Iran COVID-19 epidemic models situation report No 30 – 2021-12-03

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Combine and visualize international periodically updated estimates of COVID-19 pandemic

at the country level, countries without subnational level estimates

Iran

Based on uptake 20211203 in https://github.com/pourmalek/covir2
Study update dates in uptake 20211203:
DELP 20211203, IHME 20211119, ***IMPE 20211129***, ***SRIV 20211203***

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

Question: Why are the international COVID-19 epidemic models not very accurate in predicting new waves' timing in Iran?

Answer: Garbage in, garbage out.

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.

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 *30th* 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 // Retired on 20210926.

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:

Every Friday, a new uptake will be performed. Any model updates older than two weeks on the uptake date will not be included in the new uptake. The most recent update of each model is used.

The LANL COVID-19 Team made its last real-time forecast on September 27th, 2021. [for 20210926]. The LANL model is retired.

*

Uptakes in https://github.com/pourmalek/covir2 for Iran are as follows.

(Uptake number) uptake date: study update date, study update date

bold italic fonts show the uptake was triggered by either IHME or IMPE (before 20211008), or the model updates that are new in this uptake (20211008 and afterwards).

(53) uptake 20211203: ***DELP 20211203***, IHME 20211119, ***IMPE 20211129***, ***SRIV 20211203***
(52) uptake 20211126: ***DELP 20211123***, IHME 20211119, IMPE 20211115, ***SRIV 20211126***
(51) uptake 20211119: ***DELP 20211119***, ***IHME 20211119***, ***IMPE 20211115***, ***SRIV 20211119***
(50) uptake 20211112: ***DELP 20211112***, IHME 20211104, ***IMPE 20211103***, ***SRIV 20211112***
(49) uptake 20211105: ***DELP 20211105***, ***IHME 20211104***, ***IMPE 20211027***, ***SRIV 20211105***
(48) uptake 20211029: ***DELP 20211029***, IHME 20211021, ***IMPE 20211021***, ***SRIV 20211029***
(47) uptake 20211022: ***DELP 20211019***, ***IHME 20211021***, IMPE 20211006, ***SRIV 20211017***
(46) uptake 20211015: ***DELP 20211015***, ***IHME 20211015***, ***IMPE 20211006***, ***SRIV 20211015***
(45) uptake 20211008: ***DELP 20211008***, IHME 20211001, IMPE 20210924, LANL 20210926, ***SRIV 20211008***
(44) uptake 20211001: DELP 20210930, ***IHME 20211001***, IMPE 20210924, LANL 20210926, SRIV 20210930
(43) uptake 20210928: DELP 20210927, IHME 20210923, ***IMPE 20210924***, LANL 20210926, SRIV 20210928
(42) uptake 20210923: DELP 20210923, ***IHME 20210923***, IMPE 20210909, LANL 20210919, SRIV 20210923
(41) uptake 20210920: DELP 20210920, IHME 20210916, ***IMPE 20210909***, LANL 20210919, SRIV 20210920
(40) uptake 20210916: DELP 20210916, ***IHME 20210916***, IMPE 20210825, LANL 20210912, SRIV 20210916
(39) uptake 20210910: DELP 20210910, ***IHME 20210910***, IMPE 20210825, LANL 20210905, SRIV 20210910
(38) uptake 20210902: DELP 20210902, ***IHME 20210902***, IMPE 20210825, LANL 20210829, SRIV 20210902
(37) uptake 20210901: DELP 20210901, IHME 20210826, ***IMPE 20210825***, LANL 20210829, SRIV 20210901

(36) uptake 20210826: DELP 20210826, ***IHME 20210826***, IMPE 20210819, LANL 20210822, SRIV 20210826
(35) uptake 20210824: DELP 20210824, IHME 20210819, ***IMPE 20210819***, LANL 20210822, SRIV 20210824
(34) uptake 20210819: DELP 20210819, ***IHME 20210819***, IMPE 20210806, LANL 20210815, SRIV 20210819
(33) uptake 20210813: DELP 20210813, IHME 20210806, ***IMPE 20210806***, LANL 20210808, SRIV 20210813
(32) uptake 20210806: DELP 20210806, ***IHME 20210806***, IMPE 20210719, LANL 20210801, SRIV 20210801
(31) uptake 20210730: DELP 20210730, ***IHME 20210730***, IMPE 20210719, LANL 20210725, SRIV 20210730
(30) uptake 20210727: DELP 20210726, IHME 20210723 version 2, ***IMPE 20210719***, LANL 20210725, SRIV 20210727
(29) uptake 20210726: DELP 20210726, ***IHME 20210723 version 2***, IMPE 20210709, LANL 20210718, SRIV 20210726
(28) uptake 20210723: DELP 20210723, ***IHME 20210723***, IMPE 20210709, LANL 20210718, SRIV 20210723
(27) uptake 20210715: DELP 20210715, ***IHME 20210715***, IMPE 20210709, LANL 20210711, SRIV 20210715
(26) uptake 20210714: DELP 20210714, IHME 20210702, ***IMPE 20210709***, LANL 20210711, SRIV 20210714
(25) uptake 20210709: DELP 20210708, IHME 20210702, ***IMPE 20210702***, LANL 20210704, SRIV 20210709
(24) uptake 20210704: DELP 20210704, IHME 20210702, ***IMPE 20210626***, LANL 20210704, SRIV 20210704
(23) uptake 20210703: DELP 20210703, ***IHME 20210702***, IMPE 20210618, LANL 20210627, SRIV 20210703
(22) uptake 20210625: DELP 20210625, ***IHME 20210625***, IMPE 20210618, LANL 20210613, SRIV 20210624
(21) uptake 20210624: DELP 20210624, IHME 20210618, ***IMPE 20210618***, LANL 20210613, SRIV 20210624
(20) uptake 20210618: DELP 20210618, ***IHME 20210618***, IMPE 20210611, LANL 20210613, SRIV 20210618
(19) uptake 20210611: DELP 20210611, IHME 20210610, ***IMPE 20210611***, LANL 20210606, SRIV 20210611
(18) uptake 20210610: DELP 20210610, ***IHME 20210610***, IMPE 20210604, LANL 20210606, SRIV 20210610
(17) uptake 20210605: DELP 20210604, IHME 20210604, ***IMPE 20210604***, LANL 20210602, SRIV 20210604
(16) uptake 20210604: DELP 20210604, ***IHME 20210604***, IMPE 20210527, LANL 20210602, SRIV 20210604
(15) uptake 20210603: DELP 20210603, IHME 20210528, ***IMPE 20210527***, LANL 20210526, SRIV 20210603

(14) uptake 20210528: DELP 20210528, ***IHME 20210528***, IMPE 20210522, LANL 20210526, SRIV 20210528
(13) uptake 20210522: DELP 20210522, IHME 20210521, ***IMPE 20210522***, LANL 20210519, SRIV 20210522
(12) uptake 20210521: DELP 20210521, ***IHME 20210521***, IMPE 20210516, LANL 20210519, SRIV 20210521
(11) uptake 20210516: DELP 20210516, IHME 20210514, ***IMPE 20210516***, LANL 20210516, SRIV 20210516
(10) uptake 20210515: DELP 20210515, IHME 20210514, ***IMPE 20210510***, LANL 20210512, SRIV 20210515
(09) uptake 20210514: DELP 20210514, ***IHME 20210514***, IMPE 20210424, LANL 20210512, SRIV 20210514
(00) uptake 20210507: DELP 20210507, ***IHME 20210507***, IMPE 20210424, LANL 20210505, SRIV 20210507. IHME update 20210507 vanished after release.
(08) uptake 20210506: DELP 20210506, ***IHME 20210506***, IMPE 20210424, LANL 20210505, SRIV 20210506
(00) uptake 20210430: DELP 20210430, ***IHME 20210430***, IMPE 20210424, LANL 20210428, SRIV 20210430. IHME update 20210430 vanished after release.
(07) uptake 20210424: DELP 20210424, IHME 20210423, ***IMPE 20210424***, LANL 20210421, SRIV 20210424
(06) uptake 20210423: DELP 20210423, ***IHME 20210423***, IMPE 2010417, LANL 20210421, SRIV 20210423
(05) uptake 20210417: DELP 20210417, IHME 20210416, ***IMPE 20210417***, LANL 20210414, SRIV 20210417
(04) uptake 20210416: DELP 20210416, ***IHME 20210416***, IMPE 20210406, LANL 20210414, SRIV 20210416
(03) uptake 20210409: DELP 20210409, ***IHME 20210409***, IMPE 20210406, LANL 20210407, SRIV 20210409
(02) uptake 20210406: DELP 20210406, IHME 20210401, ***IMPE 20210406***, LANL 20210404, SRIV 20210406
(01) uptake 20210401: DELP 20210401, ***IHME 20210401***, IMPE 20210329, LANL 20210331, SRIV 20210401

Graphs of epidemic trajectory in Iran till March 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 additional 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.

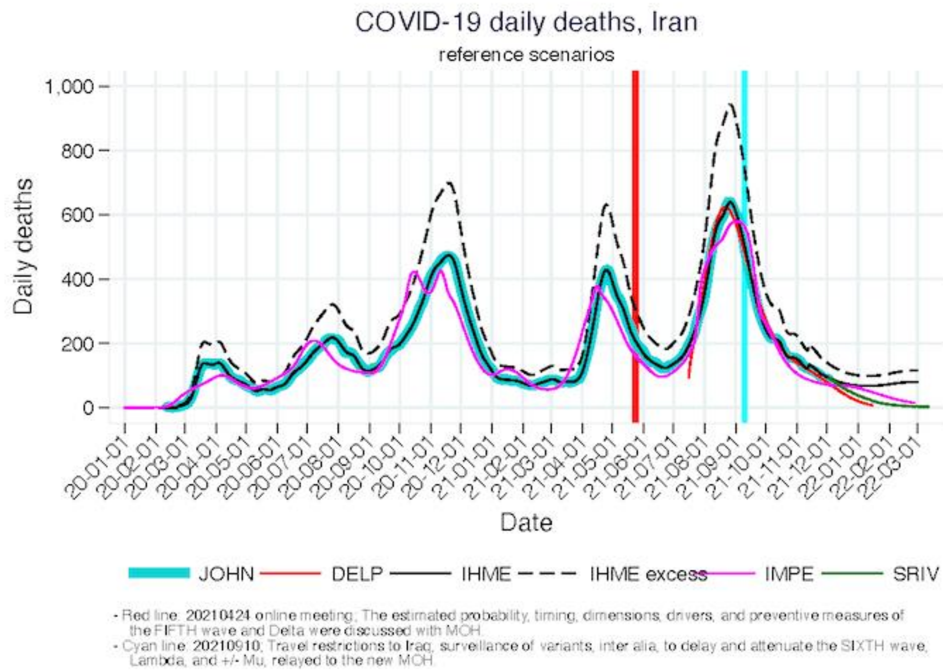
(4) *Five models*: Different models *within* each graph (for which model estimates update release dates are maximally synchronized), plus official reports of the country to WHO (curated by Johns Hopkins University) as the under-reported benchmark for trends. To examine how heterogeneity in methods used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

List of graphs

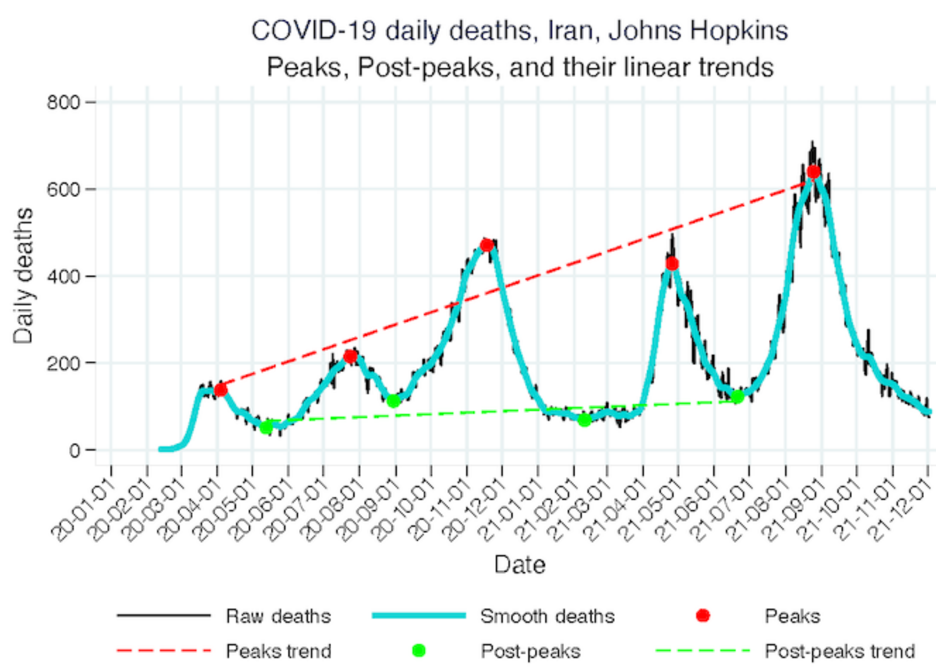
Names of models/studies in Farsi:

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

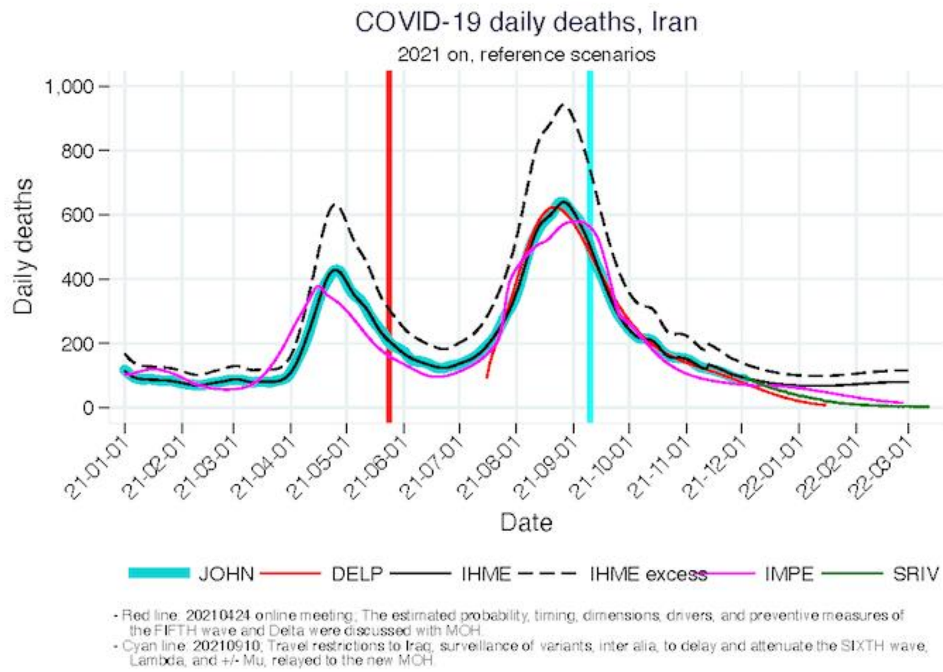
(1) Iran [Daily deaths, all time]



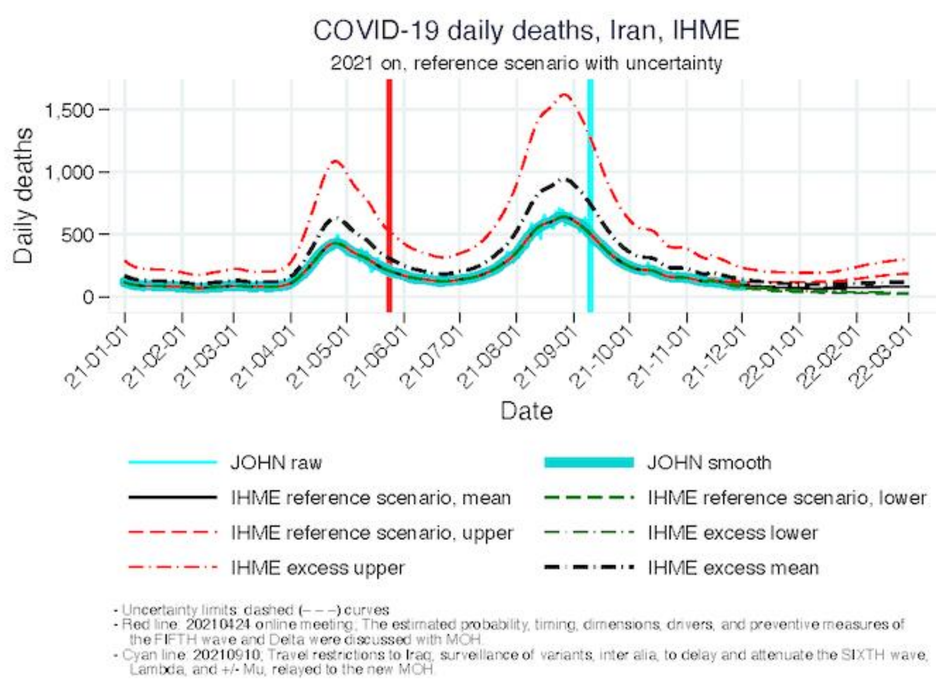
(1b) Iran [Reported daily deaths, peaks, post-peaks, and linear trends]



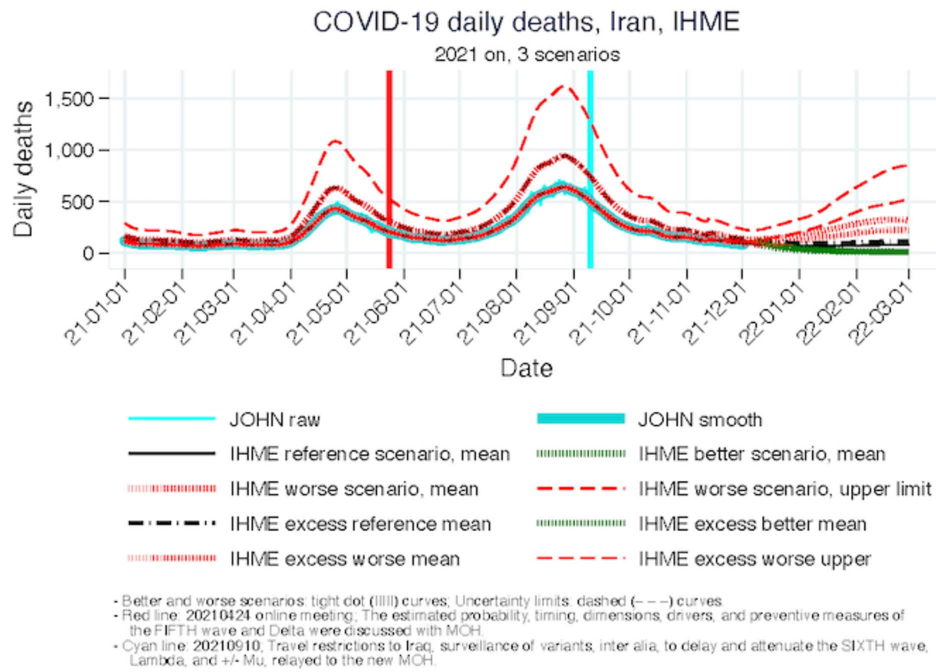
(2) Iran Daily deaths, 2021



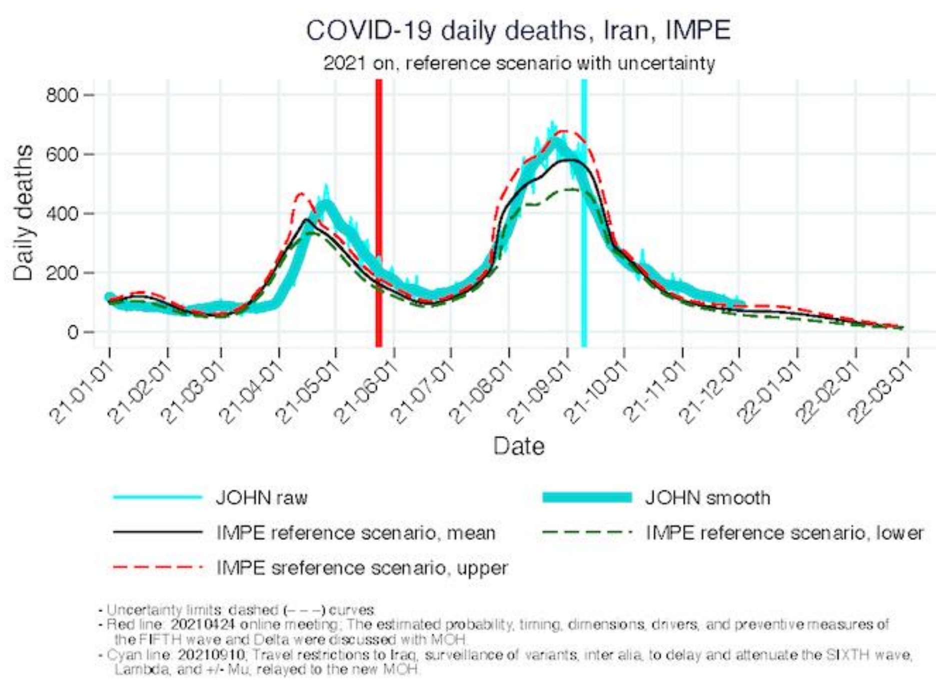
(3) Iran Daily deaths, 2021, reference scenario with uncertainty, IHME



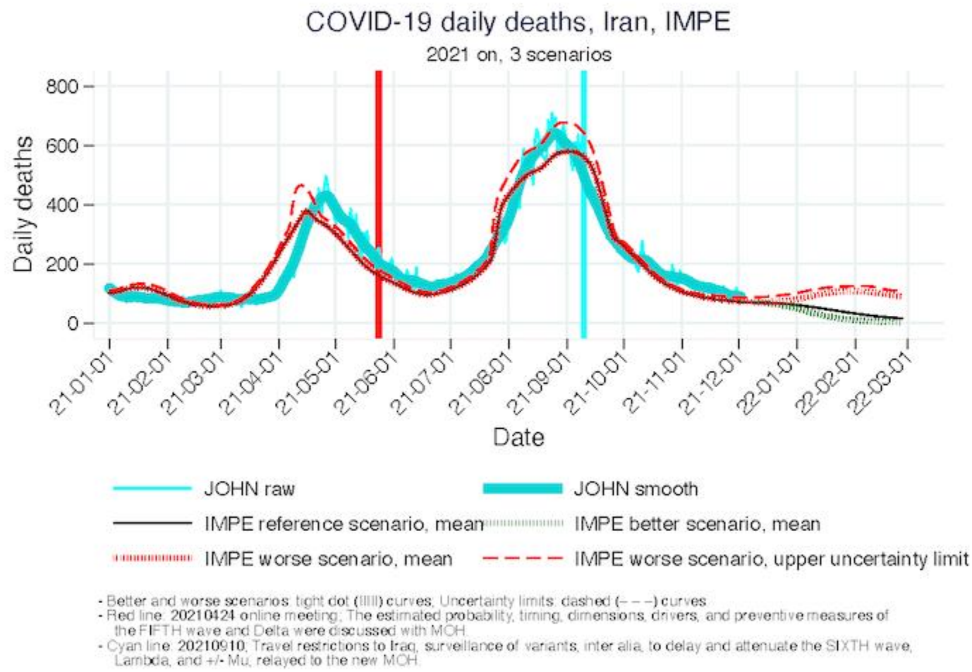
(4) Iran [Daily deaths, 2021, 3 scenarios, IHME]



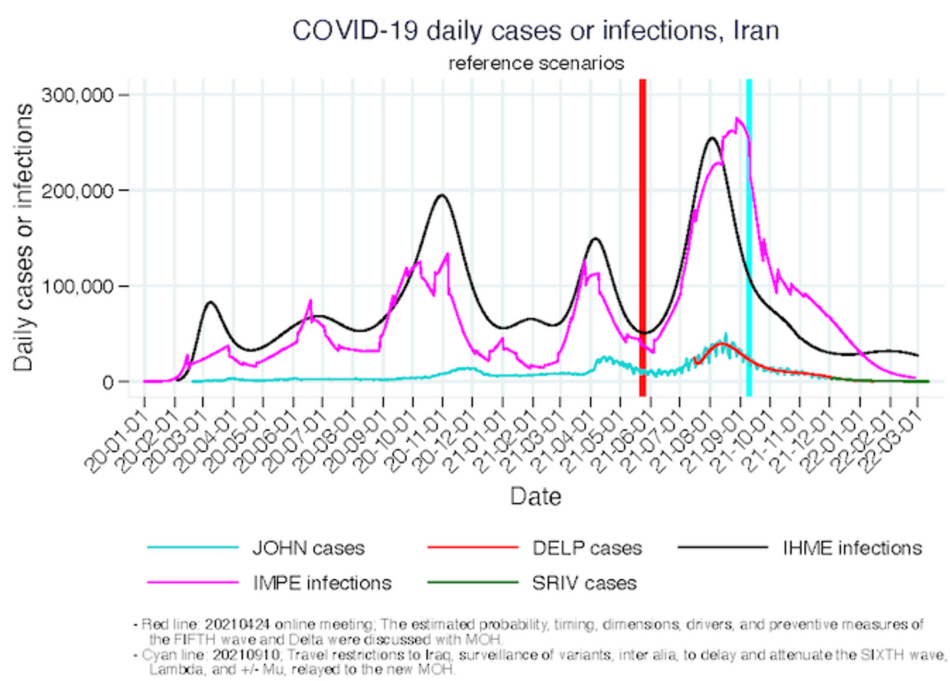
(5) Iran [Daily deaths, 2021, reference scenario with uncertainty, IMPE]



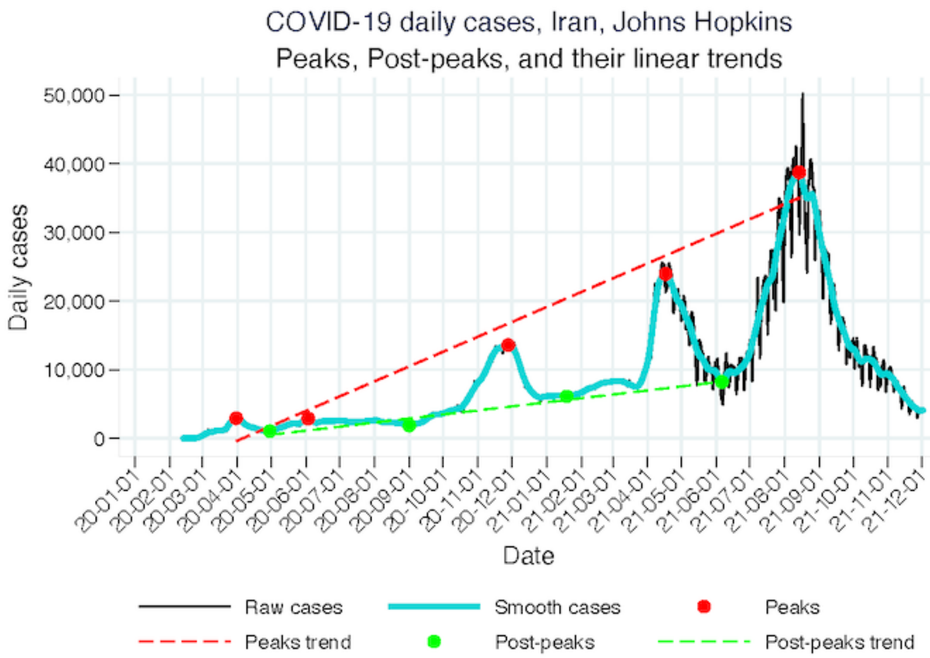
(6) Iran [Daily deaths, 2021, 3 scenarios, IMPE]



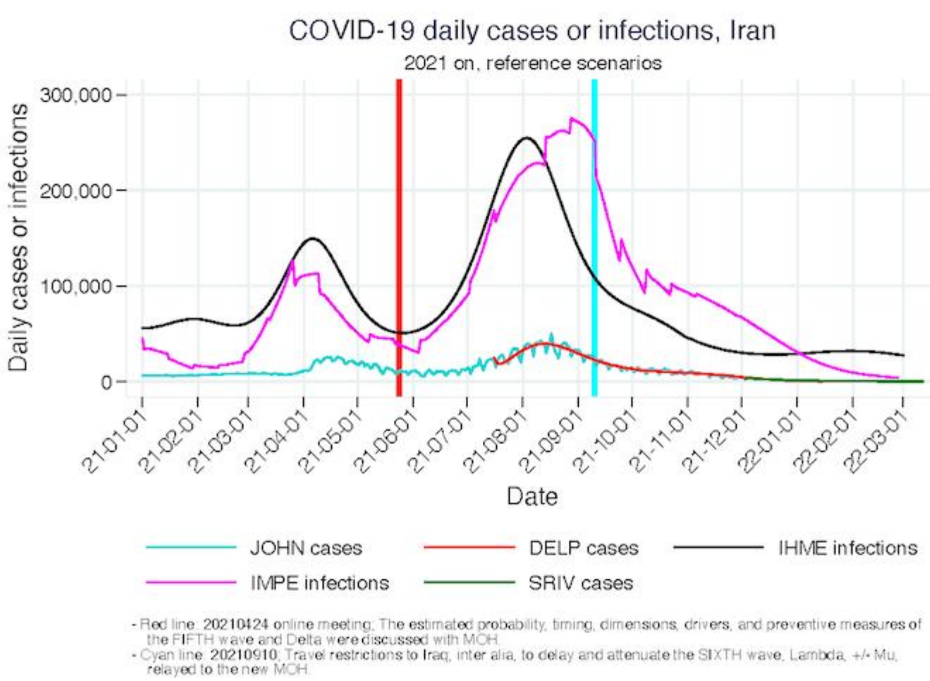
(7) Iran [Daily cases or infections, all time]



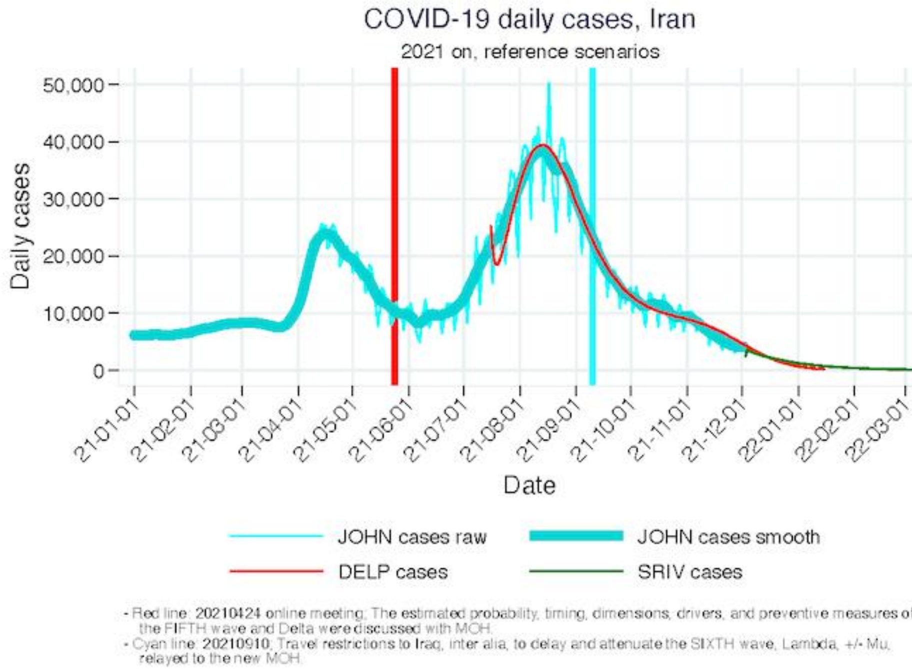
(7b) Iran [Reported cases, peaks, post-peaks, and linear trends]



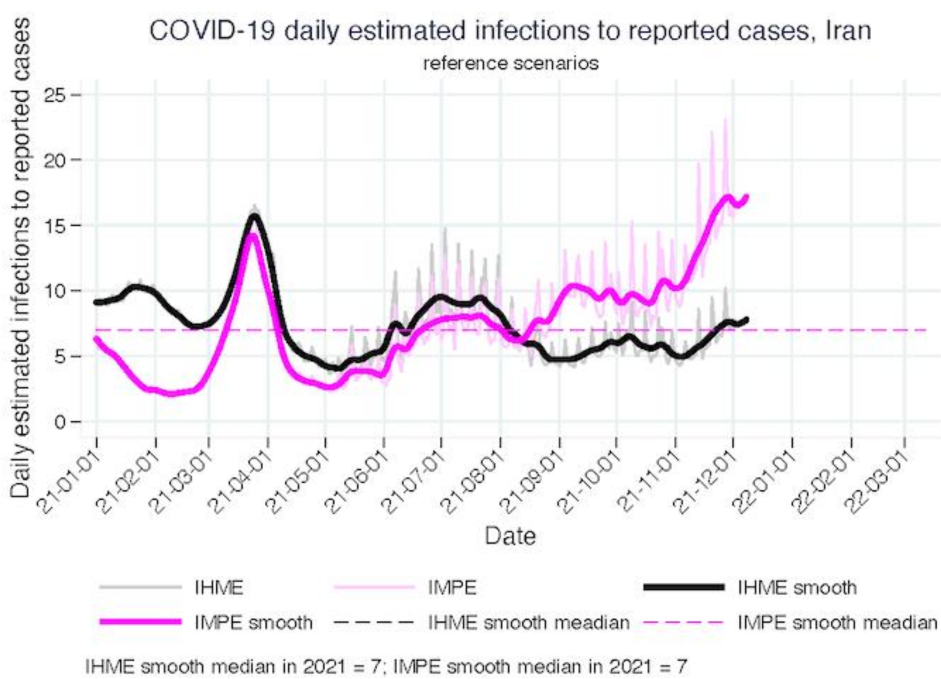
(8) Iran [Daily cases or infections, 2021]



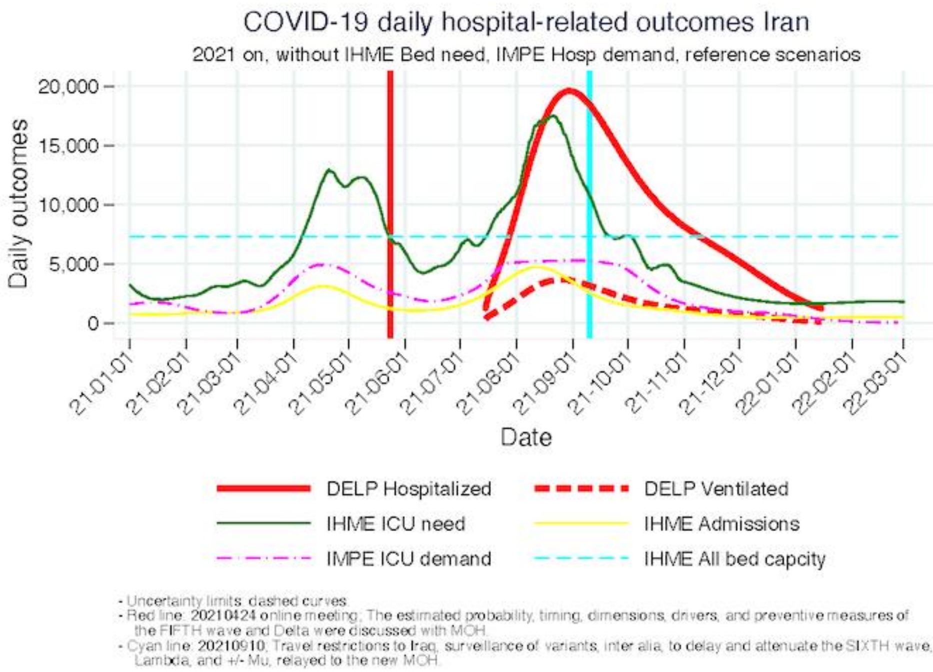
(8b) Iran [Daily cases, 2021]



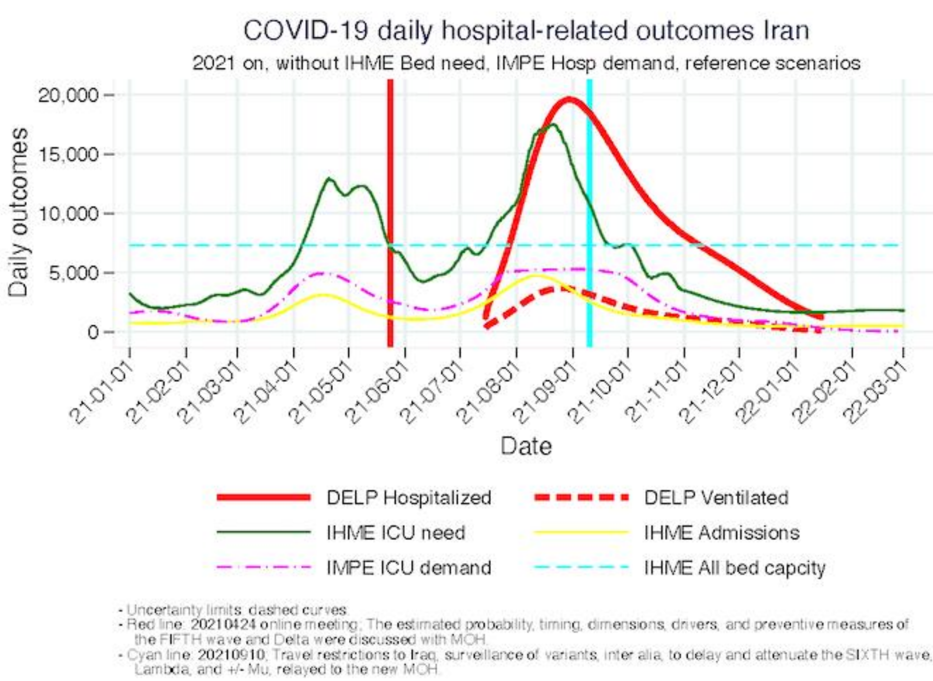
(8c) Iran [Daily estimated infections IHME IMPE to reported cases JOHN, main scenarios, 2021]



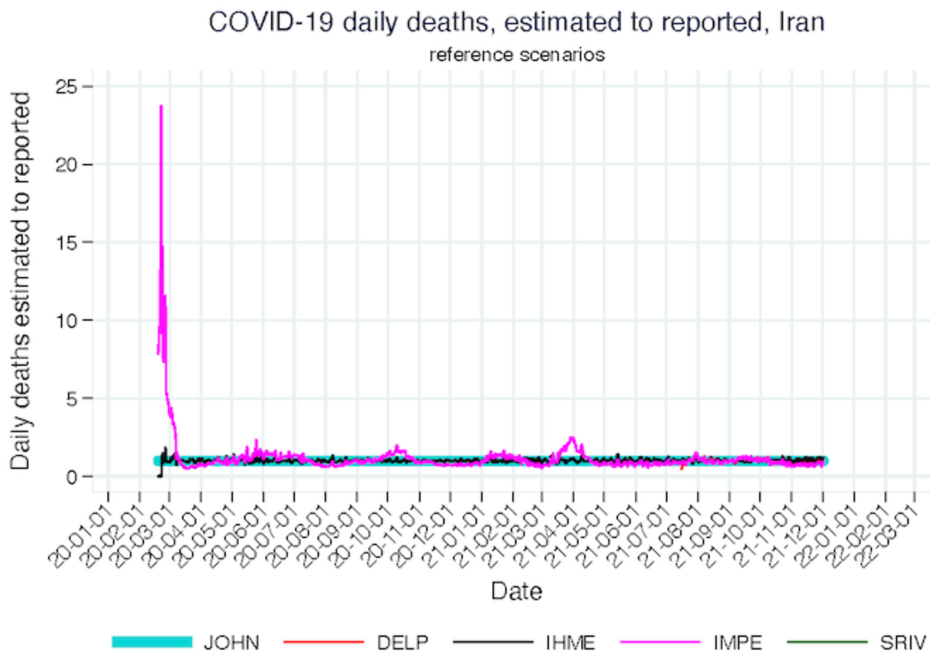
(9) Iran [Hospital-related outcomes, all time]



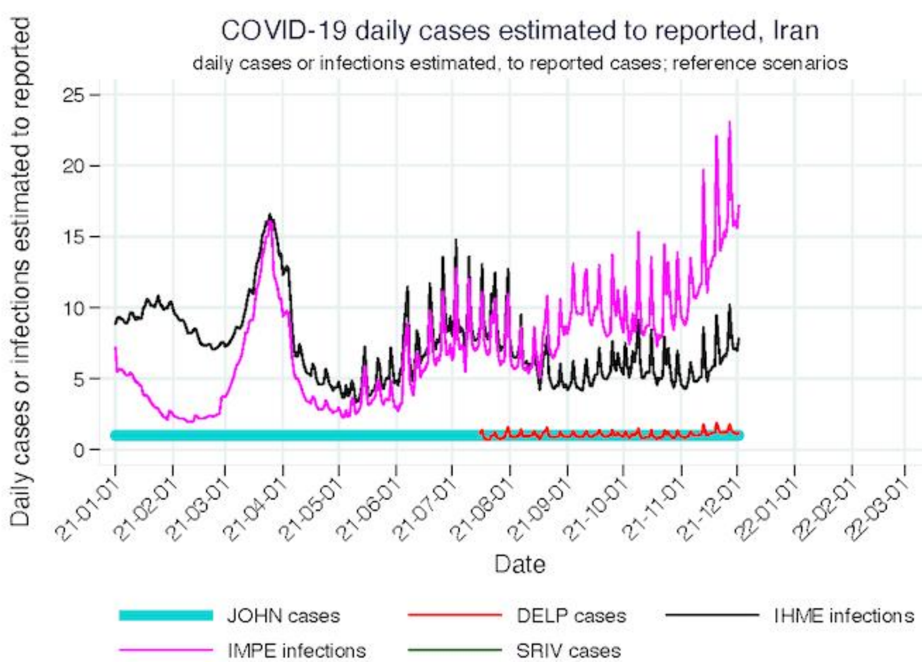
(10) Iran [Hospital-related outcomes, 2021]



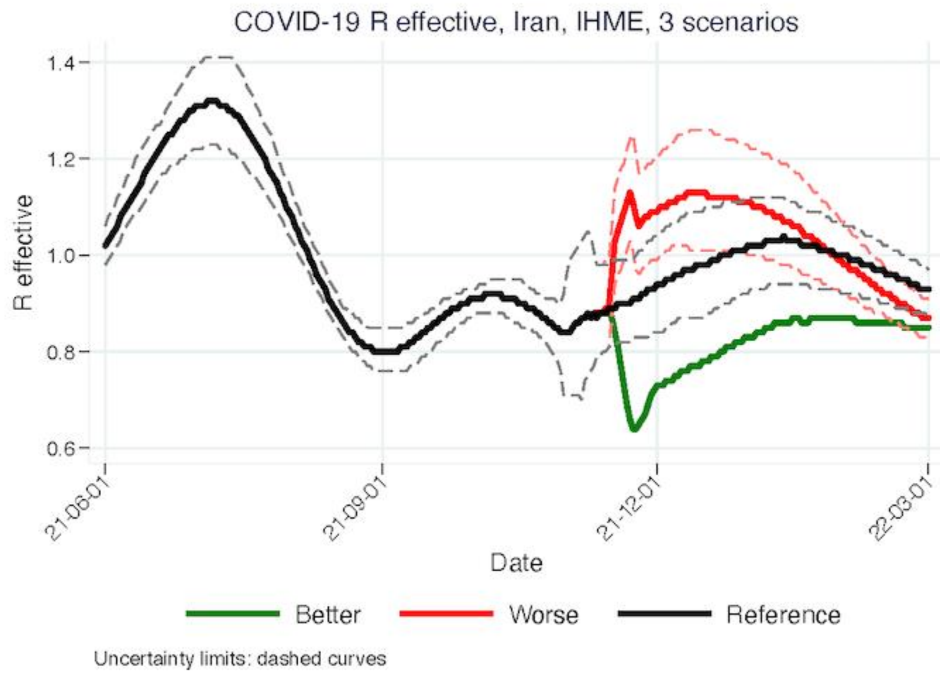
(11) Iran [Daily deaths estimated to reported, all time]



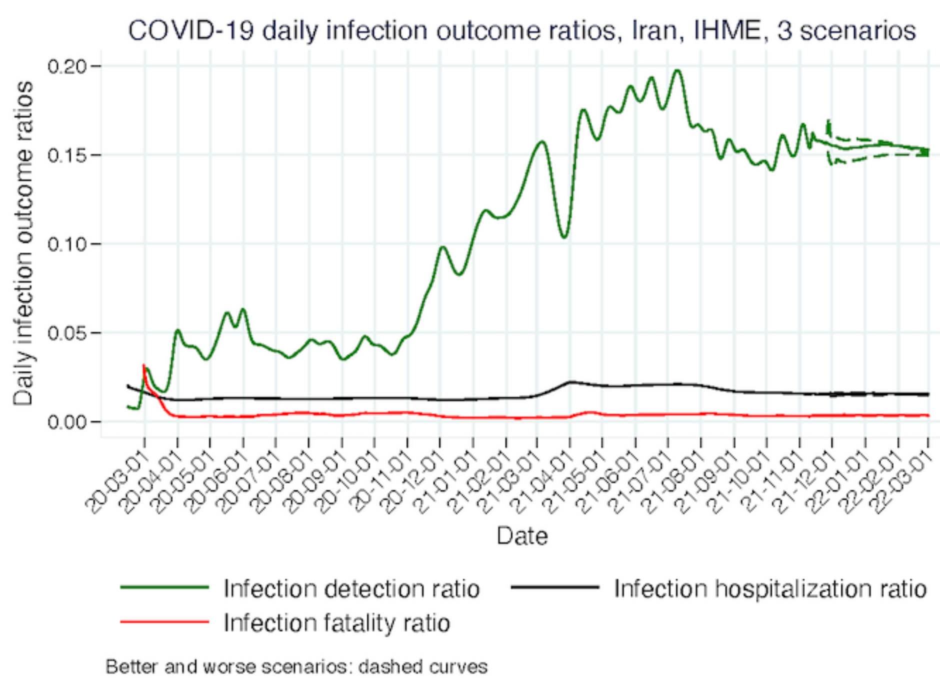
(12) Iran [Daily cases or infections estimated to reported cases, 2021]



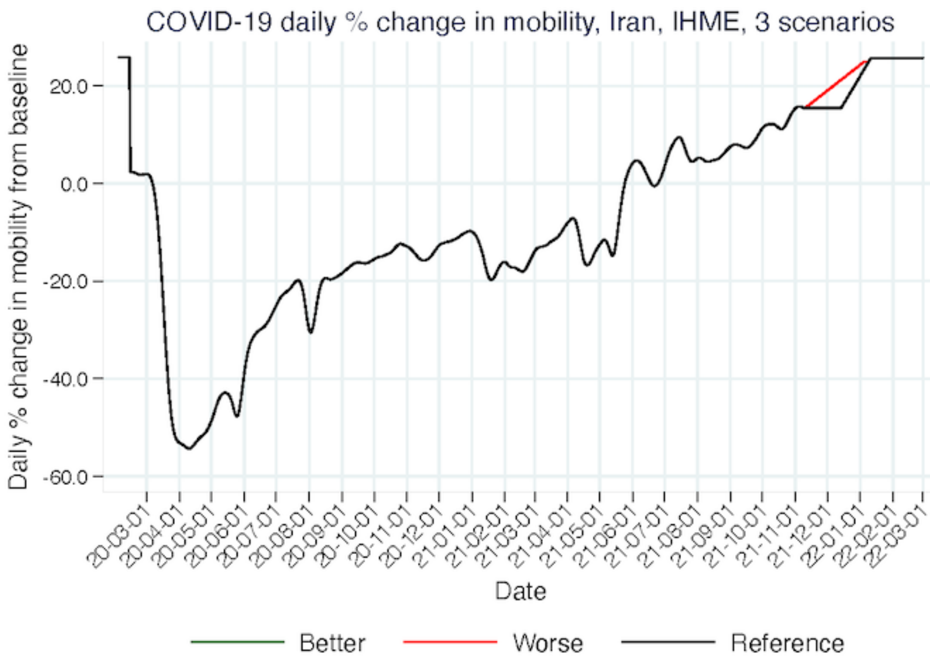
(13) Iran [R effective, 3 scenarios, IHME]



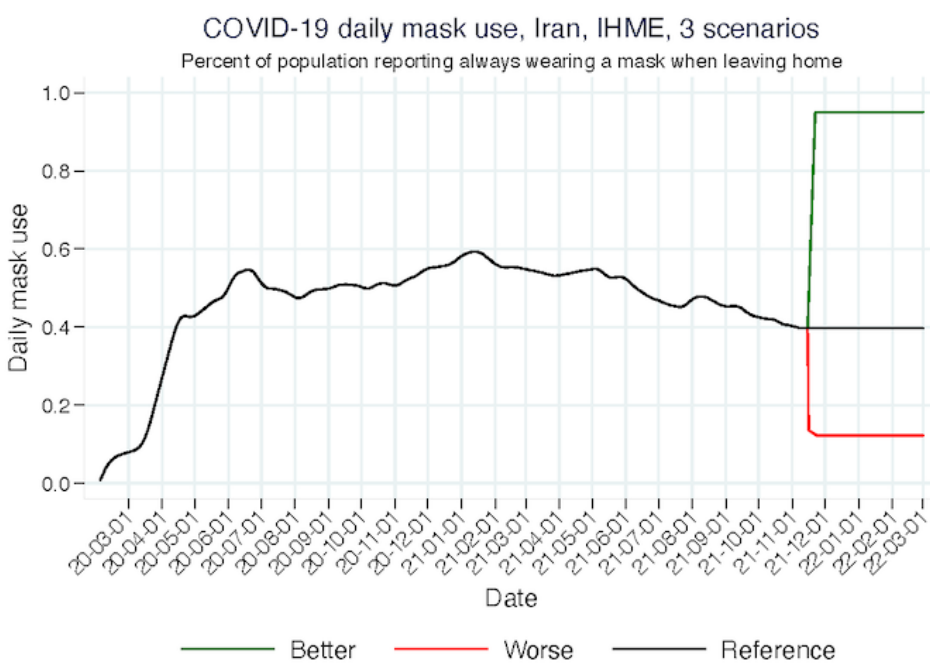
(14) Iran [Daily Infection-outcome ratios, 3 scenarios, IHME]



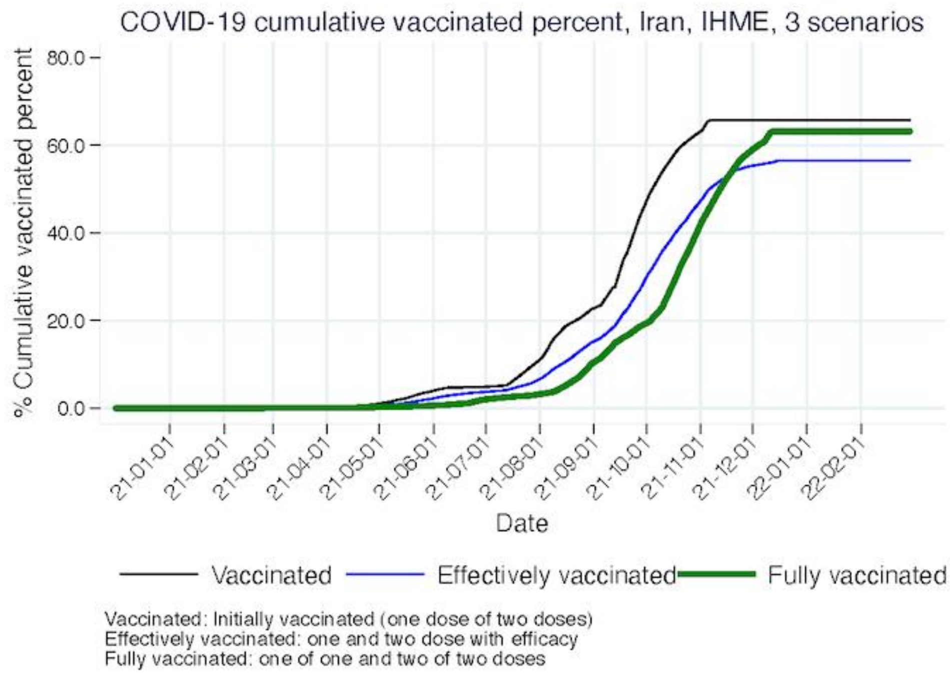
(15) Iran [Daily mobility, 3 scenarios, IHME]



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



(17) Iran [Percent cumulative vaccinated, IHME]



Strengths and weaknesses of international periodically updated models of COVID-19 epidemic

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. (۳) **این مدل ها در پیشبینی افزایش ها و قله های همه گیری کووید-۱۹ در ایران، دارای جا ماندگی (lag) هستند**. چون، **GIGO: garbage in, garbage out**

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

مدل آی اچ ام ای تا آخرین به روز-رسانی واریانت های ***لامبدا و مو*** را لحاظ نکرده و داده های جدید در مورد کاهش تدریجی ایمنی بعد از واکسیناسیون را نیز به طور کافی و کامل لحاظ ننموده و بیان کرده اند که در به روز-رسانی های بعدی، مورد اخیر (***Post-vaccination Waning immunity***) را به طور کامل، و بعدا واریانت های جدید را در مدل خود وارد خواهند نمود.

یک نقطه ضعف مدل آی اچ ام ای این است که نحوه لحاظ نمودن پوشش واکسیناسیون و انواع واکسن های تزریق شده در کشورها، در مدل خود را با جزئیات بسیار ناکافی توضیح داده اند (نوشته اند: "As expected"). مضاف بر اینکه اثربخشی واکسن های ابداع ایران را معلوم نیست چگونه حساب کرده اند. با این همه، مدل آی اچ ام ای در مجموع، کم ایراد ترین مدل است.

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. مطالعه لس آلاموس در ۲۷ سپتامبر ۲۰۲۱ بازنشسته شد.