Distribution Agreement

In presenting this thesis or dissertation as a partial fulfillment of the requirements for an advanced degree from Emory University, I hereby grant to Emory University and its agents the non-exclusive license to archive, make accessible, and display my thesis or dissertation in whole or in part in all forms of media, now or hereafter known, including display on the world wide web. I understand that I may select some access restrictions as part of the online submission of this thesis or dissertation. I retain all ownership rights to the copyright of the thesis or dissertation. I also retain the right to use in future works (such as articles or books) all or part of this thesis or dissertation.

Signature:

_____ 4/09/2024

Adrienne Van Curen

Association of Insurance Status and Hospital Admission and Mortality in Patients with Type 1 Diabetes Mellitus

By

Adrienne Van Curen, MD, MPH Candidate

Rollins School of Public Health

_____

Mohammed Ali, MD, MSc, MBA, Committee Chair

Association of Insurance Status and Hospital Admission and Mortality in Patients with Type 1 Diabetes Mellitus

By

Adrienne Van Curen, MD, MPH Candidate

Thesis Committee Chair: Mohammed Ali, MD, MSc, MBA

Abstract

Association of Insurance Status and Hospital Admission and Mortality in Patients with Type 1 Diabetes Mellitus

By Adrienne Van Curen, MD

Background: The healthcare landscape is continuously evolving, particularly for chronic diseases, and has profound implications on patient outcomes and healthcare delivery systems. For patients with type 1 diabetes mellitus (T1DM) insurance status significantly influences access to care and management technologies. The existing literature has several limitations: it predominantly pre-dates changes by Medicaid to increase access to diabetes technology in 2017; it often fails to differentiate between patients with type 1 versus type 2 diabetes mellitus; and it underrepresents patients without regular specialty care of their diabetes.

Objective: To investigate the correlation between insurance coverage and the likelihood of hospital admission or death for T1DM patients presenting to emergency departments, with a focus on the differential impacts of public versus private insurance sectors.

Methods: This cross-sectional study utilized secondary data from the 2019 Nationwide Emergency Department Sample (NEDS), including a weighted population of 772,911 patients with T1DM, identified by ICD-10-CM diagnosis. Logistic regression models were applied to assess the odds of hospital admission or death based on insurance status-defined as private, public, self-pay, or other-while adjusting for demographic variables including age, race, and urbanicity of the patient residence.

Results: Patients with public insurance or who were self-pay had a 27% higher risk of hospital admission or death compared to those with private insurance. Pediatric patients with public insurance or no insurance had lower odds of hospitalization or death compared to pediatric patients with private insurance. Patients with public insurance or who were self-pay had higher odds of leaving the emergency department (ED) against medical advice (AMA). Furthermore, living in less urban areas was associated with lower odds of severe outcomes.

Conclusion: Insurance status is strongly associated with healthcare outcomes for patients with T1DM. In this study, the higher odds of hospital admission or death were similarly elevated for both patients with public insurance and those without insurance compared to patients with private insurance suggesting that not only insurance, but insurance type, may be critical. As public health insurance coverage evolves for patients with T1DM, it will be important to periodically re-evaluate these findings. Given the notable results in pediatric patients and those who left the ED AMA, further investigation in these specific groups is warranted.

Acknowledgements

I extend my deepest gratitude to my thesis chair, Dr. Ali. Your outstanding contributions to diabetes research have set a benchmark in the field. I would also like to express my sincere appreciation to my field advisor, Dr. Turbow, whose work utilizing the HCUP databases motivated me. The guidance and time you have dedicated to this project have been invaluable, and working alongside you has been an enriching experience.

A heartfelt thanks goes out to my classmates who have both challenged and upheld me during my academic journey.

At every significant juncture of life, my family's unwavering support has been my cornerstone. Thank you especially to my husband, your unparalleled support has been my strength for many years. To Eliza, your grace and bravery in the face of your T1DM diagnosis are nothing short of inspiring. And to my mother, who endowed me with a spirit of perseverance and resilience, thank you.

This project would not be possible without each of you.

Table of Contents

Chapter 1: Introduction
- 1.1 Significance……1
- 1.2 Problem Statement……1
- 1.3 Theoretical Framework……1
- 1.4 Purpose Statement……4
- 1.5 Research Question……4
- 1.6 Significance Section……5
- 1.7 Definition of Terms……5

Chapter 2: Review of the Literature
- 2.1 Introductory Paragraph……7
- 2.2 Body……7
- 2.3 Summary of Current Problem and Study Relevance……11

Chapter 3: Methodology
- 3.1 Introduction……12
- 3.2 Data Sources……12
- 3.3 Patient Population & Variable Definitions……12
- 3.4 Data Analysis……13

Chapter 4: Results
- 4.1 Key Findings……16
- 4.2 Summary……21

Chapter 5: Conclusions, Implications, and Recommendations
- 5.1 Summary of Study……23
- 5.2 Discussion of Key Results……24
- 5.3 Limitations and Strengths……26
- 5.4 Implications……27
- 5.5 Recommendations……28
- 5.6 Conclusion……29

References 30

Appendix 33

Chapter 1: Introduction

1.1 Significance

The landscape of healthcare in the United States is ever-changing and complex, with insurance playing a pivotal role in the accessibility and quality of care received by Americans. This is particularly true for chronic conditions such as type 1 diabetes mellitus (T1DM), where continuous care and advanced management technologies are crucial.

1.2 Problem Statement

Among chronic health conditions, diabetes stands out not only for its prevalence but also for its financial implications for healthcare systems. In 2016, diabetes-related costs ranked third for healthcare spending in the United States (Dieleman 2020). This reality, as well as the complex and unclear relationship between insurance status and health outcomes for patients with T1DM, motivated this study.

1.3 Theoretical Framework

The Social Ecological Model is a framework that emphasizes the interplay between individuals and their physical and sociocultural environments. It is often used to understand the multifaceted and interactive effects of personal and environmental factors that determine behaviors. This model is well suited for examining the relationship between insurance status and T1DM outcomes because it acknowledges the complexity and interconnectedness of factors that influence behaviors and outcomes. When applied to the care of T1DM and its

relationship with insurance status, the Ecological Model can shed light on how various levels of influence impact patient care and management.

At the individual level, the Social Ecological Model considers personal knowledge, attitudes, skills, and genetics. For T1DM, in addition to the severity of the pathophysiology experienced, this includes a patient's understanding of their condition, their ability to manage it, and their personal health behaviors. Insurance status can directly affect an individual's access to education about diabetes management, quality of care, and affordability of necessary medications and technologies. Those with comprehensive insurance coverage are more likely to have the means for proper self-management, including access to insulin, monitoring devices, and educational resources.

The interpersonal level involves family, friends, and social networks that provide social identity, support, and role definition. In the context of T1DM, the support system can influence how individuals manage their disease. Insurance coverage can affect the degree to which patients can engage with support groups, healthcare professionals, or even afford the opportunity for family members to be educated about the disease, thereby influencing the care that the individual receives.

At the organizational level, the focus is on the stakeholders, agencies, and institutions that can impact the individual's life, such as schools, workplaces, and healthcare facilities. For individuals with T1DM, the quality of care and the protocols of the healthcare institutions they attend can

be dependent on their insurance status. Insurance may dictate the choice of healthcare providers and the range of services offered, potentially influencing treatment plans and access to specialized diabetes care. Additionally, physical accessibility to healthcare facilities significantly affects the care individuals with T1DM receive. Geographic location, transportation options, and the physical layout of healthcare facilities play a critical role. For example, individuals living in remote or rural areas might face challenges in reaching specialized centers that are often located in more urban settings. This can lead to disparities in the level and quality of care received. Moreover, the physical design of healthcare facilities, including ease of navigation and the availability of necessary equipment, can impact the effectiveness and efficiency of diabetes management and treatment.

The community level looks at the relationships between organizations, institutions, and informational networks within defined boundaries. This level would examine how insurance status influences the availability of community resources for T1DM care, such as local healthcare clinics, access to specialists, and community programs for chronic disease management. This level also considers how community-specific social determinants of health, such as the presence of food deserts, access to pharmacies, and the availability of healthy lifestyle options, can impact the management of T1DM. These factors are crucial in understanding the broader context in which individuals with T1DM live and manage their condition, as they directly influence the accessibility and quality of necessary resources and support systems.

At the broadest level, the policy level includes local, state, and national laws and policies. For T1DM care, this could be how healthcare policies and insurance regulations affect the management and outcomes of the disease. It encompasses the policies that regulate insurance markets, determine the coverage of and out-of-pocket costs for diabetes-related services and technologies, and provide funding for diabetes research and public health interventions.

Considering all levels of the Social Ecological Model, it is clear that insurance status is not simply an individual concern but also a complex result of interactions within and between the different levels of society. Insurance status can impact every level of the Social Ecological Model, highlighting the importance of considering a wide range of factors when looking at T1DM care and outcomes. This model suggests that interventions aiming to improve T1DM care should not only address individual behavior but also consider broader socio-ecological factors, including insurance coverage, to be effective (McLeroy 1988).

1.4 Purpose Statement

This study aims to investigate the relationship between insurance coverage and outcomes of T1DM, specifically the likelihood of hospital admission or death when presenting to an emergency department.

1.5 Research Question

Does insurance status influence the likelihood of inpatient hospitalization or death for patients with T1DM, and if so, how does this differ between public and private insurance types?

1.6 Significance Section

Understanding the role of insurance in managing T1DM is significant for policymakers, healthcare providers, families, and patients. It impacts resource allocation, healthcare delivery models, and ultimately, patient health outcomes. Existing literature often inadequately includes groups that are typically marginalized or underrepresented, leading to a gap in comprehensive understanding of health disparities. Updated data are crucial to determine whether recent expansions in public insurance coverage, specifically related to diabetes technology, have mitigated the predictive value of insurance status on diabetes-related health outcomes. Such insights could inform policy and public health interventions aimed at reducing inequities and improving care for individuals with diabetes.

1.7 Definition of Terms

T1DM: A chronic condition characterized by autoimmune beta cell destruction leading to absolute insulin deficiency and the inability to regulate blood glucose levels effectively. Incidence and prevalence are increasing worldwide. The disease is a result of genetic and environmental factors and is most often diagnosed in childhood or adolescence. Complications of the disease often require immediate attention, and the emergency department often serves as a point of contact for those that do not have access to regular medical care.

T2DM: Type 2 Diabetes Mellitus is a chronic condition characterized by insulin resistance and relative insulin deficiency, often presenting in adulthood.

DKA: Diabetic ketoacidosis is a severe complication of diabetes that arises from an excess of ketones in the bloodstream. This condition typically occurs when insulin, which is essential for glucose metabolism, is insufficient. Without enough insulin, the body cannot utilize glucose for energy, leading to fat breakdown as an alternative source. This process results in the production of ketones, which, when accumulated in high levels, can lead to the acidification of the blood, culminating in DKA.

CGMs: Continuous glucose monitors, devices used for monitoring blood glucose levels in real-time.

Chapter 2: Review of the Literature

2.1 Introductory Paragraph

The scholarly discourse on diabetes management has increasingly emphasized the role of insurance status, with studies highlighting disparities in outcomes based on insurance coverage (Everett 2022, Amin 2021, Doucette 2017). This section delves into the existing literature to provide a comprehensive understanding of the current state of research in the field.

2.2 Body

In 2019, 37.3 million people (approximately 11% of the population) in the U.S. had diabetes (American Diabetes Association, n.d.). T1DM is due to autoimmune beta cell destruction which usually causes an absolute insulin deficiency. T2DM is not autoimmune and is due to progressive loss of beta cell insulin secretion, often with a history of insulin resistance and metabolic syndrome. T1DM patients tend to be younger with age of onset usually before 35 and with lower BMI, usually less than 25 (ElSayed 2023). T1DM accounts for only about 5% of total cases of diabetes in the U.S., but the prevalence of T1DM has been increasing by 2-5% per year and impacts a significant population (Bullard 2018, Pettus 2019). In 2014-2015 the annual absolute incident cases of T1DM was 18,200 in the U.S. (American Diabetes Association n.d.).

Given that T1DM is relatively rare compared to T2DM, a major limitation of prior studies is that they do not customarily differentiate between T1DM and T2DM when examining outcomes

despite major differences in populations affected by, and the underlying pathophysiology of, the two endocrine disorders (Amin 2021). Even the US Diabetes Surveillance System, managed by the Center for Disease Control and Prevention (CDC) does not differentiate between T1DM and T2DM for most indicators it publishes (Centers for Disease Control and Prevention n.d.).

Studies that do focus on T1DM tend to rely on registry data or small population subsets and thus underrepresent patients without insurance. For instance, the largest registry of patients with T1DM is the T1D Exchange Registry which includes over 18,000 participants in the U.S (T1D Exchange n.d.). However, this is only about 1% of patients with T1DM in this country. Additionally, studies have shown that up to 50% of patients with T1DM have not visited a specialist within the past year, which is the primary source of referral to the registry (Amin 2021). This results in a selection bias in these studies that include mostly insured participants with high levels of education, higher than average income level, and that are disproportionately white non-Hispanic (Everett 2022, Allen 2001, Cengiz 2013, Rewers 2002).

Insurance plays a crucial role in quality of diabetes care. Insured patients, especially those with private insurance, are more likely to receive care from specialists and meet quality care indicators (Amin 2021, Doucette 2017). Uninsured patients with T1DM use the ED two times more than privately insured adults for diabetes-specific issues (Uppal 2022). A prospective cohort study in Colorado from 1996-2000 found a relative risk of 2.18 for developing DKA and 1.42 for severe hypoglycemia in underinsured patients (uninsured or with public insurance) with diabetes compared to those with private insurance, but the authors did not differentiate

between T1DM and T2DM (Rewers 2002). In a departure from the trend described above, wherein most studies focused on T1DM rely on registry data, a population-based study from 2021 and found the odds of DKA was lower with higher income and greater with older age, female sex, black race, non-urban hospitals, and in patients without private insurance (Everett 2021).

The advent of diabetes management technologies such as insulin pumps and continuous glucose monitors (CGMs) has transformed T1DM management. Clinical trials have shown that the use of technology for the management of T1DM, like insulin pumps and CGMs, is associated with improved Hgb A1C, fewer hypoglycemic events, less episodes of DKA, and increased quality of life. Access to such technologies is mostly determined by insurance coverage due to their high cost. These devices and their associated supplies represent a substantial financial burden that many patients cannot afford without assistance. The extent and terms of insurance coverage can vary widely, influencing the choice, quality, and frequency of the technology that patients can access. For instance, some insurance plans may cover the cost of a CGM fully or partially, while others may not cover it at all or may impose stringent eligibility criteria. A study by Everett et al suggested that improved outcomes related to insurance status are predominantly mediated via access to advanced technologies (Everett 2022).

As of January 12, 2017, Medicare expanded its coverage to include CGMs under the durable medical equipment (DME) benefit for patients with diabetes using insulin (Centers for Medicare & Medicaid Services n.d.). Following this pivotal change, an increasing number of state

Medicaid programs also began to cover CGMs. Using data from 2019, a key focus of this study will be to determine whether insurance status—specifically the distinction between private and public coverage—has an influence on the management of T1DM.

Factors other than insurance such as race and urbanicity have also been shown to play a role in disparate outcomes for patients with diabetes. Non-Hispanic white adults are more likely to have regular care and meet suggested targets (Uppal 2022, Ali 2014). Additionally, patients with diabetes in rural areas have 34% higher mean rates of ED use compared to their urban counterparts (Uppal 2022). Hence, race and urbanicity were considered when evaluating the relationship between insurance and outcomes for patients with T1DM.

In order to address the underrepresentation of patients of lower socioeconomic status in the literature, this study utilized the Nationwide Emergency Department Sample (NEDS) database. NEDS was constructed using the Health Cost and Utilization Project (HCUP) and is publicly available. It includes information about nationwide ED visits including geographic, hospital and patient characteristics in addition to ED visit details and is the largest available all-payer ED database. There are 41 HCUP partner organizations that include 84% of the United States population and data from 33 million ED visits in 2019. Utilizing the available weighting scheme for this database, that number increases to estimate 145 million ED visits. The HCUP datasets have been used to provide valuable information about trends for multiple disease processes (Healthcare Cost and Utilization Project 2019, Kaiser 2022, Kocher 2014, Wang 2015).

2.3 Summary of Current Problem and Study Relevance

Current literature indicates a significant association between insurance status and T1DM outcomes. However, these data underrepresent uninsured patients and those that do not receive regular care for their diabetes or other chronic conditions. Over the past few years there has been significant public insurance expansion, specifically coverage for diabetes technology. This study seeks to address the literature gap by analyzing recent data from a national emergency department database with implications for policy and practice in diabetes care.

Chapter 3: Methodology

3.1 Introduction

This section outlines the methods used in this study, a secondary data analysis, to explore the association between insurance status and likelihood of hospital admission and mortality in patients with T1DM presenting to EDs in the US in 2019. The research design and data sources are detailed to offer a thorough insight into the approach utilized.

3.2 Data Sources

The HCUP NEDS database was created for research use. It is a partnership between federal and state governments and industry sponsored by the Agency for Healthcare Research and Quality. In 2019, 41 states, 989 hospital-owned EDs, and 33,147,251 ED visits were included which accounted for 84.9% of the US population, making it the largest publicly available all-payer ED database in the US. The use of a nationally representative database was important as the majority of existing data analyses pertaining to T1DM are based on registry data that often underrepresents uninsured and socioeconomically disadvantaged populations. The data in NEDS can be weighted to approximate 145 million ED visits with geographic information, hospital and patient characteristics, and the nature of the ED visits available including over 100 variables.

3.3 Patient Population and Variable Definitions

Patients of all ages with *International Classification of Diseases, Tenth Revision* (ICD-10) codes indicative of T1DM (ICD-10 codes E10.XXX) in any of the 35 diagnosis code positions were included in the study. The NEDS database lists ten possible final ED dispositions; routine, transfer to short-term hospital, other transfers (including skilled nursing facility, intermediate care, and another type of facility), home health care, against medical advice, admitted as an inpatient to this hospital, died in ED, discharged/transferred to court/law enforcement, not admitted (destination unknown), discharged alive (destination unknown). Although death was initially considered as an outcome of interest, due to insufficient statistical power (as detailed in Table A1, Appendix), it was combined with hospital admissions to form a composite outcome of interest. This combined outcome captures the most severe patient trajectories. The remaining eight dispositions were collectively categorized as the non-event. This approach enabled the prioritization of the most grave consequences for subsequent analysis. Insurance status-categorized into public (Medicare and Medicaid), private, self-pay and other-served as the exposure variable.

3.4 Data Analysis

The study utilized weighted descriptive statistics to delineate the characteristics of the sample population, adhering to the methodology prescribed by HCUP for producing national-level estimates. Differences in means were tested using one-way ANOVA. Differences in proportions were tested using the chi-square test. This was followed by weighted adjusted logistic regression.

Given that the NEDS database includes an extensive number of variables, covariates were selected for the final model based on existing literature, and if they significantly impacted the odds ratio (OR) of the predictor variable. The patient comorbid status was considered. The NEDS database includes only 20 of the 38 Elixhauser comorbidity measures, thus it is not possible to calculate an Elixhauser Comorbidity Index using NEDS. Individual comorbidities were not included in the final model as they did not individually, or collectively, significantly impact the OR of the predictor variable.

Collinearity and confounding were assessed, and final adjusted models accounted for various patient characteristics. Private insurance was selected as the referent as it offers the broadest access to a range of healthcare services. Patient demographics included age, race, and insurance status. The urbanicity of the county of the patient's residence was categorized as large central metropolitan, large fringe metropolitan, medium metropolitan, small metropolitan, micropolitan, and not metro- or micropolitan in the NEDS database. This classification scheme was utilized in the final model.

To assess the robustness of the findings, sensitivity analyses were executed on distinct subgroups. First, the analysis was confined to pediatric patients, defined as under 18 years of age, to account for misclassification of patients with T2DM in the T1DM population, as T2DM is much more common in adult patients. Next, sensitivity analyses examined patients treated at private and public hospitals to determine if insurance status influenced outcomes differently

across these environments. As previous literature has shown that underinsurance is a predictor of leaving the hospital against medical advice (AMA) (Agency for Healthcare Research and Quality 2009, Albayati 2021), in an additional sensitivity analysis the outcome variable was changed to leaving the ED AMA. The final sensitivity analysis was limited to patients with a principal diagnosis of DKA, denoted by ICD codes E1010, E1011, E1310, E0810, E0811, E0910, E0911, E1110, or E1111 in the first diagnostic position, recognizing that this outcome has been more thoroughly studied in the existing literature and carries a high risk of inpatient hospitalization or death.

Statistical analysis was performed using SAS version 9.4 from August 2023 to January 2024. The study applied HCUP-provided weights to the NEDS data, adjusting for the complex survey design to produce estimates representative of roughly 145 million ED visits nationwide (HCUP, 2022). The Emory University Institutional Review Board determined that this study was exempt as the data is de-identified.

Chapter 4: Results

4.1 Key Findings

In total, the weighted study population included 772,911 ED visits by patients with T1DM. These patients were grouped by insurance status, and patients with public insurance represented over half the population (58.56%). Baseline demographics between the insurance statuses were significantly different including age, sex, race, median household income, and urbanicity (Table 1). Patients with public insurance had the highest mean age (42.82 years old ± 20.00) and had the highest percentage of female patients (53.87%).

Table 1. Weighted Descriptive Characteristics of Study Population

Baseline Characteristics		Public Insurance (n=452,604)	Private Insurance (n=227,744)	Self Pay (n=65,547)	Other (n=27,016)	P-value
Age (mean ± SD)		42.82 ± 20.00	35.45 ± 16.79	33.42 ± 11.86	36.30 ± 16.68	<0.01
Male		46.13	47.34	57.35	57.20	<0.01
Female		53.87	52.66	42.65	42.8	<0.01
Race	White	60.95	72.06	50.90	61.97	<0.01
	Black	22.72	14.79	29.29	18.57	
	Hispanic	12.16	8.89	15.27	14.20	
	Asian/Pacific Islander	1.21	1.47	1.15	1.655	
	Native American	0.59	0.46	0.40	0.84	
	Other	2.37	2.33	2.99	2.77	
Urban-Rural Designation	Large Central Metropolitan	25.0	25.44	27.46	24.61	<0.01
	Large Fringe Metropolitan	20.16	24.84	21.05	20.59	
	Medium Metropolitan	25.3	23.42	22.73	25.9	

Table 1. Weighted Descriptive Characteristics of Study Population (cont)

Baseline Characteristics		Public Insurance (n=452,604)	Private Insurance (n=227,744)	Self Pay (n=65,547)	Other (n=27,016)	P-value
Urban-Rural Designation	Small Metropolitan	10.77	9.41	11.28	12.77	<0.01
	Micropolitan	11.58	9.93	10.31	9.13	
	Not Metro- or Micropolitan	7.19	6.95	7.16	6.99	
Median Household Income	$1-$45,999	36.61	24.56	43.71	31.53	<0.01
	$46,000-$58,999	27.16	23.74	26.71	30.11	
	$59,000-$78,999	22.33	26.61	19.15	22.7	
	$79,000 or more	13.89	25.08	10.42	15.66	

*Age is presented as a mean ±SD. Categorical variables are reported as percentage of subgroup. Differences in means were tested using one-way ANOVA. Differences in proportions were tested using the chi-square test.

Patients with public insurance or no insurance were each 27% more likely to be admitted or die compared to their privately insured counterparts (adjusted OR [AOR] for public insurance, 1.27; 95% CI, 1.21-1.33, AOR for self-pay, 1.27; 95% CI, 1.17-1.37). Overall, adjusted odds of hospital admission or death as final ED disposition was higher by 1% with each additional year of age (AOR, 1.01; 95% CI, 1.01-1.01). Conversely, the adjusted odds of admission or death were lower for patients living in small metropolitan or non-metropolitan areas compared to those living in large central metropolitan areas by 23% and 37% respectively (AOR for small metropolitan, 0.77; 95% CI, 0.67-0.88, AOR for non-metropolitan 0.63; 95% CI, 0.54-0.73) (Table 2).

Table 2. Adjusted Odds Ratios for Hospital Admission or Death for Patients with T1DM

Adjusted OR (95% CI) for admit/death vs other disposition		
Insurance	Private	1.00 (reference)
	Public	1.27 (1.21-1.33)*
	Self-Pay	1.27 (1.17-1.37)*
	Other	1.09 (0.95-1.24)
Age		1.01 (1.01-1.01)*
Race	White	1.00 (reference)
	Black	1.03 (0.95-1.11)
	Hispanic	0.99 (0.90-1.09)
	Asian or Pacific Islander	0.90 (0.79-1.03)
	Native American	0.96 (0.75-1.22)
	Other	0.97 (0.87-1.09)
Urban-Rural Designation	Large Central Metropolitan	1.00 (reference)
	Large Fringe Metropolitan	0.98 (0.87-1.12)
	Medium Metropolitan	0.91 (0.79-1.05)
	Small Metropolitan	0.77 (0.67-0.88)*
	Micropolitan	0.63 (0.54-0.73)*
	Not Metropolitan or Micropolitan	0.55 (0.46-0.65)*

Table shows adjusted odds ratios for hospital admission or death as final disposition of ED visit vs all other dispositions using the NEDS database. Results are adjusted for all other variables listed in the table column.

The first sensitivity analysis looking at only pediatric patients showed a 14% lower odds of the outcome of interest for patients with public insurance (AOR, 0.86; 95% CI, 0.75-0.98) (Table A2, Appendix, Figure 1). Complared to privately insured pediatric patients, those without insurance had a lower adjusted odds of admission or mortality (AOR, 0.66; 95% CI, 0.46-0.94, Figure 2).

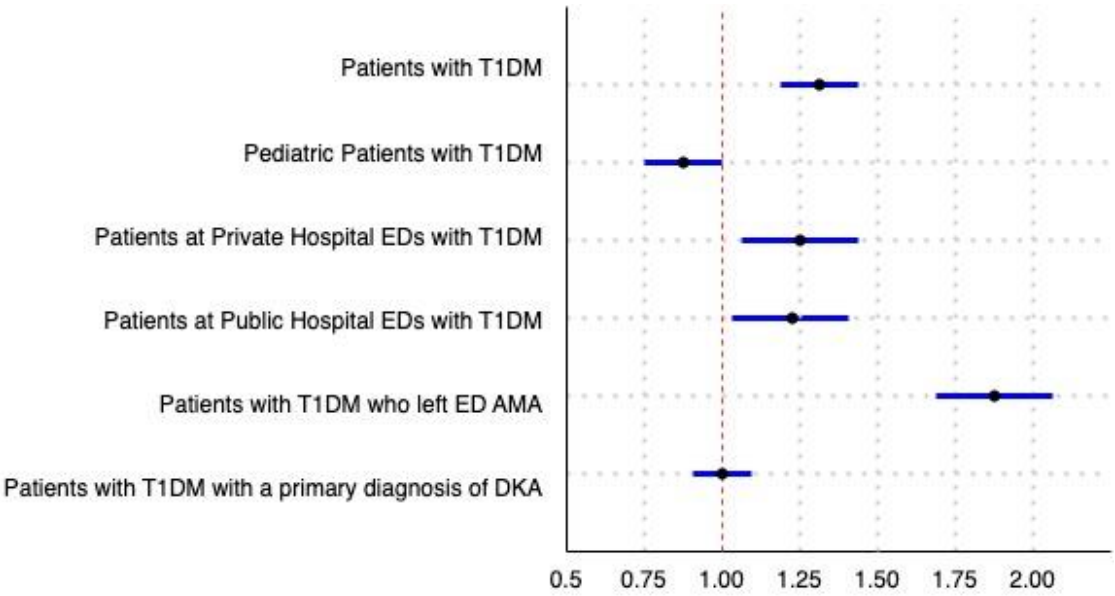
Next, looking only at private hospitals, findings were similar to the primary analysis. Odds were higher for the outcome of interest by 25% and 28% respectively for patients with public insurance or no insurance compared to those with private insurance (AOR for public insurance,

1.25; 95% CI, 1.11-1.42, AOR for self pay 1.28; 95% CI, 1.07-1.53). When examining patients at public hospitals, those with public insurance had odds higher by 22% of hospital admission or death compared to those with private insurance, but there was no significant difference in AOR for patients without insurance (AOR for public insurance, 1.22; 95% CI, 1.06-1.39, AOR for self pay 1.23; 95% CI, 0.99-1.53) (Table A2, Appendix, Figures 1 & 2).

Performing the same analysis using AMA as the outcome of interest, patients with public insurance or who were self-pay had higher odds by 83% and 137% respectively compared to those with private insurance (AOR for public insurance, 1.83; 95% CI, 1.62-2.05, AOR for self pay 2.37; 95% CI, 2.06-2.74) (Table A2, Appendix, Figures 1 & 2).

In the final sensitivity analysis, looking only at patients with T1DM whose primary diagnosis was DKA, public insurance did not significantly change odds of hospital admission or death compared to private insurance. However, self-pay patients were 42% more likely to end an ED visit with a hospital admission or death than patients with private insurance in this group (AOR for public insurance, 0.97; 95% CI, 0.89-1.06, AOR for self pay 1.42; 95% CI, 1.22-1.67) (Table A2, Appendix, Figures 1 & 2).

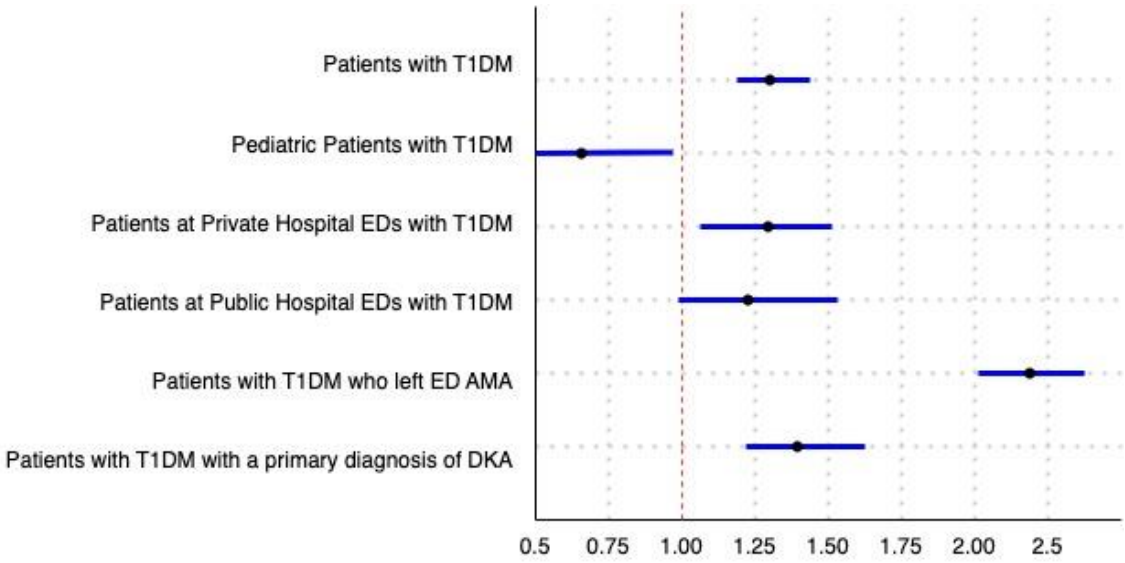
Figure 1. Forest Plot of the Adjusted Odds Ratio of Hospital Admission or Death with Public Insurance versus Private Insurance, NEDS 2019.



The forest plot displays the AORs of hospital admission or death for patients with T1DM with public insurance compared to patients with T1DM with private insurance for all analyses performed. The primary analysis included all patients with T1DM with AOR, 1.27; 95% CI, 1.21-1.33. Pediatric patients were defined as less than 18 years of age and had AOR, 0.86; 95% CI, 0.75-0.98. Private and public hospitals were defined by NEDS. Patients with T1DM with public insurance at private hospitals had AOR, 1.25; 95% CI, 1.11-1.42. Patients with T1DM with public insurance at public hospitals had AOR, 1.22; 95% CI, 1.06-1.39. When focused on patients with T1DM that left the ED AMA, the was significantly higher for patients with public insurance compared to those with private insurance (AOR, 1.83; 95% CI, 1.62-2.05). Finally, for patients with T1DM and a primary diagnosis of DKA, there was not a significant change in the odds of hospital admission or death for patients with public insurance compared to those with private insurance (AOR, 0.97; 95% CI, 0.89-1.06). Results are adjusted for age, race and urbanicity of patient residence.

AOR: Adjusted Odds Ratio CI: Confidence Interval T1DM: Type 1 Diabetes Mellitus DKA: Diabetic Ketoacidosis AMA: Against Medical Advice

Figure 2. Forest Plot of the Adjusted Odds Ratio of Hospital Admission or Death for Patients that were Self-Pay versus Private Insurance, NEDS 2019.



The forest plot displays the AORs of hospital admission or death for patients with T1DM that were self-pay compared to patients with T1DM with private insurance for all analyses performed. The primary analysis included all patients with T1DM with AOR, 1.27, 95% CI, 1.17-1.37. Pediatric patients were defined as less than 18 years of age and had AOR, AOR, 0.66; 95% CI, 0.46-0.94. Private and public hospitals were defined by NEDS. Patients with T1DM that were self-pay at private hospitals had AOR, 1.28; 95% CI, 1.07-1.53. Patients with T1DM that were self-pay at public hospitals had AOR, 1.23; 95% CI, 0.99-1.53. When focused on patients with T1DM that left the ED AMA, the AOR was significantly higher for patients that were self-pay compared to those with private insurance (AOR, 2.37; 95% CI, 2.06-2.74). Finally, for patients with T1DM and a primary diagnosis of DKA, there was not a significant change in the odds of hospital admission or death for patients that were self-pay compared to those with private insurance (AOR, 1.42; 95% CI, 1.22-1.67). Results are adjusted for age, race and urbanicity of patient residence.

AOR: Adjusted Odds Ratio CI: Confidence Interval T1DM: Type 1 Diabetes Mellitus DKA: Diabetic Ketoacidosis AMA: Against Medical Advice

4.2 Summary

The adjusted odds of inpatient hospitalization or death was 27% higher for patients with public insurance or no insurance compared to patients with private insurance (AOR for public

insurance, 1.27; 95% CI, 1.21-1.33, AOR for self-pay, 1.27; 95% CI, 1.17-1.37). Sensitivity analyses revealed that this finding does not hold true for pediatric patients and also that all patients with public insurance or no insurance were much more likely to leave the hospital AMA.

Chapter 5: Conclusions, Implications, and Recommendations

5.1 Summary of Study

This research explored the relationship between insurance status and hospital admission and death for patients with T1DM after presentation to an emergency department. Historically, T1DM has been aggregated with T2DM in research studies, despite the distinct pathophysiology and demographics affected by each condition. Recent advances in medical technology have significantly altered the management of T1DM, underscoring the necessity of contemporary research. This study contributes timely insights into the repercussions of insurance coverage for T1DM patients, particularly valuable considering recent shifts in Medicare's coverage of diabetes-related technology. Utilizing a nationally representative dataset post-dating these Medicare changes, logistic regression analyses were employed to ascertain the influence of insurance status on the specified health outcomes.

Among this study population, there were significant differences in patient demographics when stratified by insurance status. The modeling demonstrated that insurance status along with age and urban residence were significantly associated with the likelihood of hospital admission or death in the emergency department among patients with T1DM.

Specifically, the lack of private insurance was associated with higher odds of these severe outcomes for T1DM patients, even when accounting for other variables and across various insurance classifications including public coverage or self-payment options. The study demonstrates that insurance status is significantly associated with hospital admission and mortality for patients with T1DM, suggesting an urgent need for policy reforms to address coverage disparities and ensure equitable healthcare access.

5.2 Discussion of Key Results

The findings of this study underscore the multifactorial nature of healthcare outcomes for individuals with T1DM. Consistent with the literature, insurance coverage was significantly associated with healthcare outcomes; patients with public or no insurance faced a higher risk of hospital admission or death, a finding that was consistent across most analyses. This aligns with the Social Ecological Model, affirming the interdependence of systemic factors and individual health outcomes.

Contrary to expectations, pediatric ED patients with public insurance or no insurance were less likely to be hospitalized or die compared to those with private insurance. This suggests that while insurance status is a critical factor, other variables such as age and the specificities of pediatric care protocols might mitigate the risks associated with public insurance in younger populations. Additionally, children typically have fewer comorbidities, which could also account for their lower risk of hospital admission or death. A final consideration is that this study's

reliance on ICD codes for diagnosis raises the possibility of misclassifying diabetes cases as type 1 when in fact a patient has a different type of diabetes. Given the higher incidence of T1DM in children compared to adults, such misclassification could contribute to variations observed in this sensitivity analysis that only included pediatric patients.

The sensitivity analyses also interestingly revealed that patients with public insurance or no insurance had much higher odds, 83% and 137% respectively, of leaving the emergency department against medical advice compared to patients with private insurance (AOR for public insurance, 1.83; 95% CI, 1.62-2.05, AOR for self pay 2.37; 95% CI, 2.06-2.74). This suggests that the effect of underinsurance might be underestimated using the primary outcome of hospital admission or death given that prior research indicates that about 10% of patients leaving AMA from the ED had hospital admission recommended (Sayed, 2016).

Another compelling finding was the lower odds of admission or death for patients living in less urban areas which also held true across most analyses. The preponderance of healthcare evidence has shown worse outcomes for rural versus urban populations (Centers for Disease Control and Prevention, 2023). The current study did not evaluate transfers as an ED disposition which could account for the lower odds of hospital admission or death in rural areas as patients requiring inpatient hospitalization might be transferred more commonly from rural hospitals. Furthermore, the NEDS database stratifies urbanicity on six levels, which makes the comparison between urban and non-urban more complex than the traditional designation of urban versus rural.

Also of note, public insurance did not result in higher odds of hospitalization or death as the final disposition from the emergency department when the primary diagnosis was DKA which is often used as the outcome of interest in existing literature (Rewers 2002, Cengiz 2013, Everett 2021). The odds of hospitalization or death for self-pay patients with a primary diagnosis of DKA was higher by 42% compared to those with private insurance. Further investigation into this finding might reveal interesting differences in reason for hospital admission by insurance status.

5.3 Limitations and Strengths

The study's methodology, while robust due to the expansive and nationally representative nature of the NEDS database, faces inherent limitations typical of retrospective and secondary data analyses. These limitations include the inability to establish causal relationships, given that retrospective designs can only suggest associations. The NEDS database provides data linked to ED visits rather than unique individuals which may lead to an overrepresentation of frequent ED users, potentially skewing the perceived prevalence and patterns of T1DM emergencies. Moreover, the NEDS database's lack of a composite comorbidity measure, such as the Elixhauser Comorbidity Index, combined with the finding that individual comorbidities did not significantly impact the odds ratio, results in the study not accounting for the patients' overall clinical status.

This is compounded by the potential for misclassification bias, where the diagnosis of T1DM might be incorrectly recorded, and the presence of unmeasured confounders—variables that were not accounted for that could influence the study's outcomes. Furthermore, the focus on emergency department data might not fully encapsulate the experiences of the broader T1DM population, particularly those who are managing their diabetes through routine primary care and are less likely to present in emergency situations. Such a sample might inadvertently exclude a subset of patients who maintain a stable condition through effective ongoing care, leading to an overrepresentation of more acute or severe cases.

Despite these challenges, the study's use of a comprehensive dataset provides valuable insights into the healthcare patterns and outcomes of a significant section of the T1DM community. While it underscores the influence of insurance status on patient outcomes, caution must be exercised when interpreting these findings due to the retrospective nature of the analysis.

5.4 Implications

The implications of these findings are profound for public health policy and practice. They call for a targeted approach to healthcare provision, emphasizing the need for equity in insurance coverage. The lower odds of adverse outcomes in pediatric patients with public insurance may reflect successful interventions at this demographic level, implying potential areas for replication in adult care. And with insulin price caps introduced in 2023, it will be useful to study whether these measures, coupled with advancements in equitable access to diabetes

technology, will reflect in future studies as a diminished impact of insurance status on health outcomes.

5.5 Recommendations

Considering the demonstrated disparities, it is recommended that public health interventions prioritize equitable access to T1DM care across insurance statuses. Additionally, further research is warranted to explore the complexities of how insurance influences health outcomes among diverse demographic segments.

Future studies should consider a granular analysis of the initial diagnoses leading to hospital admission among patients with T1DM. This is especially pertinent as the data showed that the ORs for admission of T1DM patients with public insurance—when DKA was the primary diagnosis—did not significantly differ from those with private insurance. This finding contrasts with the primary outcomes observed in the study, suggesting a nuanced interplay between insurance type and reason for admission that warrants further investigation. A thorough examination of this observation could yield insightful information.

The research highlights areas for future prospective studies that could offer more definitive conclusions and inform policy changes to improve the management and outcomes of patients with T1DM. It is essential for future research to address these gaps, possibly by integrating

primary care data and conducting longitudinal studies that can better account for a wider range of variables and establish clearer causal links.

A final recommendation is to conduct an in-depth analysis of the impact that the urban classifications, as defined by NEDS, have on the admission rates of patients with T1DM. Given that the six-tiered stratification is not widely adopted in existing literature, such an investigation may illuminate subtle distinctions that the conventional urban versus rural dichotomy has failed to reveal.

5.6 Conclusion

In conclusion, the findings of this study underscore the critical role of insurance status in shaping health outcomes for individuals with T1DM. It highlights the imperative for expanding and enhancing insurance coverage, particularly public insurance programs. Despite recent expansions in Medicare and Medicaid that predate the data used for this analysis, outcomes for patients with public insurance were similar to those without insurance. These insights present a compelling case for policy reform aimed at ameliorating these disparities and ensuring equitable health care access for all T1DM patients.

References

1. Agency for Healthcare Research and Quality. (2009, August). Hospitalizations in which patients leave the hospital against medical advice (AMA), 2007. HCUP Statistical Brief #78. Retrieved March 5, 2024, from https://hcup-us.ahrq.gov/reports/statbriefs/sb78.jsp

2. Albayati, A., Douedi, S., Alshami, A., Hossain, M. A., Sen, S., Buccellato, V., Cutroneo, A., Beelitz, J., & Asif, A. (2021). Why Do Patients Leave against Medical Advice? Reasons, Consequences, Prevention, and Interventions. *Healthcare (Basel, Switzerland)*, *9*(2), 111. https://doi.org/10.3390/healthcare9020111

3. Allen, C., LeCaire, T., Palta, M., Daniels, K., Meredith, M., D'Alessio, D. J., & Wisconsin Diabetes Registry Project (2001). Risk factors for frequent and severe hypoglycemia in type 1 diabetes. *Diabetes care*, *24*(11), 1878–1881. https://doi.org/10.2337/diacare.24.11.1878

4. American Diabetes Association. (n.d.). Statistics About Diabetes. Retrieved November 11, 2023, from https://diabetes.org/about-diabetes/statistics/about-diabetes

5. Amin, B., Yeduri, R., Tumin, D., Buckman, C., & Bell, J. J. (2021). Insurance coverage and health care use among children with diabetes. *Pediatric diabetes*, *22*(4), 605–609. https://doi.org/10.1111/pedi.13192

6. Bullard, K. M., Cowie, C. C., Lessem, S. E., Saydah, S. H., Menke, A., Geiss, L. S., Orchard, T. J., Rolka, D. B., & Imperatore, G. (2018). Prevalence of Diagnosed Diabetes in Adults by Diabetes Type - United States, 2016. *MMWR. Morbidity and mortality weekly report*, *67*(12), 359–361. https://doi.org/10.15585/mmwr.mm6712a2

7. Cengiz, E., Xing, D., Wong, J. C., Wolfsdorf, J. I., Haymond, M. W., Rewers, A., Shanmugham, S., Tamborlane, W. V., Willi, S. M., Seiple, D. L., Miller, K. M., DuBose, S. N., Beck, R. W., & T1D Exchange Clinic Network (2013). Severe hypoglycemia and diabetic ketoacidosis among youth with type 1 diabetes in the T1D Exchange clinic registry. *Pediatric diabetes*, *14*(6), 447–454. https://doi.org/10.1111/pedi.12030

8. Centers for Disease Control and Prevention. (2023, November 28). *About Rural Health*. CDC. https://www.cdc.gov/ruralhealth/about.html

9. Centers for Disease Control and Prevention. (n.d.). Home - United States Diabetes Surveillance System. Retrieved November 11, 2023 from https://gis.cdc.gov/grasp/diabetes/diabetesatlas.html

10. Centers for Medicare & Medicaid Services. (n.d.). Glucose Monitor - Policy Article (A52464). Retrieved November 11, 2023 from https://www.cms.gov/medicare-coverage-database/view/article.aspx?articleId=52464

11. Dieleman, JL, Cao, J, Chapin, A, Chen, C, Zhiyin, L, Liu, A, Horst, C, Kaldjian, A, Matyasz, T, US Health Care Spending by Payer and Health Condition, 1996-2016. *JAMA.* 2020;323(9):863–884. doi:10.1001/jama.2020.0734

12. Doucette, E. D., Salas, J., Wang, J., & Scherrer, J. F. (2017). Insurance coverage and diabetes quality indicators among patients with diabetes in the US general population. *Primary care diabetes*, *11*(6), 515–521. https://doi.org/10.1016/j.pcd.2017.05.007

13. ElSayed, N. A., Aleppo, G., Aroda, V. R., Bannuru, R. R., Brown, F. M., Bruemmer, D., Collins, B. S., Gaglia, J. L., Hilliard, M. E., Isaacs, D., Johnson, E. L., Kahan, S., Khunti, K., Leon, J., Lyons, S. K., Perry, M. L., Prahalad, P., Pratley, R. E., Seley, J. J., Stanton, R. C., Gabbay, R. A., & American Diabetes Association. (2023). 2. Classification and Diagnosis of Diabetes: Standards of Care in Diabetes—2023. *Diabetes Care, 46*(Supplement_1), S19-S40. https://diabetesjournals.org/care/article/46/Supplement_1/S19/148056/2-Classification-and-Diagnosis-of-Diabetes

14. Everett, E. M., Copeland, T. P., Moin, T., & Wisk, L. E. (2021). National Trends in Pediatric Admissions for Diabetic Ketoacidosis, 2006-2016. *The Journal of clinical endocrinology and metabolism*, *106*(8), 2343–2354. https://doi.org/10.1210/clinem/dgab287

15. Everett, E. M., & Wisk, L. E. (2022). Relationships Between Socioeconomic Status, Insurance Coverage for Diabetes Technology and Adverse Health in Patients With Type 1 Diabetes. *Journal of diabetes science and technology*, *16*(4), 825–833. https://doi.org/10.1177/19322968211050649

16. Healthcare Cost and Utilization Project. (2019). NEDS overview. Retrieved July 13, 2023, from https://www.hcup-us.ahrq.gov/nedsoverview.jsp

17. Icks A, Rosenbauer J, Haastert B, Giani G, Keenan H, Bratton SL.(2003). Social inequality in childhood diabetes—a population-based follow-up study in Germany. *Pediatrics* 111:222-224.

18. Kaiser, S. V., Hall, M., Bettenhausen, J. L., Sills, M. R., Hoffmann, J. A., Noelke, C., Morse, R. B., Lopez, M. A., & Parikh, K. (2022, October 1). Neighborhood Child Opportunity and Emergency Department Utilization. *Pediatrics, 150*(4), Article e2021056098. https://doi.org/10.1542/peds.2021-056098

19. Kocher, K. E., Haggins, A. N., Sabbatini, A. K., Sauser, K., & Sharp, A. L. (2014, November). Emergency department hospitalization volume and mortality in the United States. *Annals of Emergency Medicine, 64*(5), 446-457.e6. https://doi.org/10.1016/j.annemergmed.2014.06.008

20. McLeroy KR, Bibeau D, Steckler A, Glanz K. (1988). An ecological perspective on health promotion programs. Health Educ Q. Winter;15(4):351-77. doi: 10.1177/109019818801500401. PMID: 3068205.

21. NEDS Database Documentation. Healthcare Cost and Utilization Project (HCUP). November 2022. Accessed August 2023. Agency for Healthcare Research and Quality, Rockville, MD. www.hcup-us.ahrq.gov/db/nation/neds/nedsdbdocumentation.jsp.

22. Pettus, J. H., Zhou, F. L., Shepherd, L., Mercaldi, K., Preblick, R., Hunt, P. R., Paranjape, S., Miller, K. M., & Edelman, S. V. (2020). Differences between patients with type 1 diabetes with optimal and suboptimal glycaemic control: A real-world study of more than 30 000 patients in a US electronic health record database. *Diabetes, obesity & metabolism*, *22*(4), 622–630. https://doi.org/10.1111/dom.13937

23. Rewers, A., Chase, H. P., Mackenzie, T., Walravens, P., Roback, M., Rewers, M., Hamman, R. F., & Klingensmith, G. (2002). Predictors of acute complications in children with type 1 diabetes. *JAMA*, *287*(19), 2511–2518. https://doi.org/10.1001/jama.287.19.2511

24. Sayed, M. E., Jabbour, E., Maatouk, A., Bachir, R., & Dagher, G. A. (2016). Discharge Against Medical Advice From the Emergency Department: Results From a Tertiary Care Hospital in Beirut, Lebanon. *Medicine*, *95*(6), e2788. https://doi.org/10.1097/MD.0000000000002788

25. T1D Exchange. (n.d.). Registry. Retrieved November 11, 2023 from https://t1dexchange.org/registry/

26. Wang, J., Geiss, L. S., Williams, D. E., & Gregg, E. W. (2015, August 7). Trends in Emergency Department Visit Rates for Hypoglycemia and Hyperglycemic Crisis among Adults with Diabetes, United States, 2006-2011. *PLoS ONE, 10*(8), Article e0134917. https://doi.org/10.1371/journal.pone.0134917

27. Yan, K. (2019, November 21). Medicaid and CGM: Who's Covered? diaTribe. Updated November 6, 2022. Retrieved November 11. 2023 from https://diatribe.org/medicaid-and-cgm-whos-covered

Appendix

Table A1. Adjusted odds ratios for sensitivity analysis comparing hospital admission/death as a combined outcome to hospital admission or death separately as outcomes for patients with T1DM.

	All (n=748,148)	Hospital Admission as Outcome (n=310,301)	Death as Outcome (n=583)
Private	1.00 (reference)	1.00 (reference)	1.00 (reference)
Public	1.27 (1.21-1.33)*	1.27 (1.21-1.32)*	2.38 (1.09-5.20)*
Self-Pay	1.27 (1.17-1.37)*	1.27 (1.17-1.37)*	2.07 (0.78-5.51)
Other	1.09 (0.95-1.24)	1.09 (0.95-1.24)	2.14 (0.61-7.53)
Age	1.01 (1.01-1.01)*	1.01 (1.01-1.01)	1.04 (1.03-1.06)*
White	1.00 (reference)	1.00 (reference)	1.00 (reference)
Black	1.03 (0.95-1.11)	1.03 (0.95-1.11)	0.97 (0.59-1.60)
Hispanic	0.99 (0.90-1.09)	0.99 (0.90 (1.09)	0.84 (0.44-1.60)
Asian or Pacific Islander	0.90 (0.79-1.03)	0.90 (0.79-1.03)	1.09 (0.27-4.38)
Native American	0.96 (0.75-1.22)	0.96 (0.75-1.23)	<0.01*
Other	0.97 (0.87-1.09)	0.97 (0.86-1.09)	1.05 (0.31-3.57)
Large Central Metropolitan	1.00 (reference)	1.00 (reference)	1.00 (reference)
Large Fringe Metropolitan	0.98 (0.87-1.12)	0.98 (0.87-1.12)	1.35 (0.80-2.28)
Medium Metropolitan	0.91 (0.79-1.05)	0.91 (0.79-1.05)	1.25 (0.66-2.36)
Small Metropolitan	0.77 (0.67-0.88)*	0.77 (0.67-0.88)*	1.02 (0.49-2.11)
Micropolitan	0.63 (0.54-0.73)*	0.63 (0.54-0.73)*	1.23 (0.64-2.40)
Not Metropolitan or Micropolitan	0.55 (0.46-0.65)*	0.55 (0.46-0.65)*	0.94 (0.40-2.23)

Table shows adjusted odds ratios for hospital admission or death as final disposition of ED visit vs all other dispositions using the NEDS database. The number of patients included in each subpopulation is weighted. Results are adjusted for all other variables listed in the table column.

Table A2. Adjusted Odds Ratios for Hospital Admission or Death for Subgroups of Patients with T1DM

	All (n=748,148)	Pediatric Patients (n=65,932)	Private Hospital Patients (n=64,309)	Public Hospital Patients (n=96,594)	Patients who left ED AMA (n=13,053)	Patients with a primary diagnosis of DKA (n=144939)
Adjusted OR (95% CI) for admit/death vs other dispositions						
Private	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Public	1.27 (1.21-1.33)*	0.86 (0.75-0.98)*	1.25 (1.11-1.42)*	1.22 (1.06-1.39)*	1.83 (1.62-2.05)*	0.97 (0.89-1.06)
Self-Pay	1.27 (1.17-1.37)*	0.66 (0.46-0.94)*	1.28 (1.07-1.53)*	1.23 (0.99-1.53)	2.37 (2.06-2.74)*	1.42 (1.22-1.67)*
Other	1.09 (0.95-1.24)	1.00 (0.62-1.61)	1.32 (1.03-1.69)*	1.21 (0.80-1.84)	1.24 (0.95-1.61)	1.12 (0.89-1.40)
Age	1.01 (1.01-1.01)*	0.977 (0.96-0.99)	1.01 (1.01-1.01)*	1.00 (1.00-1.01)	0.99 (0.99-0.99)	1.03 (1.03-1.04)*
White	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Black	1.03 (0.95-1.11)	0.94 (0.79-1.11)	1.04 (0.88-1.22)	1.14 (0.87-1.48)	1.24 (1.08-1.41)*	1.27 (1.11-1.44)
Hispanic	0.99 (0.90-1.09)	0.89 (0.71-1.13)	1.00 (0.79-1.26)	1.10 (0.82-1.47)	0.97 (0.78-1.21)	1.33 (1.12-1.57)*
Asian or Pacific Islander	0.90 (0.79-1.03)	0.81 (0.57-1.16)	0.84 (0.54-1.31)	1.24 (0.83-1.47)	0.67 (0.42-1.06)	1.00 (0.73-1.38)
Native American	0.96 (0.75-1.22)	2.59 (1.49-4.53)*	0.63 (0.35-1.11)	0.91 (0.50-1.66)	0.90 (0.53-1.55)	1.28 (0.71-2.32)
Other	0.97 (0.87-1.09)	0.84 (0.64-1.10	0.74 (0.59-0.94)*	1.20 (0.86-1.66)	1.09 (0.83-1.44)	1.01 (0.81-1.27)
Large Central Metropolitan	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Large Fringe Metropolitan	0.98 (0.87-1.12)	0.74 (0.57-0.95)*	0.78 (0.58-1.04)	1.08 (0.77-1.51)	0.84 (0.70-1.00)	0.81 (0.65-1.00)
Medium Metropolitan	0.91 (0.79-1.05)	1.00 (0.73-1.39)	0.92 (0.72-1.16)	1.01 (0.73-1.39)	0.82 (0.68-1.00)	1.06 (0.83-1.35)

Small Metropolitan	0.77 (0.67-0.88)*	0.51 (0.37-0.74)*	0.64 (0.48-0.86)*	1.04 (0.75-1.43)	0.94 (0.76-1.17)	0.72 (0.55-0.95)*
Micropolitan	0.63 (0.54-0.73)*	0.52 (0.37-0.74)*	0.45 (0.31-0.65)*	0.63 (0.41-0.96)*	0.94 (0.73-1.21)	0.47 (0.37-0.61)*
Not Metropolitan or Micropolitan	0.55 (0.46-0.65)*	0.49 (0.32-0.74)*	0.63 (0.49-0.82)*	0.48 (0.30-0.78)*	0.80 (0.64-0.99)	0.31 (0.24-0.40)*

Table shows adjusted odds ratios for hospital admission or death as final disposition of ED visit vs all other dispositions using the NEDS database. The number of patients included in each subpopulation is weighted. Results are adjusted for all other variables listed in the table column.