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# **Timing and intensity of the COVID-19 epidemic**

# **Validation of a new MEM multiple waves algorithm**

V.2

Content

[Background 2](#_Toc188974346)

[Objectives 3](#_Toc188974347)

[Main 3](#_Toc188974348)

[Complementary 3](#_Toc188974349)

[Methods 3](#_Toc188974350)

[Epidemiological data 3](#_Toc188974351)

[Analysis 3](#_Toc188974352)

[Work plan 4](#_Toc188974353)

[Participants 4](#_Toc188974354)

[References 5](#_Toc188974355)

# Background

The Moving Epidemic Method (MEM) has been widely used to monitor influenza epidemics and other acute respiratory infections (ARIs) activity1,2. However, although a new tool has been developed in MEMAPP to detect epidemics and calculate epidemic and intensity thresholds in diseases with multiple waves, this new approach has not yet been validated.

In Castilla y Leon (Spain), this MEM multiple waves (MEM-MW) has been used to establish epidemic thresholds for COVID3, although this model has not been formally reviewed to date.

Although SARS-CoV-2 circulates post-pandemic endemically in our country with periods of exacerbations throughout the year, the pattern of activity is not yet well understood. The limited availability of quality epidemiological and virological data has made statistical and epidemiological analyses difficult.

For this reason, it is proposed to validate the new MEM-MW algorithm for COVID-19, using data series from the different autonomous regions of Spain and other European and non-European countries.

A better knowledge of the behaviour of COVID-19, as well as the calculation of thresholds and the detection of the different waves, could help in making decisions on control and prevention measures, and, in a complementary way, to better understand the relationship between the activity of this disease and other circulating respiratory pathogens.

Additionally, a validated MEM-MW could be useful in tropical and subtropical regions in which influenza and other ARI usually present two epidemic-like waves or an endemic activity all year round with periods of exacerbations.

# Objectives

## Main

To validate the MEM-MW for COVID-19, define baseline COVID-19 activity with post-pandemic data and establish epidemic and intensity thresholds.

## Complementary

1. Detect the different waves of COVID-19 in the study period
2. Establish typical curves and timing for COVID-19 and their duration
3. Calculate epidemic and intensity thresholds for COVID-19 monitoring
4. Estimate validity parameters of the model (sensitivity, specificity, PPV, NPV)

# Methods

## Epidemiological data

* Weekly COVID-19 incidence rates, calculated as the number of weekly cases of COVID-19 episodes divided by the corresponding population.
  + From 1/01/2020 to 30/09/2024

## Analysis

1. The multi-wave MEM algorithm will be used to identify the different waves of COVID-19 throughout the series.
2. The main MEM indicators will be calculated
   1. Detection of each curve/wave and typical curve for COVID-19
   2. Estimation of epidemic thresholds with the weekly pre-epidemic values.
   3. Estimation of intensity thresholds with the weekly epidemic values.
   4. Average duration of the epidemic
   5. Average week of onset of the epidemic
   6. Epidemic percentage in the model

Validation of the multi-wave algorithm

* Inspect the series of each Autonomous Regions in Spain and each country, study outliers, number of waves, etc.
* Apply different window parameters.
* Calculate MEM indicators (epidemic thresholds, epidemic percentage in the model).
* Calculate model validity (sensitivity, specificity, PPV, NPV).
* Calculate the distribution of the intensity levels of the different waves, all at once and wave by wave.

The series of the Autonomous Regions will be used as 'training data' and those of the participating countries as 'testing data'.

# Work plan

1. Contact with the National Centre of Epidemiology (CNE), interested Autonomous Regions, WHO and participating countries.
2. Request for data series through the template designed for this purpose (attached in a separate document).
3. Evaluation of the quality and completeness of the data and feedback to the Autonomous Regions and participating countries.
4. Final selection of series to include in the model.
5. Analysis and validation of the multi-wave algorithm.
6. Interim report of results.
7. Discussion of results with participants.
8. Communication of results (scientific meetings, possible publication).

# Participants

* Castilla y León ARIs surveillance Team
* National Epidemiology Centre ARI Surveillance Team
* WHO\_HQ and WHO-Europe
* Technical officers responsible for ARI surveillance in the Autonomous Regions interested in this project
* Responsible or coordinators from participant countries

# References

(1)Vega T, Lozano JE, Meerhoff T, Snacken R, Mott J, Ortiz de Lejarazu R, Nunes B. Influenza surveillance in Europe: establishing epidemic thresholds by the moving epidemic method. Influenza Other Respir Viruses. 2013 Jul;7(4):546-58. doi: 10.1111/j.1750-2659.2012.00422.x. Epub 2012 Aug 16. PMID: 22897919; PMCID: PMC5855152.

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(3)Vega-Alonso T, Lozano-Alonso JE, Ordax-Díez A; VIGIRA Research Group. Comprehensive surveillance of acute respiratory infections during the COVID-19 pandemic: a methodological approach using sentinel networks, Castilla y León, Spain, January 2020 to May 2022. Euro Surveill. 2023 May;28(21):2200638. doi: 10.2807/1560-7917.ES.2023.28.21.2200638. PMID: 37227298; PMCID: PMC10283458.