Burden of diabetic ketoacidosis among youth with diabetes: A hospital claims analysis

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Background

- Diabetic ketoacidosis (DKA) is a serious complication of diabetes.[1]
- Incidence of DKA among children with type 1 diabetes (T1D) have been increasing,[1,2]
- For youth with type 2 diabetes (T2D), DKA rates are also increasing. Indeed, DKA was the reason for hospitalization in a third of youth with T2D[2]
- Data on national hospitalization rates among children in the United States is limited
- In this study, we assessed the clinical characteristics and charges of DKA hospitalizations in nationally representative sample of children age < 18 years in U.S.

Objective

- To assess differences in morbidity, mortality and charges of DKA-related hospitalizations in children with either T1D or T2D, stratified by primary or secondary DKA diagnosis

Methods

Study Design and data source

- This was a retrospective, observational, cross-sectional analysis of hospital discharge data
- Data were taken from the Kids' Inpatient Database (KID), the largest publicly available database in the United States for all-payer pediatric inpatient care, which encompasses 2-3 million hospital stays per year

Population

- T1D children (age < 18 years) were identified using International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10 codes) for E10.XX
- T2D children (age < 18 years) were identified using ICD-10 codes for E11.XX
- Cases where both T1D and T2D ICD-10 codes were reported were excluded for this analyses

Identification of admissions with DKA

- DKA hospitalizations were identified using International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10 codes) specific to T1D (E10.1, E10.10, E10.11) and T2D (E11.1, E11.10, E11.11)[3]

Data collected

- The primary endpoint was the incidence of DKA inpatient hospitalizations
- Secondary endpoints were discharge location, length of stay, mortality and 2025 inflation-adjusted hospital charges

Results

Admissions

- In 2022, there were a total of 31,238 hospitalization cases for youth with T1D and 7,636 hospitalization cases in children and adolescents with T2D
- Among all T1D hospitalizations, 22,578 (72.2%) were for DKA admissions, and among all T2D hospitalizations, 1,407 (18.4%) were for DKA admissions

Primary vs Secondary DKA admissions

- DKA was listed as the primary diagnosis 93.5% in T1D children and 88.6% in T2D children
- When DKA was a secondary diagnosis code, average length of stay and hospital charges were approximately double or more compared to primary DKA admissions (**Table 1, Table 2**)

T1D DKA admissions

- Within subpopulations of race/ethnicity, region, and insurance status of T1D DKA admissions, rates were greatest among Whites, living in the South, and covered under Medicaid, respectively
- Primary DKA admissions were similar to secondary DKA admissions in race, regions, and insurance type
- Primary DKA admissions were significantly younger, male, discharged home, had shorter length of stays, and lower hospital charges compared to secondary DKA admissions

T2D DKA admissions

- For primary DKA admissions, Black individuals and those insured by Medicaid represented the largest proportion of the cohort; no regional or age differences were noted
- For secondary DKA admissions, Hispanic individuals and those insured by Medicaid accounted for the largest proportion of the cohort
- Between primary and secondary DKA admissions, insurance status, region of the country, and age were similar

T1D vs T2D DKA admission

- DKA admission rates were similar between T1D and T2D where most of admissions were in the South, had Medicaid, and were discharged home
- Compared to T2D, DKA admissions among T1D tended to be younger and higher proportion White reflecting known demographics by diabetes type. Shorter length of stay were noted in youth with T1D, which were tied to lower hospital charges

Table 1. Characteristics of youth with T1D with DKA admissions

Patient characteristic	Primary DKA	Secondary DKA	P
T1D Hospitalizations, N	21,110	1,468	
Age, mean (SD)	11.28 (4.38)	12 (3.94)	<0.001
≤ 12 years, N (%)	11,648 (55.2)	653 (44.5)	<0.001
Male, N (%)	10,544 (49.9)	649 (44.2)	<0.001
Race/Ethnicity, N (%)			0.316
Asian or Pacific Islander	315 (1.5)	24 (1.7)	
Black	4,581 (21.7)	317 (21.6)	
Hispanic	3,340 (15.8)	255 (17.4)	
White	10,266 (48.6)	709 (48.3)	
Native American	176 (0.8)	11 (0.7)	
Other	976 (4.6)	77 (5.2)	
Missing	1,456 (6.9)	76 (5.1)	
Region, N (%)			0.903
Midwest	4,850 (23.0)	325 (22.1)	
Northeast	2,883 (13.7)	201 (13.7)	
South	8,675 (41.1)	597 (40.7)	
West	4,702 (22.3)	345 (23.5)	
Insurance, N (%)			0.070
Medicaid	11,589 (54.9)	848 (57.8)	
Private	7,660 (36.3)	523 (35.6)	
Medicare	26 (0.1)	1 (0.1)	
Other	1,835 (8.7)	96 (6.5)	
Discharge location, N (%)			<0.001
Home	20,609 (97.6)	1,402 (95.6)	
Transferred to other healthcare facility	430 (2.0)	54 (3.8)	
Against medical advice	39 (0.2)	6 (0.4)	
Death, N (%)	30 (0.1)	≤ 10*	
Length of stay, days, mean (SD)	2 (3.27)	4 (11.02)	0.001
Hospital charge, $, mean (SD)	33,244 (53,188)	64,943 (270,556)	<0.001

Table 2. Characteristics of youth with T2D with DKA admissions

Patient characteristic	Primary DKA	Secondary DKA	P
T2D Hospitalizations, N	1,247	160	
Age, mean (SD)	13.15 (3.66)	13.17 (4.11)	0.955
≤ 12 years, N (%)	449 (36.0)	50.1 (31.4)	0.369
Male, N (%)	744.5 (59.7)	77.1 (48.3)	0.023
Race/Ethnicity, N (%)			<0.001
Asian or Pacific Islander	14.8 (1.2)	12.2 (7.6)	
Black	399.3 (32.0)	45.7 (28.6)	
Hispanic	322.6 (25.9)	55.7 (34.9)	
White	344.6 (27.6)	28.5 (17.8)	
Native American	19.1 (1.5)	2.8 (1.7)	
Other	66 (5.3)	5.4 (3.4)	
Missing	80.1 (6.4)	9.4 (5.9)	
Region, N (%)			0.131
Midwest	173.5 (13.9)	18.5 (11.6)	
Northeast	164.5 (13.2)	24.2 (15.1)	
South	658.5 (52.8)	70.9 (44.4)	
West	250.1 (20.1)	46.1 (28.9)	
Insurance, N (%)			0.887
Medicaid	808.3 (64.8)	105.9 (66.3)	
Private	339.5 (27.2)	40.4 (25.3)	
Medicare	4.2 (0.3)	0 (0.0)	
Other	94.6 (7.6)	13.3 (8.4)	
Discharge location, N (%)			<0.001
Home	1193.3 (95.7)	137 (85.8)	
Transferred to other healthcare facility	44 (3.5)	16 (9.9)	
Against medical advice	1.2 (0.1)	1.3 (0.8)	
Death, N (%)	≤ 10*	≤ 10*	
Length of stay, days, mean (SD)	3.37 (6.0)	7.32 (13.9)	0.001
Hospital charge, $, mean (SD)	49,033 (111,617)	160,355 (324,411)	<0.001

Note: N reflects hospitalization admissions and not persons
*Results with ≤ 10 counts are suppressed due to the data use agreement for HCUP-KID; total deaths is 49.
Abbreviations: DKA, diabetic ketoacidosis; T1D, type 1 diabetes mellitus; T2D, type 2 diabetes mellitus.

Discussion

- This analysis provides recent U.S. national estimates of the incidence, length of stay, mortality, hospital discharge, and cost of hospitalizations for DKA events in children with T1D and T2D
- In 2022, nearly three-quarters of all hospitalizations in children with T1D and nearly one-fifth of children with T2D were associated with a diagnosis code for DKA
- As this data is cross-sectional, we could not assess rates of DKA at diagnosis, as compared to those with established disease

Conclusion

- Children with T1D who are hospitalized are commonly diagnosed with DKA
- Although DKA is less common for youth with T2D who are hospitalized, it is associated with higher rates among older youth, Medicaid enrollees, and longer hospital stays, likely contributing to higher hospital charges

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References

1. Lawrence JW et al. *JAMA* 2021;326:717-727.
2. Gildner CD et al. *Hosp Pediatr* 2026;16:134-142.

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