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# Calculating daily dose in the OMOP CDM

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# Calculating daily dose in the Observational Medical Outcomes Partnership Common Data Model

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## Abstract

**Purpose:** We aimed to develop a standardized method to calculate daily dose (i.e., the amount of drug a patient was exposed to per day) of any drug on a global scale using only drug information of typical observational data in the Observational Medical Outcomes Partnership Common Data Model (OMOP CDM) and a single reference table from Observational Health Data Sciences And Informatics (OHDSI).

**Materials and Methods:** The OMOP DRUG\_STRENGTH reference table contains information on the strength or concentration of drugs, whereas the OMOP DRUG\_EXPOSURE table contains information on patients' drug prescriptions or dispensa-

Daily dose ?



$\text{DRUG\_STRENGTH} + \text{DRUG\_EXPOSURE} \Rightarrow \text{DOSE}$

## DRUG\_STRENGTH

Drug_ concept_ id	Amount _value	Amount_unit_ concept_id	Numerator _value	Numerator_ unit_concept _id	Denominator _value	Denominator_ unit_concept_id
19023311	200	8576	NA	NA	NA	NA
1139060	NA	NA	6000	8576	30	8587
19125241	NA	NA	100	8576	NA	8587

Clinically relevant units -> 41 individual patterns

# Dose formulas - Overview

**TABLE 3** Dose formulas for the three groups of drug strength patterns.

Pattern group	DRUG_STRENGTH information	Daily dose formula	Usual dose forms
Fixed amount formulation patterns	amount_value numeric, amount_unit present, missing numerator_unit, and missing denominator_unit	$\frac{\text{Amount value} \times \text{Quantity}}{(\text{Drug exposure end date} - \text{Drug exposure start date} + 1)^a}$	Non-divisible dose forms, for example, pills, capsules, suppositories, and patches
Time-based formulation patterns	numerator_value numeric, numerator_unit present, and denominator_unit “hour”	Denominator value $\leq 24$ h: Numerator value Denominator value $> 24$ h or missing denominator value (i.e., denominator value = 1): $\frac{\text{Numerator value} \times 24}{\text{Denominator value}}$	Non-divisible dose forms particularly dosed by time, for example, patches and extended releases solid oral dose forms
Concentration formulation patterns	numerator_value numeric, numerator_unit present, and denominator_unit not “hour”	$\frac{\text{Numerator value} \times \text{Quantity}}{(\text{Drug exposure end date} - \text{Drug exposure start date} + 1)^b}$	Divisible dose forms, for example, oral/inhalable solutions and injectables

*Note:* Amount value, numerator value, and denominator value come from the DRUG\_STRENGTH table. Quantity, drug exposure start date, and drug exposure end date come from the DRUG\_EXPOSURE table. The dose formulas were implemented in the DrugUtilisation R package,<sup>15</sup> which is freely available under the Apache License (Version 2.0) and can be obtained from CRAN (<https://cran.r-project.org/web/packages/DrugUtilisation/index.html>).

<sup>a</sup>The quantity is the number of units/tablets/capsules/others prescribed or dispensed.

<sup>b</sup>Our clinical assessment suggested that the quantity depended on whether denominator value was missing (=1) or not. In cases where denominator value was missing, the quantity was mainly populated by giving the total volume/weight/others of the product prescribed or dispensed. In cases where the denominator value was not missing, we mainly saw single or multiple unit packages, and the quantity was populated with the number of bottles/units/sachets/others of the product prescribed or dispensed.

Assess coverage and output the daily dose overall,  
by unit,  
by unit + route,  
and by unit + route + drug strength pattern

## Check coverage of daily dose computation in a sample of the cdm for selected concept sets and ingredient



Check coverage of daily dose computation in a sample of the cdm for selected concept sets and ingredient

### Usage

```
dailyDoseCoverage(cdm, ingredientConceptId)
```

### Arguments

#### **cdm**

A cdm reference created using CDMConnector

#### **ingredientConceptId**

Code indicating the ingredient of interest

### Value

The function returns information of the coverage of computeDailyDose.R for the selected ingredients and concept sets

# Results – dose calculation by unit

**Table 4. Overall daily dose calculations per ingredient per database**

Bold values indicate the results of the larger strata

Ingredient WHO DDD	Median daily dose (IQR)					
	metformin 2 g oral	enoxaparin 2000 IU injection (100 IU = 1 mg)	furosemide 40 mg oral / injection	salmeterol 0.1 mg inhalation	tiotropium 0.01 mg inhalable powder, 0.005 mg inhalable solution	fentanyl 0.6 mg nasal / sublingual, 1.2 mg transdermal
CPRD GOLD	1700 mg (1000-2000)	60 mg (40-120)	40 mg (20-40)	0.00 mg (0.00-0.10)	0.018 mg (0.018-0.019)	0.6 mg (0.6-1.2)
IPCI	1000 mg (938-2000)	<b>40 mg (22-100),</b> 4000 IU (1521-4000)	40 mg (20-40)	0.10 mg (0.10-0.10)	0.018 mg (0.005-0.018)	1.4 mg (0.7-2.8)
MAITT	1700 mg (1000-2000)	2667 IU (1333-4000)	60 mg (40-60)	0.20 mg (0.10-0.20)	0.010 mg (0.005-0.010)	0.6 mg (0.6-1.2)
P+	1000 mg (500-2000)	160 mg (64-160)	40 mg (20-40)	6.00 mg (6.00-6.00)	0.018 mg (0.018-0.020)	0.1 mg (0.1-0.2)
IQVIA DA	2000 mg (1500-2000)	<b>27 mg (20-40),</b> 2.7 IU (1.3-4)	40 mg (40-40)	0.15 mg (0.15-0.15)	0.018 mg (0.015-0.054)	0.3 mg (0.1-0.6)
IQVIA LPD	1000 mg (850-1700)	8000 IU (4000-16'000)	40 mg (40-40)	0.04 mg (0.04-0.17)	0.54 mg (0.018-0.54)	NA
IMASIS	850 mg (425-850)	60 mg (20-60)	40 mg (40-40)	0.04 mg (0.04-3.00)	0.54 mg (0.54-0.054)	5 mg (0.6-7.5)

CPRD GOLD: Clinical Practice Research Datalink GOLD; DA: Disease Analyzer; IMASIS: Multicenter Integrated Hospital Information System; IPCI: Integrated Primary Care Information; LPD: Longitudinal Patient; MAITT: University of Tartu dataset of health data; NA: not available; P+: PharMetrics® Plus for Academics

# Tiotropium daily dose stratified by unit + route + drug strength pattern

Drug strength : 0.018 mcg

Table 5. Daily dose calculations of tiotropium (WHO DDD: 0.01 mg inhalable powder / 0.005 mg inhalable solution) stratified by route, and by pattern and route

The amount or numerator unit of the pattern defines the unit of the calculated daily dose.

## Additional stratification by pattern

	Stratum	%	Daily dose median (IQR)
CPRD GOLD	fixed_amount_mg	86.1	0.018 mg (0.018-0.019)
	mg_per_missing_actuation	13.9	0.005 mg (0.005-0.005)
IPCI	fixed_amount_mg	60.7	0.018 mg (0.018-0.018)
	mg_per_actuation	39.3	0.005 mg (0.005-0.005)
	mg_per_missing_actuation	0.0	0.000 mg (0.000-0.003)
	NA	0	
MAITT	mg_per_missing_actuation	100	0.010 mg (0.005-0.010)
P+	fixed_amount_mg	51.7	0.018 mg (0.018-0.018)
	mg_per_actuation	48.3	0.020 mg (0.020-0.020)
IQVIA DA	fixed_amount_mg	58.4	0.036 mg (0.018-0.054)
	mg_per_actuation	20.7	0.010 mg (0.005-0.015)
	mg_per_ml	7.8	0.000 mg (0.000-0.000)
	NA	13.0	
IQVIA LPD	fixed_amount_mg	69.2	0.540 mg (0.036-0.540)
	mg_per_actuation	30.8	0.005 mg (0.003-0.45)
IMASIS	mg_per_actuation	31.8	0.540 mg (0.540-0.054)
	NA	68.3	

all by inhalation



# Tiotropium daily dose stratified by unit + route + drug strength pattern

*Drug strength : 0.018 mcg*

Table 5. Daily dose calculations of tiotropium (WHO DDD: 0.01 mg inhalable powder / 0.005 mg inhalable solution) stratified by route, and by pattern and route

The amount or numerator unit of the pattern defines the unit of the calculated daily dose.

## Additional stratification by pattern

	Stratum	%	Daily dose median (IQR)
CPRD GOLD	<u>fixed_amount_mg</u>	86.1	0.018 mg (0.018-0.019)
	<u>mg_per_missing_actuation</u>	13.9	0.005 mg (0.005-0.005)
IPCI	<u>fixed_amount_mg</u>	60.7	0.018 mg (0.018-0.018)
	<u>mg_per_actuation</u>	39.3	0.005 mg (0.005-0.005)
	<u>mg_per_missing_actuation</u>	0.0	0.000 mg (0.000-0.003)
	NA	0	
MAITT	<u>mg_per_missing_actuation</u>	100	0.010 mg (0.005-0.010)
P+	<u>fixed_amount_mg</u>	51.7	0.018 mg (0.018-0.018)
	<u>mg_per_actuation</u>	48.3	0.020 mg (0.020-0.020)
IQVIA DA	<u>fixed_amount_mg</u>	58.4	0.036 mg (0.018-0.054)
	<u>mg_per_actuation</u>	20.7	0.010 mg (0.005-0.015)
	<u>mg_per_ml</u>	7.8	0.000 mg (0.000-0.000)
	NA	13.0	
IQVIA LPD	<u>fixed_amount_mg</u>	69.2	0.540 mg (0.036-0.540)
	<u>mg_per_actuation</u>	30.8	0.005 mg (0.003-0.45)
IMASIS	<u>mg_per_actuation</u>	31.8	0.540 mg (0.540-0.054)
	NA	68.3	

*all by inhalation*

← Inhalable **powder**

← Inhalable solution

← Inhalable **powder**

← Inhalable solution

← Inhalable solution

← Inhalable **powder**

← Inhalable solution

← Inhalable **powder**

← Inhalable solution

← Inhalable solution

# Fentanyl daily dose stratified by unit + route + drug strength pattern

**Table 6. Daily dose calculations of fentanyl (WHO DDD: 0.6 mg nasal / sublingual, 1.2 mg transdermal) stratified by route and unit, and by pattern and route**

The amount or numerator unit of the pattern defines the unit of the calculated daily dose.

Stratification by route				Additional stratification by pattern		
	Stratum	%	Daily dose median (IQR)	Stratum	%	Daily dose median (IQR)
IQVIA DA	transdermal	96.2	0.3 mg (0.1-0.6)	<u>mg_per_h</u>	51.0	0.0 mg (0.0-0.1)
				<u>mg_per_missing_h</u>	46.0	0.6 mg (0.3-1.2)
				<u>fixed_amount_mg</u>	0.0	0.0 mg (0.0-0.0)
	<u>buc./subl.</u>	3.4	0.3 mg (0.2-0.9)	<u>fixed_amount_mg</u>	3.4	0.3 mg (0.2-0.9)
	nasal	0.4	0.1 mg (0.0-0.2)	<u>mg_per_ml</u>	0.3	0.0 mg (0.0-0.2)
				<u>mg_per_missing_actuation</u>	0.0	0.2 mg (0.2-0.2)
				<u>mg_per_missing_ml</u>	0.0	0.0 mg (0.0-0.0)
	injection	0.1	0.0 mg (0.0-0.2)	<u>mg_per_ml</u>	0.1	0.0 mg (0.0-0.2)
	oral	0.0	1.5 mg (0.3-1.5)	<u>fixed_amount_mg</u>	0.0	1.5 mg (0.3-1.5)
	NA	0.0		NA	0.0	

# Fentanyl daily dose stratified by unit + route + drug strength pattern

**Table 6. Daily dose calculations of fentanyl (WHO DDD: 0.6 mg nasal / sublingual, 1.2 mg transdermal) stratified by route and unit, and by pattern and route**

The amount or numerator unit of the pattern defines the unit of the calculated daily dose.

Stratification by route				Additional stratification by pattern		
	Stratum	%	Daily dose median (IQR)	Stratum	%	Daily dose median (IQR)
IQVIA DA	transdermal	96.2	0.3 mg (0.1-0.6)	<u>mg_per_h</u>	51.0	0.0 mg (0.0-0.1)
				<u>mg_per_missing_h</u>	46.0	0.6 mg (0.3-1.2)
				<u>fixed_amount_mg</u>	0.0	0.0 mg (0.0-0.0)
	<u>buc./subl.</u>	3.4	0.3 mg (0.2-0.9)	<u>fixed_amount_mg</u>	3.4	0.3 mg (0.2-0.9)
	nasal	0.4	0.1 mg (0.0-0.2)	<u>mg_per_ml</u>	0.3	0.0 mg (0.0-0.2)
				<u>mg_per_missing_actuation</u>	0.0	0.2 mg (0.2-0.2)
				<u>mg_per_missing_ml</u>	0.0	0.0 mg (0.0-0.0)
	injection	0.1	0.0 mg (0.0-0.2)	<u>mg_per_ml</u>	0.1	0.0 mg (0.0-0.2)
	oral	0.0	1.5 mg (0.3-1.5)	<u>fixed_amount_mg</u>	0.0	1.5 mg (0.3-1.5)
	NA	0.0		NA	0.0	

# Fentanyl daily dose stratified by unit + route + drug strength pattern

**Table 6. Daily dose calculations of fentanyl (WHO DDD: 0.6 mg nasal / sublingual, 1.2 mg transdermal) stratified by route and unit, and by pattern and route**

The amount or numerator unit of the pattern defines the unit of the calculated daily dose.

Stratification by route				Additional stratification by pattern		
Stratum	%	Daily dose median (IQR)	Stratum	%	Daily dose median (IQR)	
IQVIA DA	transdermal	96.2	0.3 mg (0.1-0.6)	mg_per_h	51.0	0.0 mg (0.0-0.1)
				mg_per_missing_h	46.0	0.6 mg (0.3-1.2)
				fixed_amount_mg	0.0	0.0 mg (0.0-0.0)
	buc./subl.	3.4	0.3 mg (0.2-0.9)	fixed_amount_mg	3.4	0.3 mg (0.2-0.9)
	nasal	0.4	0.1 mg (0.0-0.2)	mg_per_ml	0.3	0.0 mg (0.0-0.2)
				mg_per_missing_actuation	0.0	0.2 mg (0.2-0.2)
				mg_per_missing_ml	0.0	0.0 mg (0.0-0.0)
	injection	0.1	0.0 mg (0.0-0.2)	mg_per_ml	0.1	0.0 mg (0.0-0.2)
	oral	0.0	1.5 mg (0.3-1.5)	fixed_amount_mg	0.0	1.5 mg (0.3-1.5)
	NA	0.0		NA	0.0	

# Strengths / limitations

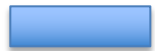


Systematic and structured approach

Stratification by route and drug strength pattern (often aligns with formulation)

Dose formulas benchmarked against international standards

Implementation in an R package



Sig would be more precise but not resolved into a standard representation yet

Ingredients and databases may not be totally representative of the entire OMOP spectrum

No standard harmonization of IU and mg

# Conclusion

We provided a standardised methodology for calculating daily doses in OMOP CDM

The suggested dose formulas enhance the reliability, transparency, and reproducibility of daily dose calculation in OMOP CDM



# THANK YOU!



Pharmaco- and Device epidemiology Group  
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Artem Gorbachev  
Lucia Bellas

