A new modelling toolbox for simulating COVID-19 non-pharmaceutical and vaccination intervention scenarios

Headlines

- The JRC COVID Scenario Analysis Toolbox simulates the effect of control and vaccination strategies in EU countries and regions.
- It can simulate precise vaccination strategies combined with non-pharmaceutical measures starting from today's situation.
- It is already used by Member States, Commission Services and EU Agencies.
- JRC developed the tool in close collaboration with the European Centre for Disease Control and the European Medicines Agency.
- Link: https://covid-model.azurewebsites.net (on request).

What if...

Since the beginning of the COVID pandemic, governments have had the difficult task to balance strong interventions to protect the health of citizens with the need to sustain social and economic activity. The roll-out of the vaccine further complicates the challenge to anticipate impacts. **With an increasing proportion of citizens protected by the vaccine, governments can progressively relax non-pharmaceutical interventions** (such as lockdowns), but risk new waves if de-escalating too fast. Decisions are made under high uncertainty and high regional differences.

Mathematical models have been a crucial tool to anticipate the effects of the outbreak on public health and on economic activity[i]. However, uncertainty on the virus' properties, citizen's behaviour and the effect of interventions strongly limit the accuracy of any forecasts. Instead of predicting the future, the power of mathematical models lays in their use to weigh different courses of action against each other. They can **simulate the likely outcome on health and economy of different scenarios of intervention**.

JRC COVID-19 Scenario Analysis Toolbox (SAT)

The EU's epidemiological space

The JRC has developed a new interactive platform to support **scenario analysis for all EU countries and their regions**. It is called the JRC COVID-19 Scenario Analysis Toolbox, or SAT for short.

Using SAT, experts can define intervention scenarios individually for each country, separate for each region, or – to explore harmonized approaches across the EU – a single intervention scenario can be developed and applied to all EU regions. Furthermore, experts can encode realistic vaccination strategies including timeline, rate, efficacy, etc., either to approximate current national strategies or to explore alternatives.
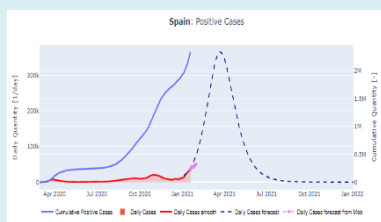
No control and no vaccination.

Lockdowns triggered by infection rate thresholds show a sequence of waves.
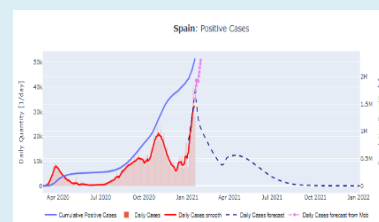
Vaccination roll-out reduces the need for lockdowns, possibly with a low fourth wave.

Example of scenarios for Spain: (left) no intervention, (middle) lockdowns without vaccination, (right) vaccination and lockdowns. Data from 15 Jan 2020. Data can be downloaded for further analysis.

Joint Research Centre

The SAT platform simulates the COVID-19 epidemiological behaviour. The platform allows analysts to choose several parameters and to see immediately their effect on the number of **positive cases, the number of patients admitted in Intensive Care Units (ICUs), the number of fatalities, as well as the number of days a region will be under lockdown conditions**.

The platform provides figures that can easily be interpreted. It also allows data to be exported for further analysis depending on the sectoral or national context.

In addition, the platform shows real-time data on vaccination rates (from open sources) and on mobility of citizens. Such data can help analysts to finetune scenarios and/or anticipate changes in outbreak dynamics.

What it is not: limitations
The platform does not provide forecasts of what will happen. The results depend on the choices for intervention that the user makes. It may or may not reflect the intervention policy that is implemented at national or regional level. Therefore, it is a **scenario analysis and not a forecasting system.** Its objective is to support experts that can judge parameters of plausible scenarios.

The models assume a homogeneous population. They do not account for age or underlying conditions of population. The simulation do not account for case importation across regional or national borders.

The **many uncertainties** related to new variants of the virus, the level of protection of the vaccine, the reduction of transmissibility due to the vaccine, effectiveness of non-pharmaceutical measures etc. are captures in a set of practical parameters that can be manipulated by the users.

Models and data
The SAT platform uses the **JRC's epidemiological COVID-19 model**. It is a SIRV model (modelling susceptible, infected, recovered, vaccinated populations) developed in collaboration with the European Centre for Disease Control. The model is calibrated for each region separately based on the latest 15 days of reported COVID epidemiological data.

The platform only uses **authoritative epidemiological data** published by Member States. Data are collected daily, at subnational level if available, and stored in the JRC epidemiological database[ii]. **Vaccination data** are from open source, and **mobility data** from Mobile Network Operators[iii] and Google.

Who is using it?
The toolbox was developed on request of the **European Medicines Agency (EMA)** to provide insight in capacity constraints for intensive care units (ICU). Through EMA, it was presented to **Member States** on 10 February 2021. Some Member State authorities have requested access to the tool and are using it to run scenarios.
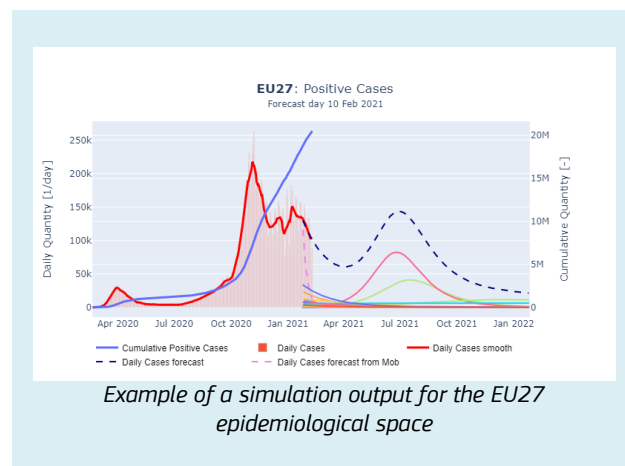
Example of a simulation output for the EU27 epidemiological space

The SAT toolbox was presented to some **Commission services** for them to inform analyses for civil protection operations and economic forecasts.

The tool was presented to **EU regions** though the Committee of the Regions on 10 February 2021.

Access
The JRC COVID-19 Scenario Analysis Toolbox (SAT) is available online at the following link:

https://covid-model.azurewebsites.net

Access is on need-to-know basis for competent authorities and experts. It requires an ECAS account.

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[i] De Groeve, T., A. Annunziato, L. Galbusera, G. Giannopoulos, S. Iacus, M. Vespe, J.M. Rueda Cantuche, A. Conte, B. Sudre, H. Johnson, Scenarios and tools for locally targeted COVID-19 Non Pharmaceutical Intervention Measures, EUR 30523 EN,
Publications Office of the European Union, Luxemburg, 2020, ISBN 978-92-76-27810-8, doi:10.2760/893842, JRC122800.

[ii] The JRC COVID-19 database is available at https://covid-statistics.jrc.ec.europa.eu. The database hosts sub-national data on COVID cases and fatalities, as well as containment measures adopted by national/regional authorities to reduce transmission of COVID-19. The response measures database is a collaboration of JRC and ECDC.

[iii] Under a public private partnership, JRC collects anonymized mobility data from 14 Mobile Network Operators in 19 EU Member States. https://ec.europa.eu/jrc/en/news/coronavirus-mobility-data-provides-insights-virus-spread-and-containment-help-inform-future

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