

# ***TreatmentPatterns R Package***

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## TreatmentPatterns: An R package to facilitate the standardized development and analysis of treatment patterns across disease domains

Aniek F. Markus<sup>1</sup>, Katia M.C. Verhamme<sup>1,2</sup>, Jan A. Kors<sup>1</sup>, Peter R. Rijnbeek<sup>1</sup>

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### Highlights

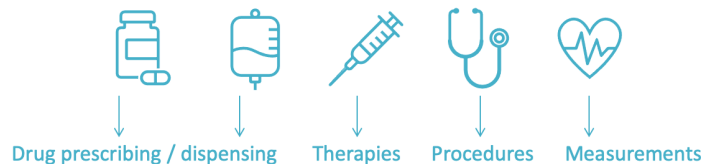
- TreatmentPatterns R package for development and analysis of treatment patterns
- Formally defines and implements the process of constructing treatment pathways
- Accessible, standardized, and interpretation friendly tool for a broad audience
- Supports the accumulation of knowledge on treatment patterns across disease domains
- Example study in Dutch IPCI database to demonstrate functionalities of the package

Markus, A. F., Verhamme, K. M., Kors, J. A., & Rijnbeek, P. R. (2022). TreatmentPatterns: An R package to facilitate the standardized development and analysis of treatment patterns across disease domains. *Computer Methods and Programs in Biomedicine*, 107081.

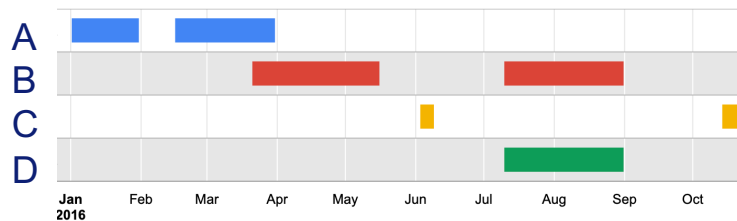
<https://doi.org/10.1016/j.cmpb.2022.107081>

# Problem definition

*A treatment pathway is a sequence of treatments over time*



**Goal:** find the treatment pathway consisting of selected 'treatments of interest' (event cohorts) for a certain study population (target cohort)



*Medical file*

$A \rightarrow B \rightarrow C \rightarrow B + D$

*Treatment pathway*

# Motivation

Knowledge of current treatment practices to improve clinical practice:

- Better design randomized control trials
- Give insight in choice of treatment and doctors preference
- Improve implementation and revisit clinical guidelines



EUROPEAN RESPIRATORY *journal*  
FLAGSHIP SCIENTIFIC JOURNAL OF ERS



Real-world treatment patterns of newly diagnosed patients with **asthma and/or COPD**

Arnik Markus, Peter Rijbeek, Jan Kore, Guy Brusselle, Edward Burn, Daniel Prieto Alhambra, Katta Verhaem  
European Respiratory Journal 2021 58: PA3320; DOI: 10.1183/13993003.congress.2021.PA3320

Article

Info & Metrics

## Abstract

Current guidelines provide clinical recommendations for asthma and COPD treatment, but there is a lack of knowledge how these are adhered to. We give insight in treatment patterns of newly diagnosed patients with asthma, COPD and ACO in three electronic data sources from the Netherlands, UK and US.

In each data source, mapped to the OMOP-Common Data Model, we created three study cohorts by identifying adult patients with a first diagnosis of asthma, COPD or ACO. Patients needed to have at least 1 year prior to incident diagnosis and 3 year follow-up time.

## ERS abstract

### Markus et al. 2021

(paper under review)

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*Erasmus*

Kern et al. BMC Psychiatry  
https://doi.org/10.1186/s12993-019-0181-7

BMC Psychiatry

J Korean Med Sci. 2020 Sep 12;36(26):e4250.  
https://doi.org/10.3346/jkms.2020.36.e4250  
e539-1588-4250-2020-1091-0504

BMC Psychiatry

## RESEARCH ARTICLE

Open Access

Treatment patterns and sequences of pharmacotherapy for patients diagnosed with depression in the United States: 2014 through 2019

David M. Kern<sup>1,2</sup>, M. Soledad Cepeda<sup>1</sup>, Frank Delafra<sup>1</sup> and Mila Etropolski<sup>1,3</sup>

## Abstract

**Background:** Understanding how patients are treated in the real-world is vital to identifying potential gaps in care. We describe the current pharmacologic treatment patterns for the treatment of depression.

**Methods:** Patients with depression were identified from four large national claims databases during 1/1/2014–1/31/2019. Patients had ≥2 diagnoses for depression or an inpatient hospitalization with a diagnosis of depression. Patients were required to have enrollment in the database ≥1 year prior to and 3 years following their first depression diagnosis. Treatment patterns were captured at the class level and included selective serotonin reuptake inhibitors (SSRI), serotonin and norepinephrine reuptake inhibitors, tricyclic antidepressants, other antidepressants, anxiolytics, hypnotics/sedatives, and antipsychotics. Treatment patterns were captured during all available follow-up.

**Results:** We identified 260,669 patients diagnosed with depression. The proportion not receiving any pharmacological treatment during follow-up ranged from 79 to 53%. Of the treated, approximately half received ≥2 different classes of therapy, a quarter received ≥3 classes and more than 10% received 4 or more. SSRIs were the most common first-line treatment; however, many patients received an anxiolytic, hypnotic/sedative, or antipsychotic prior to any antidepressant treatment. Treatment with a combination of classes ranged from approximately 20% of first-line therapies to 40% of fourth-line.

**Conclusions:** Many patients diagnosed with depression go untreated and many others receive a non-antidepressant medication class as their first treatment. More than half of patients received more than one type of treatment class during the study follow-up, suggesting that the first treatment received may not be optimal for most patients.

**Keywords:** Depression, Treatment patterns, Antidepressants, Real-world evidence

Original Article  
Endocrinology, Nutrition & Metabolism  
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OPEN ACCESS

Published: Jan 2020  
Accepted: July 2021

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**Treatment Patterns of Type 2 Diabetes Assessed Using a Common Data Model Based on Electronic Health Records of 2000–2019**

Kyung Ae Lee<sup>1,2</sup>, Heung Yong Jin<sup>1,2</sup>, Yu Ji Kim<sup>1,2</sup>, Yong-jin Im<sup>1,2</sup>, Eun-Young Kim<sup>1,2</sup> and Tae Sun Park<sup>1,2</sup>

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<sup>2</sup>Center for Clinical Pharmacology, Biomedical Research Institute, Jeonbuk National University Hospital, Jeonju, Korea

## ABSTRACT

**Background:** Real-world data analysis is useful for identifying treatment patterns. Understanding drug prescription patterns of type 2 diabetes mellitus may facilitate diabetes management. We aimed to analyze treatment patterns of type 2 diabetes mellitus using Observational Medical Outcomes Partnership Common Data Model based on electronic health records.

**Methods:** This retrospective, observational study employed electronic health records of patients who visited Jeonbuk National University Hospital in Korea during January 2000–December 2019. Data were transformed into the Observational Medical Outcomes Partnership Common Data Model and analyzed using R version 4.0.3 and ATLAS ver. 2.7A. Prescription frequency for each anti-diabetic drug, combination therapy pattern, and prescription pattern according to age, renal function, and glycated hemoglobin were analyzed.

## Characterizing treatment pathways at scale using the OHDSI network

George Hripcsak<sup>1,2,3,4,5,6,7</sup>, Patrick B. Ryan<sup>4,6</sup>, Jon D. Duke<sup>4,6</sup>, Nigam H. Shah<sup>4,7</sup>, Rae Woong Park<sup>4,8,9</sup>, Vojtech Huser<sup>4,10</sup>, Marc A. Suchard<sup>11,12</sup>, Martijn J. Schuemie<sup>13</sup>, Frank J. Defalco<sup>14</sup>, Adler Perotte<sup>15</sup>, Juan M. Banda<sup>16</sup>, Christian G. Reich<sup>4,7</sup>, Lisa M. Schilling<sup>17,18</sup>, Michael E. Matheny<sup>19,20</sup>, Danielle Meeker<sup>21,22</sup>, Nicole Pratt<sup>23</sup>, and David Madigan<sup>24</sup>

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Edited by Richard M. Shiffman, Indiana University, Bloomington, IN, and approved April 5, 2018 (received for review June 14, 2015)

**Abstract** Health care systems are increasingly using electronic health records (EHRs) to collect and analyze data on patient care. EHRs are a rich source of information for understanding the delivery of care, but they are often difficult to use for research. We present a network of EHRs that can be used to study the delivery of care at scale.

## Hripcsak et al. 2016

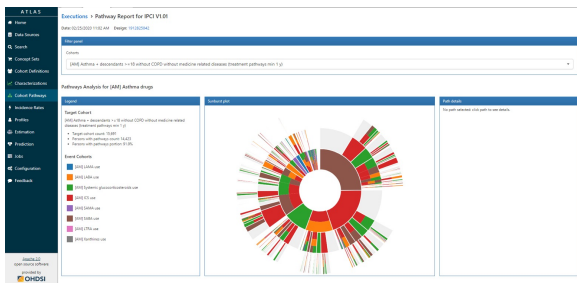
## Kern et al. 2020

## Lee et al. 2021

# Tools

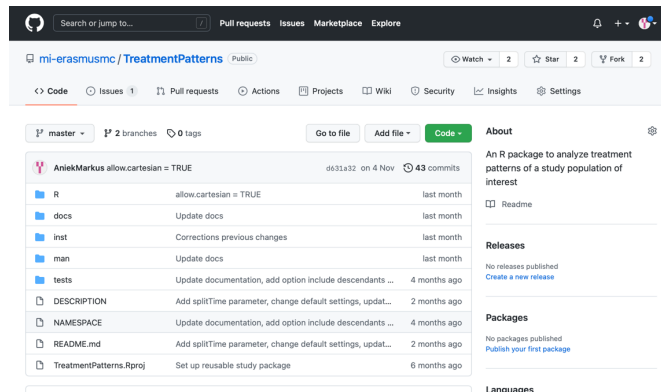
## ATLAS Cohort Pathways

- Quick, exploratory analysis
- Limited settings (4x)



# TreatmentPatterns R Package

- More choice in study settings (> 10x)
- Shiny application to explore output
- Possibility for customization



# Overview R package

Definition target (*study population*) and event cohort(s) (*treatments*)

e.g. Target cohort = T2DM

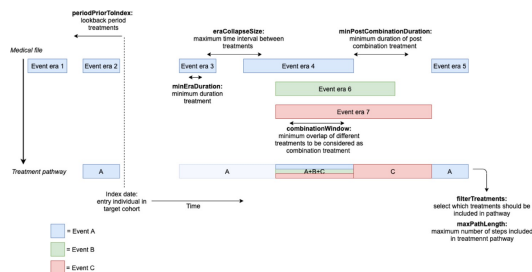
Event cohort(s) = Various medication classes

Extract raw medical data from OMOP-CDM

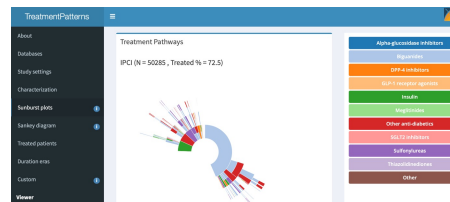
Study settings

Construct individual treatment pathway

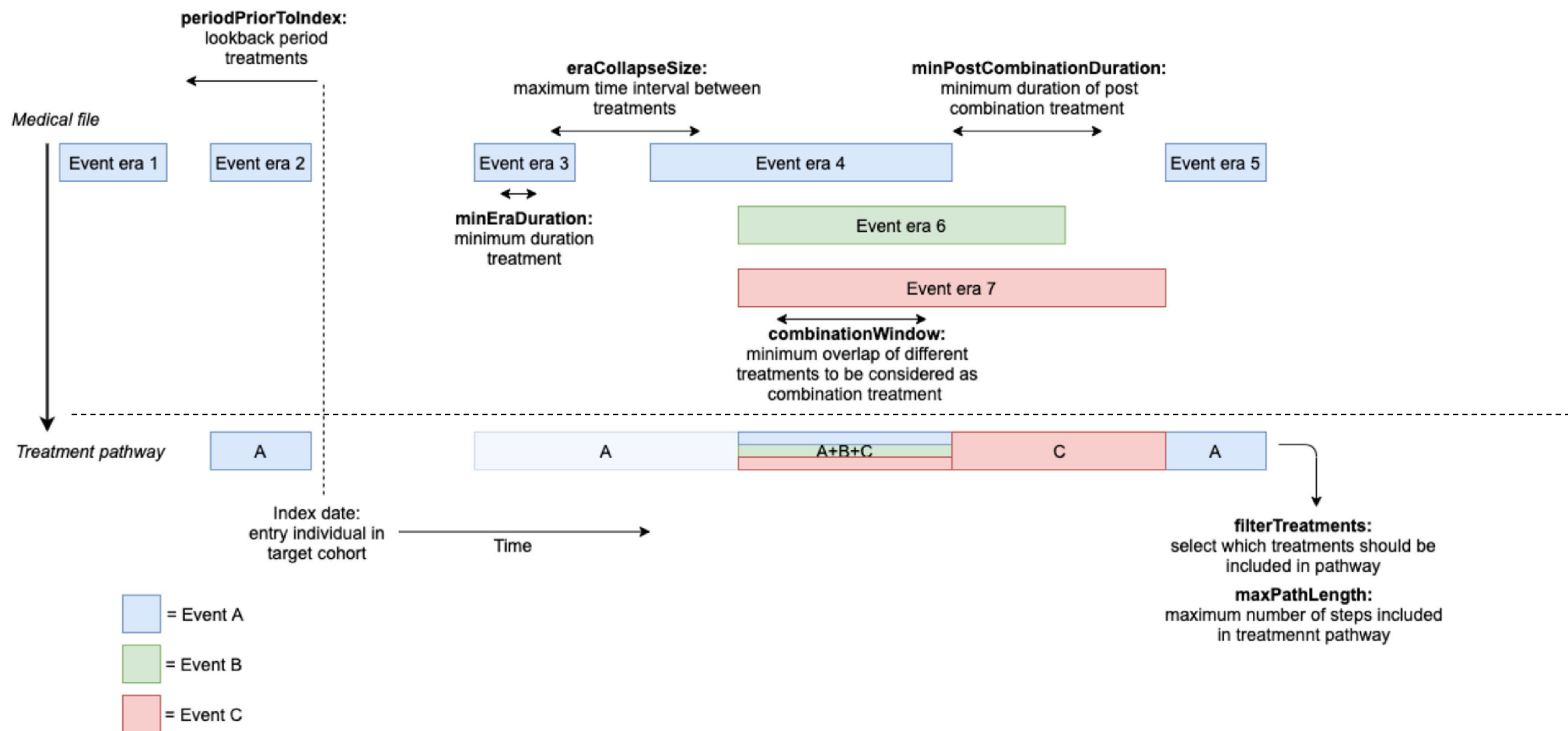
Shiny application



Aggregate all treatment pathways

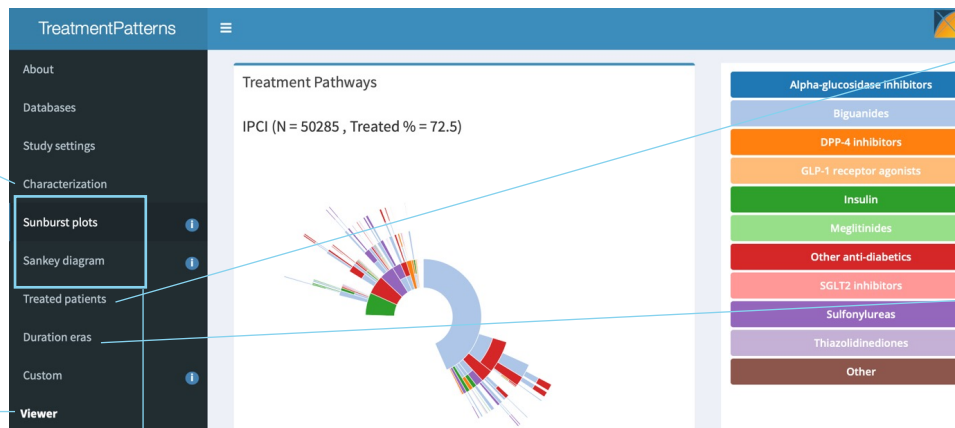


# Input: (cohorts &) study settings



# Output: shiny application

*Optional: baseline characterization of study population*



*Summarizing table with % patients treated (per treatment/ for monotherapy vs combinations)*

*Average duration of treatments across layers*

*Possibility to compare across databases, study populations, time*

*Treatment pathways visualized in Sunburst plots / Sankey diagrams*

Link example output: <https://mi-erasmusmc.shinyapps.io/TreatmentPatterns/>



# Get started!

Paper: <https://doi.org/10.1016/j.cmpb.2022.107081>

- Markus, A. F., Verhamme, K. M., Kors, J. A., & Rijnbeek, P. R. (2022). TreatmentPatterns: An R package to facilitate the standardized development and analysis of treatment patterns across disease domains. Computer Methods and Programs in Biomedicine, 107081.
- **For details on construction of treatment pathways, implementation and example study Dutch IPCI database**

Github: <https://github.com/mi-erasmusmc/TreatmentPatterns>

- **For package installation, code examples and vignette “Perform a study using the TreatmentPatterns package”**
- Please use the issue tracker for all bug/issues/enhancements
  - Contributions are welcome 😊

**EHDEN Academy course: work in progress (end 2022?)**

