

# INSULIN DOSING IN US ADULTS WITH TYPE 2 DIABETES (T2D) ON MULTIPLE DAILY INJECTIONS (MDI): A RETROSPECTIVE COHORT STUDY

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### Introduction

- People with type 2 diabetes (T2D) account for up to 90-95% of all diagnosed cases of adult diabetes<sup>1</sup>
- Due to the progressive nature of T2D, treatment intensification is often required to meet patient-specific glycemic goals<sup>2</sup>
- People who do not achieve glycemic targets may eventually progress from lifestyle modification to oral antidiabetic agents and, ultimately, to insulin<sup>2</sup>
- Limited evidence is available on real-world insulin prescribing and dosing of basal and prandial insulin in adults with T2D
- The aim of this study was to investigate total daily doses (TDD) of insulin in US adults with T2D receiving multiple daily injections (MDI)

### Methods

- This retrospective US observational cohort study was conducted using IQVIA ambulatory electronic medical record (aEMR) data from 01/2017 to 07/2022
- Adults (aged ≥18 years) with T2D using MDI, defined as those who were prescribed ≥3 insulin injections daily (basal-prandial regimen), were included in this study
- Descriptive analyses evaluated demographic and clinical characteristics and total daily dose (TDD) of insulin
- Mean TDD was calculated using the mean TDD per patient, overall and per year

Table 1. Study cohort identification

Criteria	N
1. Unique people with 1 or more T2D diagnoses <sup>a</sup>	3,437,290
2. Of #1, unique people with <u>no</u> T1D diagnosis <sup>b</sup>	3,350,464
3. Of #2, people aged 18 years or older on 1/1/2017	3,339,663
4. Of #3, people with ≥1 order for basal OR prandial insulin <sup>c</sup> from 1/1/2017 through end of study period <sup>d</sup>	520,847
5. Of #4, people with ≥1 basal AND ≥1 prandial insulin <sup>c</sup> order from 1/1/2017 through end of study period <sup>d</sup>	206,000
6. Of #5, people with no U-500 or premixed insulin	183,324
7. Of #6, people with ≥1 prandial insulin order <sup>c</sup> with frequency AND dose information available <sup>e</sup>	46,350
8. Of #7, people using MDI <sup>f</sup>	41,926
9. Of #8, number of people excluding top and bottom 1% of TDD values <sup>g</sup>	41,215

<sup>a</sup>ICD-9-CM codes 250.x0 or 250.x2 or ICD-10-CM code E11.x

<sup>b</sup>ICD-9-CM codes 250.x1 or 250.x3 or ICD-10-CM code E10.x

<sup>c</sup>Insulin NDC codes used to identify basal and prandial insulin were for the commonly used insulin types.

<sup>d</sup>Last date available in aEMR dataset.

<sup>e</sup>Prescription records with missing or invalid information on dose quantity or frequency of administration were not included while identifying the MDI cohort. This may underestimate the MDI cohort size.

<sup>f</sup>MDI was defined as receiving 3 or more insulin injections per day (basal-prandial regimen)

<sup>g</sup>Top and bottom 1% of TDD values removed due to potential coding errors. These values were considered not clinically feasible.

Table 2. Baseline demographic and clinical characteristics

Variable	Total n=41,215	TDD quartile			
		Quartile 1 n=10,312	Quartile 2 n=10,358	Quartile 3 n=10,283	Quartile 4 n=10,262
TDD (U), mean (SD)	95.9 (58.1)	38.7 (9.2)	66.8 (8.0)	100.5 (12.2)	178.4 (47.8)
TDD/kg (U/kg), mean (SD)	1.0 (2.3)	0.4 (0.4)	0.7 (0.3)	1.0 (0.5)	1.6 (1.9)
Sex, female (%)	21,481 (52.1)	5,422 (52.6)	5,449 (52.6)	5,436 (52.9)	5,174 (50.4)
Age, mean (SD)	57.8 (13.3)	59.6 (14.2)	57.9 (13.6)	57.4 (12.9)	56.4 (12.1)
Age group, n (%)					
18-34	2,429 (5.9)	643 (6.2)	647 (6.3)	596 (5.8)	543 (5.3)
35-44	4,259 (10.3)	955 (9.3)	1,065 (10.3)	1,072 (10.4)	1,167 (11.4)
45-54	8,471 (20.6)	1,747 (16.9)	2,135 (20.6)	2,148 (20.9)	2,441 (23.8)
55-64	12,219 (29.7)	2,716 (26.3)	2,914 (28.1)	3,238 (31.5)	3,351 (32.7)
≥65	13,837 (33.6)	4,251 (41.2)	3,597 (34.7)	3,229 (31.4)	2,760 (26.9)
Race, n (%)					
Caucasian	25,460 (61.8)	5,949 (57.7)	6,194 (59.8)	6,407 (62.3)	6,910 (67.3)
African American	5,830 (14.2)	1,710 (16.6)	1,626 (15.7)	1,419 (13.8)	1,075 (10.5)
Asian	893 (2.2)	322 (3.1)	214 (2.1)	194 (1.9)	163 (1.6)
Hispanic	87 (0.2)	17 (0.2)	33 (0.3)	22 (0.2)	15 (0.1)
Other/Unknown	8,945 (21.7)	2,314 (22.4)	2,291 (22.1)	2,241 (21.8)	2,099 (20.5)
Geography, n (%)					
Northeast	5,261 (12.8)	1,514 (14.7)	1,393 (13.5)	1,257 (12.2)	1,097 (10.7)
Midwest	7,494 (18.2)	1,826 (17.7)	1,834 (17.7)	1,824 (17.7)	2,010 (19.6)
South	19,844 (48.2)	4,474 (43.4)	4,917 (47.5)	5,115 (49.7)	5,338 (52.0)
West	8,608 (20.9)	2,497 (24.2)	2,213 (21.4)	2,085 (20.3)	1,813 (17.7)
Unknown	8 (<0.1)	1 (<0.1)	1 (<0.1)	2 (<0.1)	4 (<0.1)
CCI score, mean (SD)	1.5 (1.8)	1.6 (1.9)	1.5 (1.8)	1.5 (1.7)	1.5 (1.7)
BMI (kg/m <sup>2</sup> ) at index, mean (SD)	34.1 (6.7)	31.0 (6.6)	33.4 (6.4)	35.1 (6.3)	37.0 (6.0)
Height (inches) at index, mean (SD)	66.6 (4.2)	66.1 (4.2)	66.5 (4.2)	66.6 (4.2)	67.2 (4.2)
Weight (kg) at index, mean (SD)	98.3 (25.3)	87.5 (22.9)	95.6 (23.6)	101.1 (24.0)	109.7 (25.4)

- Over half (63%) of the study population was aged 55 years or older.
- Most people (62%) with T2D on MDI were Caucasian.
- The mean TDD prescribed for the study cohort was 95.9 U; and the mean BMI was 34.1 kg/m<sup>2</sup>.

Table 3. Insulin regimens, by year, for adults with T2D

Year	T2D (Age ≥18 yr)	Insulin regimen, n (%)		
		Basal insulin	Basal + prandial insulin	MDI <sup>a</sup>
2017	3,111,645	164,493 (5.3)	59,355 (1.9)	7,121 (0.2)
2018	3,092,896	152,812 (4.9)	54,293 (1.8)	10,466 (0.3)
2019	3,072,032	125,905 (4.1)	44,995 (1.5)	11,551 (0.4)
2020	3,085,555	115,407 (3.7)	40,199 (1.3)	13,705 (0.4)
2021	3,044,497	94,673 (3.1)	33,043 (1.1)	12,933 (0.4)
2022 <sup>b</sup>	2,684,477	50,564 (1.9)	15,389 (0.6)	6,635 (0.2)
Overall	3,339,663	453,954 (13.6)	207,472 (6.2)	41,215 <sup>c</sup> (1.2)

Note: Basal, basal and prandial, and MDI estimates for individual years include only people who met the criteria for those categories within that respective year. For the overall estimate, patients met the criteria for those categories in at least one of the follow-up years.

<sup>a</sup>Excluding top and bottom 1% of TDD values.

<sup>b</sup>Included 6 months of data for 2022.

<sup>c</sup>Based on insulin prescription orders with dose and frequency information to categorize the individual as using MDI (≥3 insulin injections daily) and calculate TDD.

Table 4. Total daily dose of insulin for people with T2D receiving MDI insulin

Time Period	N	Mean (SD)	Min <sup>a</sup>	Max <sup>a</sup>	Median
2017	7,121	95 (58)	19	98	80
2018	10,466	97 (58)	19	100	82
2019	11,551	100 (59)	19	102	85
2020	13,705	100 (59)	19	103	85
2021	12,933	100 (61)	19	102	84
2022 <sup>b</sup>	6,635	98 (62)	19	101	81
Overall	41,215	96 (58)	19	99	80

<sup>a</sup>Min/max values represent the average of minimum and average of maximum TDD values among patients.

<sup>b</sup>Included 6 months of data for 2022.

- Over the entire study period (2017–2022), about 1.2% of people with T2D received MDI insulin therapy.
- The mean TDD of people with T2D on MDI was 96 U/day, and ranged from 19 to 99 U/day.

### Key Findings

- Among US adults with T2D, 1.2% received ≥3 daily insulin injections, i.e., multiple daily injections (MDI)
- The mean total daily dose (TDD) of insulin prescribed for adults with T2D on MDI was 95.9 U/day
- Overall, 23% of adults with T2D were using TDD <50 U/day; 41% were using TDD from 50–100 U/day; 21% were using TDD from 100–150 U/day; and 15% were using TDD >150 U/day.
- Increasing BMI was observed as TDD quartile increased.



1.2%

Proportion of adults with T2D receiving MDI insulin



The majority of African American and Asian individuals were in lower TDD quartiles (quartiles 1 and 2), compared with Caucasian individuals, who were more concentrated in higher TDD quartiles (quartiles 3 and 4)

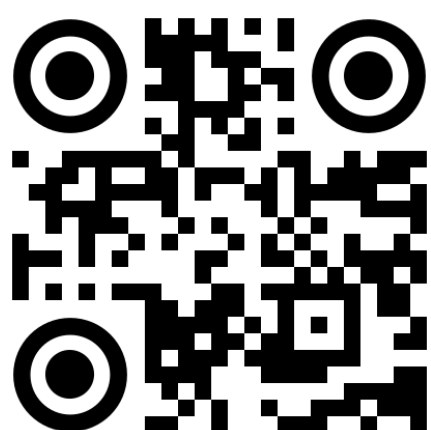


95.9 U

Mean TDD

Mean (SD) TDD was 95.9 (±58.1) U and ranged from 94.6 to 100.0 U across individual years

Presented at ATTD 2024  
March 6–9, Florence



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#### Abbreviations

aEMR, ambulatory electronic medical record  
BMI, body mass index  
CCI, Charlson Comorbidity Index  
MDI, multiple daily injections  
T1D / T2D, type 1 / type 2 diabetes  
TDD, total daily dose of insulin;

#### References

1. Type 2 Diabetes. 2021. Available from: <https://www.cdc.gov/diabetes/basics/type2.html>.
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#### Acknowledgments

This study was funded by Embecta Corp., Parsippany, NJ, USA. embecta, formerly part of BD.

#### Disclosures

EEW reports consulting fees from Abbott Diabetes Care, Bayer, Boehringer Ingelheim, embecta, GlaxoSmithKline, Lilly, Medtronic, Renalix, and Sanofi; honoraria from Abbott Diabetes Care, Bayer, Boehringer Ingelheim, GlaxoSmithKline, Lilly, Medtronic, Renalix, and Sanofi; Speakers' Bureau fees from Abbott Diabetes Care, Bayer, Boehringer Ingelheim, GlaxoSmithKline, Lilly, Renalix, and Sanofi. VNS reports funding to his institution from NovoNordisk, Alexion, Insulet, Tandem Diabetes Care, Dexcom, JDRF and NIH, and honoraria from Sanofi, NovoNordisk, Medscape, Embecta, Insulet, Dexcom, Sensironics, and Tandem Diabetes Care for speaking, consulting or serving on an advisory board. AT, PJ, and RS are employees and stockholders of embecta. EM reports fees for Advisory Board for Eli Lilly, Boehringer Ingelheim, Novo Nordisk, Abbott, Insulet, embecta; Consultant for Semler Scientific; Speaker for Abbott, Eli Lilly, Boehringer Ingelheim, Novo Nordisk; and research from Abbott. SD, TA, and EB are employees of PRECISIONheor, which provides consulting services to the medical device and pharmaceutical industries, including embecta.