Aggregating Expert Opinion on COVID-19

tom mcandrew

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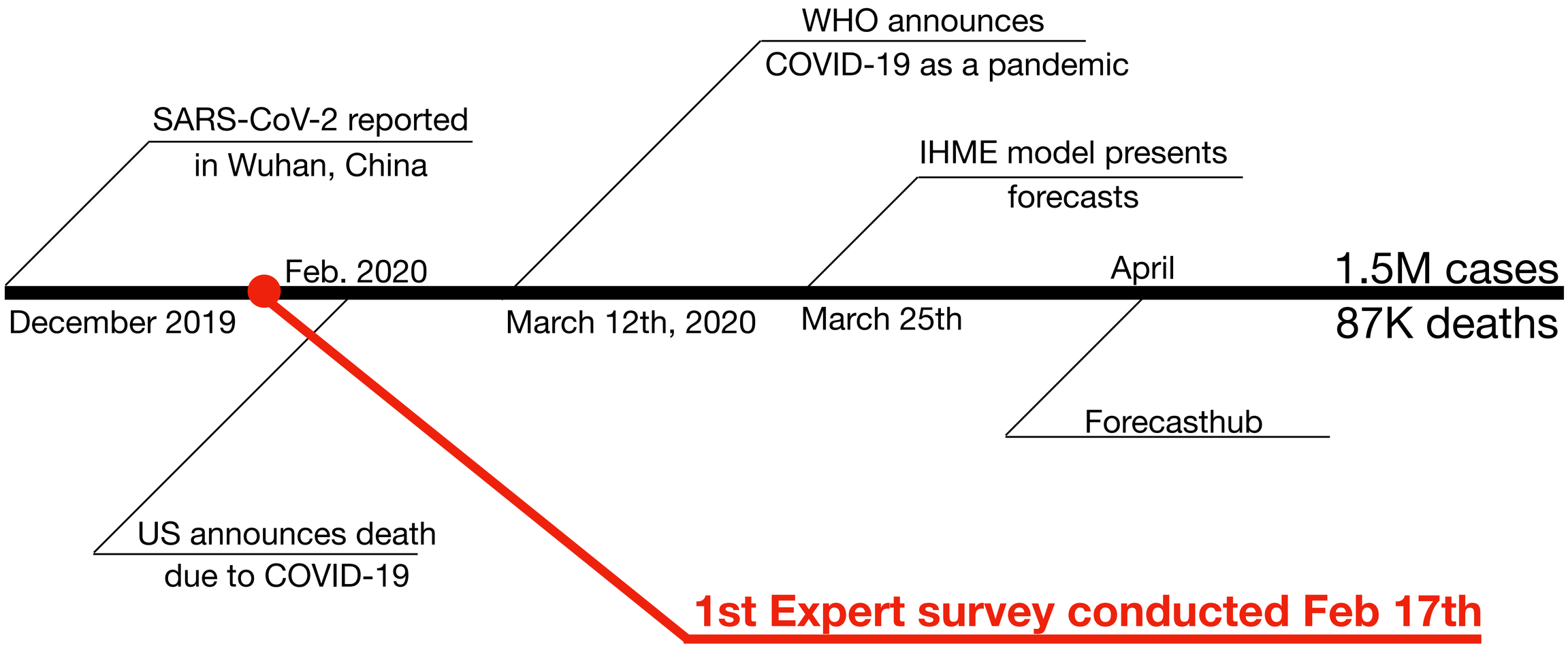
UMass Amherst

School of Public Health & Health Sciences

Impact of COVID-19



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February 17th Questions

Do you think that the confirmed case count of COVID-19 cases in the US reported by WHO on April 1, 2020 will exceed 100?

As reported by the WHO this coming Sunday, 2020-02-23, will the number of cumulative confirmed cases in the US with possible or confirmed transmission outside of China exceed 5?

What is the smallest, most likely, and largest number of all cumulative confirmed cases (including both imported cases and local transmission) in the US the WHO will report this coming Sunday 2020-02-23?

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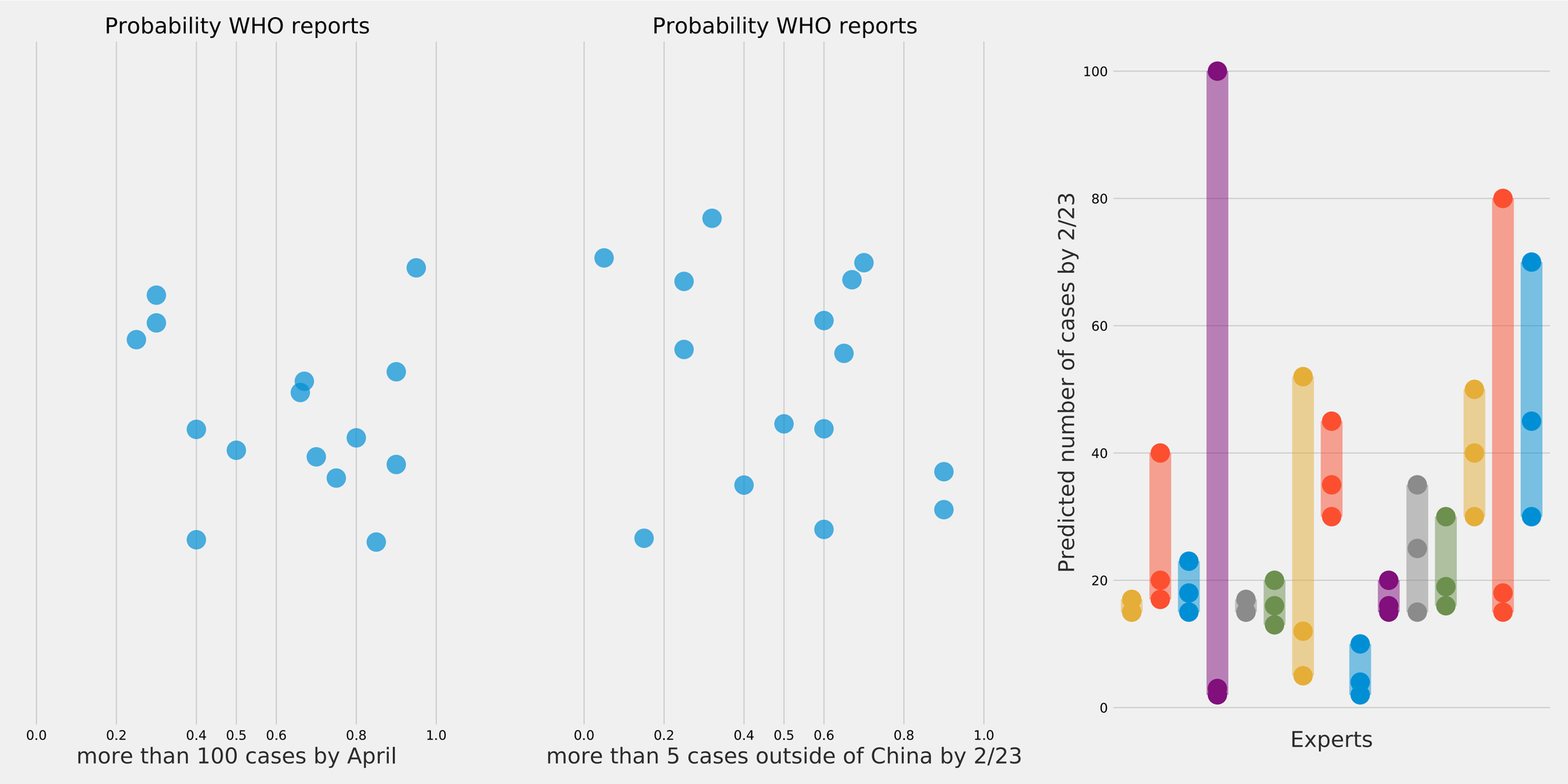
February 17th Answers



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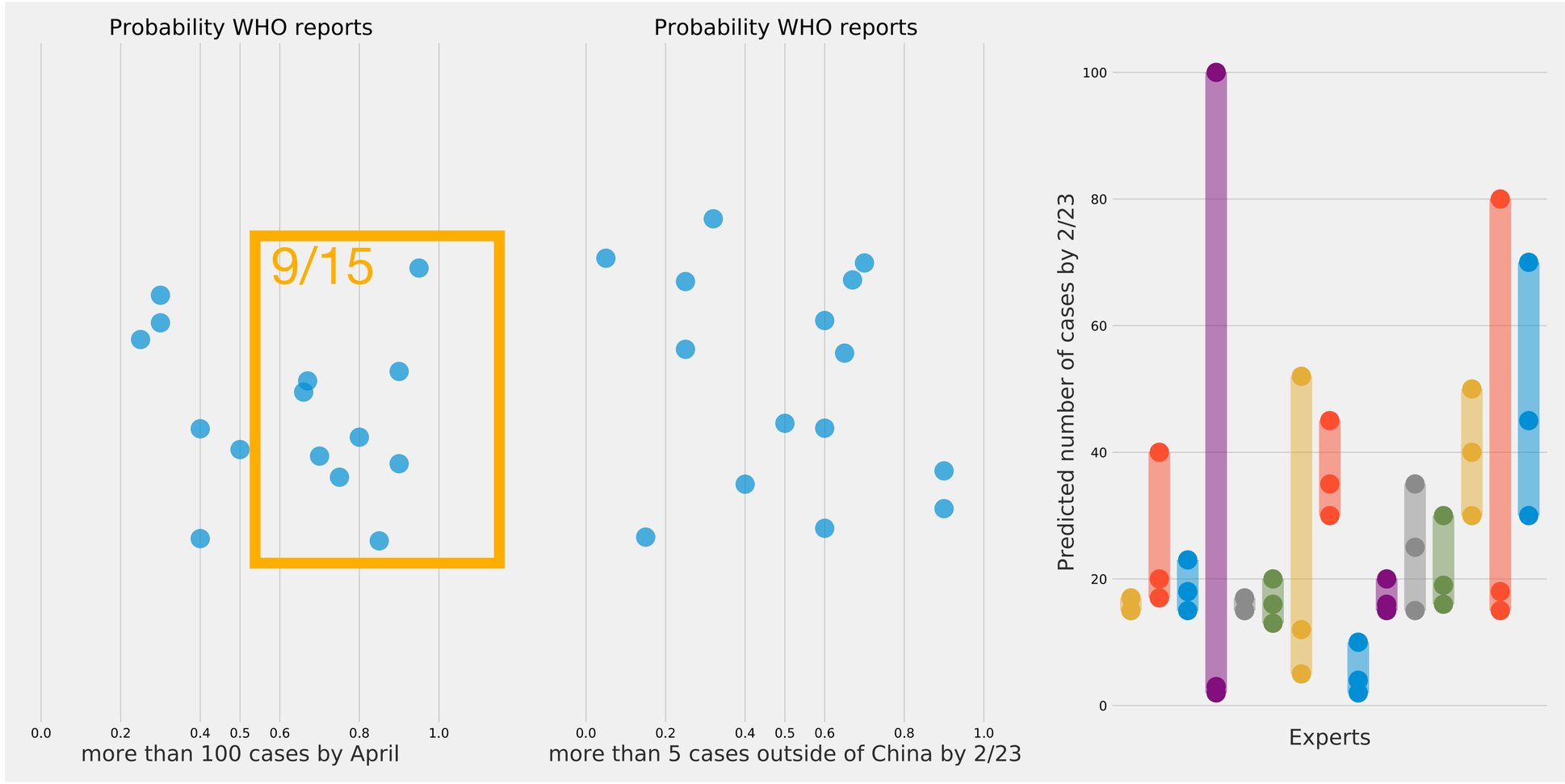

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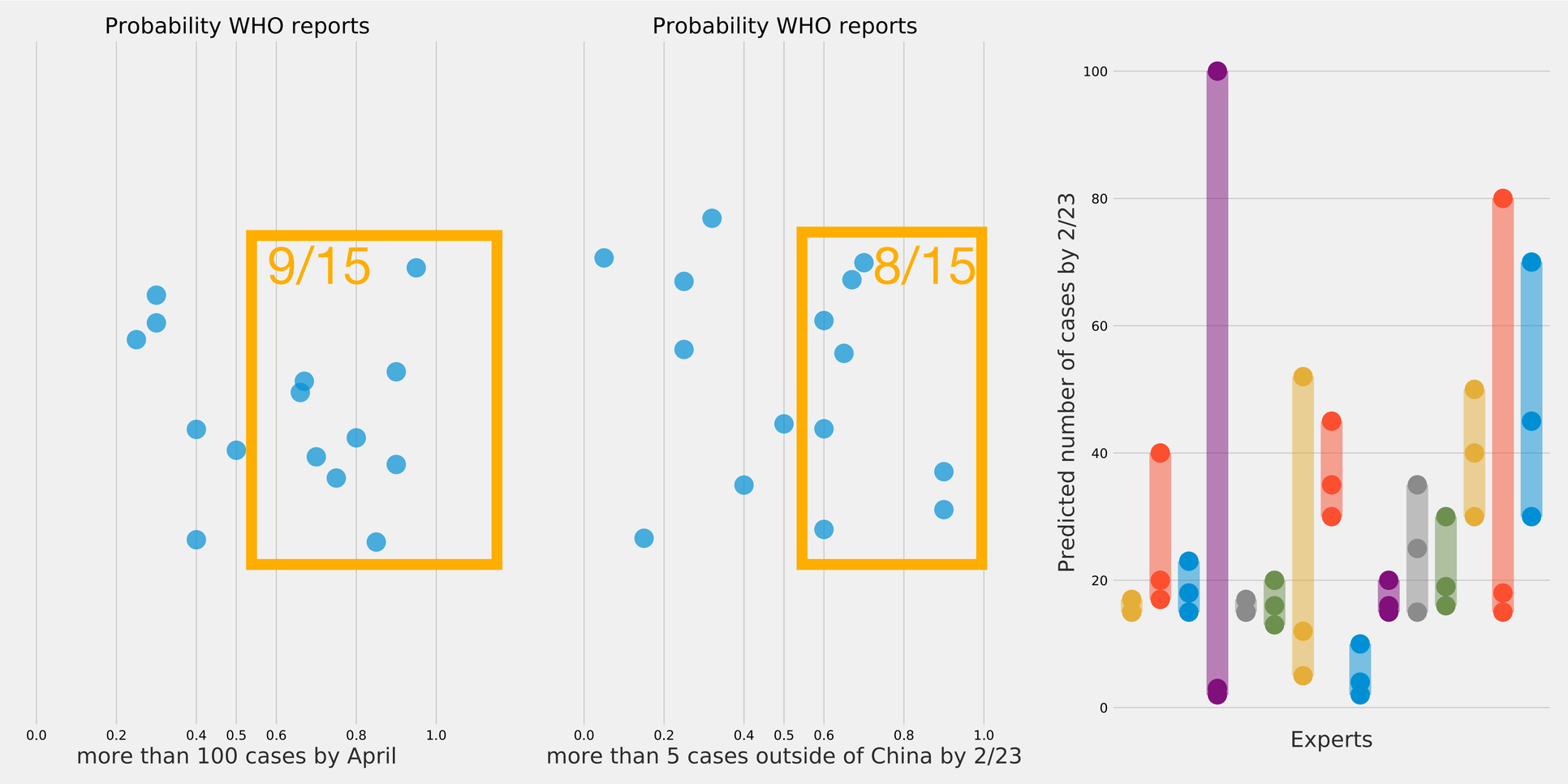

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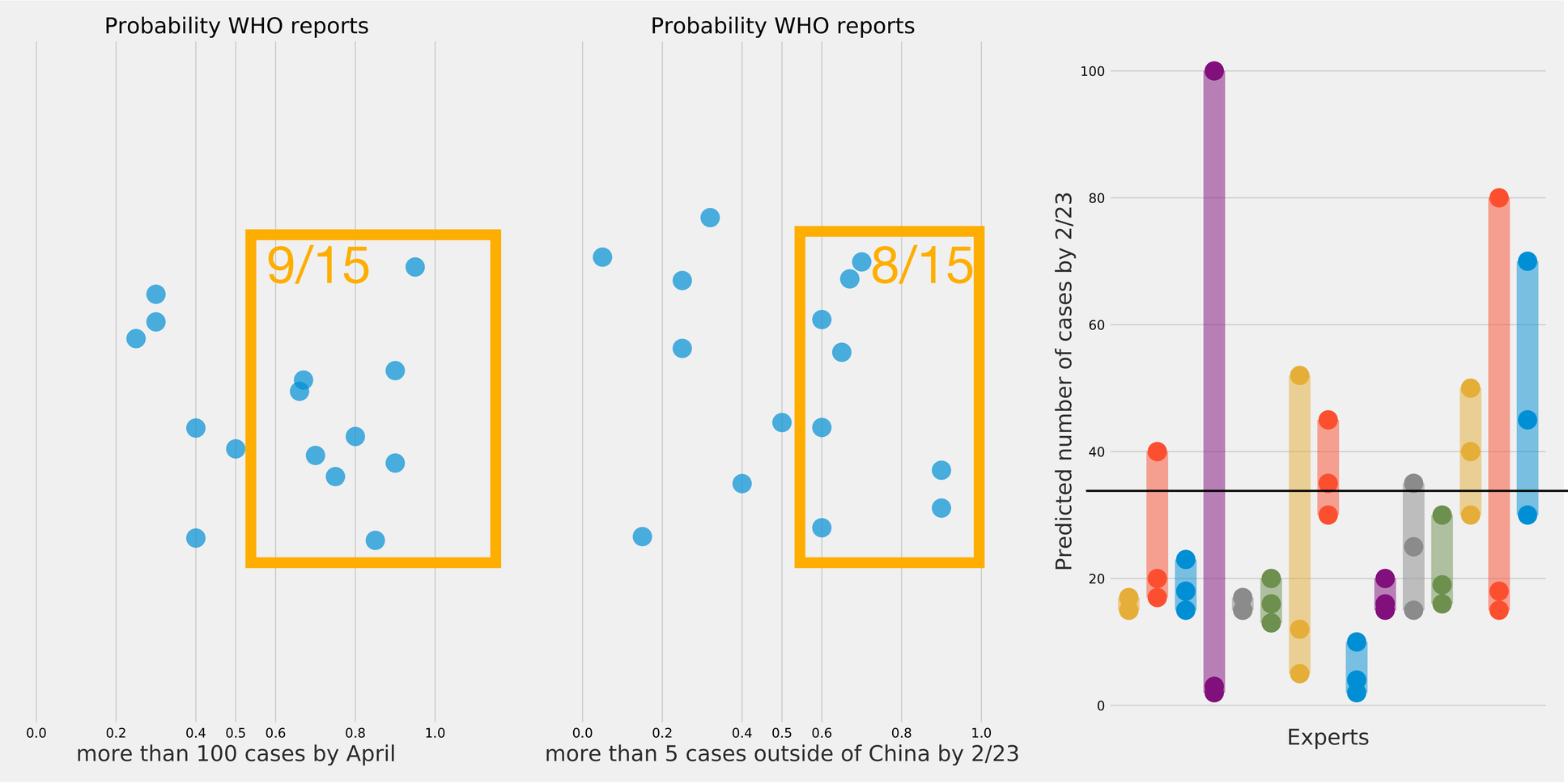
February 17th Answers



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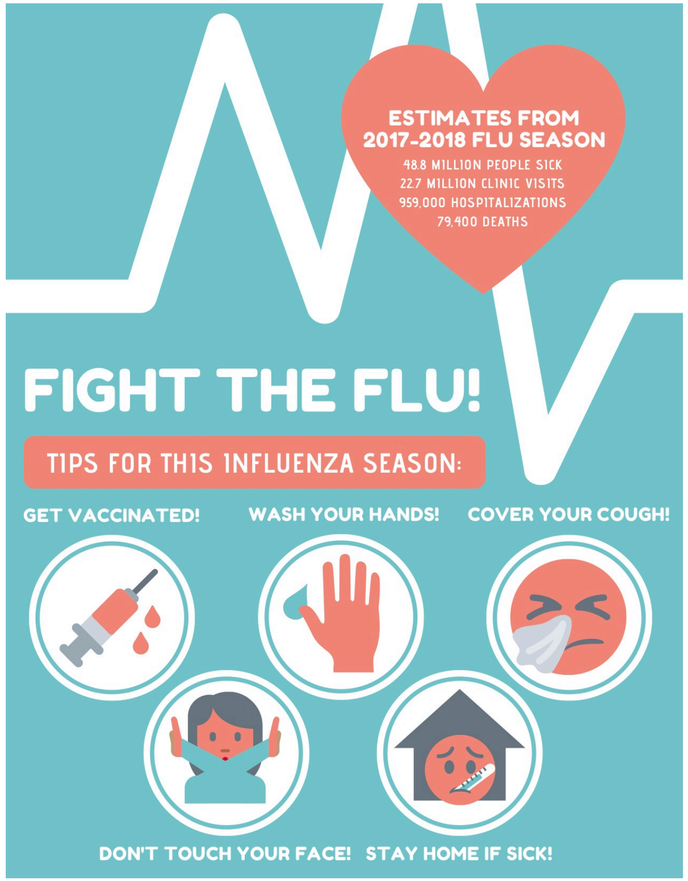
Goal of forecasting

Public Health Officials **actionable information**



Public health campaigns

Vaccine stockpile

Hospital burden

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Past success with human judgment

Human Judgment

Politics

Economics / Marketing

Ecology

Engineering

Infectious Disease

PollyVote

Demand for products

Fish kills and wildlife populations

Reliability analysis

Epicast

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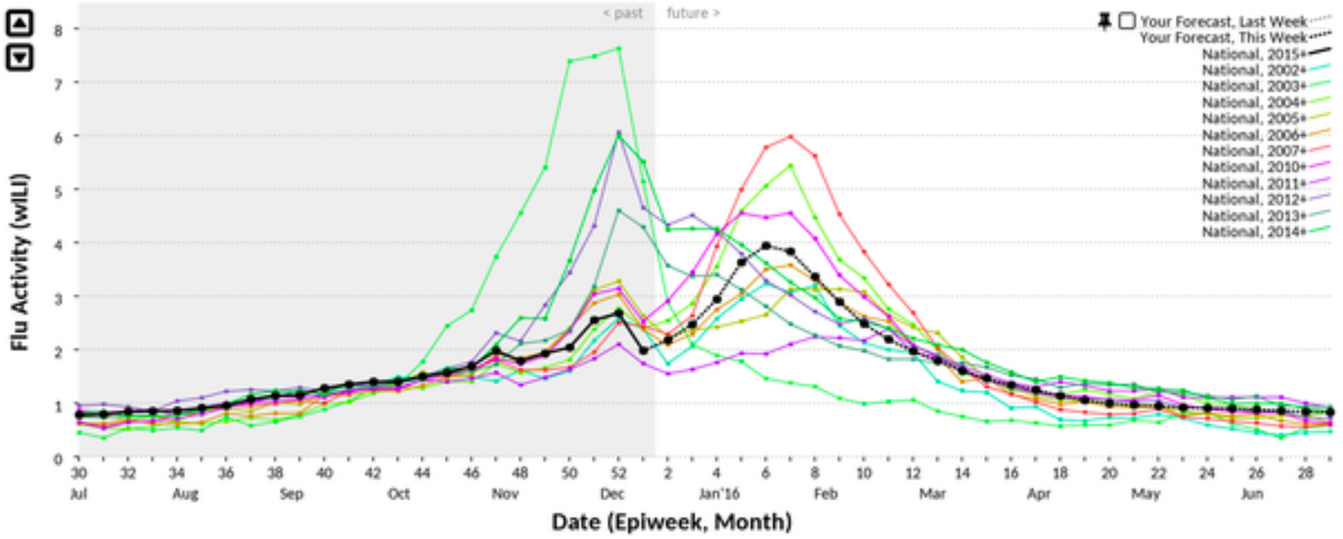

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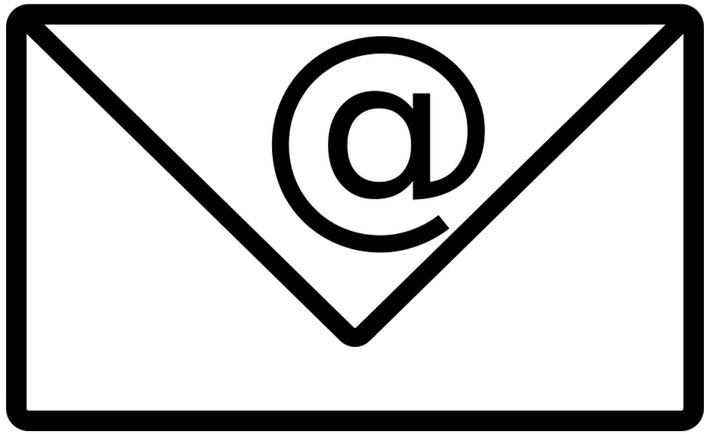
Our expert crowd

An expert was defined as a researcher who has spent a substantial amount of time in their professional career

- designing
- building
- interpreting

models to explain and understand infectious disease dynamics and/or the associated policy implications in human populations.



slack

41 Experts

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Survey logistics

Dear Dr. [redacted]

Thank you for your previous participation in our project to aggregate expert opinion on the future trajectory of the COVID-19 outbreak. Please find attached the results from last week's survey: 20200429 covid19 expert report v0.1

The names of experts who participate more than once will be made public, as will their participation rates, as we believe this will give more credence and transparency to the results. Your answers, as well as those from other experts, will be anonymized and shared publicly and with stakeholders at the US CDC. If you participated in last week's survey, your forecasts and the results from COVID tracker are included below.

We hope you will continue to participate in this brief weekly survey. To fill out this week's survey, please click the personalized link below. The survey will be open until 4:00pm on Tuesday, May 5th.

Follow this link to the Survey:
Take the Survey

Or copy and paste the URL below into your internet browser:
https://umassamherst.co1.qualtrics.com/jfe/form/SV_br2RQO5DFvBHreZ?Q_DL=owMBv8VTFTETBdl_br2RQO5DFvBHreZ_MLRP_55b8lcWrfzm9KxT&Q_CHL=email

Follow the link to opt out of future emails:
Click here to unsubscribe

Thanks for your time and effort,
Tom McAndrew and Nicholas Reich
UMass-Amherst Department of Biostatistics and Epidemiology

Feedback on your forecasting
Please find below your forecasts, and the COVID tracker reported data as of May 3rd, 2020. We hope you find this information useful feedback for your future forecasting efforts.

Personalized email, a social contract and a default

Feedback on forecasting results

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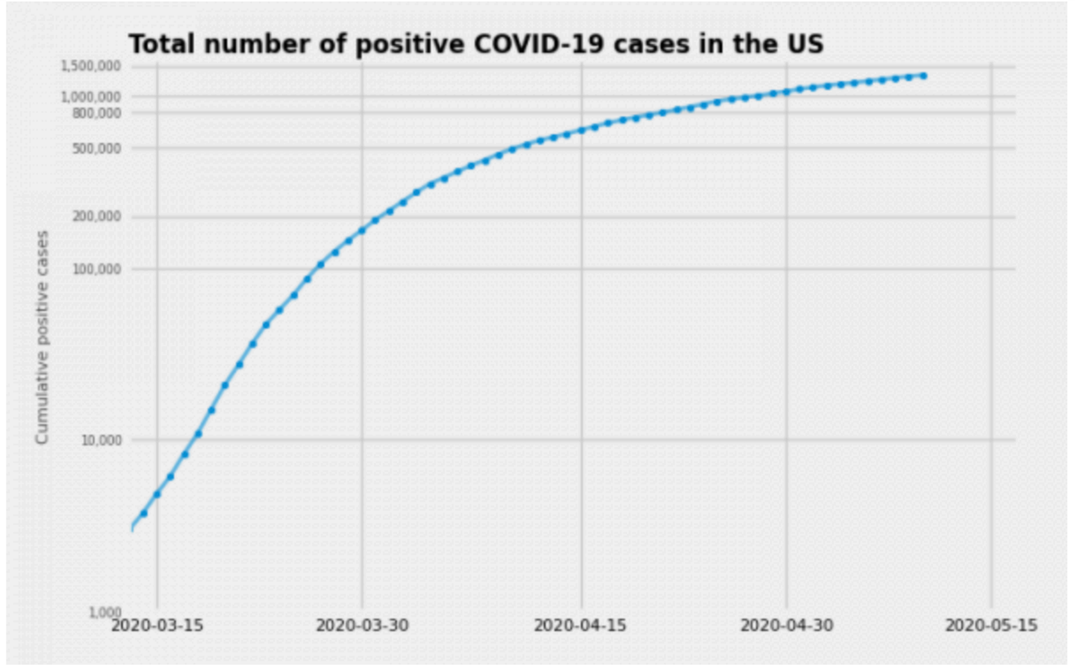
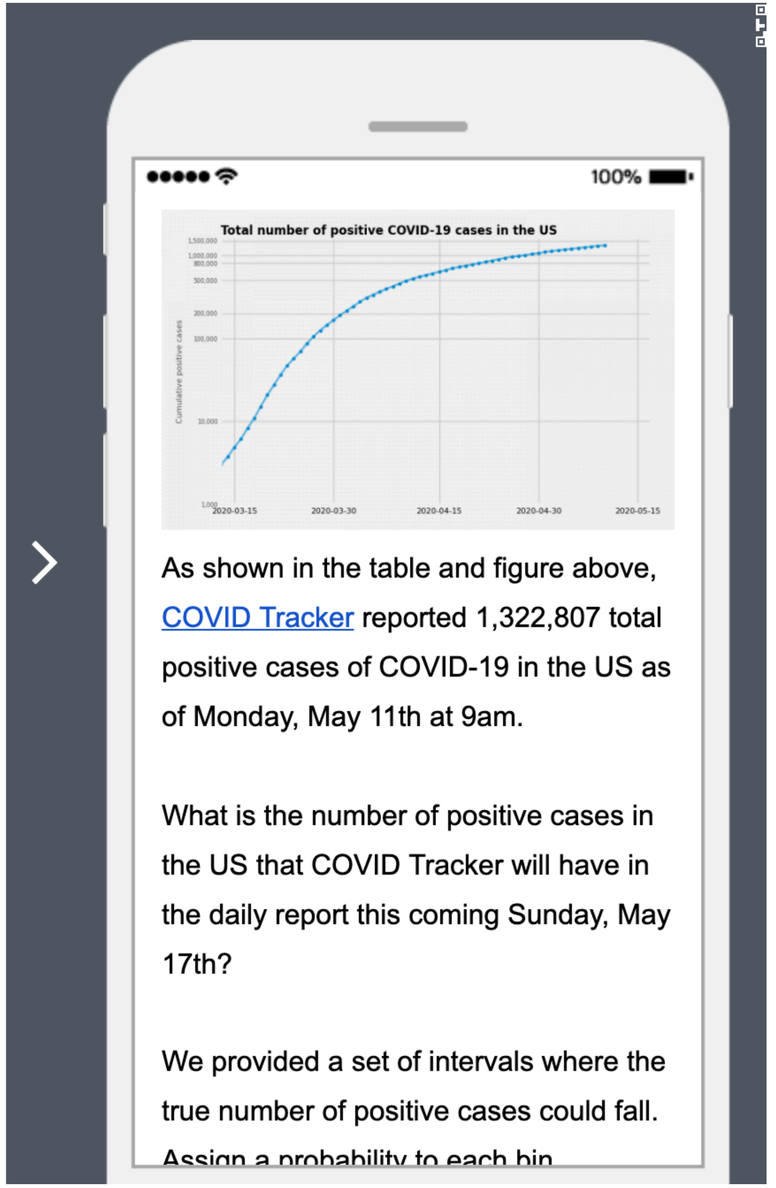
Survey platform



As shown in the table and figure above, COVID Tracker reported 1,322,807 total positive cases of COVID-19 in the US as of Monday, May 11th at 9am.

What is the number of positive cases in the US that COVID Tracker will have in the daily report this coming Sunday, May 17th?

We provided a set of intervals where the true number of positive cases could fall. Assign a probability to each bin corresponding to your belief of how many cases will be reported next Sunday. Each number must be between 0 and 1 and all numbers provided must sum to 1.



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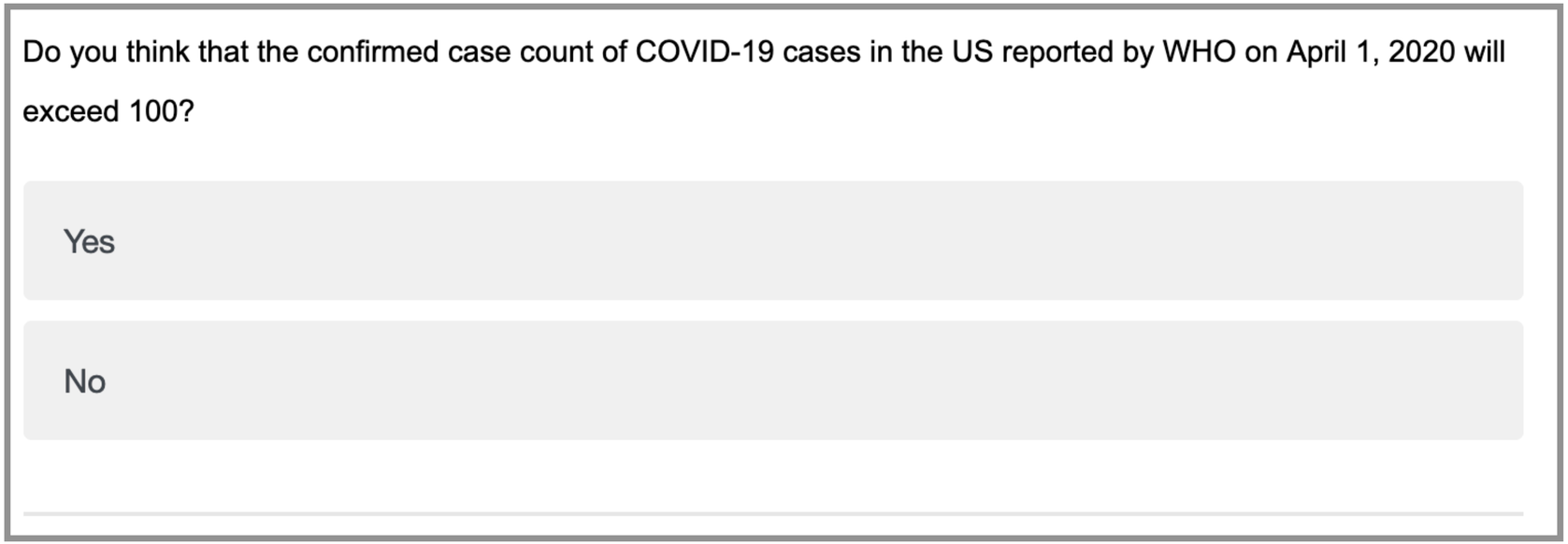
The questions we ask

Categorical

Categorical probabilistic



Triplets

Percentiles

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The questions we ask

Categorical

Categorical probabilistic

Triplets

Percentiles

Which of the next 6 months will see the highest total number of deaths nationwide in the US for COVID-19 illness? Assign a probability to each month representing the likelihood of peak US deaths occurring in that month. Each number must be between 0 and 1 and all numbers provided must sum to 1.

Prob for April	0
Prob for May	0
Prob for June	0
Prob for July	0
Prob for August	0
Prob for September	0
Total	0

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The questions we ask

Categorical

Categorical probabilistic

Triplets

Percentiles

Outside view or Base rate

Relative thinking

Over the last 9 seasons, the CDC estimates that the seasonal death toll from influenza outbreaks has ranged from between 11,000 and 95,000. What are the smallest, most likely, and largest number of deaths that will occur due to COVID-19 by the end of 2020?

Smallest number of deaths	
Most likely number of deaths	
Largest number of deaths	

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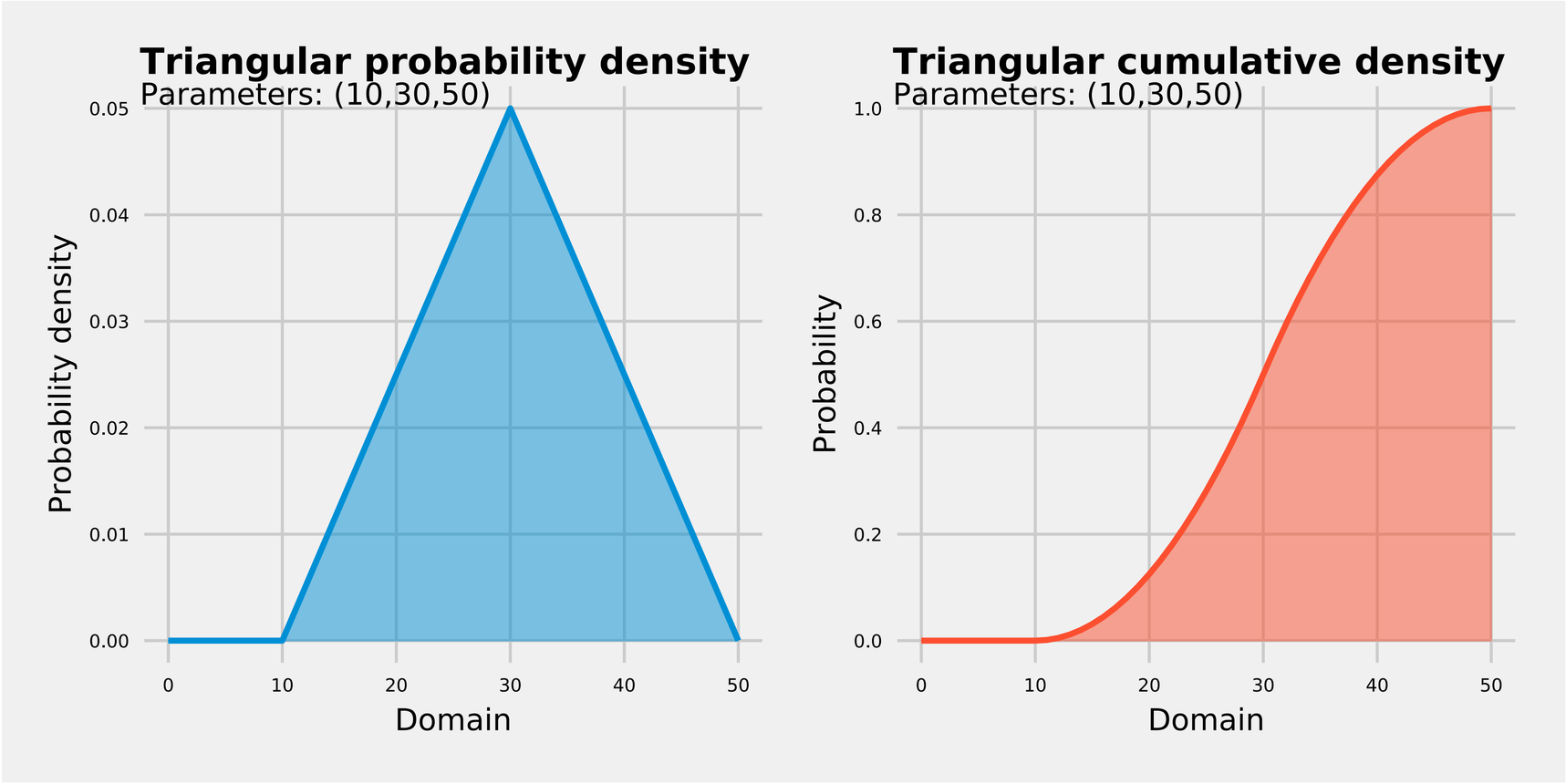
The questions we ask

Categorical

Categorical probabilistic

Triplets

Percentiles



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The questions we ask

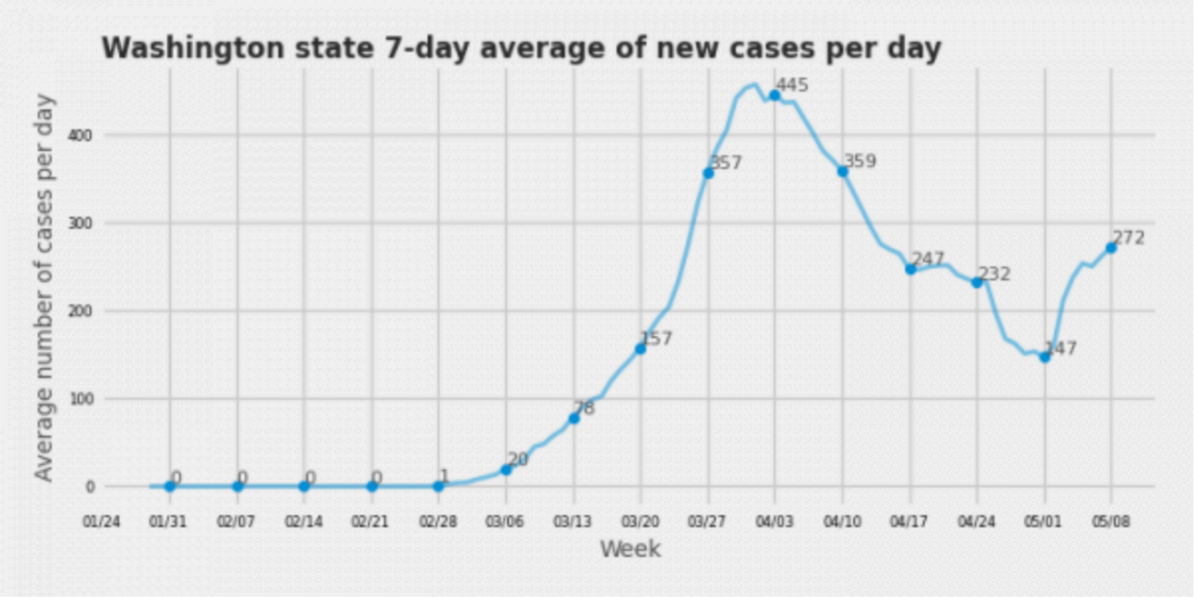
Categorical

Categorical probabilistic

Triplets

Percentiles

Stay-home-orders were extended in Washington state until at least May 31st, and the state entered phase one of four phases of their "Safe Start" reopening on May 4. The first phase allows some recreation and construction to reopen and the state will remain in each phase for a minimum of three weeks. Five counties in Washington, with less than 75,000 residents and no new reported cases in the past three weeks, were allowed to begin phase 2. To aid your forecast, the Washington DOH provides a detailed dashboard here.



Given the information above about current orders in Washington state, and accounting for any updates over the coming weeks, what will be the seven day average of new cases per day for the week of June 1, 2020 through June 7, 2020?

Please report a 10th, 50th and 90th percentile, in other words a 80% confidence interval and a median.

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The questions we ask

Categorical

Categorical probabilistic

Triplets

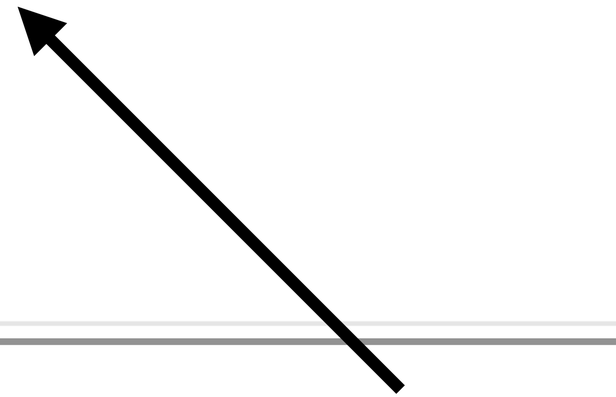
Percentiles

Please report a 10th, 50th and 90th percentile, in other words a 80% confidence interval and a median.

10th percentile
50th percentile (median)
90th percentile

If an accelerated restart in Washington allowed all counties to enter Phase 2 on May 16, 2020 (and was not rescinded before June 1, 2020), what will be the seven day average of new cases per day for the week of June 1, 2020 through June 7, 2020?

10th percentile
50th percentile (median)
90th percentile



Counter-factual

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Predictions

Deaths

Hospitalizations

Total infections

Confirmed cases

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Predictions

Deaths

Hospitalizations

Total infections

Confirmed cases

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Predictions

Over the last 9 seasons, the CDC estimates that the seasonal death toll from influenza outbreaks has ranged from between 11,000 and 95,000. What are the smallest, most likely, and largest number of deaths that will occur due to COVID-19 by the end of 2020?

Triplet

Smallest number of deaths	
Most likely number of deaths	
Largest number of deaths	

Pct

5th percentile	
50th percentile (median)	
95th percentile	

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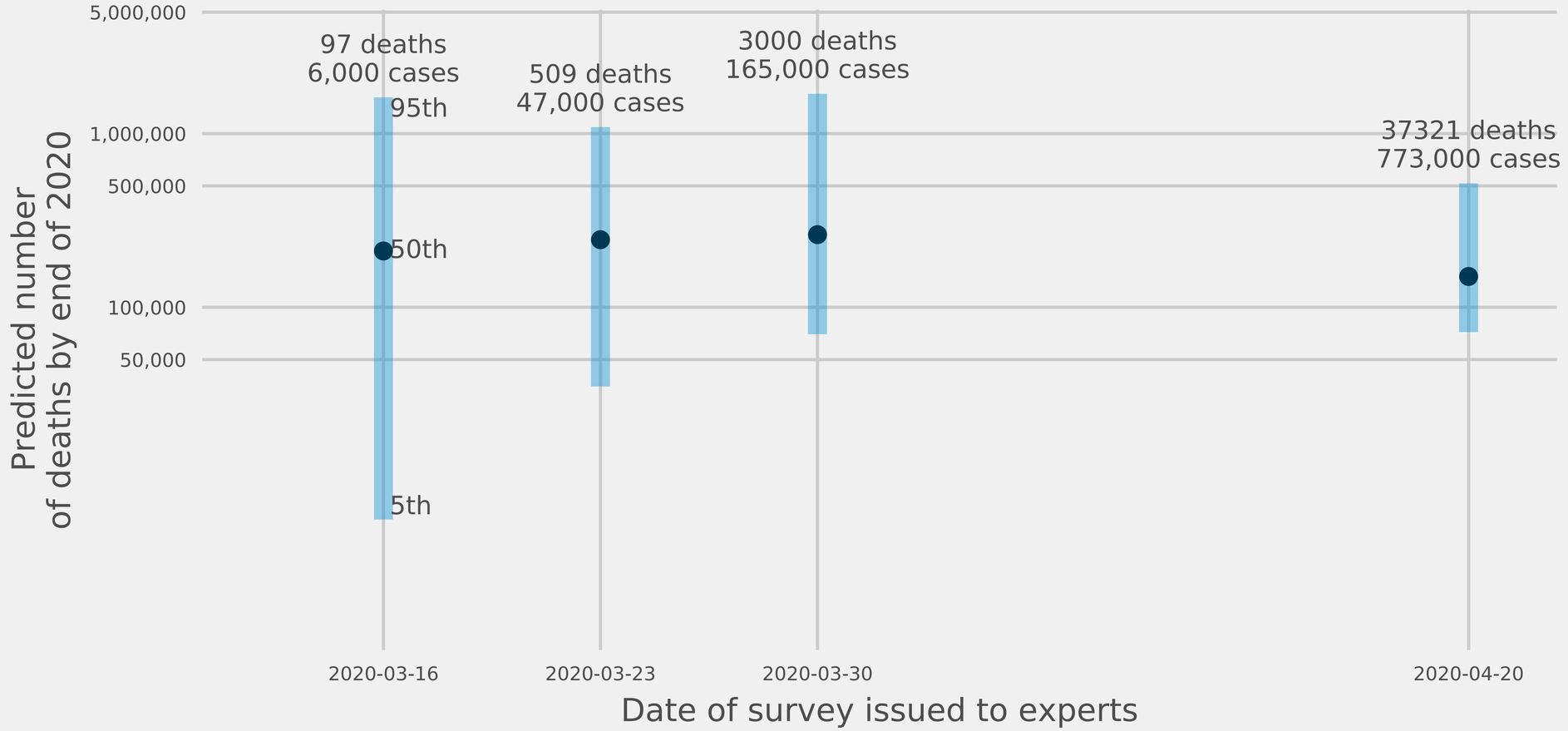
Predictions



Mar 23rd: Varied social distancing practices begin.

Mar 16th: The number of new cases begins to show signs of exponential growth. Foreign travel is restricted.

Apr 12th-15th: The US reports 22,000 deaths, surpassing Italy's death toll. The White House signals social distancing guidelines may be relaxed.

150K - 250K deaths by the end of 2020

Stable predictions

Broad uncertainty

Different question format results in different prediction

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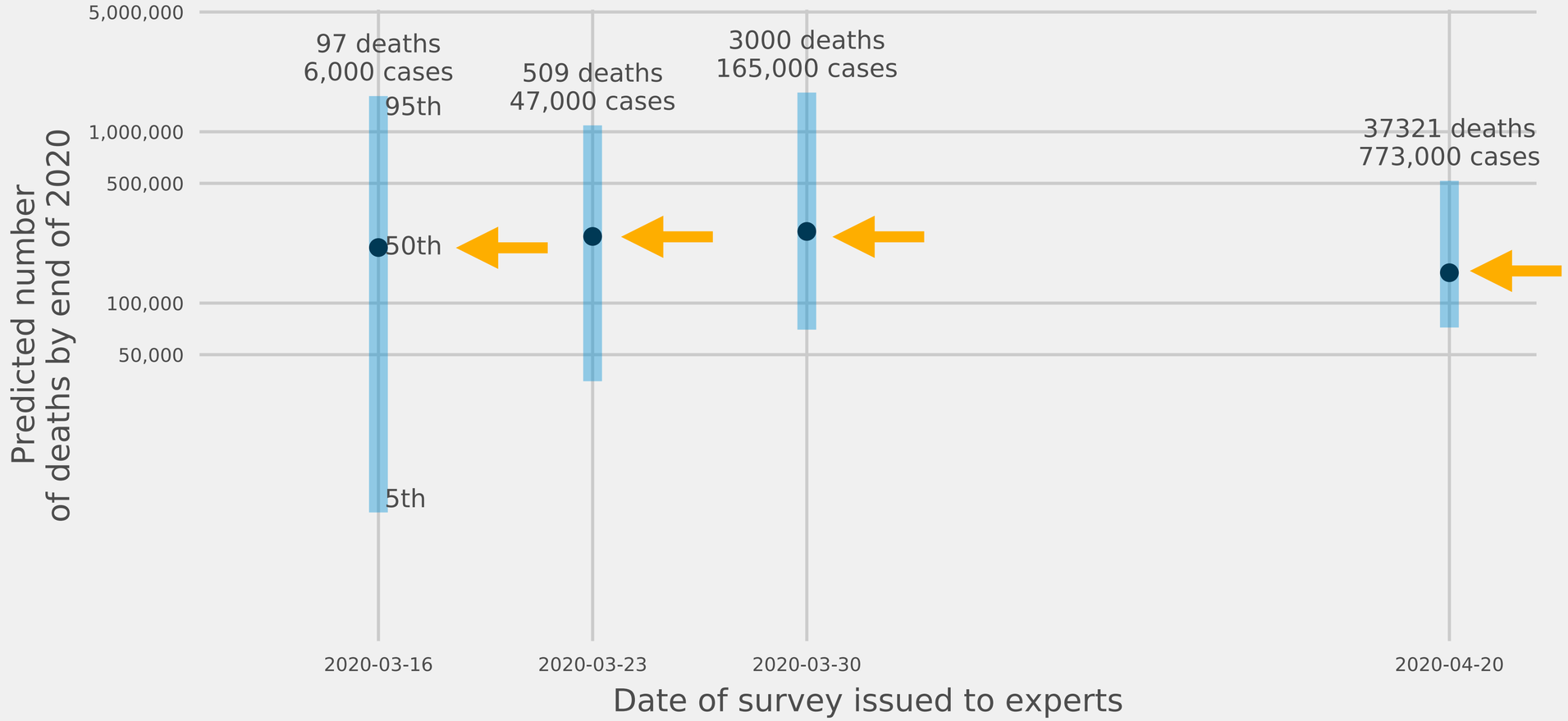
Predictions



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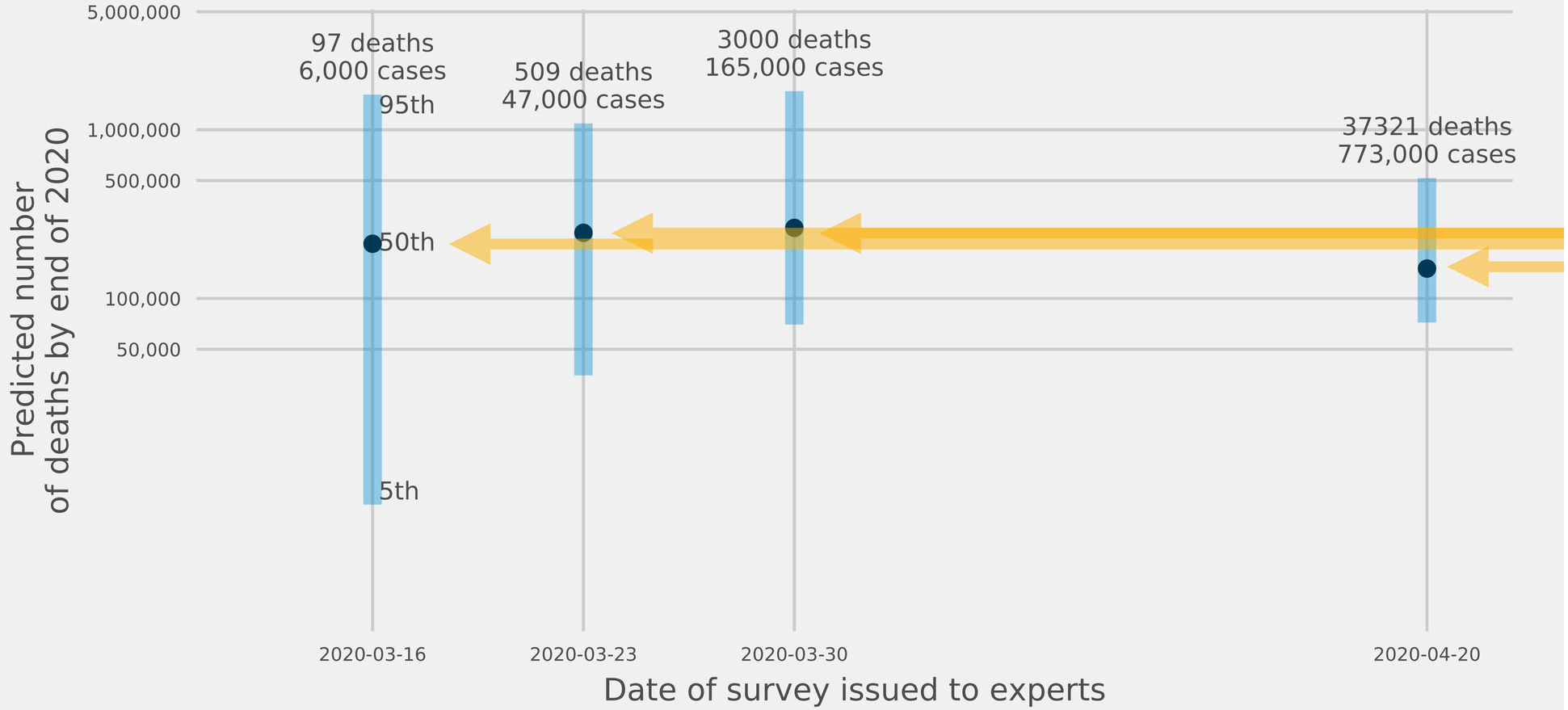

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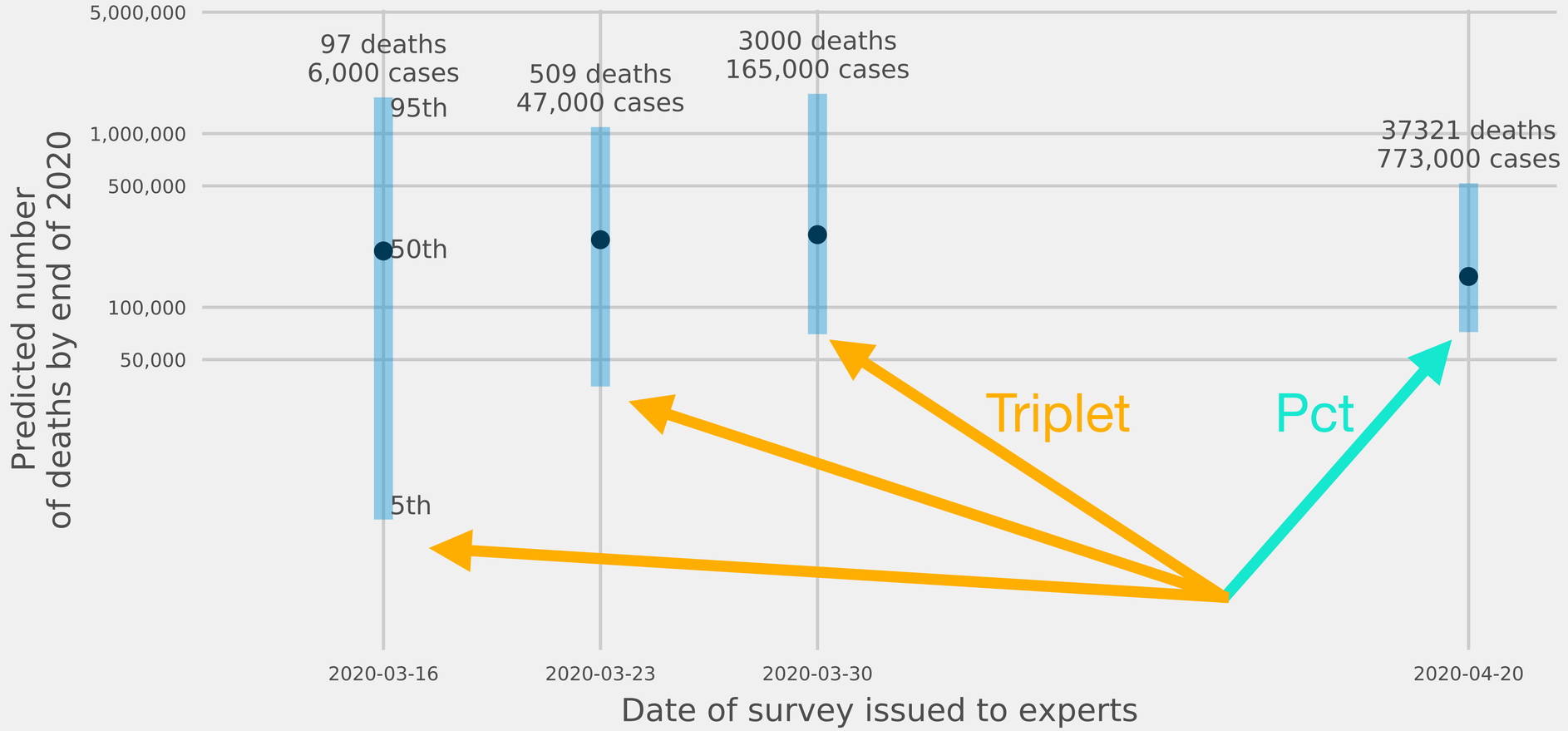

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Predictions

Deaths

Hospitalizations

Total infections

Confirmed cases

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Predictions

Which of the next 6 months will see the highest total number of hospitalizations nationwide in the US for COVID-19 illness? Assign a probability to each month representing the likelihood of peak US hospitalizations occurring in that month. Each number must be between 0 and 1 and all numbers provided must sum to 1.

Prob for March	0
Prob for April	0
Prob for May	0
Prob for June	0
Prob for July	0
Prob for August	0
Total	0

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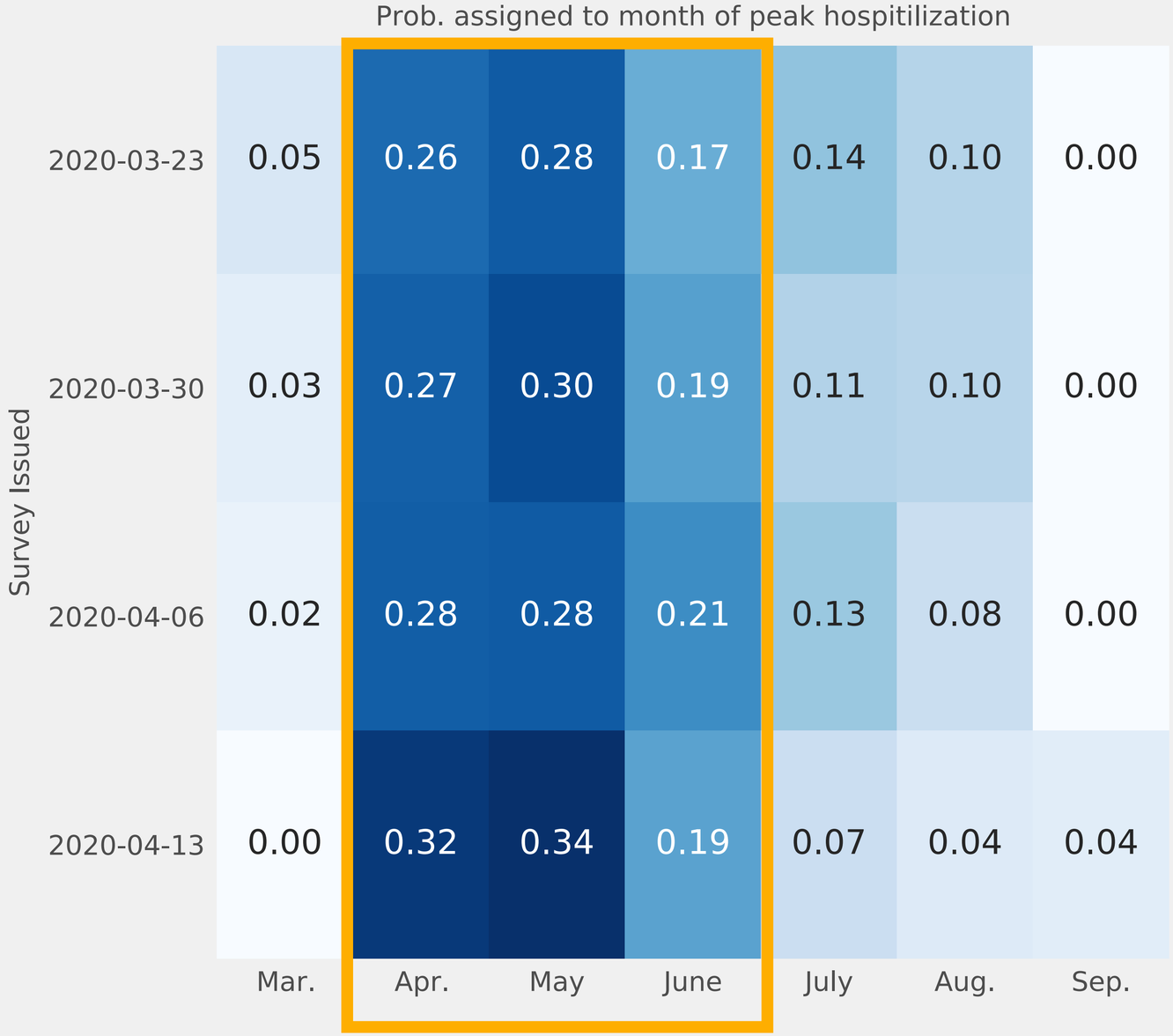
Predictions



Mar. 23rd: NYC mayor says hospitals have only enough supplies for one week.

Mar. 30th: CMS announces regulatory waiver to better equip hospitals.

April 6th: US dept of Health and Human Services report 3 out of every 4 hospitals have COVID-19 patients.

April 15th: NYC congressional delegation asks for larger stimulus aid

Peak hosps to occur between April and June

Probability assigned over each survey is similar

Appreciable probability assigned to a later peak

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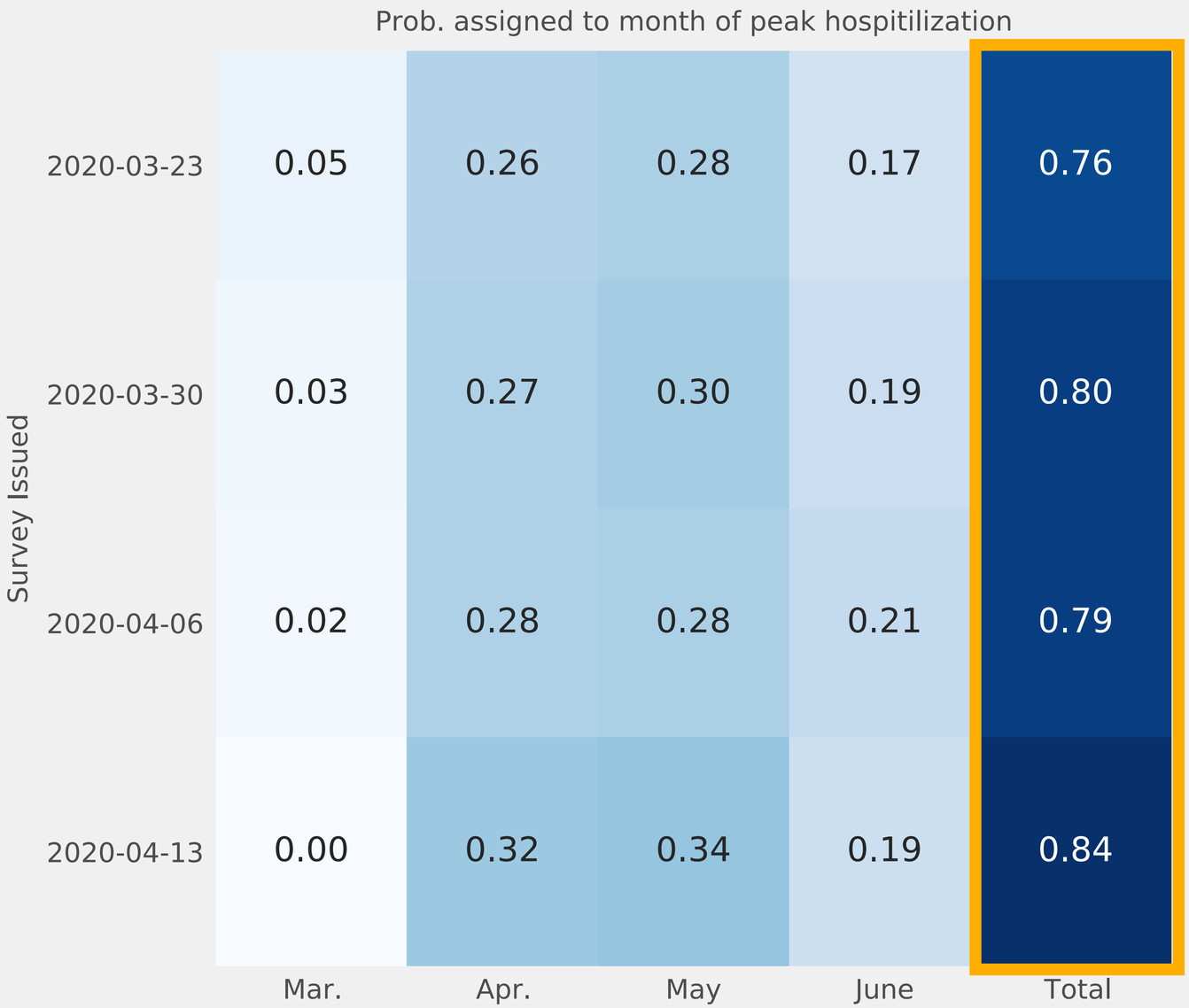
Predictions



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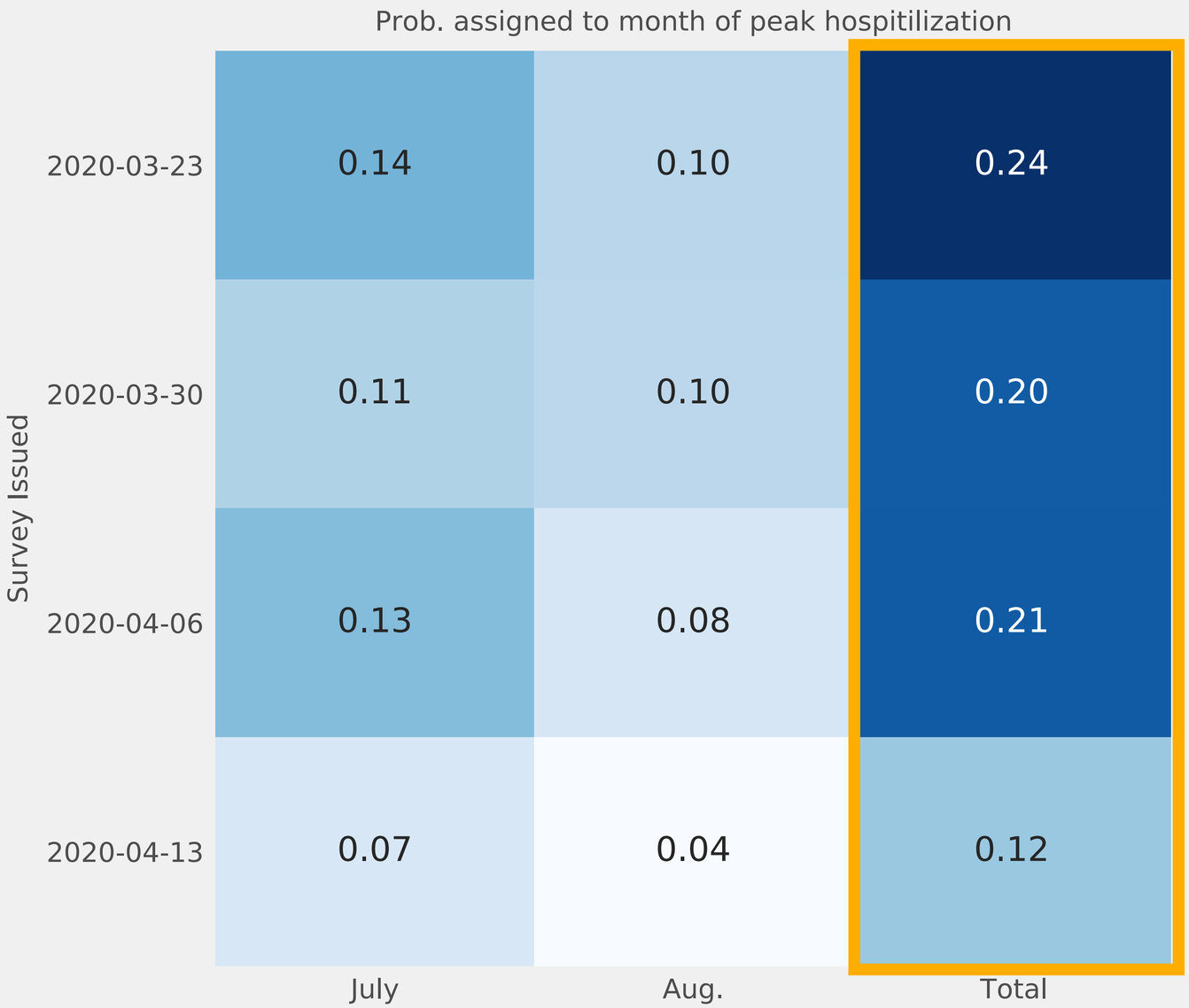

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Predictions

Deaths

Hospitalizations

Total infections

Confirmed cases

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Predictions

As of Monday, March 9th what percentage of all COVID-19 infections in the US (resulting in either symptomatic or asymptomatic illness) do you believe were reported as confirmed cases in the table above? Please indicate the smallest, most likely, and largest percentages below, as values between 0 and 100.

Smallest percentage	
Most likely percentage	
Largest percentage	

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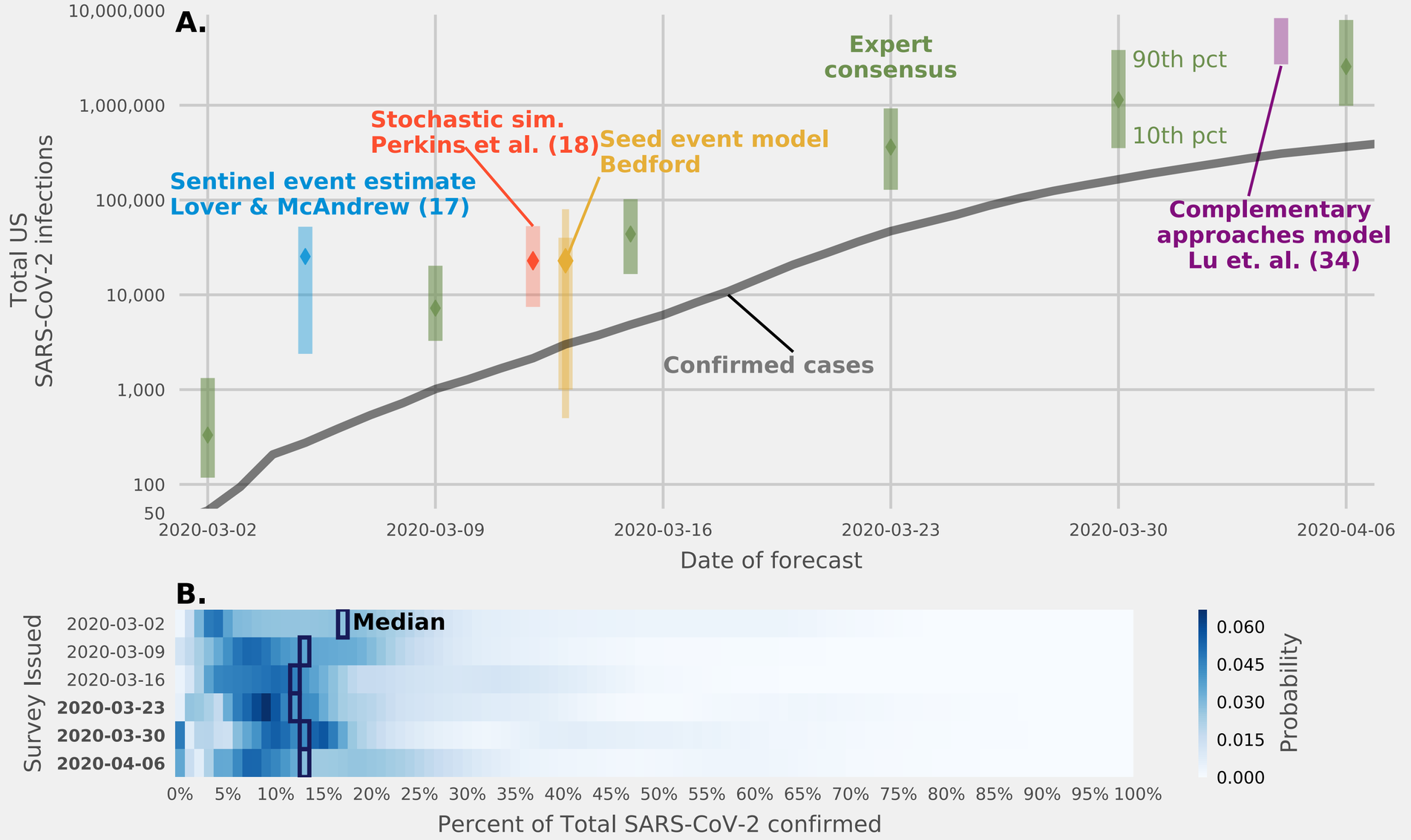
Predictions



Expert and model predictions agree

Experts predict many more total infections than confirmed infections

Their estimates of the fraction of detected cases is consistent

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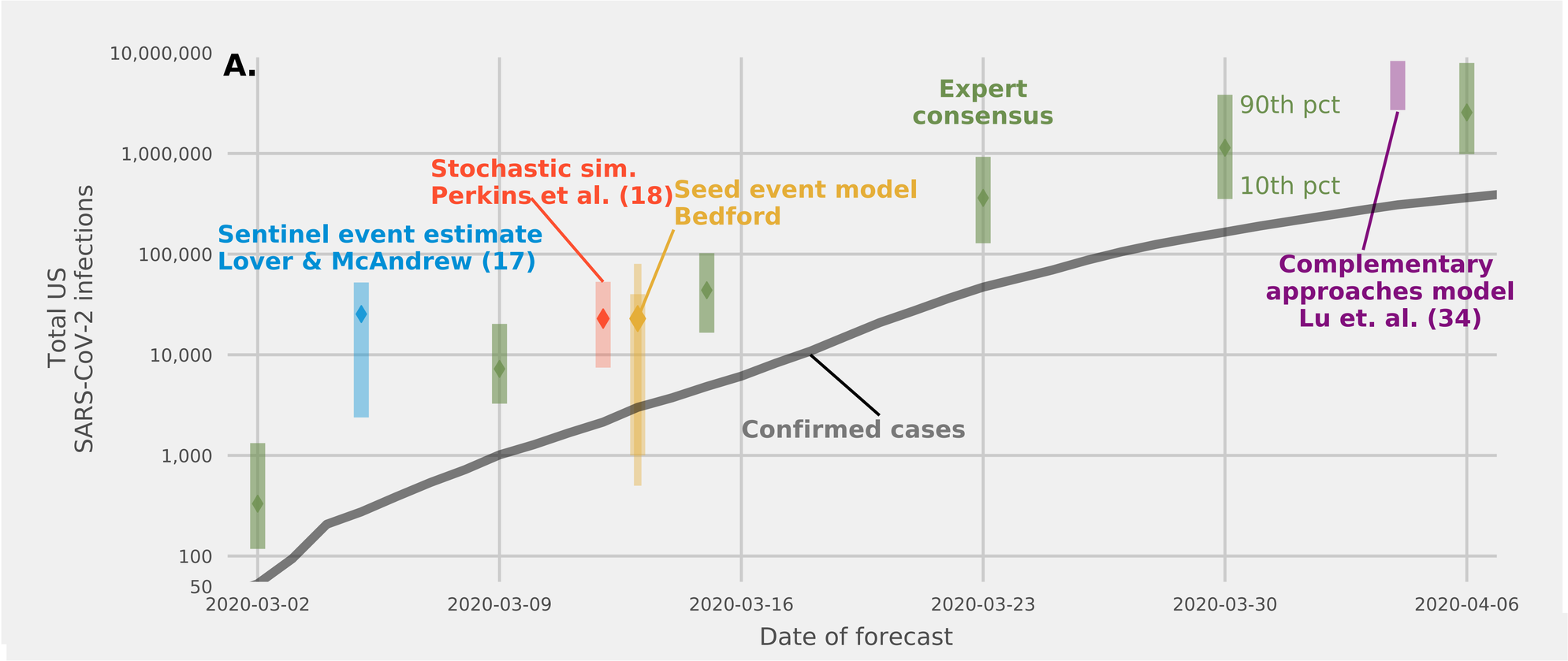
Predictions



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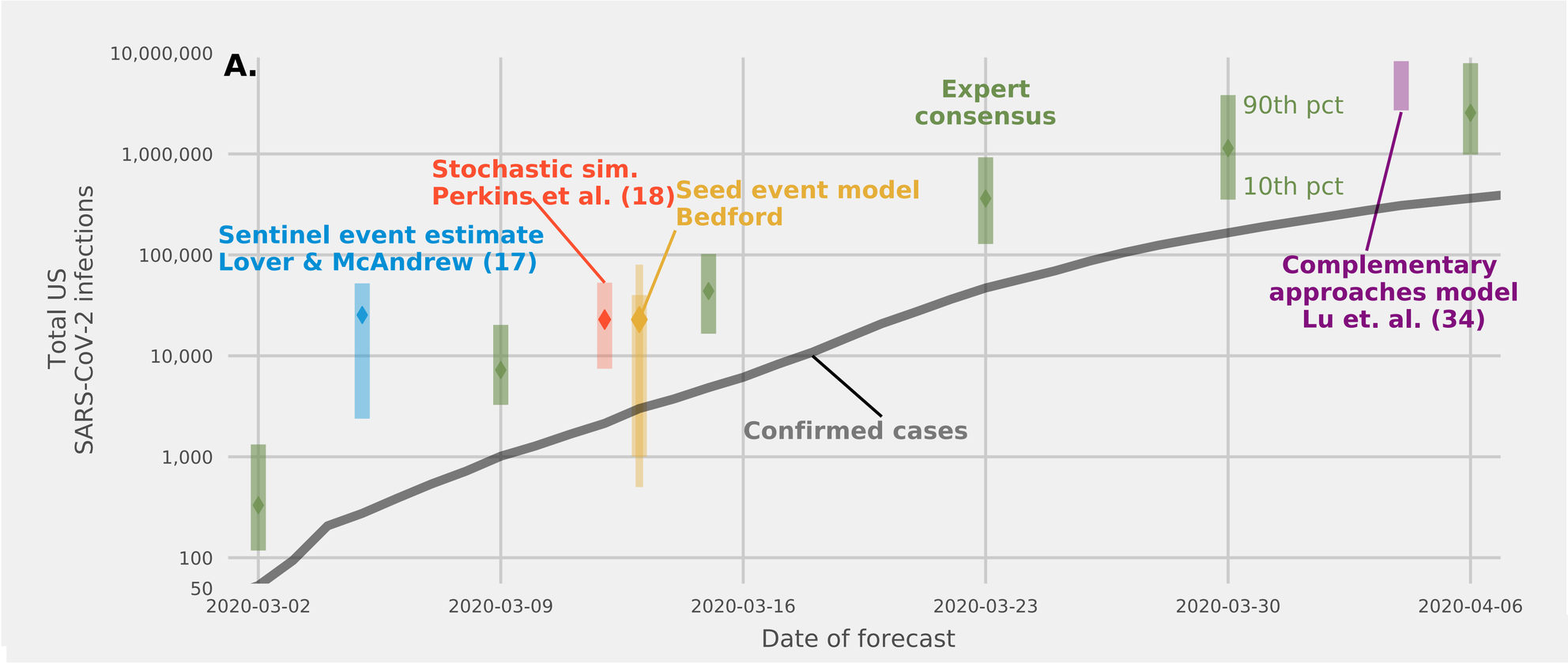

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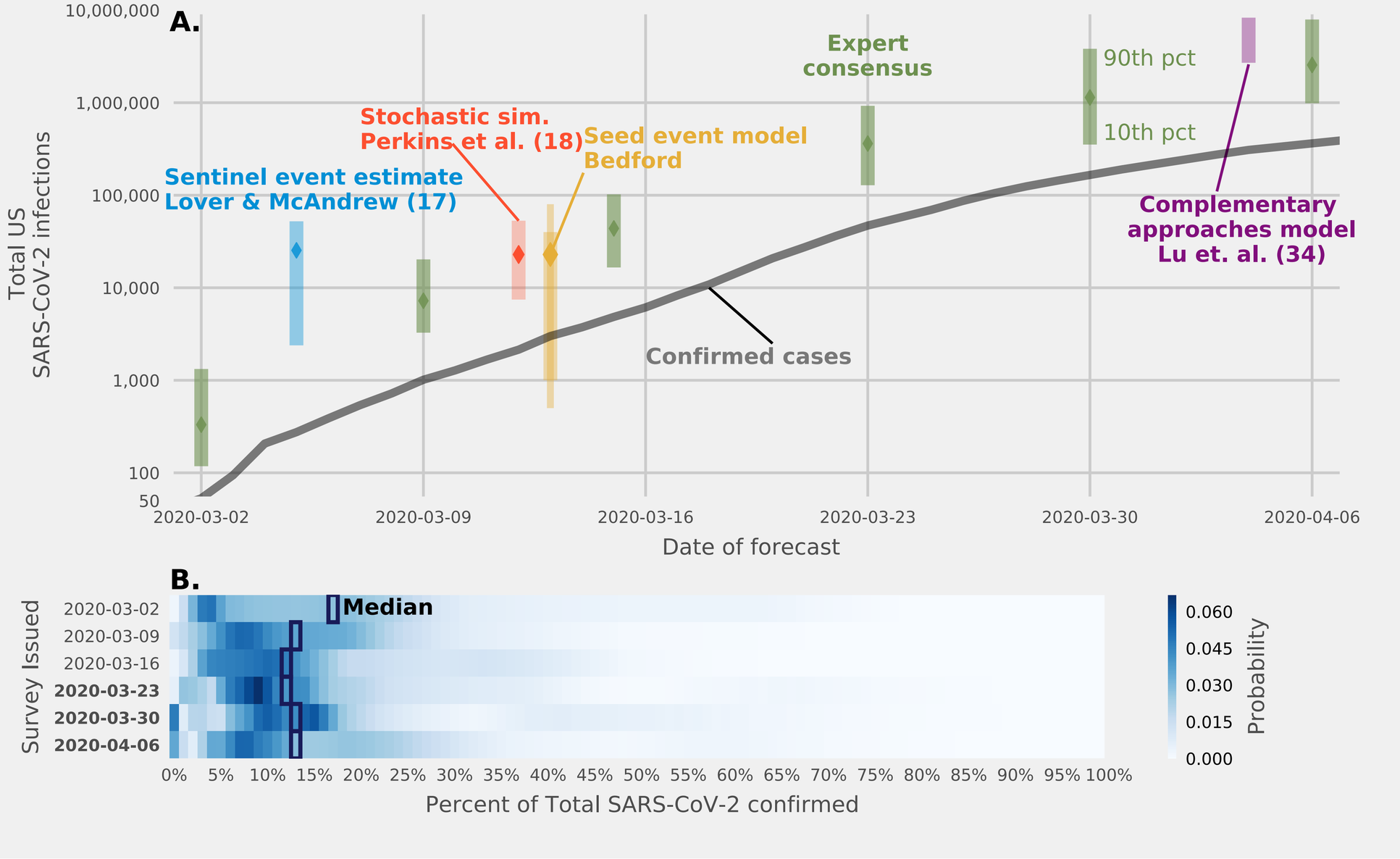

Expert and model predictions agree

Experts predict a small number of infections have been detected

Their estimates of the fraction of detected cases is consistent

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Predictions

Deaths

Hospitalizations

Total infections

Confirmed cases

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Predictions

As shown in the table and figure above, COVID Tracker reported 751,062 total confirmed cases of COVID-19 in the US as of Monday, April 20th at 9am. What is the number of total confirmed cases in the US that COVID Tracker will have in the daily report this coming Sunday, April 26th?

We provided a set of ranges of possible confirmed cases. Assign a probability to each bin corresponding to your belief of how many cases will be reported next Sunday. Each number must be between 0 and 1 and all numbers provided must sum to 1.

Less than 850,000 - [0,850,000]	0
Greater than 850,000 and less than or equal to 900,000 - (850,000, 900,000]	0
Greater than 900,000 and less than or equal to 950,000 - (900,000, 950,000]	0
Greater than 950,000 and less than or equal to 1,000,000 - (950,000, 1,000,000]	0
Greater than 1,000,000 and less than or equal to 1,050,000 - (1,000,000, 1,050,000]	0
Greater than 1,050,000 and less than or equal to 1,100,000 - (1,050,000, 1,100,000]	0
Greater than 1,100,000 - (1,100,000,)	0
Total	0

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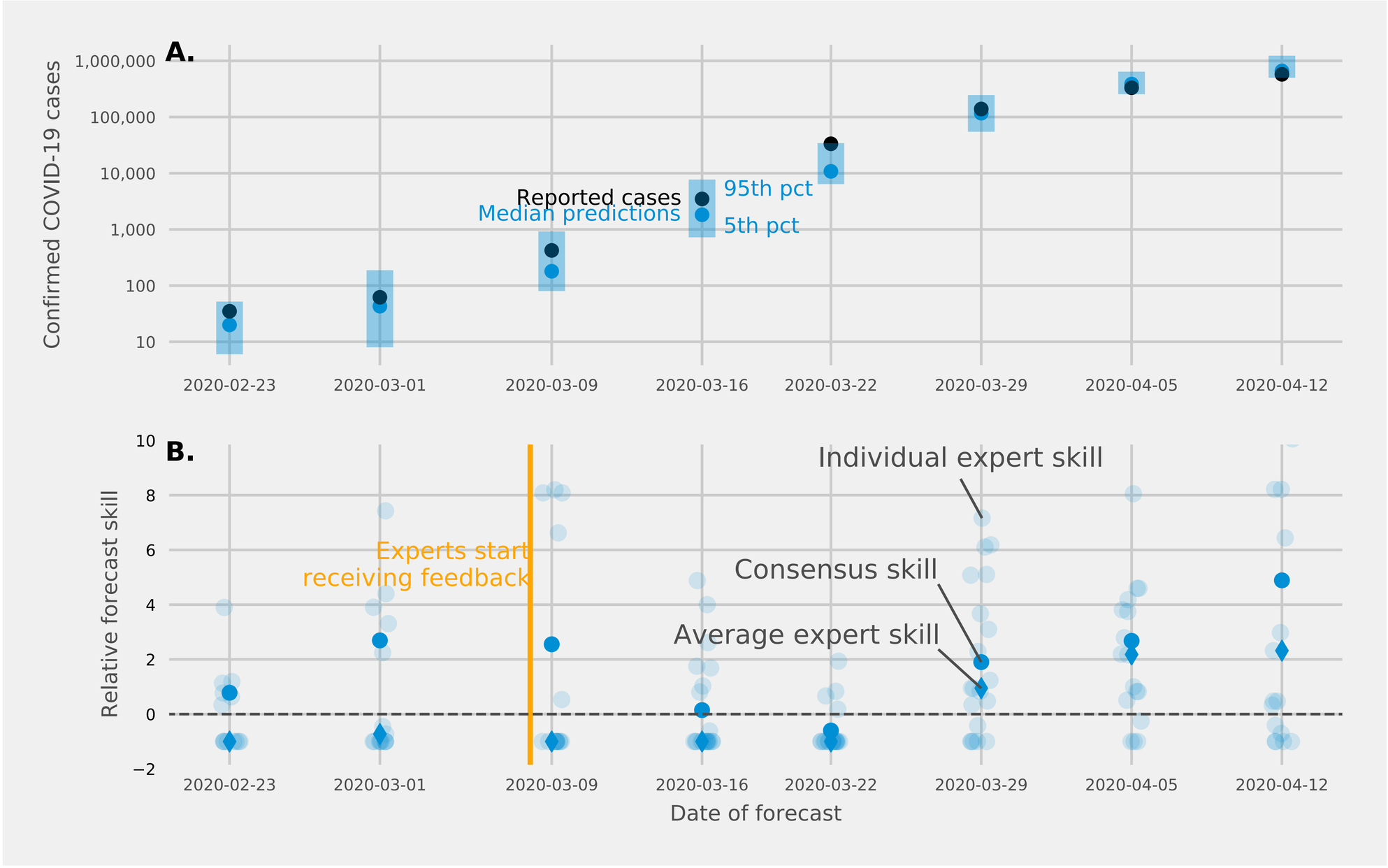
Predictions



The 90% prediction interval from our expert consensus covers the truth number of confirmed cases 7/8 times

Expert performance improves over time

Consensus is more accurate than the “average expert”

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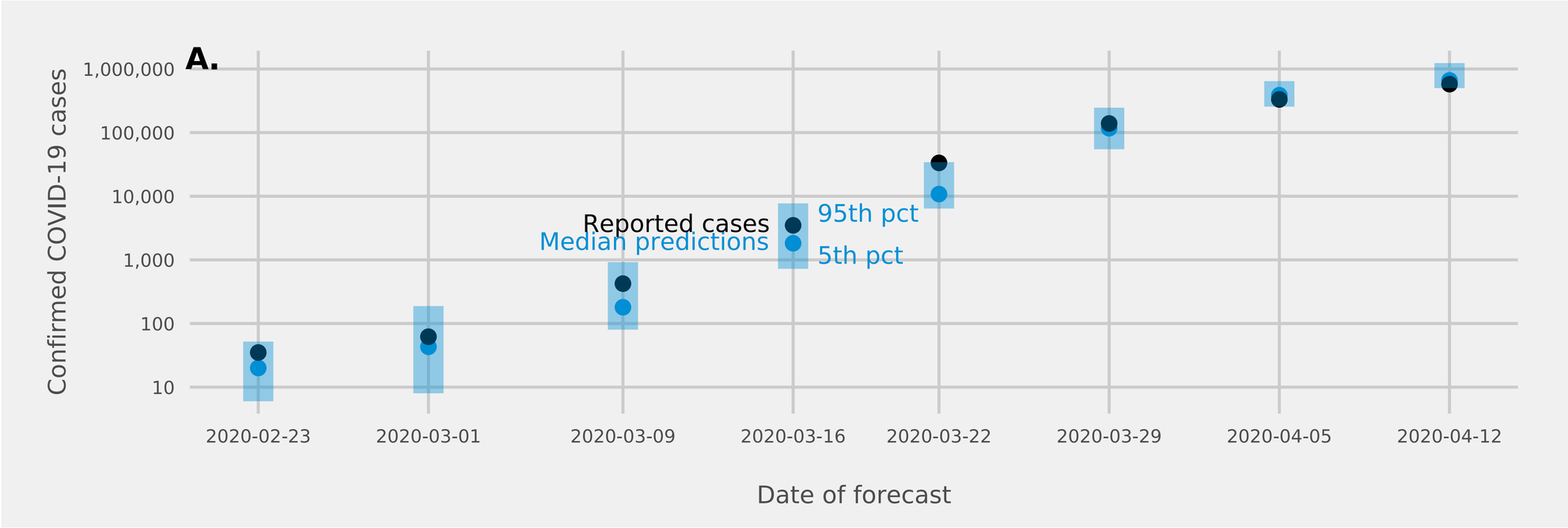
Predictions



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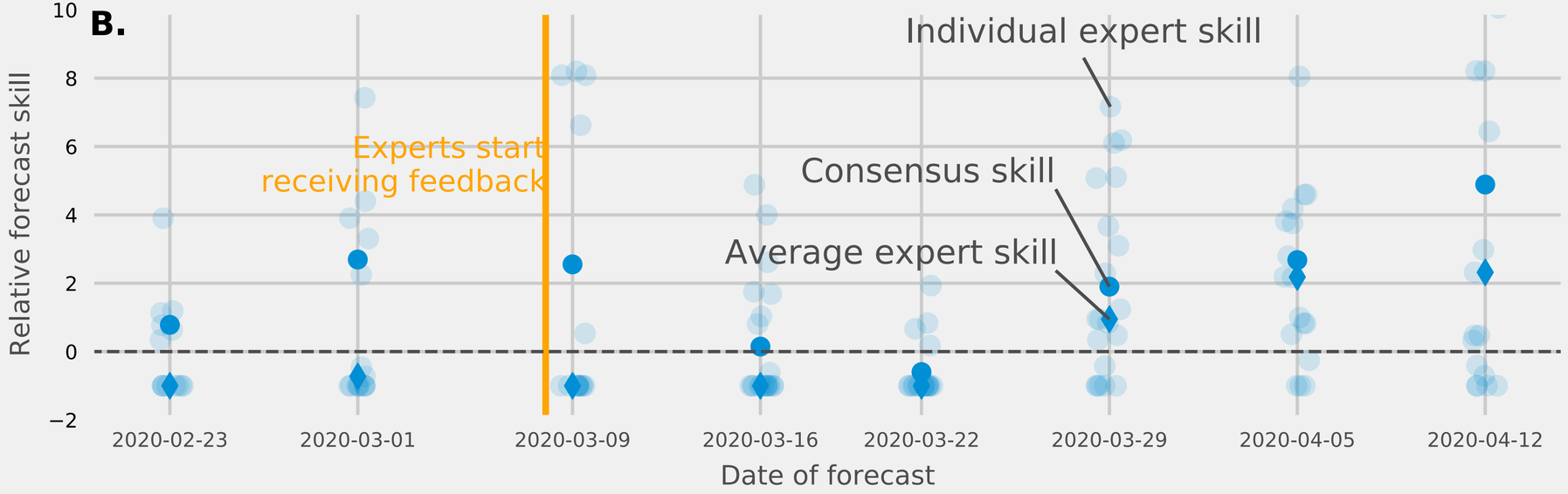

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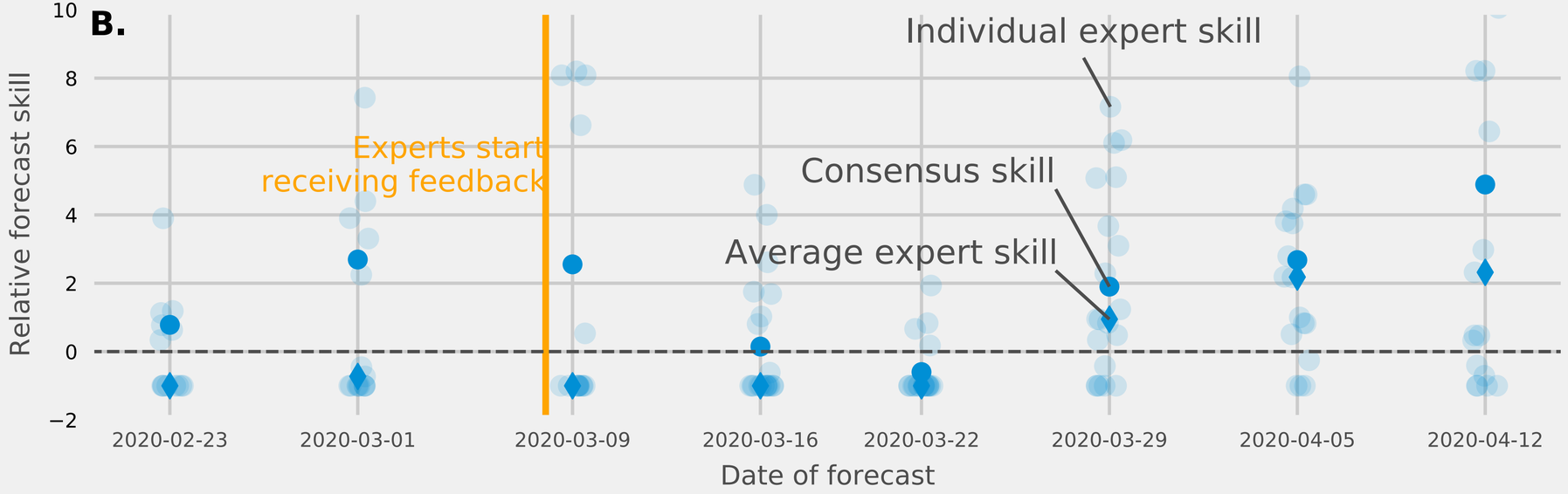
Predictions

$$p(x) = \sum_{e=1}^{N_{\text{experts}}} \pi_e p_e(x)$$ Linear Pool

$$\pi_e \geq 0; \sum_{e=1}^{N_{\text{experts}}} \pi_e = 1$$ Equal Weights



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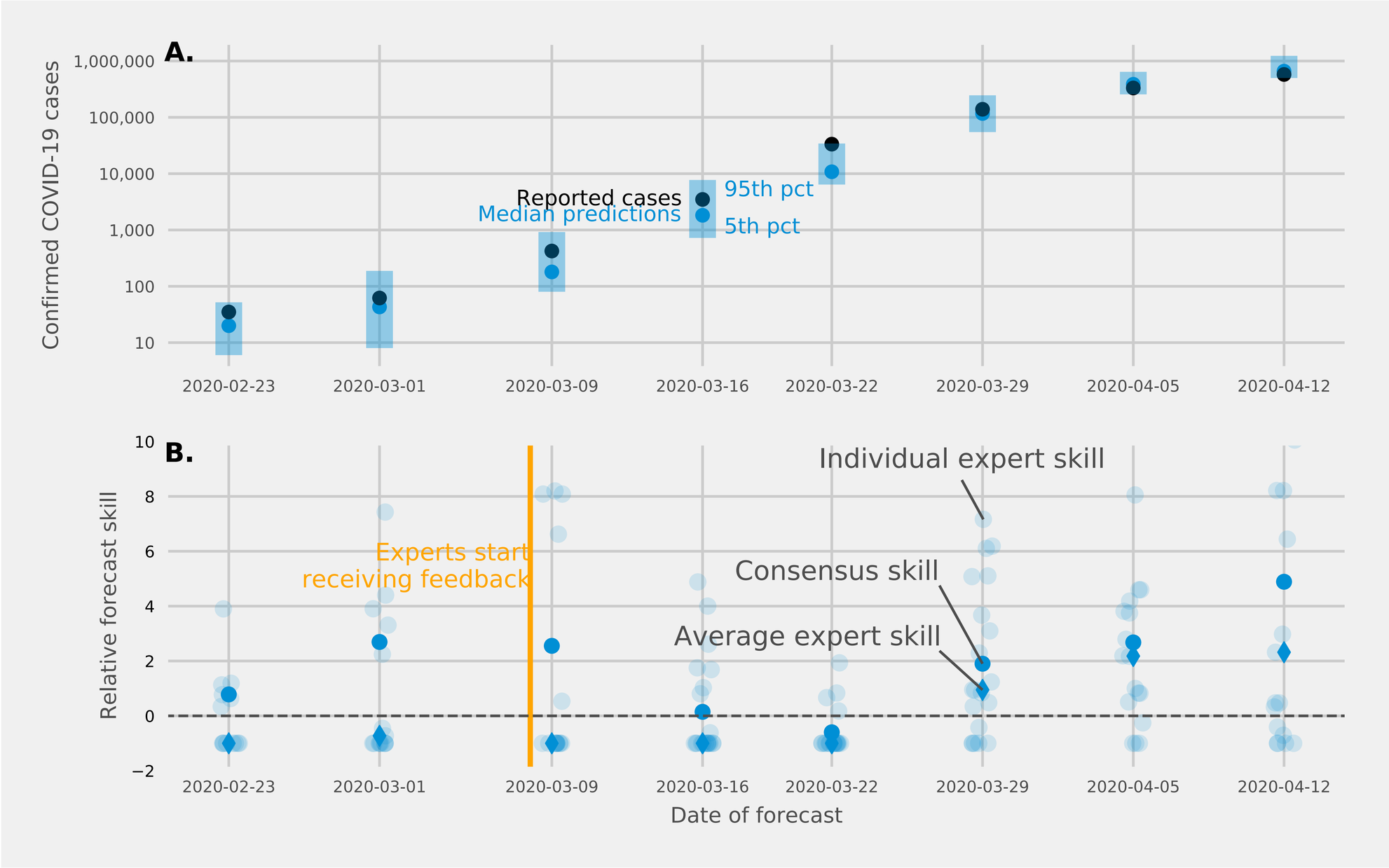

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Recap

Experts gave fast, calibrated forecasts of the early COVID-19 outbreak to support decision making directly

Future

Shift to a complementary role to support decision making and forecast models

Good judgment Inc and Metaculus

Vaccines and Therapeutics

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Good judgment Inc and Metaculus

Vaccines and Therapeutics

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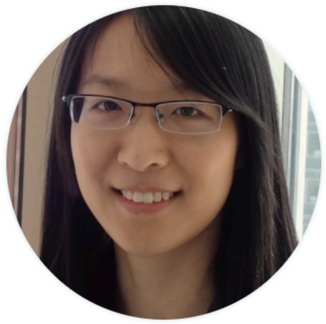
Thank you to the lab







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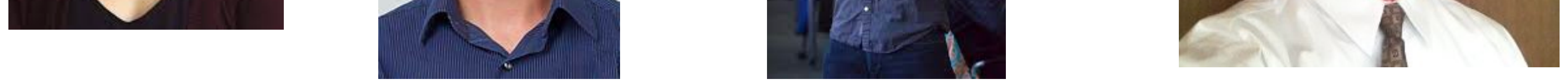
Thank you to experts



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Monthly format and solicitation

An expert was defined as a researcher who has spent a substantial amount of time in their professional career

- designing
- building
- interpreting

models to explain and understand infectious disease dynamics and/or the associated policy implications in human populations.

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Questions