Research Design and Methods

Data Sources

We used two nationally representative data sources. First, we queried drug prescriptions from the IQVIA National Prescription Audit (NPA) from 2020–2021[1]. IQVIA collects prescription data from retail, mail order, and long-term care pharmacies. For this analysis, we excluded long-term care pharmacies. NPA provides a national estimate of prescriptions dispensed, receiving over 3 billion prescription claims per year. Over 48,000 pharmacies are included in the data, representing 90% of all retail pharmacies. IQVIA uses proprietary weighting methods, therefore it is not possible to estimate confidence intervals for their estimates. Second, we used data from the Medical Expenditure Panel Survey (MEPS) for 2020–2021 from the Agency for Healthcare Research and Quality, accessed through IPUMS[2,3]. This survey consists of a nationally representative sample of households of the noninstitutionalized population of the U.S, which are a subsample of households surveyed in the National Health Interview Survey. IPUMS provides a harmonized version of MEPS data that standardizes variable names and coding through time[4].

The MEPS prescription medication records provide data on self-reported prescribed medicine; each record is one household-reported medicine purchased or otherwise obtained in a year. Participants were asked to supply the names of prescribed medicine and, the reason for the prescription, the number of times the prescription was obtained, and the names and locations of pharmacies that filled the prescriptions. Industry experts were consulted to identify outliers. Outliers were identified by comparing the number of reported prescriptions with the number of days the participant was in the round for the survey and any identified outliers imputed. These data were then linked with the person-level data from the full-year consolidated files to provide demographic data. We used diabetes status to restrict analysis to drugs purchased by someone with diabetes. This resulted in a dataset of 27005 records of medication purchases for 2373 individuals.

Analysis

For each medication fill record, the name of the medicine is reported as well as the most commonly used generic name based on the Multum Lexicon database. Generic medications used in the management of diabetes found in the data include sulfonylureas, biguanides, insulin, thiazolidinediones (TZD), dipeptidyl peptidase 4 inhibitors (DPPi-4), GLP-1 receptor agonists (GLP-1RA), SGLT-2 inhibitors (SGLT2i), and antidiabetic combinations. Records for antidiabetic combinations were split into two records, one for each of the constitutive drug class (e.g. a record for glyburide-metformin was split into a record for sulfonylureas and a record for biguanides). We used the provided generic drug names and medicine names to further classify insulin records into basal, bolus, or pre-mixed as well as human or analog categories. In cases where the generic drug name conflicted with the provided drug name, the insulin was classified as "insulin - unknown". Similarly, any non-insulin medications where provided data conflicted were classified as "unknown". Accounting for complex survey weights and pooling data for two years, we estimated the number of prescriptions purchased for each generic medication previously listed[2]. All estimates were age-adjusted using direct standardization and standardized to the 2000 U.S. population for ages 20–39, 40–59, 60–64, 65–74, and ≥75 years. We present these estimates overall, as well as stratified by sex, race and ethnicity, age, highest educational degree obtained, ratio of the family income to poverty line (poverty income ratio), type of health insurance, and copay amount. Suppression rules were applied to results from MEPS to suppress unreliable estimates and to present only those results that were considered reliable[5]. Additionally, each dataset contains stratifying variables unique to those data; IQVIA provides information on the medical specialty of the provider, while MEPS provides additional sociodemographic data on race and origin as well as educational attainment. As a result, we were unable to make comparisons between all available IQVIA values and MEPS.

Results

Insulin

Total prescription count estimates from IQVIA and MEPS for insulins are in Table 1. Analog insulins comprised most (93.1%) of the short-acting insulins prescription claims in the IQVIA data. Almost 90% of patients using human short-acting insulin were ≥40 years while nearly 20% of the patients using analog short-acting insulin were <40 years (Table 1).

Data from IQVIA showed analog insulins comprised 96.0% of the basal insulin prescription claims. Among patients using human basal insulin (NPH), 19.6% were age 20–39 years compared to 8.3% of those using analog basal insulins. Females comprised a higher percentage of the NPH users (58.1%) compared to the analog basal insulin users (50.4%). Almost 10% of the NPH claims were prescribed by obstetrics and gynecology specialists while those specialists only prescribed 0.3% of the analog basal insulin prescriptions. Among NPH users, 9.4% were uninsured. Less than 1% of analog basal insulin users were uninsured. For NPH users, 30.5% of the patients paid over $75. Only 6.1% of insulin prescriptions were for premixed insulins.

Among NPH insulin users in the IQVIA data, the younger population aged 10-19 years had the highest percentage of uninsured patients for both females (31.6%) and males (34.8%) (Figure 1). For the 20-39 year age group, 15.5% of males using NPH insulin were uninsured compared to 3.7% of females.

Overall, among insulin types, the largest differences between datasets were seen in the bolus analog and basal analog categories (Figure 1). For these categories, the MEPS estimate for the percentage of bolus analog prescriptions was 4.7 percentage points higher than the IQVIA value, while the raw number of prescriptions for bolus analog insulins reported in MEPS was almost double the value reported in IQVIA. In contrast, the MEPS estimate for the percentage of basal analog prescriptions was 6.6 percentage points lower than IQVIA. For the remaining insulin groups, MEPS generally reported similar, although often lower percentages (Figure 1). Based on the information provided by MEPS, 5.3% of insulin prescriptions could not be categorized.

Among insulin prescriptions, the largest discrepancies between datasets were observed for the insurance groups and copay groups, especially for copays over $75 (Figure 2A). For example, the MEPS estimates were between 16.0 and 19.2 percentage points higher for all categories of insulin prescriptions among those with public insurance, while IQVIA estimates were 19 percentage points higher for for all insulin prescriptions among those with private insurance. Differences in estimates between the two data sources were lower for both the age and sex groups than the insurance or copay groups. Estimates among the age groups ranged from 10.0 percentage points higher for MEPS (bolus analog prescriptions for those age 60–74) to 7.1 percentage points higher for IQVIA (all insulins estimate for adults age 40–59). Nine of the age groups had higher MEPS estimates, while only four of the age groups had higher IQVIA estimates. Within the sex groups, the estimate for bolus analog prescriptions for males was the largest difference: MEPS had the higher estimate (5.8 percentage points higher), while the estimated percentage for the same prescription for females had the largest difference where IQVIA provided the higher estimate (5.7 percentage points higher). IQVIA estimates were higher for females across all insulin prescriptions, while MEPS estimates were higher for males.

Non-insulin medications

Total prescription count estimates from IQVIA and MEPS are available for non-insulins in Table 2. Almost half (49.3%) of all non-insulin diabetes medications prescriptions were for metformin. Over ¾ of patients received the medication for ≤ $10. Sulfonylureas were the second most commonly prescribed diabetes medications and 20.0% of patients using that medication were ≥75 years of age. Thiazolidinediones were the least prescribed and of those taking that class of medication, 64.7% were ≥60 years of age, 58.3% were male, and 63.7% paid ≤ $10. DDP-4i were the second least commonly prescribed medication and of those patients taking the medication, 15.8% paid >$75. A higher percentage of patients taking GLP1-RA were female (54.4%) and 18.7% of the prescriptions came from endocrinologists, a higher percentage than any of the other diabetes medication classes. Among those prescribed a GLP1-RA, 69.7% had private insurance and 28.0% had Medicare Part D. A higher percentage of patients taking SGLT2i were male (58.1%), 14.8% of the prescriptions were from endocrinologists and 2.2% from cardiologists, 71.1% had private insurance, and 14.2% paid > $75.

Non-insulin medication percentages were similar for both IQVIA and MEPS across many drug categories (Figure 1). However, the largest differences were seen in the all insulin, sulfonylureas, biguanides, and SGLT2i medications, with MEPS estimated percentages being higher for insulin (4.3 percentage points) and lower for the other three medications (1.3 percentage points, 1.7 percentage points, 1.3 percentage points, respectively). As with the insulin prescriptions, 1.3% of non-insulin medications could not be classified.

Similar to the insulins, the largest discrepancies between the two datasets in the percentage of non-insulin medications prescriptions were observed among the insurance and copay groups (Figure 2B). Within the insurance groups, the discrepancies ranged from 22.0 percentage points higher for MEPS (biguanides estimate for those on public only insurance) to 20.2 percentage points higher for IQVIA (TZD estimate for those on any private). The estimates from IQVIA were higher for eight of the 13 insurance groups where MEPS estimates were available. Among the copay groups, MEPS estimates were higher for all non-insulin medications except for those with no copay, where the IQVIA estimate was 34.2 percentage points higher than the MEPS estimate. The differences for all other copay groups ranged from 15.2 to 87.6 percentage points higher. The largest differences were seen for those paying more than $75 for their copay, where the estimates for DPP-4i, GLP-1RA, and SGLT2i were more than 80 percentage points higher than the equivalent IQVIA estimates. The age group with the largest difference was the estimate for GLP-1RA for adults age 40–59, which had an IQVIA estimate that was 7.3 percentage points higher than the MEPS estimate. The largest difference where MEPS was the higher estimate was for adults age 75 or greater, where the MEPS estimate for sulfonylureas prescriptions was 6.1 percentage points higher than the IQVIA estimate. IQVIA estimates were higher for all non-insulin medication among adults age 40–59, while for other groups there was variation in which dataset had the higher estimate. The estimates for non-insulin medication prescriptions within the sex groups followed similar patterns to the insulin estimates: all of the values for females were higher in the IQVIA dataset, while estimates for males were higher in the MEPS dataset. The largest differences within the sex group were for TZD prescriptions: the IQVIA estimate was 8.4 percentage points higher for females, while the MEPS estimate was 8.4 percentage points higher for males.

Tables

Table 1: Estimates from IQVIA and the Medical Expenditure Panel Survey from 2020–2021 for age-adjusted number of prescriptions for different categories of insulin purchased in 2020–2021 by individuals with diabetes in the United States.

	Bolus/ Human		Bolus/ Analog		Basal/ Human		Basal/ Analog		Pre-mixed		All insulins	
	IQVIA	MEPS	IQVIA	MEPS	IQVIA	MEPS	IQVIA	MEPS	IQVIA	MEPS	IQVIA	MEPS
Overall (n)												
	1,975,000	1,054,000	26,720,000	41,655,000	2,017,000	1,729,000	48,704,000	58,469,000	5,143,000	5,704,000	84,559,000	114,659,000
Sex (%)												
Female	50.7	-	50.5	44.9	58.1	-	50.4	46.1	51.9	46.2	50.7	45.8
Male	49.2	-	49.4	55.1	41.7	-	49.5	53.9	48.0	53.8	49.2	54.2
Age (%)												
20-39	9.8	-	19.5	16.1	19.6	-	8.3	-	4.2	N/A	11.7	11.4

40-59	38.6	-	35.5	28.4	25.2	-	34.1	28.7	27.9	-	34.0	28.0
60-74	40.7	-	33.7	42.5	37.9	-	41.6	45.6	45.0	55.0	39.4	45.7
75+	10.7	-	11.2	13.0	17.3	-	15.8	16.1	22.8	-	14.8	14.9
Insurance (%)												
Public only	41.0	-	33.1	54.5	38.0	-	42.1	57.6	50.7	62.6	39.6	57.0
Any private	54.0	-	66.5	44.7	52.5	-	57.5	38.4	45.1	-	59.4	40.5
Uninsured	5.0	-	0.4	-	9.4	-	0.4	-	4.1	-	0.9	-
Copay (%)												
0	38.9	-	38.0	-	30.0	-	33.1	-	31.6	-	34.6	-
>0-10	14.0	-	12.1	-	13.1	-	14.4	-	17.6	-	13.8	-
>10-20	3.5	-	3.6	-	4.1	-	3.5	-	3.2	-	3.5	-

>20-30	10.3	-	7.6	N/A	14.7	-	7.6	-	8.5	-	7.9	-
>30-75	15.7	-	15.5	3.0	19.9	-	16.4	3.6	18.1	-	16.3	4.5
>75	9.2	-	12.1	96.8	10.6	-	14.7	94.7	12.3	72.8	13.5	93.6
Race (%)												
Asian/not Hispanic	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Black/not Hispanic	N/A	-	N/A	16.7	N/A	-	N/A	19.4	N/A	-	N/A	18.1
Hispanic	N/A	-	N/A	21.3	N/A	-	N/A	20.6	N/A	-	N/A	21.2

Other Race/not Hispanic	N/A	-	N/A	3.4	N/A	-	N/A	2.5	N/A	-	N/A	3.1
White/not Hispanic	N/A	-	N/A	54.9	N/A	-	N/A	55.6	N/A	51.5	N/A	55.0
Education (%)												
Less than high school	N/A	-	N/A	16.8	N/A	-	N/A	20.2	N/A	-	N/A	18.3
High school	N/A	-	N/A	42.1	N/A	-	N/A	40.1	N/A	32.8	N/A	41.0

Greater than high school	N/A	-	N/A	41.1	N/A	-	N/A	39.7	N/A	47.6	N/A	40.8
Poverty (%)												
Poor (<100% of poverty line)	N/A	-	N/A	30.1	N/A	-	N/A	26.2	N/A	16.9	N/A	26.6

Low income (100% - 200% of poverty line)	N/A	-	N/A	19.6	N/A	-	N/A	24.4	N/A	-	N/A	22.0

Middle income (200% - 399% of poverty line)	N/A	-	N/A	22.2	N/A	-	N/A	18.6	N/A	-	N/A	22.4

High income (>=400% of poverty line)	N/A	-	N/A	28.1	N/A	-	N/A	30.8	N/A	-	N/A	29.1
Prescribing medical speciality (%)												
Cardiology	0.3	N/A	0.2	N/A	0.3	N/A	0.3	N/A	0.4	N/A	0.3	N/A
Emergency Med	0.3	N/A	0.2	N/A	0.2	N/A	0.2	N/A	0.2	N/A	0.2	N/A

Endocrinology	28.4	N/A	31.9	N/A	14.3	N/A	17.2	N/A	15.6	N/A	21.9	N/A
General surgery	0.1	N/A	0.1	N/A	0.1	N/A	0.1	N/A	0.1	N/A	0.1	N/A
Geriatrics	0.4	N/A	0.4	N/A	0.6	N/A	0.6	N/A	0.8	N/A	0.5	N/A
Nephrology	0.5	N/A	0.4	N/A	0.5	N/A	0.4	N/A	0.6	N/A	0.4	N/A
NP/PA	26.8	N/A	26.9	N/A	22.2	N/A	26.1	N/A	22.9	N/A	26.1	N/A
OBGYN	2.1	N/A	0.6	N/A	9.8	N/A	0.3	N/A	0.1	N/A	0.7	N/A
Other	1.6	N/A	1.3	N/A	2.1	N/A	1.5	N/A	1.7	N/A	1.4	N/A

Primary care	38.6	N/A	36.8	N/A	47.1	N/A	52.0	N/A	56.6	N/A	47.1	N/A

- represents data that has been suppressed following data presentation standards, N/A cells indicate that data for that group is not available from that data source

Table 2: Estimates from the Medical Expenditure Panel Survey from 2020–2021 for age-adjusted number of prescriptions for non-insulin medications used in the management of diabetes purchased in 2020–2021 by individuals with diabetes in the United States.

	Biguanides		Sulfonylureas		TZD		DPP-4i		GLP-1RA		SGLT2i		All insulins	
	IQVIA	MEPS	IQVIA	MEPS	IQVIA	MEPS	IQVIA	MEPS	IQVIA	MEPS	IQVIA	MEPS	IQVIA	MEPS
Overall (n)														
	160,080,000	171,995,000	53,052,000	53,439,000	11,534,000	10,559,000	28,239,000	31,330,000	38,221,000	39,797,000	31,323,000	29,233,000	84,559,000	114,659,000
Sex (%)														
Female	50.2	49.8	46.0	46.2	41.6	40.9	49.6	51.9	54.4	46.0	41.8	40.4	50.7	45.8
Male	49.7	50.2	53.9	53.8	58.3	59.1	50.4	48.1	45.5	54.0	58.1	59.6	49.2	54.2
Age (%)														
20-39	7.2	6.8	3.2	-	2.9	-	2.8	-	6.1	8.6	4.1	-	11.7	11.4
40-59	37.5	33.1	32.4	27.1	32.4	-	31.3	27.2	45.2	37.9	43.5	39.1	34.0	28.0

60-74	41.5	45.3	44.2	43.7	46.8	45.7	44.2	44.4	40.6	46.1	43.5	46.6	39.4	45.7
75+	13.6	14.7	20.0	26.2	17.8	-	21.6	18.6	8.0	7.4	8.8	8.6	14.8	14.9
Insurance (%)														
Public only	30.8	45.0	37.0	47.8	36.8	58.8	41.7	49.8	30.1	36.6	28.6	36.4	39.6	57.0
Any private	65.5	52.8	59.5	50.4	61.1	40.9	58.0	48.0	69.7	62.2	71.2	62.3	59.4	40.5
Uninsured	3.6	2.2	3.4	1.8	2.0	-	0.3	-	0.2	-	0.3	-	0.9	-
Copay (%)														
0	35.3	1.1	34.2	-	31.5	-	25.1	-	25.8	-	25.8	-	34.6	-
>0-10	41.1	60.0	39.4	48.1	32.2	36.9	17.3	-	9.8	-	9.4	-	13.8	-
>10-20	6.0	21.0	9.3	30.9	14.1	24.3	3.2	-	3.6	-	9.8	-	3.5	-
>20-30	1.9	5.9	3.1	9.7	4.3	-	6.4	-	19.6	N/A	10.2	-	7.9	-

>30-75	2.0	6.0	1.2	9.4	2.9	12.2	17.9	2.7	18.7	-	18.9	-	16.3	4.5
>75	1.1	6.1	0.1	-	0.5	-	15.8	94.8	11.7	99.4	14.2	93.6	13.5	93.6
Race (%)														
Asian/not Hispanic	N/A	7.1	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Black/not Hispanic	N/A	15.2	N/A	13.8	N/A	-	N/A	14.3	N/A	13.9	N/A	14.9	N/A	18.1
Hispanic	N/A	17.4	N/A	15.4	N/A	-	N/A	10.2	N/A	18.9	N/A	17.2	N/A	21.2

Other Race/not Hispanic	N/A	5.0	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	3.1
White/not Hispanic	N/A	55.2	N/A	59.4	N/A	46.5	N/A	52.4	N/A	61.9	N/A	54.1	N/A	55.0
Education (%)														
Less than high school	N/A	15.6	N/A	13.0	N/A	13.7	N/A	20.3	N/A	9.0	N/A	11.0	N/A	18.3
High school	N/A	33.7	N/A	38.5	N/A	51.2	N/A	28.1	N/A	40.8	N/A	34.4	N/A	41.0

Greater than high school	N/A	50.6	N/A	48.5	N/A	35.2	N/A	51.5	N/A	50.2	N/A	54.6	N/A	40.8
Poverty (%)														
Poor (<100% of poverty line)	N/A	16.8	N/A	14.4	N/A	-	N/A	23.4	N/A	13.9	N/A	14.5	N/A	26.6

Low income (100% - 200% of poverty line)	N/A	21.1	N/A	24.5	N/A	27.2	N/A	20.9	N/A	20.1	N/A	13.7	N/A	22.0

Middle income (200% - 399% of poverty line)	N/A	26.7	N/A	31.2	N/A	27.2	N/A	23.8	N/A	23.1	N/A	28.6	N/A	22.4

High income (>=400% of poverty line)	N/A	35.4	N/A	29.9	N/A	-	N/A	32.0	N/A	43.0	N/A	43.2	N/A	29.1
Prescribing medical speciality (%)														
Cardiology	0.8	N/A	0.7	N/A	0.6	N/A	0.8	N/A	0.4	N/A	2.2	N/A	0.3	N/A
Emergency Med	0.3	N/A	0.2	N/A	0.1	N/A	0.1	N/A	0.1	N/A	0.1	N/A	0.2	N/A

Endocrinology	6.2	N/A	6.4	N/A	9.1	N/A	7.5	N/A	18.7	N/A	14.8	N/A	21.9	N/A
General surgery	0.1	N/A	0.1	N/A	0.1	N/A	0.1	N/A	0.1	N/A	0.1	N/A	0.1	N/A
Geriatrics	0.7	N/A	0.8	N/A	0.6	N/A	0.8	N/A	0.4	N/A	0.5	N/A	0.5	N/A
Nephrology	0.3	N/A	0.6	N/A	0.4	N/A	0.8	N/A	0.3	N/A	0.7	N/A	0.4	N/A
NP/PA	24.8	N/A	23.5	N/A	20.8	N/A	22.5	N/A	27.2	N/A	24.3	N/A	26.1	N/A
OBGYN	1.0	N/A	0.2	N/A	0.1	N/A	0.1	N/A	0.2	N/A	0.0	N/A	0.7	N/A
Other	1.9	N/A	1.6	N/A	1.3	N/A	1.7	N/A	1.1	N/A	1.1	N/A	1.4	N/A

Primary care	62.8	N/A	65.2	N/A	66.1	N/A	64.6	N/A	50.6	N/A	55.3	N/A	47.1	N/A

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Figures

Figure 1: Comparison of A) percentage of insulin prescriptions that come from each type of insulin and B) percentage of all diabetes prescriptions that come from each type of medication as reported by IQVIA and MEPS.

Figure 2: Heatmap showing the percentage point difference between IQVIA and MEPS estimates of the percentage of prescriptions for each type of medication out of A) the total number of insulin prescriptions and B) the total number of prescriptions for diabetes medications.