

Canada COVID-19 epidemic models situation report No 02 on 20210801

Farshad Pourmalek MD PHD

Former lecturer, University of British Columbia, Vancouver | [UBC SPPH](#) | [ORCID](#) | [PubMed](#)

pourmalek_farshad@yahoo.com

Based on uptake 20210730 in <https://github.com/pourmalek/CovidVisualizedCountry>

Study update dates in uptake 20210730:

DELP 20210730, **IHME 20210730**, IMPE 20210719, LANL 20210725, SRIV 20210730

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Executive Summary

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

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

Summary of outcomes on last date of estimates available in this update of IHME model (21-11-01) and IMPE model (21-10-16) can be seen below on page 3.

Model estimations predict start of the fourth wave of the epidemic at the national level in Canada in August, reaching 21,111 daily infections, 5,552 daily bed needs, 1,663 daily ICU bed needs, and 32 daily deaths on November 1st, with a still-would-be-increasing slope.

This report summarizes results of a project named *CovidVisualizedCountry*, that is online tool developed to function as an early warning tool for technical advisers to 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, PREPRINT (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* \(for Iran\)](#).

Creator of the [*CovidVisualizedCountry*](#) tool and this report is a physician and epidemiologist who worked before in School of Population and Public Health of University of British Columbia and Vancouver General Hospital.

Summary of outcomes on last date of estimates available in this update of IHME model (21-11-01) and IMPE model (21-10-16)

	CAN IMPE	CAN IHME	AB IHME	BC IHME	MB IHME	NS IHME	ON IHME	QC IHME	SK IHME
Daily deaths mean reference scenario	0	32	12	2	1	0	10	2	2
Daily deaths upper reference scenario	1	84	71	4	3	1	21	6	5
Daily deaths mean worse scenario	17	109	36	7	3	1	49	7	3
Daily deaths upper worse scenario	42	246	168	17	9	4	104	19	5
Total deaths mean reference scenario	26,950	44,066	4,042	2,967	2,027	167	15,299	18,171	1,145
Total deaths upper reference scenario	28,500	44,982	4,941	3,071	2,090	185	15,582	18,250	1,275
Total deaths mean worse scenario	27,453	45,476	4,445	3,060	2,098	181	15,909	18,244	1,201
Total deaths upper worse scenario	29,202	48,015	6,917	3,237	2,326	239	16,641	18,411	1,352
Daily infections mean reference scenario	103	21,111	8,528	2,355	1,171	138	5,461	1,350	1,767
Daily infections upper reference scenario	280	49,488	35,849	6,317	3,416	550	12,546	4,072	2,734
Daily infections mean worse scenario	15,207	75,833	13,494	11,160	2,911	962	38,298	6,742	1,822
Daily infections upper worse scenario	35,718	163,000	41,413	34,134	5,782	3,531	97,540	20,487	3,188
Total infections mean reference scenario	7,109,303	4,914,318	798,742	653,893	583,382	22,086	1,327,465	719,553	768,505
Total infections upper reference scenario	7,616,182	6,263,997	1,833,182	850,503	764,141	39,236	1,635,153	902,084	1,132,454

IHME: Institute for Health Metrics and Evaluation, University of Washington, Seattle. IMPE: Imperial College, London

Summary of hospitalization-related outcomes on last date of estimates available in this update of IHME model (21-11-01)

	Daily Bed Needs	Daily ICU Bed Needs
National	5,552	1,663
Alberta	1,714	443
British Columbia	735	226
Manitoba	163	51
Nova Scotia	21	7
Ontario	1,620	507
Quebec	304	117
Saskatchewan	936	293

What is this report and where does it come from?

This report is second situation report of predictions of five international and periodically updating COVID-19 epidemic models about future trajectory of epidemic in Canada and its provinces. The report is based on “CovidVisualizedCountry” online tool, that is a GitHub repository for sharing data and codes, available at

<https://github.com/pourmalek/CovidVisualizedCountry>

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/CovidVisualizedCountry/tree/main/situation%20reports>

Objectives of the “CovidVisualizedCountry” 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 model show an increase in daily cases or infections, hospitalizations, or deaths in 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, strengths and weaknesses of individual models need to be considered, as well as 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.

Similar work: Situation Reports from “covir2” (<https://github.com/pourmalek/covir2>), a sister repository, have been presented for and shared with three deputy ministers of health in Iran.

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, PREPRINT (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).

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:

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

DELPHI: 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

*

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>

*

Models' updates and their acquisition in this work:

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

Models' updates dates in this report, uptake 20210730:

DELP 20210730, **IHME 20210730**, IMPE 20210719, LANL 20210725, SRIV 20210730

Full names of model name abbreviations on previous page.

*

Graphs

Graphs of epidemic trajectory in Canada and provinces till November 1st

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/CovidVisualizedCountry>

Logical order of graphs:

- (1) *Location levels*: National, followed by provinces for which estimations are available: Alberta, British Columbia, Manitoba, Nova Scotia, Ontario, Quebec, and Saskatchewan.
- (2) *Outcomes*: Daily deaths, Daily cases or infections, Hospital-related outcomes, Daily deaths estimated to reported, Daily cases or infections estimated to reported cases.
- (3) *Calendar time of estimates coverage*: All-time, followed by 2021. To view the whole epidemic trajectory, and further focus on near future.
- (4) *Scenarios*: Reference scenarios, followed by alternative scenarios. To examine the main (aka. status quo) scenario, and alternative (better and worse) scenarios.
- (5) *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 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)

Among the 5 available international periodically updating studies or models of COVID-19 pandemic, only TWO studies, DELP and IHME, provide subnational level estimates for some countries.

List of graphs

- (1) Daily deaths, reference scenarios, all time
- (2) Daily deaths, reference scenarios, 2021
- (3) Daily deaths, 3 scenarios, 2021
- (4) Daily cases or infections, reference scenarios, all time
- (5) Daily cases or infections, reference scenarios, 2021
- (6) Daily cases or infections, 3 scenarios, 2021
- (7) Hospital-related outcomes, all time
- (8) Hospital-related outcomes, 2021, without IHME Bed need and IMPE Hospital demand
- (9) Daily deaths estimated to reported, reference scenarios, 2021
- (10) Daily cases or infections estimated to reported cases, reference scenarios, 2021

Study update dates in uptake 20210730

DELP 20210730, **IHME 20210730**, IMPE 20210719, LANL 20210725, SRIV 20210730

IHME update 20210730 (original release on 20210730) was identical with previous update, i.e., update 20210723 version 2.

As of 20210801, the replaced (or version 2) of the IHME update 20210730 has changed and is not identical with the previous update.

Merged graphs of this uptake [here](#)

Selected graphs

Selected graphs - [Canada](#)

Selected graphs - [Alberta](#)

Selected graphs - [British Columbia](#)

Selected graphs - [Manitoba](#)

Selected graphs - [Nova Scotia](#)

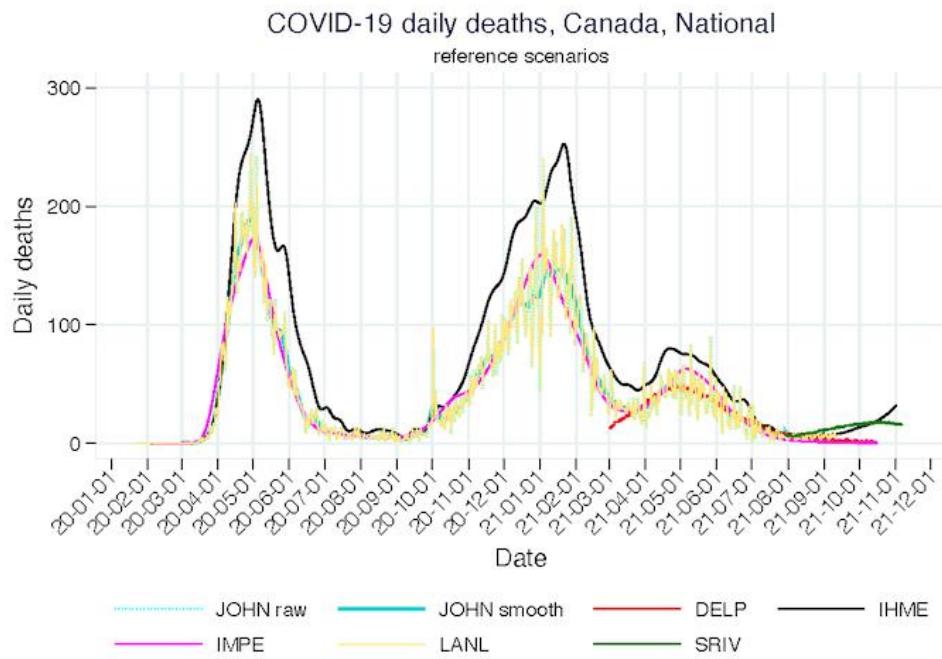
Selected graphs - [Ontario](#)

Selected graphs - [Quebec](#)

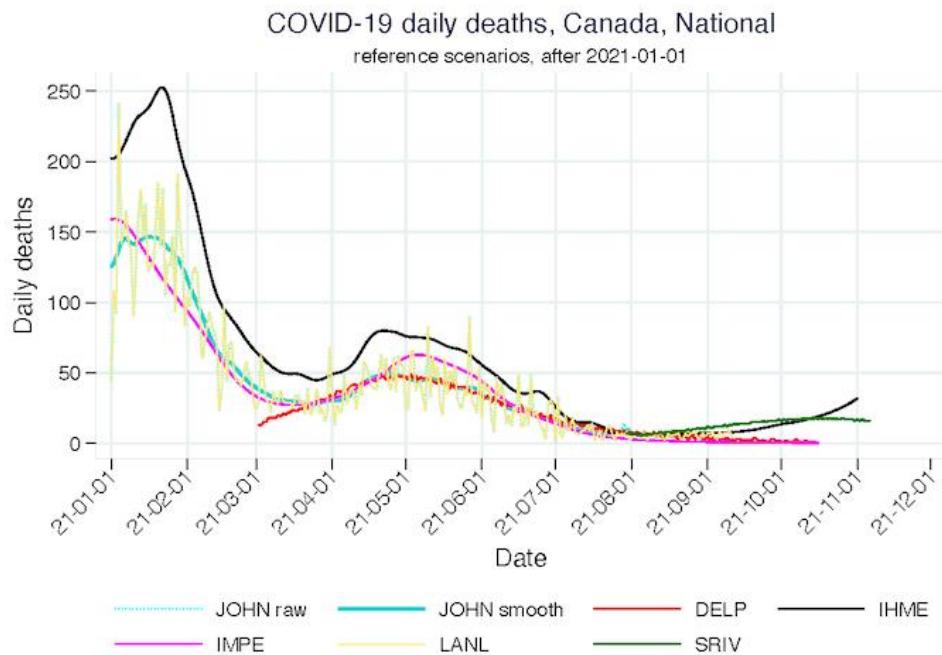
Selected graphs - [Saskatchewan](#)

Selected graphs - Canada

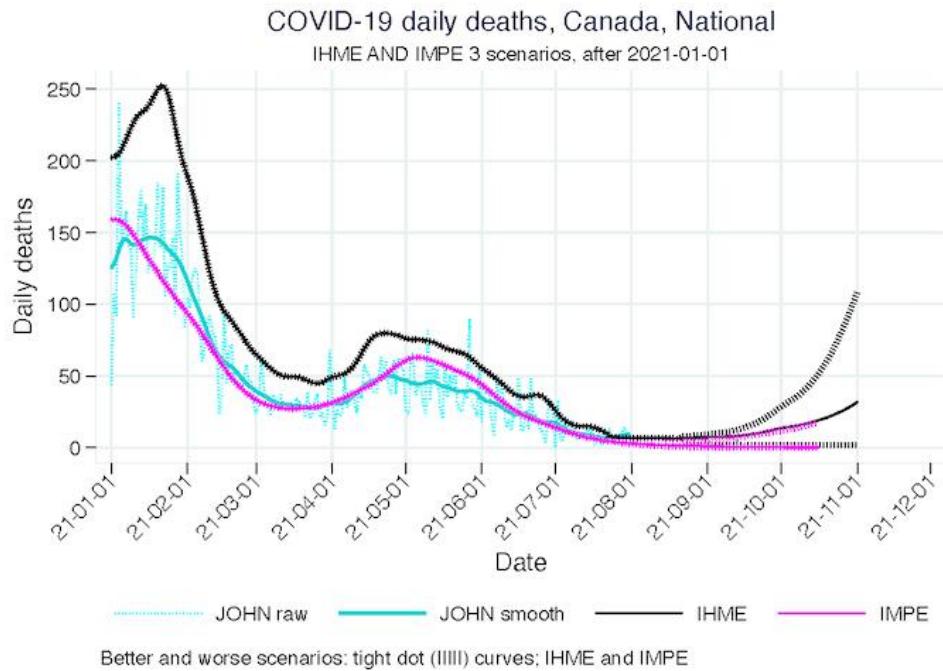
(1) Canada [Daily deaths, reference scenarios, all time](#)



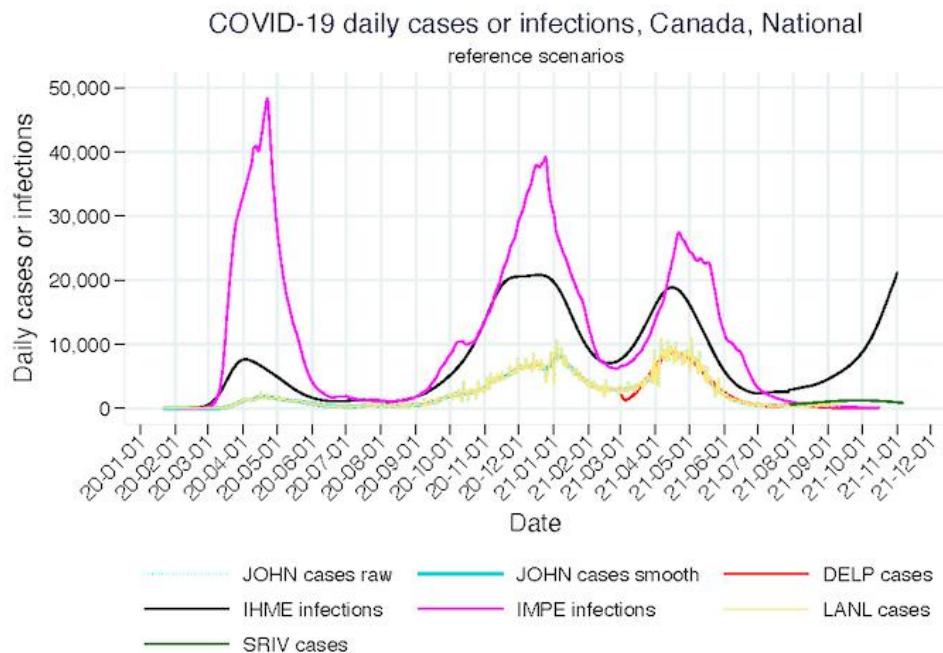
(2) Canada [Daily deaths, reference scenarios, 2021](#)



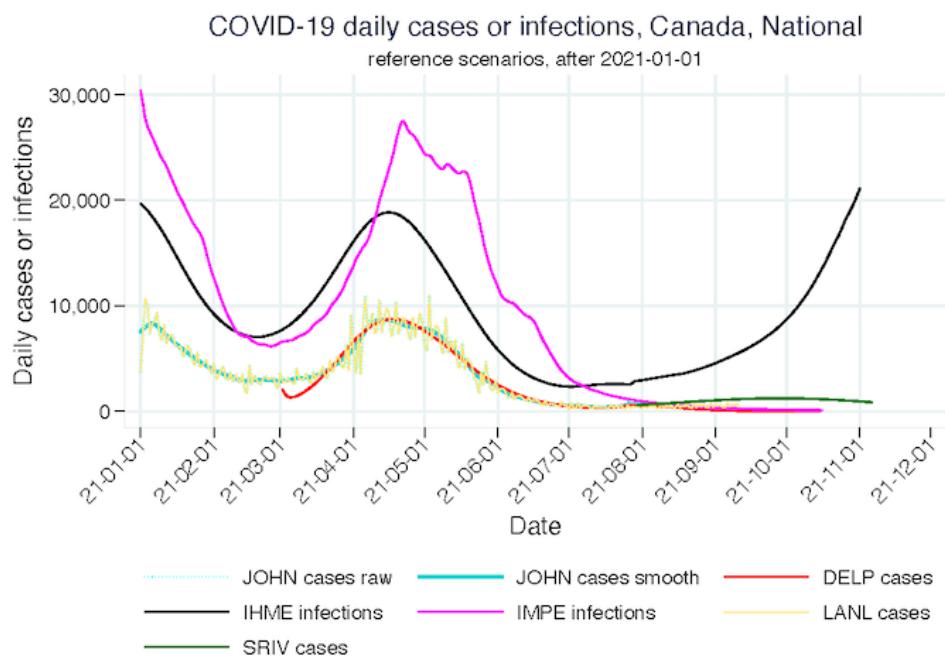
(3) Canada Daily deaths, 3 scenarios, 2021



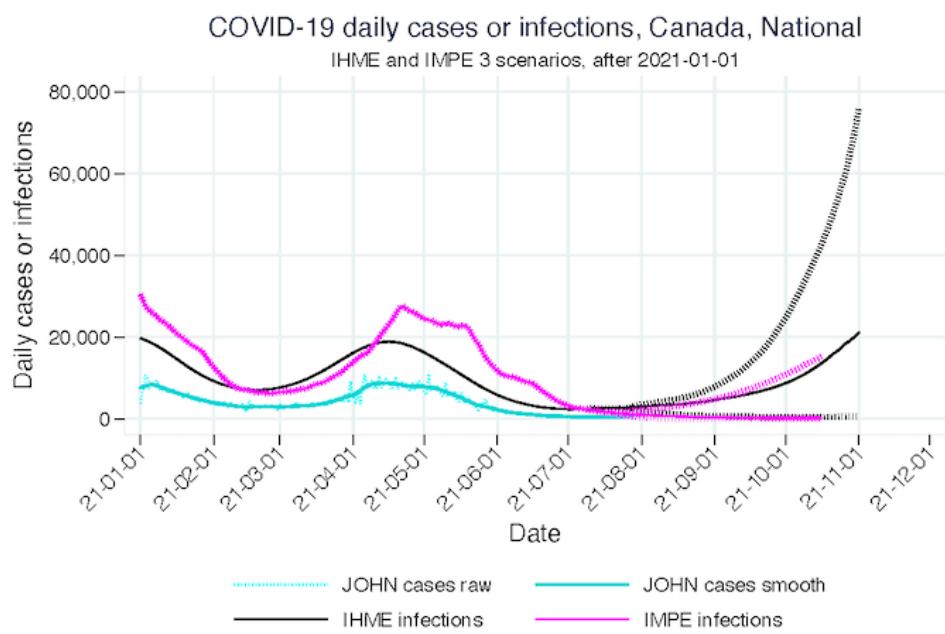
(4) Canada Daily cases or infections, reference scenarios, all time



(5) Canada [Daily cases or infections, reference scenarios, 2021](#)

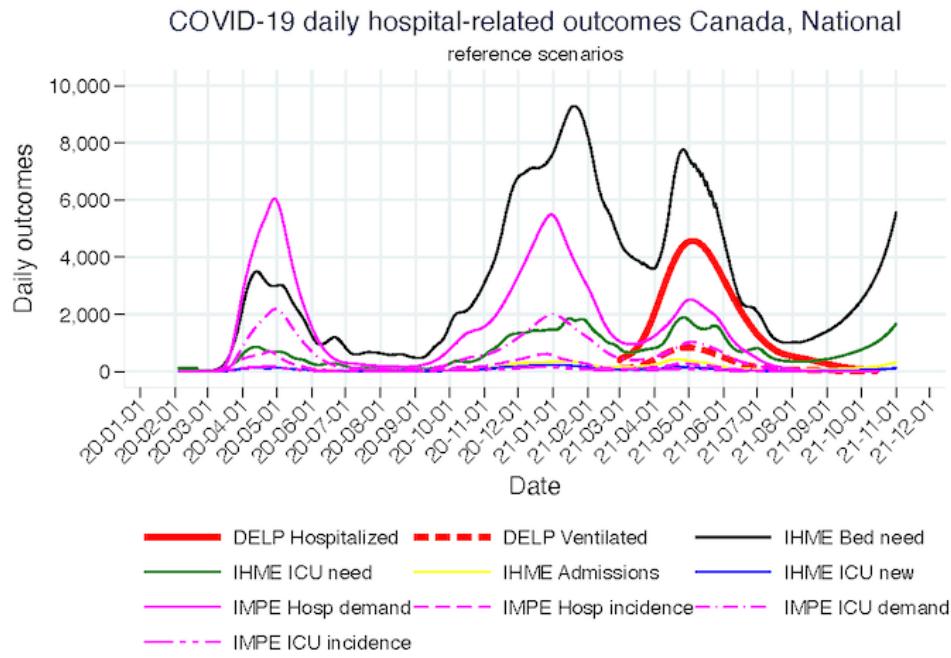


(6) Canada [Daily cases or infections, 3 scenarios, 2021](#)

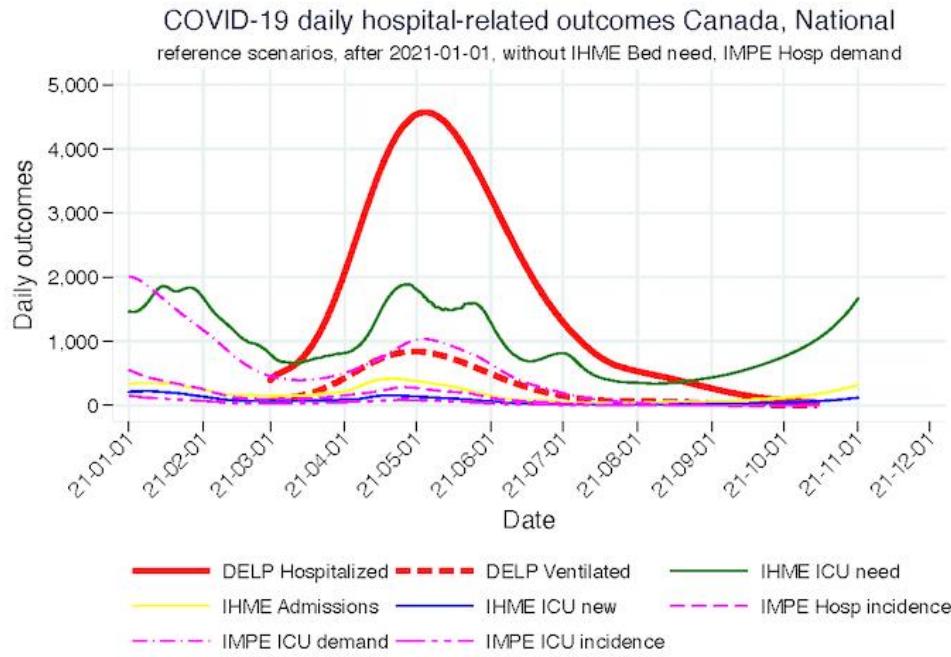


Better and worse scenarios: tight dot (||||) curves; IHME and IMPE

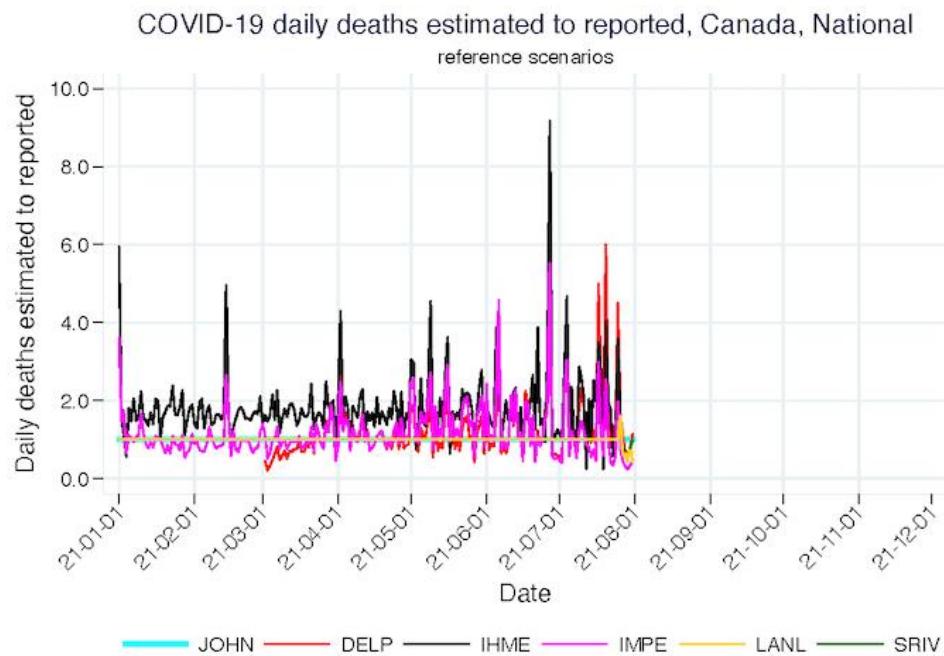
(7) Canada [Hospital-related outcomes, all time](#)



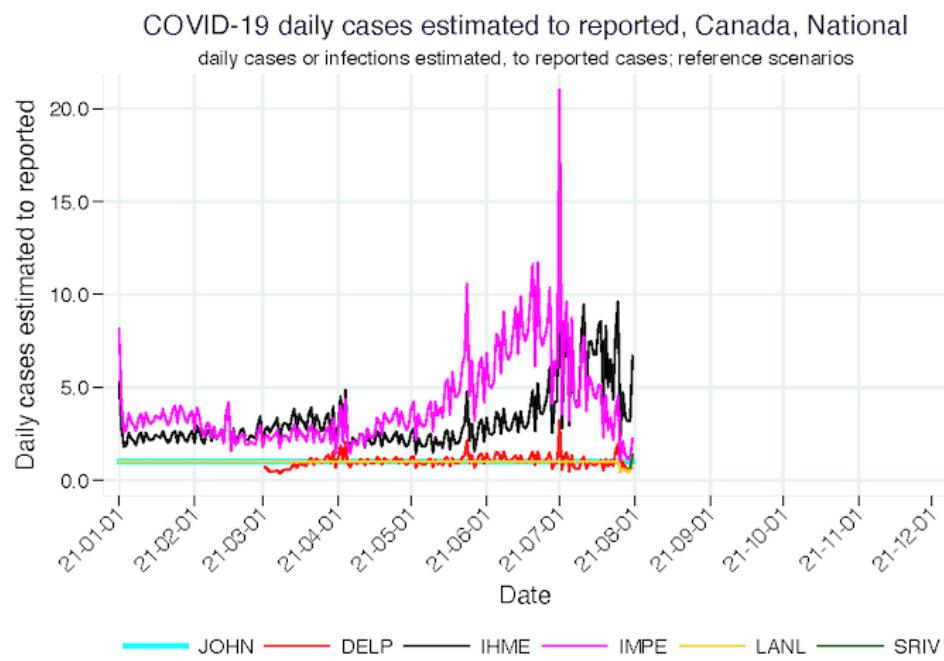
(8) Canada [Hospital-related outcomes, 2021, without IHME Bed need and IMPE Hospital demand](#)



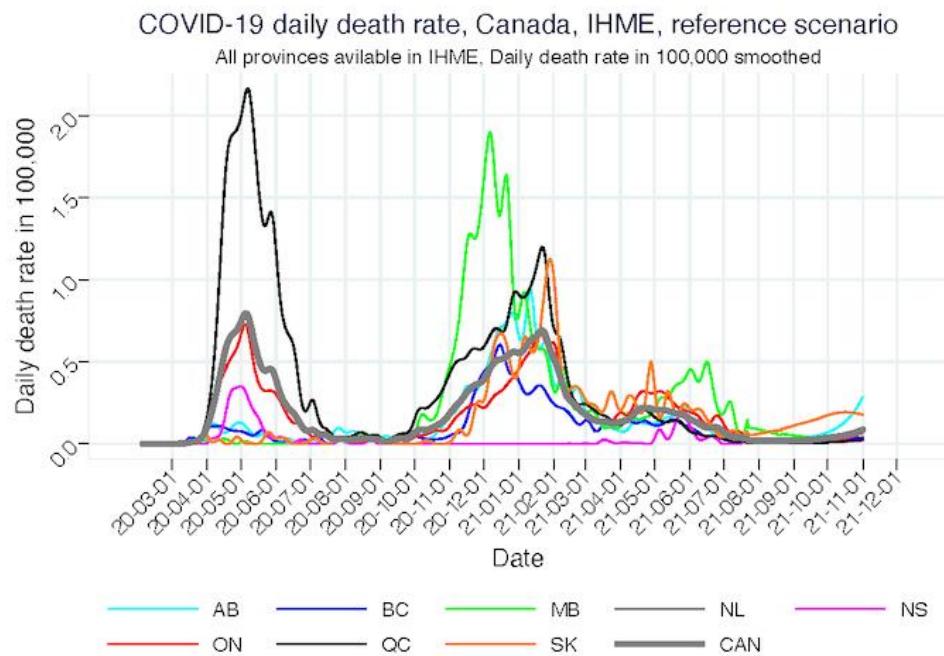
(9) Canada [Daily deaths estimated to reported, reference scenarios, 2021](#)



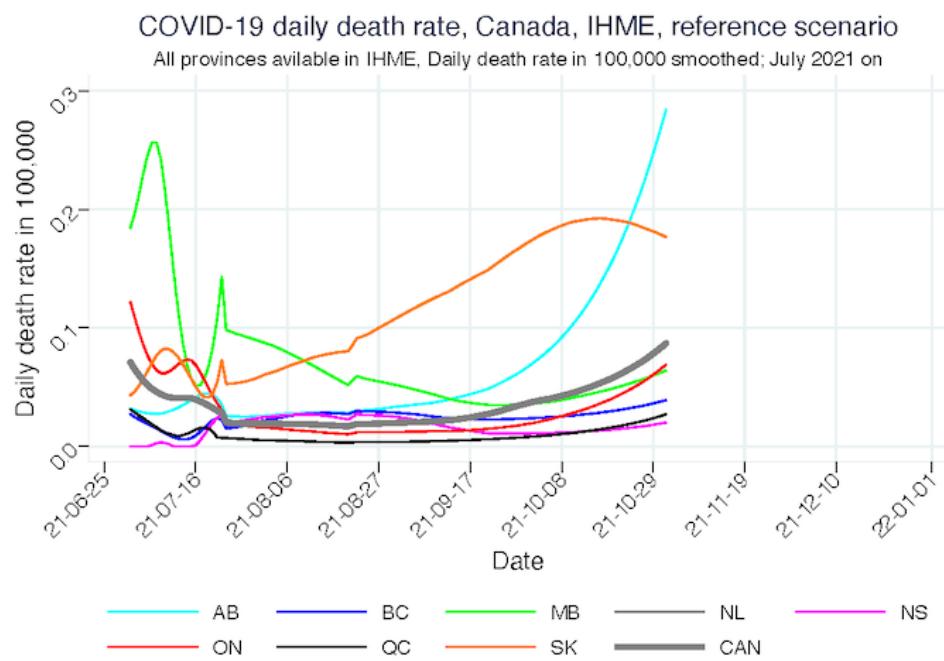
(10) Canada [Daily cases or infections estimated to reported, reference scenarios, 2021](#)



(11) Canada and provinces [Daily death rates, reference scenario, all time, IHME](#)

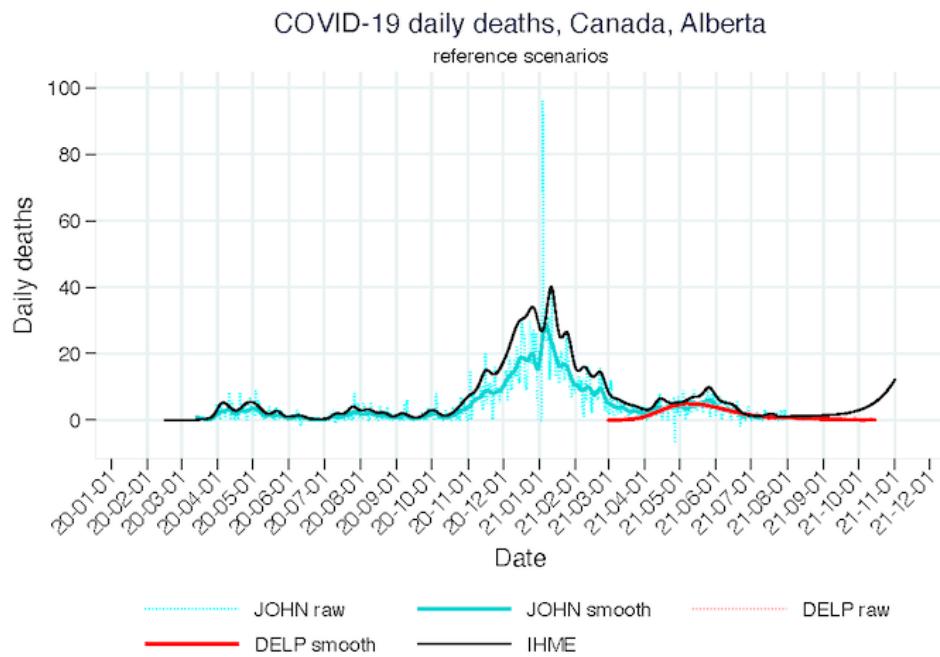


(12) Canada and provinces [Daily death rates, reference scenario, 2021 IHME](#)

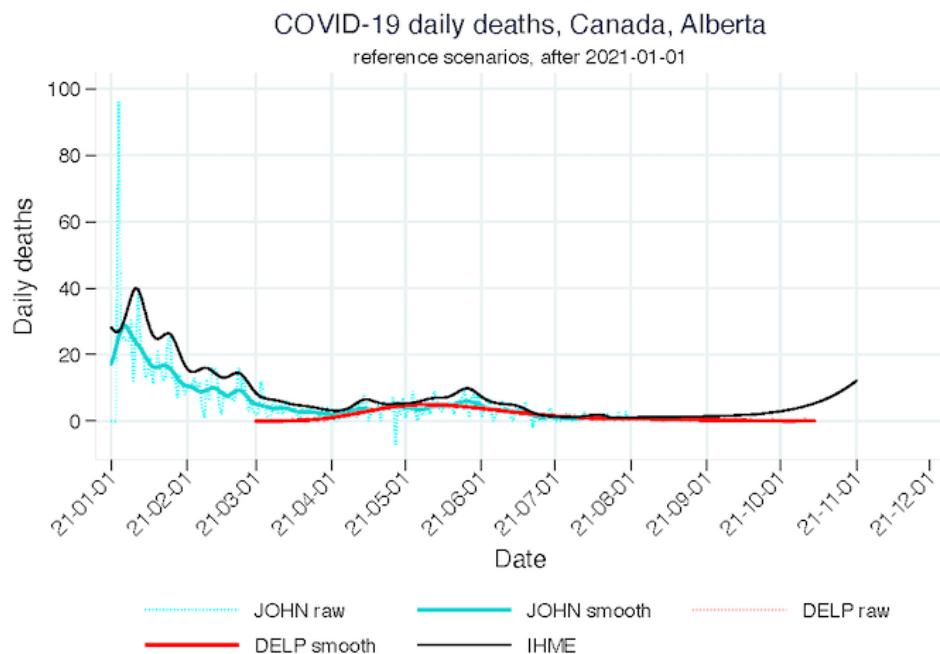


Selected graphs - Alberta

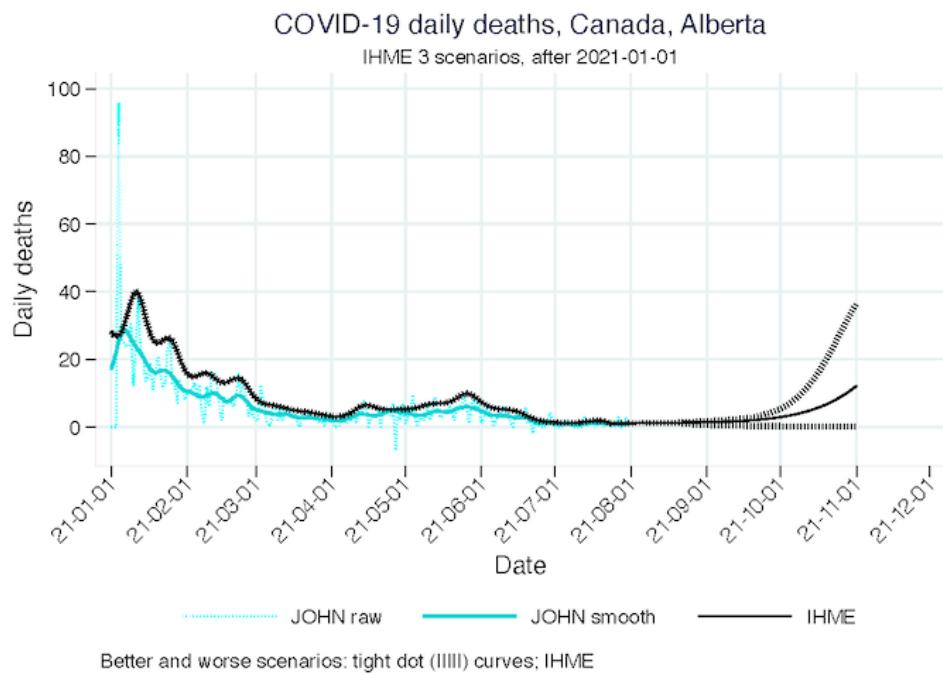
(1) Alberta Daily deaths, reference scenarios, all time



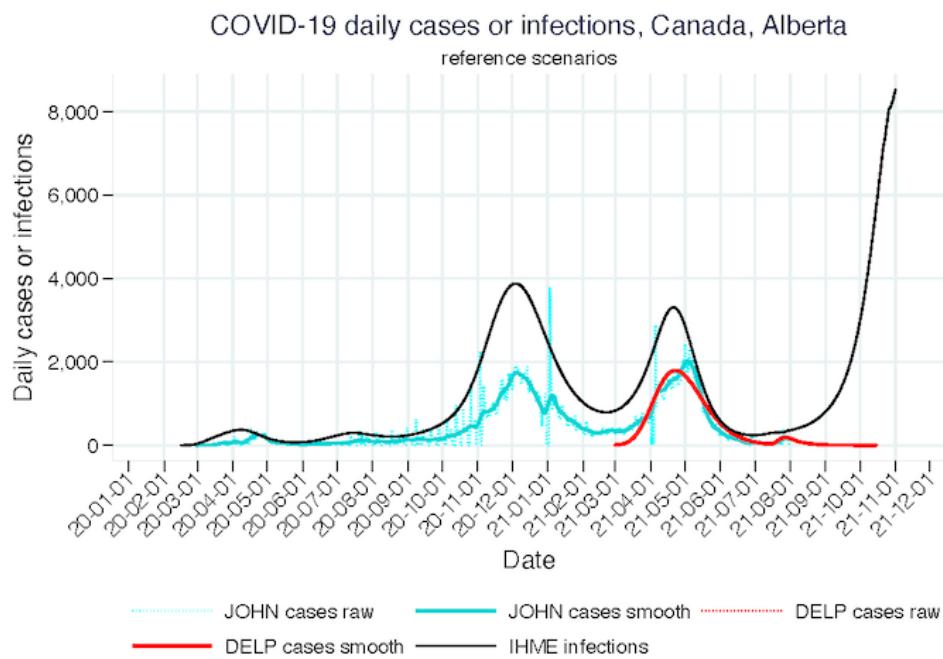
(2) Alberta Daily deaths, reference scenarios, 2021



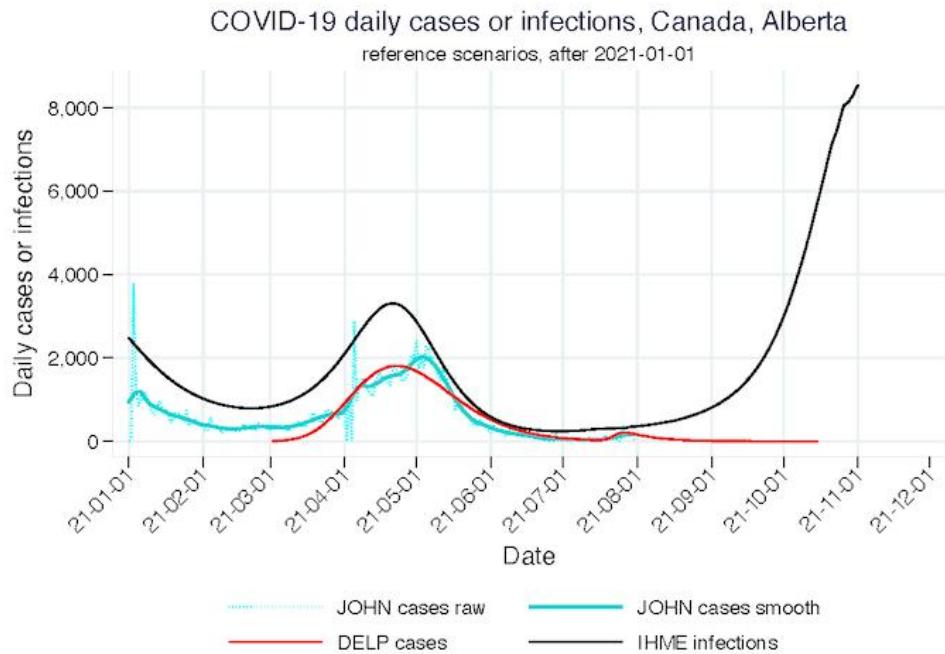
(3) Alberta Daily deaths, 3 scenarios, 2021



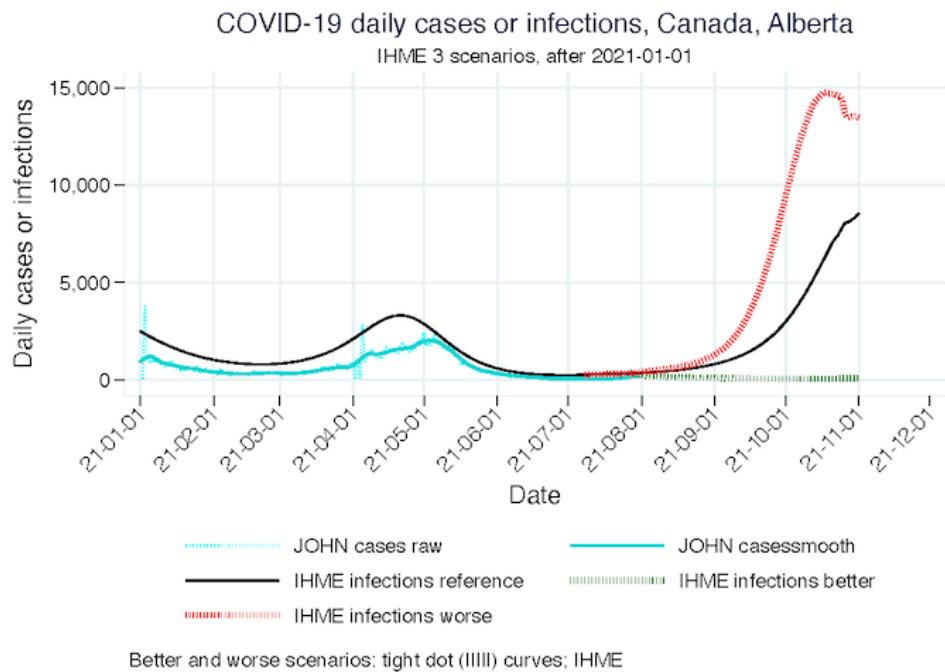
(4) Alberta Daily cases or infections, reference scenarios, all time



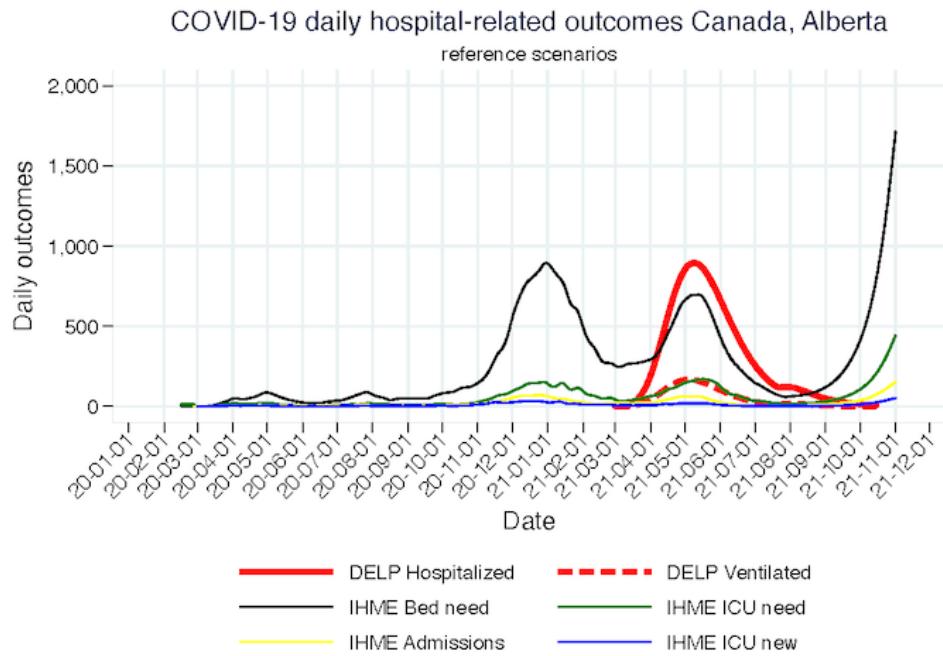
(5) Alberta Daily cases or infections, reference scenarios, 2021



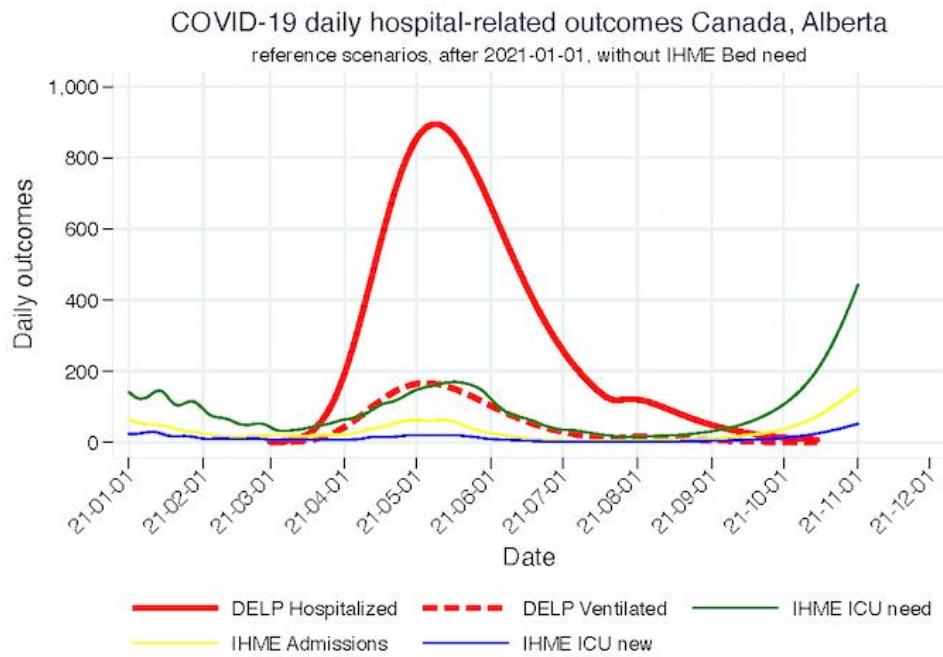
(6) Alberta Daily cases or infections, 3 scenarios, 2021



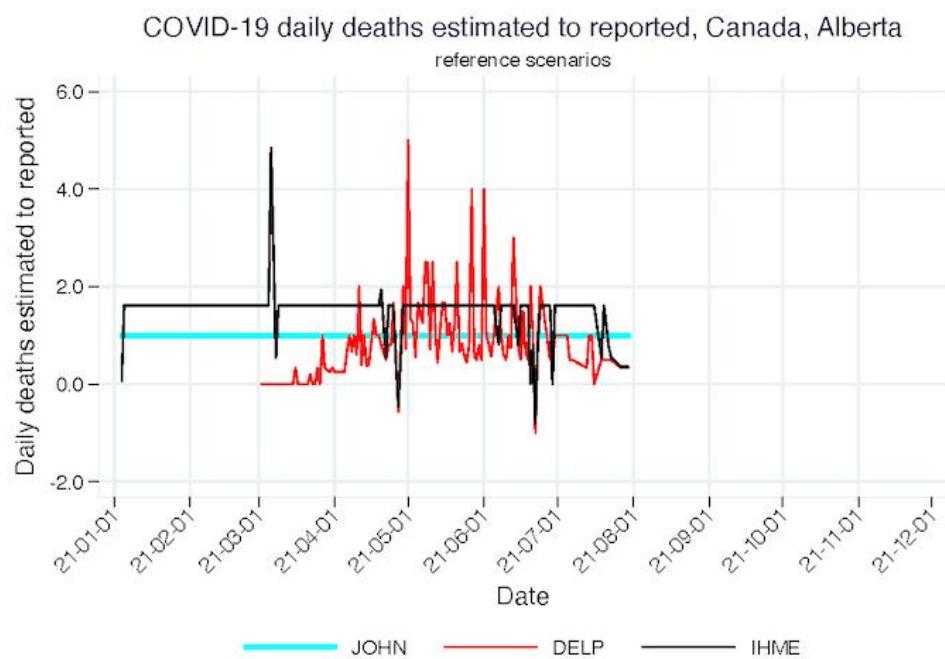
(7) Alberta [Hospital-related outcomes, all time](#)



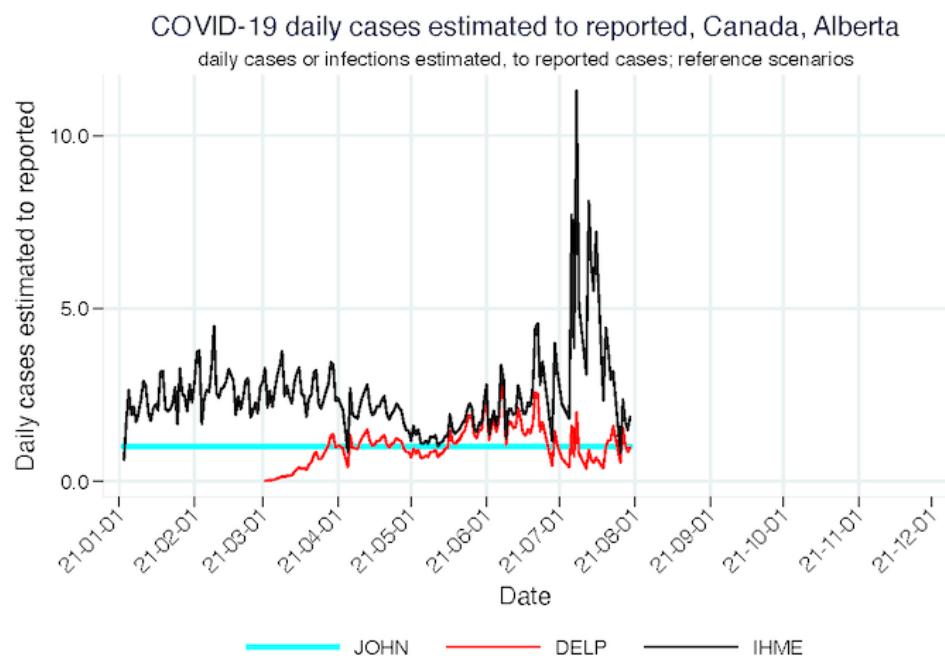
(8) Alberta [Hospital-related outcomes, 2021, without IHME Bed need and IMPE Hospital demand](#)



(9) Alberta [Daily deaths estimated to reported, reference scenarios, 2021](#)

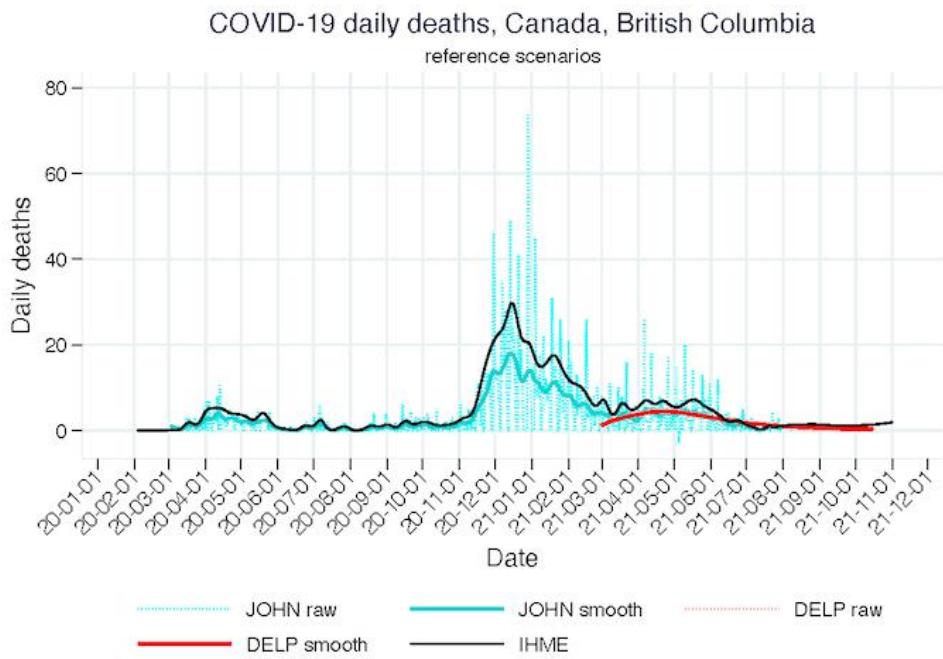


(10) Alberta [Daily cases or infections estimated to reported, reference scenarios, 2021](#)

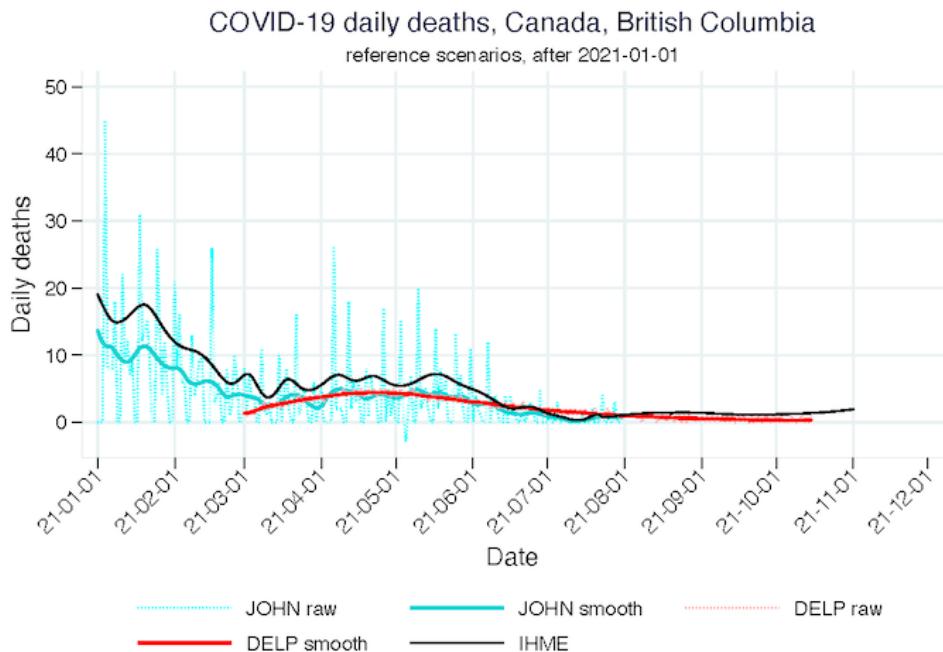


Selected graphs - British Columbia

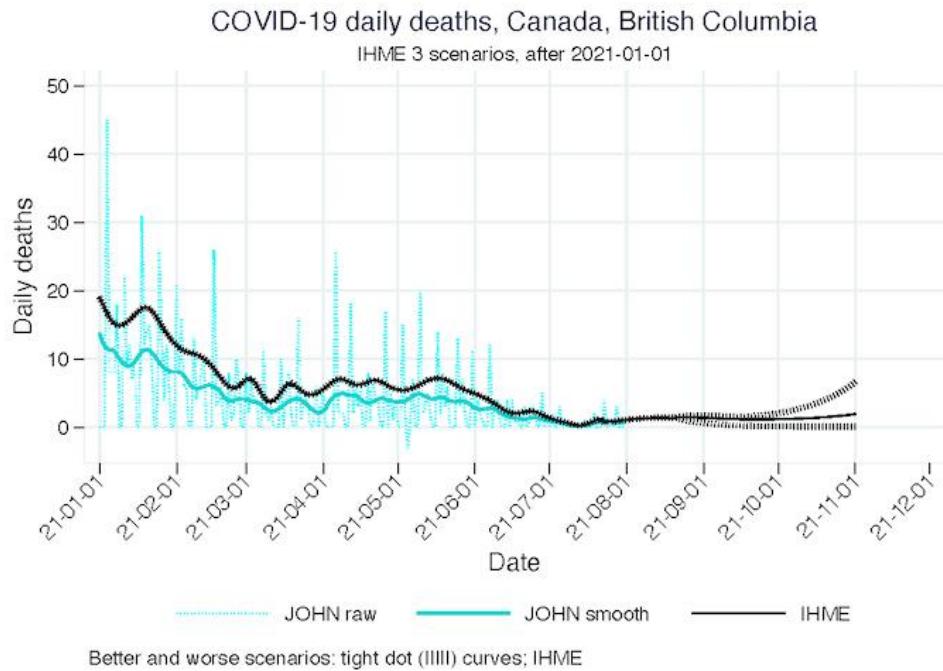
(1) British Columbia [Daily deaths, reference scenarios, all time](#)



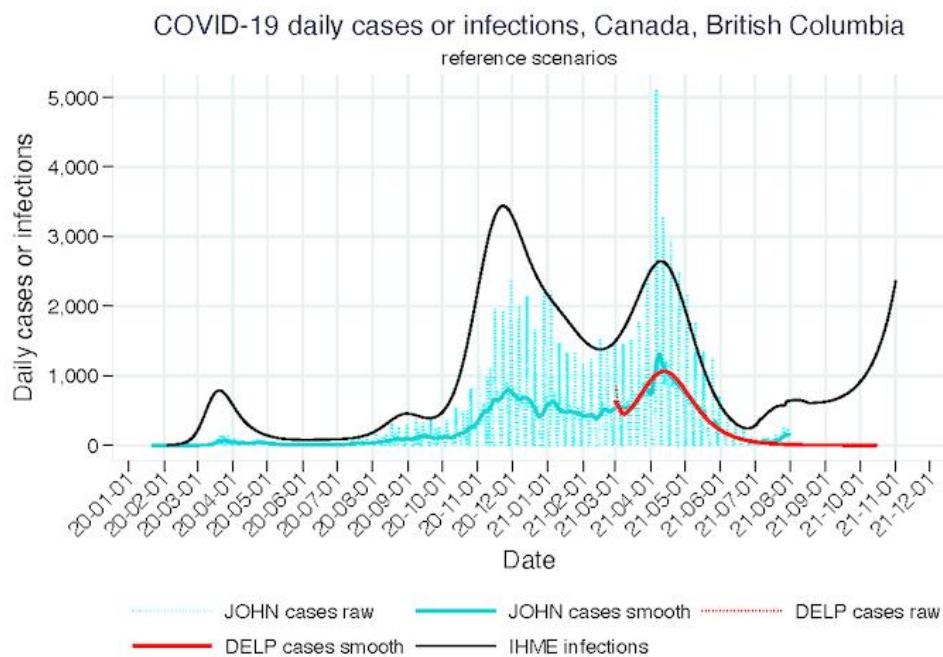
(2) British Columbia [Daily deaths, reference scenarios, 2021](#)



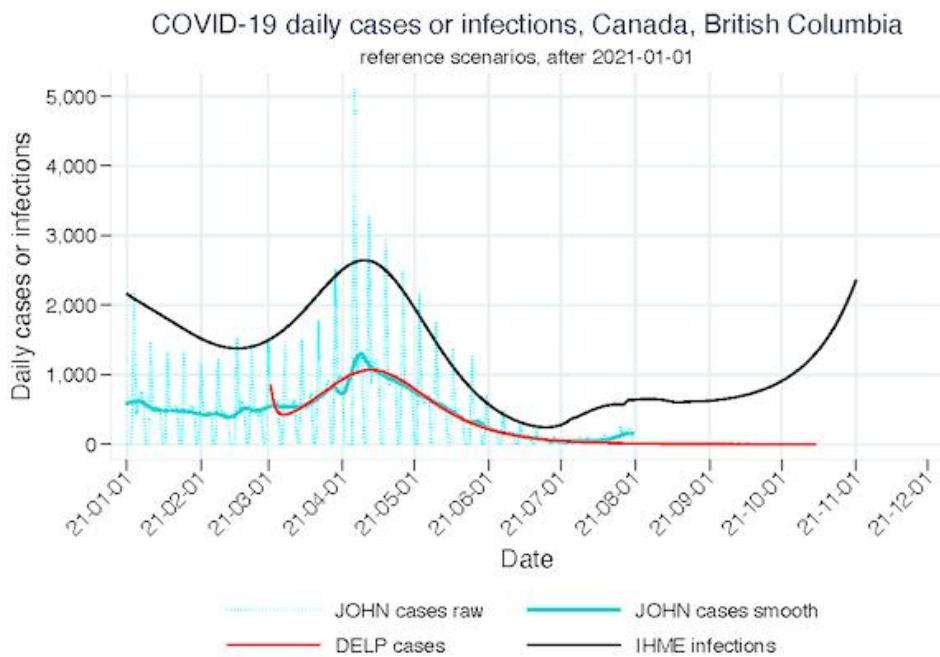
(3) British Columbia [Daily deaths, 3 scenarios, 2021](#)



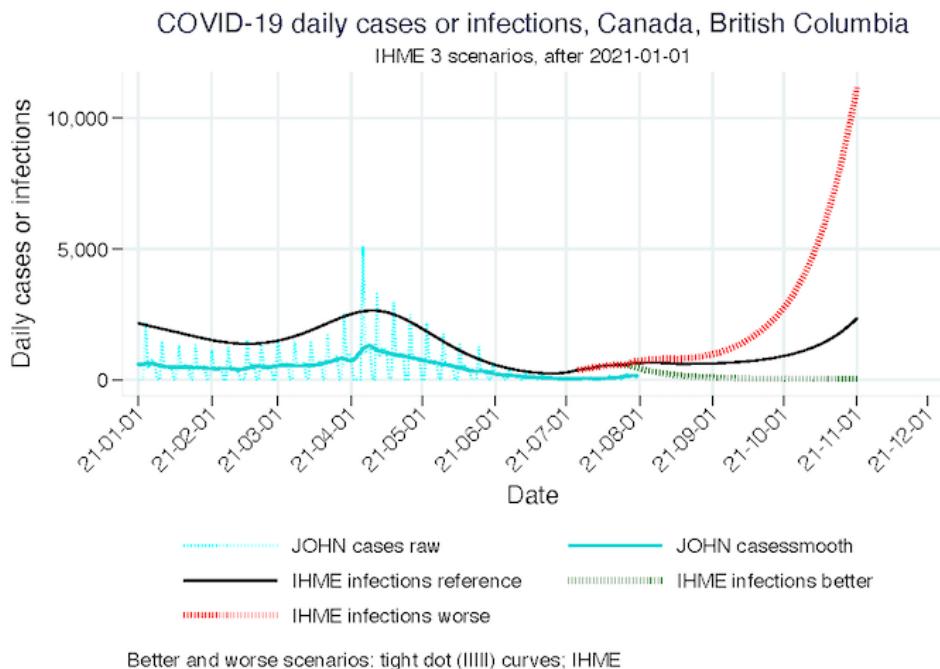
(4) British Columbia [Daily cases or infections, reference scenarios, all time](#)



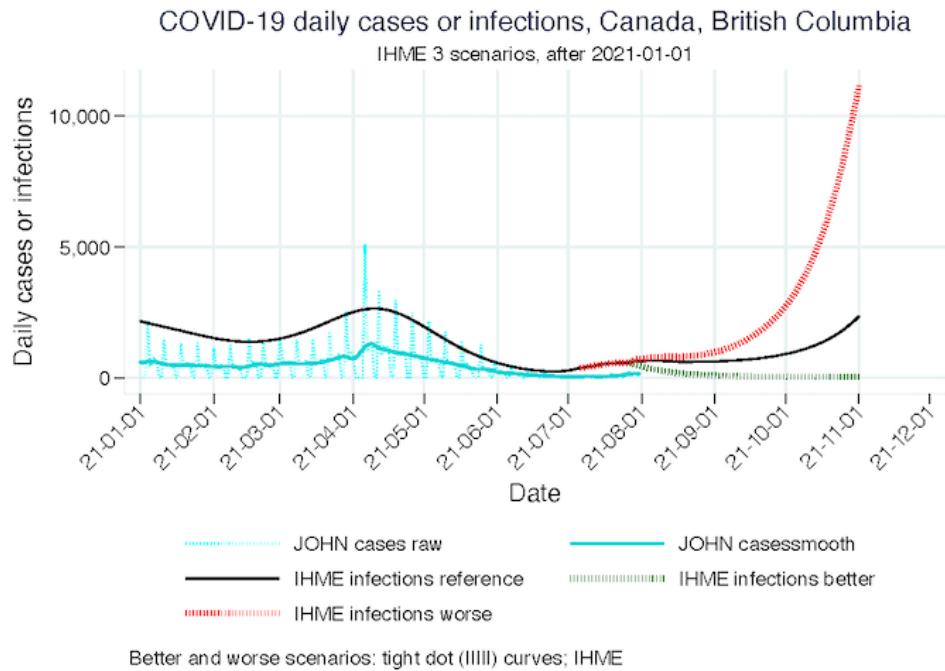
(5) British Columbia [Daily cases or infections, reference scenarios, 2021](#)



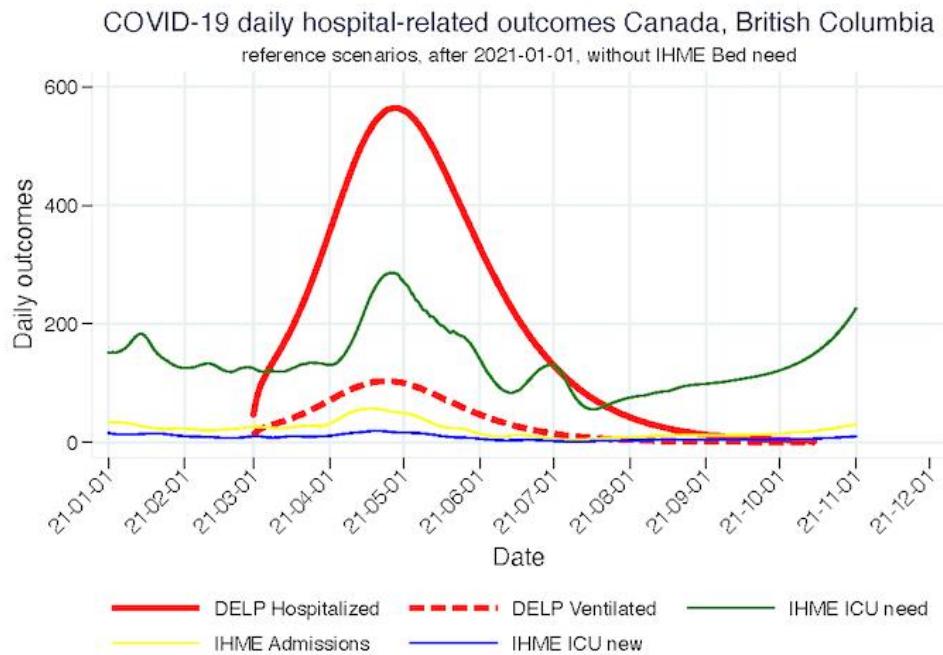
(6) British Columbia [Daily cases or infections, 3 scenarios, 2021](#)



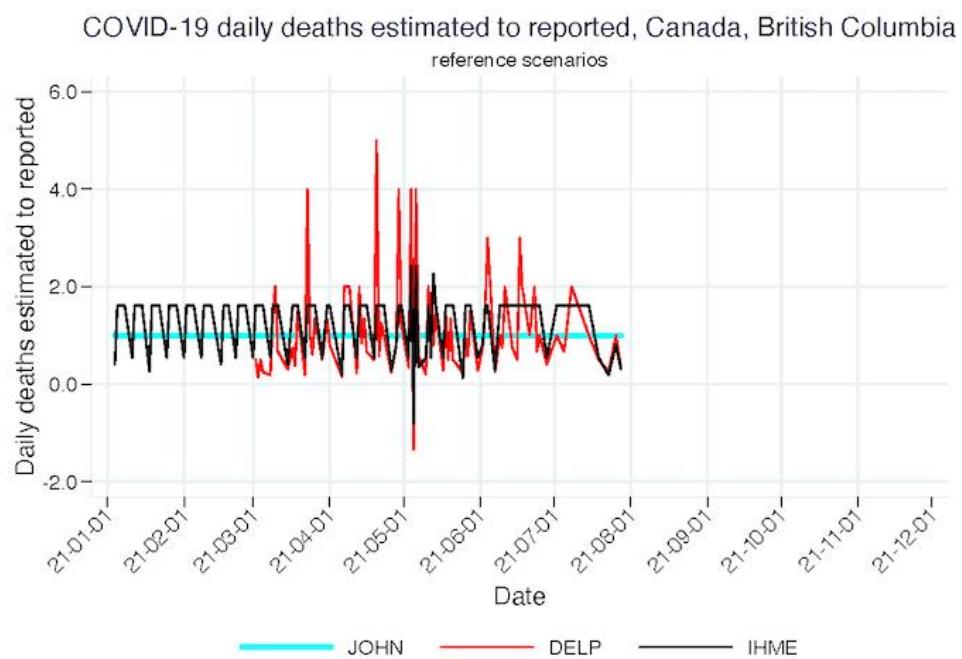
(7) British Columbia [Hospital-related outcomes, all time](#)



(8) British Columbia [Hospital-related outcomes, 2021, without IHME Bed need and IMPE Hospital demand](#)



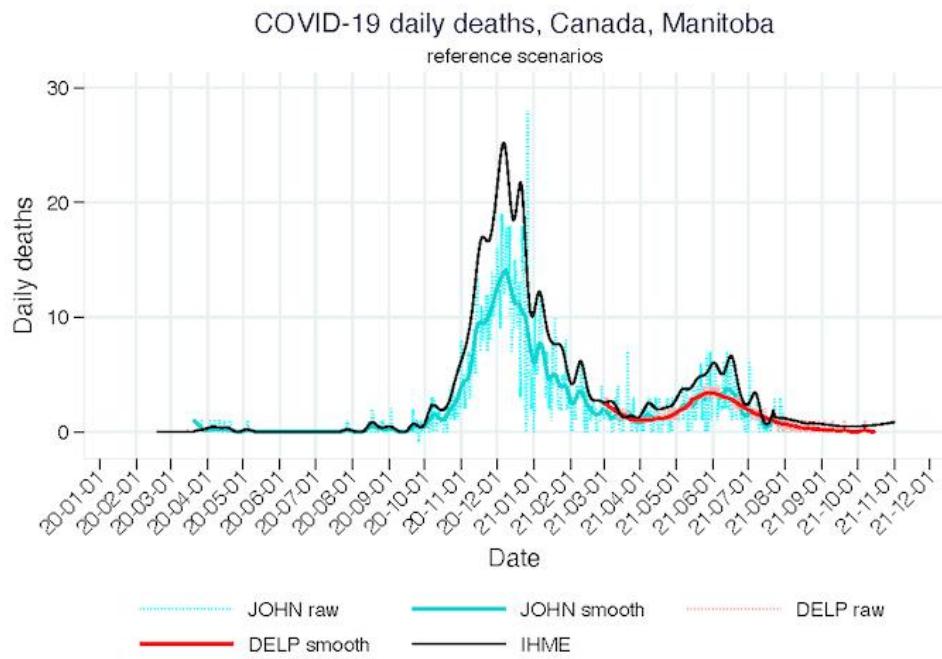
(9) British Columbia [Daily deaths estimated to reported, reference scenarios, 2021](#)



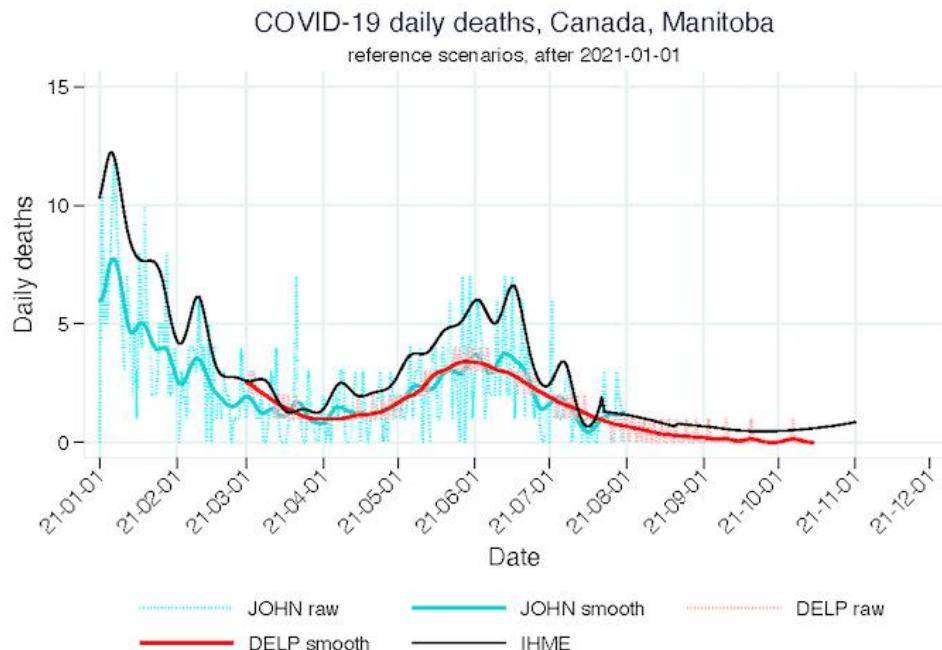
(10) British Columbia [Daily cases or infections estimated to reported, reference scenarios, 2021](#)

Selected graphs - Manitoba

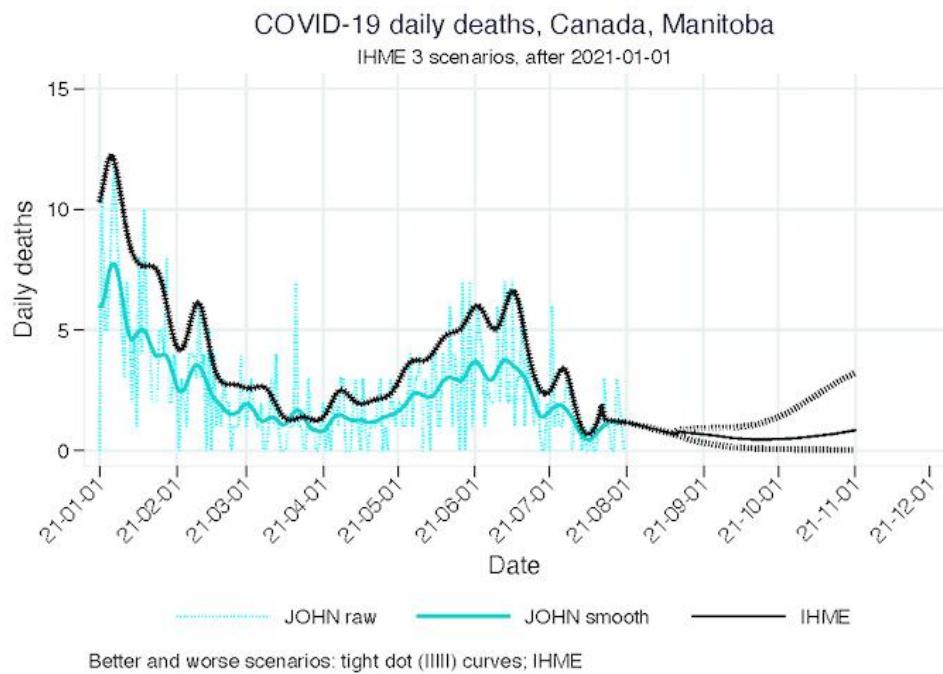
(1) Manitoba [Daily deaths, reference scenarios, all time](#)



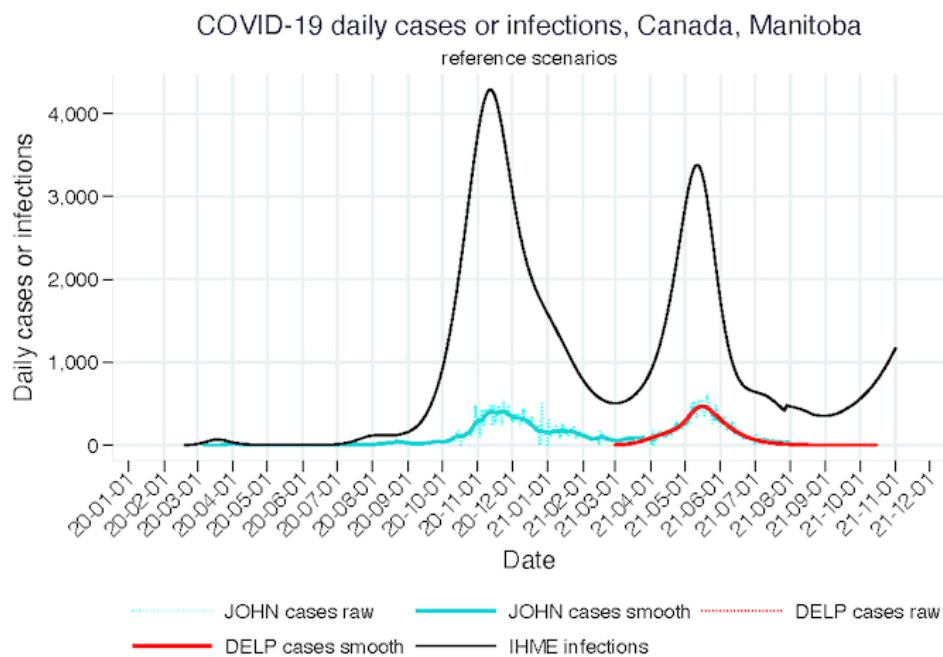
(2) Manitoba [Daily deaths, reference scenarios, 2021](#)



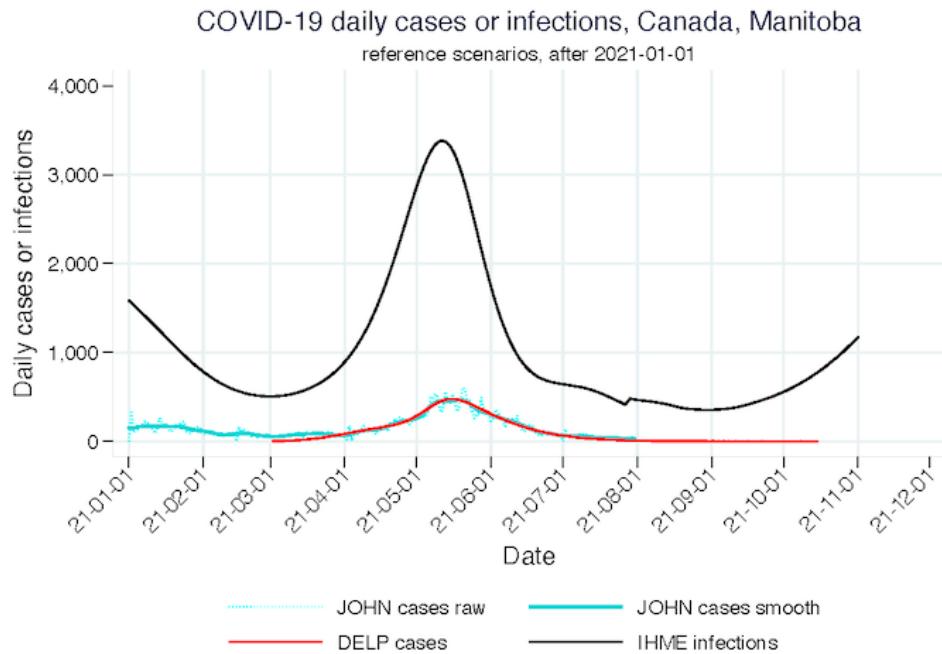
(3) Manitoba [Daily deaths, 3 scenarios, 2021](#)



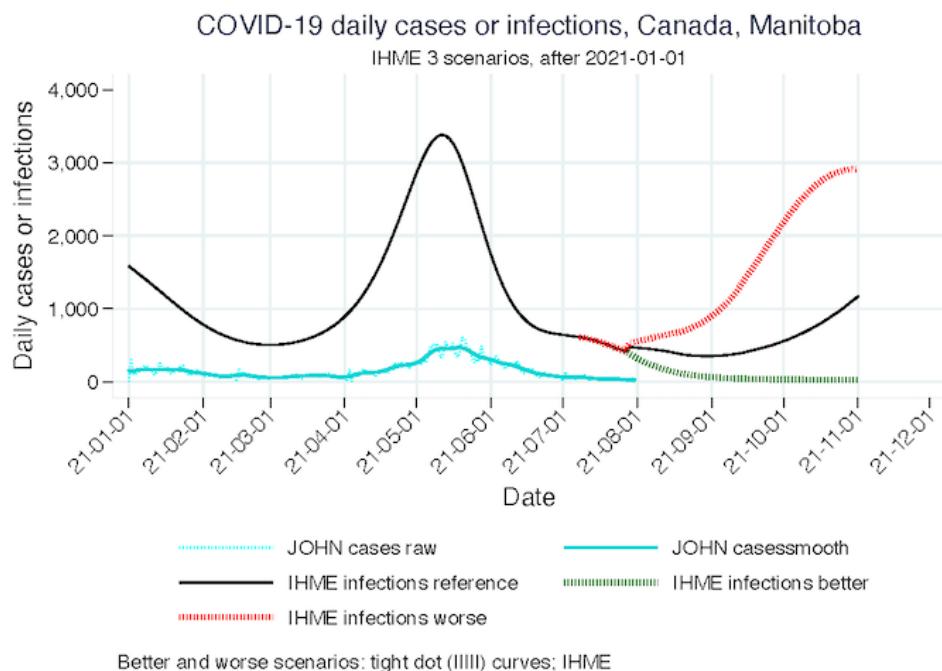
(4) Manitoba [Daily cases or infections, reference scenarios, all time](#)



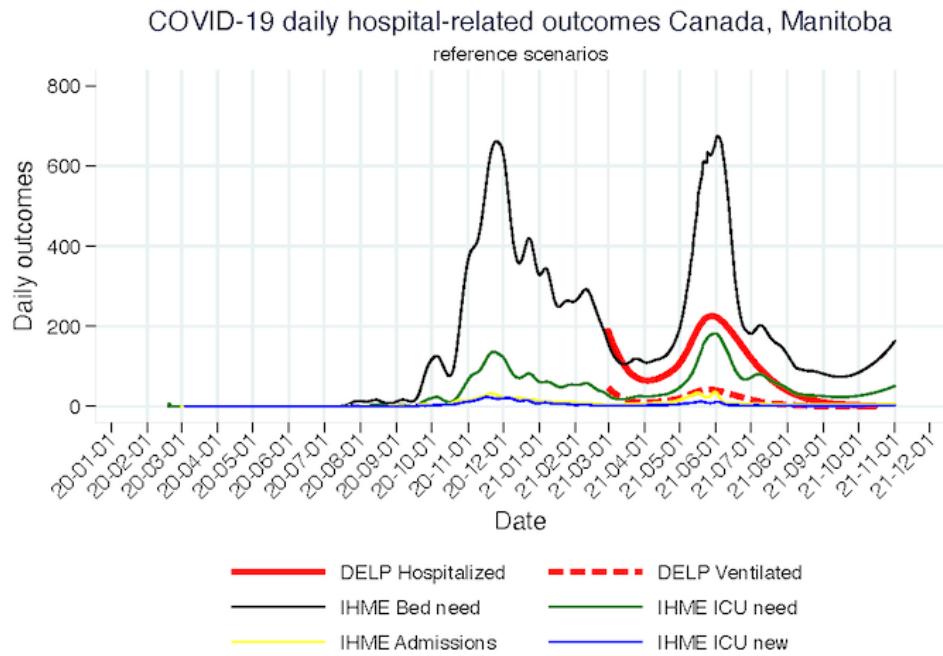
(5) Manitoba [Daily cases or infections, reference scenarios, 2021](#)



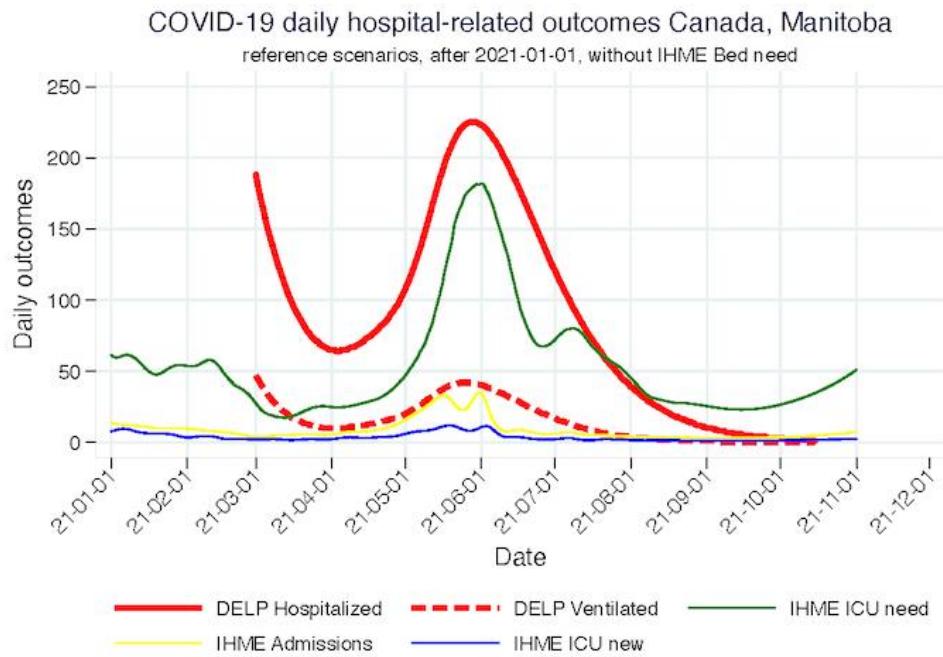
(6) Manitoba [Daily cases or infections, 3 scenarios, 2021](#)



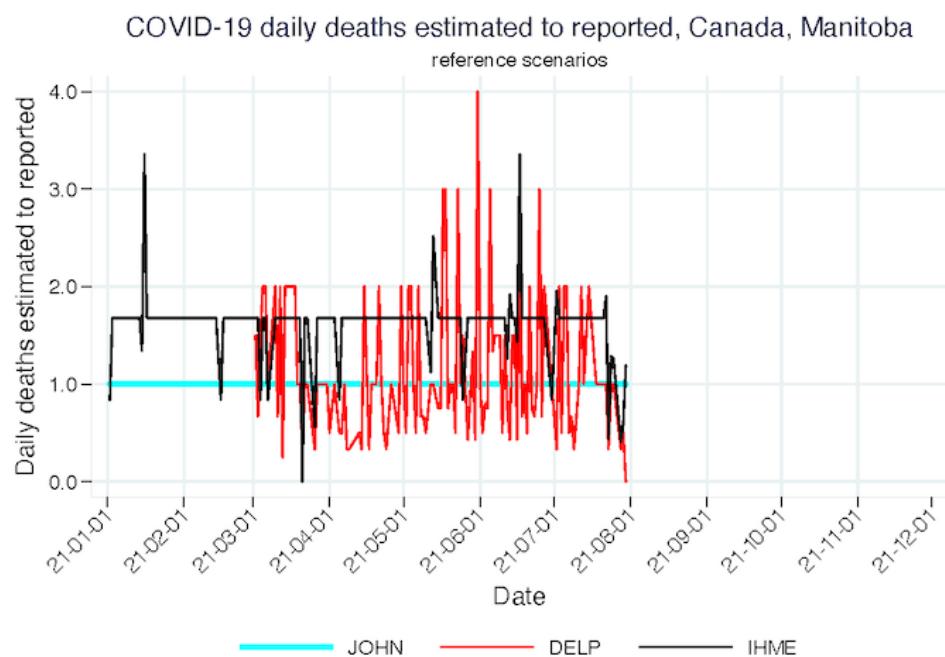
(7) Manitoba [Hospital-related outcomes, all time](#)



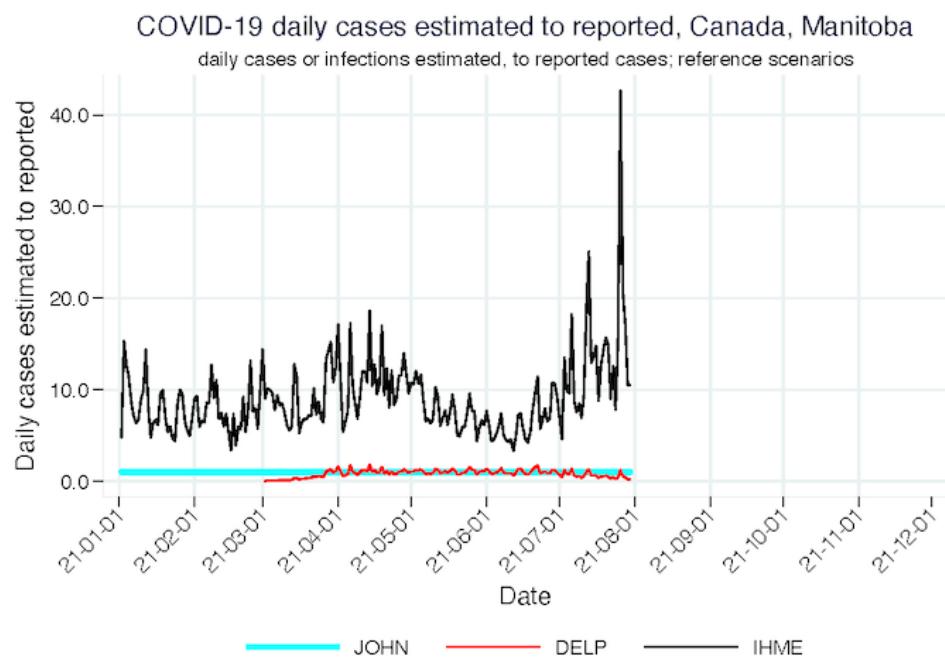
(8) Manitoba [Hospital-related outcomes, 2021, without IHME Bed need and IMPE Hospital demand](#)



(9) Manitoba [Daily deaths estimated to reported, reference scenarios, 2021](#)

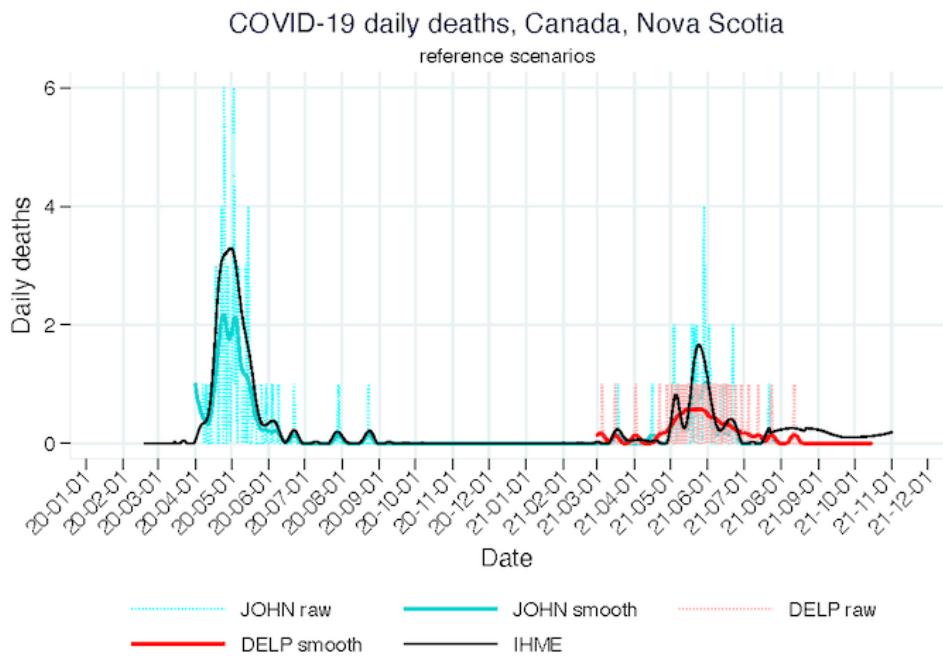


(10) Manitoba [Daily cases or infections estimated to reported, reference scenarios, 2021](#)

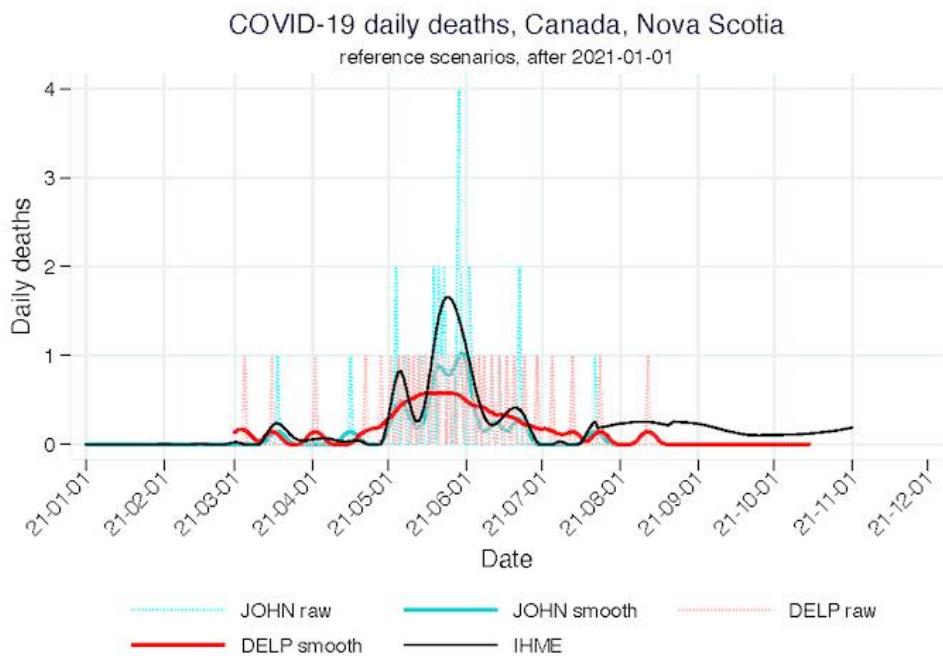


Selected graphs - Nova Scotia

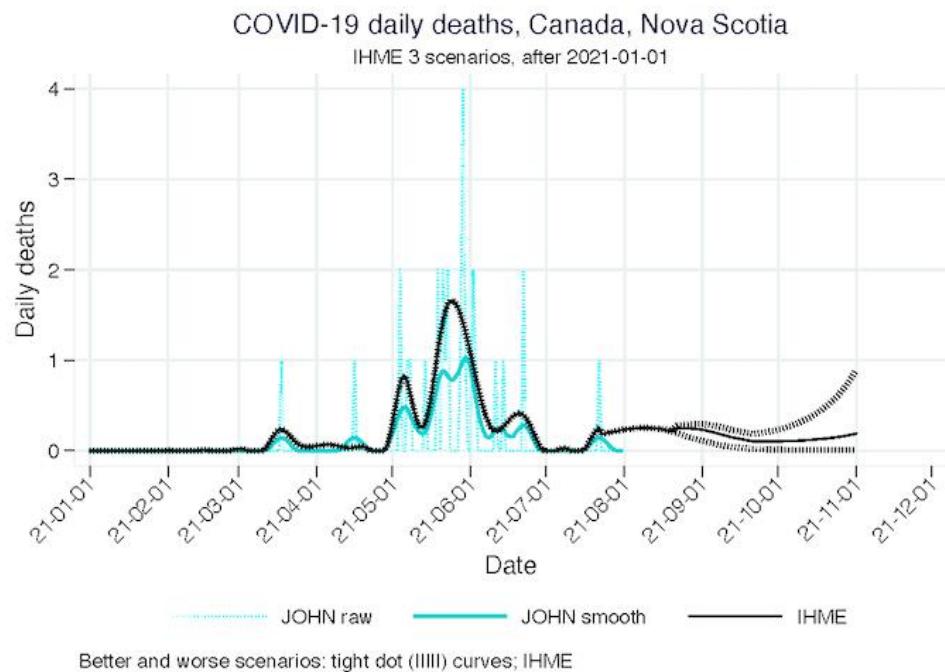
(1) Nova Scotia [Daily deaths, reference scenarios, all time](#)



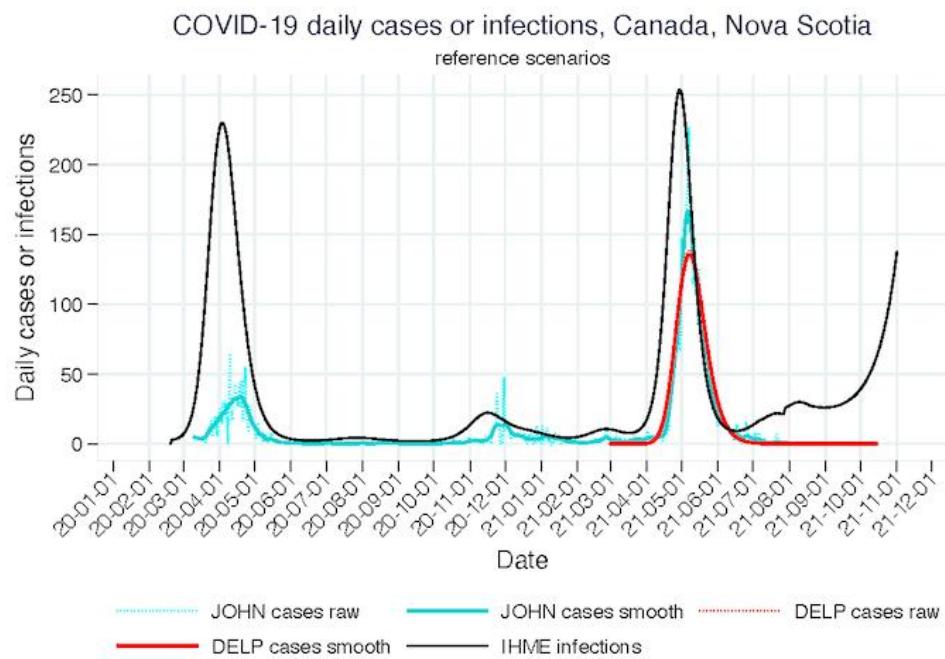
(2) Nova Scotia [Daily deaths, reference scenarios, 2021](#)



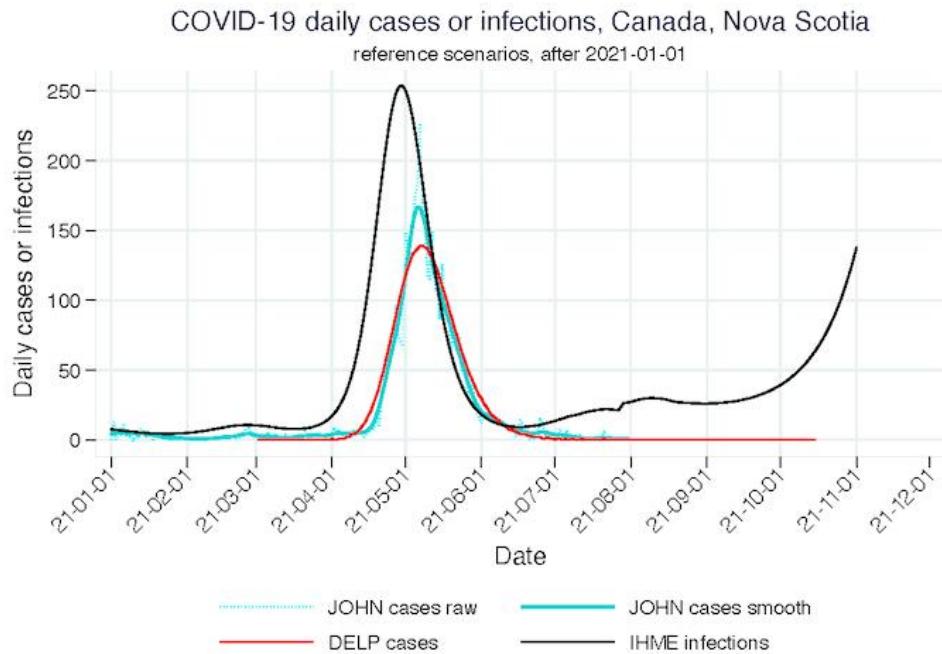
(3) Nova Scotia [Daily deaths, 3 scenarios, 2021](#)



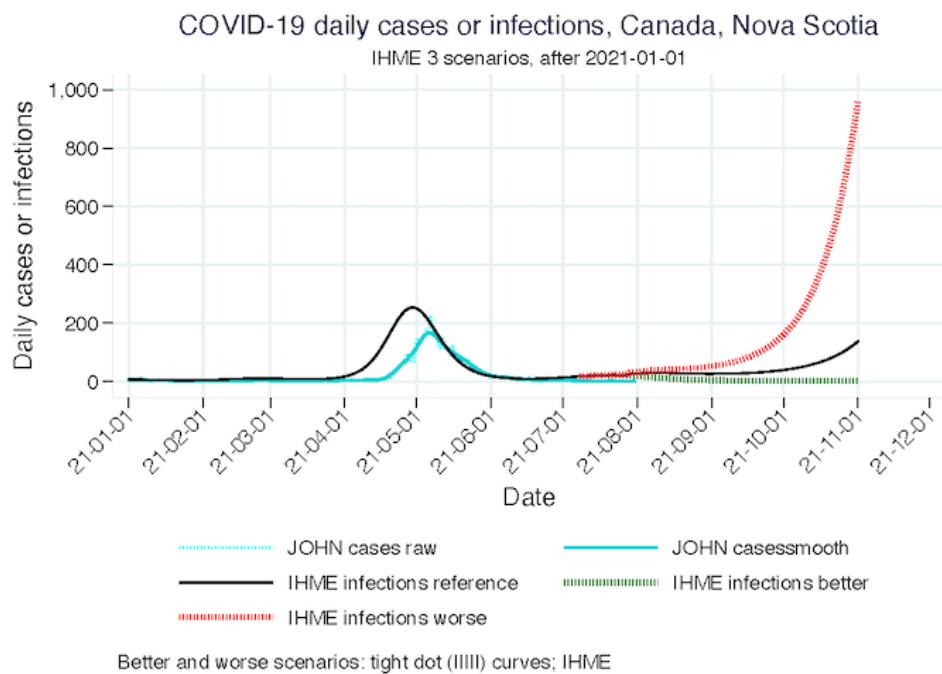
(4) Nova Scotia [Daily cases or infections, reference scenarios, all time](#)



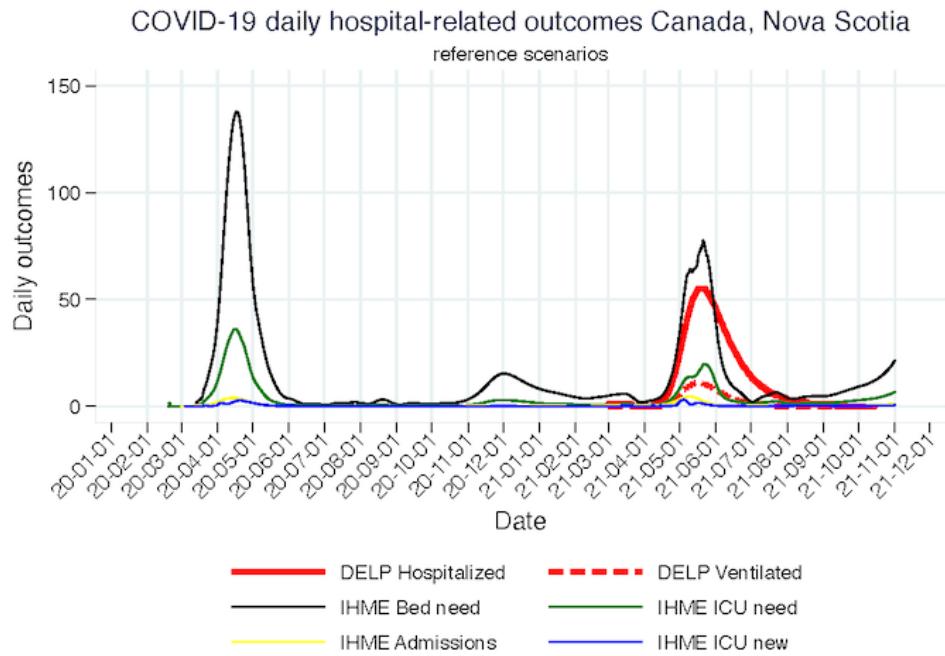
(5) Nova Scotia [Daily cases or infections, reference scenarios, 2021](#)



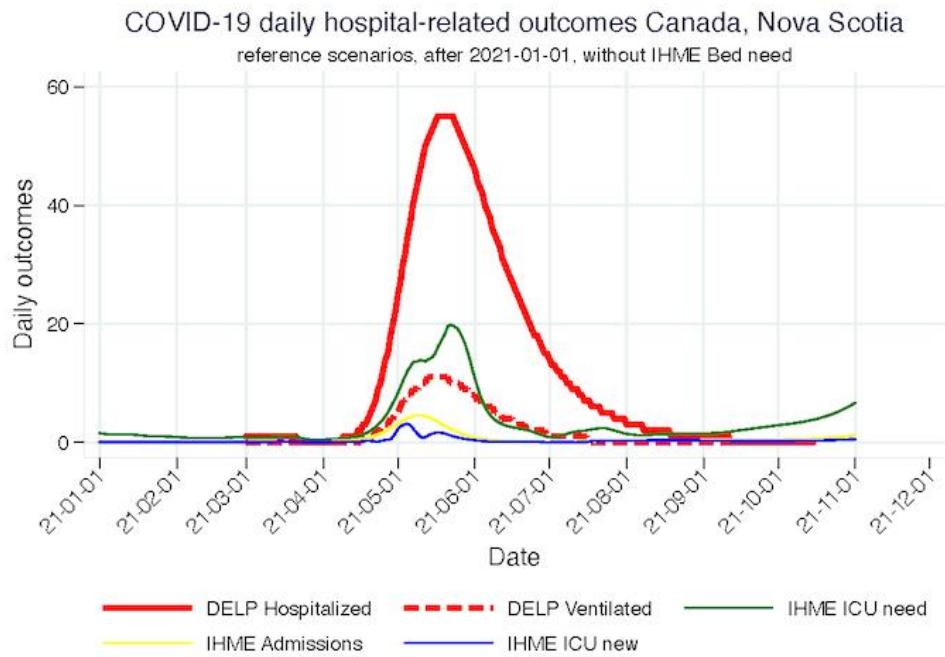
(6) Nova Scotia [Daily cases or infections, 3 scenarios, 2021](#)



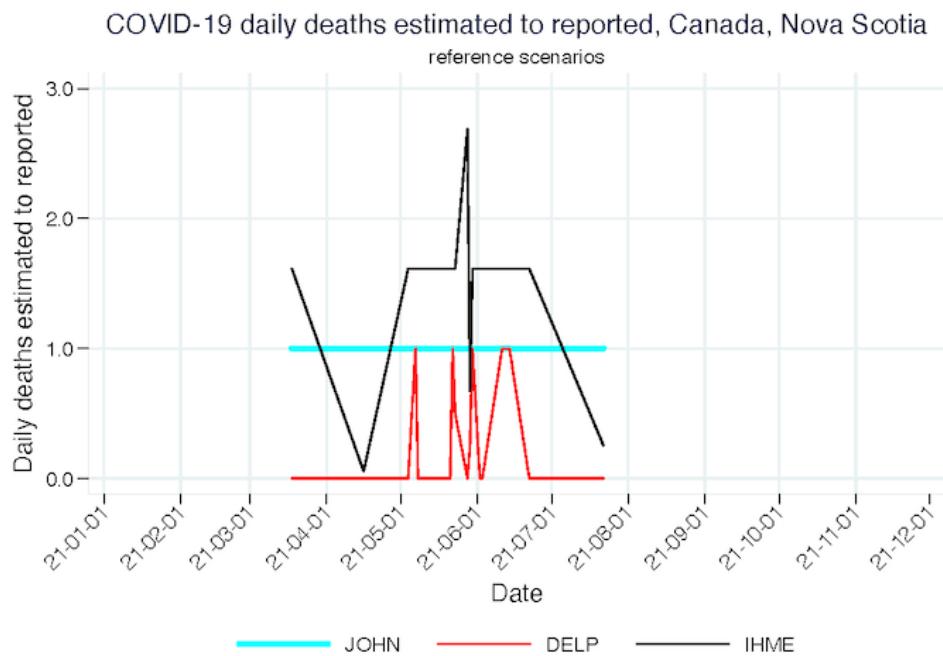
(7) Nova Scotia [Hospital-related outcomes, all time](#)



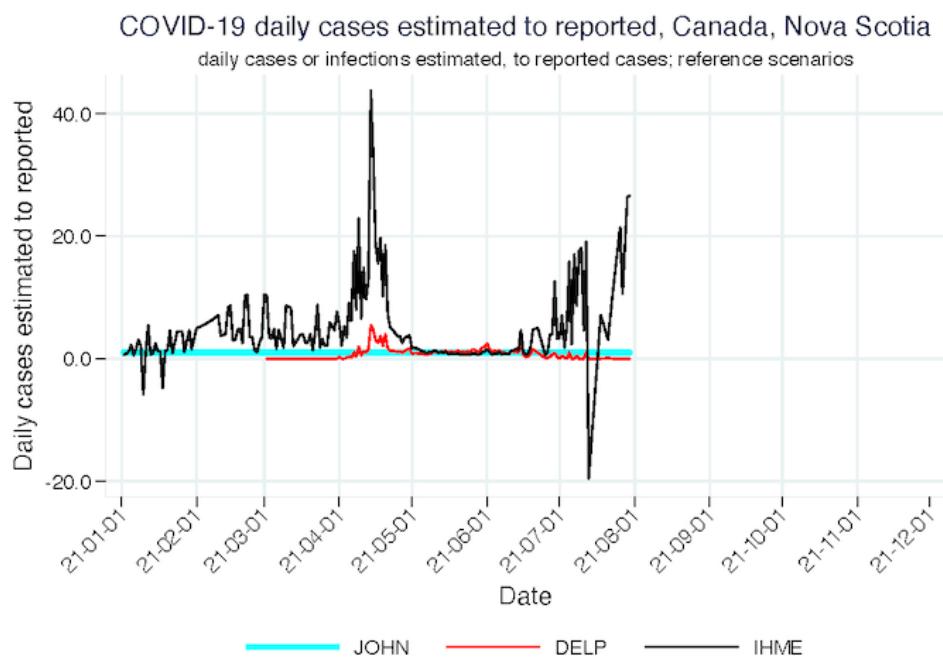
(8) Nova Scotia [Hospital-related outcomes, 2021, without IHME Bed need and IMPE Hospital demand](#)



(9) Nova Scotia [Daily deaths estimated to reported, reference scenarios, 2021](#)

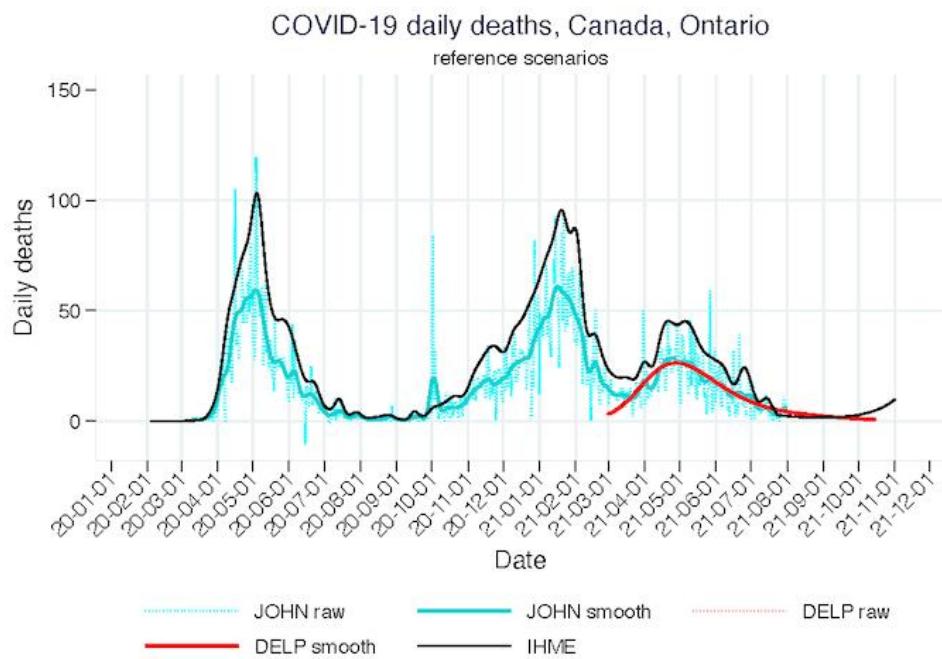


(10) Nova Scotia [Daily cases or infections estimated to reported, reference scenarios, 2021](#)

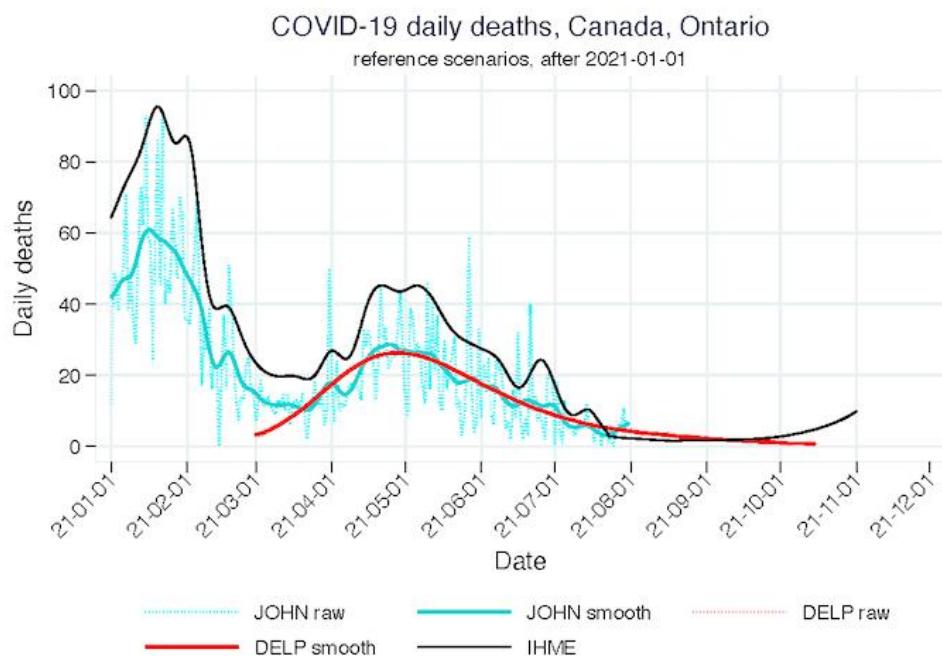


Selected graphs - Ontario

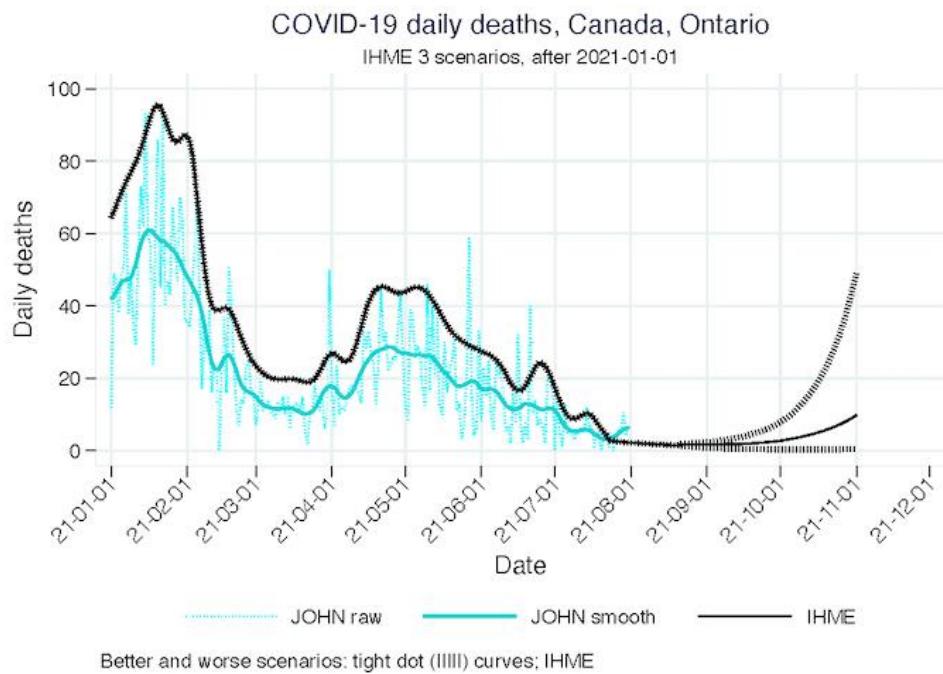
(1) Ontario [Daily deaths, reference scenarios, all time](#)



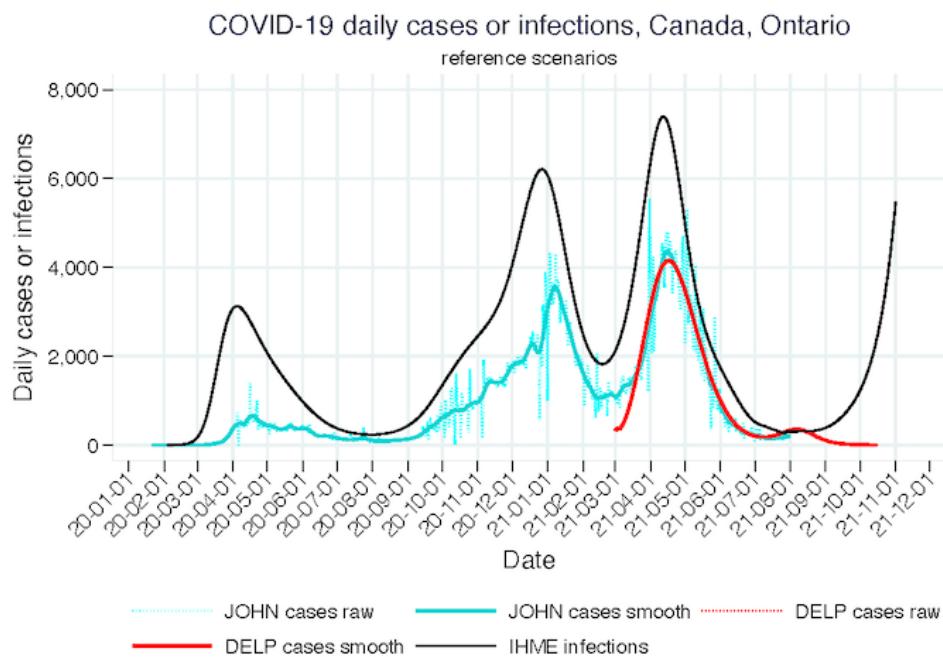
(2) Ontario [Daily deaths, reference scenarios, 2021](#)



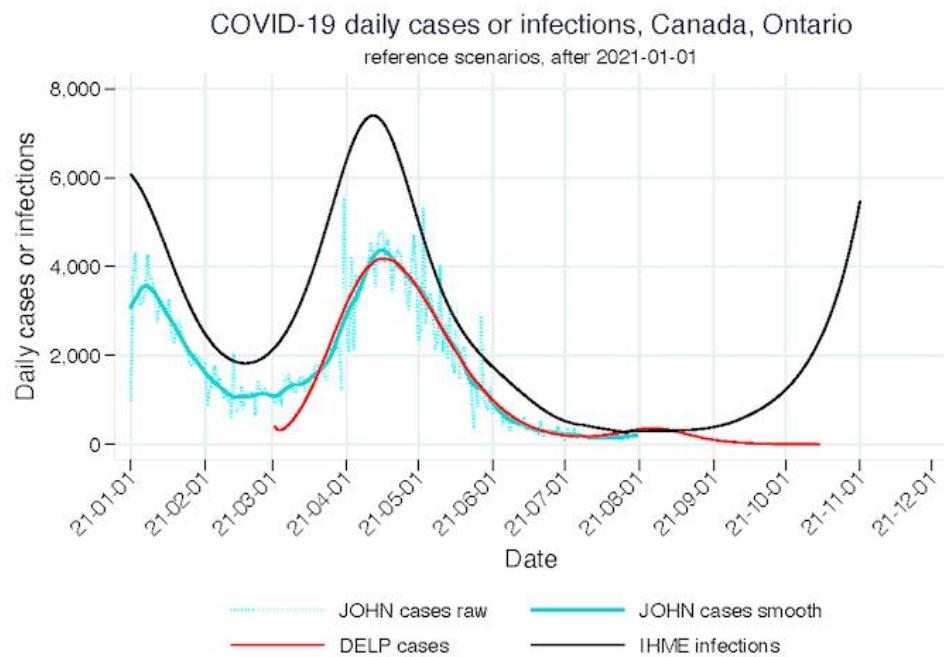
(3) Ontario [Daily deaths, 3 scenarios, 2021](#)



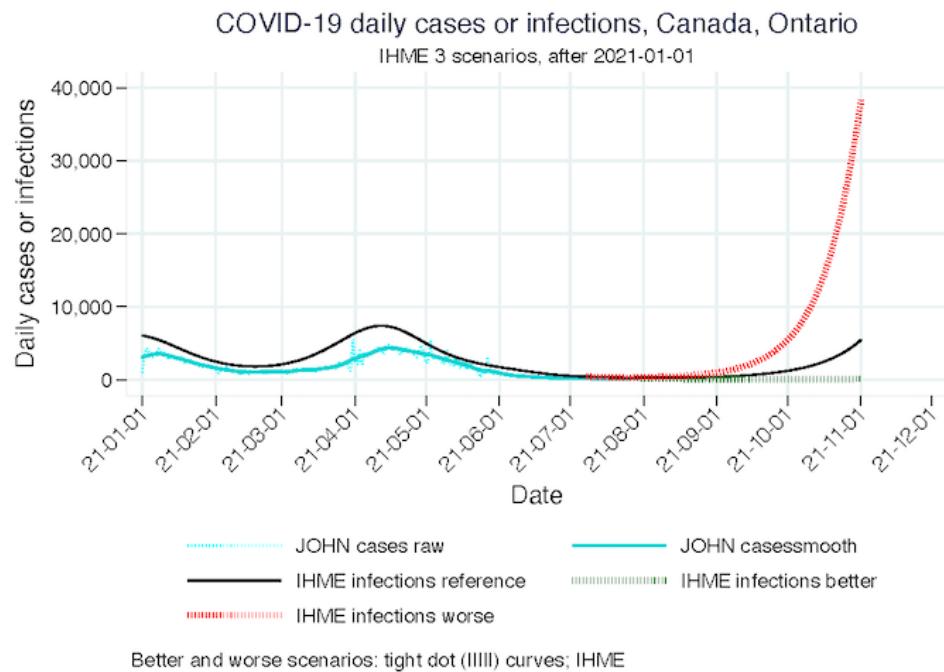
(4) Ontario [Daily cases or infections, reference scenarios, all time](#)



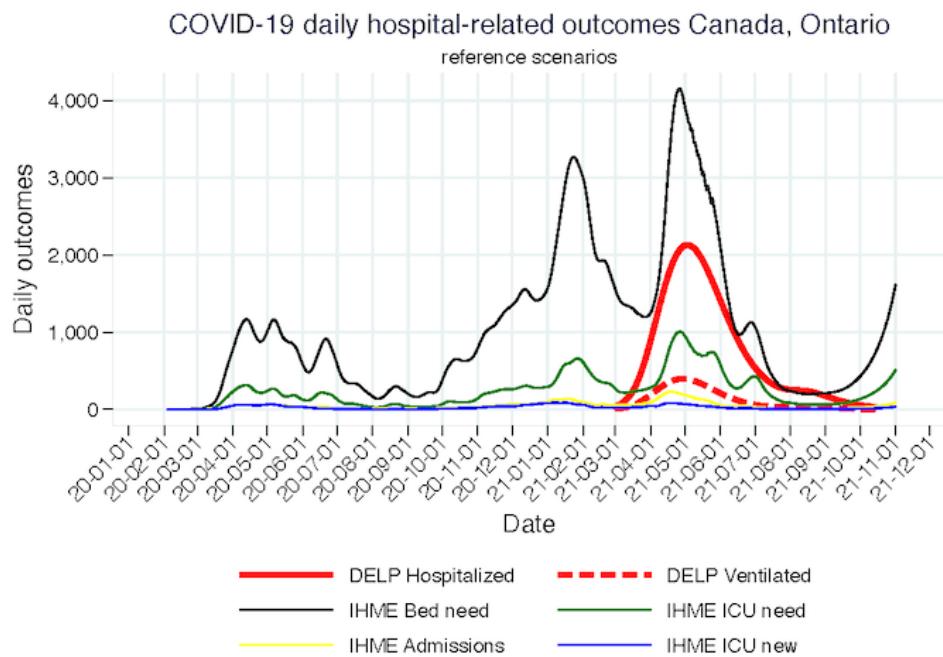
(5) Ontario [Daily cases or infections, reference scenarios, 2021](#)



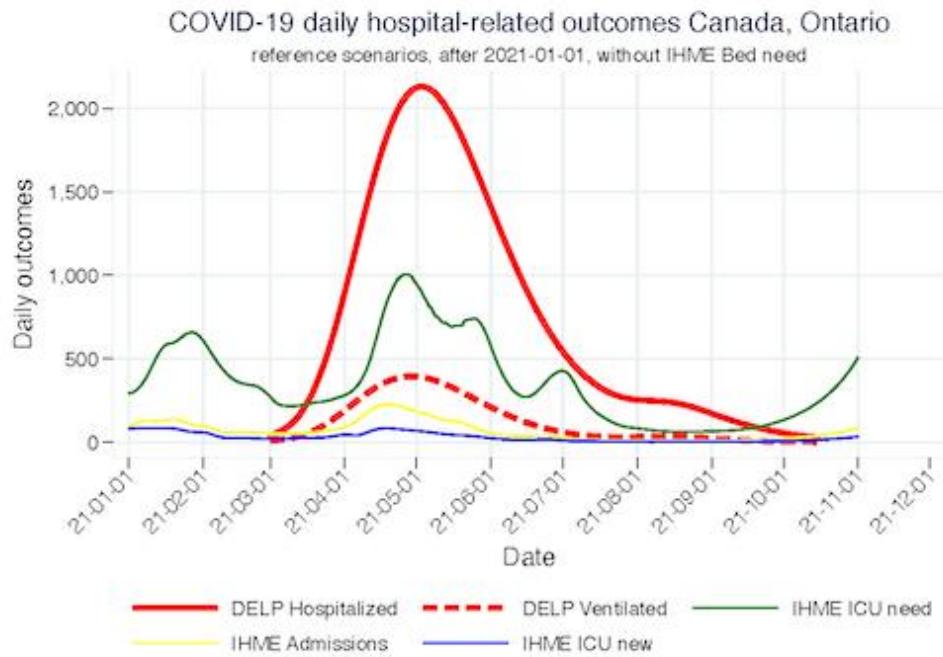
(6) Ontario [Daily cases or infections, 3 scenarios, 2021](#)



(7) Ontario [Hospital-related outcomes, all time](#)

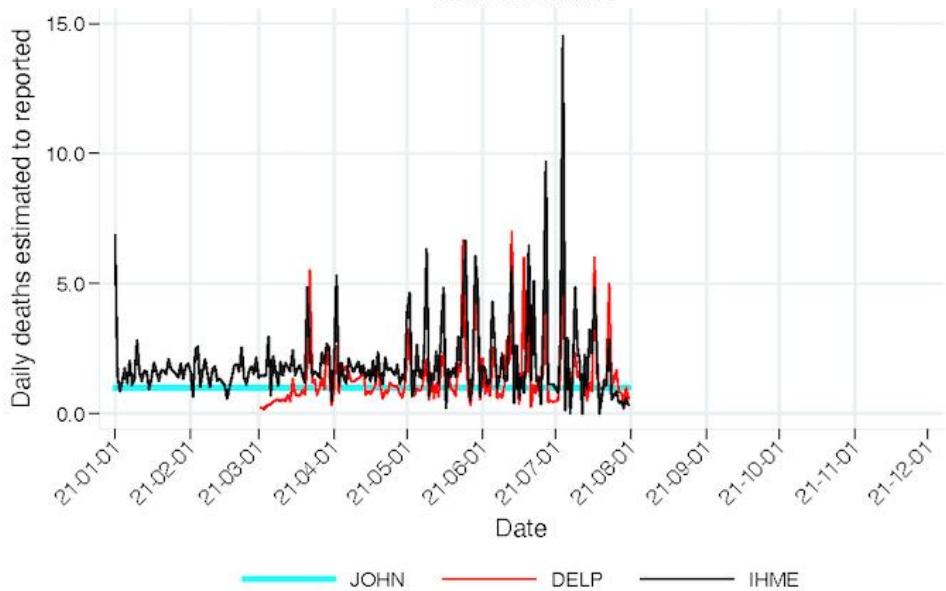


(8) Ontario [Hospital-related outcomes, 2021, without IHME Bed need and IMPE Hospital demand](#)



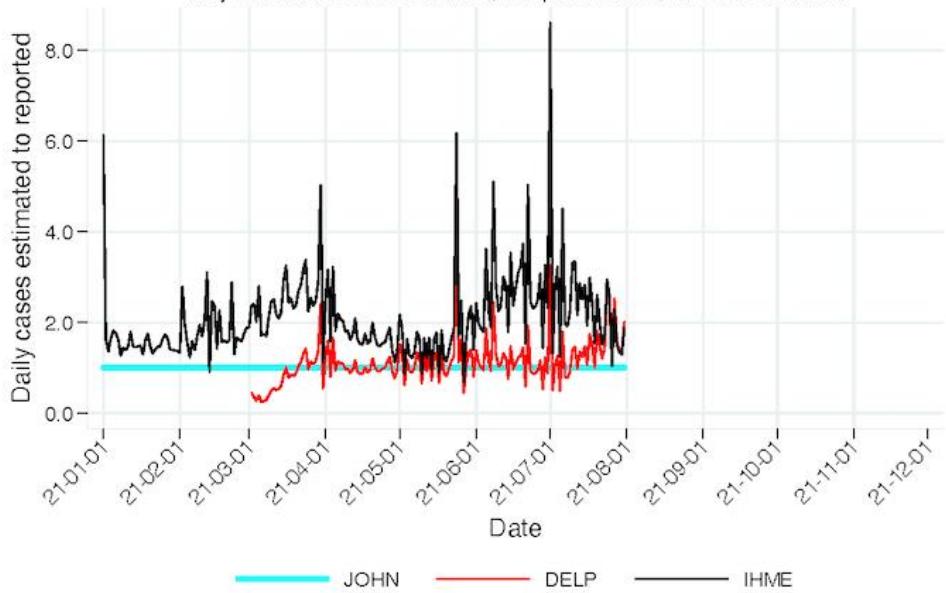
(9) Ontario [Daily deaths estimated to reported, reference scenarios, 2021](#)

COVID-19 daily deaths estimated to reported, Canada, Ontario
reference scenarios



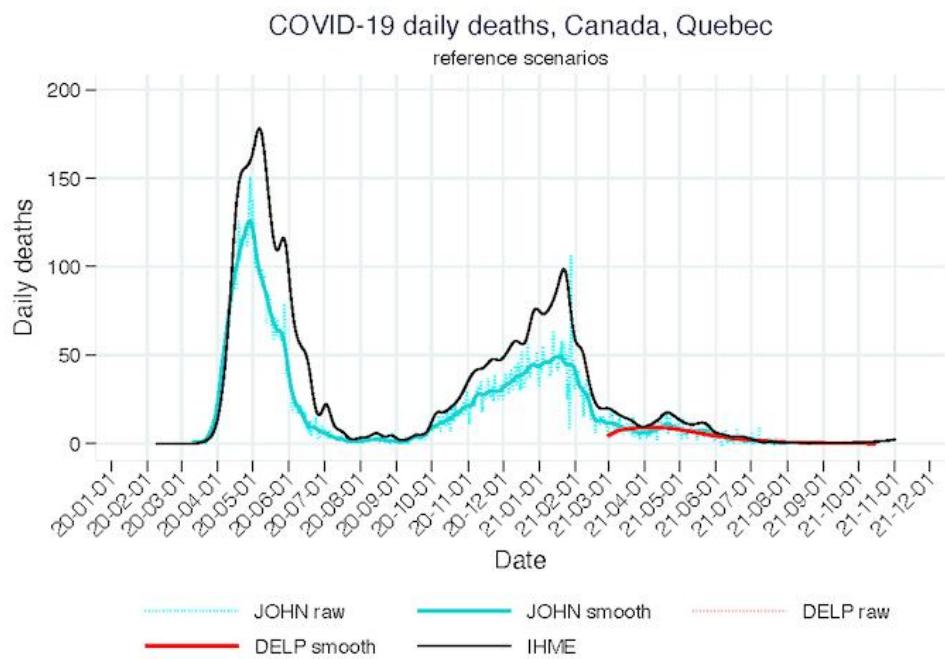
(10) Ontario [Daily cases or infections estimated to reported, reference scenarios, 2021](#)

COVID-19 daily cases estimated to reported, Canada, Ontario
daily cases or infections estimated, to reported cases; reference scenarios

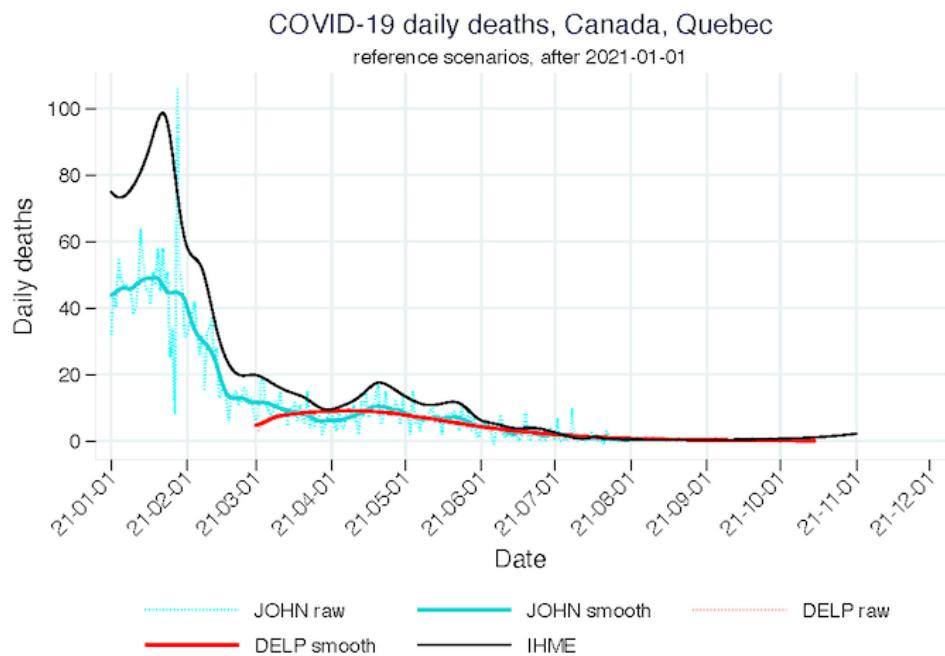


Selected graphs - Quebec

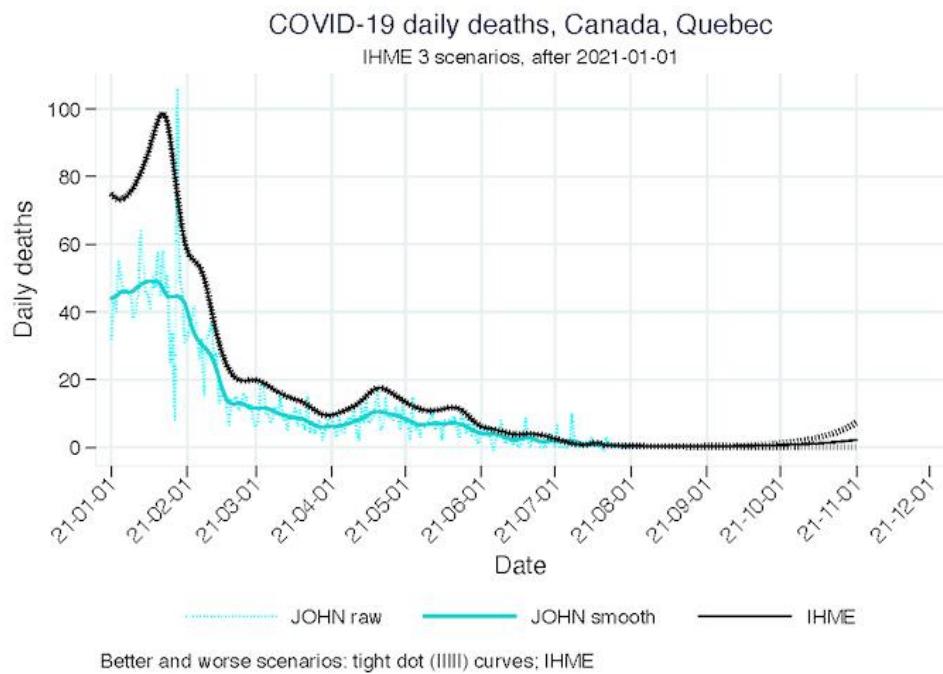
(1) Quebec [Daily deaths, reference scenarios, all time](#)



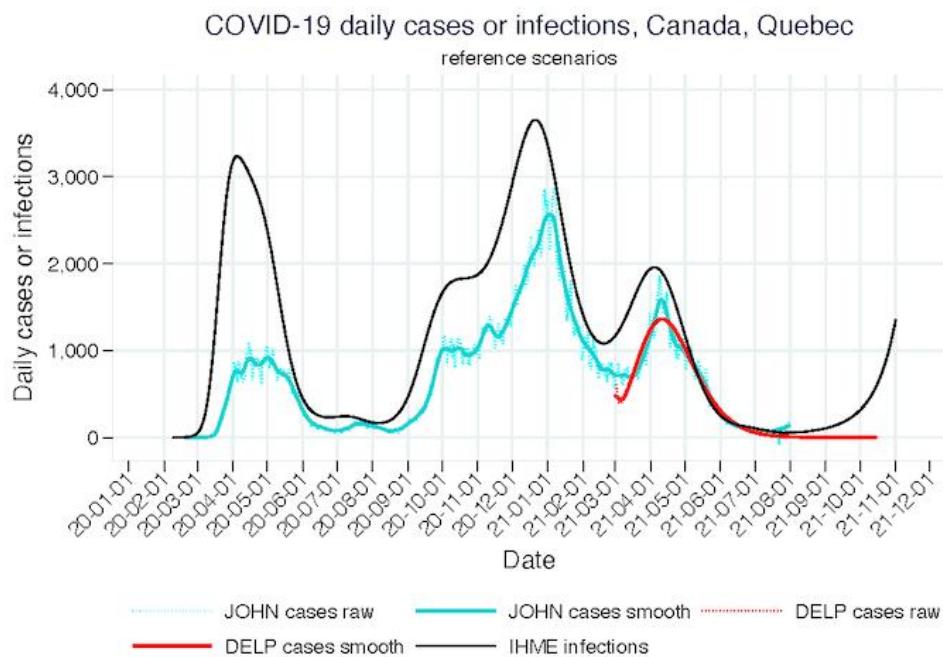
(2) Quebec [Daily deaths, reference scenarios, 2021](#)



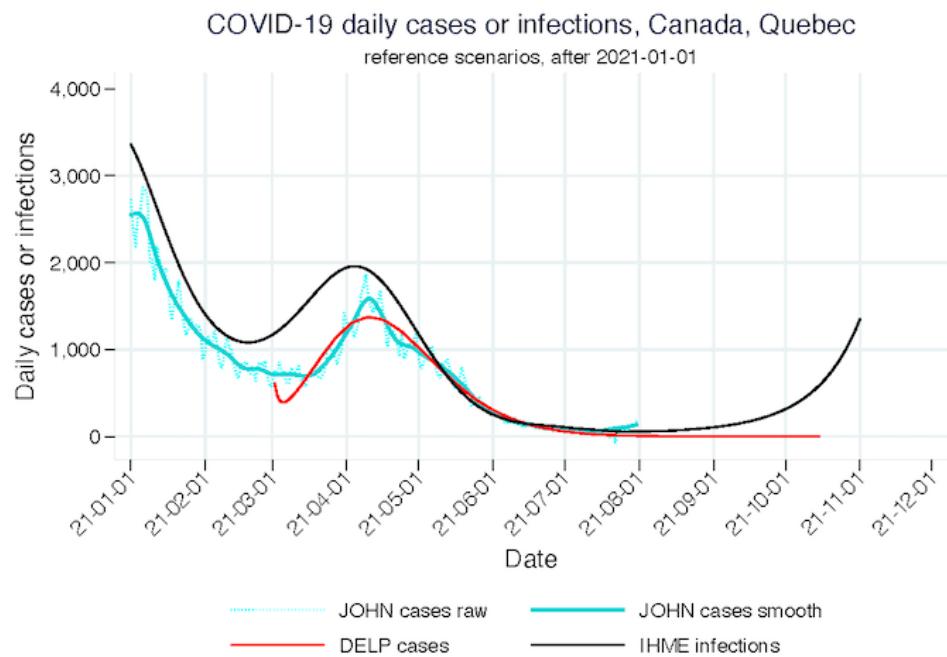
(3) Quebec [Daily deaths, 3 scenarios, 2021](#)



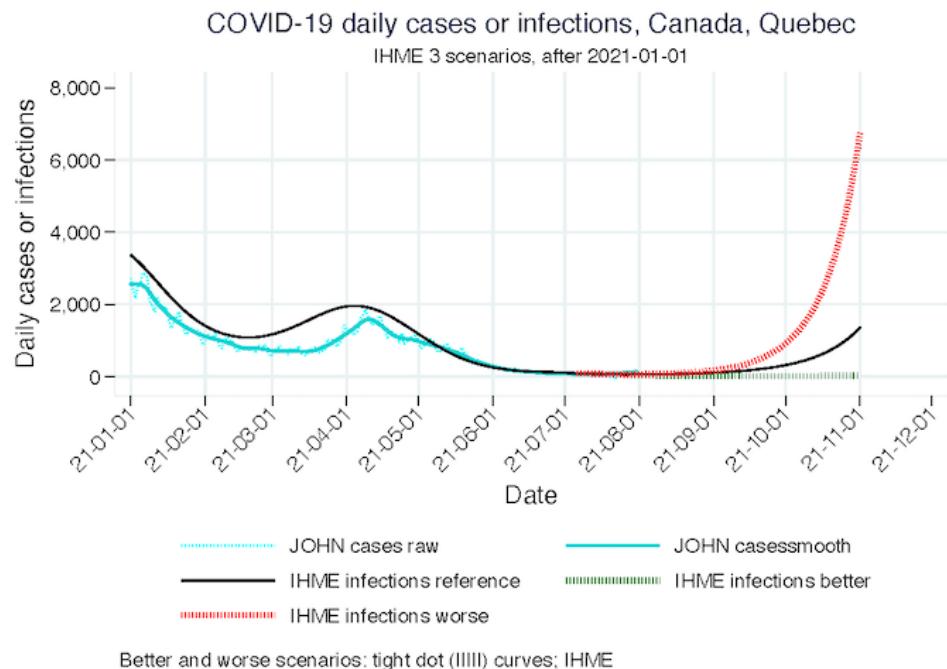
(4) Quebec [Daily cases or infections, reference scenarios, all time](#)



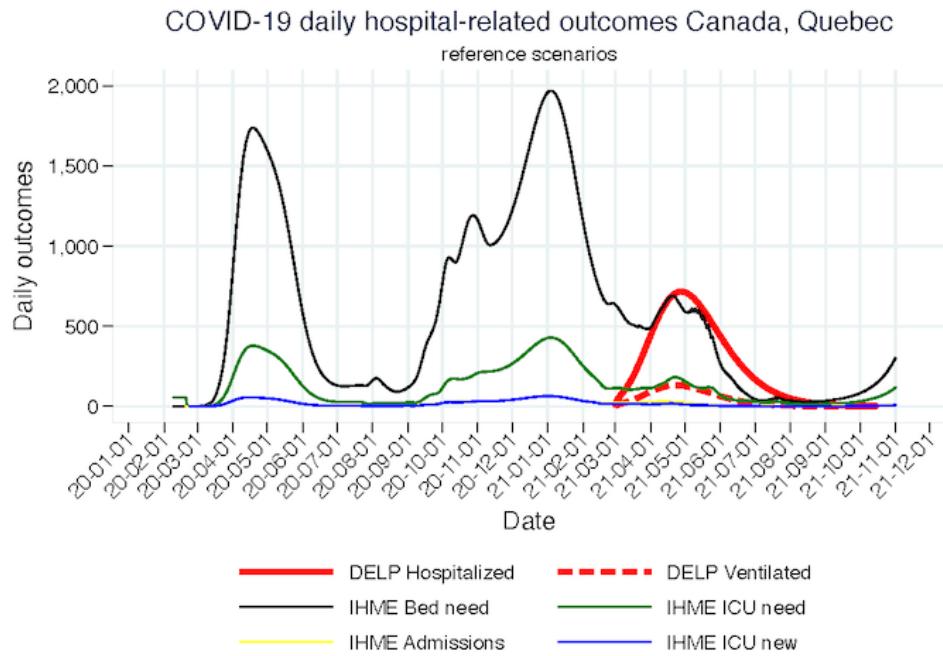
(5) Quebec [Daily cases or infections, reference scenarios, 2021](#)



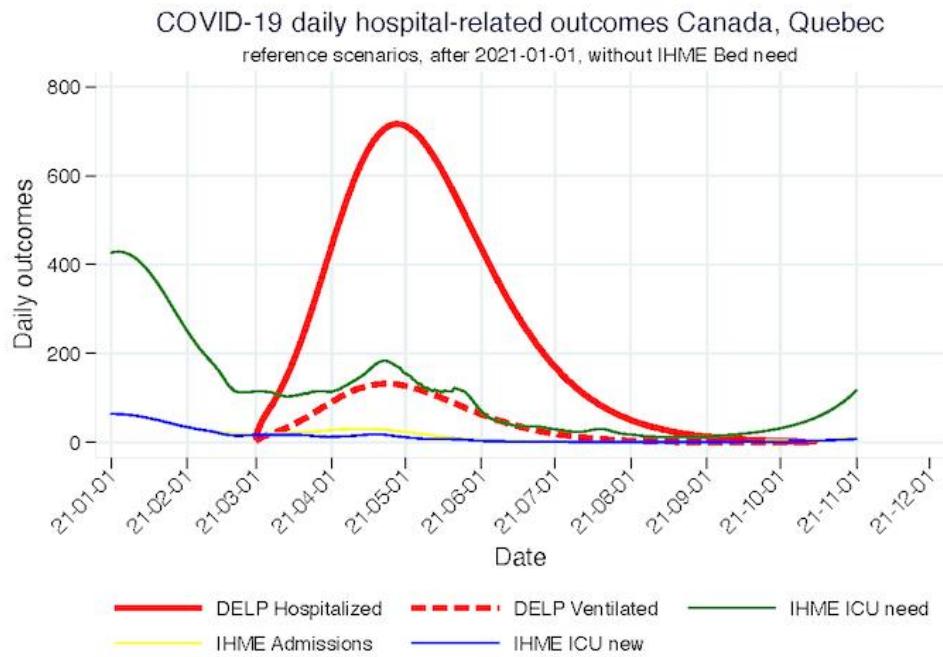
(6) Quebec [Daily cases or infections, 3 scenarios, 2021](#)



(7) Quebec [Hospital-related outcomes, all time](#)

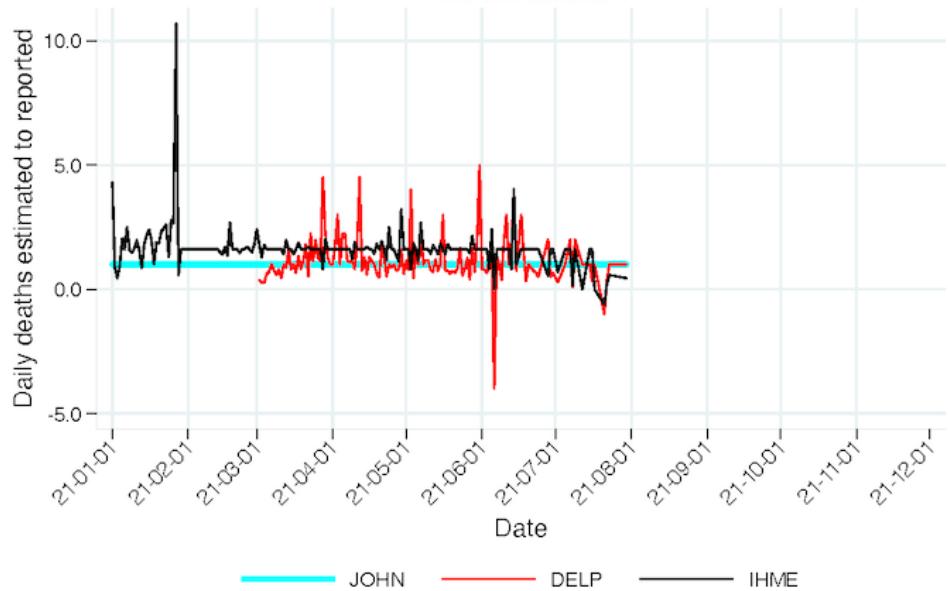


(8) Quebec [Hospital-related outcomes, 2021, without IHME Bed need and IMPE Hospital demand](#)

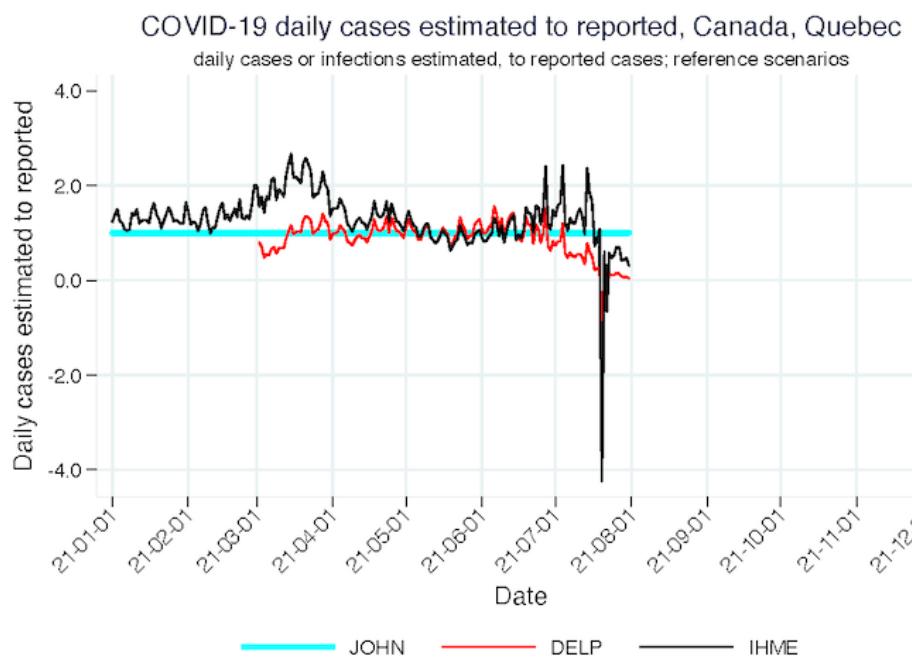


(9) Quebec [Daily deaths estimated to reported, reference scenarios, 2021](#)

COVID-19 daily deaths estimated to reported, Canada, Quebec
reference scenarios

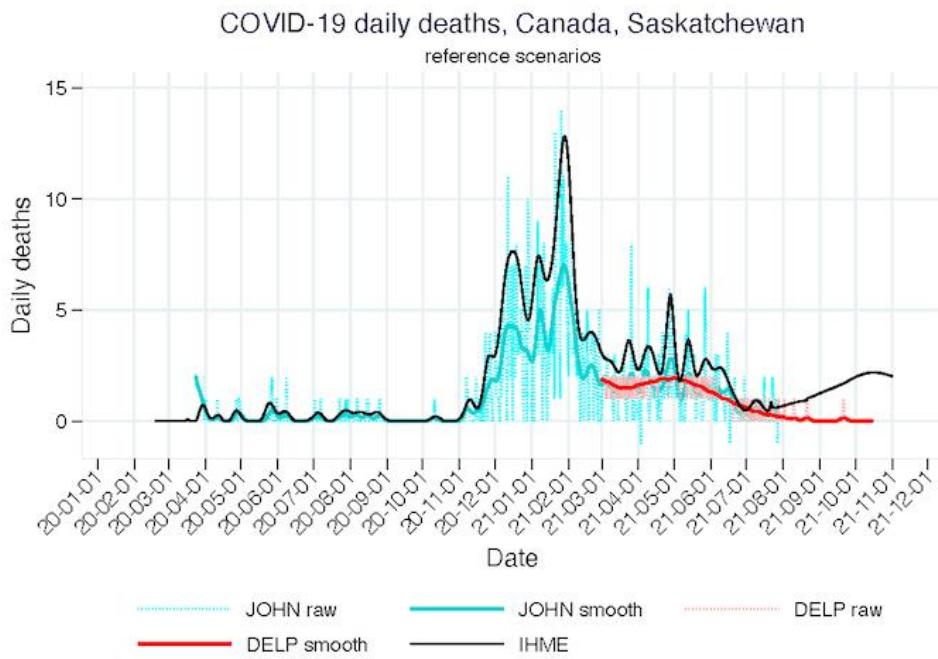


(10) Quebec [Daily cases or infections estimated to reported, reference scenarios, 2021](#)

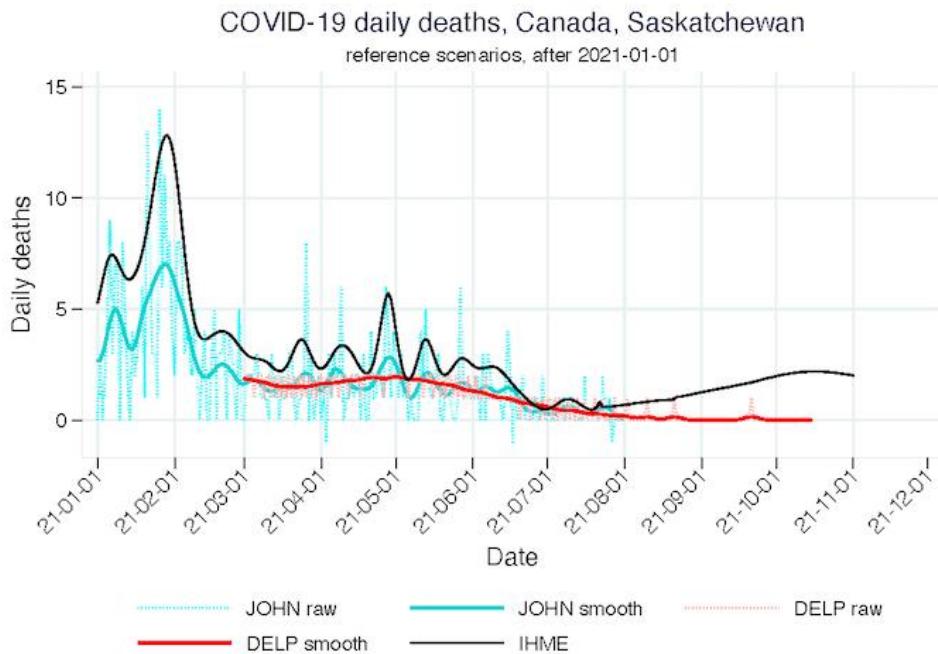


Selected graphs - Saskatchewan

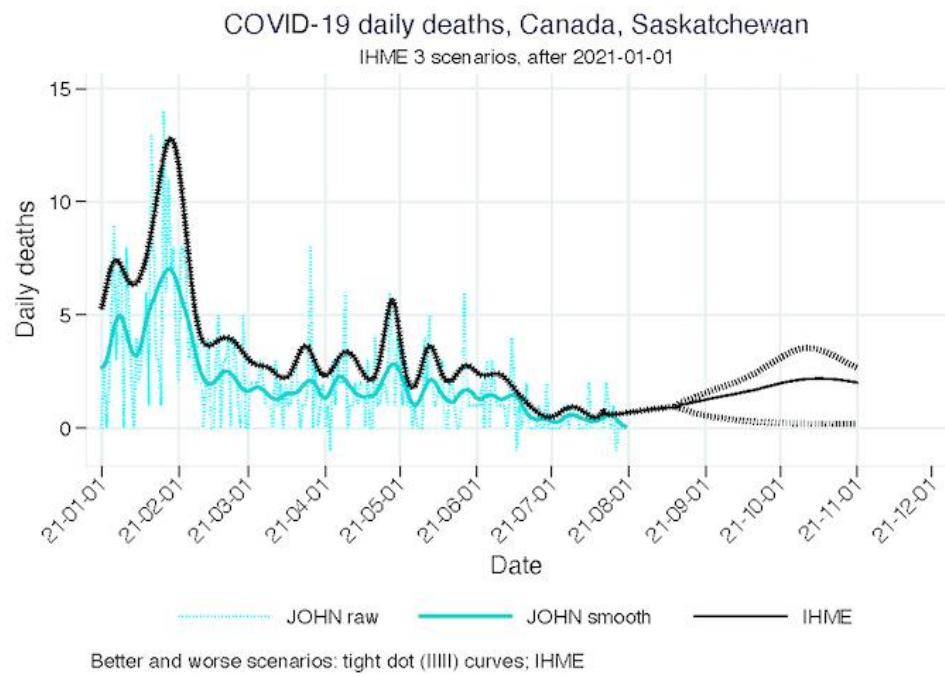
(1) Saskatchewan [Daily deaths, reference scenarios, all time](#)



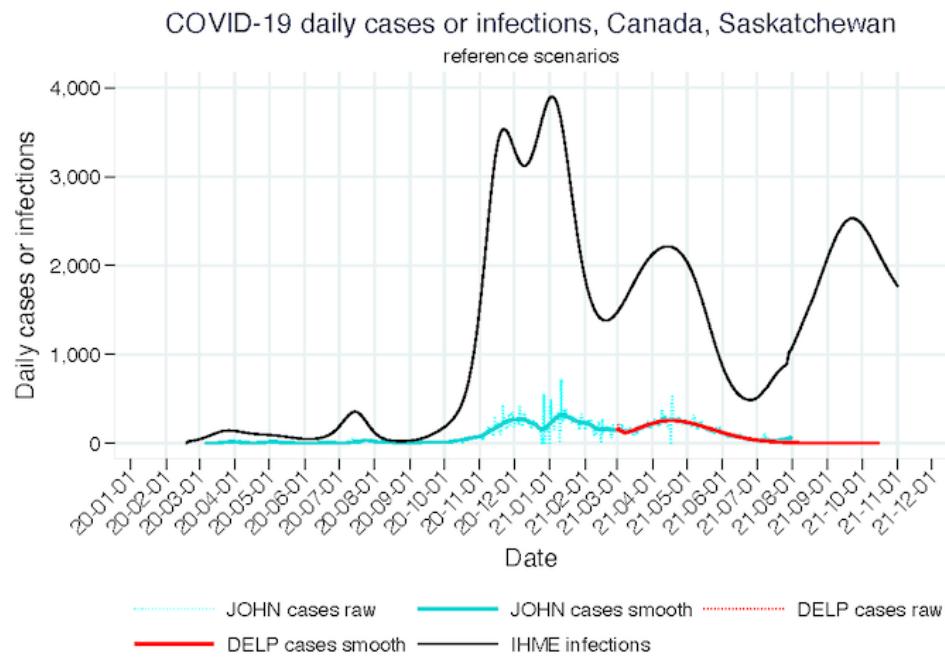
(2) Saskatchewan [Daily deaths, reference scenarios, 2021](#)



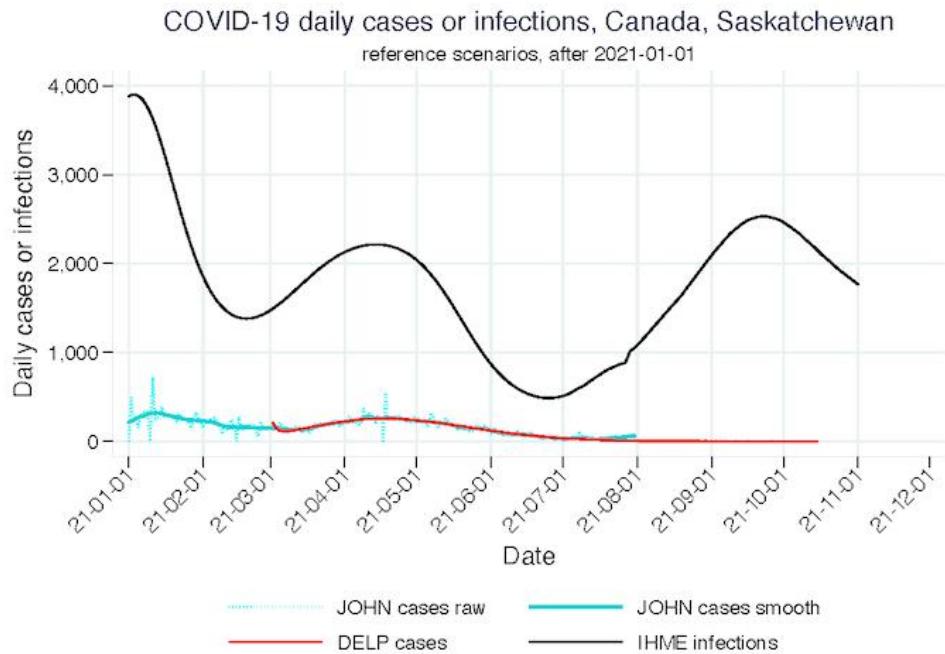
(3) Saskatchewan [Daily deaths, 3 scenarios, 2021](#)



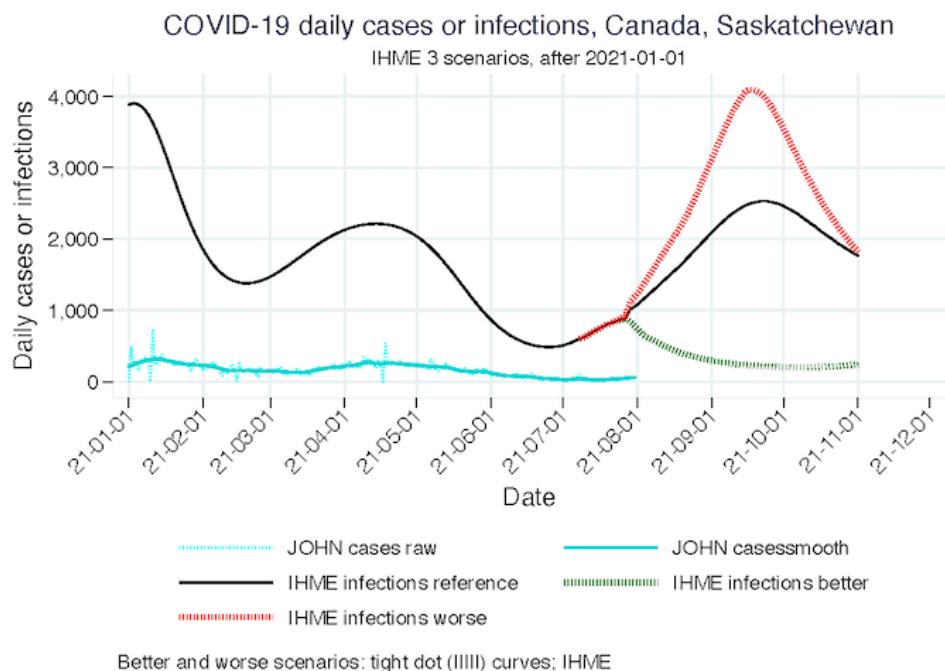
(4) Saskatchewan [Daily cases or infections, reference scenarios, all time](#)



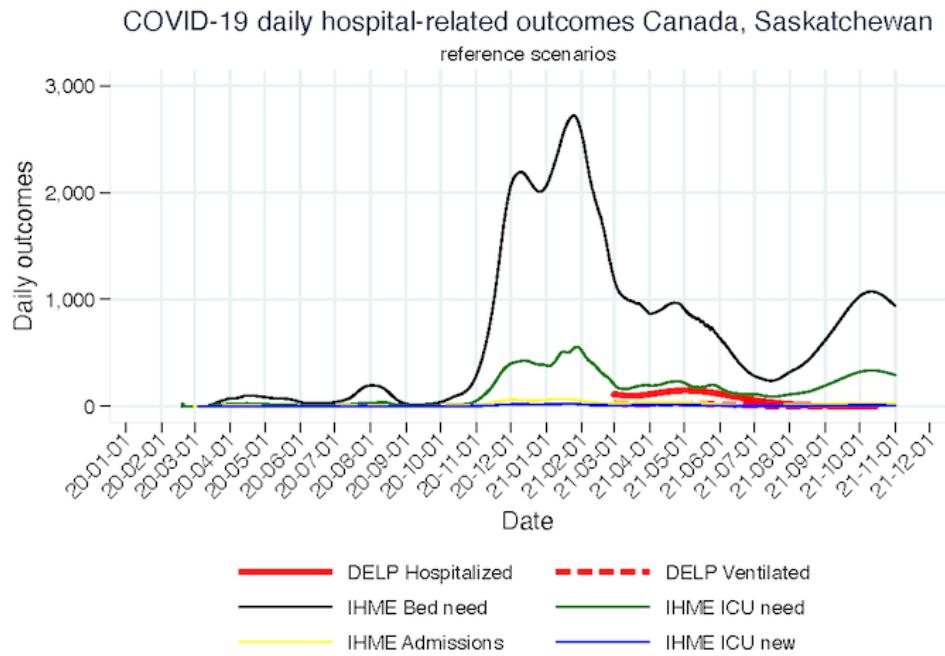
(5) Saskatchewan [Daily cases or infections, reference scenarios, 2021](#)



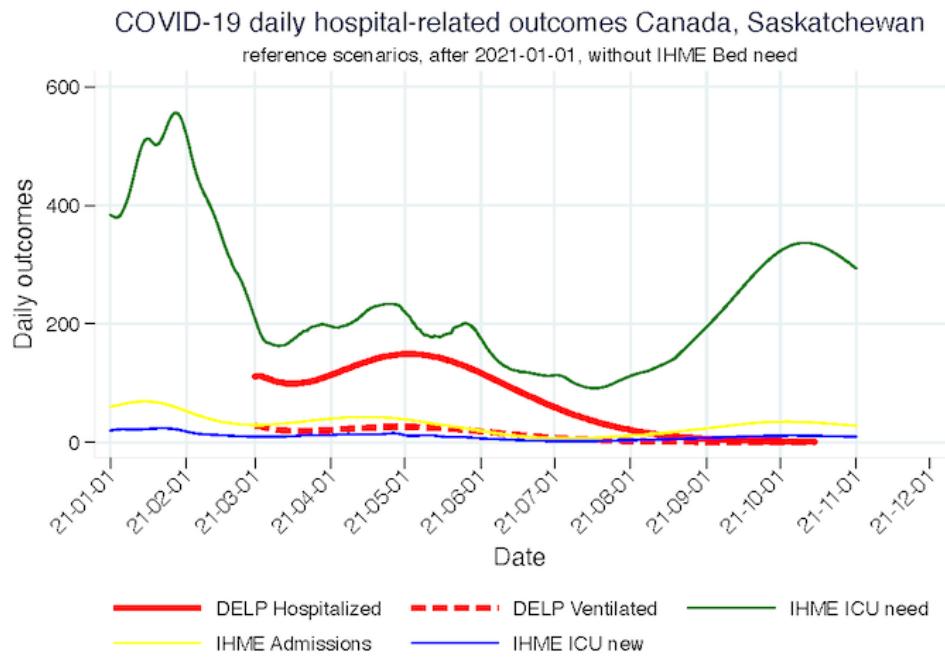
(6) Saskatchewan [Daily cases or infections, 3 scenarios, 2021](#)



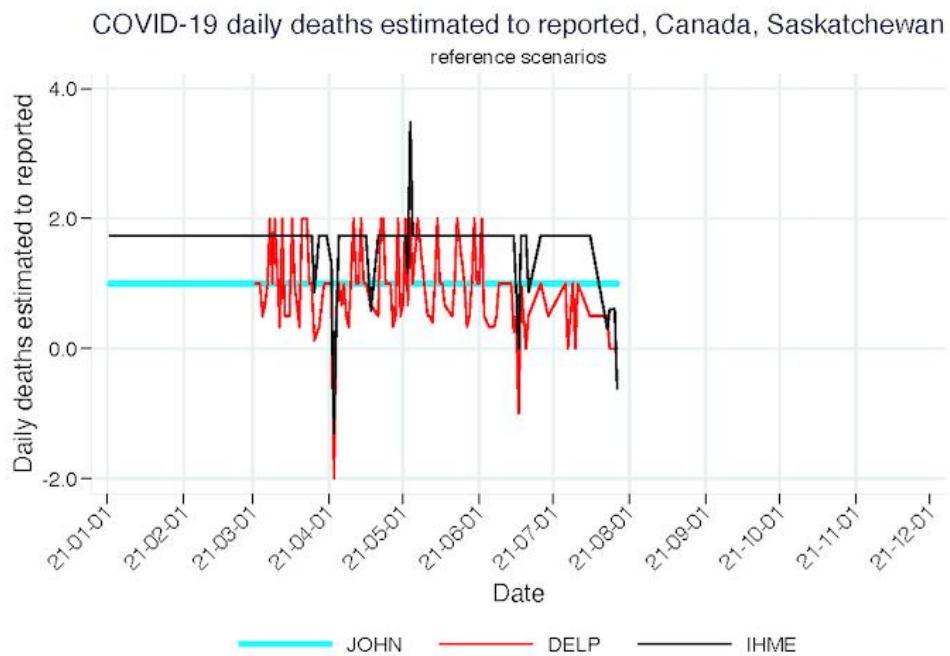
(7) Saskatchewan [Hospital-related outcomes, all time](#)



(8) Saskatchewan [Hospital-related outcomes, 2021, without IHME Bed need and IMPE Hospital demand](#)



(9) Saskatchewan [Daily deaths estimated to reported, reference scenarios, 2021](#)



(10) Saskatchewan [Daily cases or infections estimated to reported, reference scenarios, 2021](#)

