Package 'mmequiv'

April 17, 2025

Title Calculate Standardized Morphine Milligram Equivalent Doses

Version 0.1.1

Description Calculate morphine milligram equivalents (MME) for opioid dose
comparison using standardized methods. Includes API wrapper functions to
call 'NIH HEAL MME Online Calculator' and functions that replicate API
calculations on the user's local machine from the comfort of 'R'.
Creation of the 'NIH HEAL MME Online Calculator' and the MME calculations
implemented in this package are described in Adams MCB, Sward KA, Perkins
ML, Hurley RW (2025) <doi:10.1097/j.pain.0000000000003529>.

License GPL (>= 3)

Imports cli, glue, httr2, lifecycle, rlang, tibble

Suggests dplyr, httptest2 (>= 1.1.0), spelling, testthat (>= 3.0.0),
withr

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Encoding UTF-8

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URL https://kennethataylor.github.io/mmequiv/,
https://github.com/KennethATaylor/mmequiv

Depends R (>= 4.1.0)

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BugReports https://github.com/KennethATaylor/mmequiv/issues

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Contents

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calculate_mme	*Calculate morphine milligram equivalents (MME)*

Description

Calculates the single-day MME and total MME for each individual prescription opioid medication submitted for calculation. Also calculates total MME, total days of supply, and four distinct Total MME/Day calculations from the NIH HEAL Online MME Calculator across all prescription medications for two different medication groupings: 1) opioids without buprenorphine and 2) opioids with buprenorphine.

Usage

```
calculate_mme(therapy_days, observation_window_days, medications)

calculate_mme_local(therapy_days, observation_window_days, medications)
```

Arguments

therapy_days   Either a single positive number or a vector of two positive numbers indicating the sum of prescription duration (days) for each medication, but *with each calendar day counted only ONCE*. When a single number is provided, it is used for the both the "with buprenorphine" and "without buprenorphine" MME calculations; when a vector of 2 numbers is provided (e.g., c(10, 18)) then the first and second numbers in the vector are used for the "with buprenorphine" and "without buprenorphine" MME calculations, respectively. This is the denominator for MME/Day definition 2.

- If there is only one prescription *or* if there is no calendar overlap (i.e., no days on which more than one prescription is active) this will be the same as the total days supply returned by the calculator API (total_days).
- If there are overlapping prescriptions, this is the number of *unique* calendar days.

observation_window_days

Either a single positive number or a vector of two positive numbers indicating a study-defined fixed observation window of time. Typical choices are 7 day, 14 day, 30 day, 90 day. When a single number is provided, it is used for the both the "with buprenorphine" and "without buprenorphine" MME calculations;

when a vector of 2 numbers is provided (e.g., c(7, 30)) then the first and second numbers in the vector are used for the "with buprenorphine" and "without buprenorphine" MME calculations, respectively. This is the denominator for MME/Day definition 3.

medications   A list of medication definitions. Each element must be a list containing each of the following fields:

- medication_name: a string matching an API-accepted medication name and its dosage units. To see a full list of API-accepted values, run get_med_list().

- dose: a positive number indicating the dose of the associated opioid medication listed in the medication_name field. Units of dose should match the units listed in medication_name.

- doses_per_24_hours: a positive number indicating the number of doses in 24 hours.

- days_of_medication: a positive number indicating the duration of the opioid medication prescription listed in the associated medication_name in days.

Details

calculate_mme() and calculate_mme_local() produce the same calculation results with and without using the API, respectively. This helps overcome the online calculator API rate limit of 50 (patient-level) requests per 15 minutes. In addition to returning user-specified arguments, calculate_mme() also returns several other variables mentioned in the **Description** section, which are described in more detail below. Output variable description details are below; see Adams, *et al.* (2025) for a comprehensive overview.

Value

A list of MME calculations from the API. Will error if any medications are invalid or if any numeric parameters are not positive numbers.

Prescription-Level

Conversion Factor for <medication_name> (factor): the conversion factor used for calculating total MME/day.

MME for <medication_name> (mme): Morphine milligram equivalent for the whole prescription specified in medication_name, calculated as (dose) * (doses_per_24_hours) * (factor) * (days_of_medication).

24h MME for <medication_name> (single_day_mme): Morphine milligram equivalent for the prescription specified in medication_name for a single day, calculated as (dose) * (doses_per_24_hours) * (factor).

One day: Typically, the day with highest opioid exposure is entered, and the sum of 24-hour MME across the drugs that apply to this day is calculated. Highest MME in one day is definition 4.

Summary-Level:

> **On-therapy Days** (`therapy_days`): The sum of prescription duration (`days_of_medication`) for each medication, but *with each calendar day counted only ONCE*. User-supplied; this is the denominator for MME/Day definition 2.
>
> - If there is only one prescription, or if there is no calendar overlap (no days on which more than one prescription is active), this will be the same as the total days supply.
> - If there are overlapping prescriptions, this is the number of unique calendar days.

> **Total MME** (`total_mme`): The MME for each medication, summed across all prescriptions. This is the numerator for MME/Day definitions 1, 2, and 3.

> **Total Days Supply** (`total_days`): The sum of the entered prescription duration (`days_of_medication`) for each of the `medications` (Med 1 duration + med 2 duration...). Automatically calculated. This is the denominator for MME/Day definition 1.

> **MME/Day:**
>
> MME/Day is an aggregate measure, calculating the total MME divided by a specified time window (a number of days). The MME/Day definitions specify the number of days:
>
> **MME/Day Definition 1** (`mme1`)**: Total Days Supply**
>
> MME Definition 1 = Total MME / Total Days Supply time window (sum of entered prescription durations).
>
> `mme1 = total_mme / total_days`
>
> - Note that the same calendar day may contribute multiple times, if overlapping prescriptions.
> - Reason to select this definition: This is the least complicated calculation; appears best suited when immediate-release opioids are prescribed for short discrete times.
> - Identified challenge with this definition: It consistently underestimated MME per day when overlapping prescriptions were present or when immediate-release and extended release opioids were prescribed concurrently.
>
> **MME/Day Definition 2** (`mme2`)**: On-therapy Days**
>
> MME Definition 2 = Total MME / On-therapy Days time window (sum of entered prescription durations except each calendar day is counted only ONCE).
>
> `mme2 = total_mme / therapy_days`
>
> - Note - On-therapy Days unique calendar days.
> - Reason to select this definition: Provides a smoothed measure useful in studies of dose-dependent adverse effects, including opioid-induced constipation or overdose in patients with opioid tolerance or who have been stable on opioids.
> - Identified challenge with this definition: The metric is time-varying and affords the greatest flexibility to define medication gap periods and leftover/unused medications to improve pharmacoepidemiologic studies.
>
> **MME/Day Definition 3** (`mme3`)**: Fixed Observation Window**
>
> Uses the Total MME study-specified fixed observation window. MME Definition 3 = Total MME / Number of days in observation window:
>
> `mme3 = total_mme / observation_window_days`

- If this definition is selected, it is important to report on the duration of the fixed window.
- Reason to select this definition: Most suitable for studies with a known or suspected duration of risk during which adverse events are expected to occur, such as incidence of opioid use disorder. This definition may be useful when prescriptions are filled at irregular time intervals on a as needed basis (*pro re nata*, PRN).
- Identified challenge with this definition: The definition consistently had the lowest milligrams per day for immediate-release opioids. It is the most robust to misspecification, amenable to transformations, and has the least noise when constructing continuous functions. However, since it assumes uniform exposure/risk within a window, there is less scope for time-varying adjustment.
- This is the definition recommended by the Department of Health and Human Services Office of the Inspector General.

MME/Day Definition 4 (`mme4`): Maximum Daily Dose

Uses the sum of 24-hour MME for the day with highest opioid exposure.

MME Definition 4 = Drug 1 (dose (mg) x # of doses per day) x conversion factor + Drug 2 (dose (mg) x # of doses per day) x conversion factor + ...

```
mme4 = sum(dose * doses_per_24_hours * factor)
```

- Report the highest single-day exposure.
- Reason to select this definition: A toxicological perspective may be appropriate for patients with no opioid tolerance and in the presence of comorbidities for respiratory depression. It appears to be best suited for immediate dose-dependent toxic effects, such as respiratory depression.
- Identified challenged with this definition: This definition may have limited use if it includes opioids where fatal toxicity does not involve respiratory depression (e.g., tramadol) or have atypical *mu*-opioid receptor agonism (e.g., tapentadol, buprenorphine).
- The definition assumes uniform risk of adverse outcomes regardless of time on-therapy. More so than the others, this definition is prone to influence from early refills, unused medication, and how the 90 MME threshold is operationalized.
- This definition underlies the algorithm embedded in the CDC Opioid Guideline mobile app. There may be difficulty reconciling findings with studies using the other definitions because it returns a MME per day that is significantly higher.
- This calculator sums the 24-hour MME for every prescription, without considering calendar dates.

See Also

[calculate_mme_df()](#) which this function wraps.

Examples

```
meds_list <- list(
  list(
    medication_name = "Buprenorphine buccal film (mcg) buccal",
    dose = 50,
    doses_per_24_hours = 2,
    days_of_medication = 5
    ),
```

```
    list(
      medication_name = "Hydrocodone (mg)",
      dose = 75,
      doses_per_24_hours = 3,
      days_of_medication = 10
      )
)

calculate_mme(10, 5, meds_list)

# Clean up meds_list
rm(meds_list)
```

---

calculate_mme_df   *Calculate MME for medication data in long format*

Description

This function takes medication data in long format (multiple rows per patient ID), calculates MME using the local calculation method ([calculate_mme_local()](#)), and adds prescription-level values as new columns. It also returns two additional data frames with patient-level MME summaries (one with buprenorphine included and one without).

Usage

```
calculate_mme_df(
  data,
  id_col = "patient_id",
  medication_col = "medication_name",
  dose_col = "dose",
  doses_per_day_col = "doses_per_24_hours",
  days_col = "days_of_medication",
  therapy_days_col = "therapy_days",
  observation_days_col = "observation_window_days",
  therapy_days_without_col = NULL,
  observation_days_without_col = NULL
)
```

Arguments

data	A `data.frame` or `tibble` in long format with one row per medication per patient or participant (`id_col`)
id_col	Name of the column containing patient identifier; default is `"patient_id"`
medication_col	Name of the column containing medication names; default is `"medication_name"`
dose_col	Name of the column containing dose values; default is `"dose"`
doses_per_day_col	
	Name of the column containing doses per 24 hours; `"doses_per_24_hours"`

days_col   Name of the column containing days of medication; default is "days_of_medication"

therapy_days_col

                  Name of the column containing therapy days with buprenorphine (up to one
                  unique value per patient); default is "therapy_days"

observation_days_col

                  Name of the column containing observation window days with buprenorphine
                  (up to one unique value per patient); default is "observation_window_days"

therapy_days_without_col

                  Name of the column containing therapy days without buprenorphine (up to one
                  unique value per patient). If NULL (default), uses the value from therapy_days_col.

observation_days_without_col

                  Name of the column containing observation window days without buprenor-
                  phine (up to one unique value per patient). If NULL (default), uses the value from
                  observation_days_col.

Value

A list containing three elements:

- medications: The original data.frame with added prescription-level MME columns
- patient_summary_with_buprenorphine: Patient-level MME summary including buprenor-
  phine
- patient_summary_without_buprenorphine: Patient-level MME summary excluding buprenor-
  phine

See Also

calculate_mme_local()

Examples

```
library(dplyr)
# Calculate MME using long-format data
# Subset of opioid_trial data used for speedier example
mme <- calculate_mme_df(
  data = opioid_trial |> dplyr::filter(patient_id %in% sprintf("P%03d", 1:100)),
  therapy_days_without_col = "therapy_days_without",
  observation_days_without_col = "observation_window_days_without"
  )

head(mme$medications)

head(mme$patient_summary_with_buprenorphine)

head(mme$patient_summary_without_buprenorphine)

# Cleanup
rm(mme)
```

---

get_med_list   *Retrieve full opioid medication list*

Description

Retrieve full opioid medication list

Usage

```
get_med_list()
```

Value

A `data.frame` with full list of opioid medication names (`med_name`) that are compatible with the MME calculator along with their conversion factors (`cf`).

See Also

search_meds()

Examples

```
get_med_list()
```

---

opioid_trial   *Opioid Trial Data*

Description

Example (synthetic) data provided as an example of long format data to use with `calculate_mme_df()`.

Usage

```
opioid_trial
```

Format

`opioid_trial`:
A data frame with 2,371 rows and 9 columns:

patient_id Patient identifier; includes 1000 separate patients

medication_name Medication names of prescription opioids used by the patient

dose Dosage of the medication

doses_per_24_hours Number of daily doses for the medication

days_of_medication Duration of medication in days

therapy_days Sum of prescription duration (days) for across all of the patient's medications, but with each calendar day counted only ONCE

observation_window_days study-defined fixed observation window of time, applied to all of the patient's medications

therapy_days_without Sum of prescription duration (days) for across all of the patient's medications (excluding buprenorphine), but with each calendar day counted only ONCE

observation_window_days_without study-defined fixed observation window of time, applied to all of the patient's medications (excluding buprenorphine)

---

search_meds *Search opioid medication list*

Description

Search opioid medication list

Usage

```
search_meds(med_name = NULL)
```

Arguments

med_name   A single string specifying the medication name to search for.

Value

A `data.frame` containing medications matching the `med_name` argument and their associated conversion factor(s) (`cf`).

See Also

get_med_list()

Examples

```
search_meds("oxy")
```

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