

Canada COVID-19 epidemic models situation report No 04 - 2021-08-24

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Based on uptake 20210824 in <https://github.com/pourmalek/CovidVisualizedCountry>

Study update dates in uptake 20210824:

DELP 20210824, IHME 20210819, **IMPE 20210819**, LANL 20210822, SRIV 20210824

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](#)

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Executive Summary

This report shows the trajectory of daily deaths, infections, bed needs, and ICU bed needs for Canada and its provinces, 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.

This report summarizes the results of a project named *CovidVisualizedCountry*, 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 and [*CovidVisualizedCountry*](#) tool (and [*covir2*](#) tool for Iran and [*CovidVisualizedGlobal*](#) tool for global level) 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 *third* situation report of predictions of five international and periodically updating COVID-19 epidemic models about the future trajectory of the epidemic in Canada and its provinces. The report is based on the “[**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 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/CovidVisualizedCountry> for Canada and its provinces, <https://github.com/pourmalek/covir2> for Iran, 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.](https://doi.org/10.1186/s12889-021-10183-3)

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; 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

*

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 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.

*

Uptakes in <https://github.com/pourmalek/CovidVisualizedCountry> for Canada and its provinces are as follows.

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

- (20) uptake [20210824](#): DELP 20210824, IHME 20210819, **IMPE 20210819**, LANL 20210822, SRIV 20210824
- (19) uptake [20210819](#): DELP 20210819, **IHME 20210819**, IMPE 20210806, LANL 20210815, SRIV 20210819
- (18) uptake [20210806](#): DELP 20210806 , **IHME 20210806**, IMPE 20210719, LANL 20210801, SRIV 20210801
- (17) uptake [20210730](#): DELP 20210730, **IHME 20210730**, IMPE 20210719, LANL 20210725, SRIV 20210730
- (16) uptake [20210727](#): DELP 20210727, IHME 20210723, **IMPE 20210719**, LANL 20210725, SRIV 20210727
- (15) uptake [20210726](#): DELP 20210726, **IHME 20210723**, IMPE 20210709, LANL 20210718, SRIV 20210726
- (14) uptake [20210723](#): DELP 20210723, **IHME 20210723**, IMPE 20210709, LANL 20210718, SRIV 20210723
- (13) uptake [20210715](#): DELP 20210715, **IHME 20210715**, IMPE 20210709, LANL 20210711, SRIV 20210715
- (12) uptake [20210714](#): DELP 20210714, IHME 20210702, **IMPE 20210709**, LANL 20210711, SRIV 20210714
- (11) uptake [20210709](#): DELP 20210708, IHME 20210702, **IMPE 20210702**, LANL 20210704, SRIV 20210709
- (10) uptake [20210704](#): DELP 20210704, IHME 20210702, **IMPE 20210626**, LANL 20210704, SRIV 20210704
- (09) uptake [20210703](#): DELP 20210703, **IHME 20210702**, IMPE 20210618, LANL 20210627, SRIV 20210703
- (08) uptake [20210625](#): DELP 20210625, **IHME 20210625**, IMPE 20210618, LANL 20210613, SRIV 20210624
- (07) uptake [20210624](#): DELP 20210624, IHME 20210618, **IMPE 20210618**, LANL 20210613, SRIV 20210624
- (06) uptake [20210618](#): DELP 20210618, **IHME 20210618**, IMPE 20210611, LANL 20210613, SRIV 20210618
- (05) uptake [20210611](#): DELP 20210611, IHME 20210610, **IMPE 20210611**, LANL 20210606, SRIV 20210611
- (04) uptake [20210610](#): DELP 20210610, **IHME 20210610**, IMPE 20210604, LANL 20210606, SRIV 20210610
- (03) uptake [20210605](#): DELP 20210605, IHME 20210604, **IMPE 20210604**, LANL 20210602, SRIV 20210605
- (02) uptake [20210604](#): DELP 20210604, **IHME 20210604**, IMPE 20210527, LANL 20210602, SRIV 20210604
- (01) uptake [20210603](#): DELP 20210603, IHME 20210528, **IMPE 20210527**, LANL 20210526, SRIV 20210603

Graphs of epidemic trajectory in Canada and provinces 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/CovidVisualizedCountry>

Logical order of graphs:

- (1) *Location levels*: National level, 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 ratio, Daily cases or infections estimated to reported cases ratio.
- (3) *Calendar time of estimates coverage*: All-time, followed by 2021. To view the whole epidemic trajectory and further focus on the near future.
- (4) *Scenarios*: Reference scenarios, followed by alternative scenarios. To examine the main or reference (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 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)

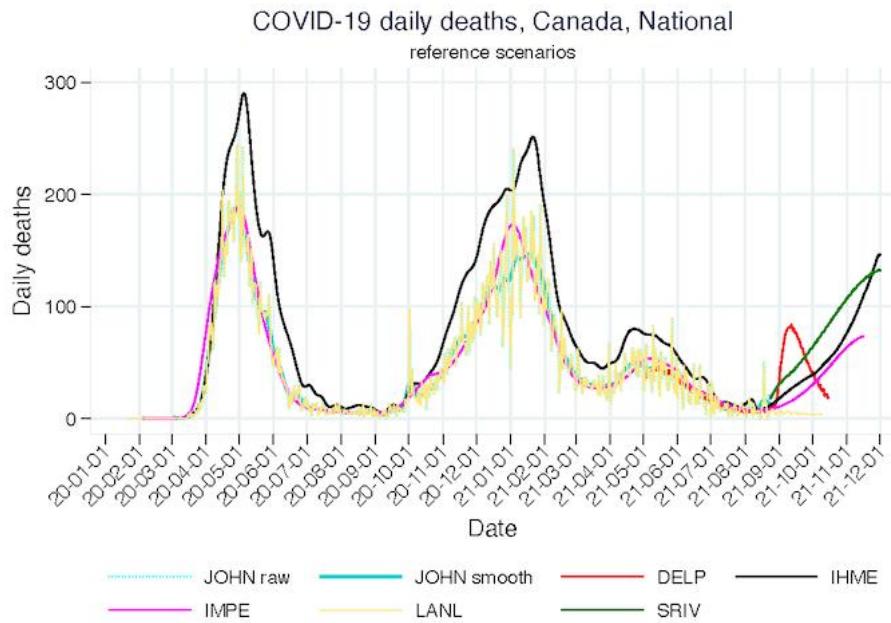
Among the 5 available international periodically updating studies or models of COVID-19 pandemic, only **TWO** studies, DELP and IHME, provide subnational level estimates for some countries. For Canada, they provide estimates for **SEVEN** provinces.

List of graphs

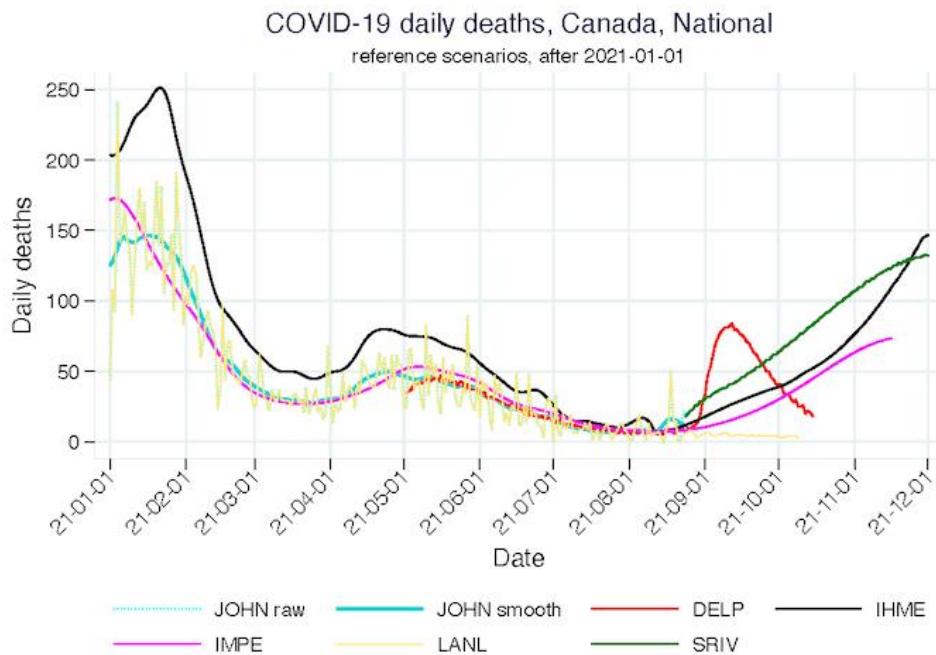
- (1) Daily deaths, reference scenarios, all time
- (2) Daily deaths, reference scenarios, 2021
- (3) Daily deaths, 3 scenarios, 2021
- (4) Daily cases or infections, reference scenarios, all time
- (5) Daily cases or infections, reference scenarios, 2021
- (6) Daily cases or infections, 3 scenarios, 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

Selected graphs - Canada

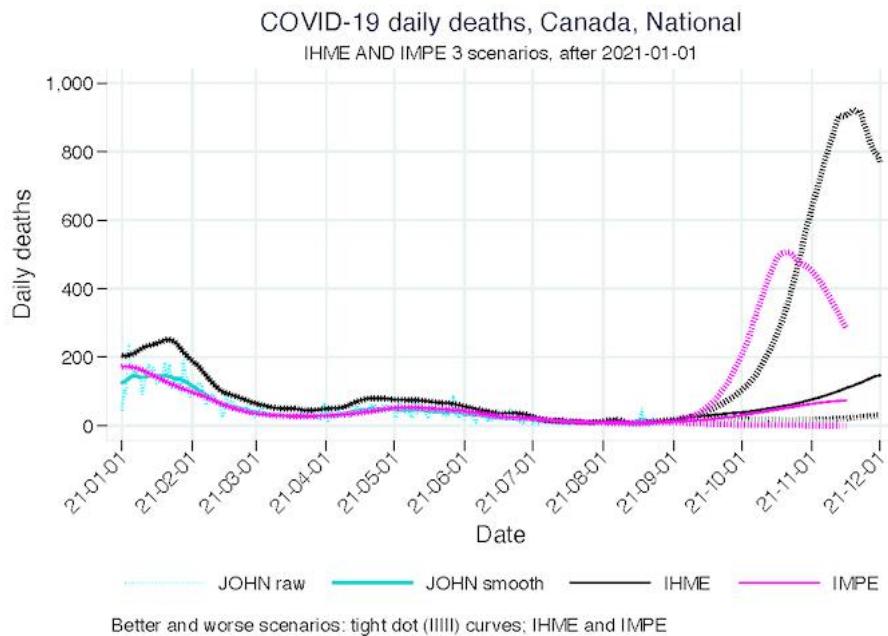
(1) Canada Daily deaths, reference scenarios, all time



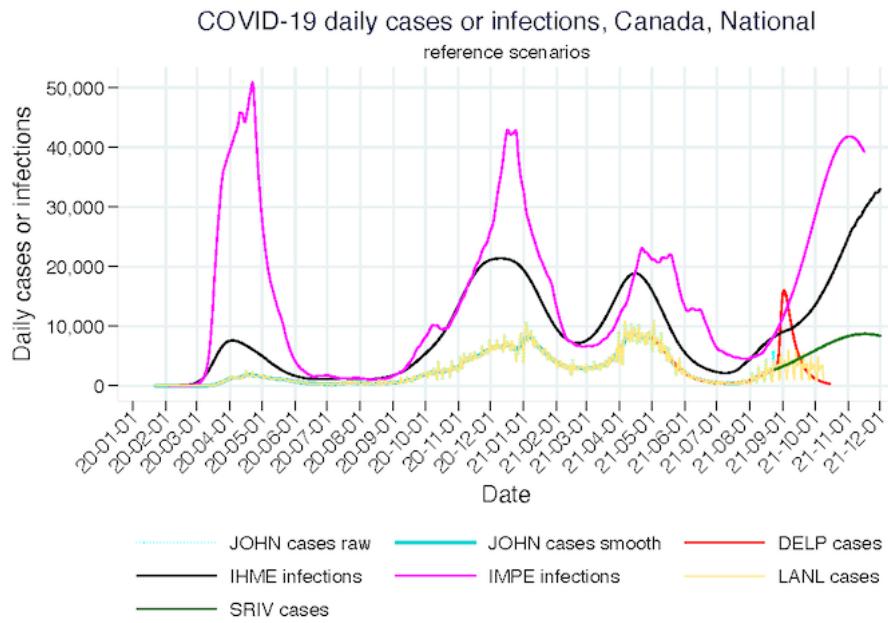
(2) Canada Daily deaths, reference scenarios, 2021



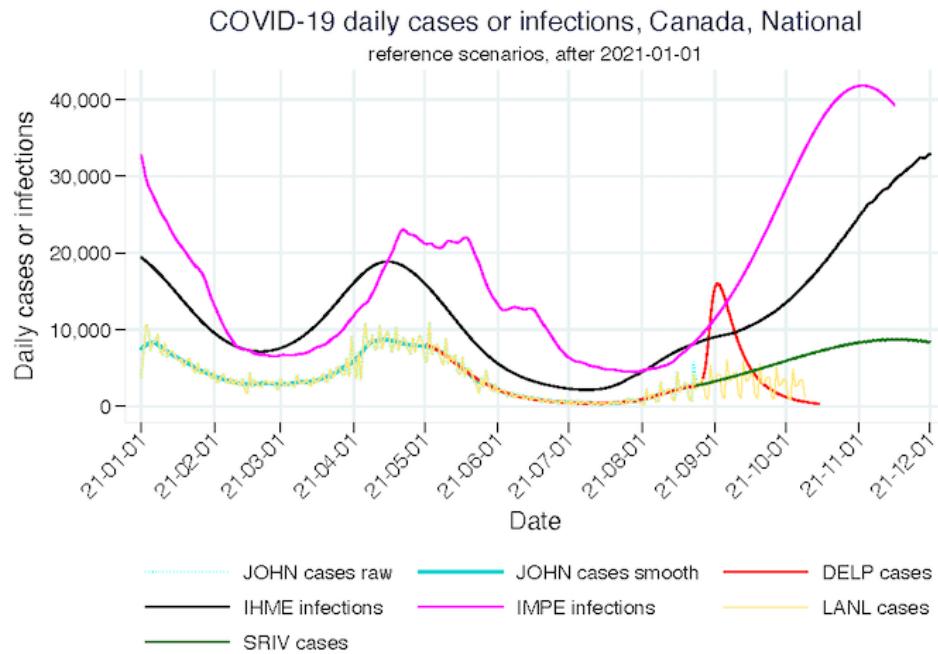
(3) Canada Daily deaths, 3 scenarios, 2021



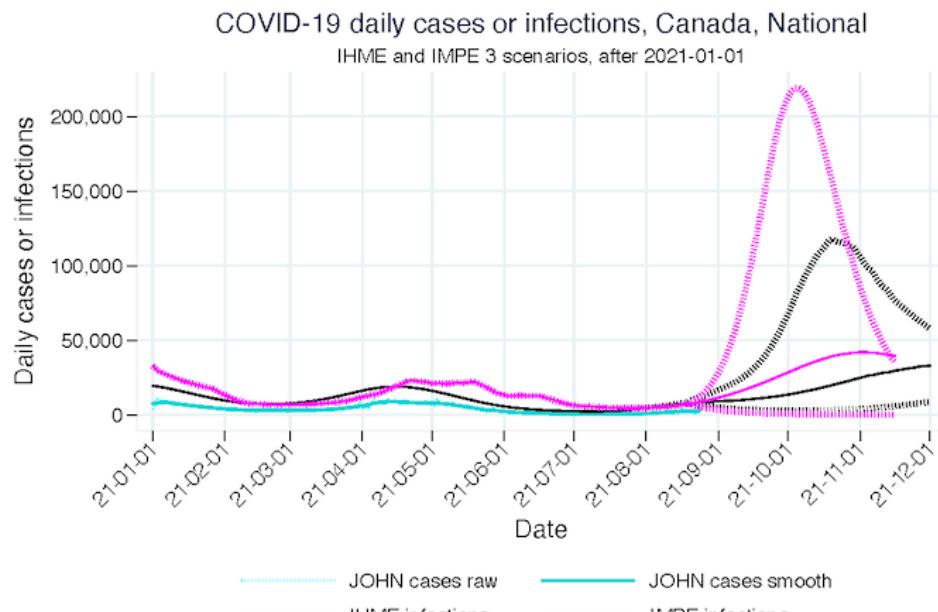
(4) Canada Daily cases or infections, reference scenarios, all time



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

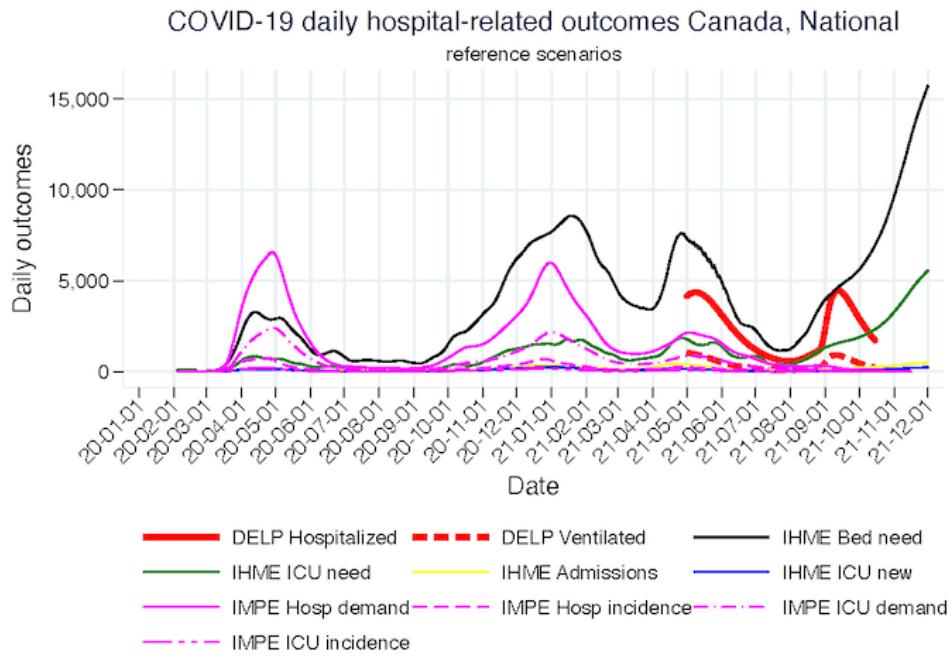


(6) Canada Daily cases or infections, 3 scenarios, 2021

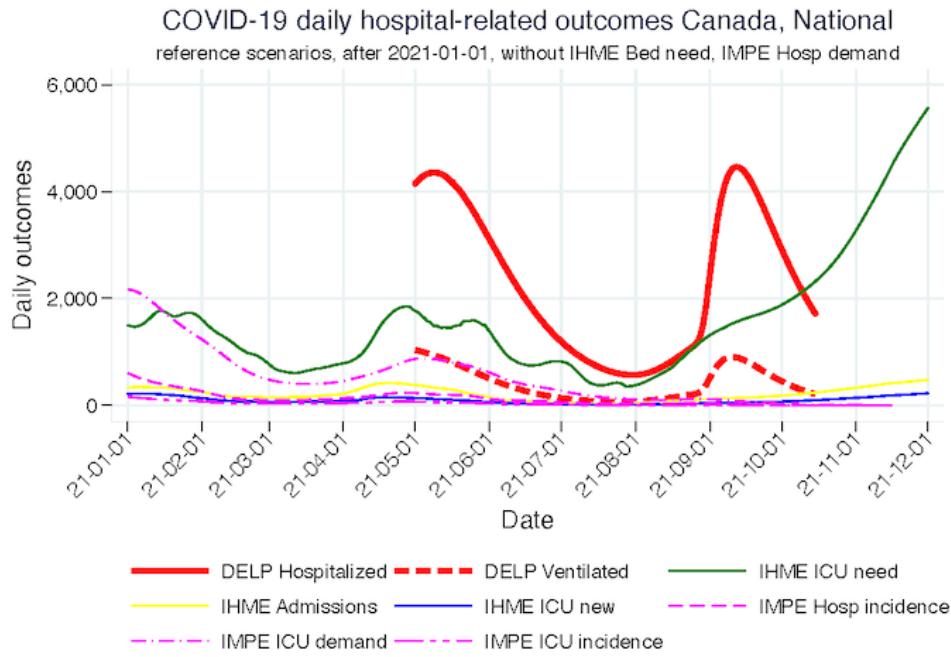


Better and worse scenarios: tight dot (||||) curves; IHME and IMPE

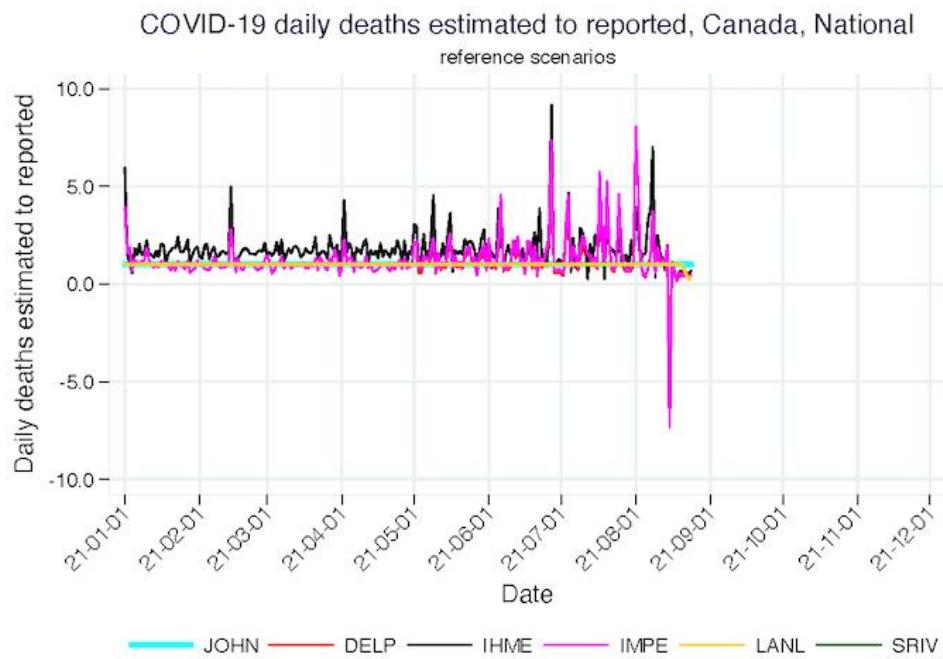
(7) Canada Hospital-related outcomes, all time



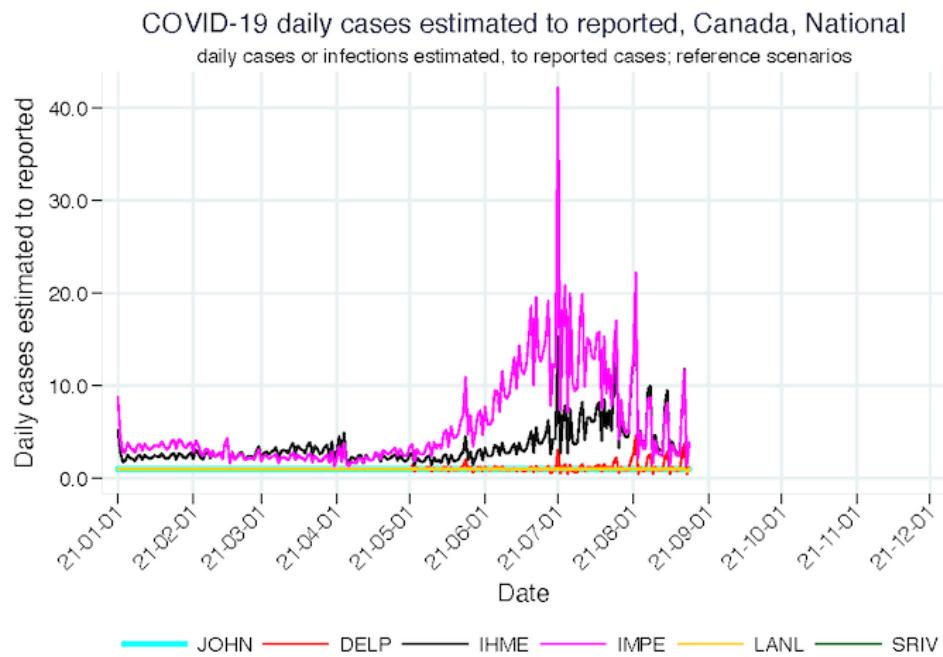
(8) Canada Hospital-related outcomes, 2021, without IHME Bed need and IMPE Hospital demand



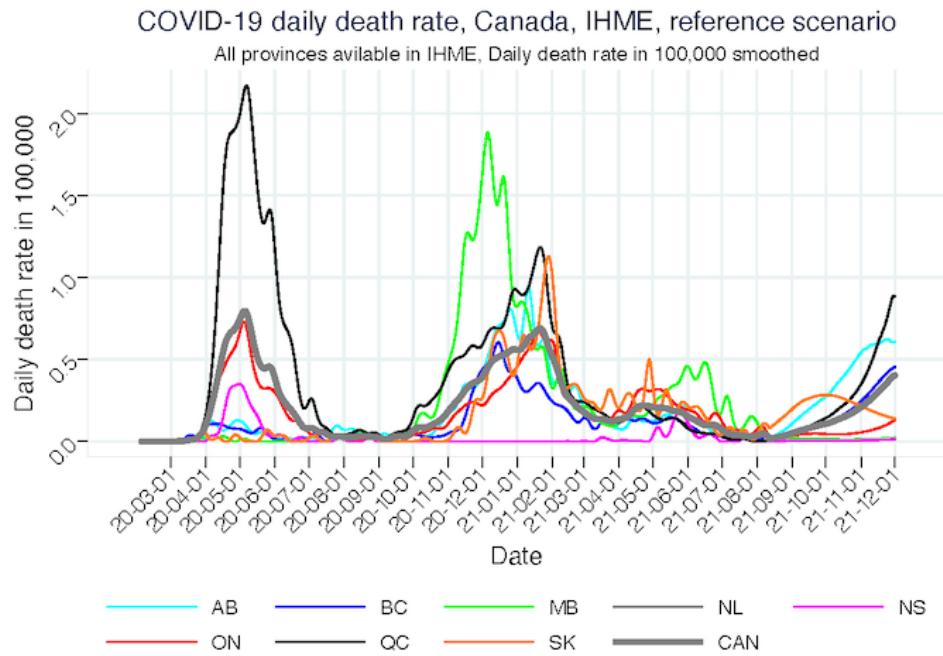
(9) Canada Daily deaths estimated to reported, reference scenarios, 2021



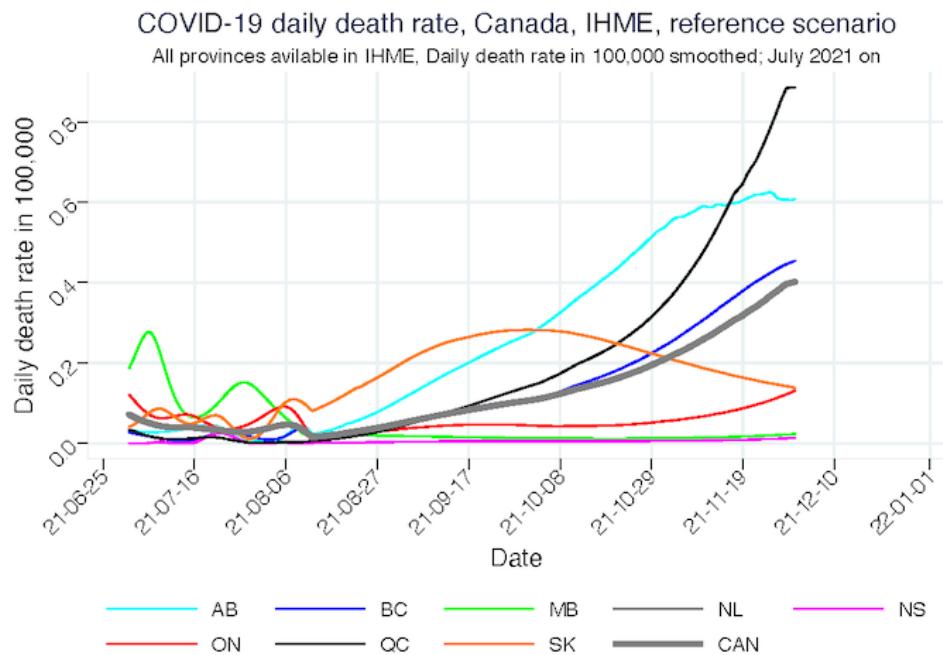
(10) Canada Daily cases or infections estimated to reported, reference scenarios, 2021



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

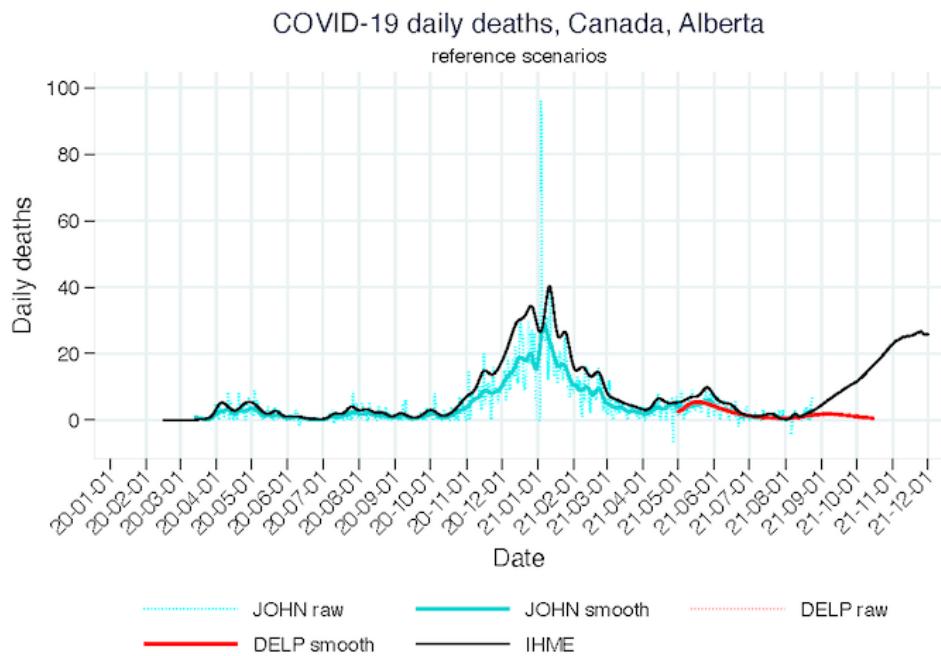


(12) Canada and provinces Daily death rates, reference scenario, 2021 IHME

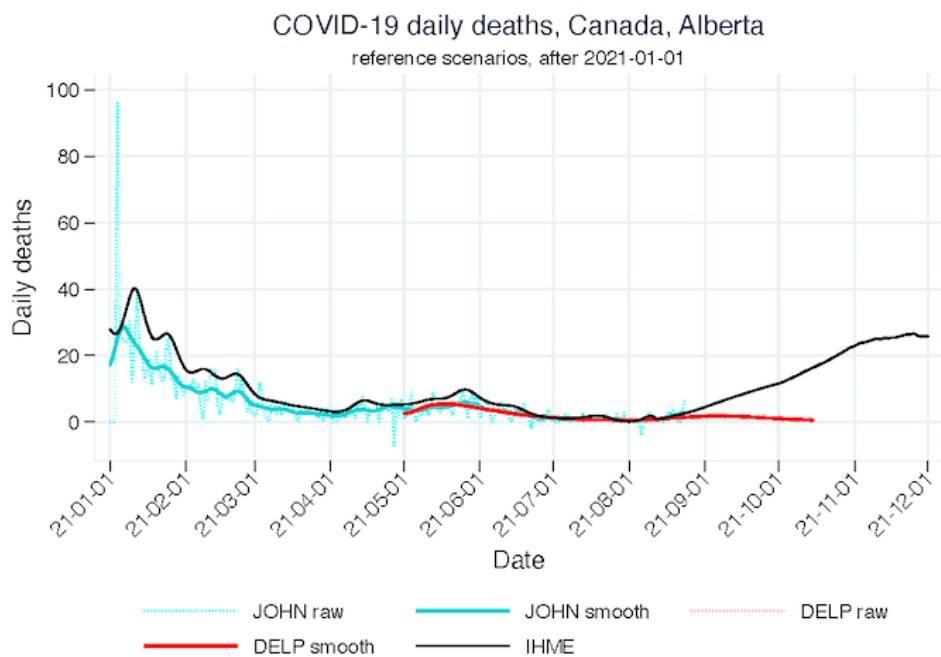


Selected graphs - Alberta

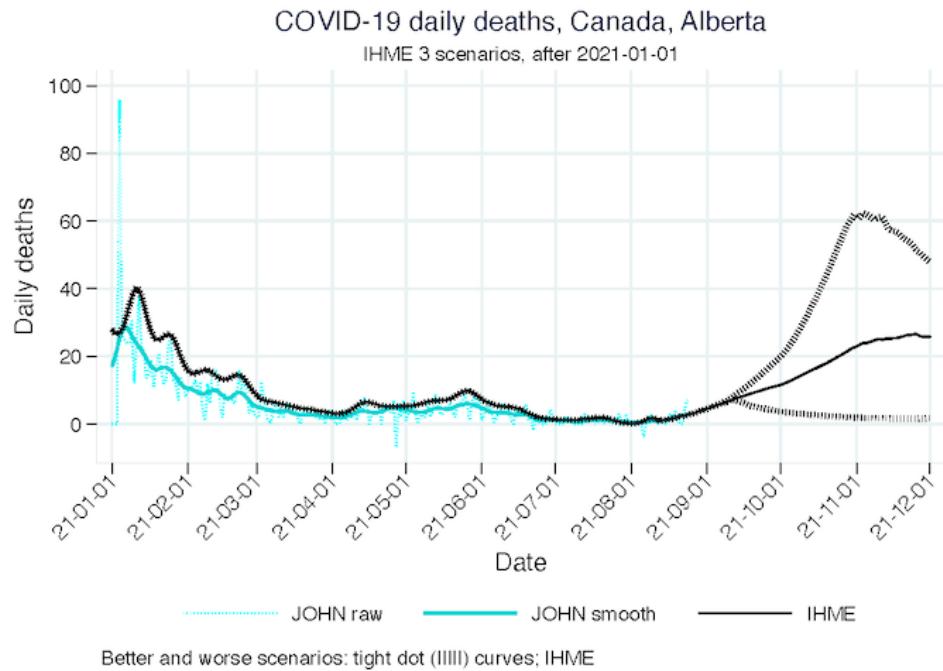
(1) Alberta Daily deaths, reference scenarios, all time



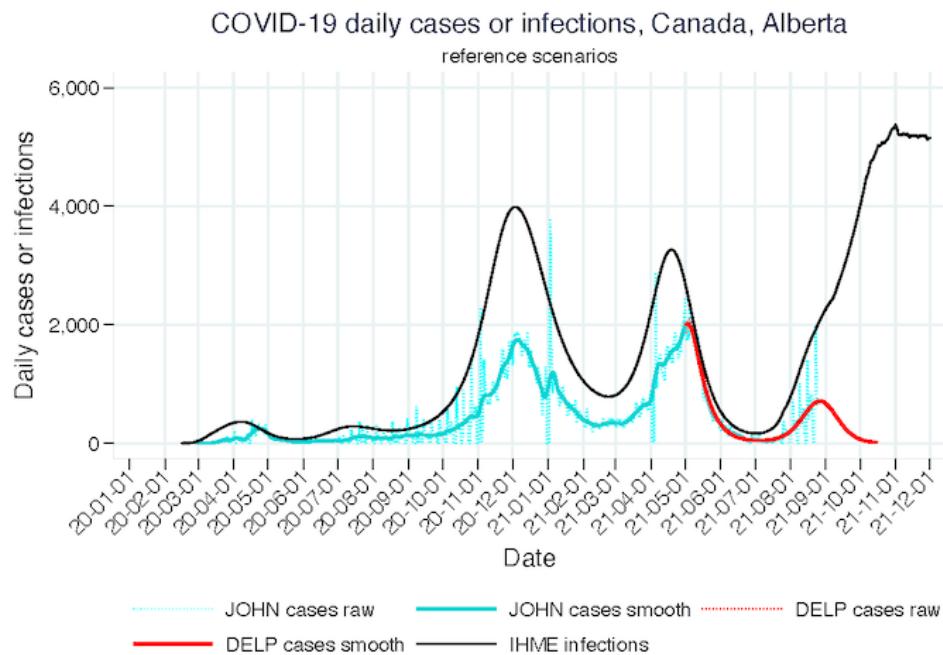
(2) Alberta Daily deaths, reference scenarios, 2021



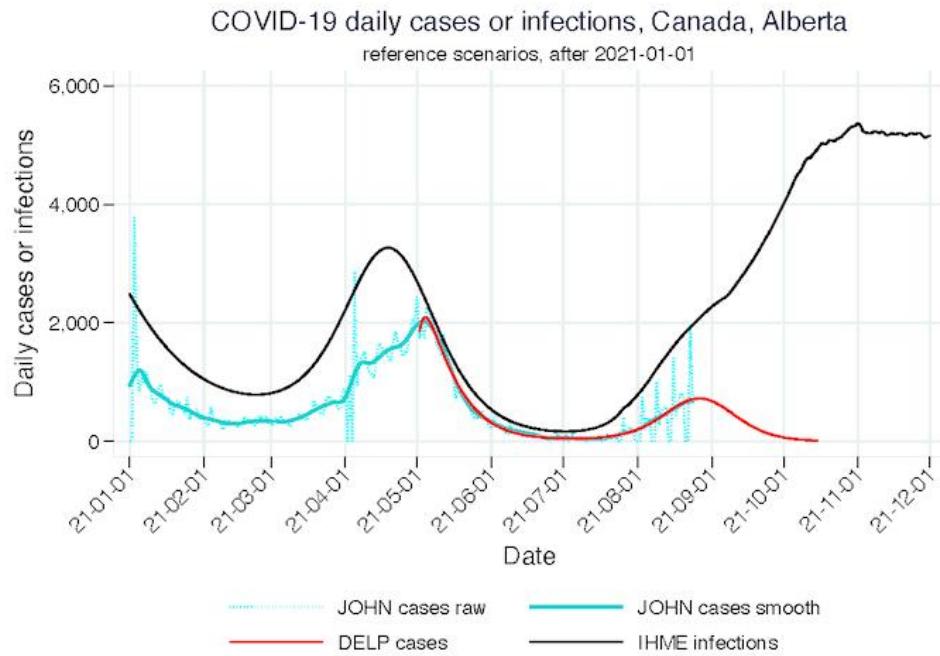
(3) Alberta Daily deaths, 3 scenarios, 2021



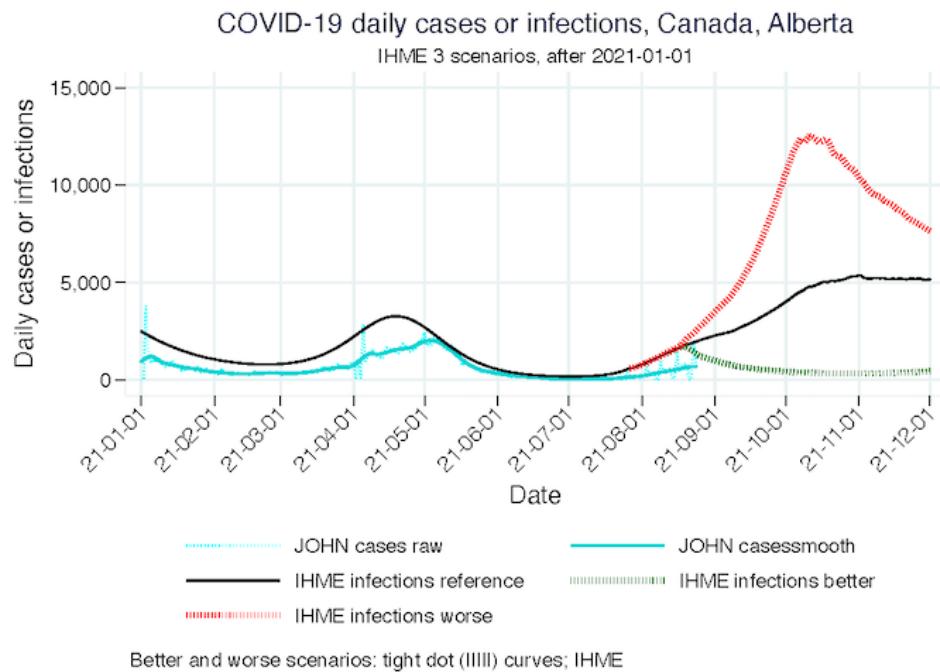
(4) Alberta Daily cases or infections, reference scenarios, all time



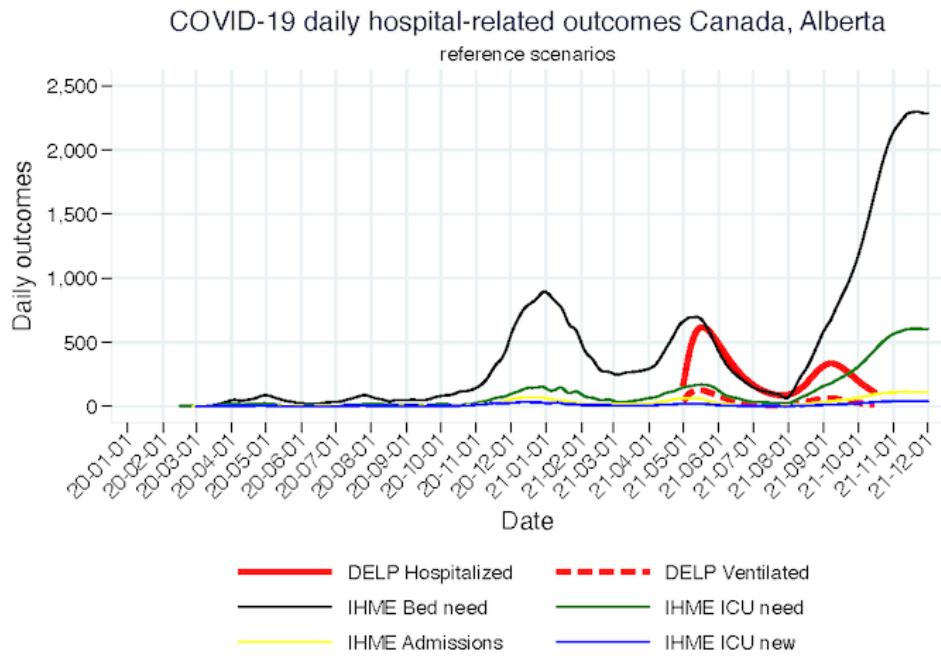
(5) Alberta Daily cases or infections, reference scenarios, 2021



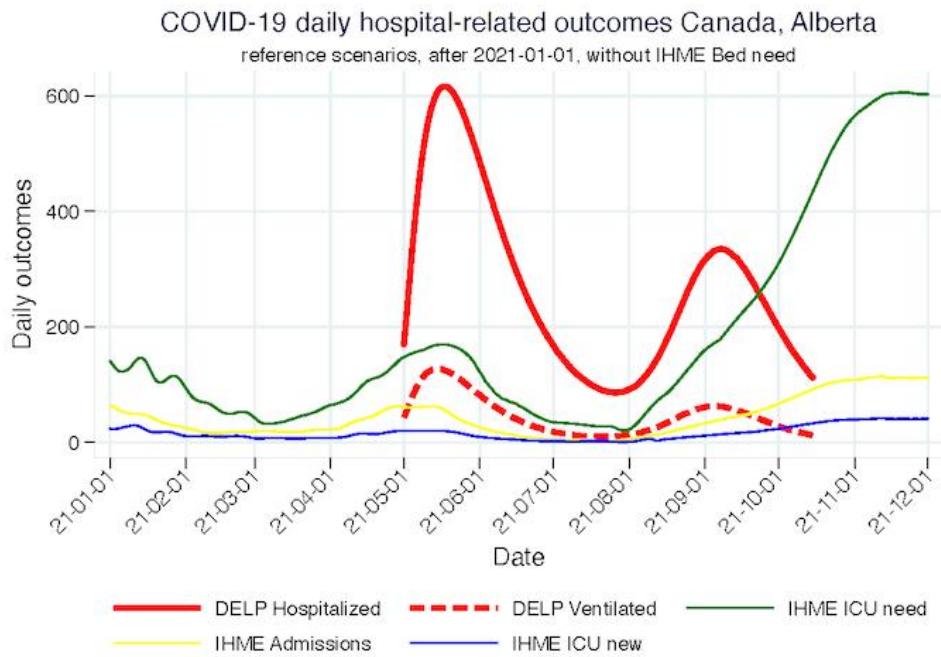
(6) Alberta Daily cases or infections, 3 scenarios, 2021



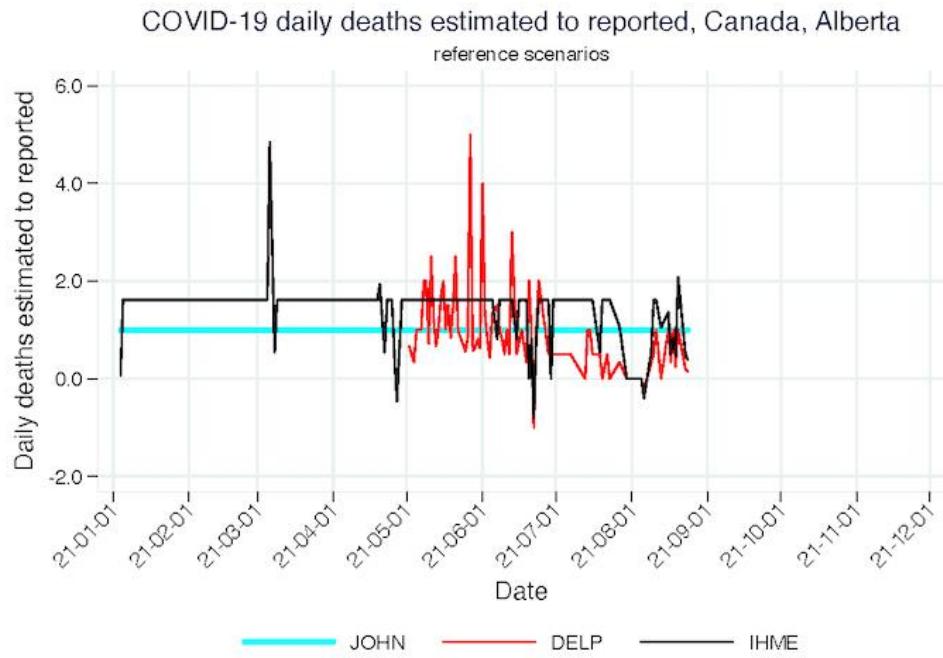
(7) Alberta Hospital-related outcomes, all time



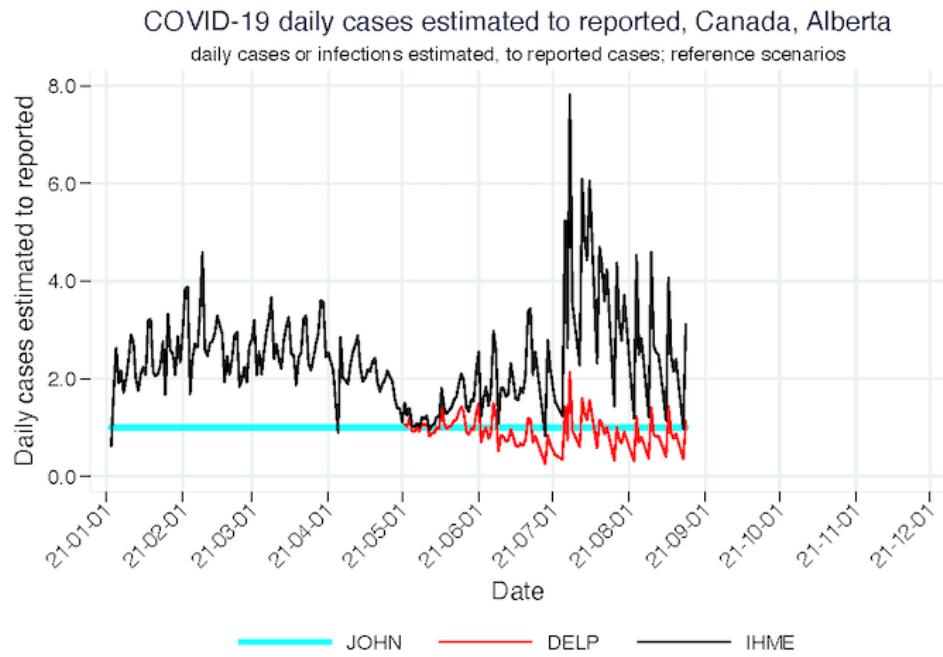
(8) Alberta Hospital-related outcomes, 2021, without IHME Bed need and IMPE Hospital demand



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

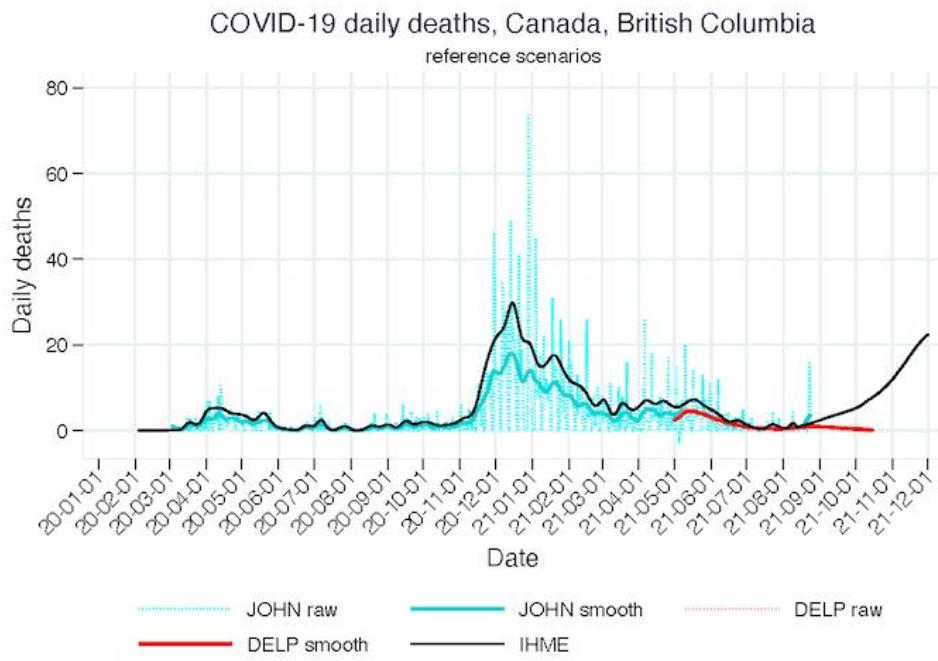


(10) Alberta Daily cases or infections estimated to reported, reference scenarios, 2021

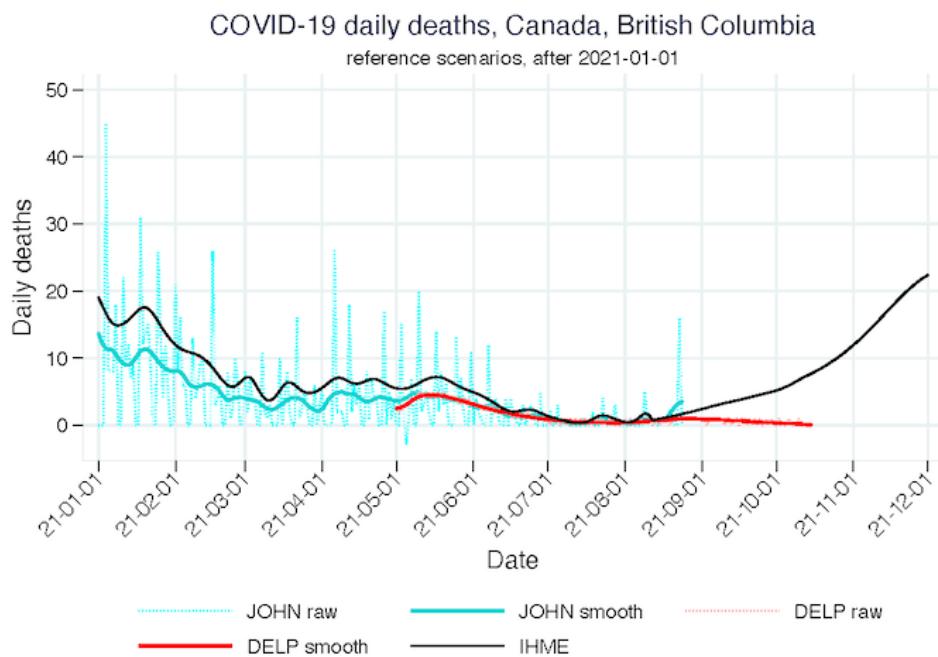


Selected graphs - British Columbia

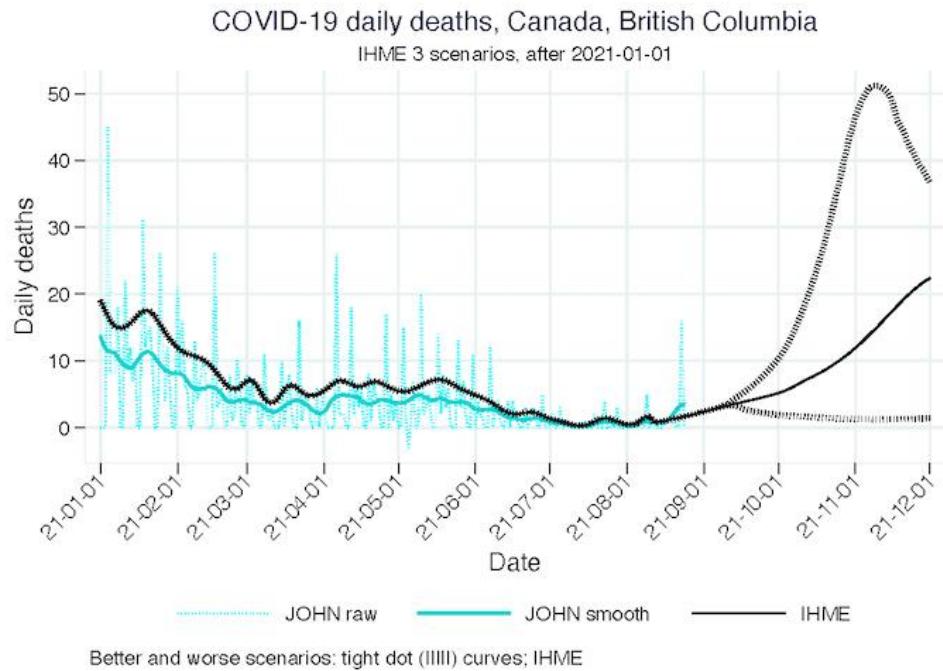
(1) British Columbia Daily deaths, reference scenarios, all time



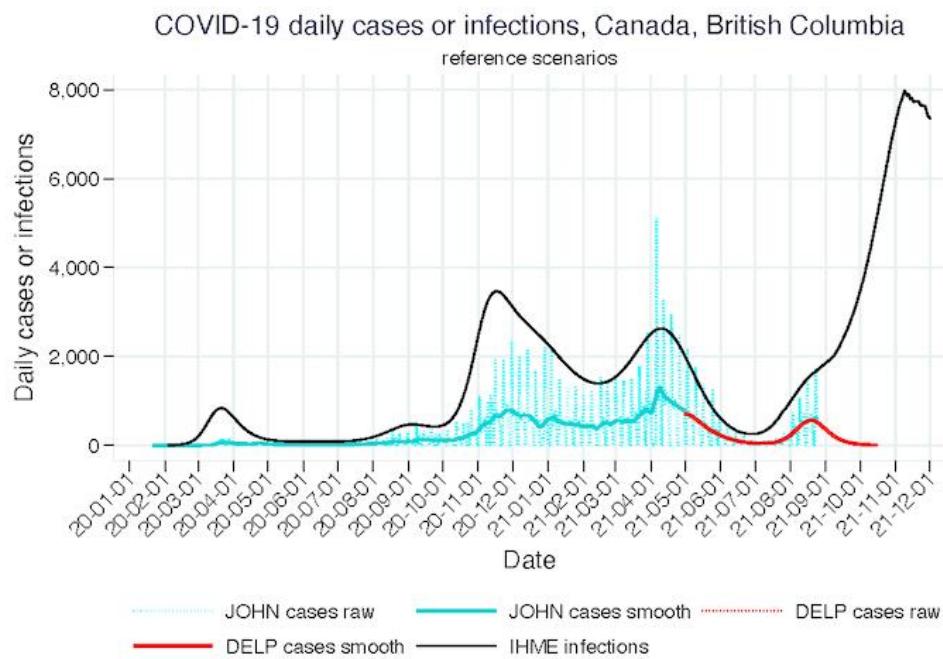
(2) British Columbia Daily deaths, reference scenarios, 2021



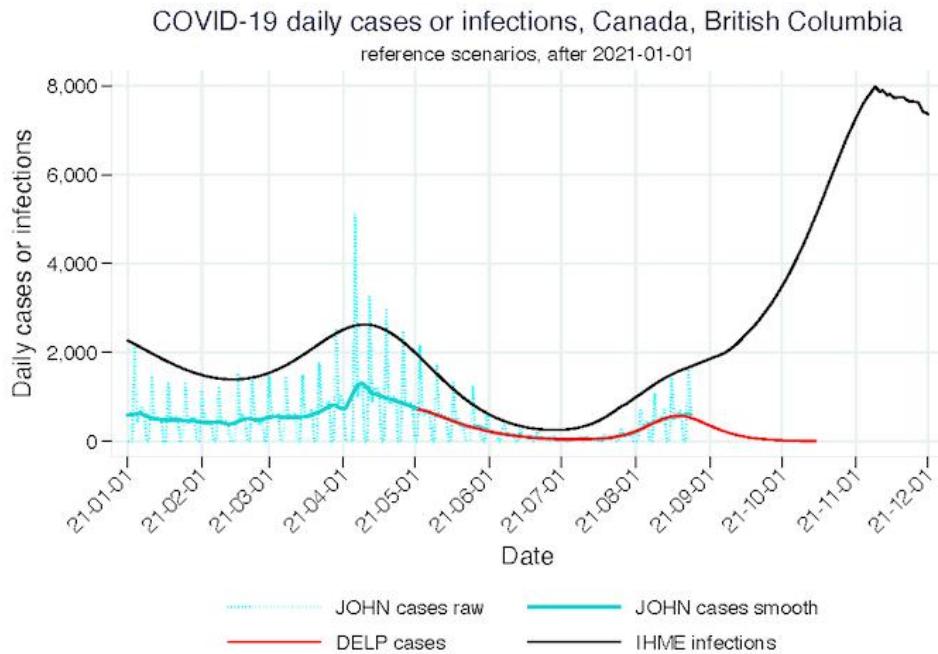
(3) British Columbia Daily deaths, 3 scenarios, 2021



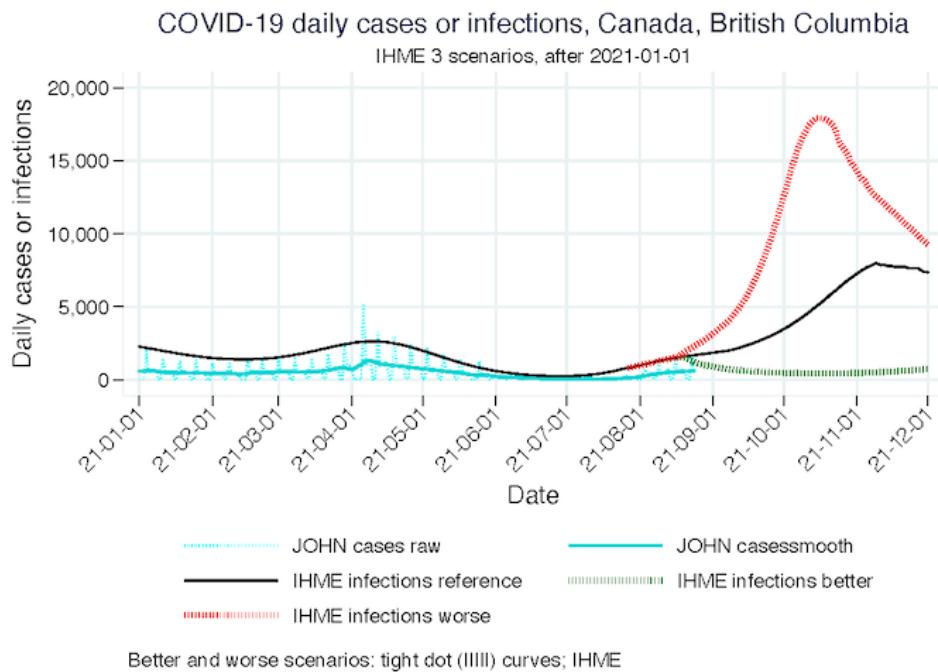
(4) British Columbia Daily cases or infections, reference scenarios, all time



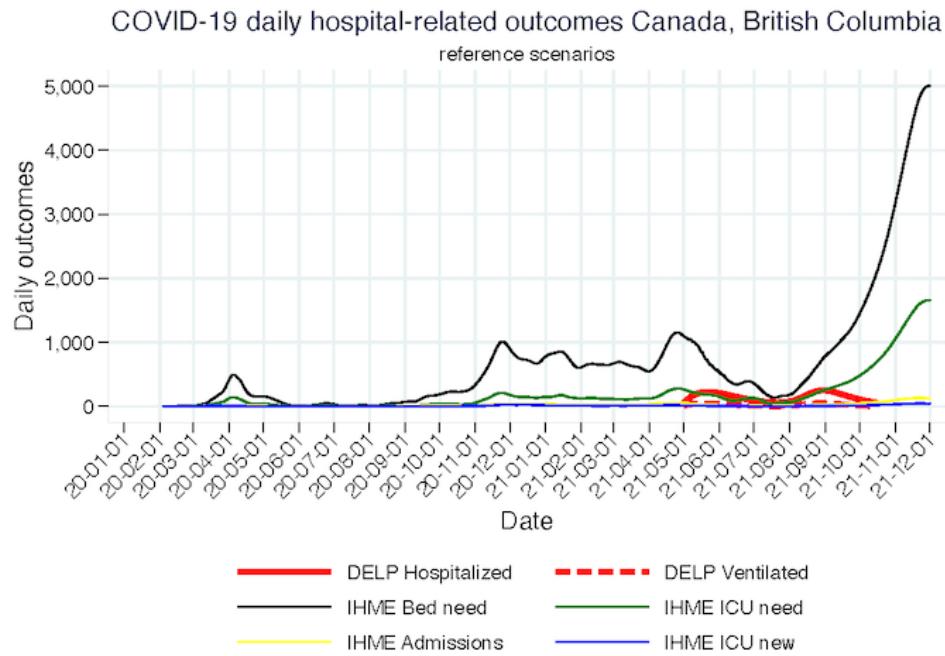
(5) British Columbia Daily cases or infections, reference scenarios, 2021



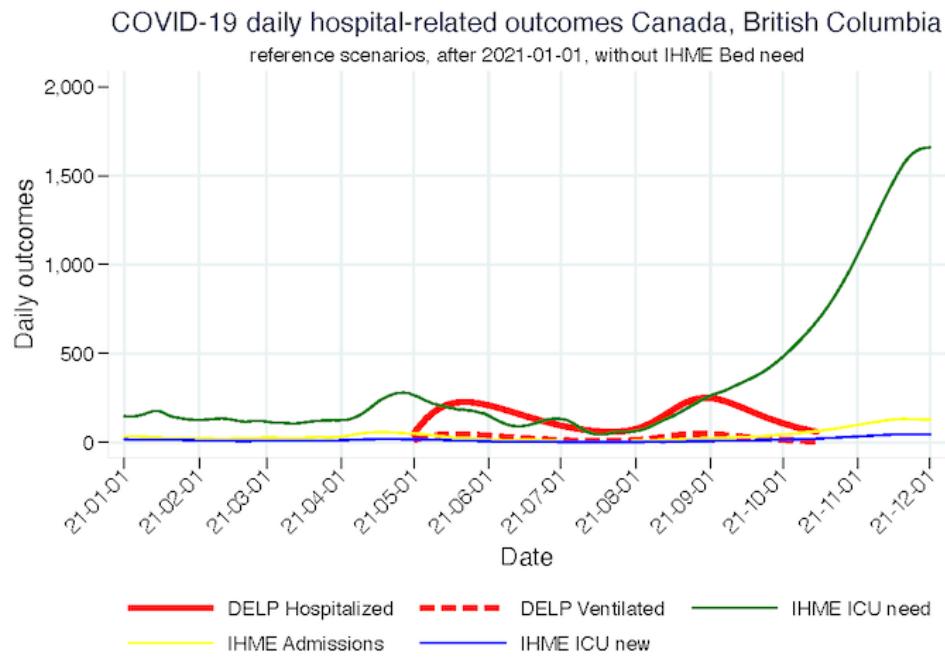
(6) British Columbia Daily cases or infections, 3 scenarios, 2021



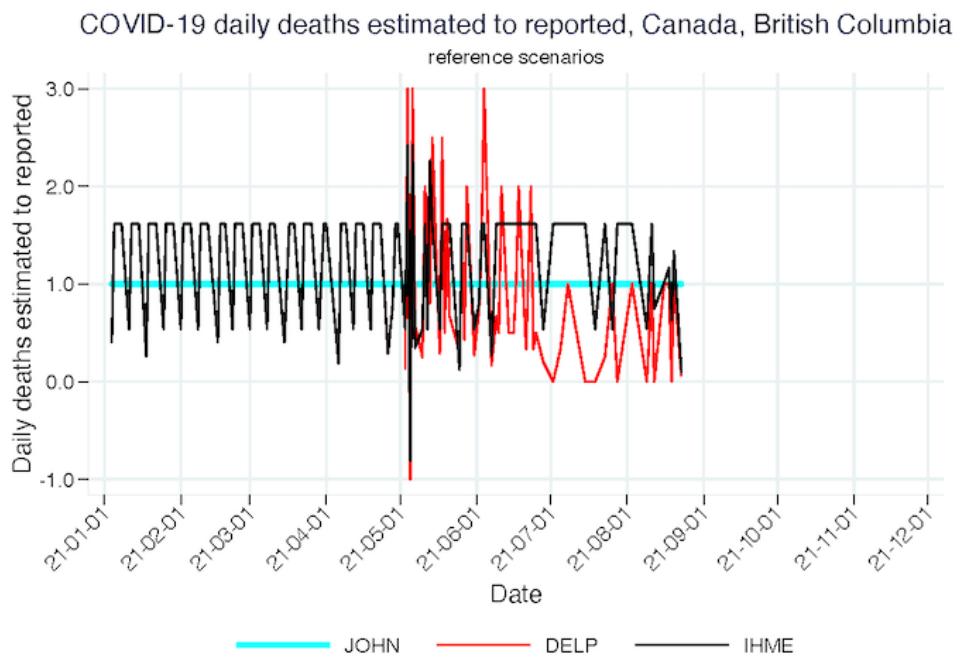
(7) British Columbia Hospital-related outcomes, all time



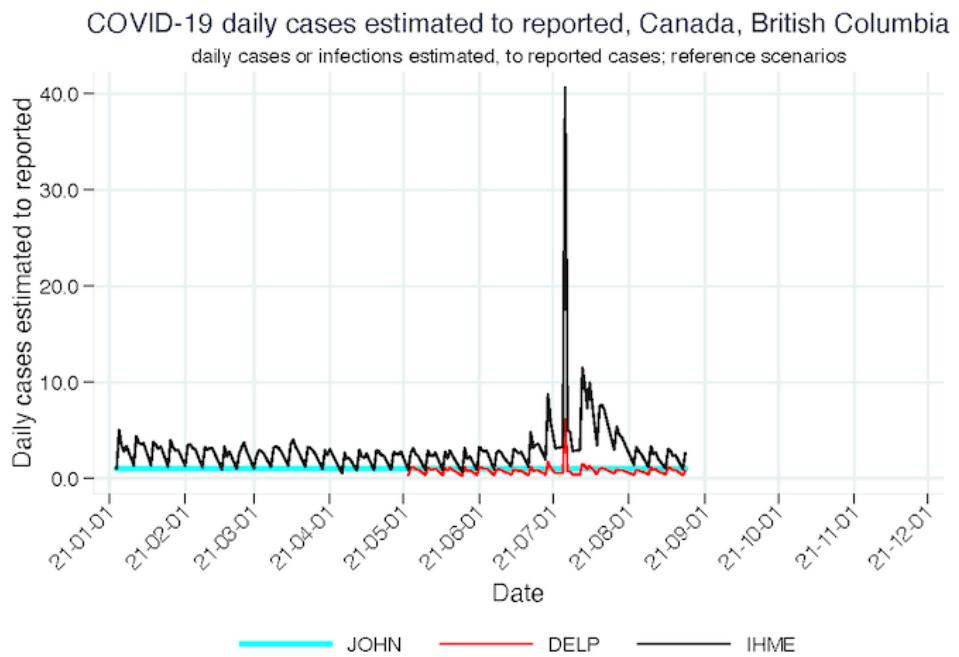
(8) British Columbia Hospital-related outcomes, 2021, without IHME Bed need and IMPE Hospital demand



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

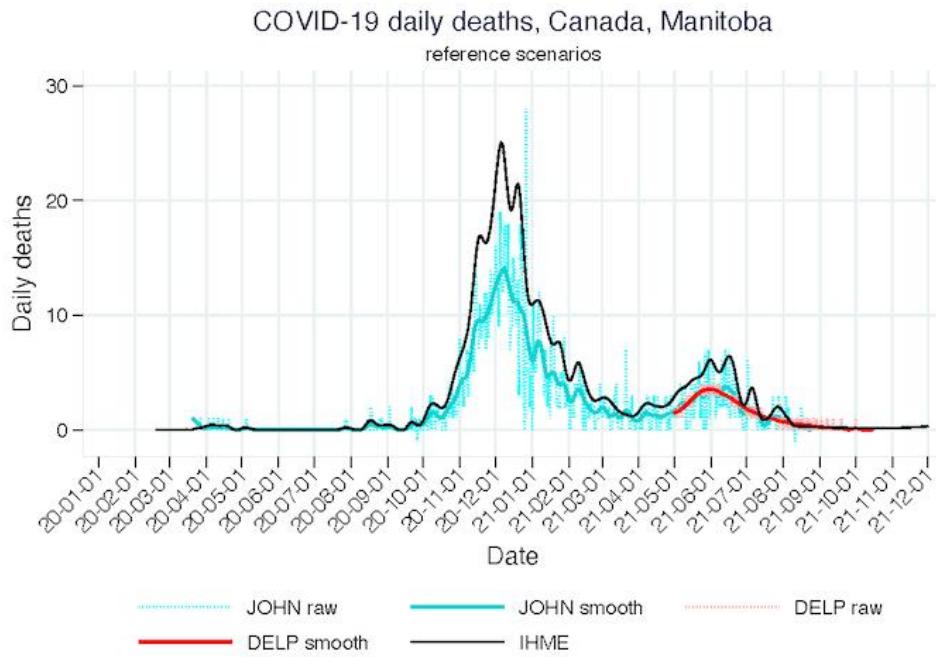


(10) British Columbia Daily cases or infections estimated to reported, reference scenarios, 2021

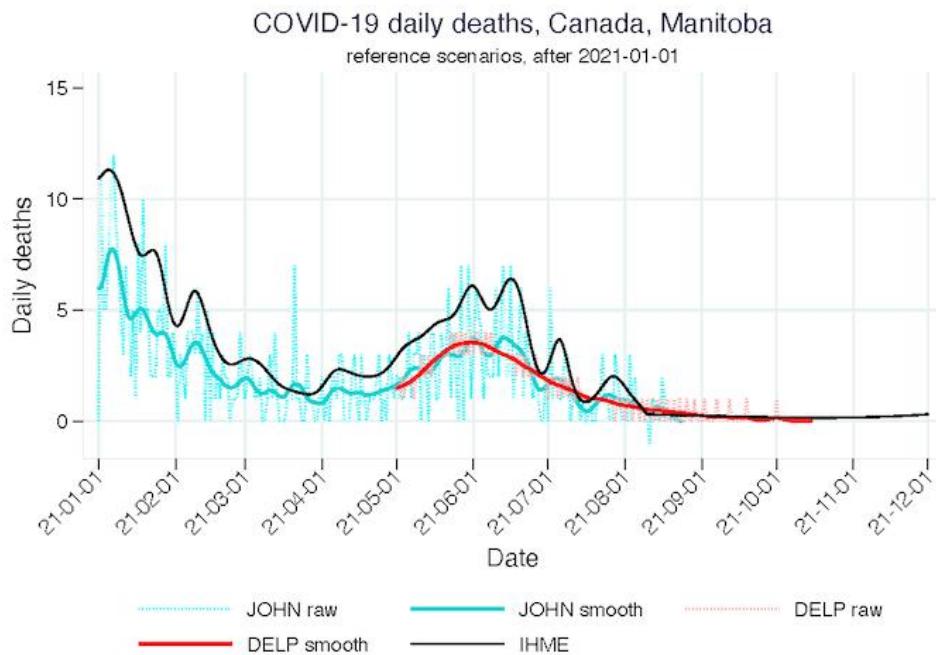


Selected graphs - Manitoba

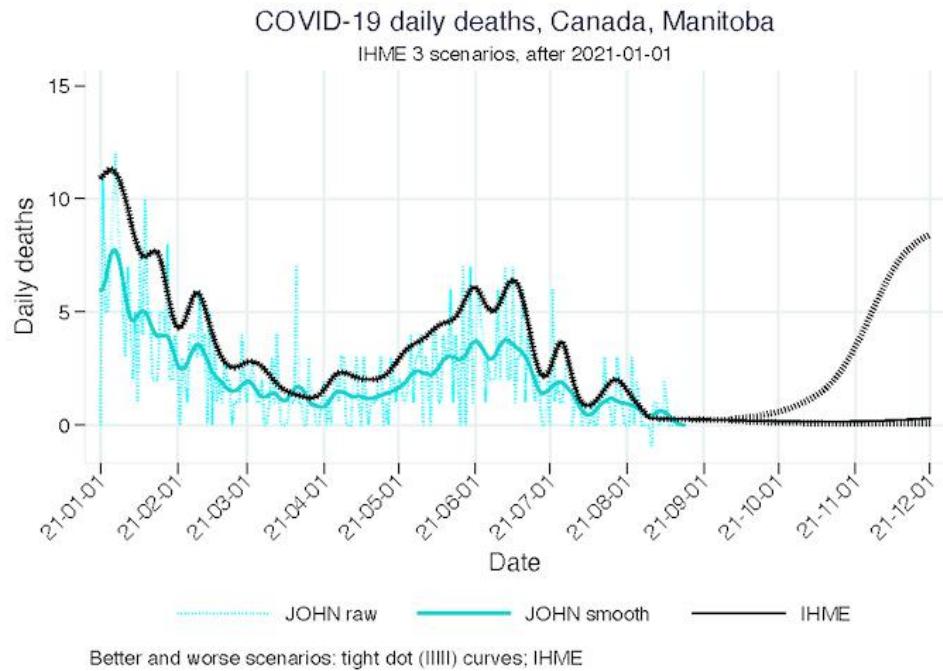
(1) Manitoba Daily deaths, reference scenarios, all time



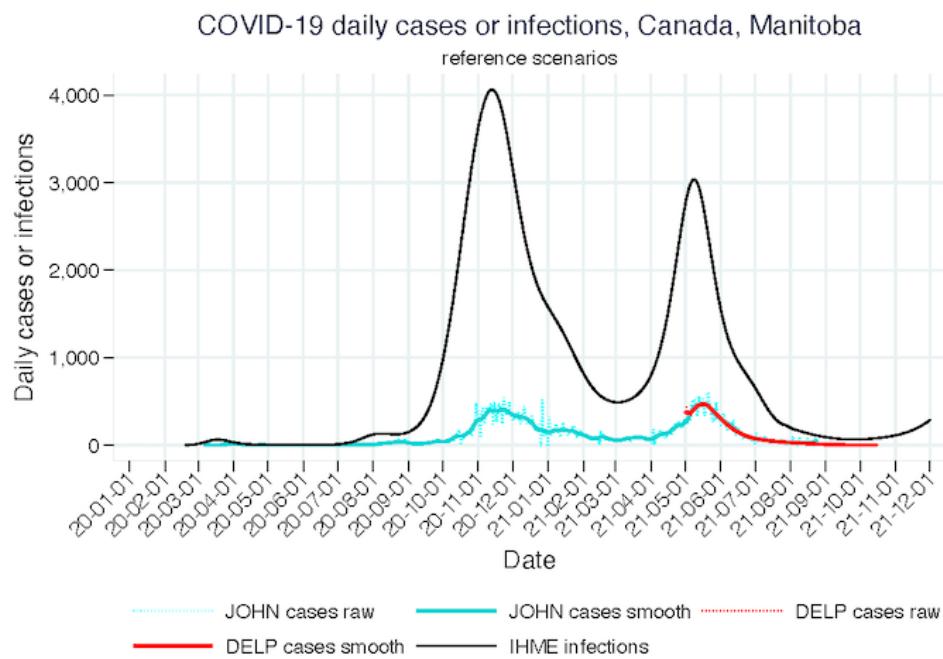
(2) Manitoba Daily deaths, reference scenarios, 2021



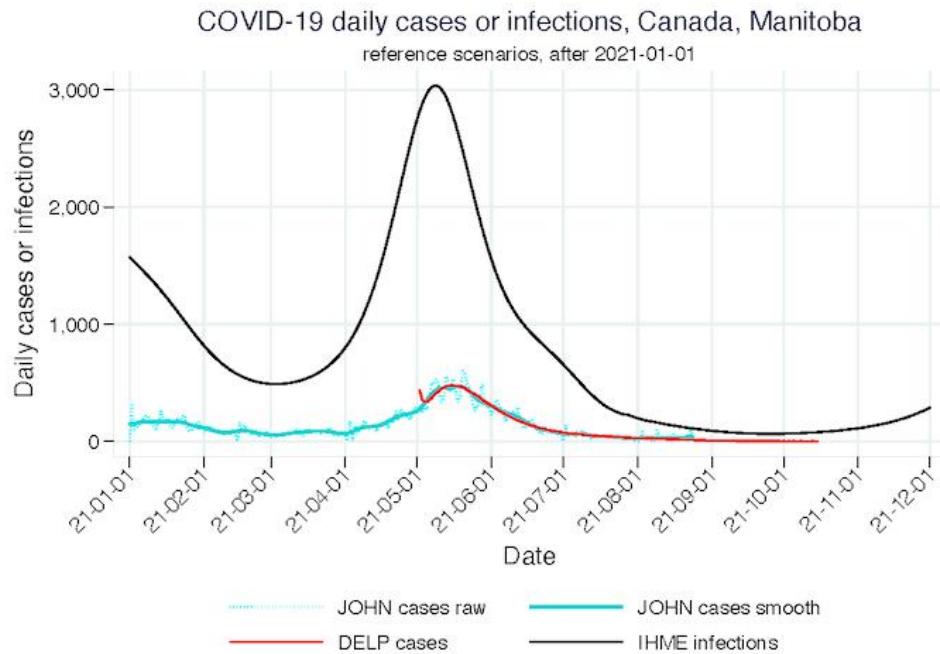
(3) Manitoba Daily deaths, 3 scenarios, 2021



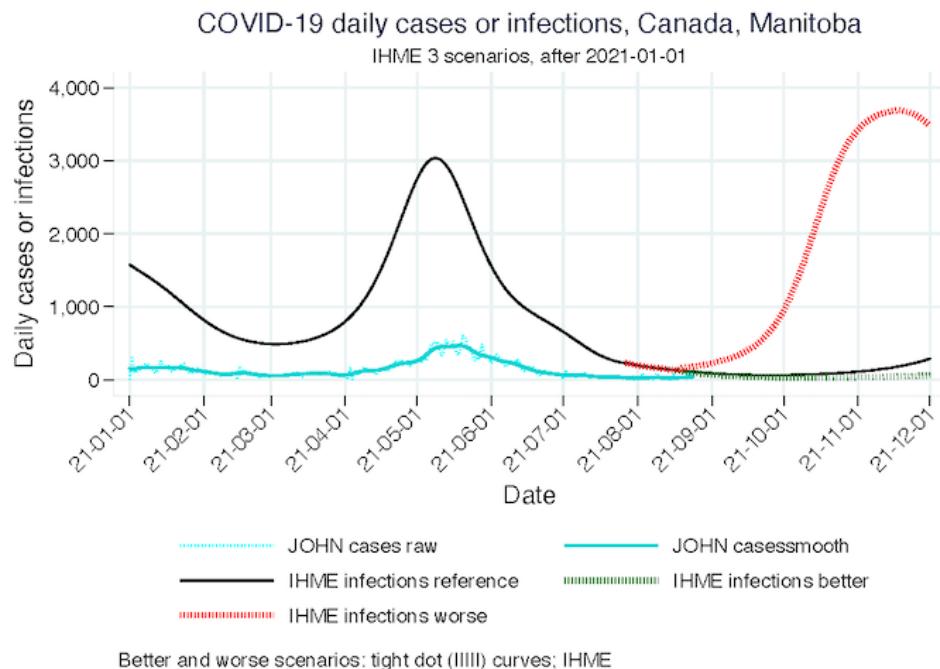
(4) Manitoba Daily cases or infections, reference scenarios, all time



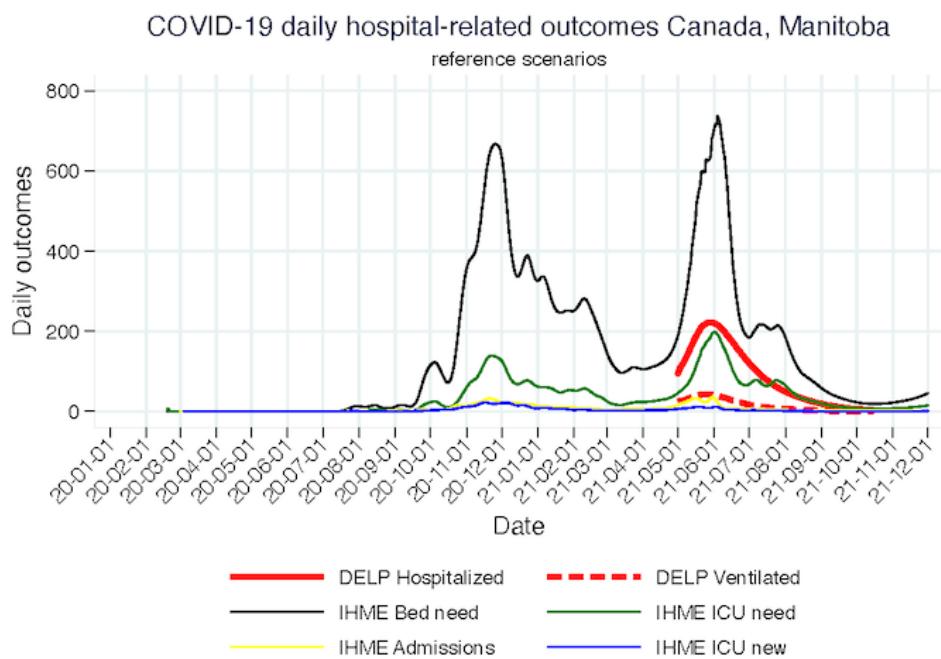
(5) Manitoba Daily cases or infections, reference scenarios, 2021



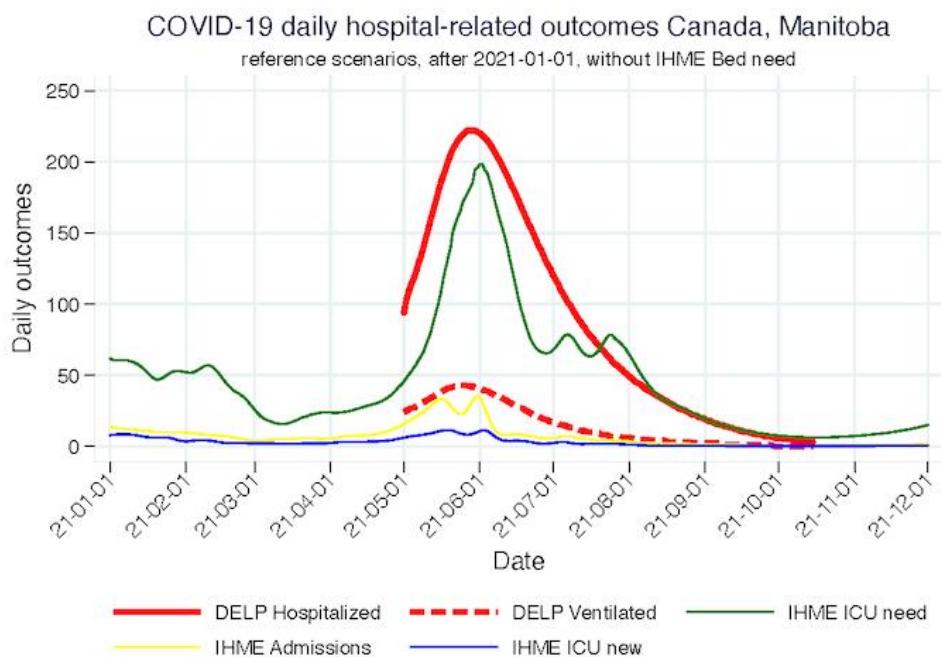
(6) Manitoba Daily cases or infections, 3 scenarios, 2021



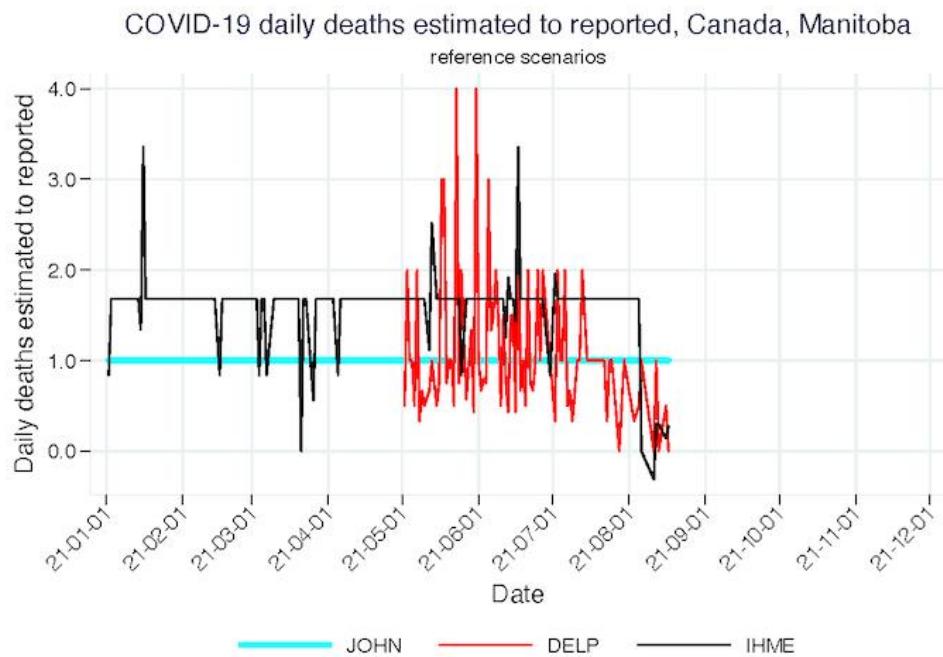
(7) Manitoba Hospital-related outcomes, all time



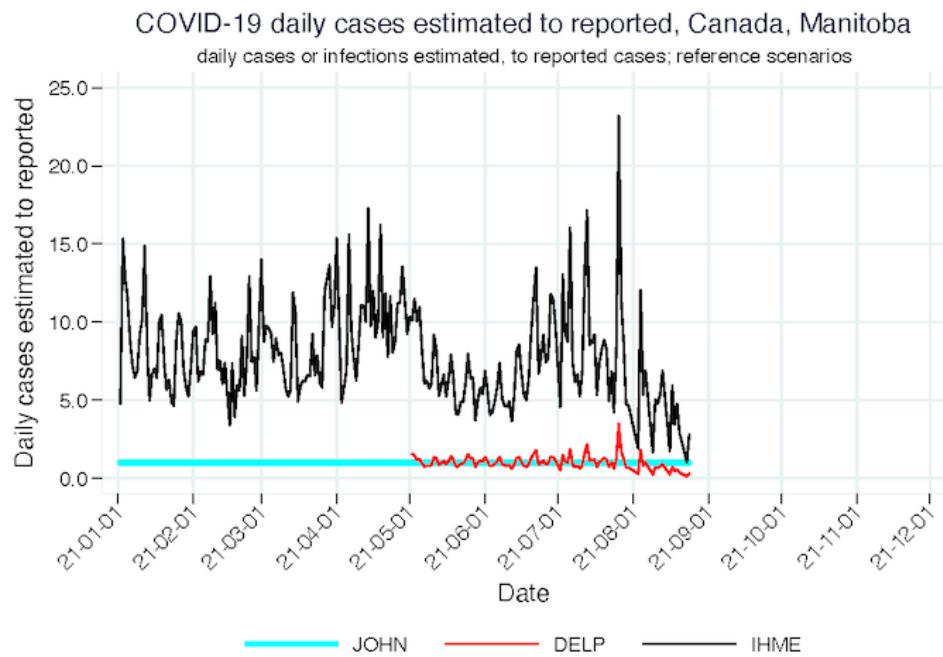
(8) Manitoba Hospital-related outcomes, 2021, without IHME Bed need and IMPE Hospital demand



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

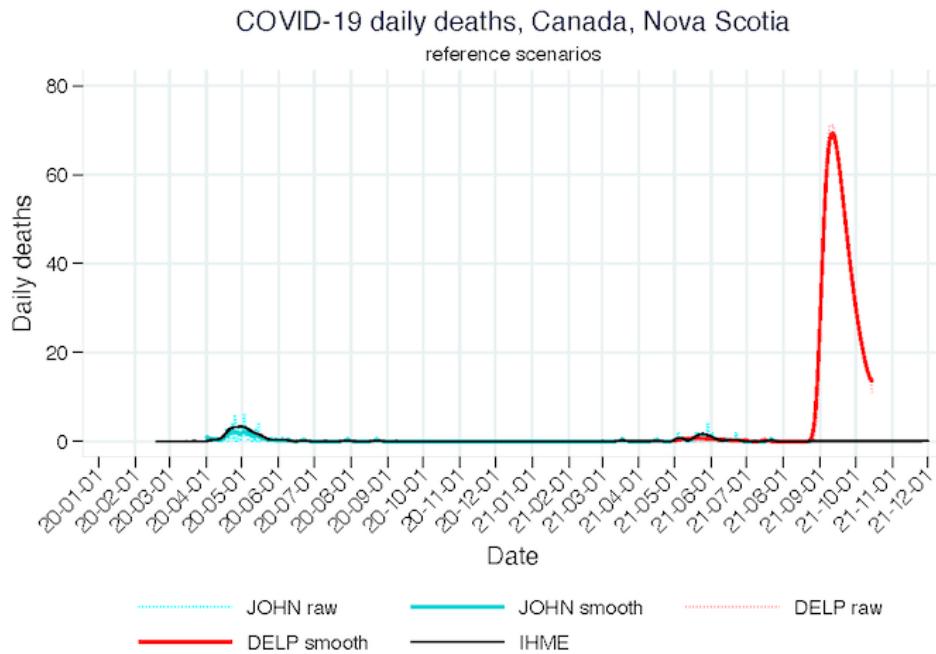


(10) Manitoba Daily cases or infections estimated to reported, reference scenarios, 2021

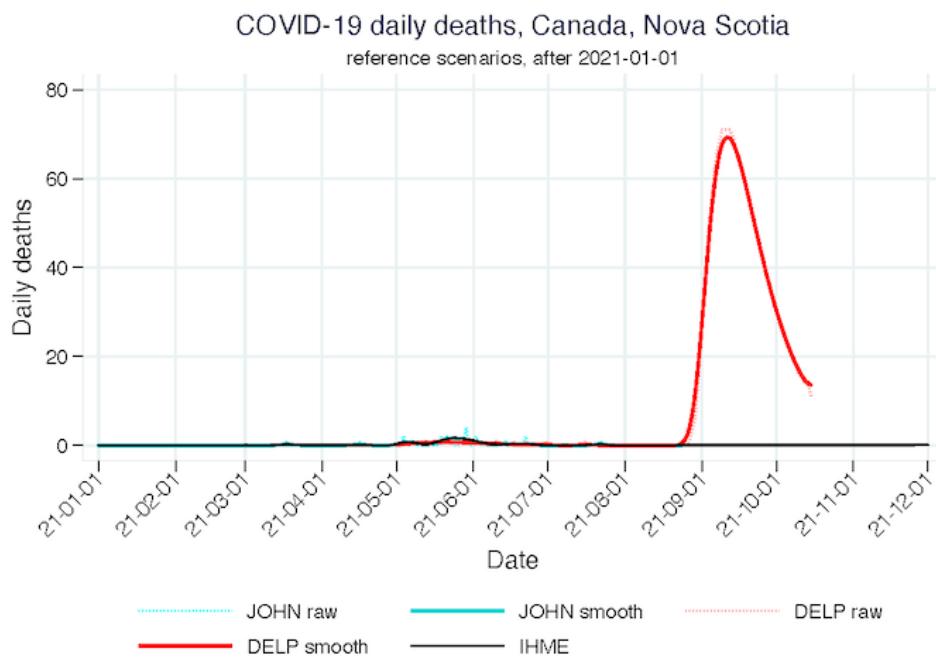


Selected graphs - Nova Scotia

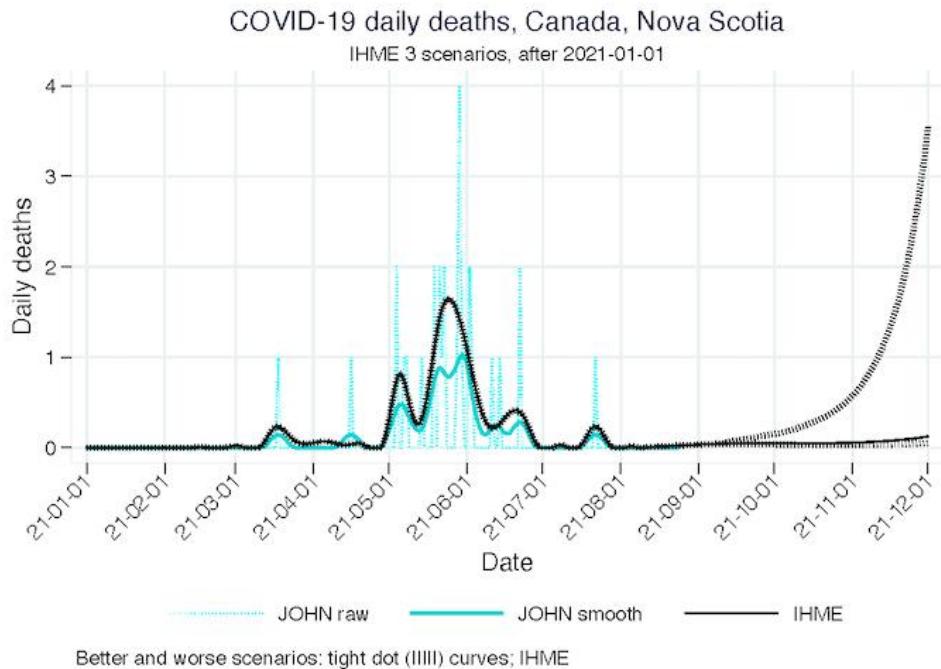
(1) Nova Scotia Daily deaths, reference scenarios, all time



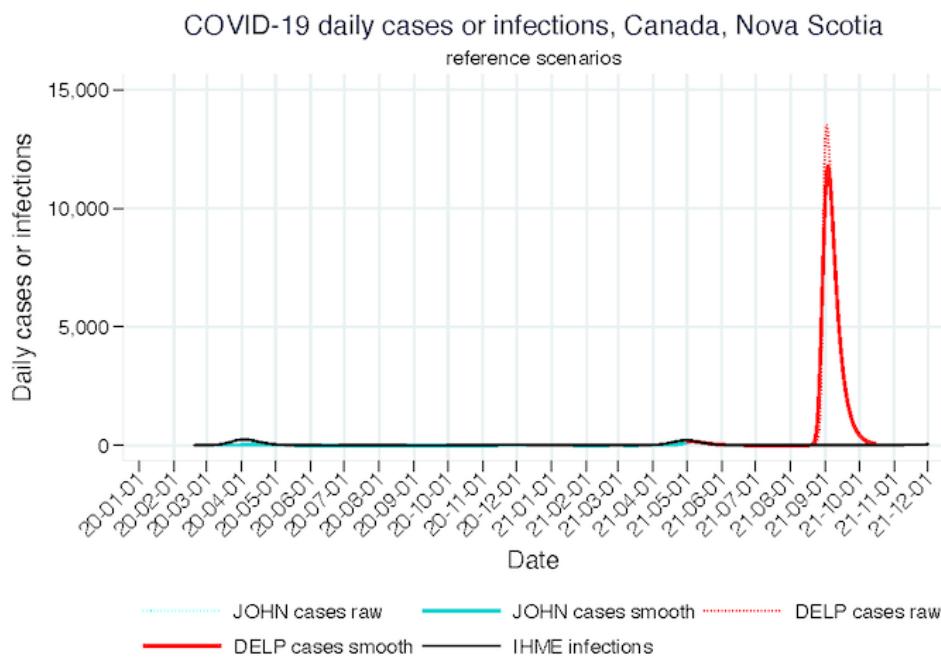
(2) Nova Scotia Daily deaths, reference scenarios, 2021



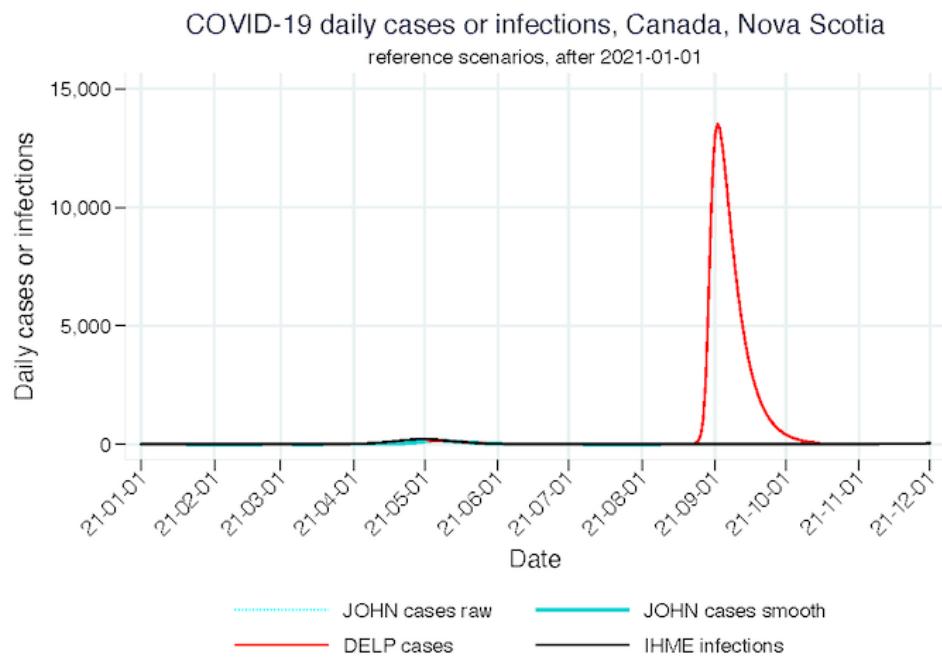
(3) Nova Scotia Daily deaths, 3 scenarios, 2021



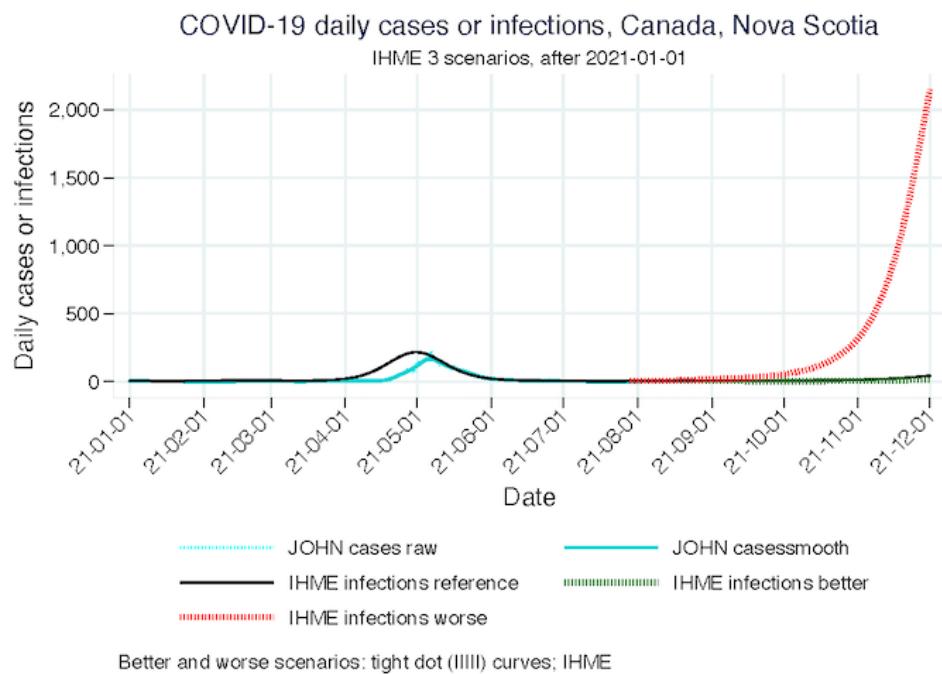
(4) Nova Scotia Daily cases or infections, reference scenarios, all time



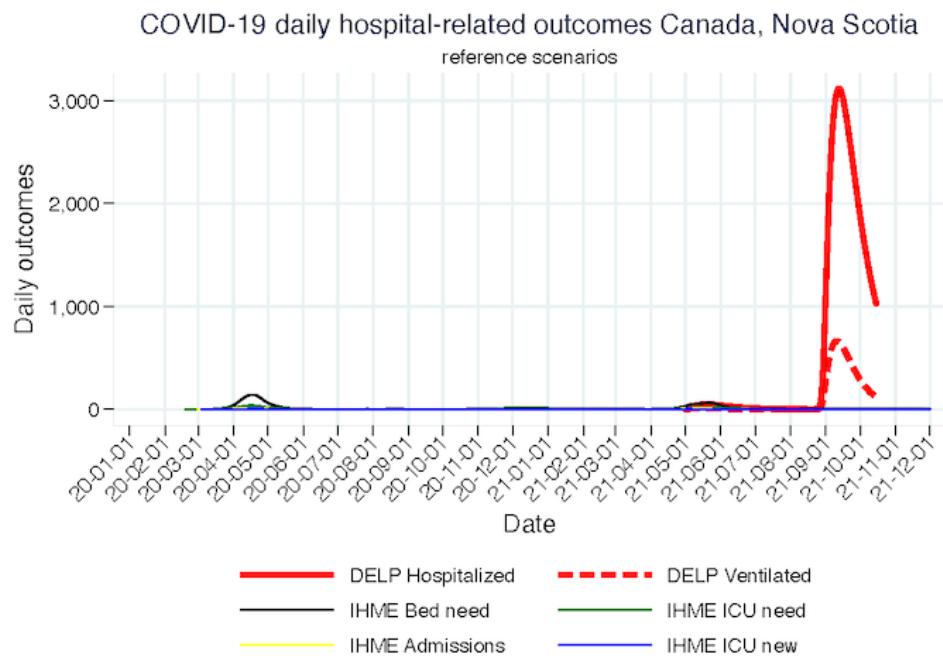
(5) Nova Scotia Daily cases or infections, reference scenarios, 2021



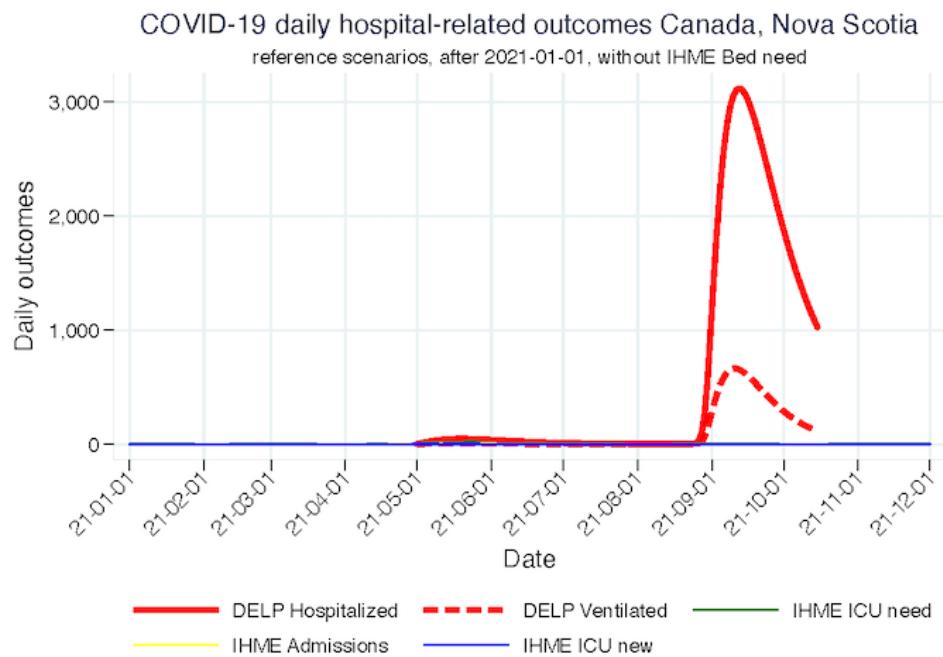
(6) Nova Scotia Daily cases or infections, 3 scenarios, 2021



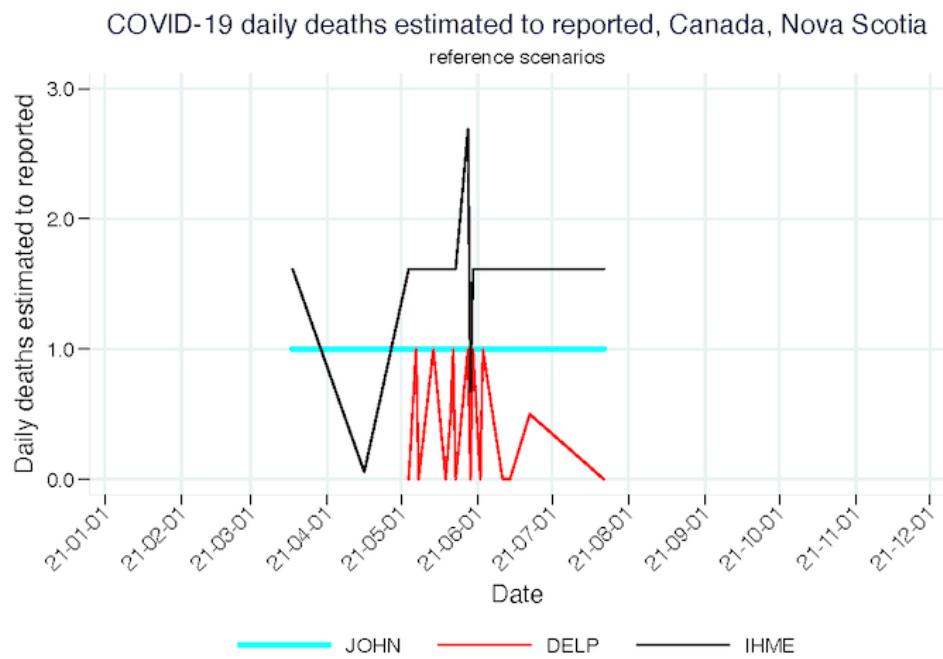
(7) Nova Scotia Hospital-related outcomes, all time



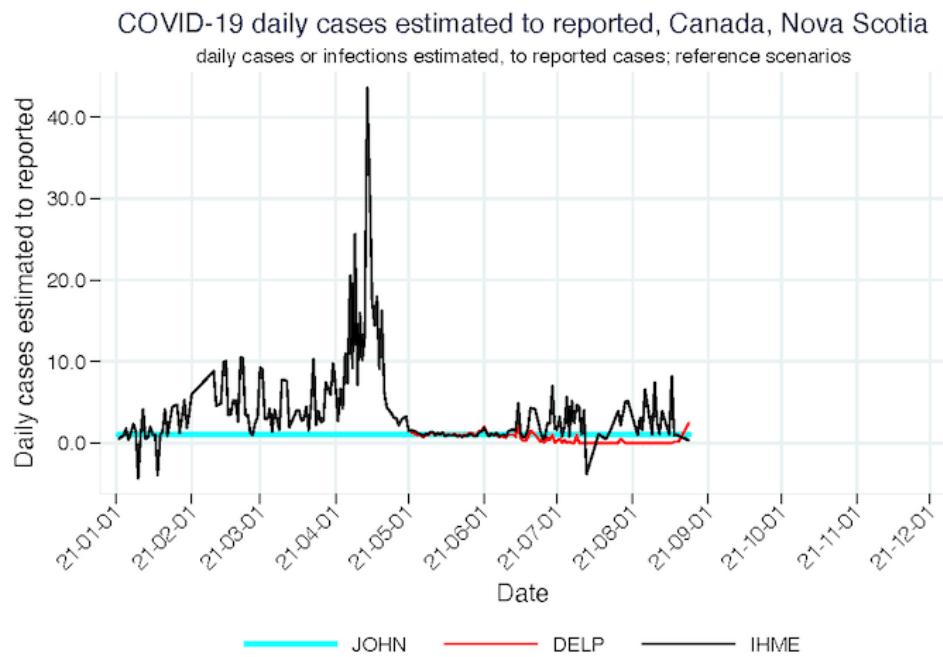
(8) Nova Scotia Hospital-related outcomes, 2021, without IHME Bed need and IMPE Hospital demand



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

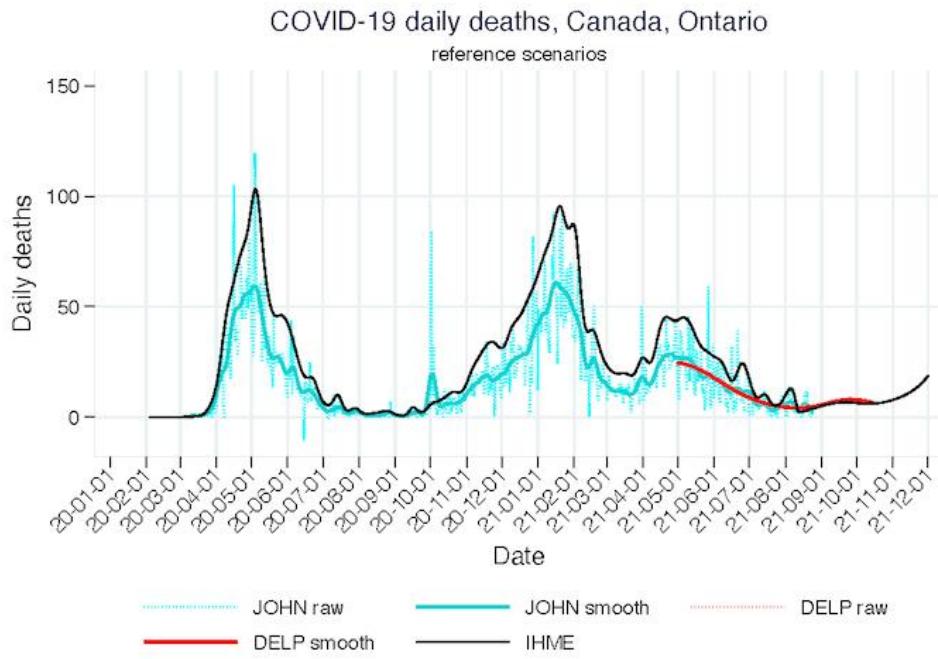


(10) Nova Scotia Daily cases or infections estimated to reported, reference scenarios, 2021

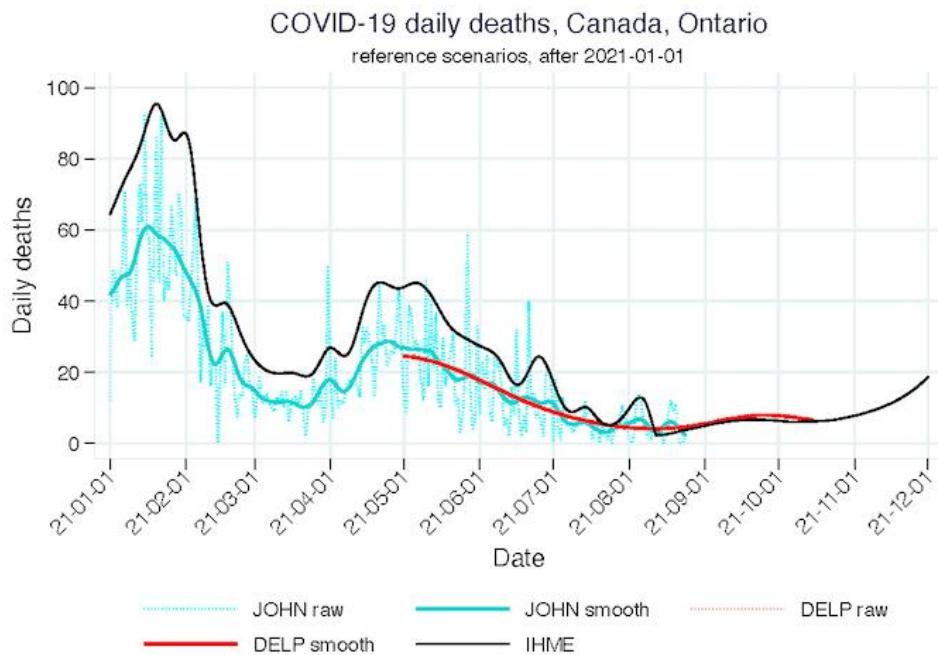


Selected graphs - Ontario

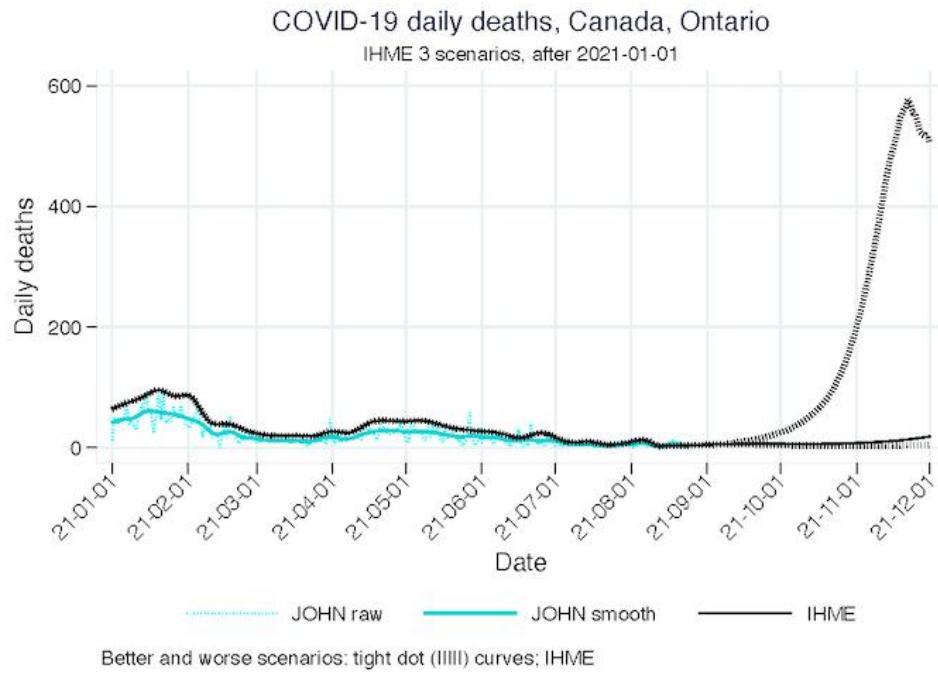
(1) Ontario Daily deaths, reference scenarios, all time



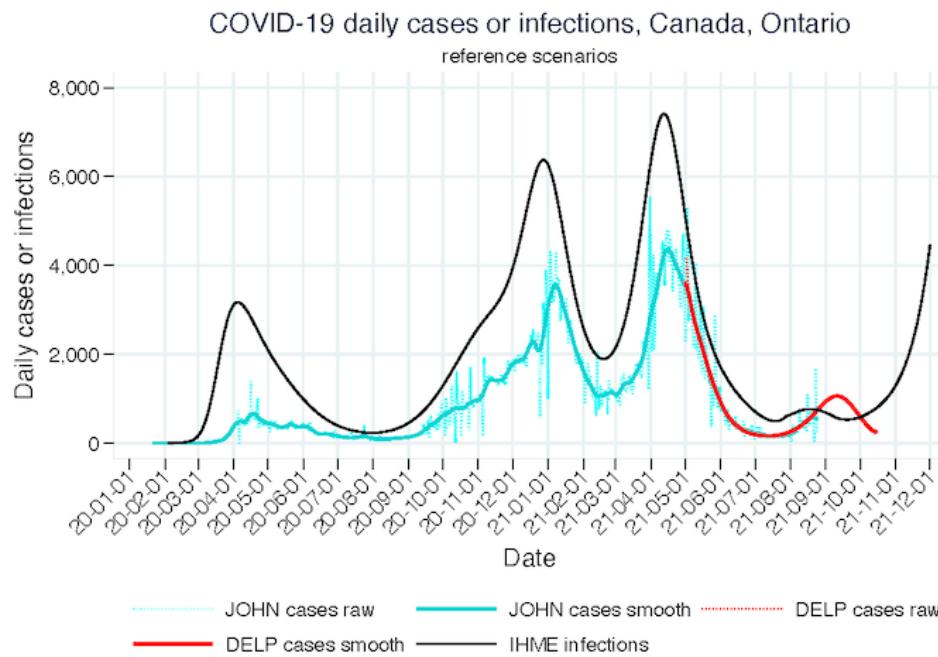
(2) Ontario Daily deaths, reference scenarios, 2021



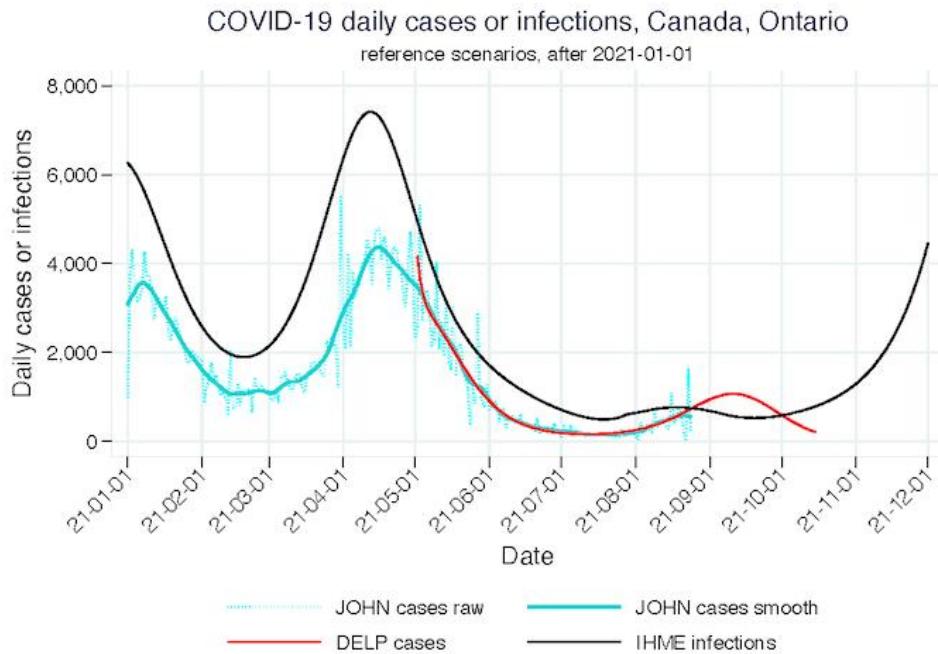
(3) Ontario Daily deaths, 3 scenarios, 2021



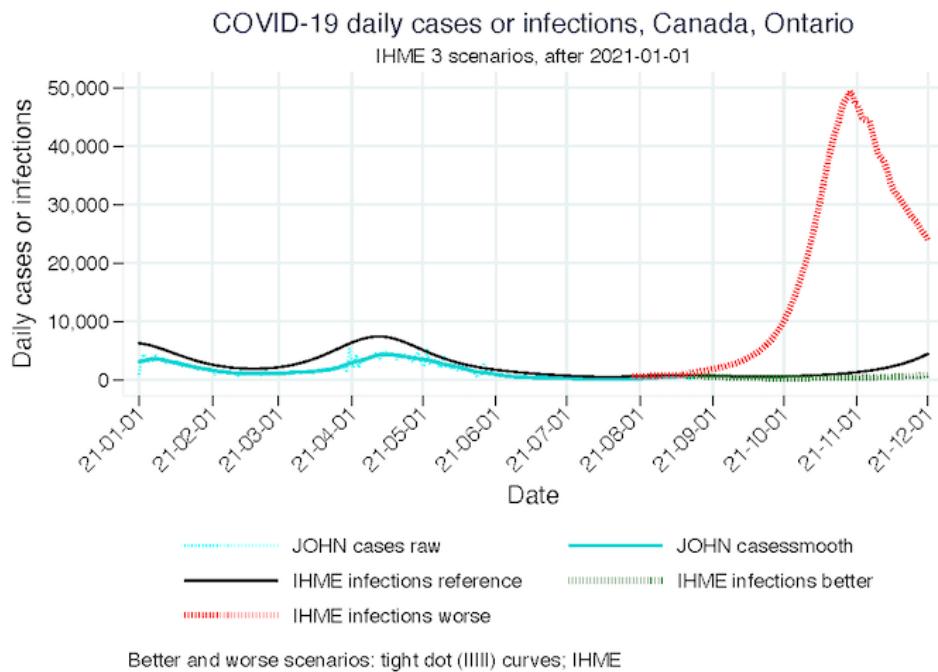
(4) Ontario Daily cases or infections, reference scenarios, all time



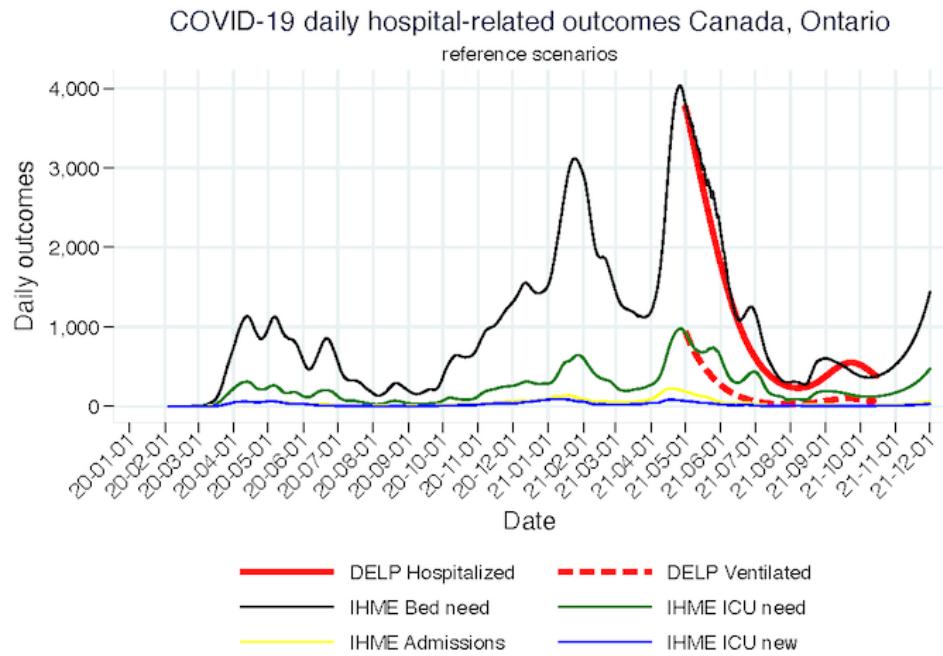
(5) Ontario Daily cases or infections, reference scenarios, 2021



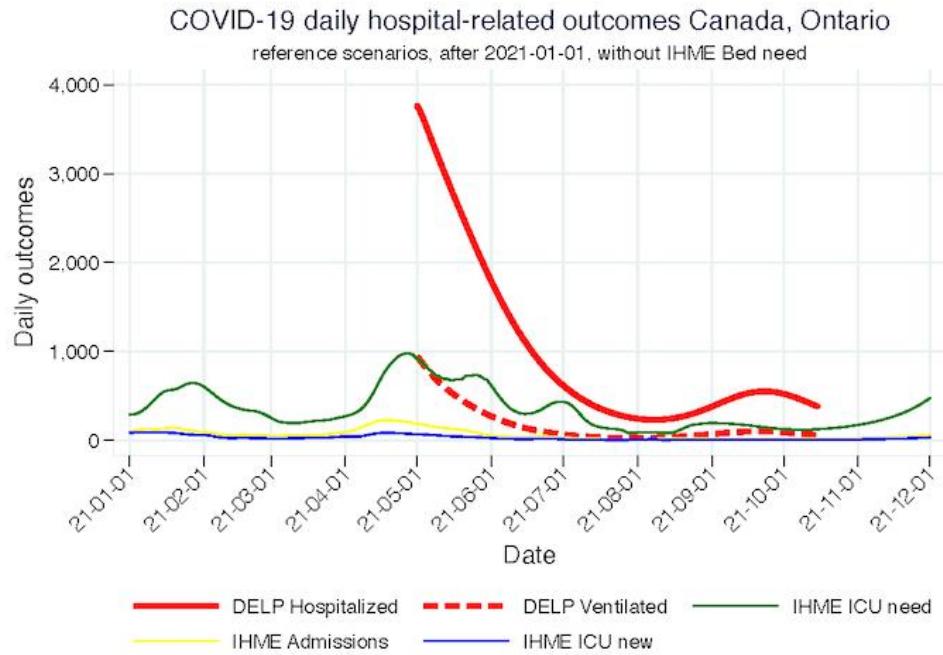
(6) Ontario Daily cases or infections, 3 scenarios, 2021



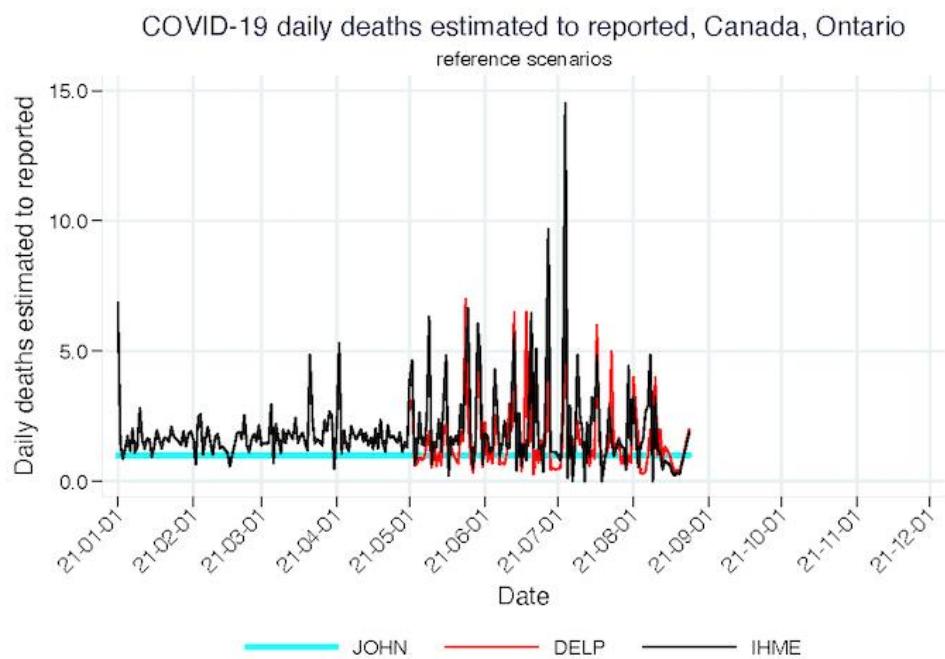
(7) Ontario Hospital-related outcomes, all time



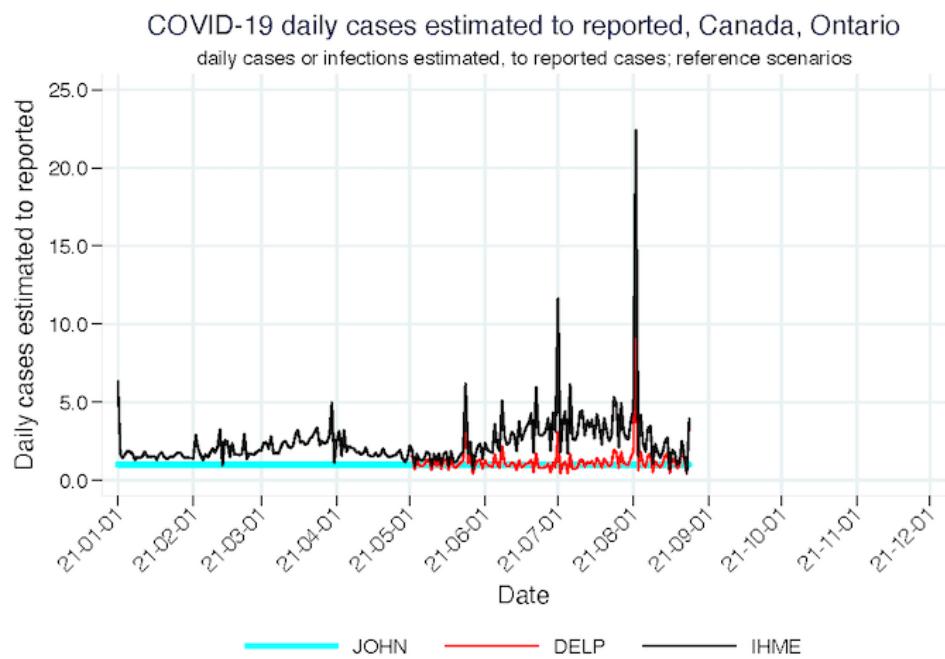
(8) Ontario Hospital-related outcomes, 2021, without IHME Bed need and IMPE Hospital demand



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

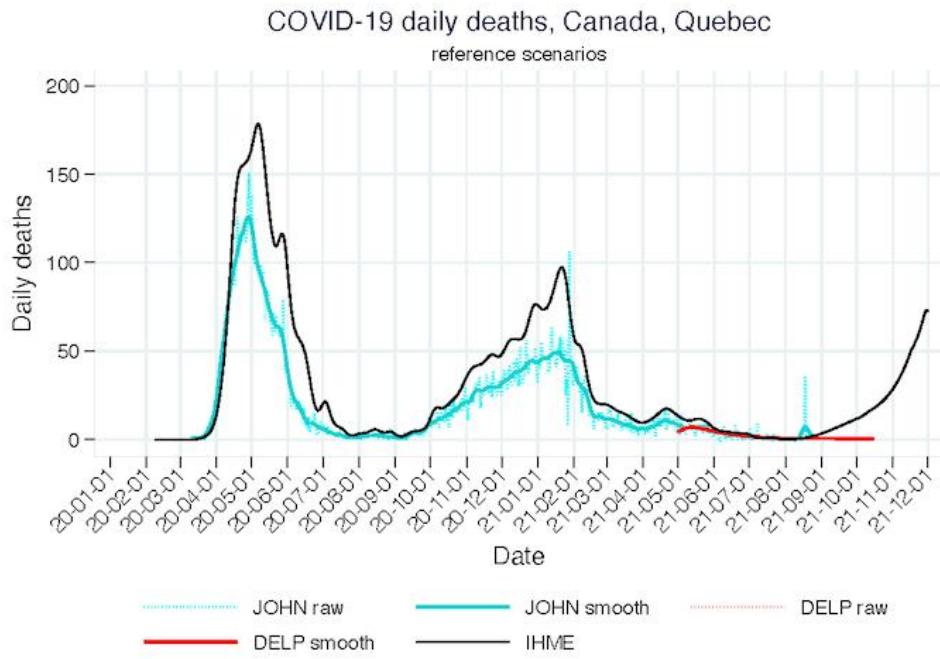


(10) Ontario Daily cases or infections estimated to reported, reference scenarios, 2021

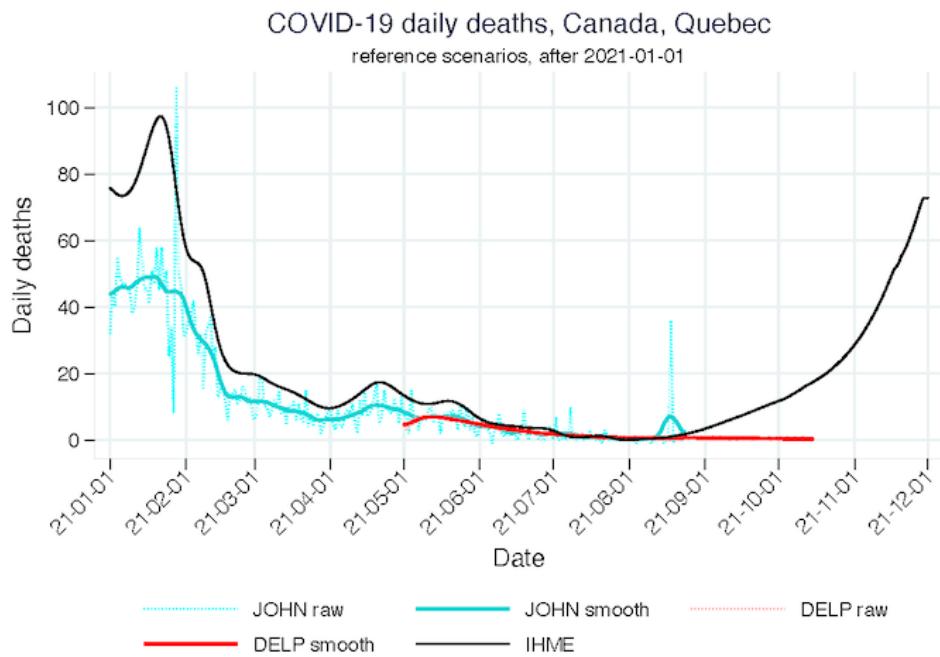


Selected graphs - Quebec

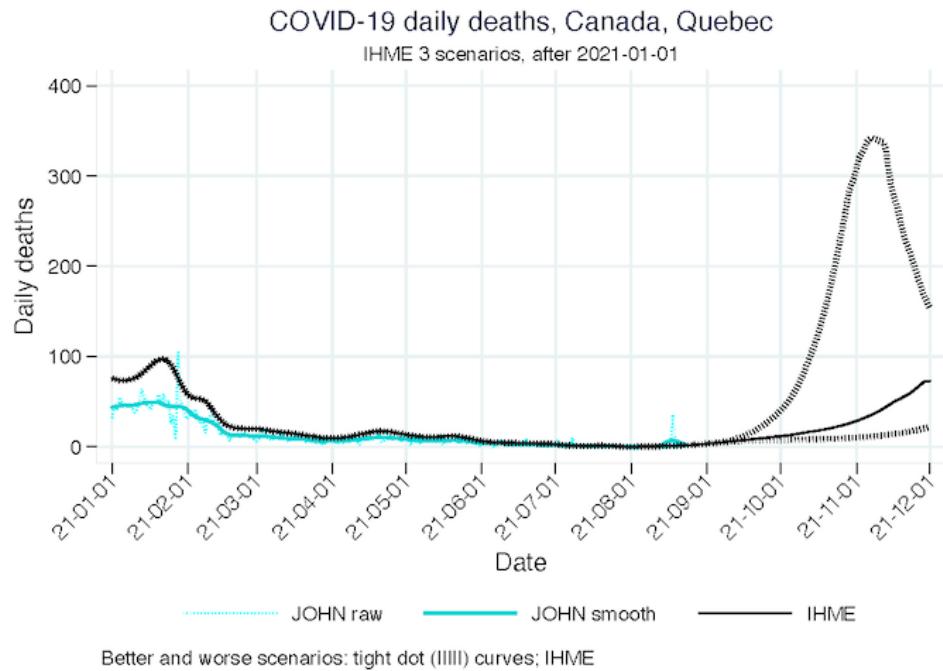
(1) Quebec Daily deaths, reference scenarios, all time



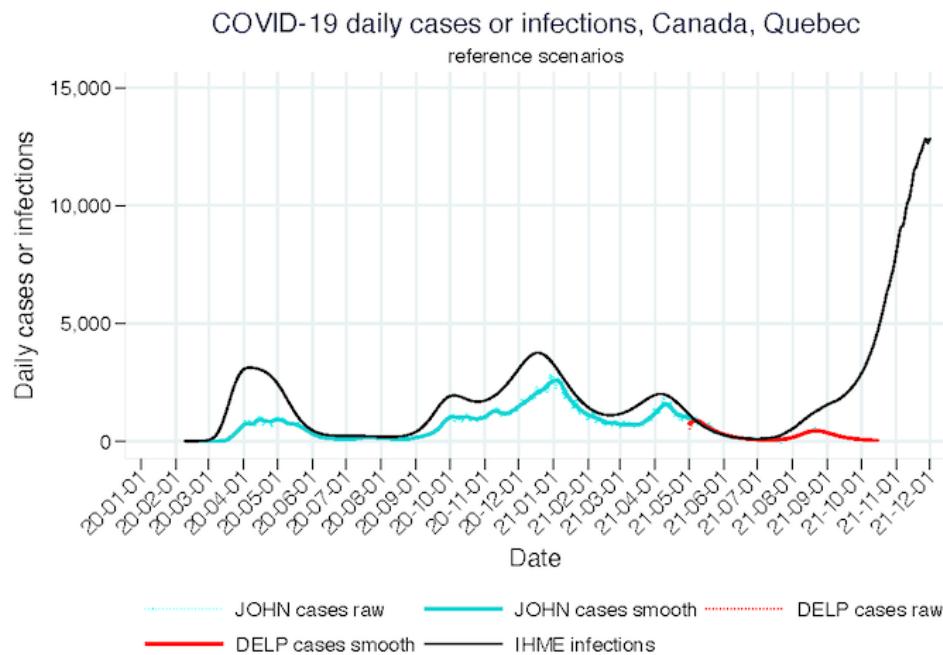
(2) Quebec Daily deaths, reference scenarios, 2021



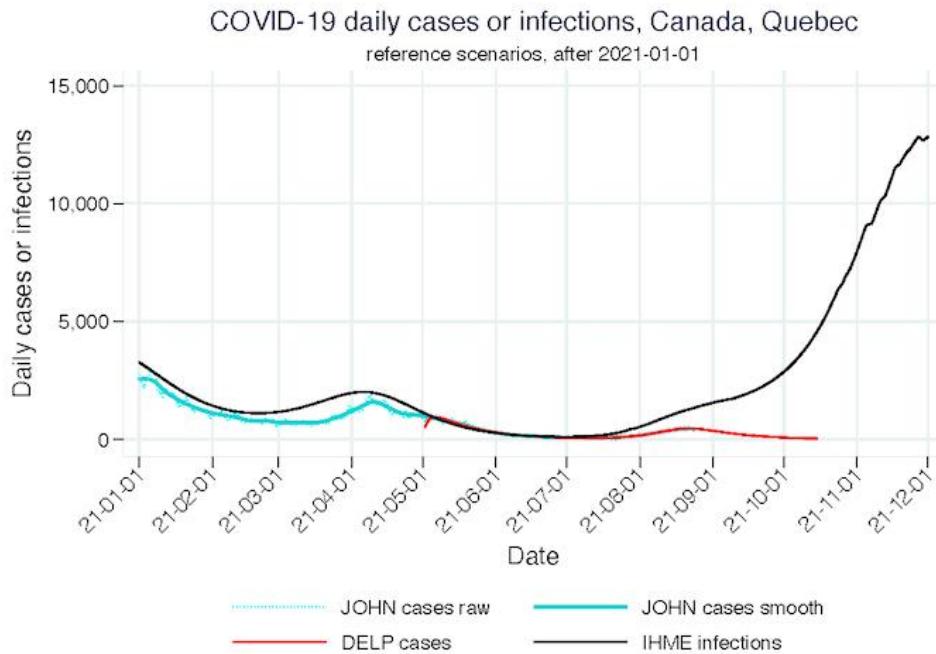
(3) Quebec Daily deaths, 3 scenarios, 2021



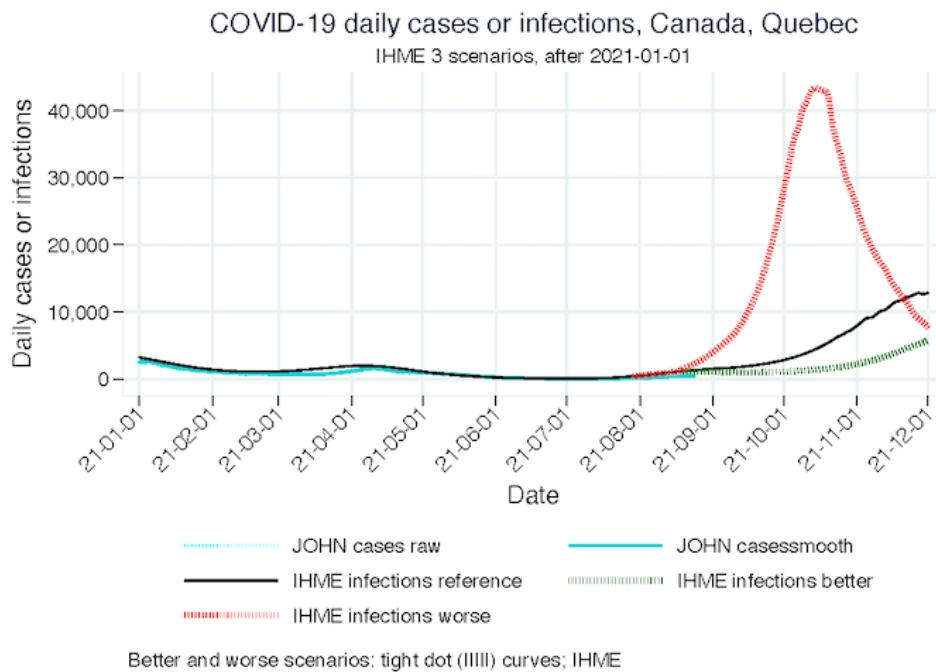
(4) Quebec Daily cases or infections, reference scenarios, all time



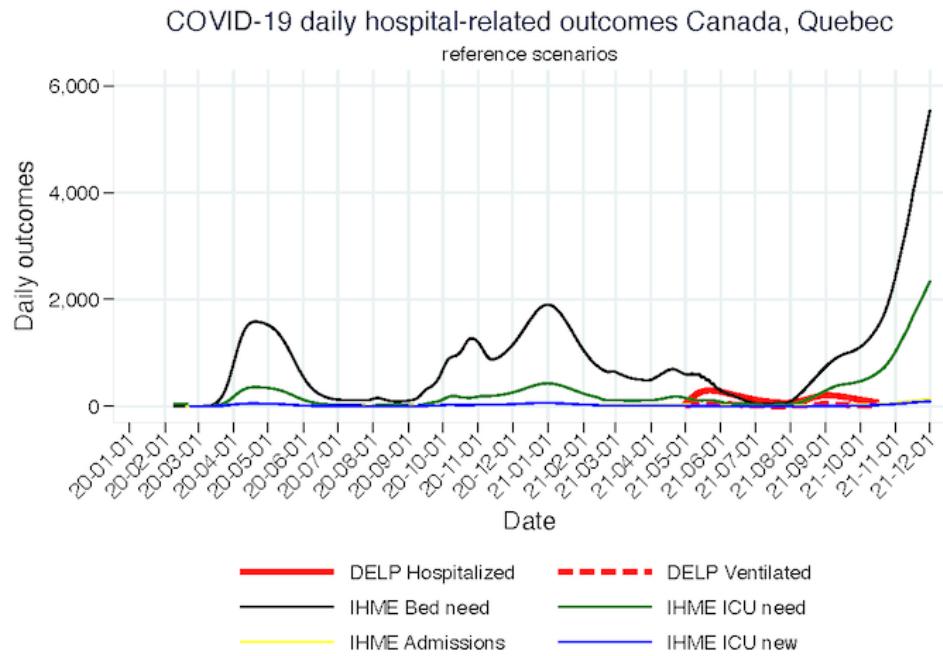
(5) Quebec Daily cases or infections, reference scenarios, 2021



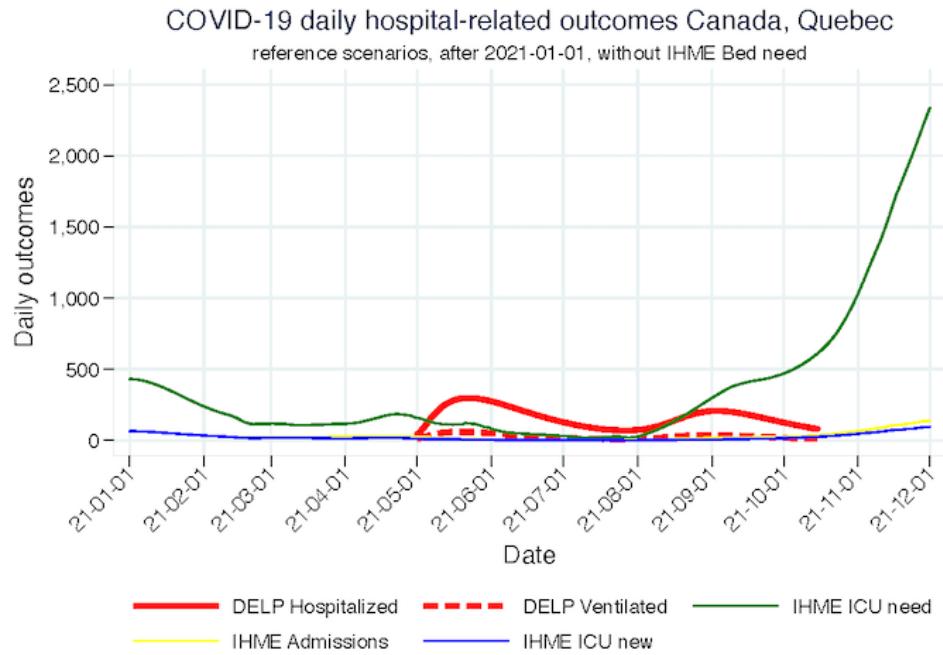
(6) Quebec Daily cases or infections, 3 scenarios, 2021



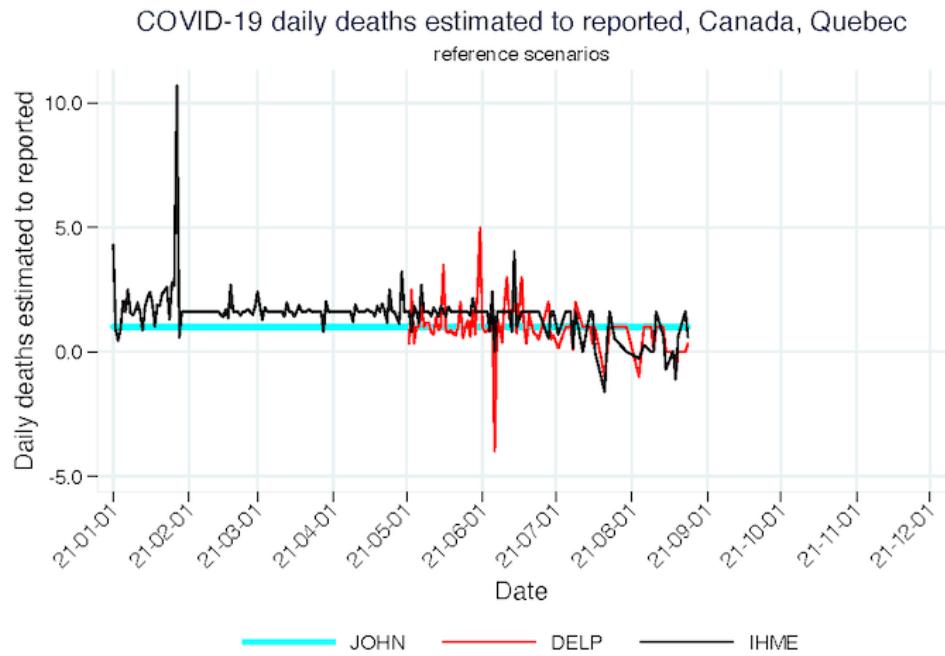
(7) Quebec Hospital-related outcomes, all time



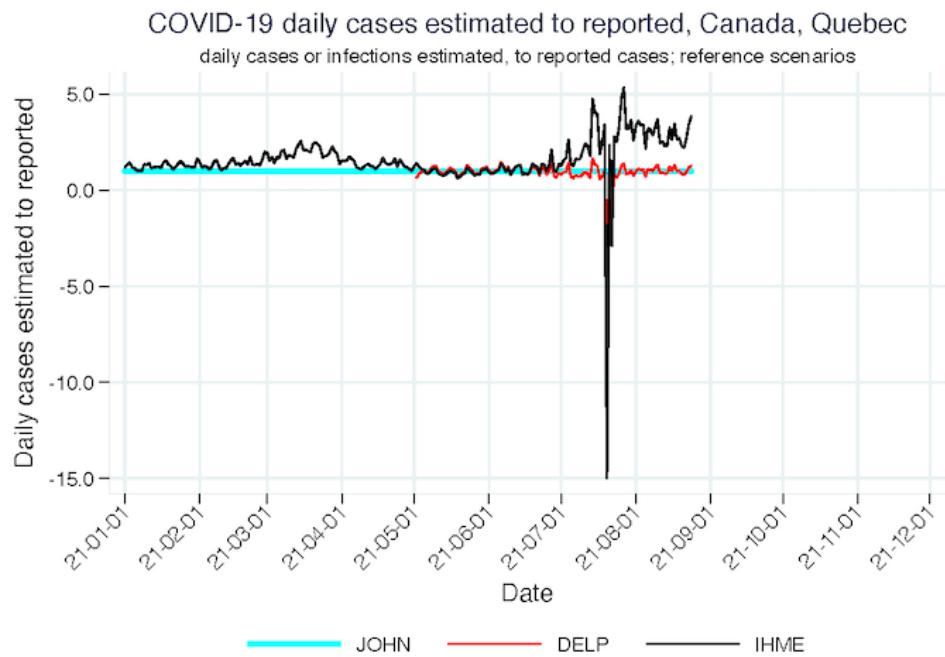
(8) Quebec Hospital-related outcomes, 2021, without IHME Bed need and IMPE Hospital demand



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

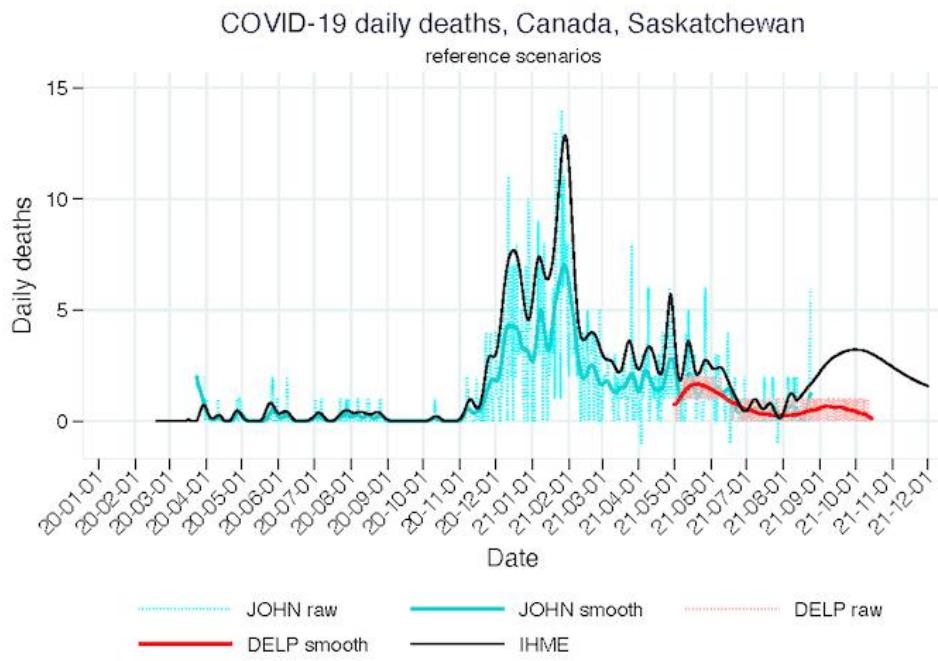


(10) Quebec Daily cases or infections estimated to reported, reference scenarios, 2021

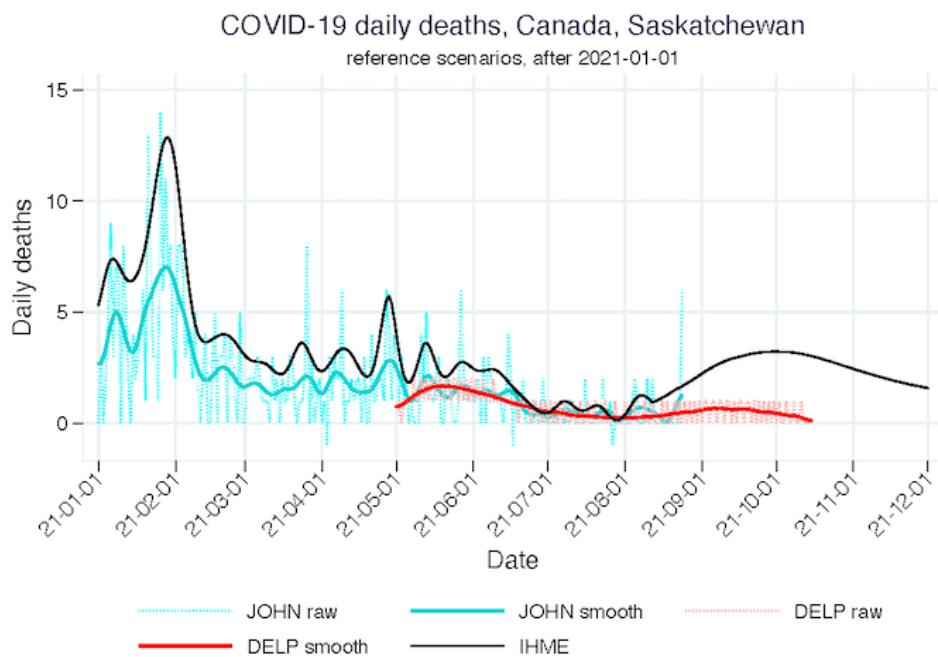


Selected graphs - Saskatchewan

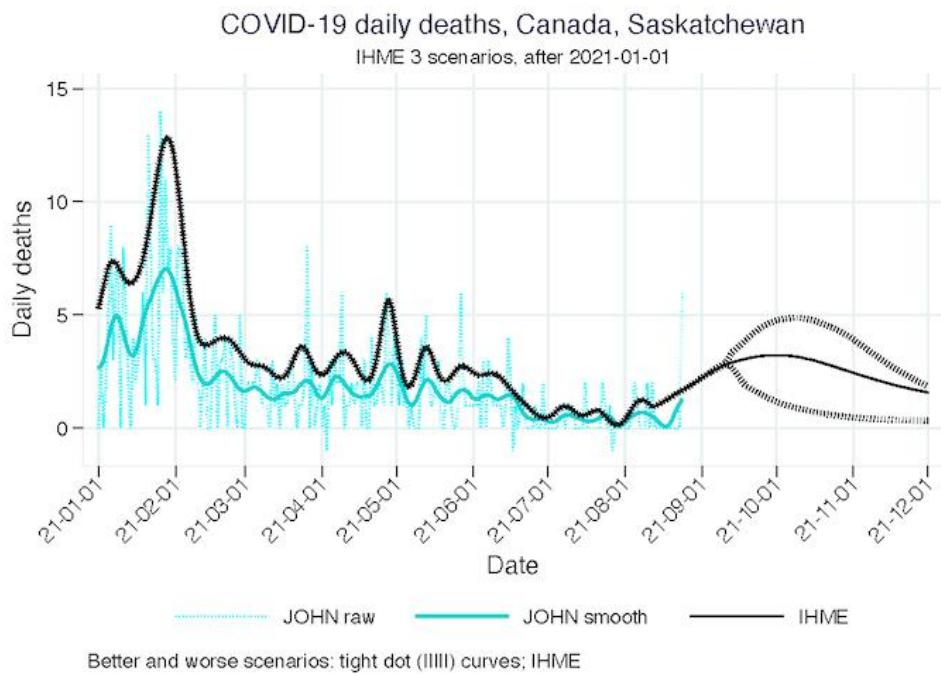
(1) Saskatchewan Daily deaths, reference scenarios, all time



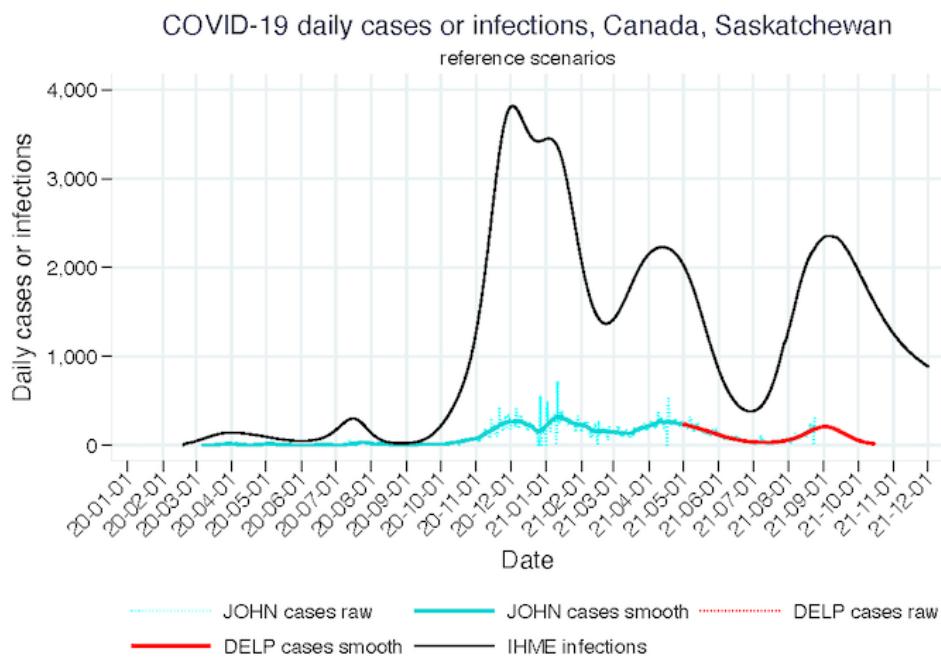
(2) Saskatchewan Daily deaths, reference scenarios, 2021



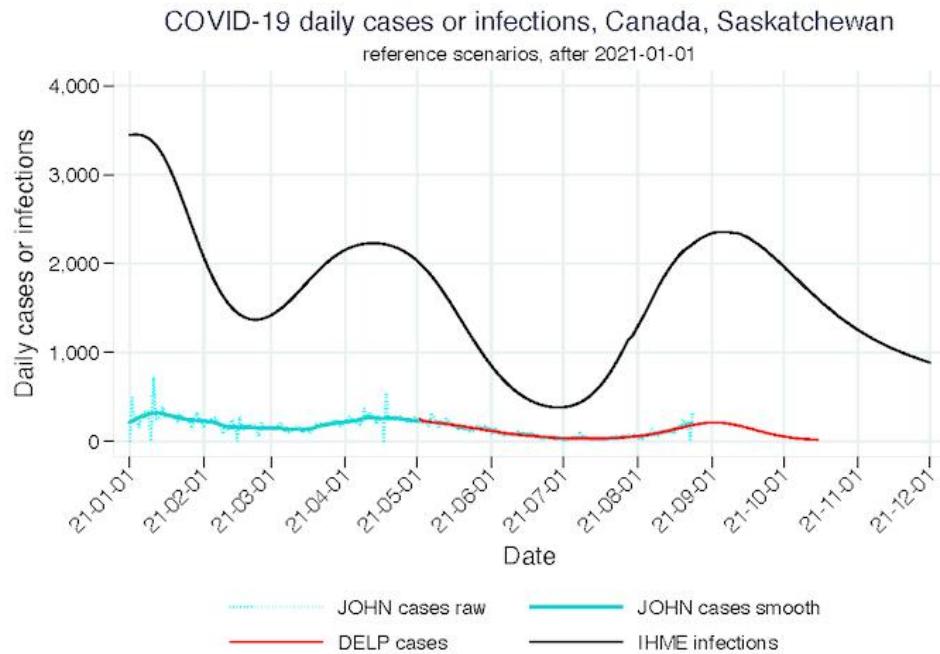
(3) Saskatchewan Daily deaths, 3 scenarios, 2021



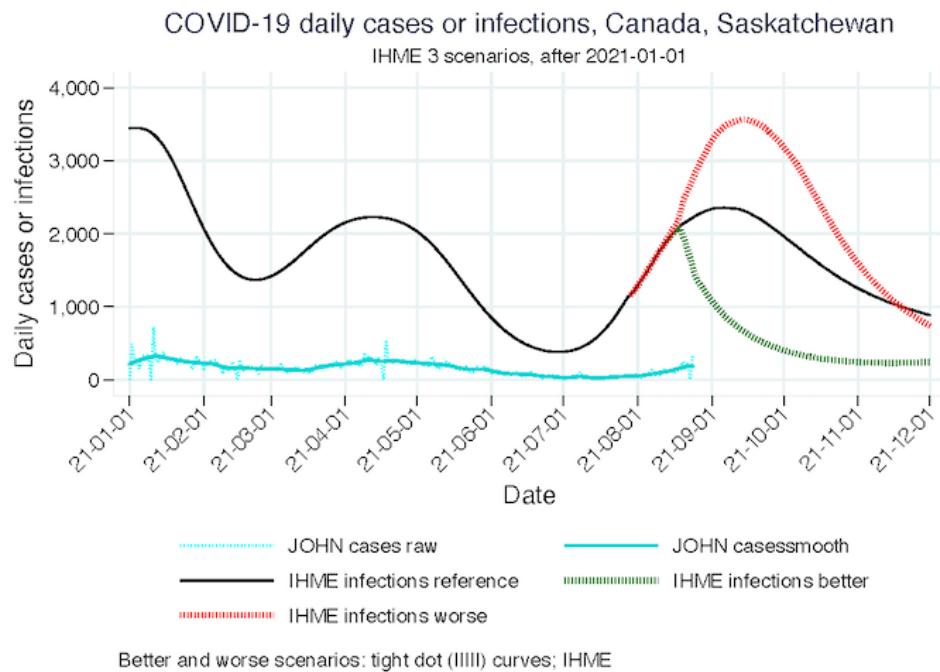
(4) Saskatchewan Daily cases or infections, reference scenarios, all time



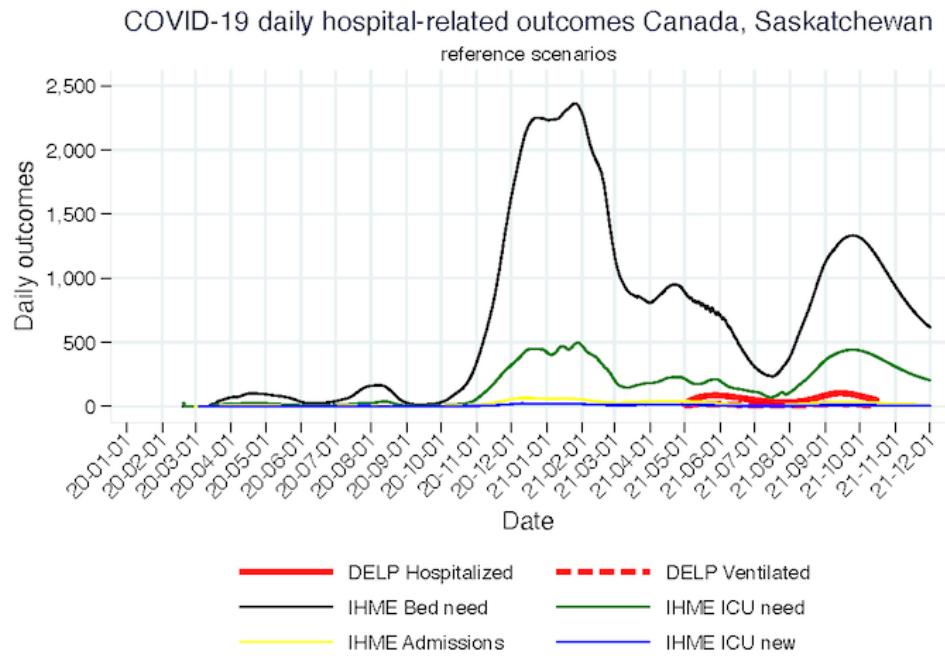
(5) Saskatchewan Daily cases or infections, reference scenarios, 2021



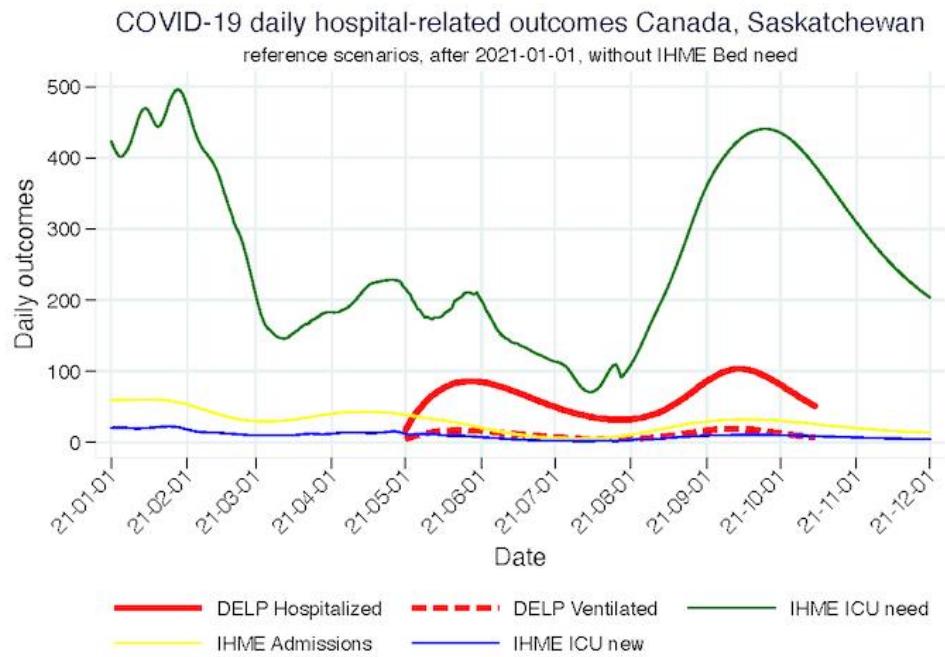
(6) Saskatchewan Daily cases or infections, 3 scenarios, 2021



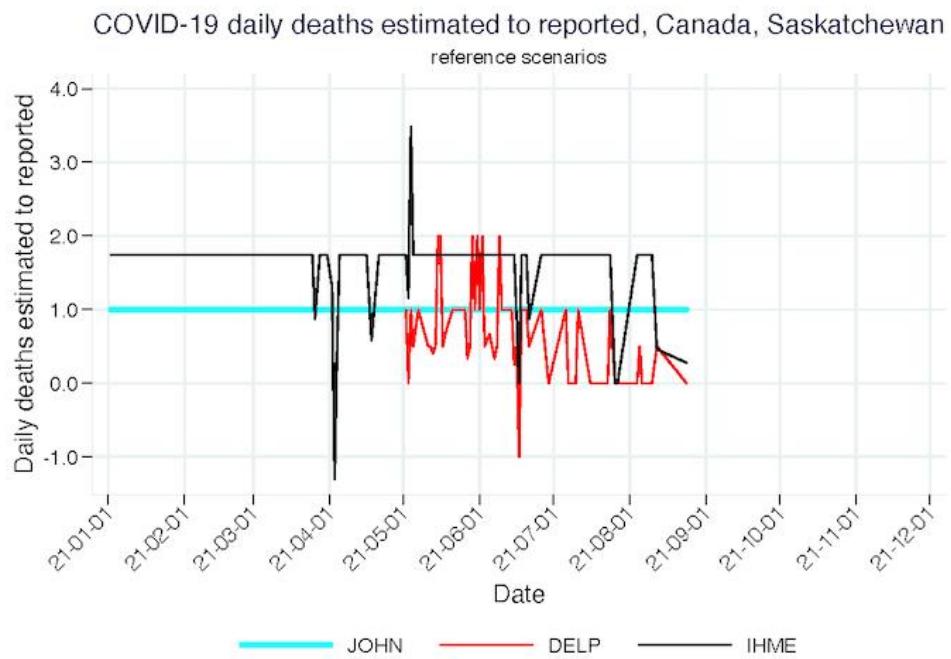
(7) Saskatchewan Hospital-related outcomes, all time



(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

