Iran COVID-19 epidemic models situation report No 14 – 1400-06-01, 2021-08-23

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Based on uptake 20210819 in https://github.com/pourmalek/covir2
Study update dates in uptake 20210819:
DELP 20210819, ***IHME 20210819***, IMPE 20210806, LANL 20210815, SRIV 20210819

DELP: model by Massachusetts Institute of Technology, Cambridge
IHME: model by Institute for Health Metrics and Evaluation, Seattle
IMPE: model by Imperial College, London
LANL: model by Los Alamos National Laboratories, Los Alamos
SRIV: model by Srivastava, Ajitesh, University of Southern California, Los Angeles

Executive Summary

This report shows the trajectory of daily deaths, infections, bed needs, and ICU bed needs for Iran, estimated by five international and periodically updating COVID-19 epidemic models.

The graphs show the predictions for *when* and *how much* increase/decrease in infections, deaths, and bed needs.

Table 1 on the next page summarizes the predictions in this uptake.

Predictions by IHME of daily deaths reach their peak of 1,806 on 21-08-29 (reference scenario, mean), 2,832 on 21-09-05 (reference scenario, upper 95% uncertainty limit), 1,806 on 21-08-29 (worse scenario, mean), and 3,167 on 21-10-18 (worse scenario, upper). Predictions by IHME of daily infections reach their peak of 289,635 on 21-08-11 (reference scenario, mean), 455,409 on 21-08-14 (reference scenario, upper), 292,510on 21-08-20 (worse scenario, mean), and 519,514 on 21-09-23 (worse scenario, upper).

Predictions by IHME of total deaths on 21-12-01 reach 314,369 (reference scenario, mean), 361,754 (reference scenario, upper), 380,817 (worse scenario, mean), and 434,468 (worse scenario, upper). Predictions by IHME of total infections on 21-12-01 reach 54,442,668 (reference scenario, mean) and 76,622,968 (reference scenario, upper 95% uncertainty limit).

This report summarizes the results of a project named *CovidVisualized covir2*, an online tool developed to function as an early warning tool for technical advisers and health decision-makers.

Pre-print Data Note manuscript on Research Square, titled "CovidVisualized: Visualized compilation of international updating models' estimates of COVID-19 pandemic at global and country levels", 02 August 2021, PRE-PRINT (Version 1) available at Research Square [https://doi.org/10.21203/rs.3.rs-768714/v1] describes the methods and results of CovidVisualized tools: *CovidVisualizedCountry (for Canada),* CovidVisualizedGlobal (for global level), and covir2 (for Iran).

Farshad Pourmalek MD MPH PhD, who has created the *covir2* tool (and CovidVisualizedCountry and CovidVisualizedGlobal tools) and this report is a physician and epidemiologist who worked in School of Population and Public Health of University of British Columbia and Vancouver General Hospital, University of Washington, WHO, UNDEP, and UNICEF. ORCID ID https://orcid.org/0000-0002-2134-0771 , PubMed.

Table 1 – Daily outcomes' peak values and dates and total outcomes' values on the last date of estimates available in this update of IHME model (21-12-01) and IMPE model (21-11-03) for Iran

	IHME value	IHME date	IMPE value	IMPE date
Daily deaths reference scenario, mean	1,806	21-08-29	413	21-08-09
Daily deaths reference scenario, upper	2,832	21-09-05	510	21-08-14
Daily deaths worse scenario, mean	1,806	21-08-29	1,358	21-09-10
Daily deaths worse scenario, upper	3,167	21-10-18	1,633	21-09-08
Daily infections reference scenario, mean	289,635	21-08-11	181,446	21-08-05
Daily infections reference scenario, upper	455,409	21-08-14	213,188	21-08-08
Daily infections worse scenario, mean	292,510	21-08-20	N/A	N/A
Daily infections worse scenario, upper	519,514	21-09-23	N/A	N/A
Total deaths reference scenario, mean	314,369	21-12-01	113,142	21-11-03
Total deaths reference scenario, upper	361,754	21-12-01	120,270	21-11-03
Total deaths worse scenario, mean	380,817	21-12-01	160,758	21-11-03
Total deaths worse scenario, upper	434,468	21-12-01	171,639	21-11-03
Total infections reference scenario, mean	54,442,668	21-12-01	40,126,948	21-11-03
Total infections reference scenario, upper	76,622,968	21-12-01	42,868,760	21-11-03
Total infections worse scenario, mean	N/A	N/A	60,041,520	21-11-03
Total infections worse scenario, upper	N/A	N/A	62,675,944	21-11-03

IHME: Institute for Health Metrics and Evaluation, University of Washington, Seattle
IMPE: Imperial College, London
N/A: Not available

Note: This update 20210806 of IMPE is dead at birth FOR IRAN. See graph for Iran here: (5) Daily deaths, 2021, reference scenario with uncertainty, IMPE. While JOHN and Worldometer web site show PCR-positive daily deaths officially report by Ministry of Health of Iran surpassed 411 on 20210802, the IMPE update 20210806 released on 20210813 says daily deaths will soon go below 400 in Iran.

What is this report, and where does it come from?

This report is the *14th* situation report of predictions of five international and periodically updating COVID-19 epidemic models about the future trajectory of the epidemic in Iran. The report is based on the **"covir2"** online tool, that is a GitHub repository for sharing data and codes, available at https://github.com/pourmalek/covir2
This report is meant to serve as an offline and stand-alone version of the online tool. Situation Reports are available online at
https://github.com/pourmalek/covir2/tree/main/situation%20reports

Objectives of the "covir2" tool are to identify international and periodically updated models of the COVID-19 epidemic, compile and visualize their estimation results, and periodically update the compilations.

The ultimate objective is to provide an ***early warning system*** for technical advisors to the decision-makers. When the predictions of one or more models show an increase in daily cases or infections, hospitalizations, or deaths in the near future, ***technical advisors to the national and subnational decision-makers*** may consider suggesting augmentation of non-pharmacologic preventive interventions and vaccination. In doing so, the strengths and weaknesses of individual models need to be considered and those of this work. Models' estimates demonstrate the trajectory of COVID-19 deaths, cases or infections, and hospital-related outcomes in one to three months into the future.

The "CovidVisualized" project includes https://github.com/pourmalek/covir2 for Iran, https://github.com/pourmalek/CovidVisualizedCountry for Canada and its provinces, and https://github.com/pourmalek/CovidVisualizedGlobal for the global level.

Methods and technical details of this work are available in a pre-print Data Note manuscript on Research Square, titled "CovidVisualized: Visualized compilation of international updating models' estimates of COVID-19 pandemic at global and country levels", 02 August 2021, PRE-PRINT (Version 1) available at Research Square [https://doi.org/10.21203/rs.3.rs-768714/v1] describes the methods and results of CovidVisualized tools: *CovidVisualizedCountry (for Canada),* CovidVisualizedGlobal (for global level), and covir2 (for Iran).

Strengths and weaknesses of international and periodically updating COVID-19 epidemic models are discussed in Pourmalek F, Rezaei Hemami M, Janani L, Moradi-Lakeh M. Rapid review of COVID-19 epidemic estimation studies for Iran. BMC Public Health. 2021 Feb 1;21(1):257. doi: 10.1186/s12889-021-10183-3. PMID: 33522928.

Stata codes written and used for this whole work can be examined online and/or downloaded and re-run to check, securitize, verify, or flag any mistakes.
https://github.com/pourmalek/CovidVisualizedCountry#iii-inner-works-of-this-repository-1

Five international and periodically updating COVID-19 epidemic models:

DELP, IHME, IMPE, LANL, SRIV; and JOHN (these abbreviations are used in the graphs)

DELP: DELPHI. Differential Equations Lead to Predictions of Hospitalizations and Infections. COVID-19 pandemic model named DELPHI by Massachusetts Institute of Technology, Cambridge. *Reference:* COVID Analytics. DELPHI epidemiological case predictions. Cambridge: Operations Research Center, Massachusetts Institute of Technology. https://www.covidanalytics.io/projections and https://github.com/COVIDAnalytics/website/tree/master/data/predicted

IHME: Institute for Health Metrics and Evaluation. COVID-19 pandemic model by Institute for Health Metrics and Evaluation, Seattle. *Reference:* Institute for Health Metrics and Evaluation (IHME). COVID-19 mortality, infection, testing, hospital resource use, and social distancing projections. Seattle: Institute for Health Metrics and Evaluation (IHME), University of Washington. http://www.healthdata.org/covid/ and http://www.healthdata.org/covid/data-downloads

IMPE: Imperial. COVID-19 pandemic model by Imperial College, London. *Reference:* MRC Centre for Global Infectious Disease Analysis (MRC GIDA). Future scenarios of the healthcare burden of COVID-19 in low- or middle-income countries. London: MRC Centre for Global Infectious Disease Analysis, Imperial College London. https://mrc-ide.github.io/global-lmic-reports/ and https://github.com/mrc-ide/global-lmic-reports/tree/master/data

LANL: Los Alamos National Laboratories. COVID-19 pandemic model by Los Alamos National Laboratories, Los Alamos. *Reference:* Los Alamos National Laboratory (LANL). COVID-19 cases and deaths forecasts. Los Alamos: Los Alamos National Laboratory (LANL). https://covid-19.bsvgateway.org

SRIV: Srivastava, Ajitesh. COVID-19 pandemic model by University of Southern California, Los Angeles. *Reference:* Srivastava, Ajitesh. University of Southern California (USC). COVID-19 forecast. Los Angeles: University of Southern California. https://scc-usc.github.io/ReCOVER-COVID-19 and https://github.com/scc-usc/ReCOVER-COVID-19/tree/master/results/historical_forecasts

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JOHN: Johns Hopkins. Coronavirus resource center, Johns Hopkins University, Baltimore. Curation of official reports of countries to World Health Organization. **Ground truth for comparison**. *Reference:* Johns Hopkins University. Coronavirus resource center. https://coronavirus.jhu.edu/map.html and https://github.com/CSSEGISandData/COVID-19

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Models' updates and their acquisition in this work:

The two models with the least frequency of periodic updates of estimates are IHME and IMPE, which are updated on a weekly and bi-weekly basis, respectively. With the release of each update of either IHME or IMPE models, the whole set of the five included models are updated in the **covir2** GitHub repository. The most recent update of each model is used.

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Graphs of epidemic trajectory in Iran till 01 December 2021

Graphs of the most recent models' updates are shown here. These graphs, as well as graphs of previous updates, are available online at https://github.com/pourmalek/covir2

Logical order of graphs:

(1) *Outcomes*: Daily deaths, Daily cases or infections, Hospital-related outcomes, Daily deaths estimated to reported ratio, Daily cases or infections estimated to reported cases ratio.

(2) *Calendar time of estimates coverage*: All-time, followed by 2021. To view the whole epidemic trajectory and further focus on the near future.

(3) *Scenarios*: Reference scenarios, followed by alternative scenarios. To examine the main or reference (aka. status quo) scenario and alternative (better and worse) scenarios.

(4) *Five models*: Different models *within* each graph (for which model estimates update release dates are maximally synchronized), plus official reports of the country to WHO (curated by Johns Hopkins University) as the under-reported benchmark for trends. To examine how heterogeneity in methods used by different models results in heterogeneous results for the same outcome (same time-place-person aggregated units)

List of graphs

Names of models/studies in Farsi:

(JOHN) دانشگاه جانز هاپکینز، انعکاس گزارش های رسمی کشور ها به سازمان جهانی بهداشت (منحنی آبی رنگ)

(DELP) مطالعه دلفی، انستیتوی فناوری ماساچوست کمبریج (منحنی قرمز رنگ)

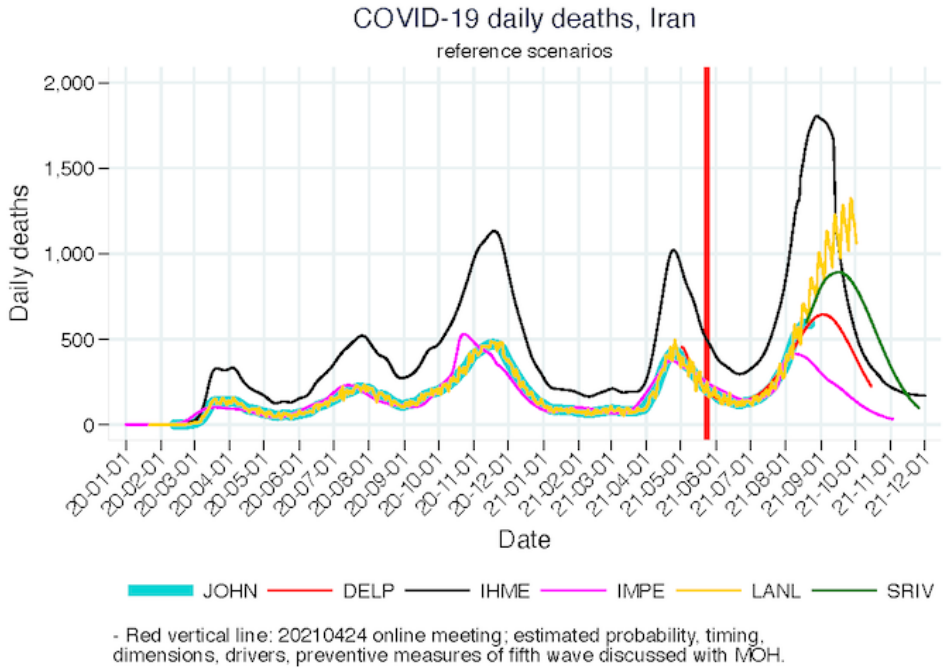
(IHME) مطالعه موسسه آی اچ ام ای، دانشگاه واشنگتن سیاتل (منحنی سیاه رنگ)

(IMPE) مطالعه ایمپریال کالج لندن (منحنی صورتی رنگ)

(LANL) مطالعه آزمایشگاه لس آلاموس نیو مکزیکو (منحنی طلایی رنگ)

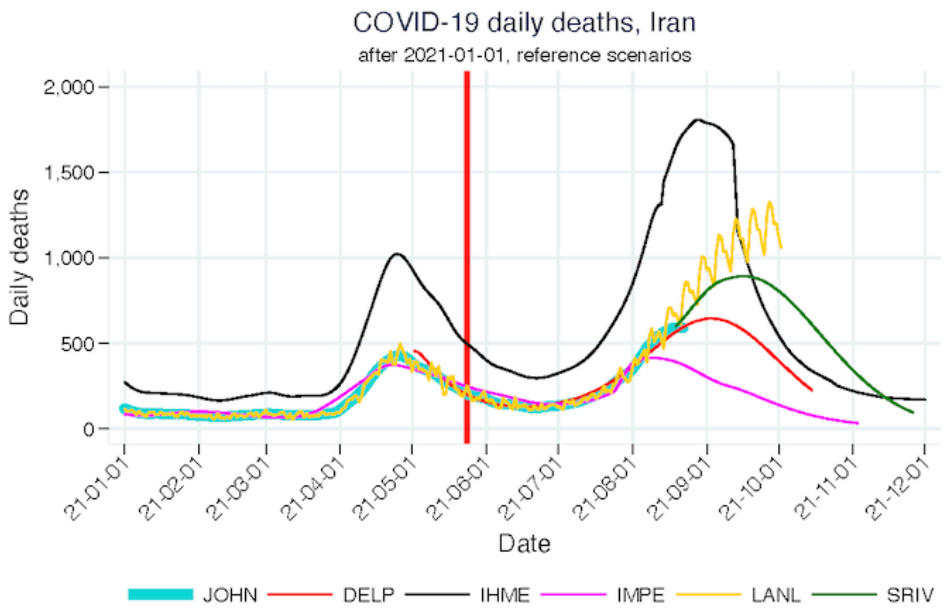
(SRIV) مطالعه اسریواستاوا در دانشگاه کالیفرنیای جنوبی (منحنی سبز رنگ)

(1) Daily deaths, all time



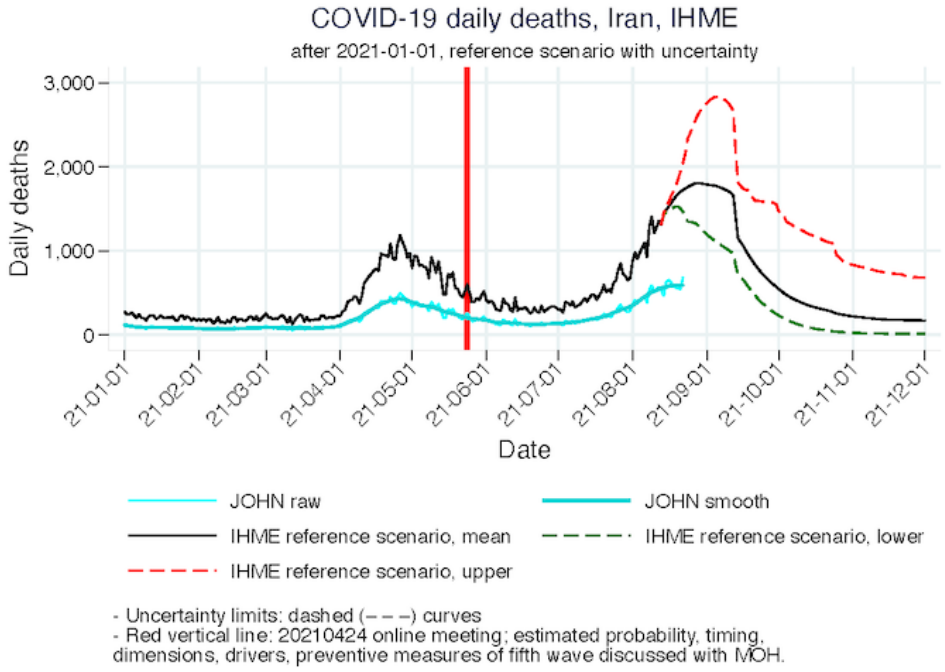
- Red vertical line: 20210424 online meeting; estimated probability, timing, dimensions, drivers, preventive measures of fifth wave discussed with MOH.

(2) Daily deaths, 2021

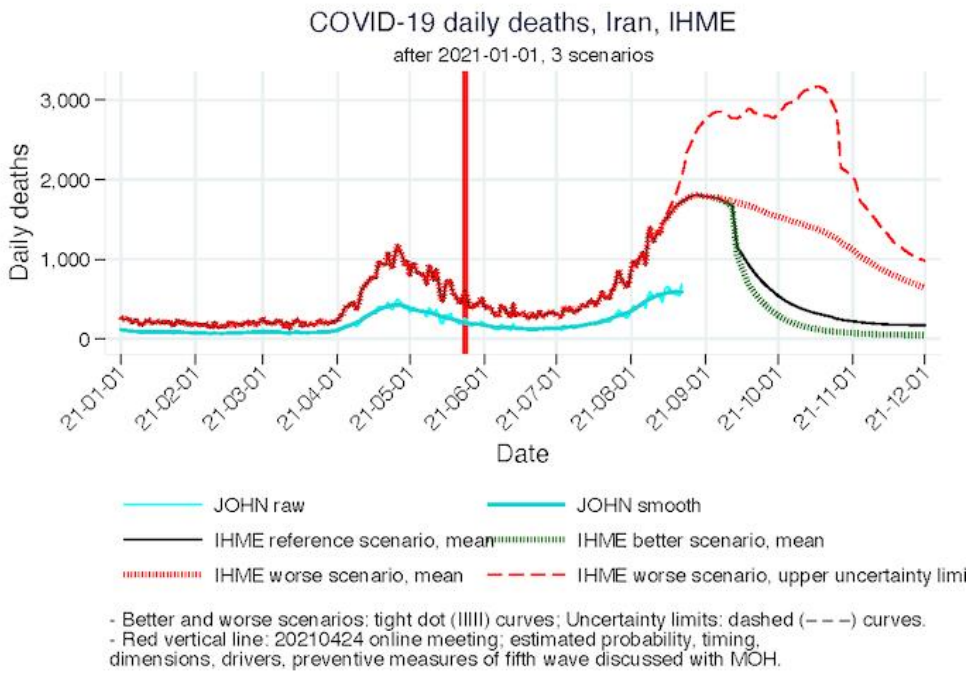


- Red vertical line: 20210424 online meeting; estimated probability, timing, dimensions, drivers, preventive measures of fifth wave discussed with MOH.

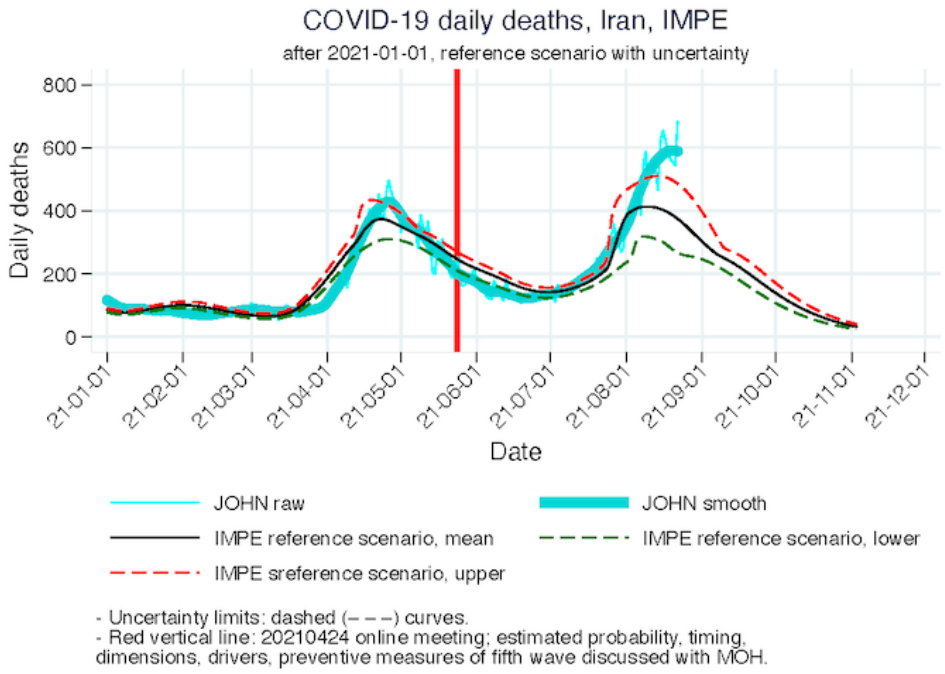
(3) Daily deaths, 2021, reference scenario with uncertainty, IHME



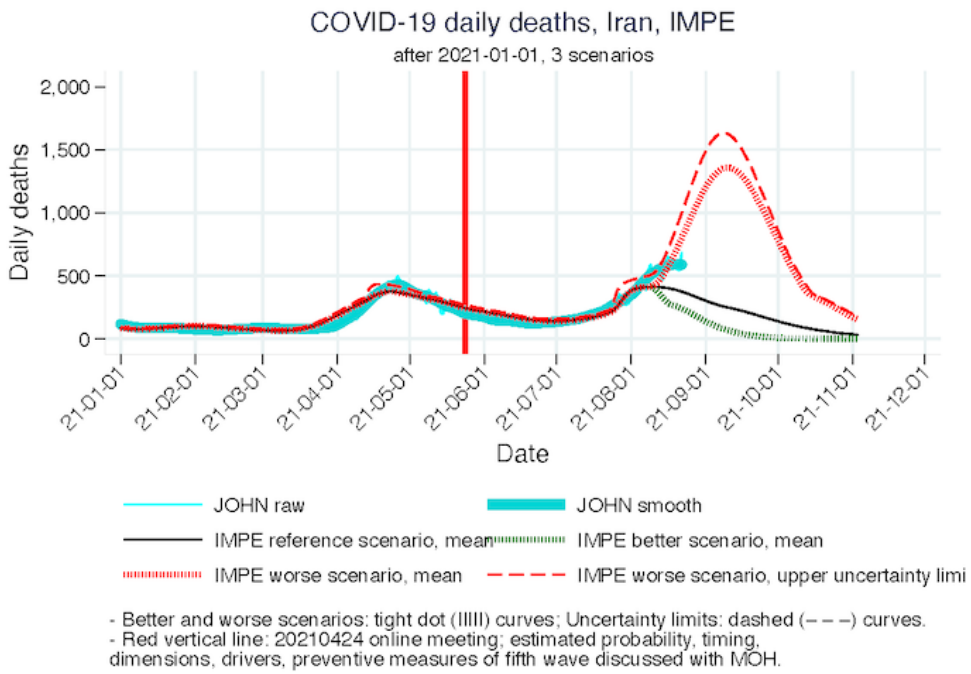
(4) Daily deaths, 2021, 3 scenarios, IHME



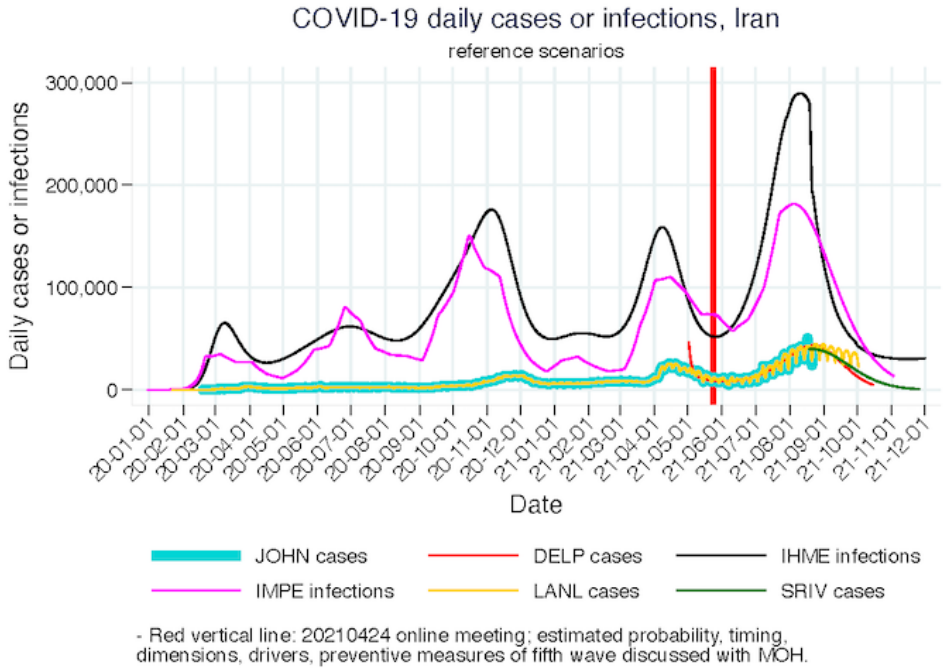
(5) Daily deaths, 2021, reference scenario with uncertainty, IMPE



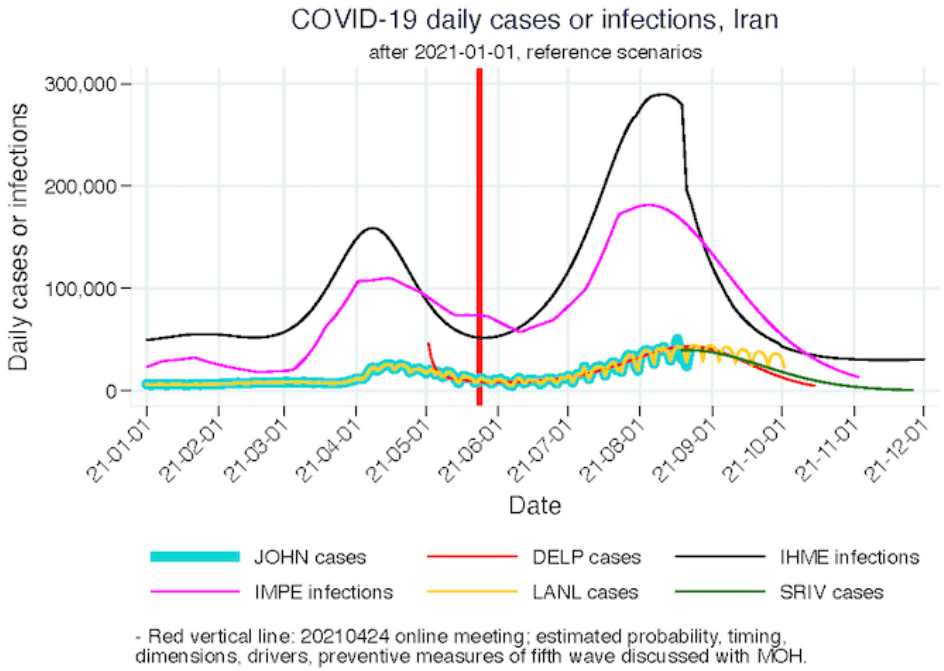
(6) Daily deaths, 2021, 3 scenarios, IMPE



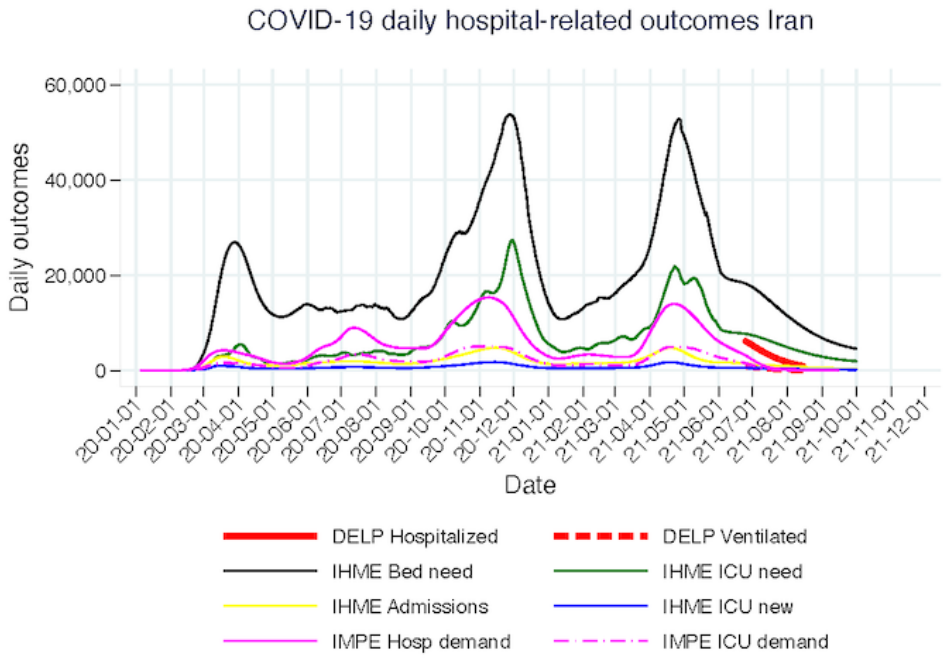
(7) Daily cases or infections, all time



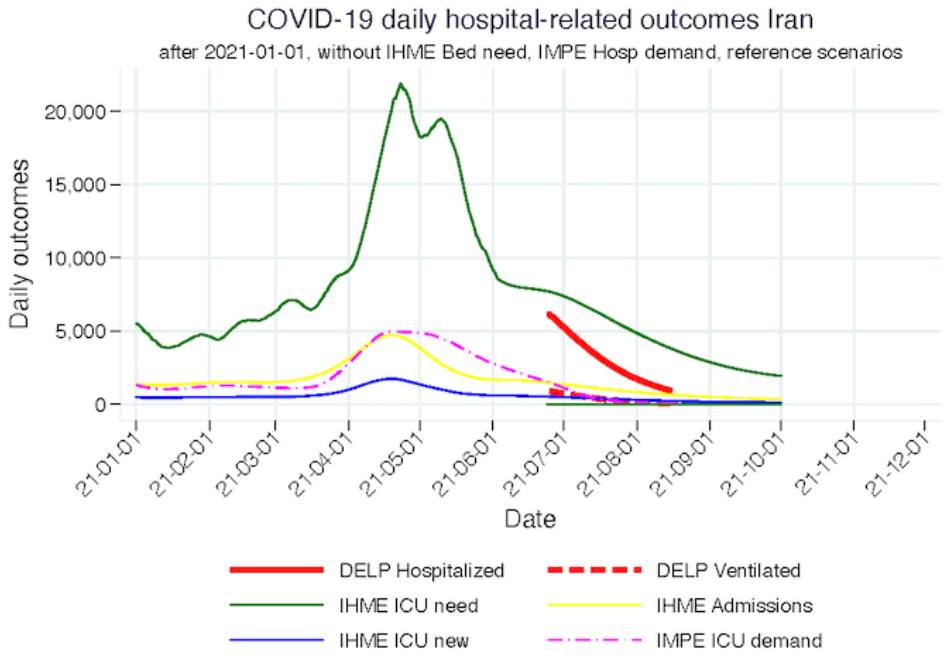
(8) Daily cases or infections, 2021



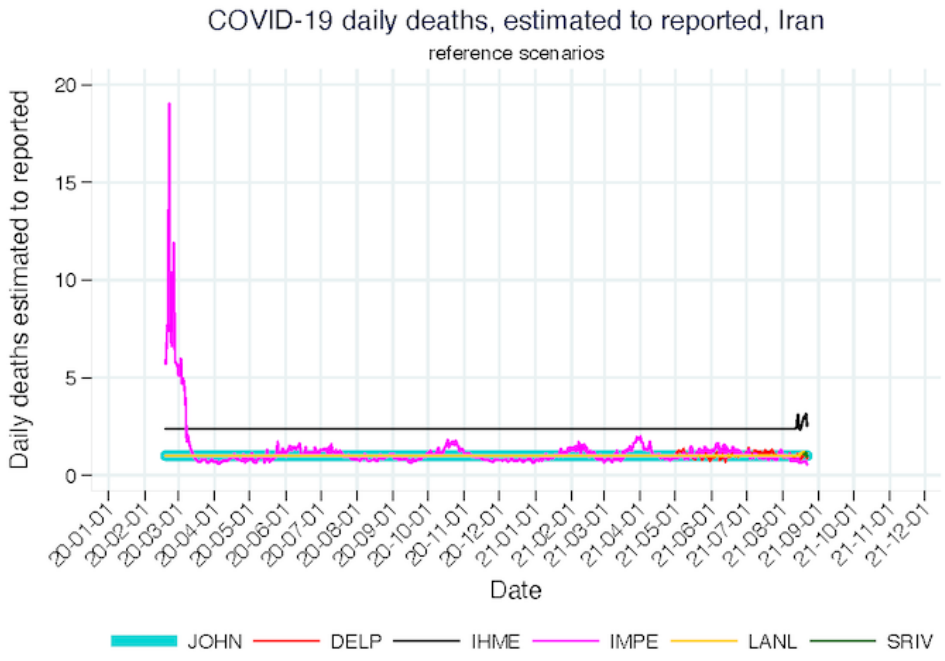
(9) Hospital-related outcomes, all time



(10) Hospital-related outcomes, 2021



(11) [Daily deaths estimated to reported, all time]



(12) [Daily cases or infections estimated to reported cases, 2021]