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Racial and Ethnic Disparities in Diabetes Technology Use amongst Adult Patients with Type 1 Diabetes

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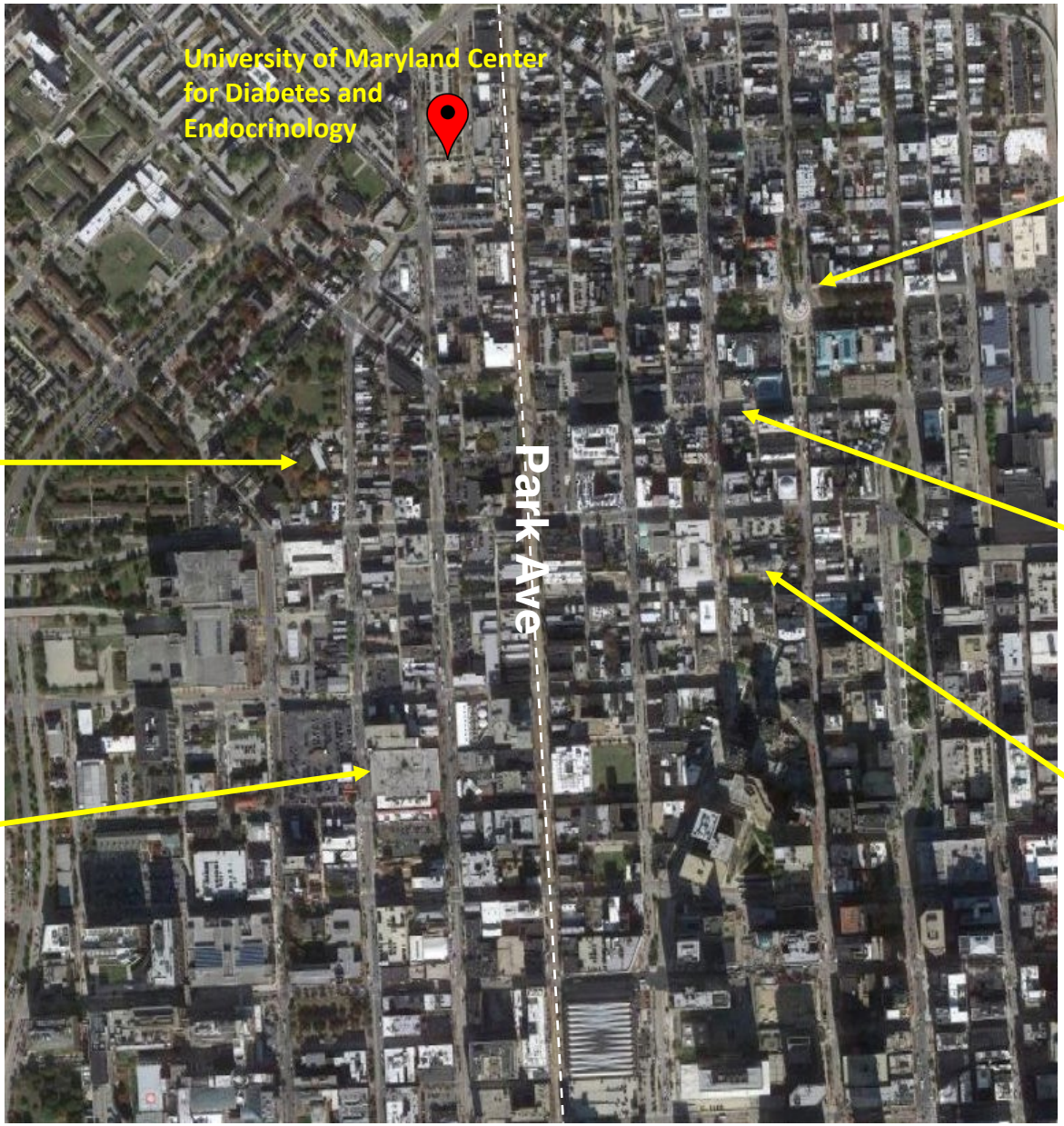
A Divide along Park Ave

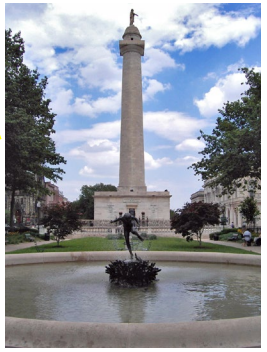
Seton Hill Area

Mother Seton House

Lexington Market



Mt. Vernon/Cathedral Hill Area



Washington Monument

Walters Art Museum

Baltimore Basilica

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Purpose/Hypothesis

- Despite advances in diabetes technology, the distribution of healthcare resources among patients with Type 1 Diabetes Mellitus (T1DM) is often unequal among racial and socio-economic groups.
- Recent studies suggest that socio-economic status is not the only driver of disparities. In these studies, adjusting for income, insurance level, and health literacy did not significantly attenuate disparities.
- We conducted a retrospective cohort study to explore potential factors that exacerbate racial/ethnic disparities in insulin pump and continuous glucose monitor (CGM) use in adults with T1DM, including follow-up rates and provider bias.

Image: Macrovector (2020) Diabetes illustration stock illustration [JPEG]
Retrieved from https://www.istockphoto.com/vector/diabetes-illustration-gm1201263660-344425702

Methods

- We reviewed the charts of all adults aged 18 to 89 with T1DM who attended the University of Maryland Center for Diabetes and Endocrinology (UMCDE) between 1/2019 and 12/2019.

Inclusion	Exclusion
Visit to UMCDE or any affiliate in 2019, including pediatric endo clinic	No visits to any affiliate in 2019
Diagnosis of T1DM or LADA by either Positive antibodies or high clinical suspicion	T2DM, MODY, unclear DM subtypes, Patients undergoing pancreatic transplant

- Patient charts from this 2019 cohort were re-accessed in 2021 to check for changes in diabetes technology use throughout 1/2020-12/2021.

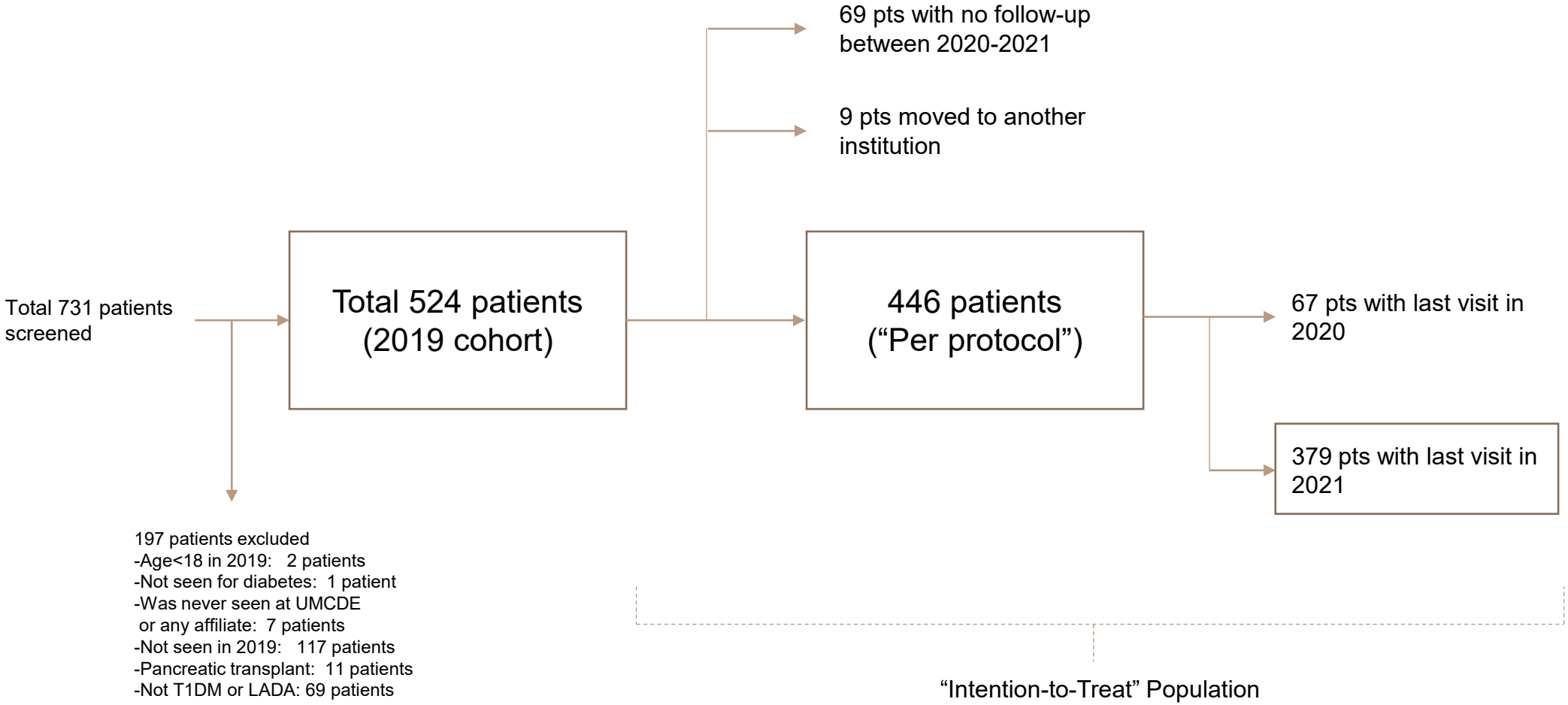
- The following parameters were recorded:
  - Age
  - Gender
  - Race/Ethnicity
  - Insurance type
  - ZIP code
  - Last provider
  - Last known BMI
  - Last known A1c
  - Insulin pump vs multiple daily injections (MDI)
  - CGM vs self blood glucose monitoring (SBGM)

- For income levels, we utilized the 2019 US Census data to estimate the median income for each ZIP code.

- Multiple logistic regression was performed to control for age, gender, race, insurance type, ZIP code, BMI, and A1c. Separate regression models were built for 2019 and 2021 populations. Hosmer-Lemeshow tests were used to evaluate goodness of fit.

- Stratified analysis with the Breslow-Day test and Likelihood Ratio test for nested models were done to evaluate potential effect modifiers, such as insurance type and income level.

<Patient Group Definitions>



Results

Table 1. Patient Characteristics (Unadjusted)

	Baseline (2019)			
	NH Black N=196	**NH White N=278**	**Hispanic/Other N=50**	***P***
Age (2019)	36.6 ± 15.1	38.6 ± 16.9	32.6 ± 13.7	**0.0385**
Sex- Female	107 (54.6%)	135 (48.6%)	24 (48%)	0.3982
Last BMI	28.65 ± 20.02	27.30 ± 5.20	27.95 ± 5.11	0.5335
Last A1c	9.59 ± 2.25	7.73 ± 1.79	8.58 ± 2.17	**0.0139**
Insurance Type				**<0.0001**
Commercial	60	195	28	
Medicaid	99	39	15	
Medicare	31	37	4	
Other	5	6	2	
Self-pay	1	1	1	
Zip-based Income				**<0.0001**
<30000	89	34	10	
30000-50000	97	166	33	
>50000	10	78	7	
Insulin Pump	36 (18.4%)	150 (54.0%)	16 (32.0%)	**<0.0001**
CGM	69 (35.2%)	185 (66.5%)	25 (50.0%)	**<0.0001**

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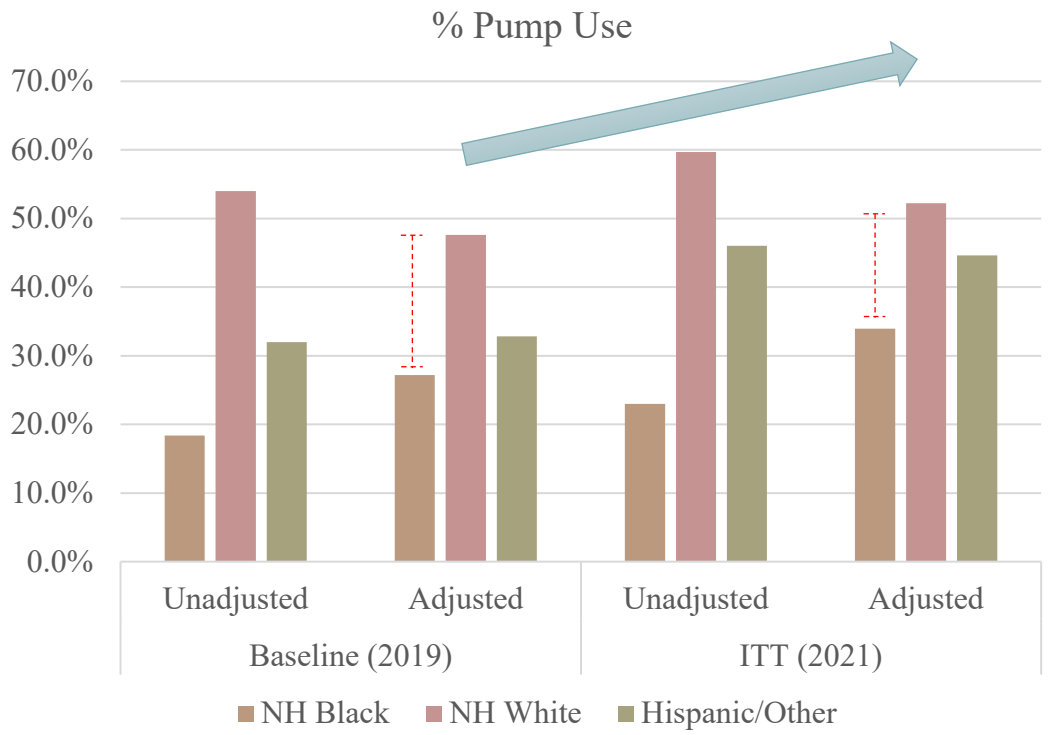
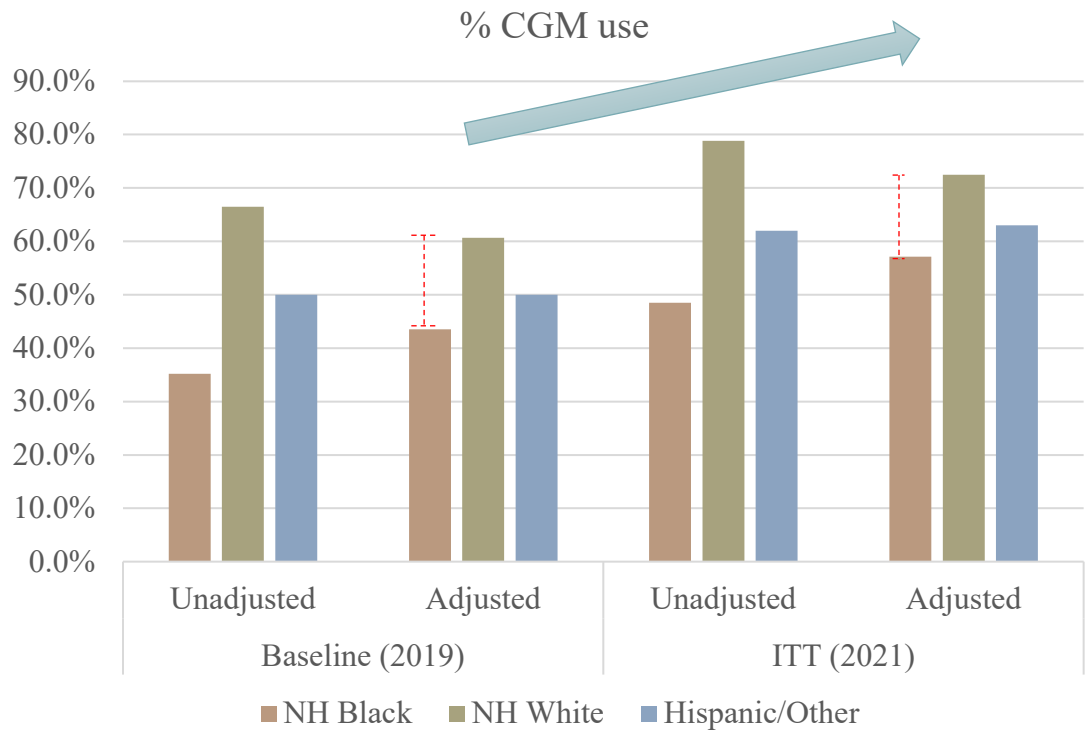
Fig 1. Unadjusted and Adjusted Pump and CGM Usage Percentages





Adjusted %Pump Use:

NH Black 27.2% vs NH White 47.6% (2019)

NH Black 34.0% vs NH White 52.2% (2021)

Adjusted %CGM Use:

NH Black 43.5% vs NH White 57.1% (2019)

NH Black 60.7% vs NH White 72.5% (2021)

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Table 2. Adjusted OR for Pump and CGM Use between Different Racial Groups after Logistic Regression

Pump Use	Adjusted OR (95% CI)		
	Baseline (2019)	ITT (2021)	PP (2021)
NH White:NH Black	**2.43 (1.41-4.22)**	**2.12 (1.28-3.54)**	**1.99 (1.11-3.56)**
Hispanic:NH Black	0.33 (0.02-2.68)	1.83 (0.33-9.08)	2.54 (0.38-20.8)
Other:NH Black	1.60 (0.68-3.70)	1.66 (0.74-3.70)	1.42 (0.51-3.94)

CGM Use	Adjusted OR (95% CI)		
	Baseline (2019)	ITT (2021)	PP (2021)
NH White:NH Black	**2.00 (1.24-3.22)**	**1.98 (1.19-3.28)**	**2.02 (1.08-3.77)**
Hispanic:NH Black	0.89 (0.16-4.69)	1.85 (0.37-13.5)	2.30 (0.31-46.7)
Other:NH Black	1.51 (0.71-3.24)	1.02 (0.47-2.27)	1.10 (0.39-3.40)

(Area under ROC curve 0.74-0.82 between models)
(Hosmer-Lemeshow test was >0.05 for all models)

- NH White patients were **~2x** more likely to be using advanced diabetes technologies compared to NH Black patients, even after adjusting for age, sex, BMI, A1c, insurance type, and ZIP-based income.
- OR was statistically significant and was seen over different time periods. Both ITT and PP populations had significantly different NH White:NH Black ORs

Effect of Follow-up

- Lost-to-followup population was similar in terms of population characteristics, but the proportion of NH Black patients were marginally higher in the lost-to-followup group.
- The per-protocol population were more likely to have been prescribed insulin pumps and CGMs since 2019.
- However, as seen in the previous slide, the ORs for NH White:NH Black in 2021 were significant for both ITT and PP populations.

	ITT (2021)	PP (2021)
Pump	2.12 (1.28-3.54)	1.99 (1.11-3.56)
CGM	1.98 (1.19-3.28)	2.02 (1.08-3.77)

Table 2. Comparison of PP (per-protocol) and LTF (lost-to-followup) groups

	PP N=379	LTF N=135	*P*
Age (2019)	37.6 ± 16.8	36.5 ± 13.9	0.6049
Sex- Female	195 (51.5%)	62 (45.9%)	0.3162
Race/Ethnicity			**0.0363**
NH Black	**140 (36.9%)**	**53 (39.3%)**	
NH White	**211 (55.7%)**	**62 (45.9%)**	
Hispanic	5 (1.3%)	2 (1.5%)	
Other	23 (6.1%)	18 (13.3%)	
Last BMI	28.3 ± 14.7	26.7 ± 5.84	0.0647
Last A1c	8.31 ± 2.02	9.11 ± 2.47	**0.0009**
Insurance Type			0.7179
Commercial	200 (54.4%)	72 (53.3%)	
Medicaid	106 (29.3%)	38 (28.1%)	
Medicare	49 (12.9%)	22 (16.3%)	
Other/Self-Pay	13 (3.4%)	3 (2.2%)	
Zip-based Income			0.0754
<30000	86 (22.7%)	44 (32.6%)	
30000-50000	221 (58.3%)	69 (51.1%)	
>50000	72 (19.0%)	22 (16.3%)	
Insulin Pump (2019)	**158 (41.9%)**	**40 (29.6%)**	**0.0134**
CGM (2019)	**217 (57.4%)**	**58 (43.0%)**	**0.0048**

Effect of Insurance Type on Racial Disparities

Table 3-A. OR NH White:NH Black for Pump and CGM Use when Stratified by Insurance Type

	ITT (2021)	
	Pump:MDI	CGM:SBGM
Commercial	2.95 (1.61-5.42)	2.68 (1.37-5.26)
Medicaid	*1.78 (0.89-3.60)*	*1.79 (0.79-4.06)*
Medicare	4.83 (1.65-14.1)	2.79 (1.07-7.29)
Other/Self-pay	27.0 (2.3-311.1)	25.7 (2.21-298.5)
Breslow-Day test for heterogeneity	*p*=0.080	*p*=0.039 (*)
LR test for nested model	*p*=0.14	*p*=0.37

- Certain insurance types worsened racial disparities in pump and CGM prescriptions.
- Disparities were the worst in the “Other/Self-pay” population.
- There was possible effect modification by insurance type on CGM use between NH White and NH Black patients based on the Breslow-Day test. However, when the interaction was added in the overall logistic regression model, the likelihood ratio test for nest models did not show significance.

Effect of ZIP-based Income on Racial Disparities

Table 3-B. OR NH White:NH Black for Pump and CGM Use when Stratified by ZIP-based Income

	ITT (2021)	
	Pump:MDI	CGM:SBGM
< $30,000 (**poverty line**)	2.68 (1.11-6.44)	2.30 (1.02-5.18)
$30,000-50,000	5.17 (2.98-8.98)	4.80 (2.71-8.51)
> $50,000	2.80 (0.76-10.38)	4.00 (1.09-14.65)
Breslow-Day test for heterogeneity	*p*=0.38	*p*=0.34
LR test for nested model	*p*=0.79	*p*=0.44

- Racial disparities between NH White and NH Black patients were present in all income levels but worst in the $30,000-50,000 group.
- ZIP-based income was not a significant effect modifier for racial disparities in Insulin Pump use nor CGM use.

Effect of Providers on Racial Disparities

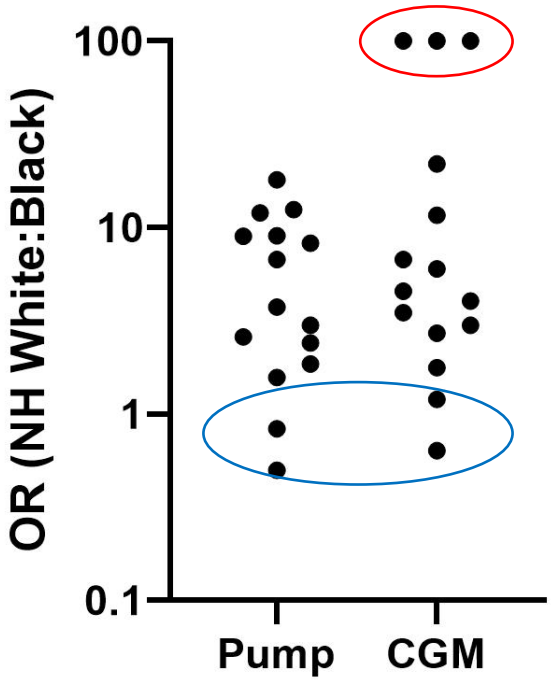
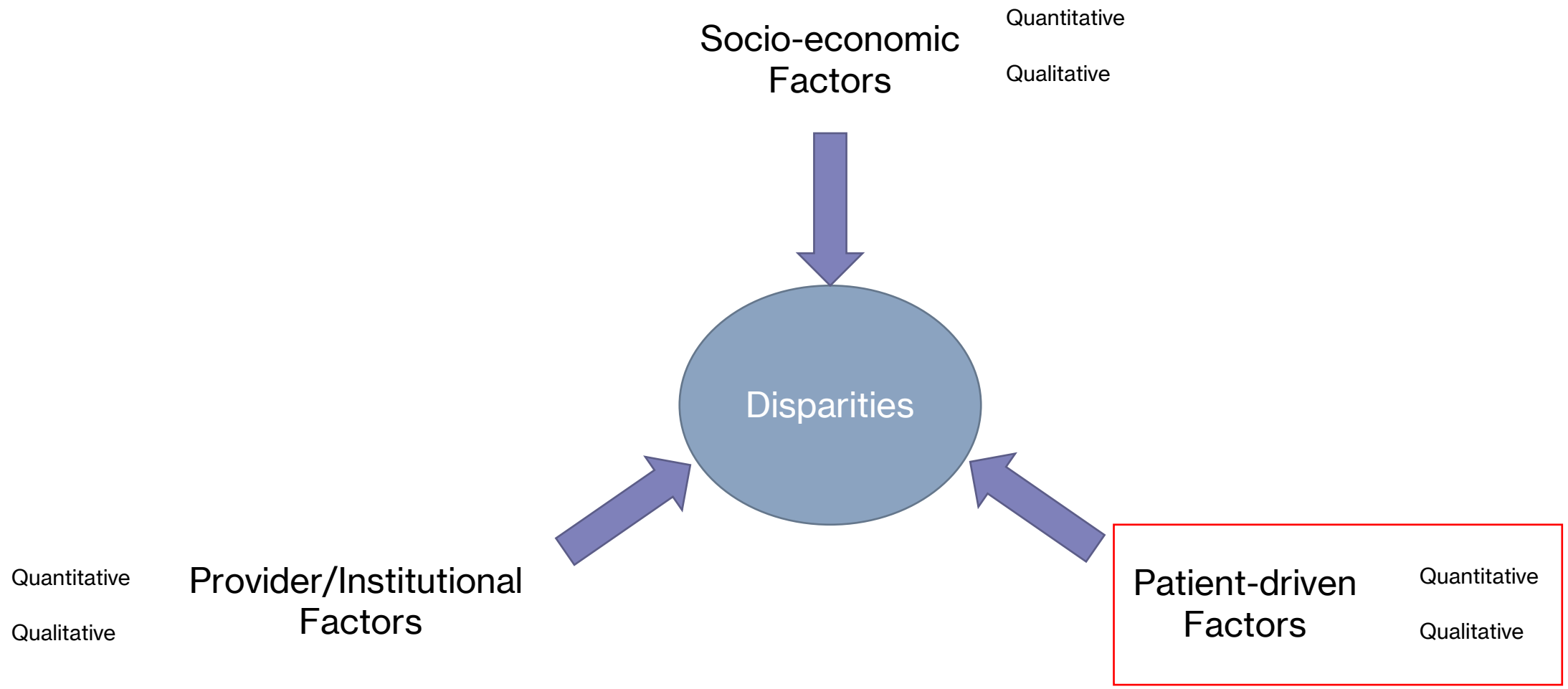


Fig 4. Scatter plot of OR for different providers

- There was large heterogeneity in the ORs of Pump or CGM among providers.
- A few providers did not prescribe any CGMs to NH Black patients, and thus OR was unable to be calculated (divide by zero)
- Only a handful of providers had an OR close or lower than 1 in terms of prescribing Pumps or CGMs to NH Black and NH White patients.
- Given the large variety of providers the study was underpowered to test effect modification or include provider name into the logistic regression model.

Summary of Findings

- In the year 2019, NH White patients were ~2x more likely to be using advanced diabetes technologies compared to NH Black patients, even after adjusting for age, sex, BMI, A1c, insurance type, and ZIP-based income.
- 2 years of follow-up (2020-2021) at the Endocrinology clinic did not resolve these differences.
- Lost-to-followup patients only differed marginally in terms of demographics with the per-protocol population. Disparities were seen in both ITT and PP populations.
- Insurance and income level may exacerbate racial/ethnic disparities, but not significantly.
- There was wide heterogeneity in terms of providers regarding disparities in Pump or CGM prescriptions.


Socio-economic Factors
Quantitative
Qualitative
Disparities
Quantitative
Qualitative
Provider/Institutional Factors
Patient-driven Factors
Quantitative
Qualitative

Future Directives

- We are conducting a comprehensive survey of all patients from the 2019 Cohort.
- The survey focuses on **patient-derived** and **patient-perceived factors** in Pump/CGM use.
  - Examples: Being happy with MDI regimen, Insulin pump being too complicated.
- Survey also asks open-ended questions regarding their perceived barriers to Pump/CGM use.
- Recruitment is undergoing via letter or contact from the patient's Endocrinologist, and patient preference for verbal or written questionnaire was also reflected.
- We aim to use this qualitative assessment to supplement the quantitative/statistic approach we have outlined in this presentation.

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Thank you

Please contact: Jeayoung.park@umm.edu
for any other inquiries!

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