



MODELOS PREDICTIVOS EN LA EVOLUCIÓN DE LA PANDEMIA

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Grup Interdisciplinari de Professionals Vinculats amb la Salut (GIPS)

Barcelona, 25 de novembre de 2022



Biología Computacional y Sistemas Complejos: Investigación multidisciplinaria



Dr. Cardona



Dra. Vilaplana



Microbiólogos



Dr. Sergio
Alonso



Dr. Clara Prats



Biofísicos
computacionales



Dr. Daniel
López



Germans Trias i Pujol
Hospital



Radiólogos



Dr. Bechini
Dra. Tenesa
Dr. Pérez
Dr. Nogueira



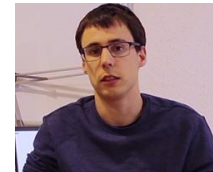
Epidemiòlogos



Dr. Enric
Álvarez



Aida
Perramon



Dr. Martí
Català



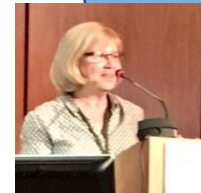
Pediatras



Dr. Bassat



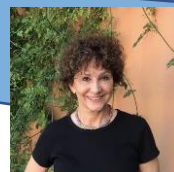
Dra. Jordan



Dra. Orcau



Dr. Millet



Dra. Gatell



Pediatras



Dr. Soriano

Outline

- ¿De dónde venimos?
- Modelos en pandemia
- ¿Hacia dónde vamos?
- Conclusiones

¿De dónde venimos?

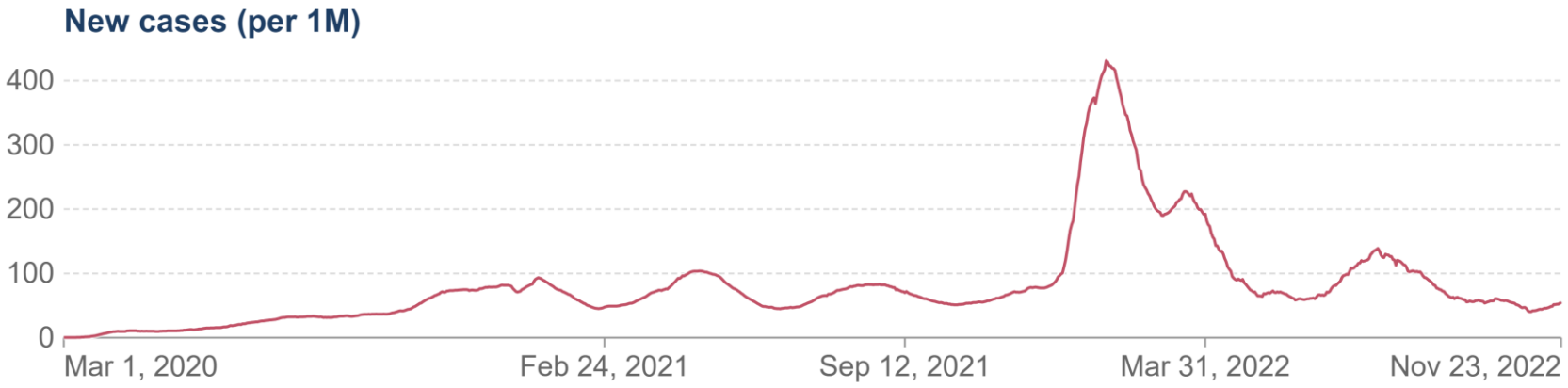
La pandemia de COVID-19 en el mundo

Daily new confirmed COVID-19 cases & deaths per million people

7-day rolling average. Limited testing and challenges in the attribution of cause of death means the cases and deaths counts may not be accurate.



■ World



Source: Johns Hopkins University CSSE COVID-19 Data

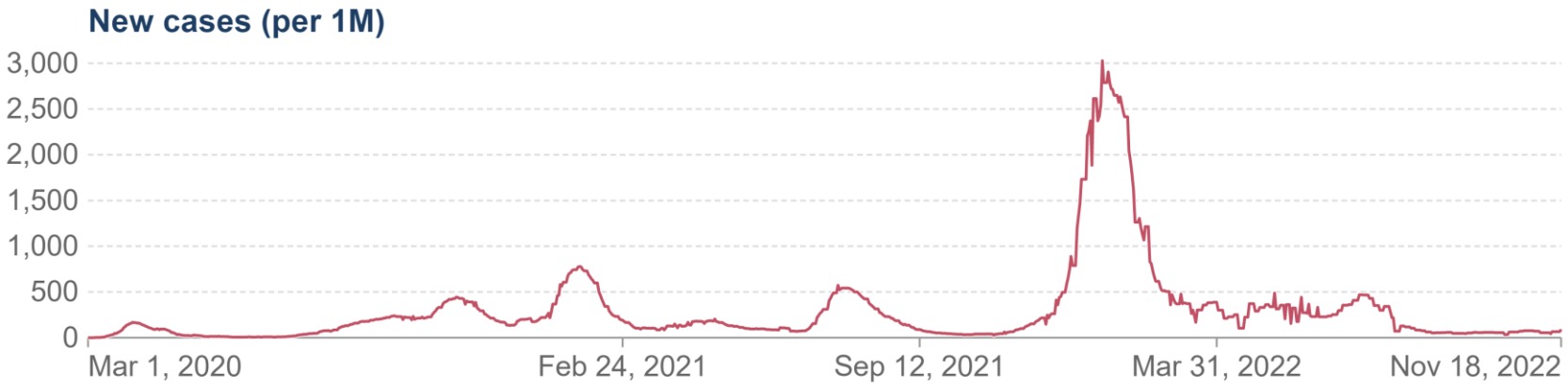
La pandemia de COVID-19 en España

Daily new confirmed COVID-19 cases & deaths per million people

7-day rolling average. Limited testing and challenges in the attribution of cause of death means the cases and deaths counts may not be accurate.



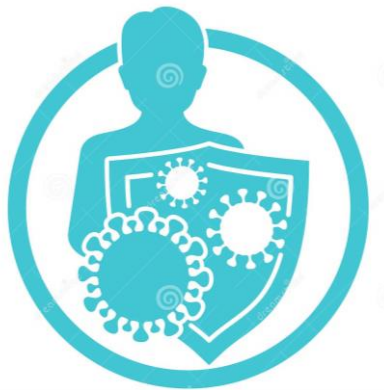
Spain



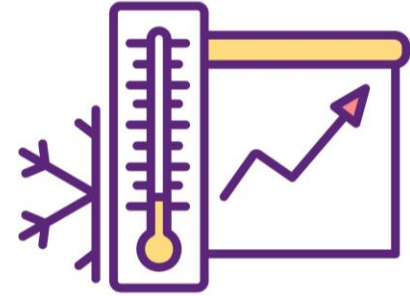
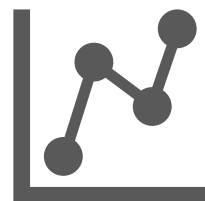
Source: Johns Hopkins University CSSE COVID-19 Data

CC BY

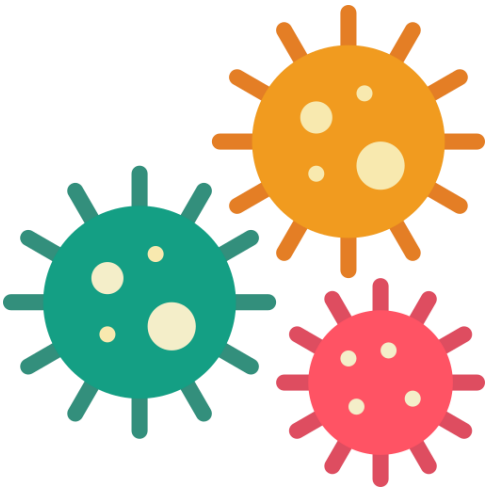
Factores determinantes para la dinámica epidemiológica



Inmunidad



Estacionalidad

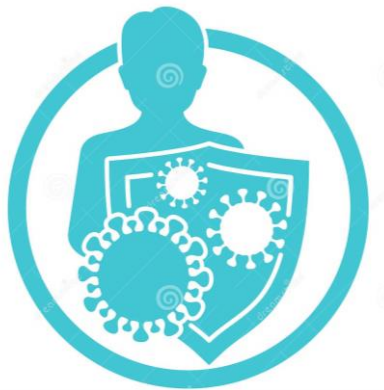


Virus

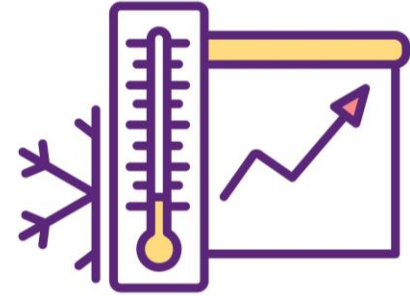
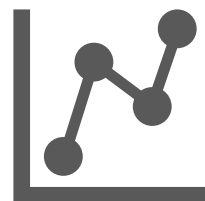


Factor humano

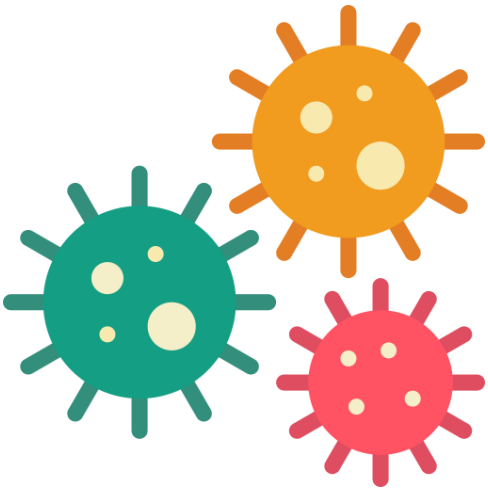
Factores determinantes para la dinámica epidemiológica



Inmunidad



Estacionalidad



Virus

Factores determinantes el primer año...

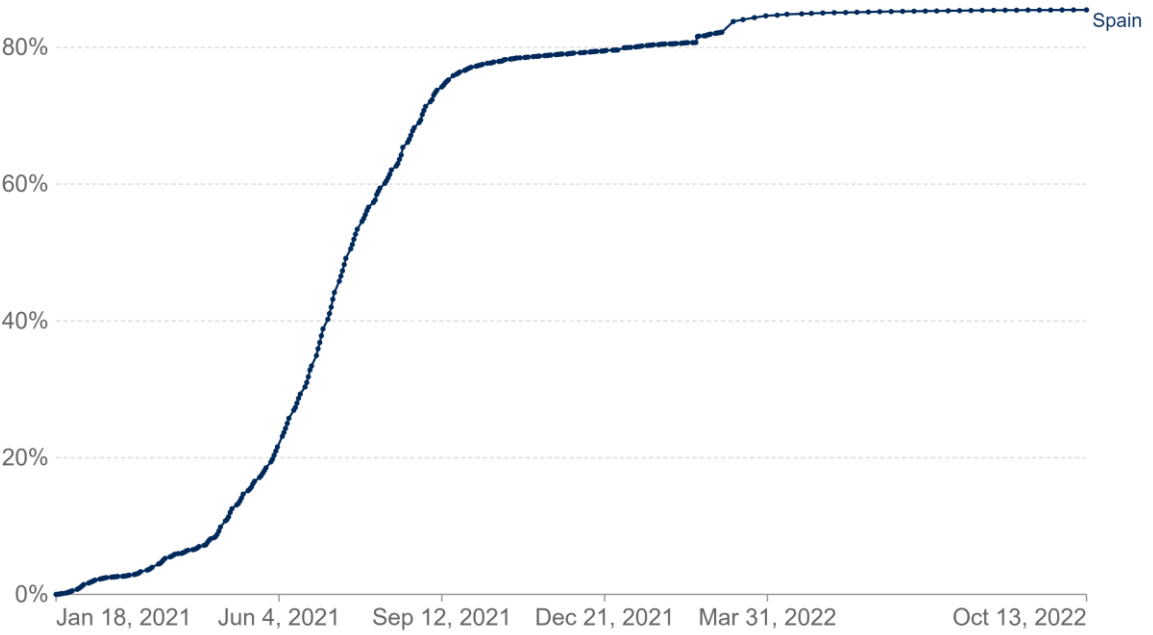


Factor humano

A lo largo del segundo y tercer año...

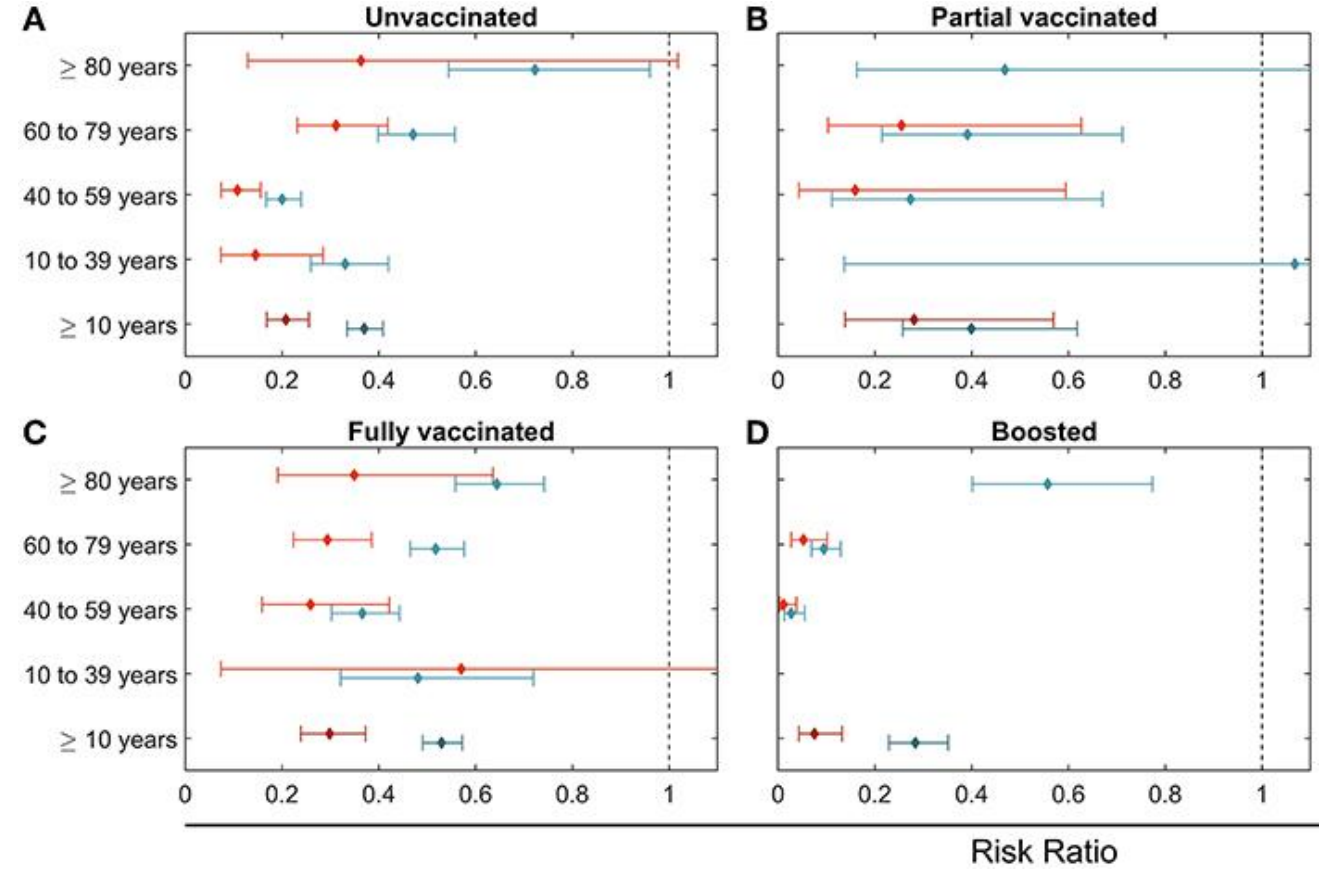
Fully vaccinated population in Spain

Share of people who completed the initial COVID-19 vaccination protocol
 Total number of people who received all doses prescribed by the initial vaccination protocol, divided by the total population of the country.



Source: Official data collated by Our World in Data
 Note: Alternative definitions of a full vaccination, e.g. having been infected with SARS-CoV-2 and having 1 dose of a 2-dose protocol, are ignored to maximize comparability between countries.

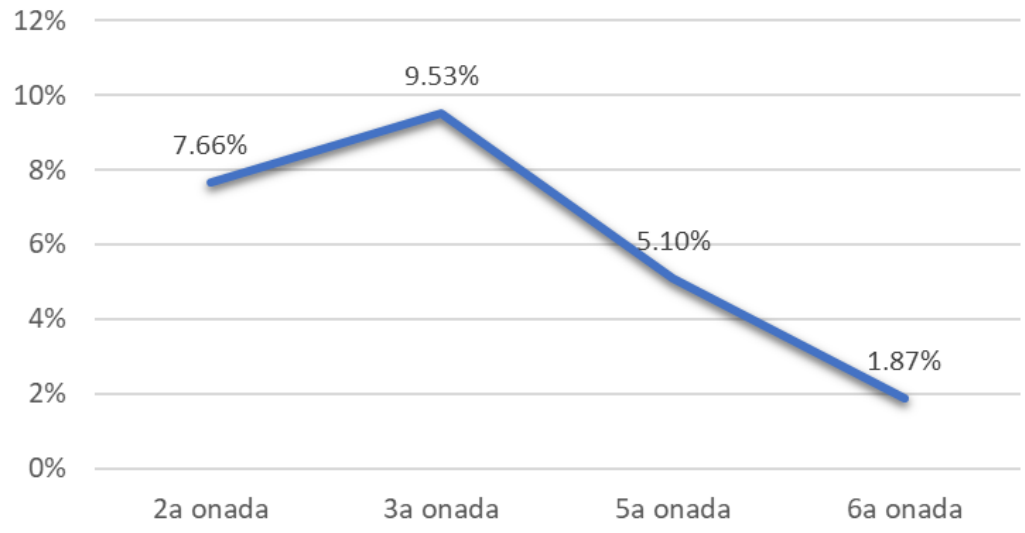
Rate ratio (RR) estimation between **omicron** and **delta** cohorts for the different vaccination status (A–E) and age groups (vertical axes).



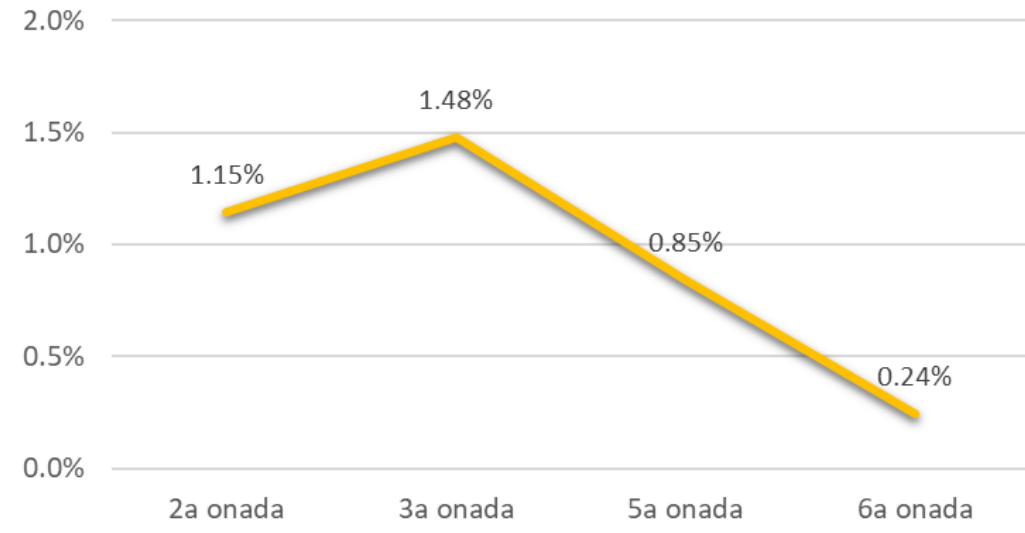
- Hospital admission RR (Blue diamond)
- ICU admission RR (Red diamond)

A lo largo del segundo y tercer año...

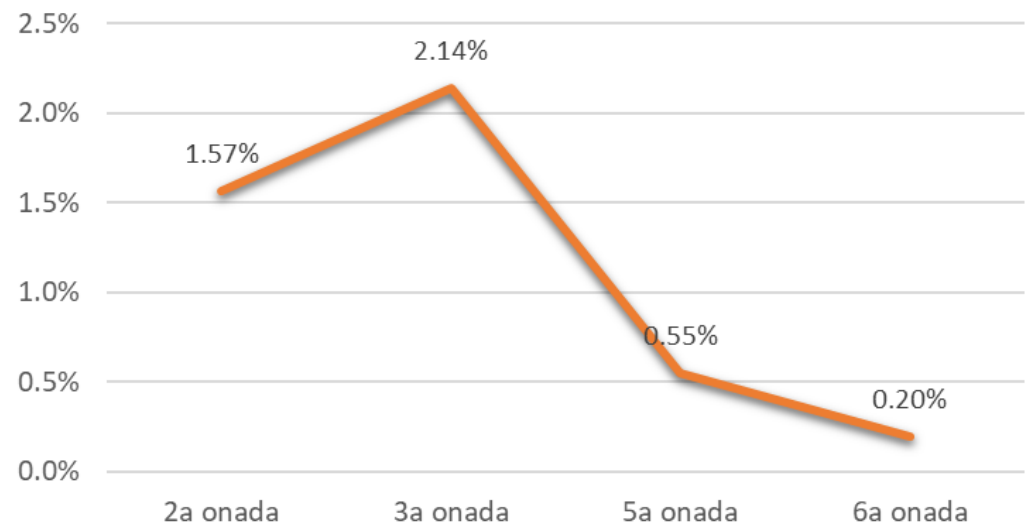
Relación ingreso/caso, por olas



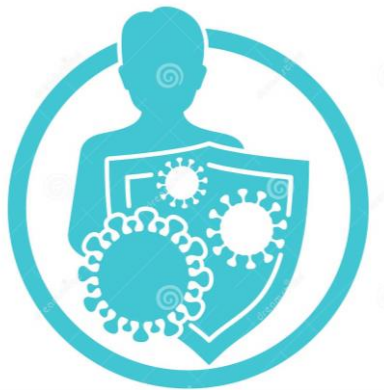
Relación UCI/caso, por olas



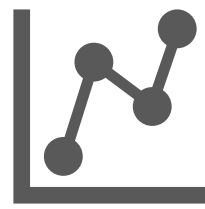
Relación defunción/caso, por olas



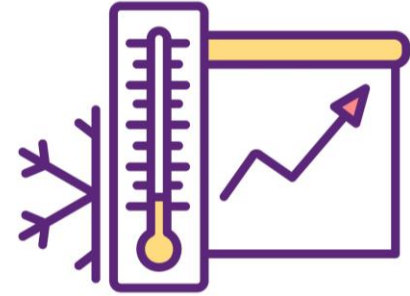
Factores determinantes para la dinámica epidemiológica



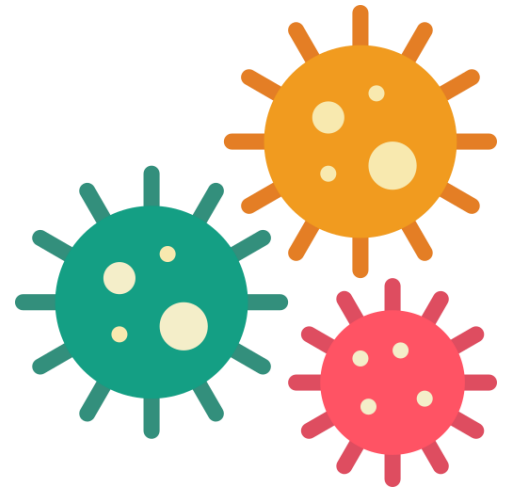
Inmunidad



Factores determinantes el **tercer año...**



Estacionalidad



Virus



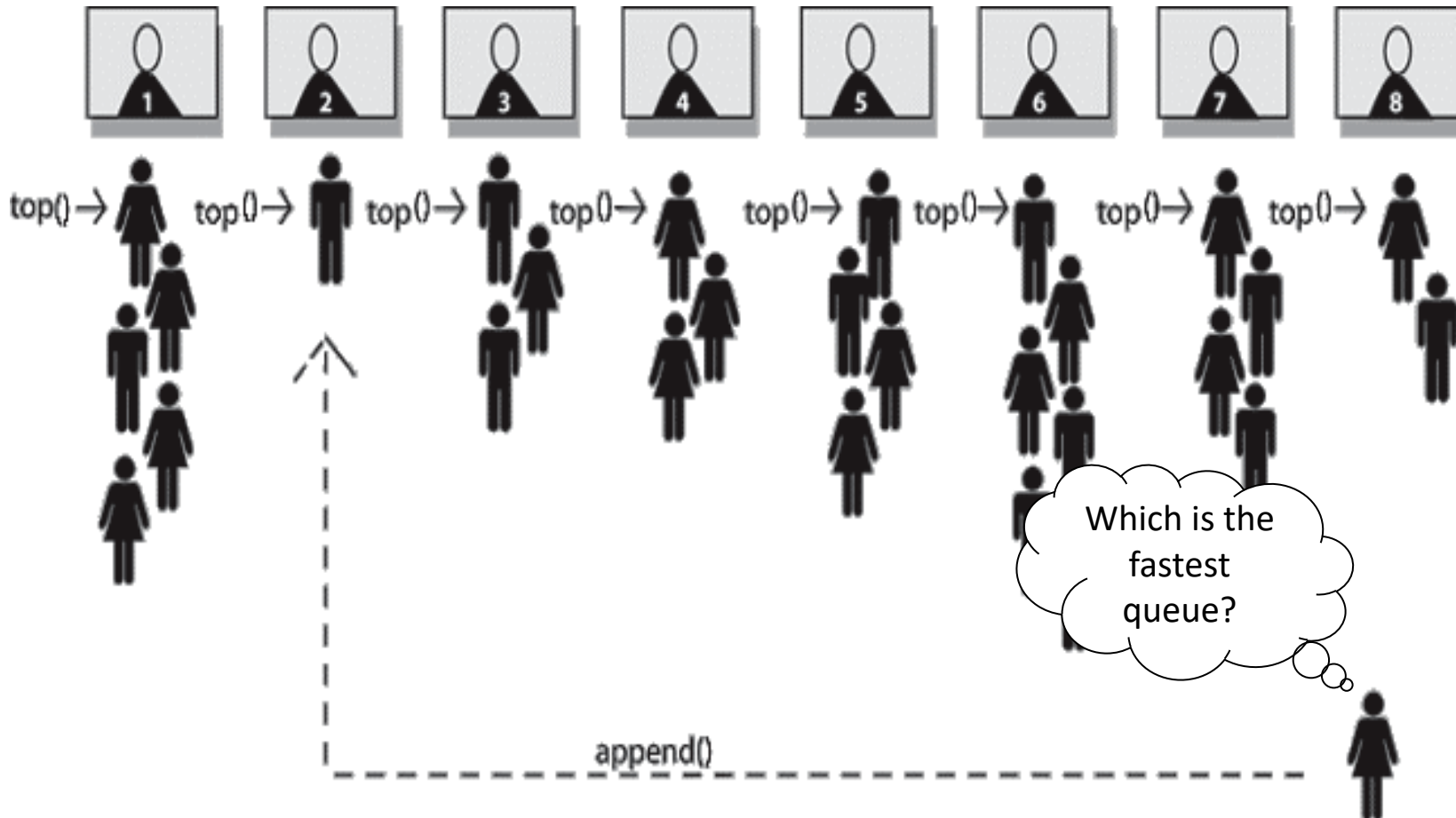
Factor humano

Modelos en pandemia

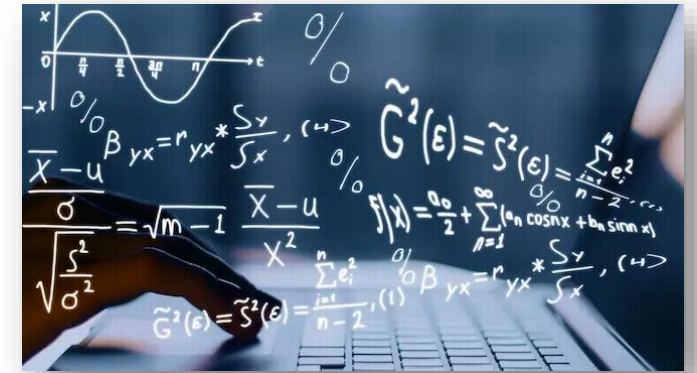
Modelos matemáticos... ¿Qué son?

Modelo (RAE):

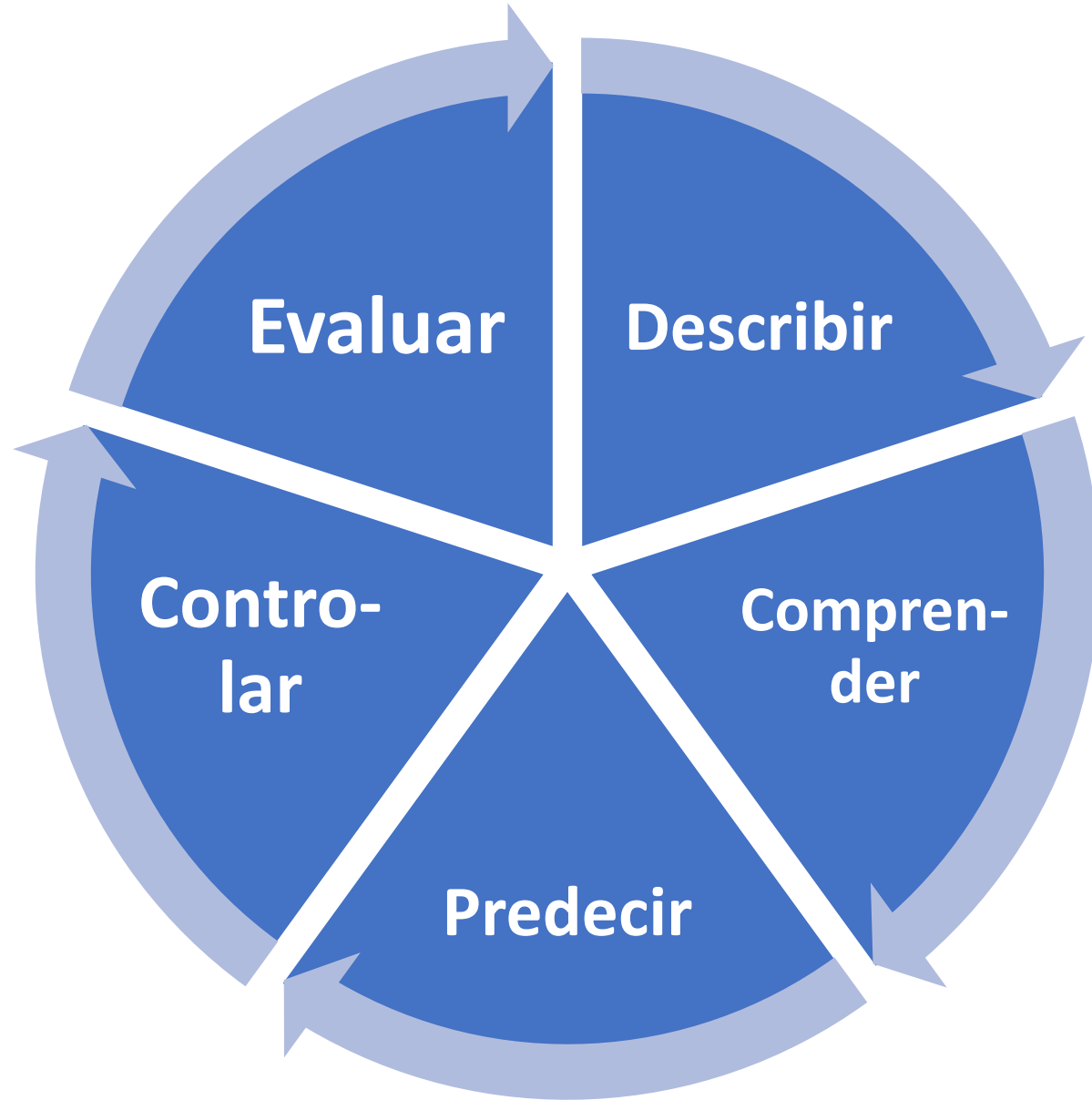
Esquema teórico, generalmente en forma matemática, de un sistema o de una realidad compleja, que se elabora para facilitar su comprensión y el estudio de su comportamiento.



Pero...

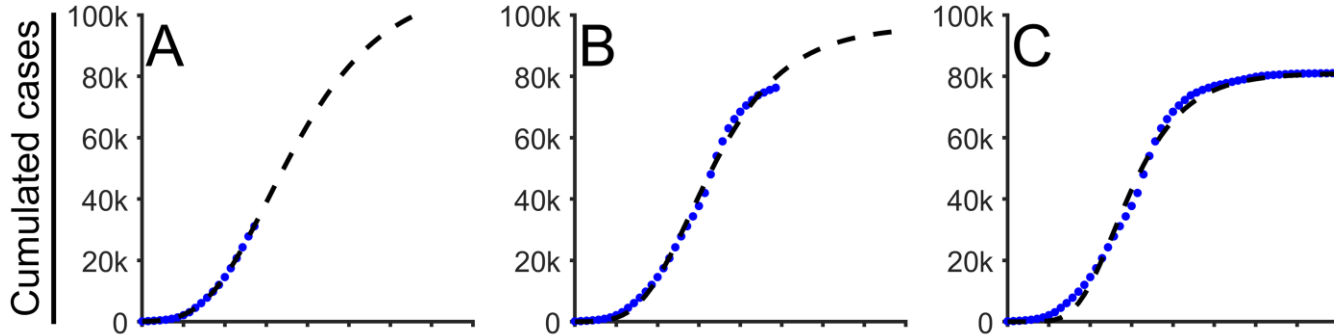


Modelos matemáticos... ¿para qué?



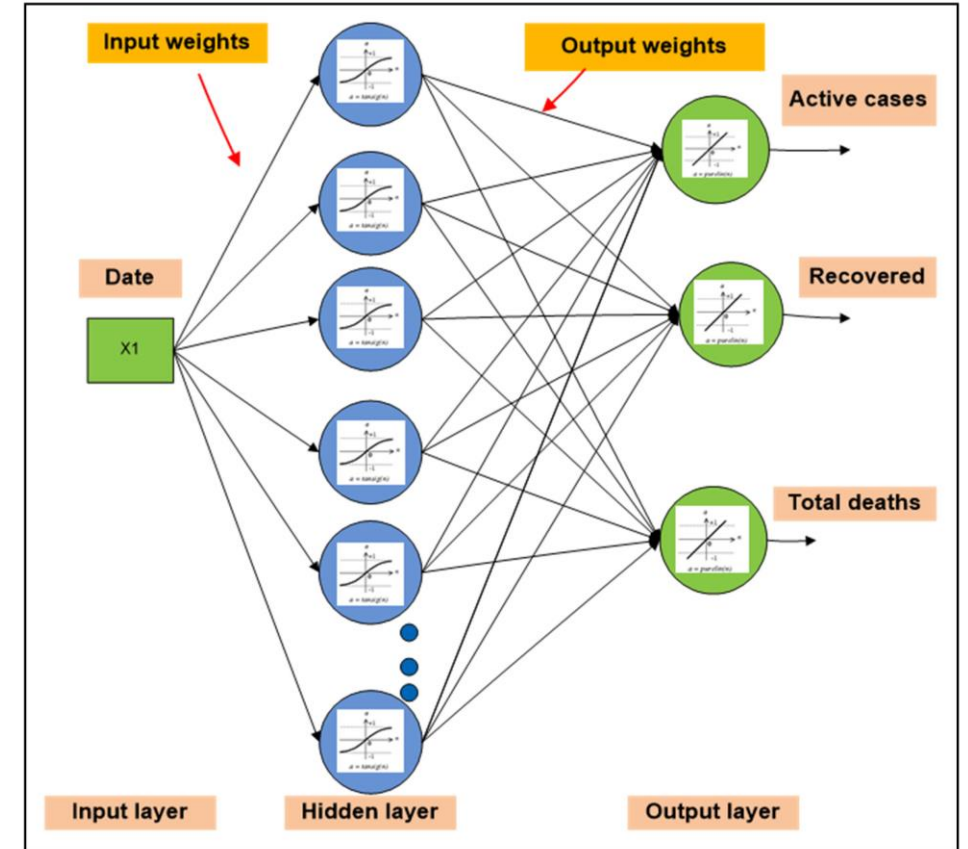
Modelos para describir y predecir

Modelos empíricos



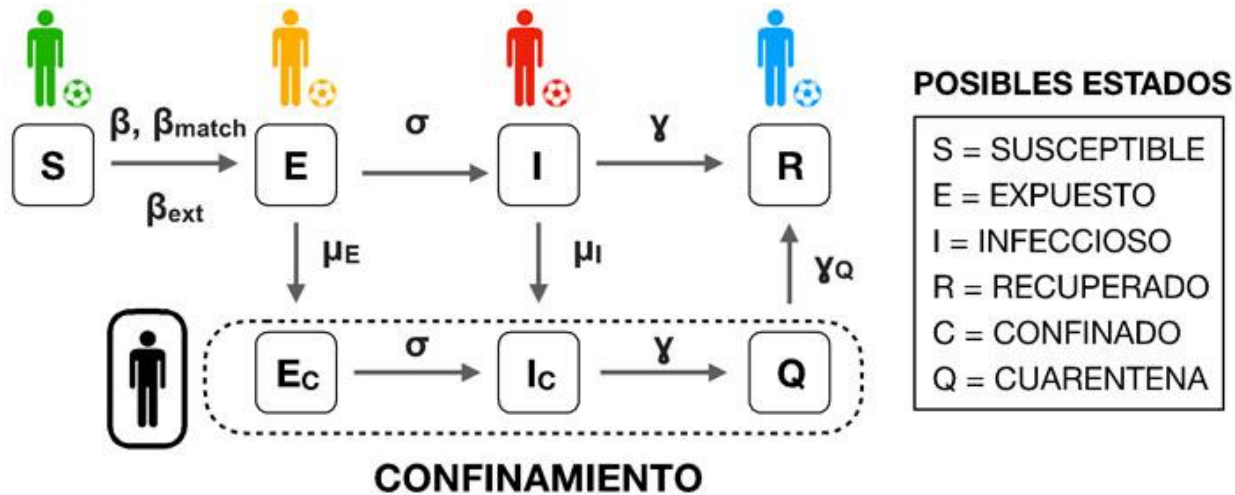
<https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1008431>

Modelos de IA



<https://www.mdpi.com/2227-7390/9/2/180>

Modelos SEIR



Modelos para describir y predecir

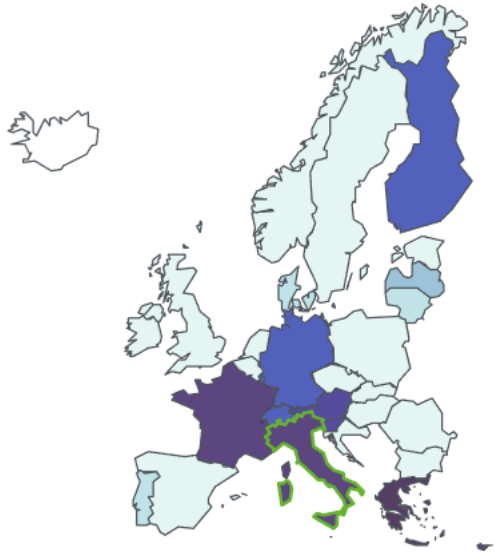
known for transparency but should not be taken on their own without fully acknowledging their assumptions and limitations and engaging with the listed authors.

Warning! Many countries are undergoing changes in testing criteria and reporting procedures. We recommend focusing on trends rather than absolute numbers when interpreting the forecasts.

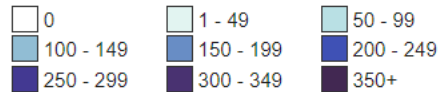
Country by clicking in the below map.

Current Location

Italy

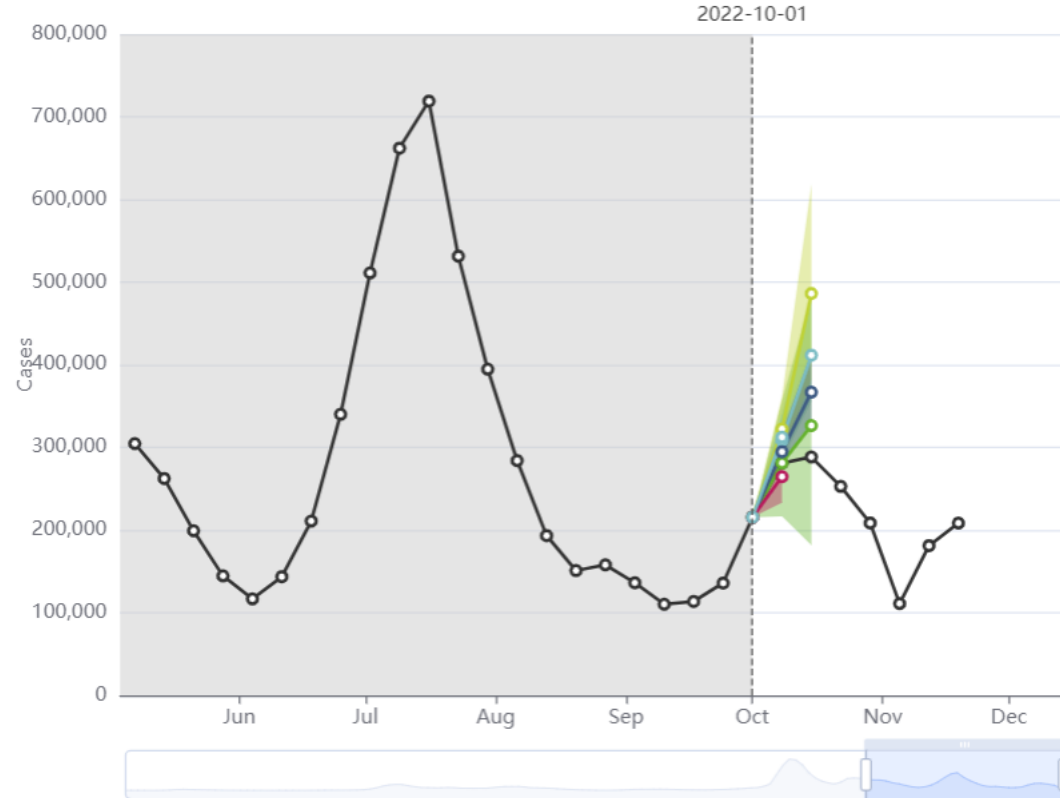


Cases / 100,000 inhabitants



Leaflet

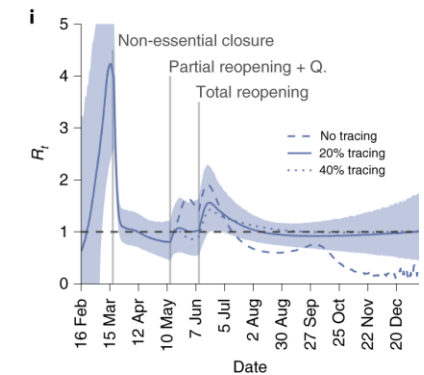
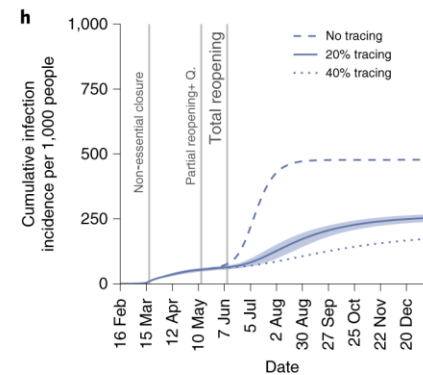
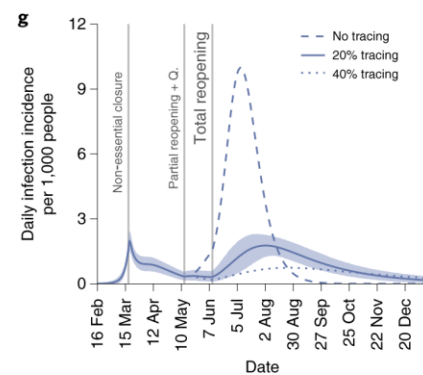
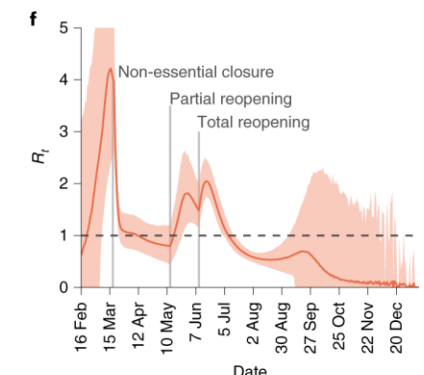
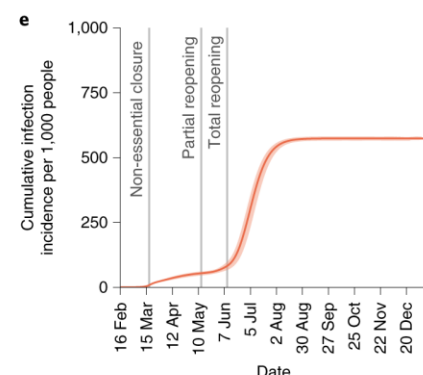
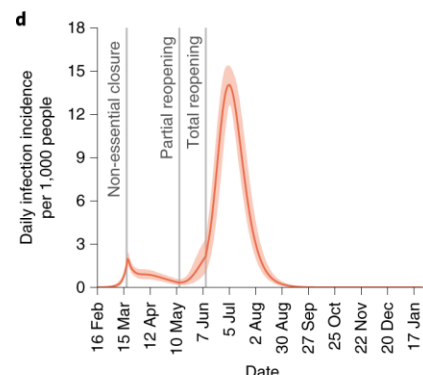
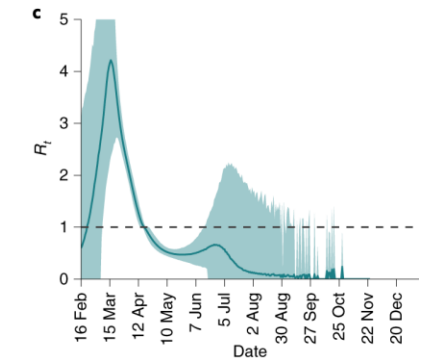
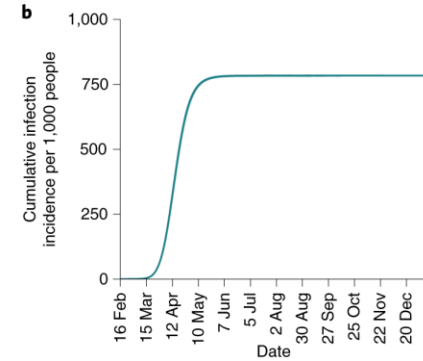
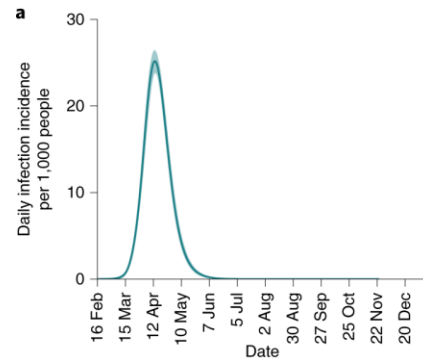
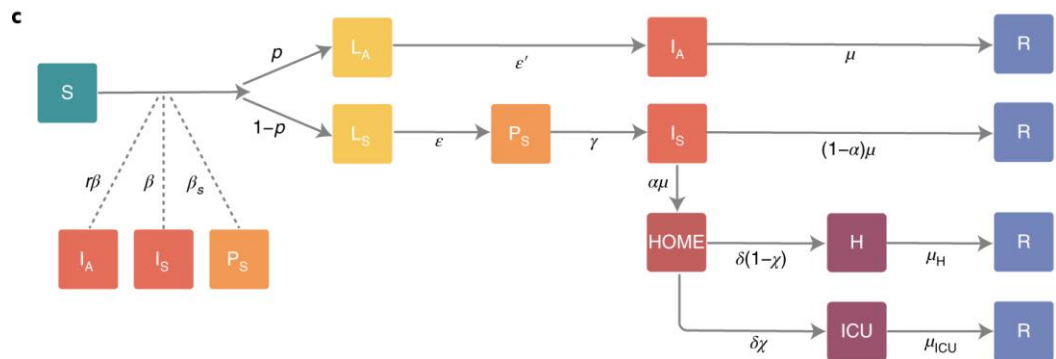
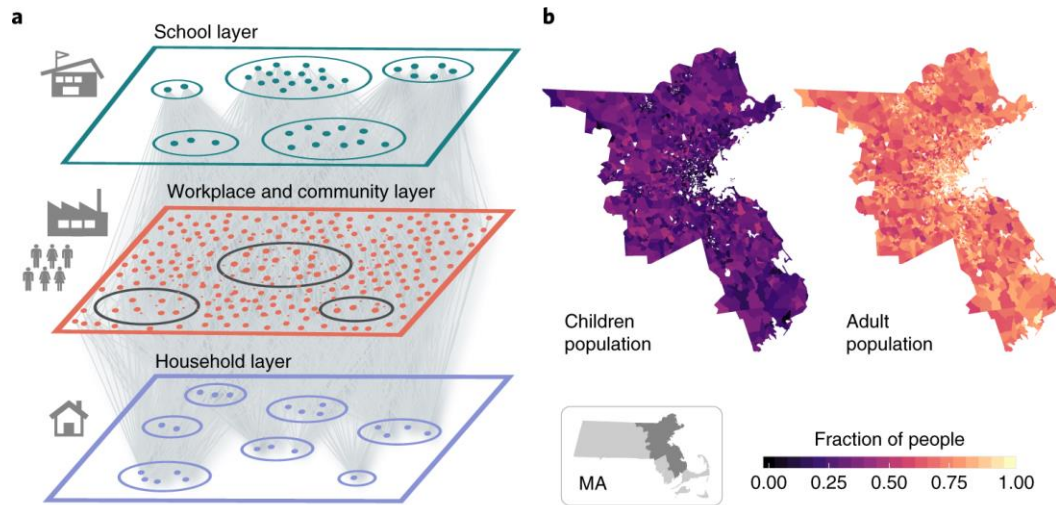
Forecasts · Cases, Italy · issued on Oct 3, 2022



- AMM-EpiInvert
- BIOCOSM-Gompertz
- EuroCOVIDhub-ensemble
- ILM-EKF
- MUNI-ARIMA
- RobertWalraven-ESG
- SDSC_ISG-TrendModel
- USC-SikJalpha
- UpgUmibUsi-MultiBayes
- epiMOX-SUIHTER
- epiforecasts-weeklygrowth

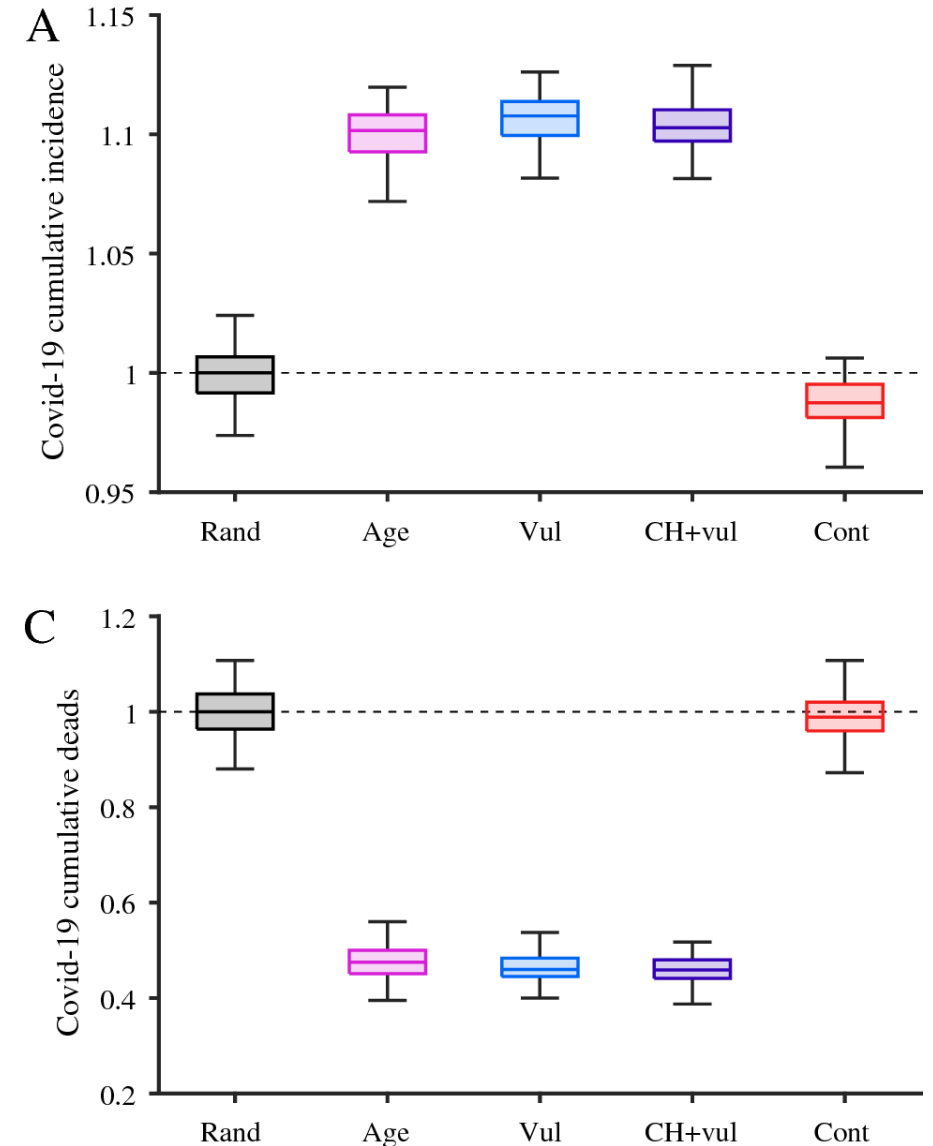
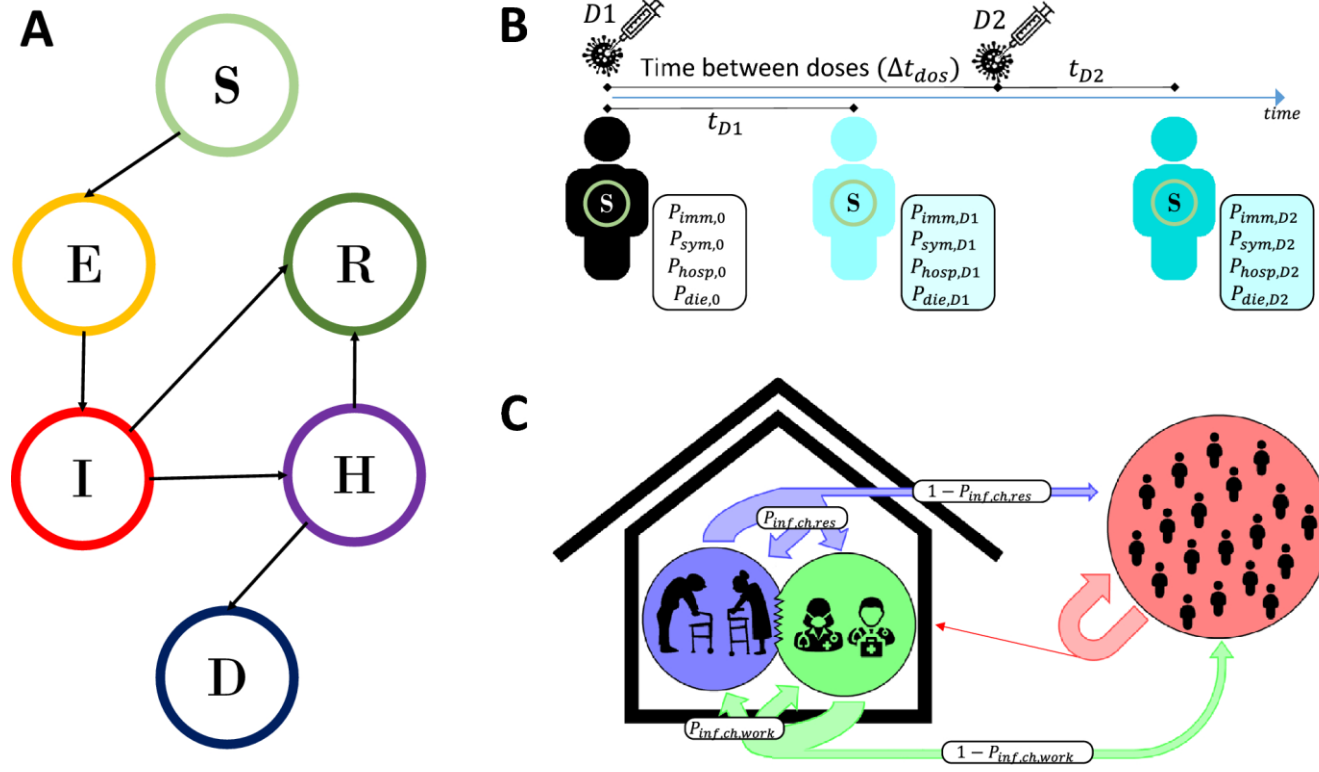
Modelos para comprender y controlar

Modelling the impact of testing, contact tracing and household quarantine on second waves of COVID-19



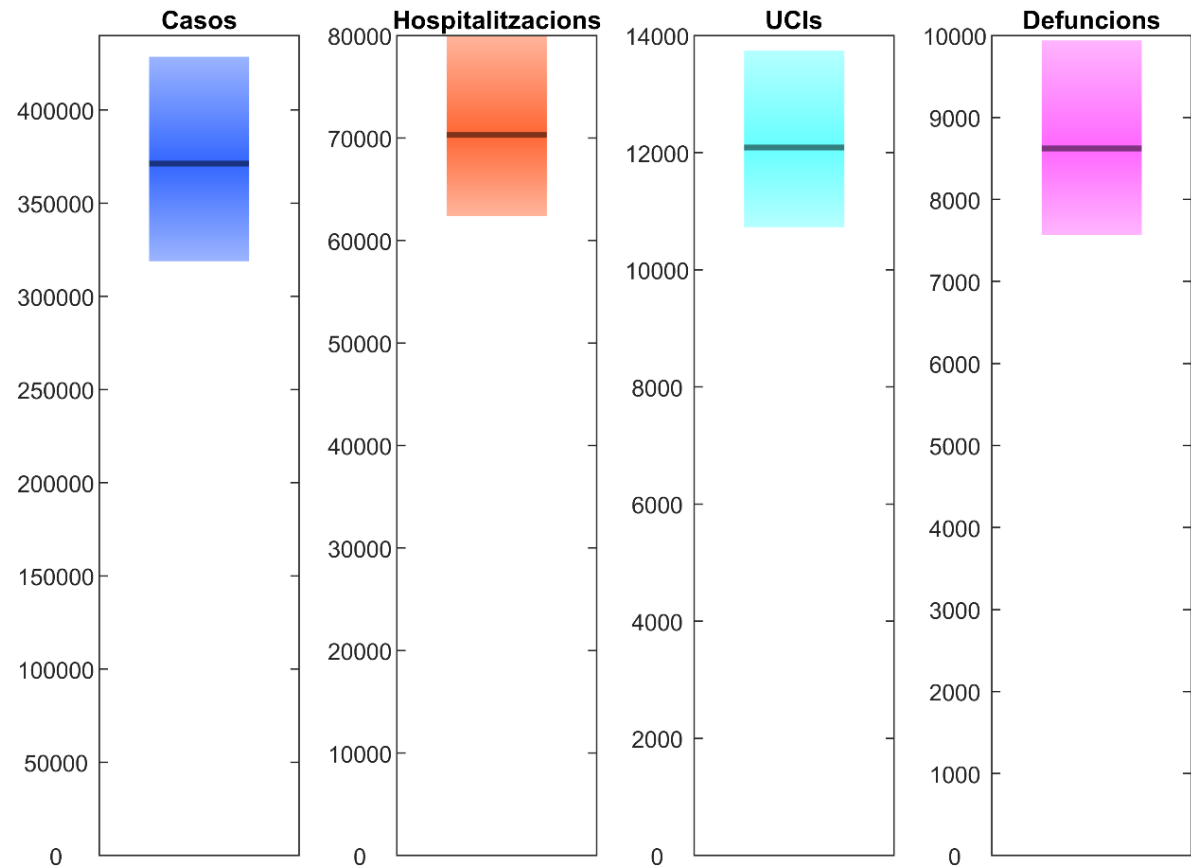
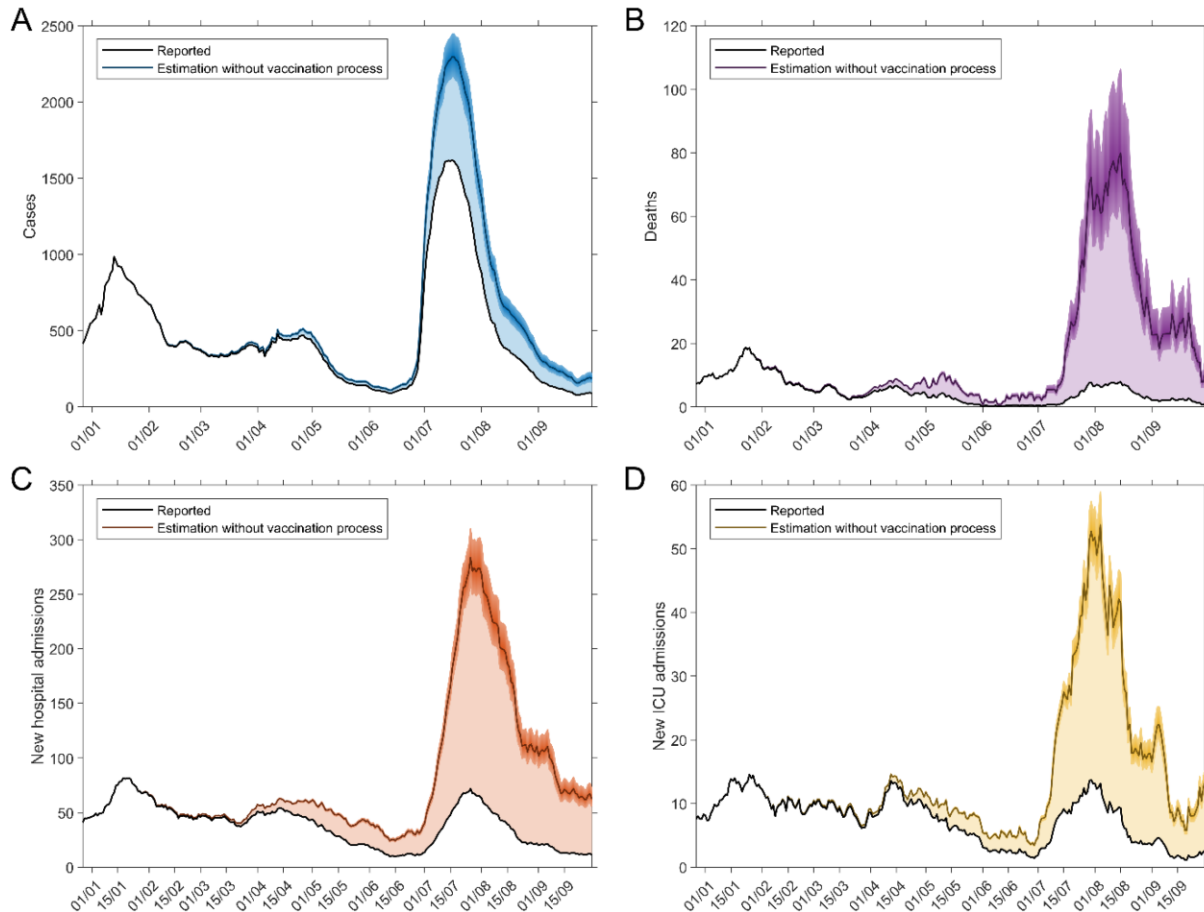
Modelos para comprender y controlar

The impact of prioritisation and dosing intervals on the effects of COVID-19 vaccination in Europe: an agent-based cohort model



Modelos para evaluar

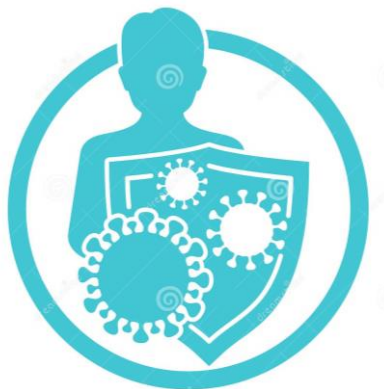
A Cost-Benefit Analysis of COVID-19 Vaccination in Catalonia



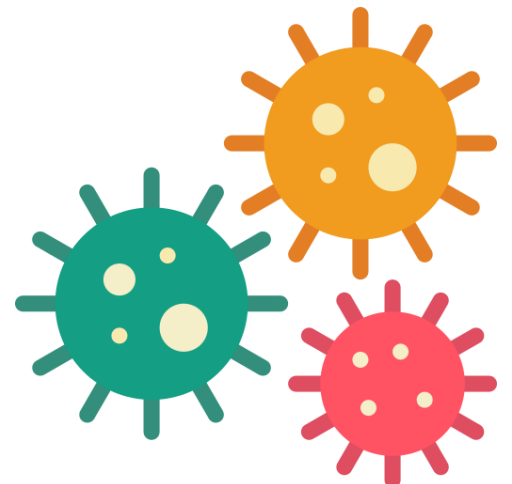
“From the perspective of the health system (considering the savings in hospital discharges and ICU units), **the benefit/cost ratio is 1.4**; if, in addition, the monetization of the reduction in mortality and morbidity (social perspective) is taken into account, **this ratio increases to 3.4**. These results are robust at the lower and upper threshold of vaccine effectiveness.”

¿Hacia dónde vamos?

Factores determinantes para la dinámica epidemiológica



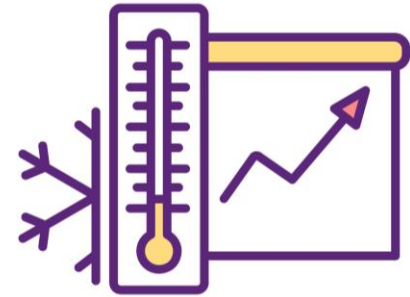
Immunidad



Virus



Factores determinantes **actuales...**

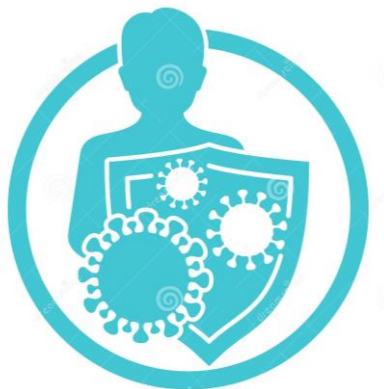


Estacionalidad

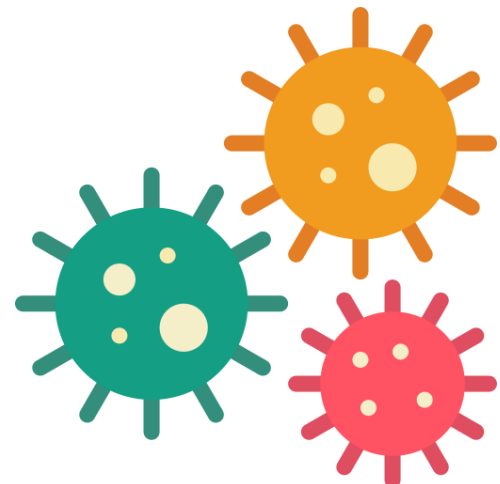


Factor humano

Factores determinantes para la dinámica epidemiológica



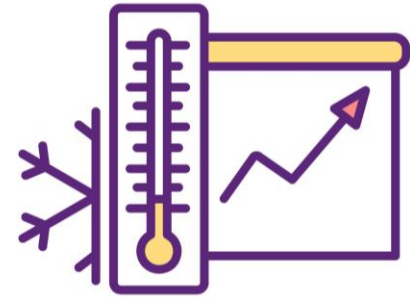
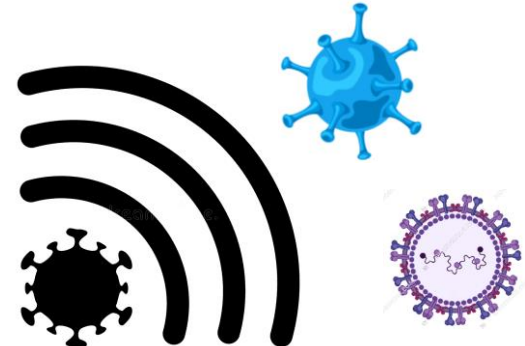
Immunidad



Virus



Interferencia viral



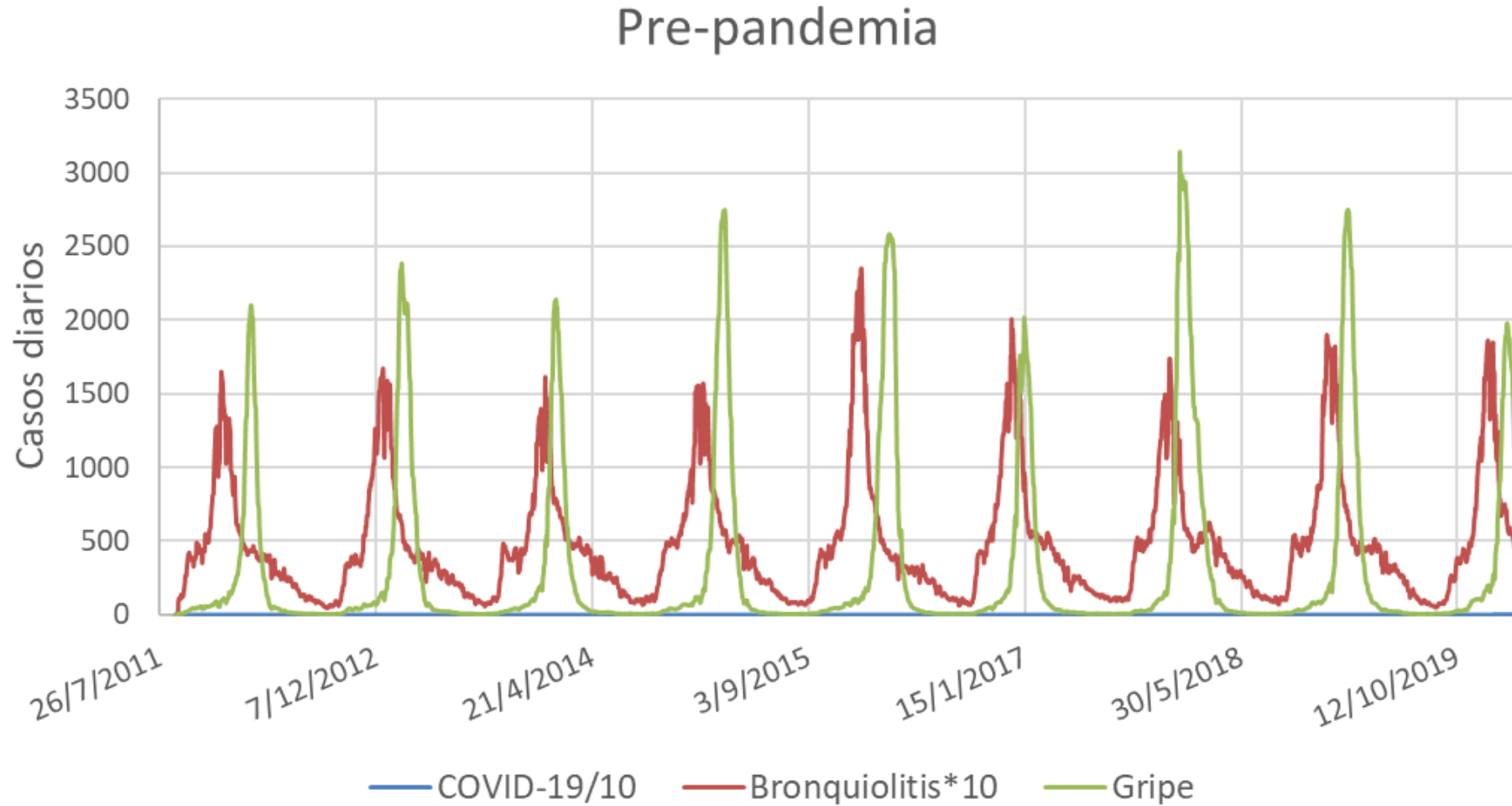
Estacionalidad



Factor humano

La “vieja normalidad” viral...

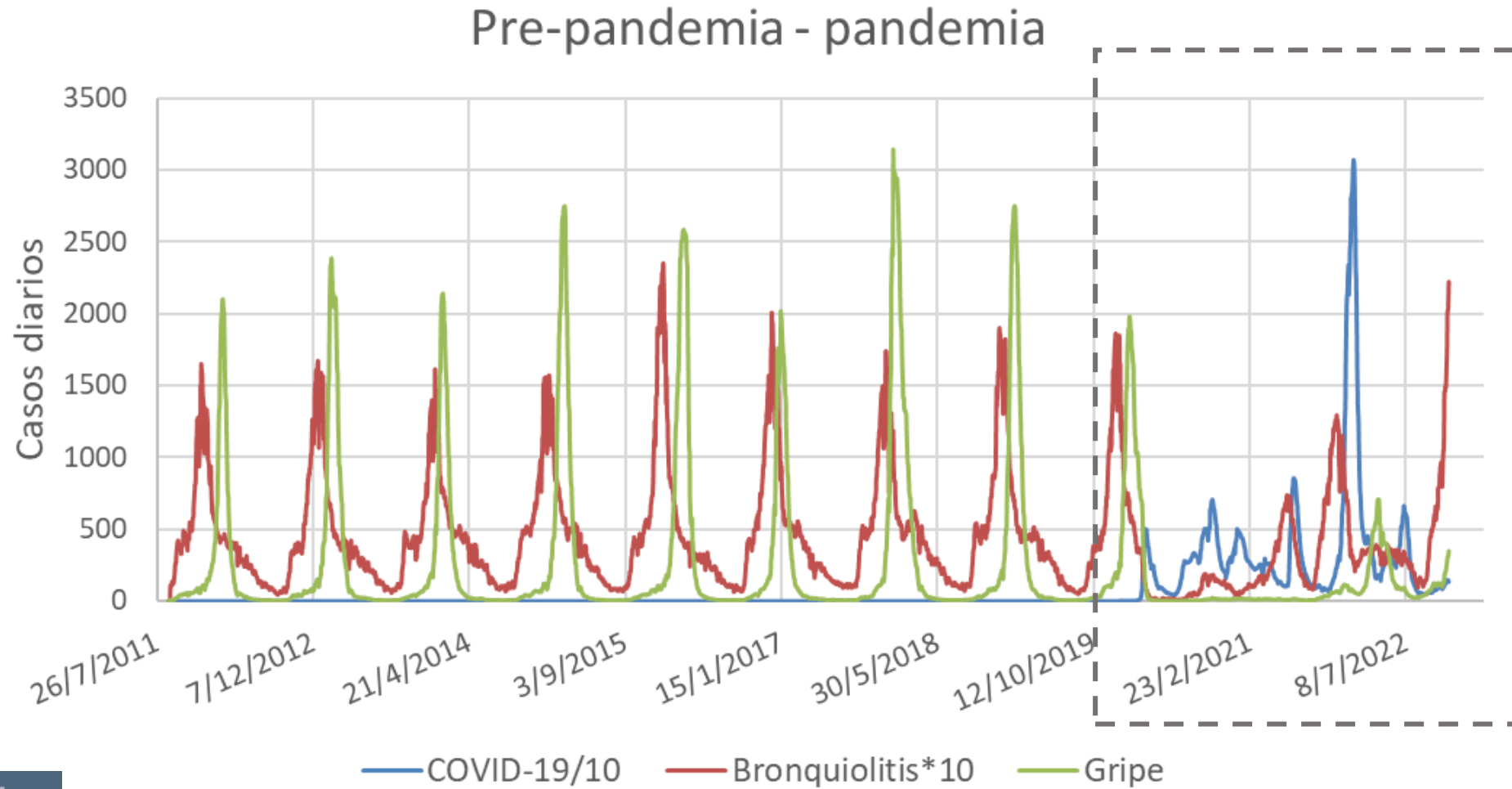
Diagnósticos sindrómicos en atención primaria - Cataluña



Datos:

Entra SARS-CoV-2 en juego...

Diagnósticos sintrómicos en atención primaria - Cataluña

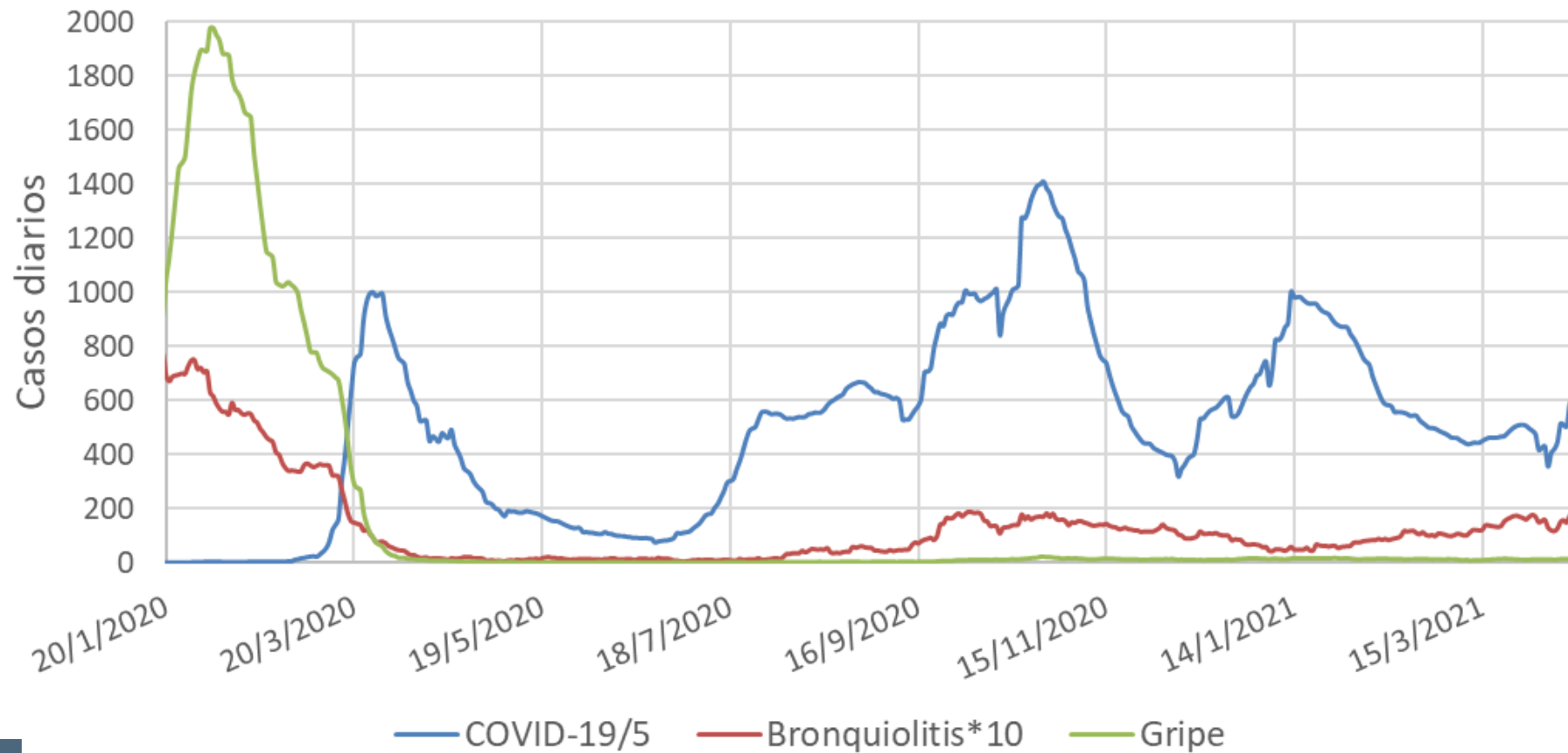


Datos:

Primer año de pandemia...

Diagnósticos sindrómicos en atención primaria - Cataluña

2020-2021 - Domina SARS-CoV-2

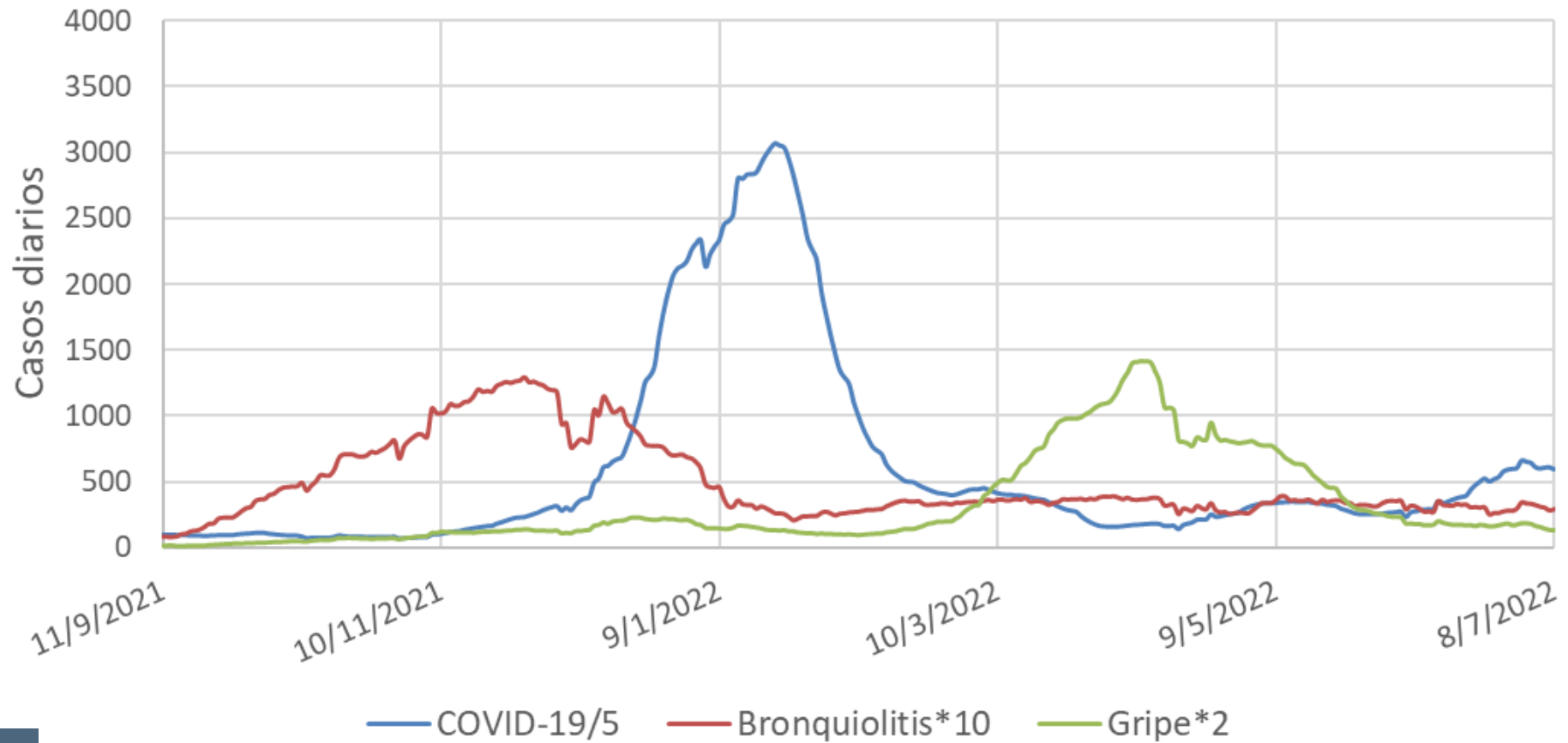


Datos:

Segundo año de pandemia... Empieza la transición

Diagnósticos sintrómicos en atención primaria - Cataluña

2021-2022 - Transición I



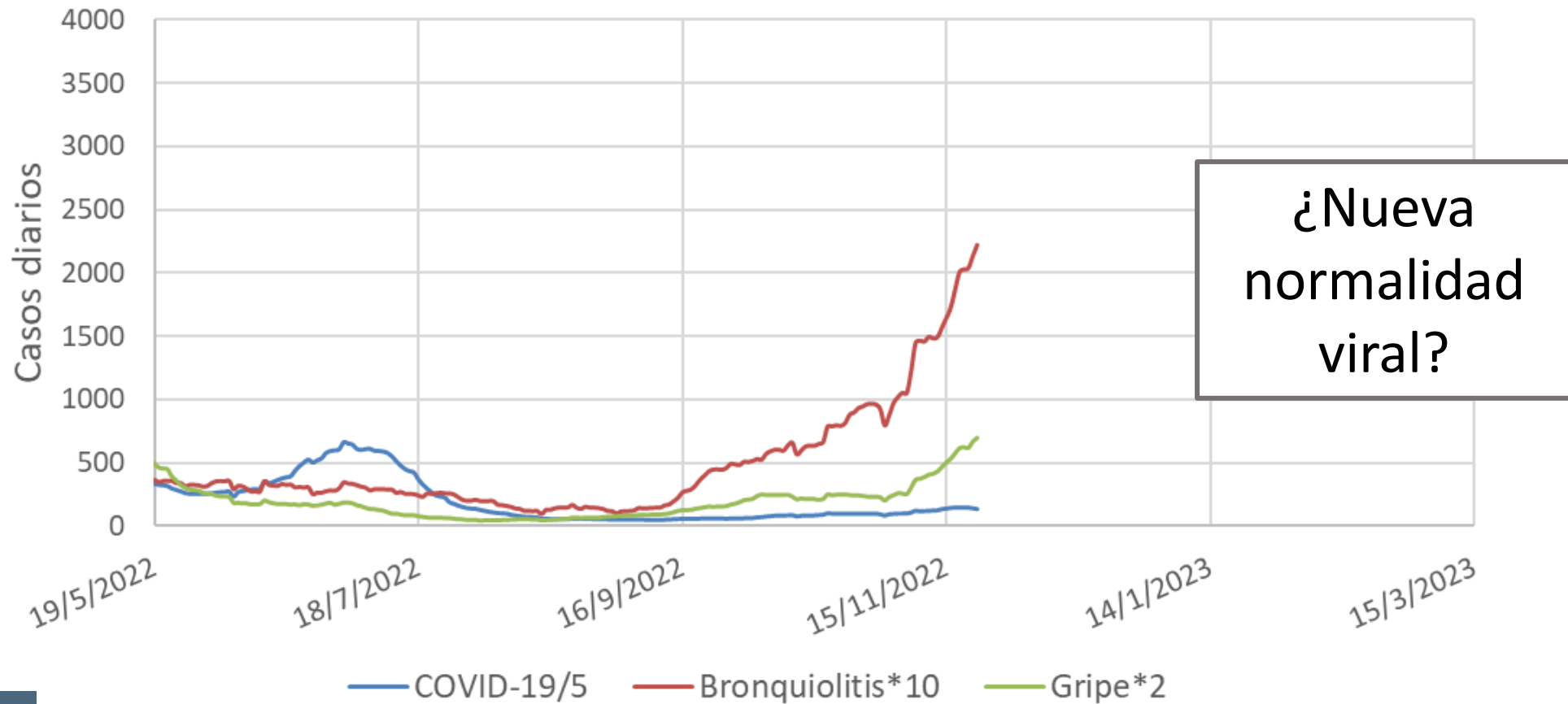
Datos:



Tercer año de pandemia... Seguimos en transición

Diagnósticos sintrómicos en atención primaria - Cataluña

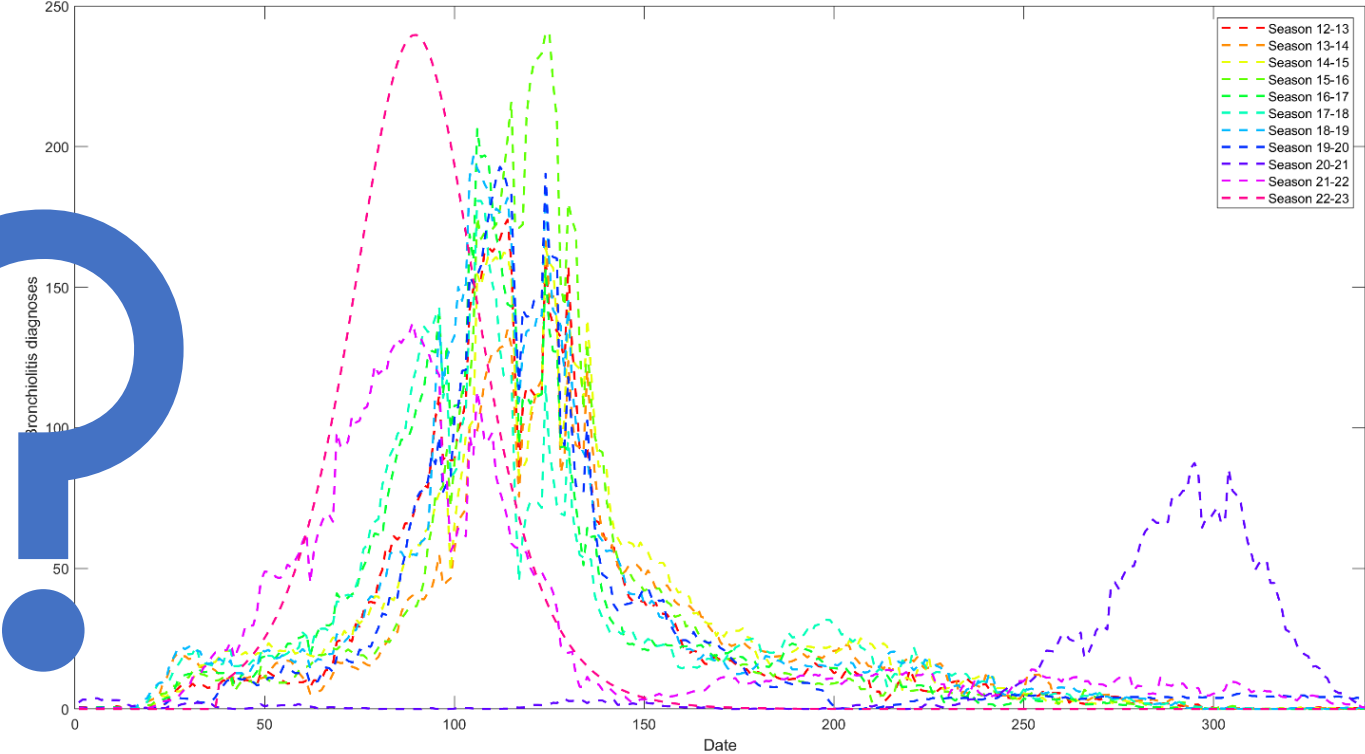
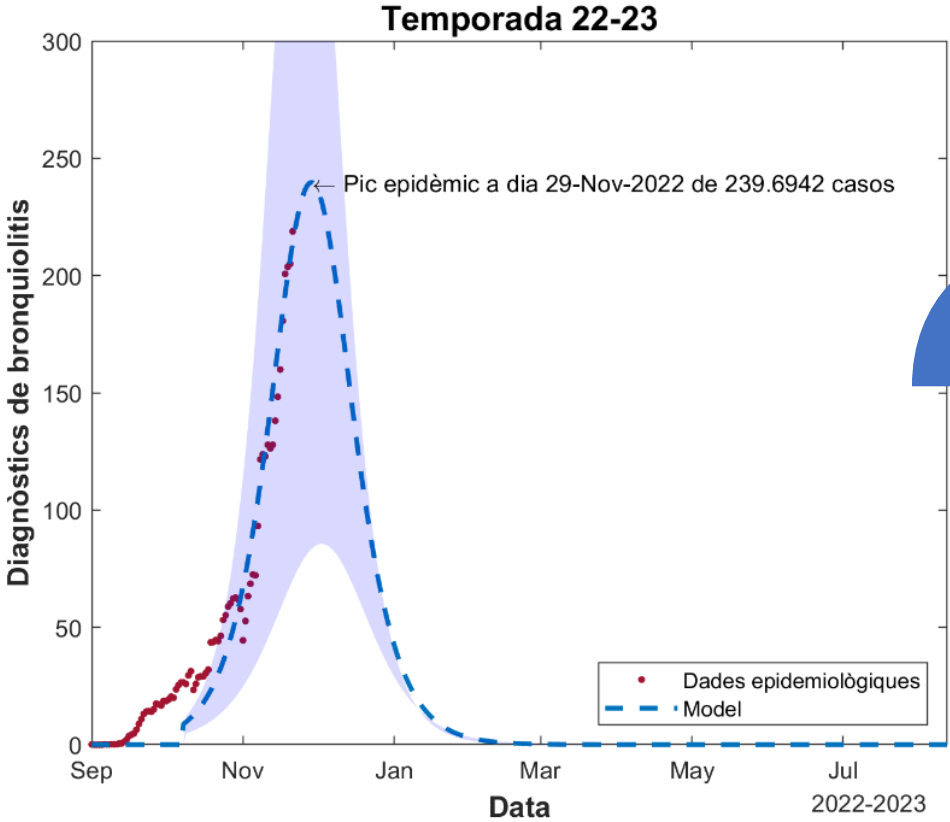
2021-2022 - Transición II



Datos:

Predicciones para esta temporada. Bronquiolitis.

Diagnósticos sintrómicos en atención primaria - Cataluña



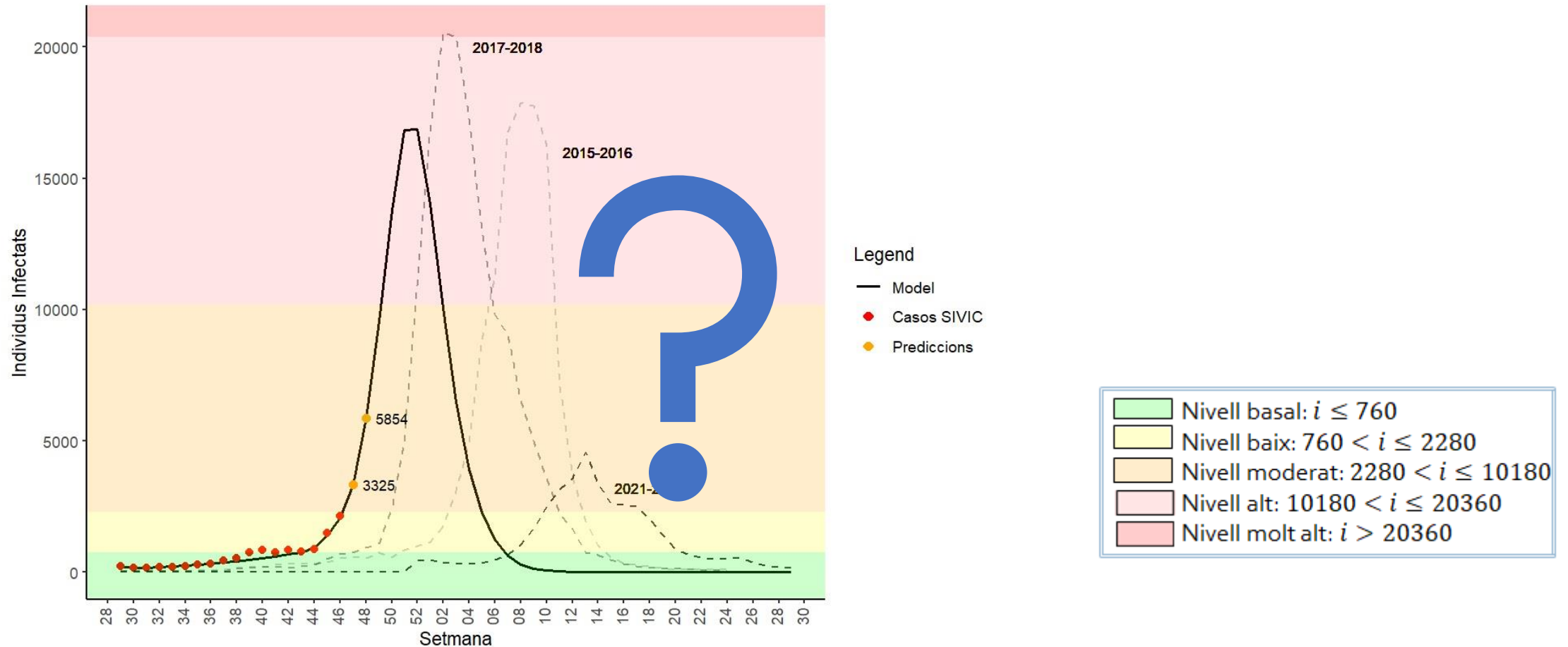
Datos:



Modelo y gráficas: Aida Perramon

Predicciones para esta temporada. Gripe.

Diagnósticos sintromicos en atención primaria - Cataluña



Datos:



Modelo y gráficas: Mario Bravo

Conclusiones...



Continuará...

Últimas (pero no menos importantes) reflexiones sobre el uso de modelos computacionales en salud pública

La **interdisciplinariedad** no es controlar todas las disciplinas, sino trabajar en estrecha colaboración con especialistas de otras disciplinas.



Los **modelos** nunca deben confundirse con la **realidad**: pueden proporcionar información extremadamente útil, pero debe ponerse en el contexto preciso, incluidas las limitaciones.





¡Muchas gracias!

Clara Prats, PhD

Computational Biology and Complex Systems (BIOCOM-SC) – UPC
Centre for Comparative Medicine and Bioimage (CMCiB)
Grup Interdisciplinari de Professionals Vinculats amb la Salut (GIPS)

Barcelona, 25 de novembre de 2022

