Iran COVID-19 epidemic models situation report No 18 – 1400-06-29, 2021-09-20

Farshad Pourmalek MD PhD
Former lecturer, University of British Columbia, Vancouver | UBC SPPH | ORCID | PubMed
pourmalek_farshad@yahoo.com

Based on uptake 20210920 in https://github.com/pourmalek/covir2
Study update dates in uptake 20210920:
DELP 20210920, IHME 20210920, ***IMPE 20210909***, LANL 20210919, SRIV 20210920

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

IHME predicts in its 20200916 update for Iran a gradual uprise of cases to start in late-October (end-of-MEHR to early-ABAN), followed by a gradual uprise of deaths starting in mid-November (late ABAN) (reference scenario). Their predicted R effective starts to rise in mid-September (late SHAHRIVAR) and surpasses 1.0 in November (ABAN) (reference scenario) or easier, in October (MEHR) in worse scenario. Population mobility reduction is returning to pre-pandemic era levels, as of 20200916, and mask use is less than 50%.

IMPE update 20210909 (released on 20210920) is almost dead at birth since predicted daily deaths was less than report daily deaths during the overlap interval.

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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.

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.

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

This report is the *18th* 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. *Summary, HERE*.

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 January 2022

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.

Followed by extra outcomes estimated by IHME and added starting from uptake 20210916, i.e., R effective, Daily Infection-outcome ratios, Daily mobility, Daily mask use, and (Percent) cumulative vaccinated.

(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)

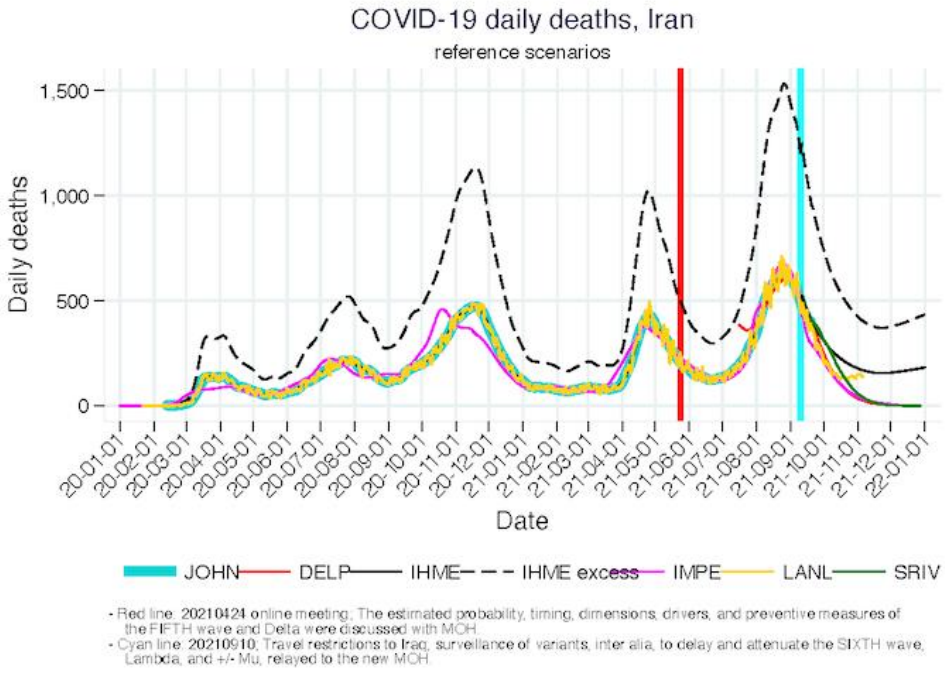
(IHME) مطالعه موسسه آی اچ ام ای، دانشگاه واشنگتن سیاتل (منحنی سیاه رنگ)

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

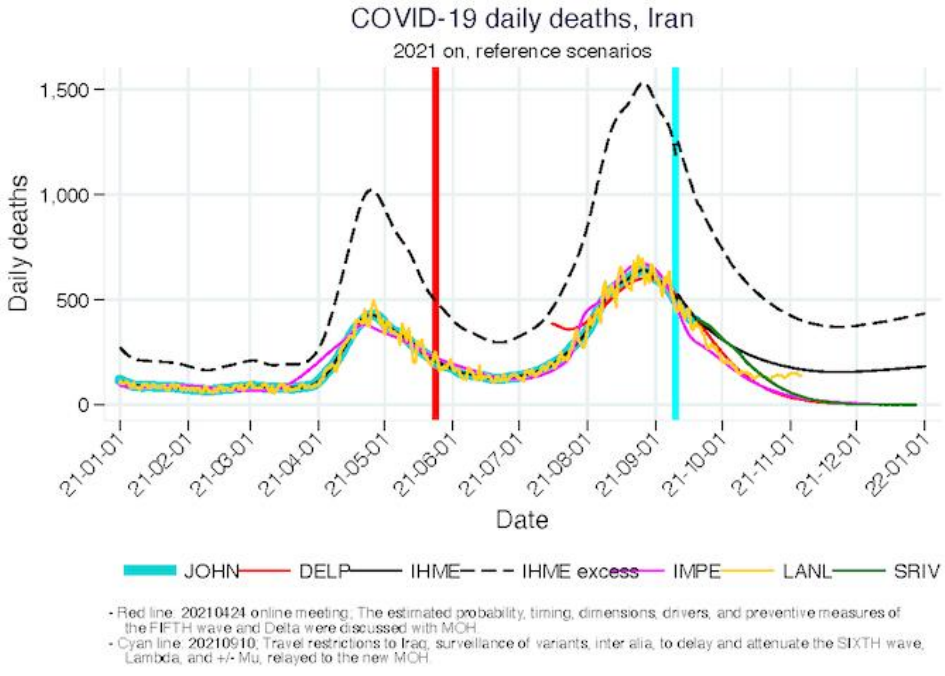
(LANL) مطالعه آزمایشگاه لس آلاموس نیو مکزیکو (منحنی طلایی رنگ)

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

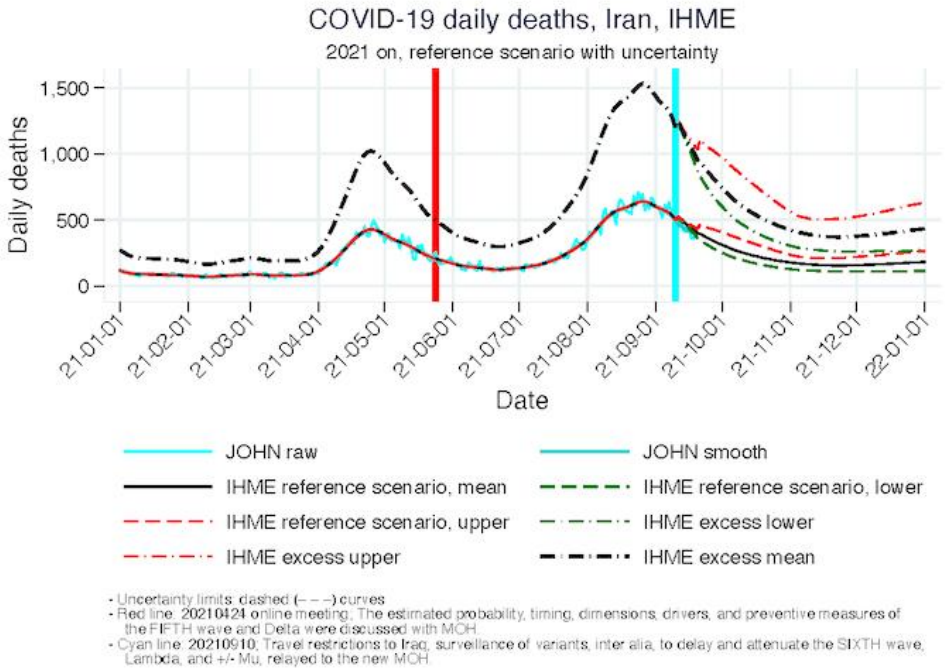
(1) Iran [Daily deaths, all time]



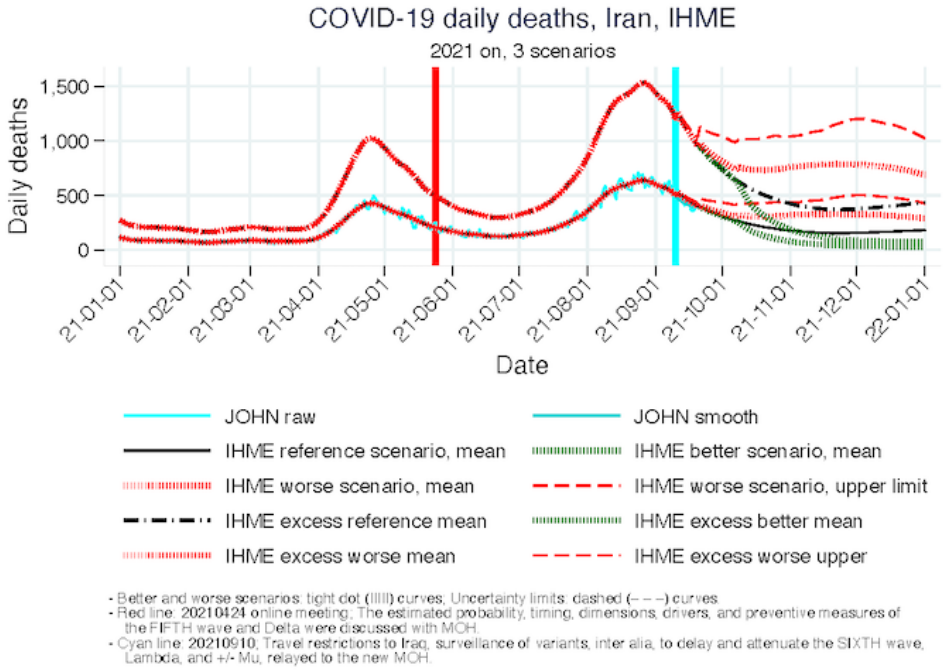
(2) Iran [Daily deaths, 2021]



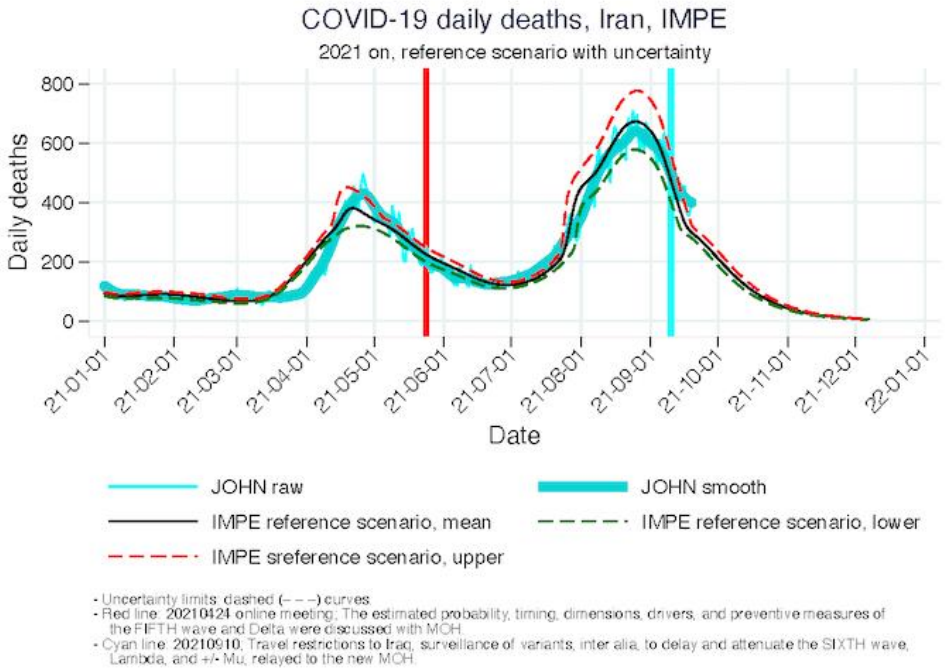
(3) Iran [Daily deaths, 2021, reference scenario with uncertainty, IHME]



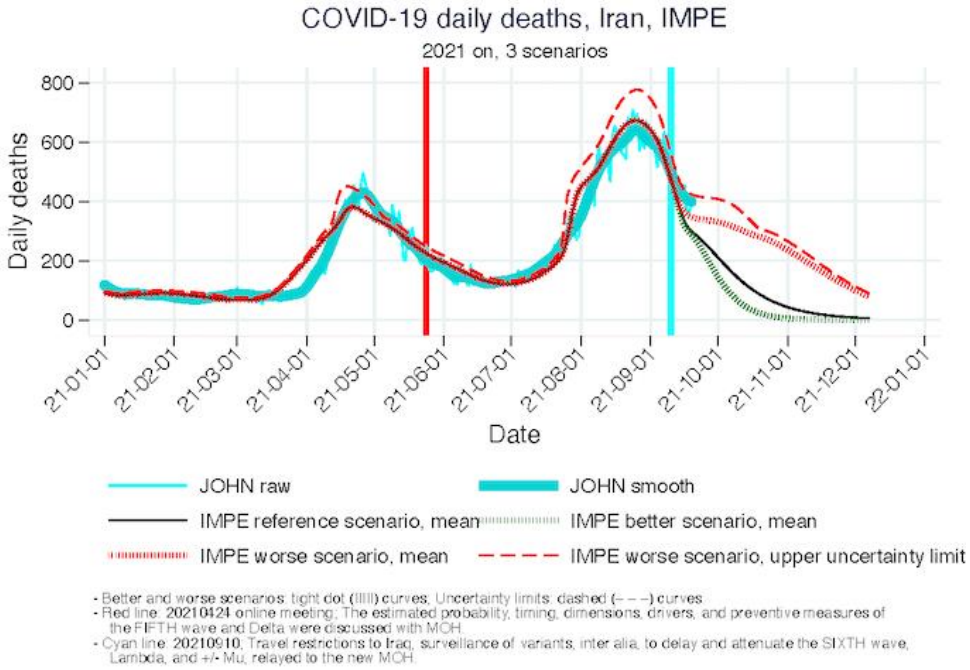
(4) Iran [Daily deaths, 2021, 3 scenarios, IHME]



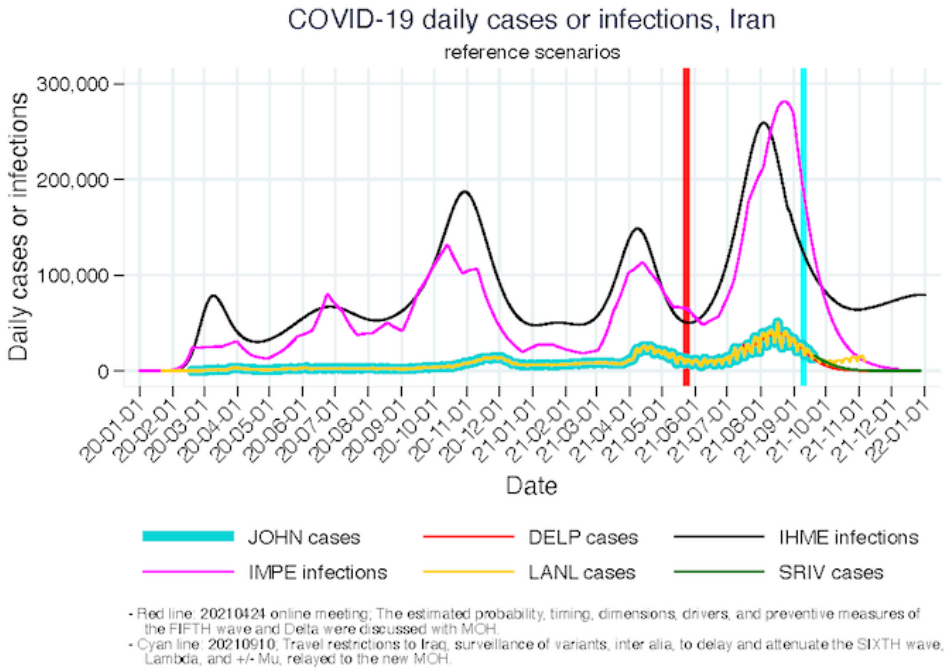
(5) Iran [Daily deaths, 2021, reference scenario with uncertainty, IMPE]



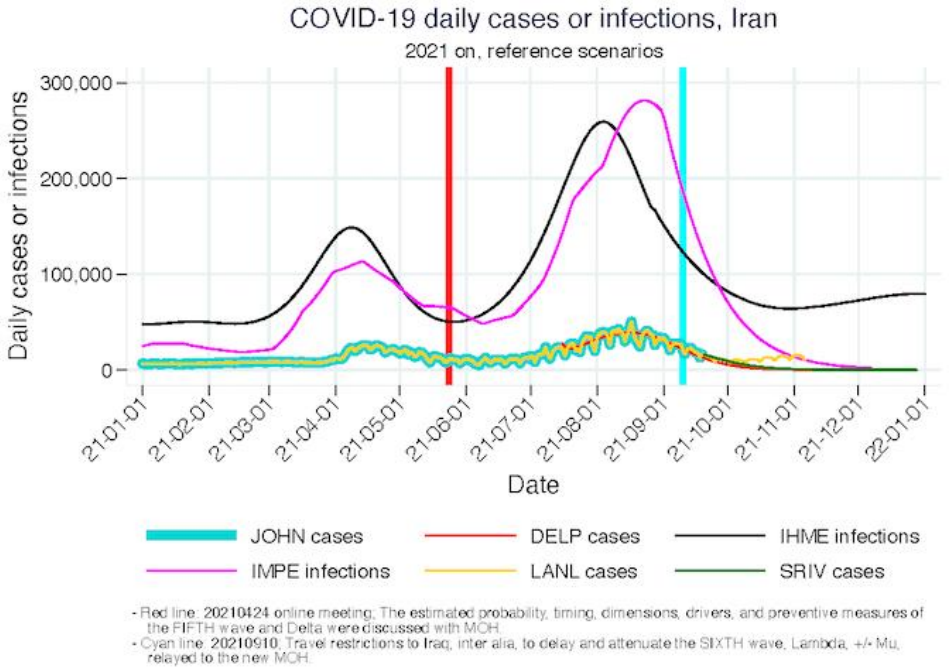
(6) Iran [Daily deaths, 2021, 3 scenarios, IMPE]



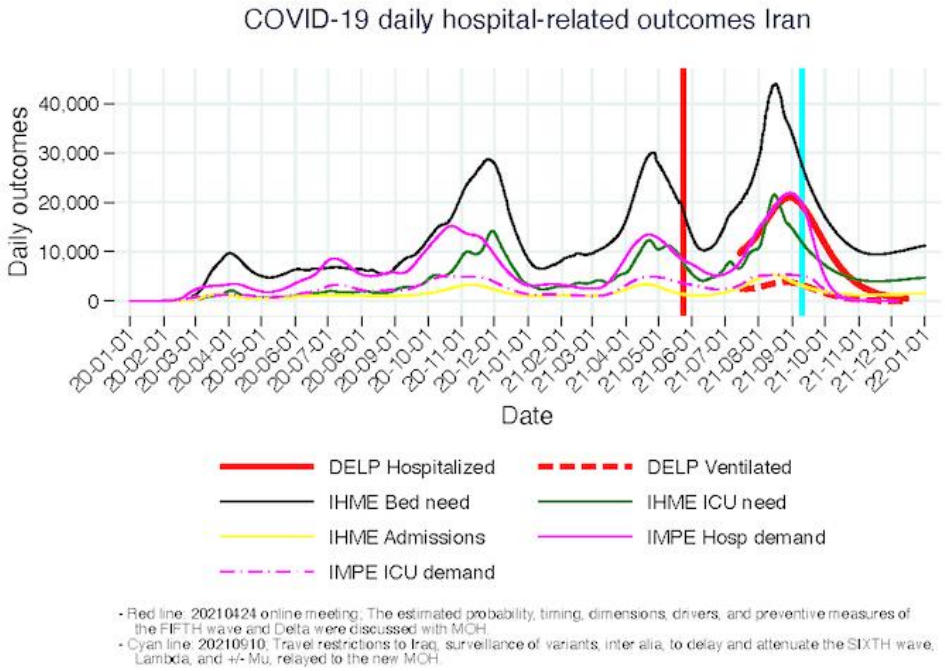
(7) Iran [Daily cases or infections, all time]



(8) Iran [Daily cases or infections, 2021]

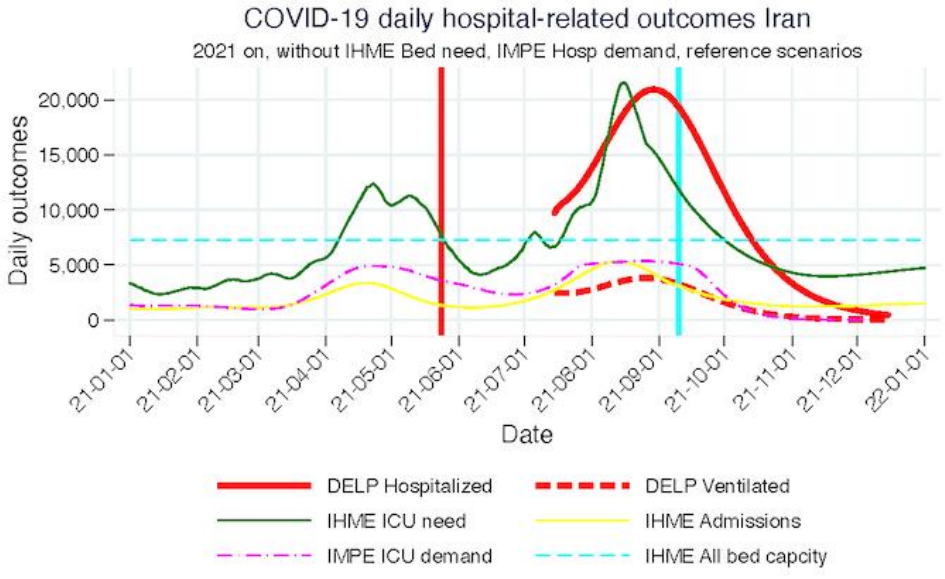


(9) Iran [Hospital-related outcomes, all time]



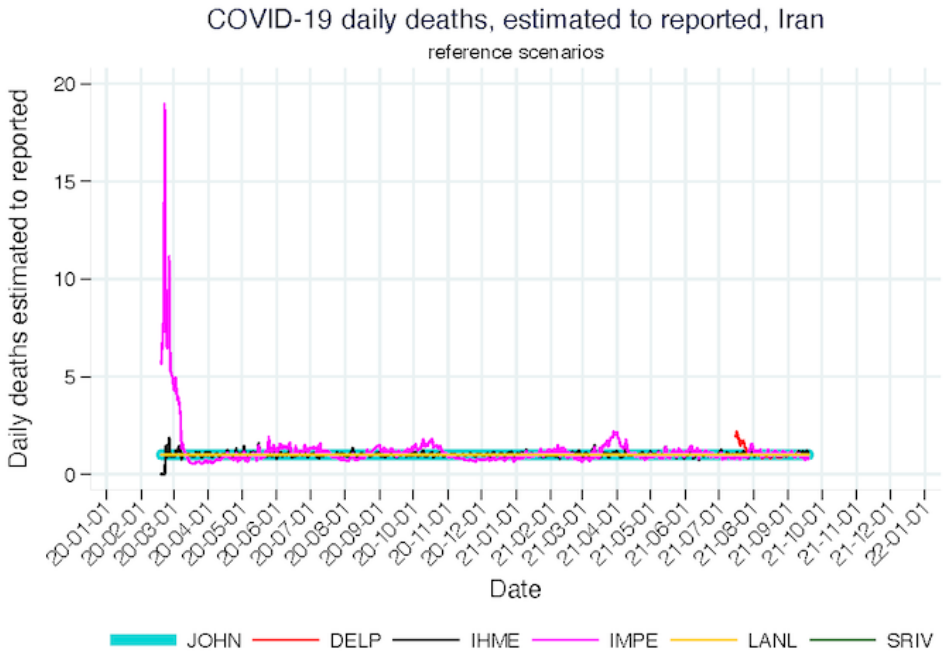
- Red line: 20210424 online meeting; The estimated probability, timing, dimensions, drivers, and preventive measures of the FIFTH wave and Delta were discussed with MOH.
- Cyan line: 20210910; Travel restrictions to Iraq, surveillance of variants, inter alia, to delay and attenuate the SIXTH wave, Lambda, and +/- Mu, relayed to the new MOH.

(10) Iran [Hospital-related outcomes, 2021]

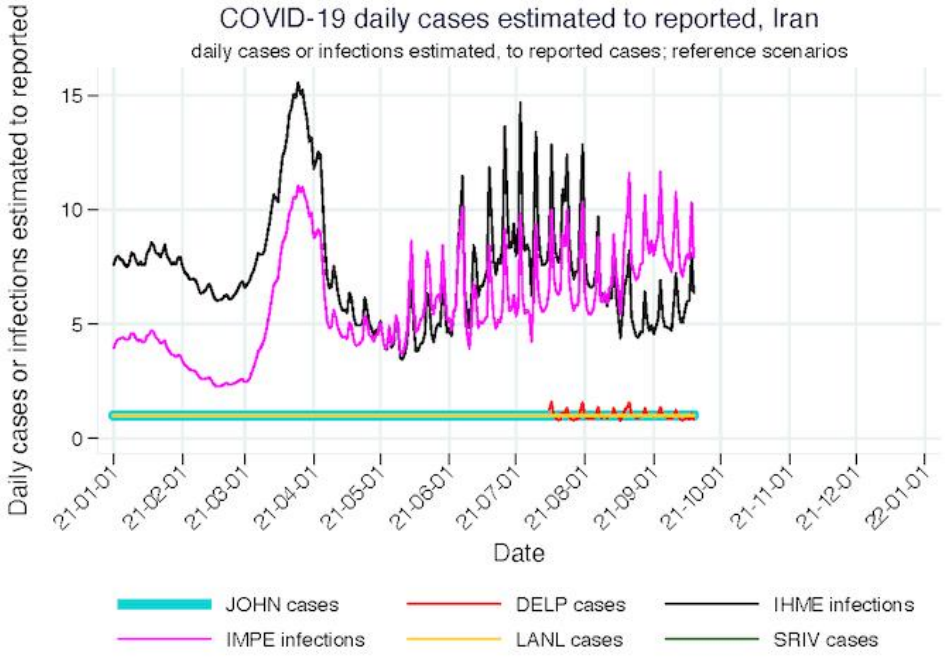


- Uncertainty limits: dashed curves.
- Red line: 20210424 online meeting; The estimated probability, timing, dimensions, drivers, and preventive measures of the FIFTH wave and Delta were discussed with MOH.
- Cyan line: 20210910; Travel restrictions to Iraq, surveillance of variants, inter alia, to delay and attenuate the SIXTH wave, Lambda, and +/- Mu, relayed to the new MOH.

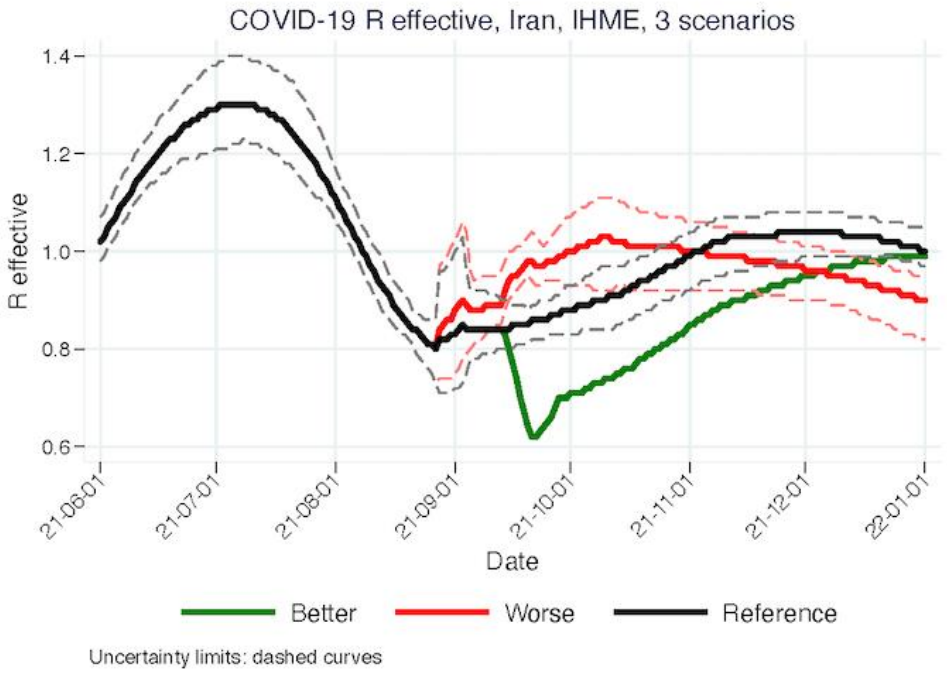
(11) Iran [Daily deaths estimated to reported, all time]



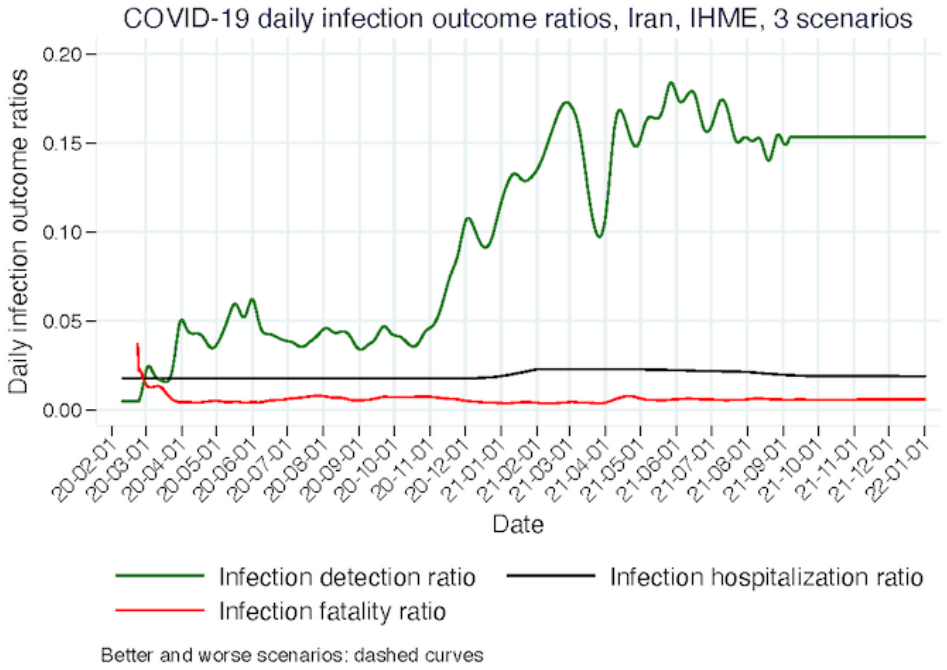
(12) Iran [Daily cases or infections estimated to reported cases, 2021]



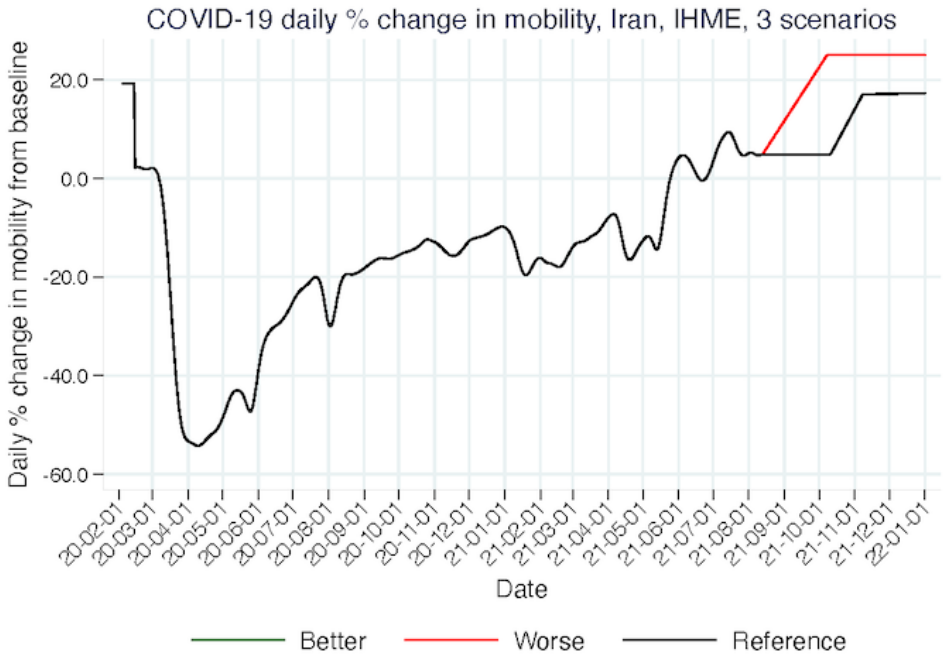
(13) Iran R effective, 3 scenarios



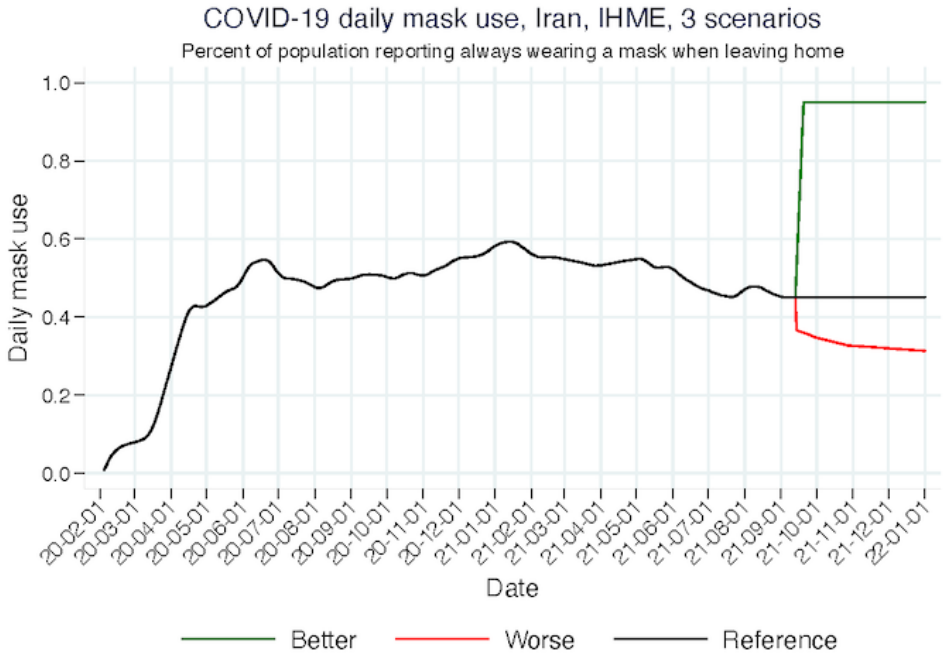
(14) Iran Daily Infection-outcome ratios, 3 scenarios, IHME
Note: values of the three scenarios for this estimand by IHME are the same for Iran.



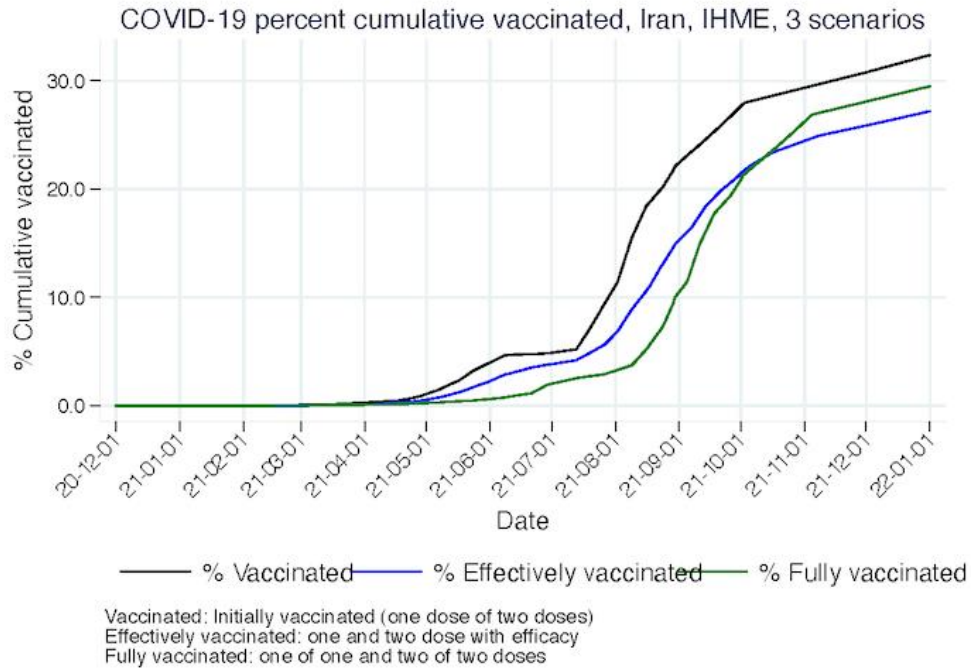
(15) Iran [Daily mobility, 3 scenarios, IHME]



(16) Iran [Daily mask use, 3 scenarios, IHME]



(17) Iran [Percent cumulative vaccinated, IHME]



نقاط قوت و ضعف مدل های به روز شونده همه گیری کووید-۱۹

- نقاط قوت مشترک:

(۱) بروز شدن دوره ای باعث می شود بتوانند احتمال تغییرات آینده در سیر اپیدمی را بهتر منعکس کنند.

(۲) ارائه دامنه عدم قطعیت برای پیامدها برای تصمیم گیری مفید تر از صرف ارائه برآورد نقطه ای پیامدها می باشد.

- نقاط ضعف مشترک:

(۱) لحاظ نشدن واریانت ها و واکسن ها - به غیر از مدل آی اچ ام ای

(۲) برآوردها برای سطح ملی هستند و نسبت به سیر همه گیری در سطح استان ها نابینا و ناآگاه هستند و بنابراین در مقایسه با مدل هایی که از تجمیع نتایج مدل های استانی به دست می آیند، اولا از واقعیت دور تر هستند (دقت کمتری دارند) و ثانیا قدرت آن ها در اعلام خطر در مورد بالا رفتن مواد و یا مرگ در آینده نزدیک کمتر بوده و فایده کمتری برای تصمیم گیری های به موقع و پیشگیرانه دارند. راه حل، استفاده از مدل های است که از تجمیع نتایج مدل های استانی به دست می آیند و به صورت دوره ای بروز می شوند.

- سایر نقاط قوت و ضعف مدل ها

مطالعه	لحاظ کردن کم-گزارش دهی	لحاظ کردن موارد بی علامت	لحاظ کردن تغییرات فصلی	اعتبار سنجی مدل	وجود سناریو های بدیل مداخله ای
۱ آی چ ام ای	بله	خیر	بله	بله	بله
۲ ایمپریال	بله	بله	خیر	بله	بله
۳ اسریواستاوا	بله	بله	خیر	بله	خیر
۴ دلفی	بله	بله	بله	بله	خیر
۵ لس آلاموس	خیر	خیر	خیر	خیر	خیر

- مطالعه دلفی با وجود اینکه در شرح تئوری مدل، کم-گزارش دهی و موارد بی علامت را لحاظ کرده است، ولی در عمل، معمولا اندازه برآورد های آن از مطالعات دیگر دورتر است و به نظر می رسد خروجی آن plausible نیست. مشابه این موضوع ولی با شدت کمتر در مورد مطالعه اسریواستاوا صادق است. مدل لس آلاموس کمترین تعداد خصوصیات ضروری را دارد. البته بحث و مطالب نقاط قوت و ضعف مدل ها گسترده تر از خلاصه فوق الذکر است.

- نتیجه در مورد نقاط قوت و ضعف مدل ها اینکه بر اساس معیارهای فوق الذکر، دو مطالعه آی اچ ام ای و ایمپریال معمولا بیشتر از سایر مدل ها به واقعیت نزدیک بوده و برای تصمیم گیری مفید تر هستند. بهتر: آی اچ ام ای و ایمپریال .بدتر: اسریواستاوا، دلفی، لس آلاموس