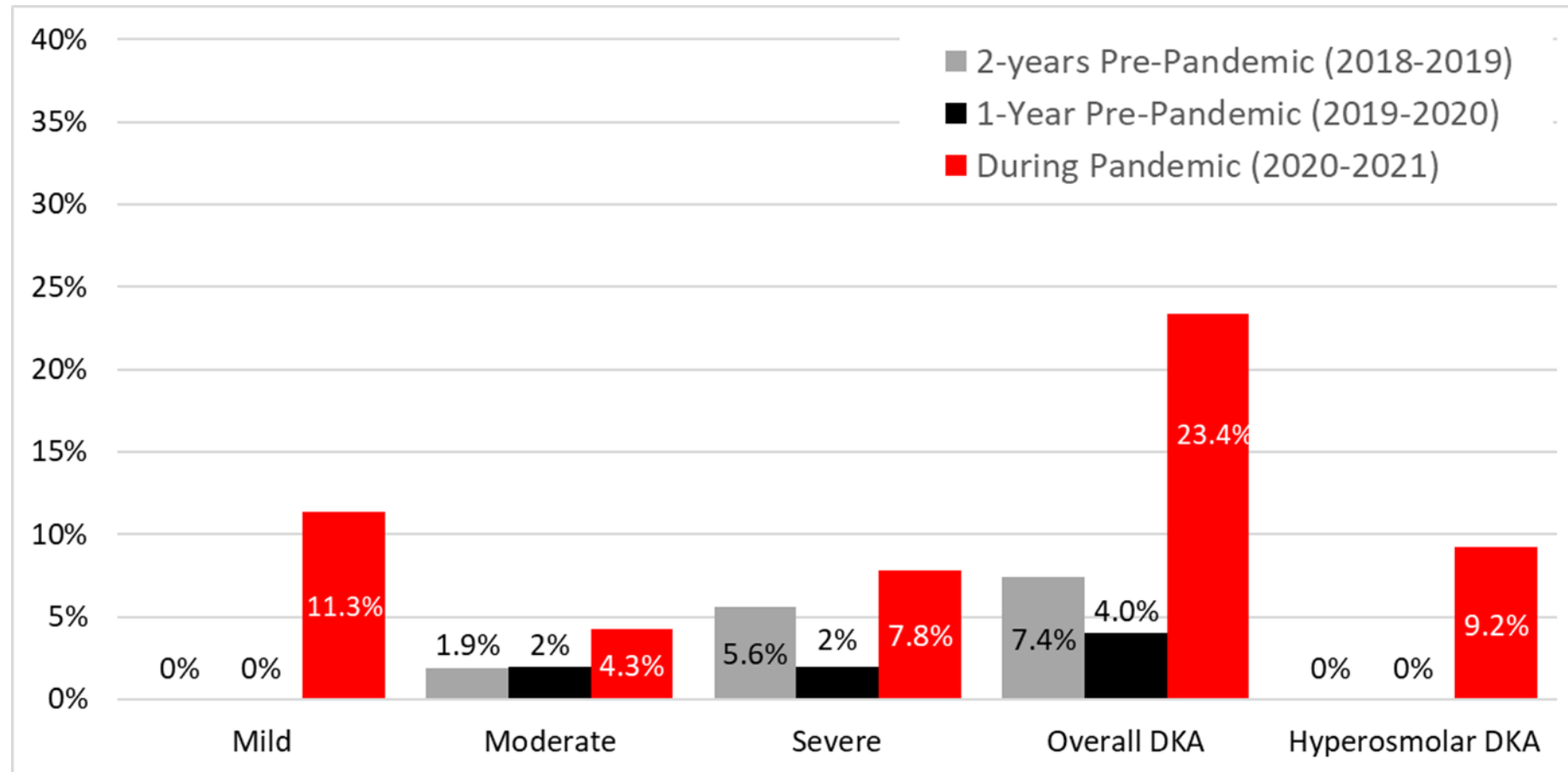
- Increase in **incidence**
- Increase in **severity** of presentation
- Disturbing **disparities**

We need your help!

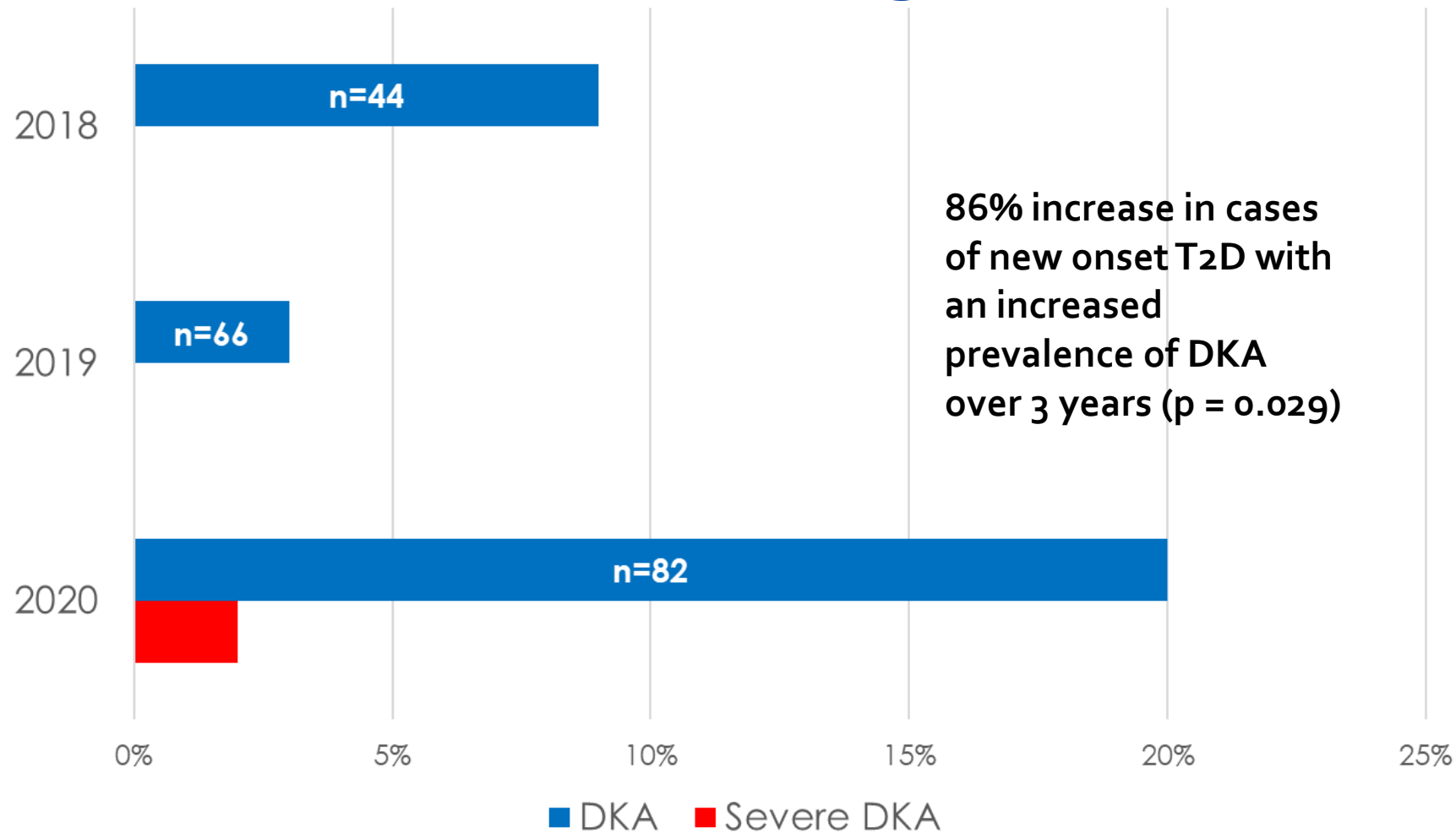
Cases of New Onset T2D at CNH



DKA at T2D Diagnosis at CNH



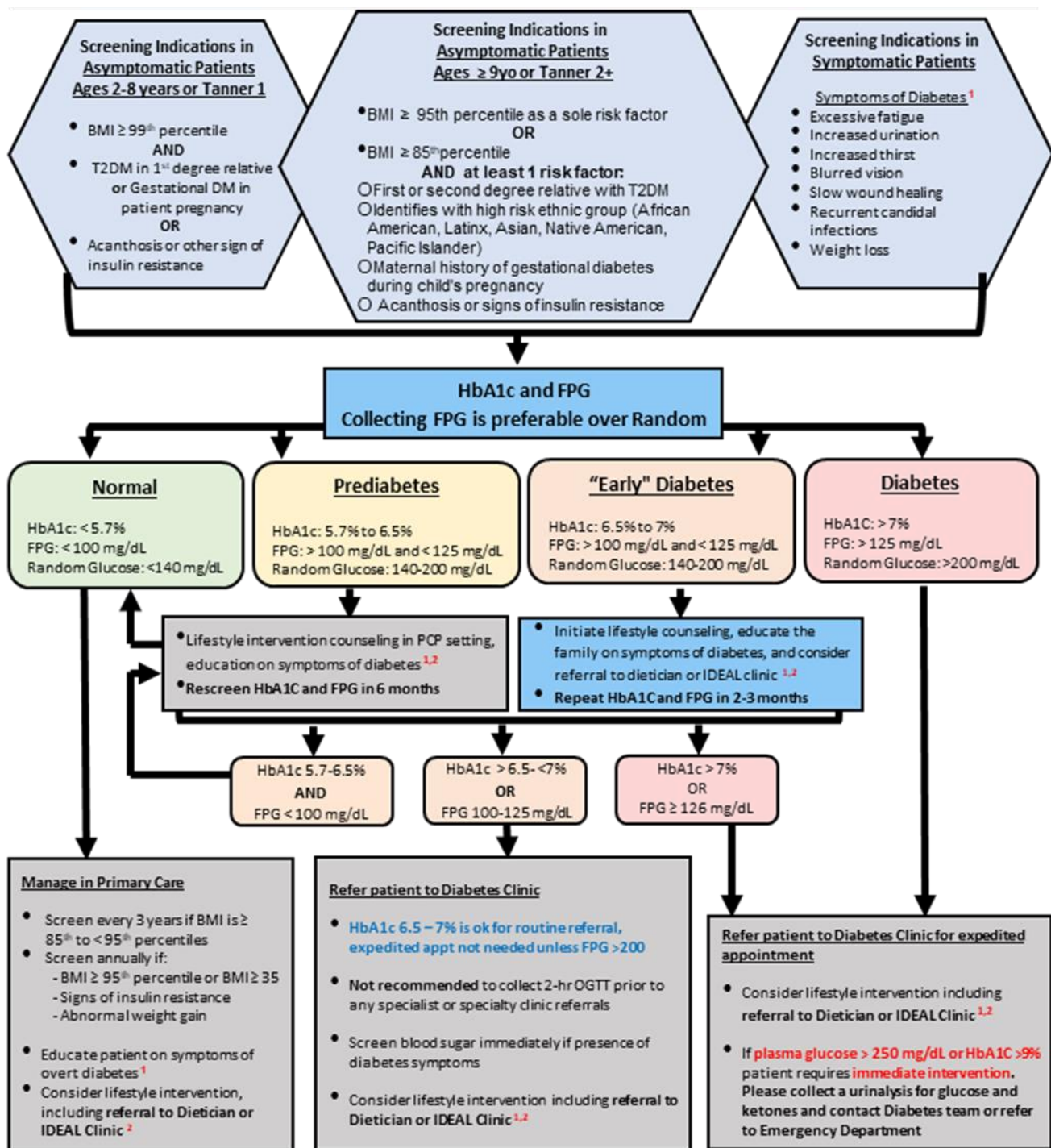
Prevalence of DKA at T2 Diagnosis: 2018-2020



Risk-based screening for type 2 diabetes in asymptomatic youth in a clinical setting (ADA 2020)

After the onset of puberty or ≥ 10 years if BMI $>85\%$ **AND** one of the following:

- Maternal history GDM or SGA at birth
- Family history T2DM
- High risk race/ethnicity
 - Native American, African American, Latinx, Asian American, Pacific Islander
- Signs of insulin resistance
 - Acanthosis nigricans, HTN, dyslipidemia, PCOS



When and How To Refer

1. Urgent referrals

- Call **202-476-5000** and ask hospital operator to page on-call endocrinologist

2. Non-urgent referrals:

- Fax records to 202-476-4095

3. Not sure?

- See #1

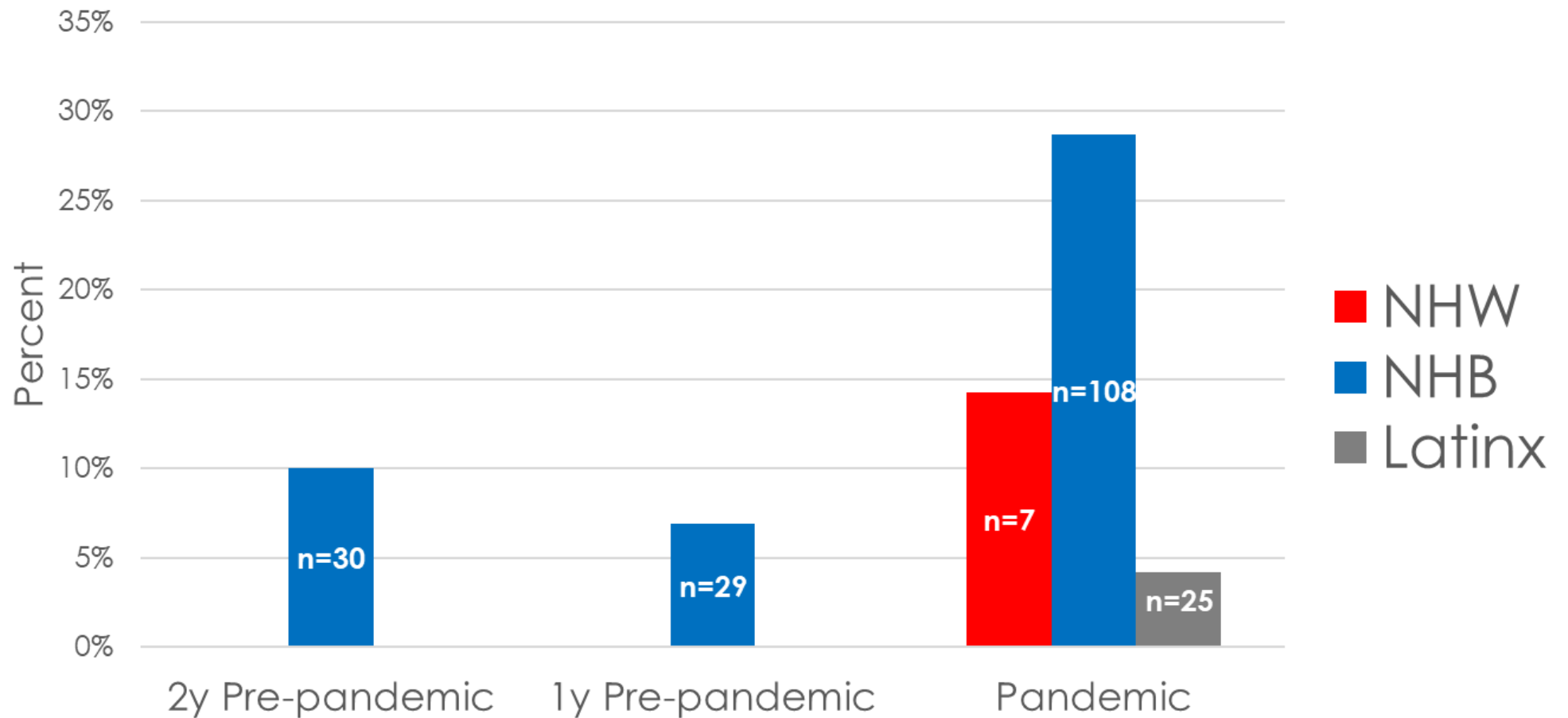
Case Study- MW

- 12yo African American female screened by PCP 8/27/21
 - Weight: 209lb (Z-score: 2.97)
 - BMI: 37.1 kg/m² (Z-score: 2.59)
 - A1c 10.1%, Random Glucose 276 mg/dL
- Cut out juice and soda
- Records faxed and presented to Endocrinology 9/28/21
 - Weight: 202lb (Z-score: 2.89)
 - BMI: 36.7 kg/m² (Z-score: 2.56)
 - A1c 8.0%, Fasting Glucose 102 mg/dL

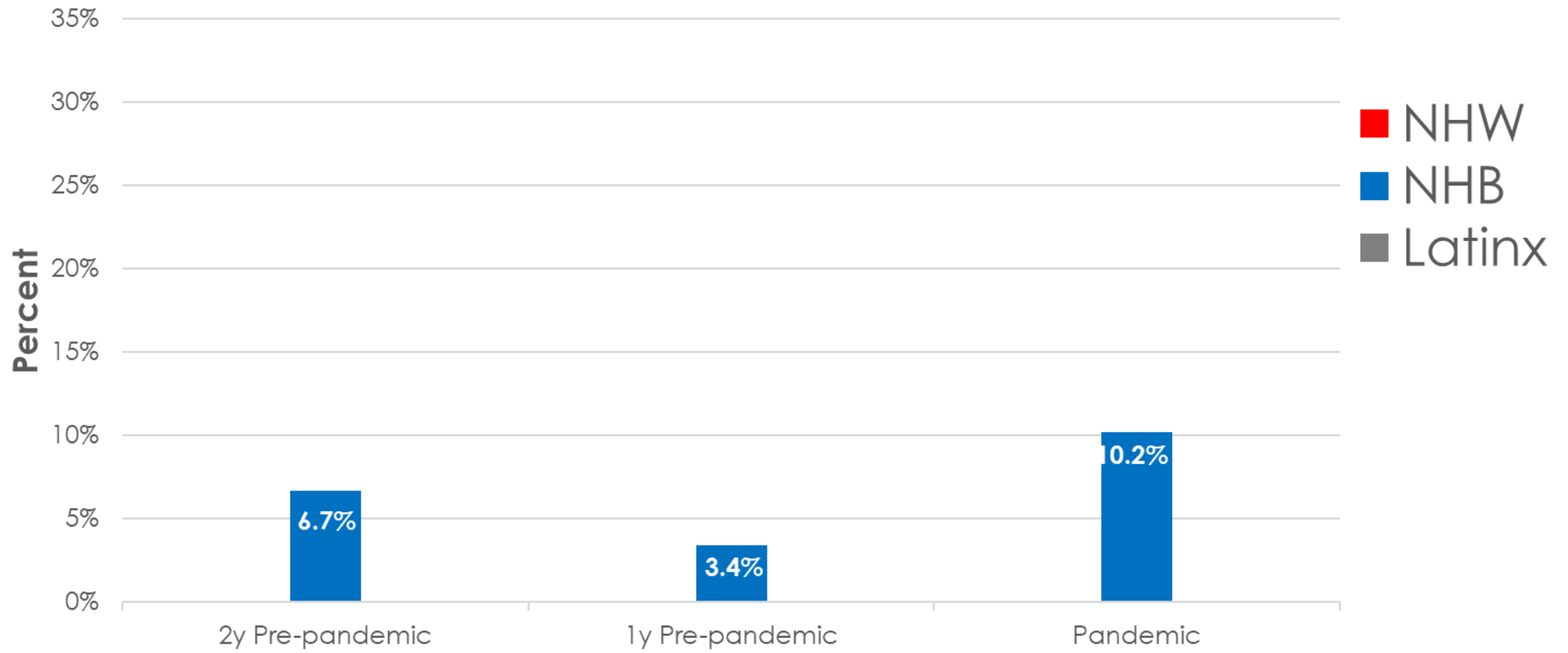
Disparities: Pediatric Diabetes Consortium

- **NHB and Latinx youth vs NHW youth at T2DM diagnosis**
 - Higher A1c
 - Lower C-peptide
 - Worse A1c trajectory over 3yrs following diagnosis
 - NHB youth 3X as likely to present in DKA as NHW and Latinx youth

T2D Disparities by Race/Ethnicity: DKA at Diagnosis



T2D DKA Disparities by Race/Ethnicity: Severe DKA

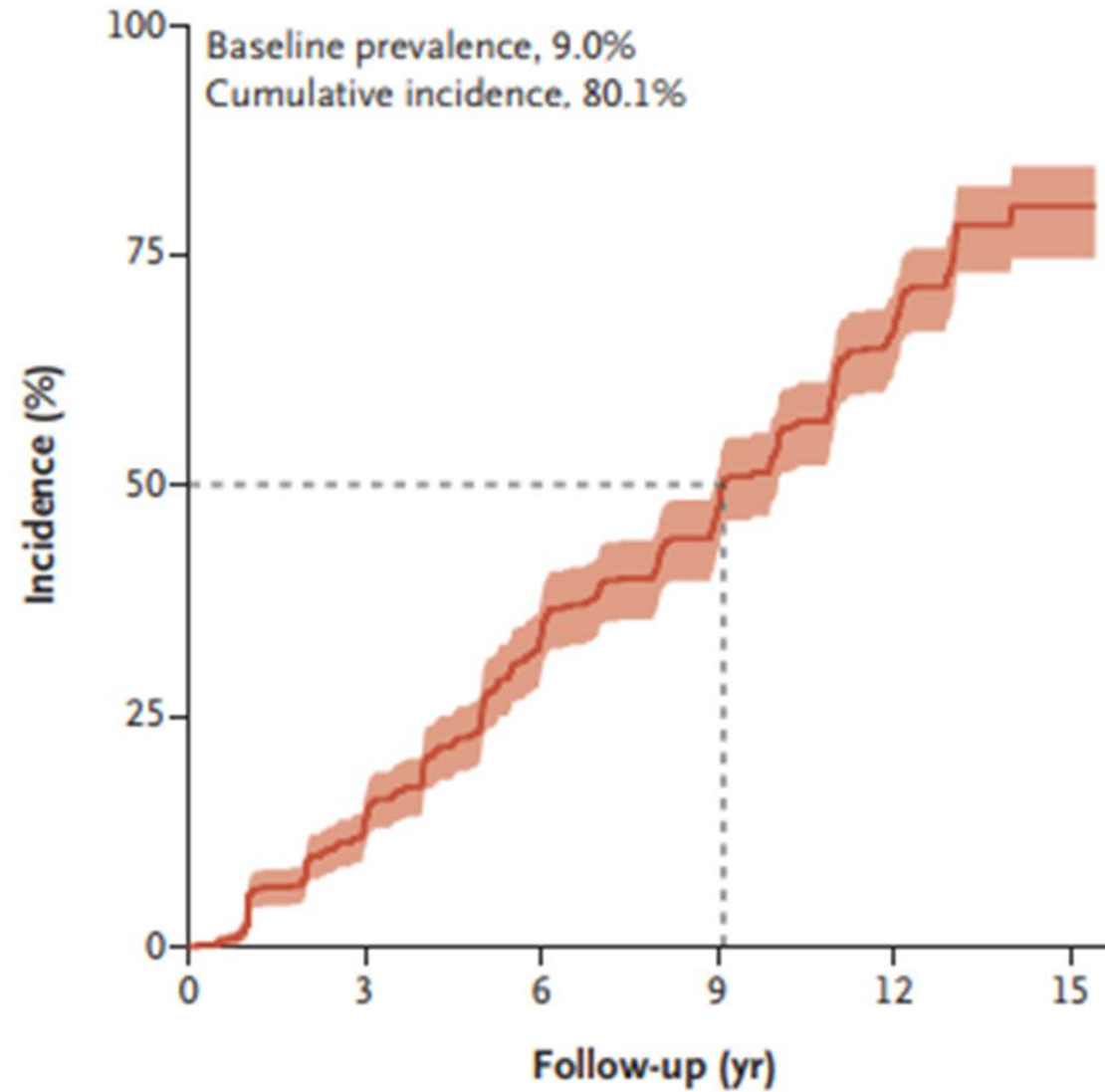


COMPLICATIONS: TODAY Study

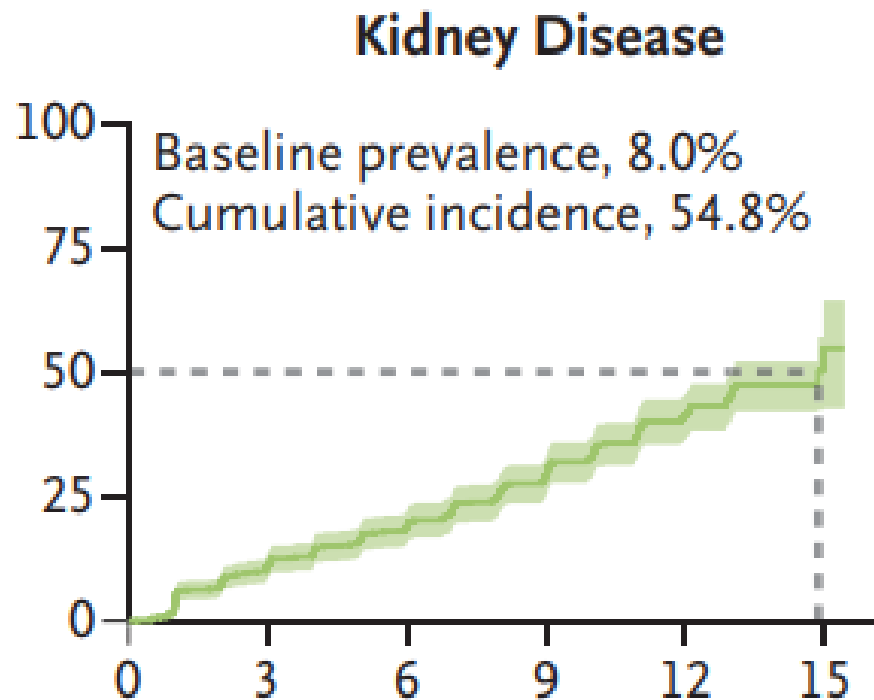
- Multi-center clinical trial of youth diagnosed with T2DM 2004-2011 and followed up through 2011-2020
 - $n=500$, $M_{age} = 26 \pm 2.8$, $M_{DurationT2D} = 13 \pm 1.8$ years

- **Hypertension: 67.5%**
- **Dyslipidemia: 51.6%**
- **At least 1 microvascular complication: 60.1%**
- **At least 2 microvascular complications: 28.4%**
 - **Kidney disease: 54.8%**
 - **Retinal disease 13.7% → 51%**

B Any Microvascular Disease



Incidence of complications



Compared to:

Type 1:

- cumulative risk of 32% for diabetic kidney disease at 25y diabetes duration

Type 2:

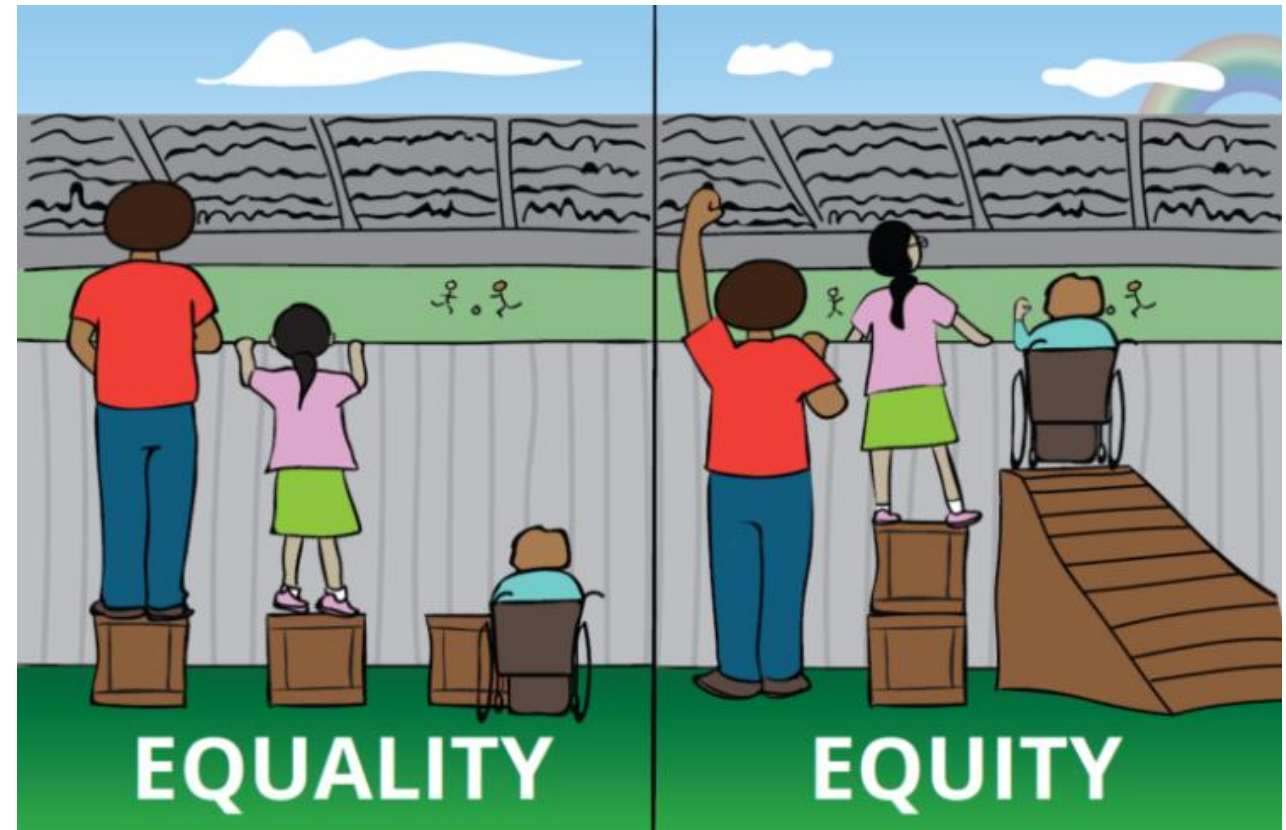
- 25% prevalence of albuminuria at 10 years
→ cumulative risk of 55% at 25 years

COMPLICATIONS: TODAY Study

- Why rapid progression?
 - Extreme metabolic phenotype: Severe insulin resistance + rapid worsening of beta cell function
 - Challenging socioeconomic circumstances
- Risk factors for development of complications:
 - Hyperglycemia
 - Hypertension
 - Dyslipidemia
 - Minority race or ethnic group

Efforts to Address Disparities

- Food pharmacy
- Expansion of Spanish teaching materials
- Culturally appropriate teaching
- Multi-Disciplinary clinics for T2DM with CDE, Nutrition, Psychology in PG County, the ARC
- New psychologist
- QI project to address disparities in CGM uptake



Conclusions

- We have seen increasing incidence, severity and disparities in pediatric type 2 diabetes during pandemic nationally and at CNH
- Complications are not uncommon at a young age
- Primary care providers can help with screening, appropriate referrals and awareness of social factors
- We look forward to continued collaboration with you all

QUESTIONS?

References

- American Diabetes Association. "2. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes—2021." *Diabetes Care* 44.Supplement 1 (2021): S15-S33.
- Arslanian, Silva, et al. "Evaluation and management of youth-onset type 2 diabetes: a position statement by the American Diabetes Association." *Diabetes care* 41.12 (2018): 2648-2668.
- Bacha, Fida, et al. "Racial and Ethnic Disparities in Comorbidities in Youth With Type 2 Diabetes in the Pediatric Diabetes Consortium (PDC)." *Diabetes Care* (2021).
- Chao, Lily C., Alaina P. Vidmar, and Senta Georgia. "Spike in Diabetic Ketoacidosis Rates in Pediatric Type 2 Diabetes During the COVID-19 Pandemic." *Diabetes Care* 44.6 (2021): 1451-1453.
- Dabelea, Dana, et al. "Prevalence of type 1 and type 2 diabetes among children and adolescents from 2001 to 2009." *Jama* 311.17 (2014): 1778-1786.
- Dabelea, Dana, et al. "Trends in the prevalence of ketoacidosis at diabetes diagnosis: the SEARCH for diabetes in youth study." *Pediatrics* 133.4 (2014): e938-e945.
- Fournier, Shannon H., Stuart A. Weinzierl, and Lorraine E. Levitt Katz. "Hyperglycemic hyperosmolar non-ketotic syndrome in children with type 2 diabetes." *Pediatric diabetes* 6.3 (2005): 129-135.
- Imperatore, Giuseppina, et al. "Projections of type 1 and type 2 diabetes burden in the US population aged < 20 years through 2050: dynamic modeling of incidence, mortality, and population growth." *Diabetes care* 35.12 (2012): 2515-2520.

References

- Lange SJ, Kompaniyets L, Freedman DS, Kraus EM, Porter R; DNP3, Blanck HM, Goodman AB. Longitudinal Trends in Body Mass Index Before and During the COVID-19 Pandemic Among Persons Aged 2-19 Years - United States, 2018-2020. *MMWR Morb Mortal Wkly Rep*. 2021 Sep 17;70(37):1278-1283. doi: 10.15585/mmwr.mm7037a3. PMID: 34529635; PMCID: PMC8445379.
- Lawrence JM, Divers J, Isom S, Saydah S, Imperatore G, Pihoker C, Marcovina SM, Mayer-Davis EJ, Hamman RF, Dolan L, Dabelea D, Pettitt DJ, Liese AD; SEARCH for Diabetes in Youth Study Group. Trends in Prevalence of Type 1 and Type 2 Diabetes in Children and Adolescents in the US, 2001-2017. *JAMA*. 2021 Aug 24;326(8):717-727. doi: 10.1001/jama.2021.11165. PMID: 34427600; PMCID: PMC8385600.
- Marks, Brynn E., et al. "Increase in the Diagnosis and Severity of Presentation of Pediatric Type 1 and Type 2 Diabetes During the COVID-19 Pandemic." *Hormone Research in Paediatrics* (2021). Mayer-Davis, Elizabeth J., et al. "Incidence trends of type 1 and type 2 diabetes among youths, 2002–2012." *N Engl J Med* 376 (2017): 1419-1429.
- Praveen, Pradeep A., et al. "Diabetic ketoacidosis at diagnosis among youth with type 1 and type 2 diabetes: Results from SEARCH (United States) and YDR (India) registries." *Pediatric diabetes* 22.1 (2021): 40-46.
- TODAY Study Group. "Long-term complications in youth-onset type 2 diabetes." *New England Journal of Medicine* 385.5 (2021): 416-426.

CME

6 easy steps

to claim credit
with Inova CME

Questions? Please contact us at cme@inova.org.



Six easy steps to claim credit with Inova CME



✓ CME must be claimed within **90 days** of event!

Pediatric Health Network



Thank you

PHN@childrensnational.org

