COVID-19 ScenarioModelingHub

Round 13: Planning scenarios projecting COVID-19 burden March 2022-March 2023 under current vaccination policy

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June 28, 2022 - *Vaccines and Related Biological Products Advisory Committee meeting*

PennState Huck Institutes of the Life Sciences · Infectious Disease DYNAMICS, Johns Hopkins Bloomberg School of Public Health · University of Massachusetts Amherst · NIH Fogarty · International Vaccine Access Center · MIDAS · University of Pittsburgh · University of Notre Dame

Johns Hopkins Applied Physics Laboratory · University of Virginia Biocomplexity Institute · USC University of Southern California · MOBS Lab · Northeastern University · University of Victoria · The University of North Carolina at Chapel Hill

IHME · UF University of Florida · NC State University · The University of Texas at Austin COVID-19 Modeling Consortium · COVID-19 ForecastHub

Disclaimers

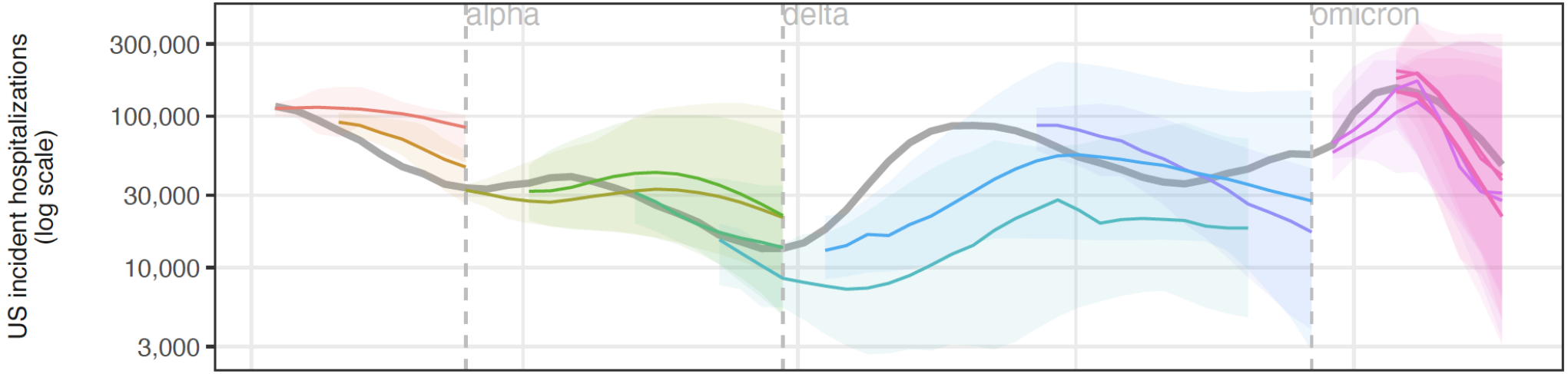
- This work is the independent work of the COVID-19 Scenario Modeling Hub, and does not reflect the views or work of the CDC or any other institution.

- I am funded under multiple CDC contracts for epidemic modeling of emerging national and global infectious disease threats, including SARS-CoV-2.

- If there are questions regarding the CDC's views on this work, Dr. Matthew Biggerstaff is available at this meeting to respond.

What is the COVID-19 Scenario Modeling Hub?

- A multi-team effort aimed at creating and modeling planning scenarios of the mid- to long-term COVID-19 situation.
- Project cases, hospitalizations and deaths.
- Scenarios developed in close collaboration with the government agencies and other stakeholders
- To date 13 (11 public) rounds have been completed
- 6-10 submissions per round at the national level.
- Results are ensembled and summarized by the hub.

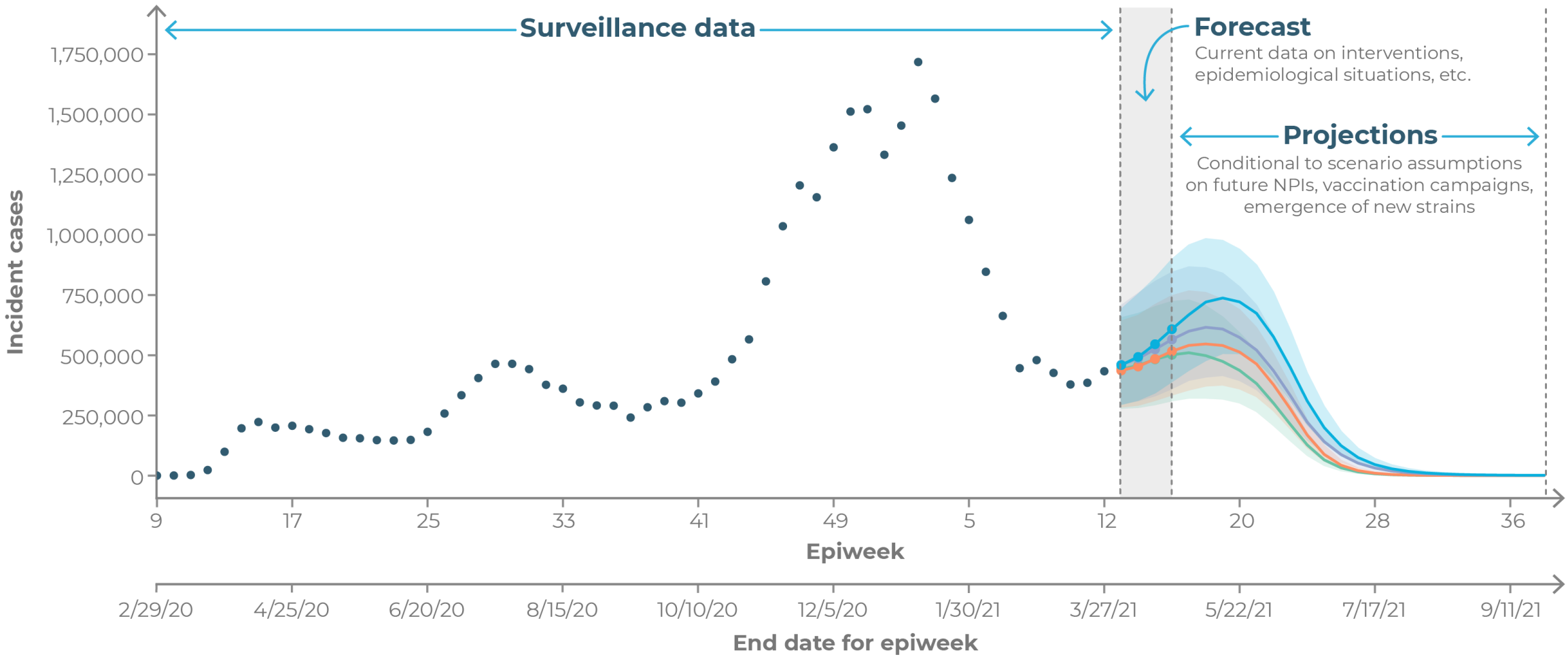


What is a scenario?

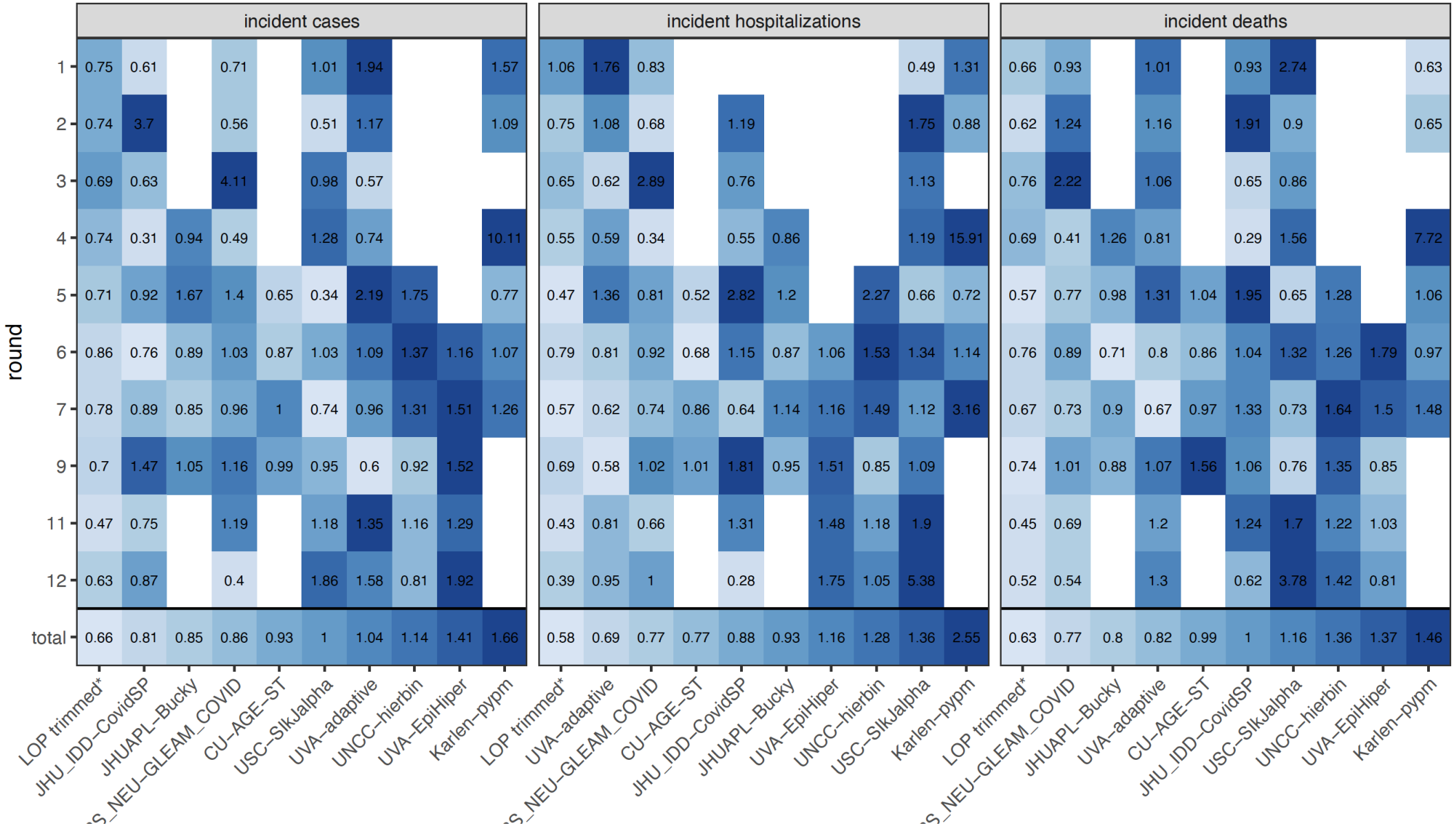
*“Models are not oracles…Any model is providing an answer that is conditional on certain assumptions.”**

*Alessandro Vespignani in All together now: the most trustworthy covid-19 model is an ensemble | MIT Technology Review

COVID-19 ScenarioModelingHub

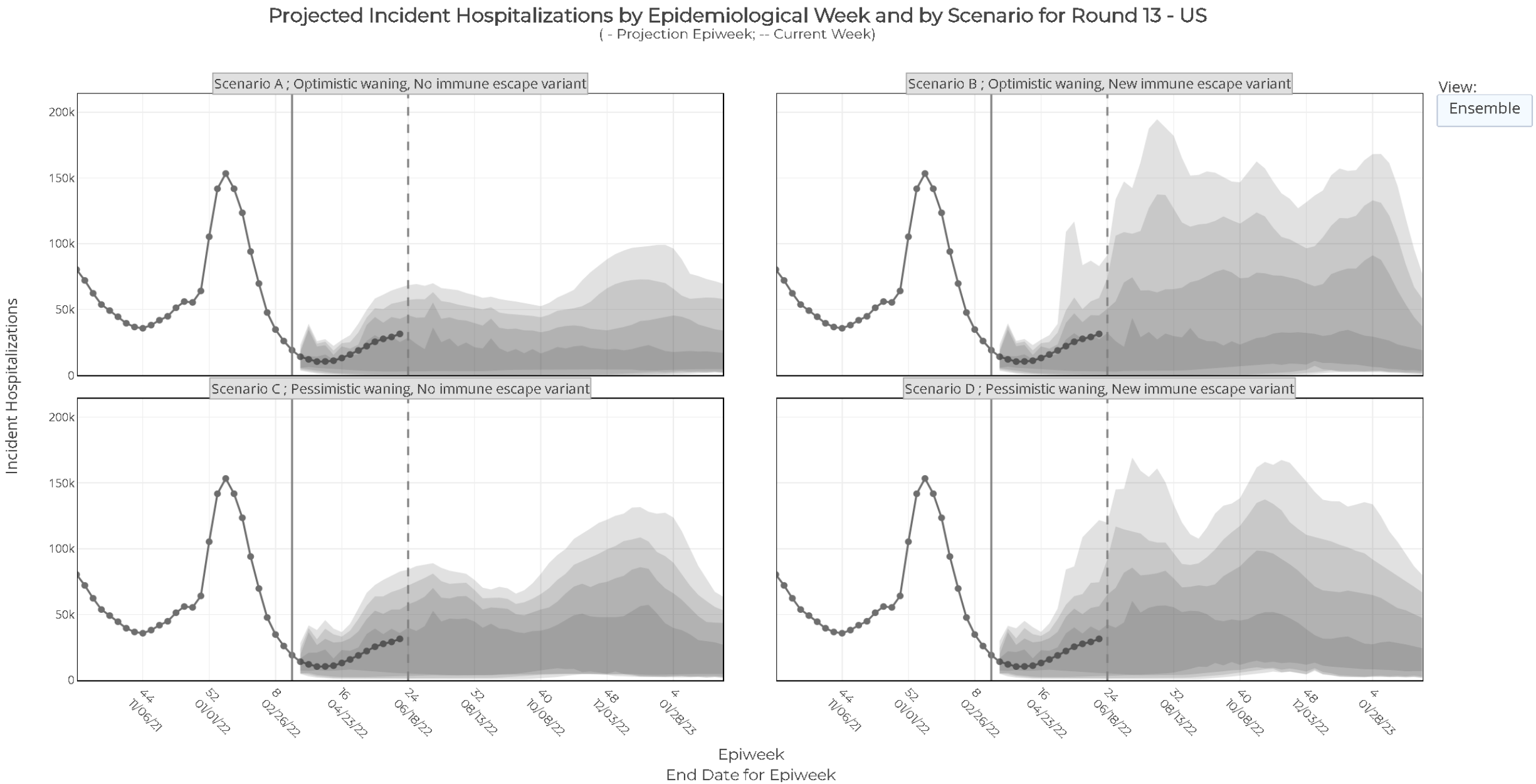


Individual model performance vs. ensemble



Round 13 Scenario Assumptions

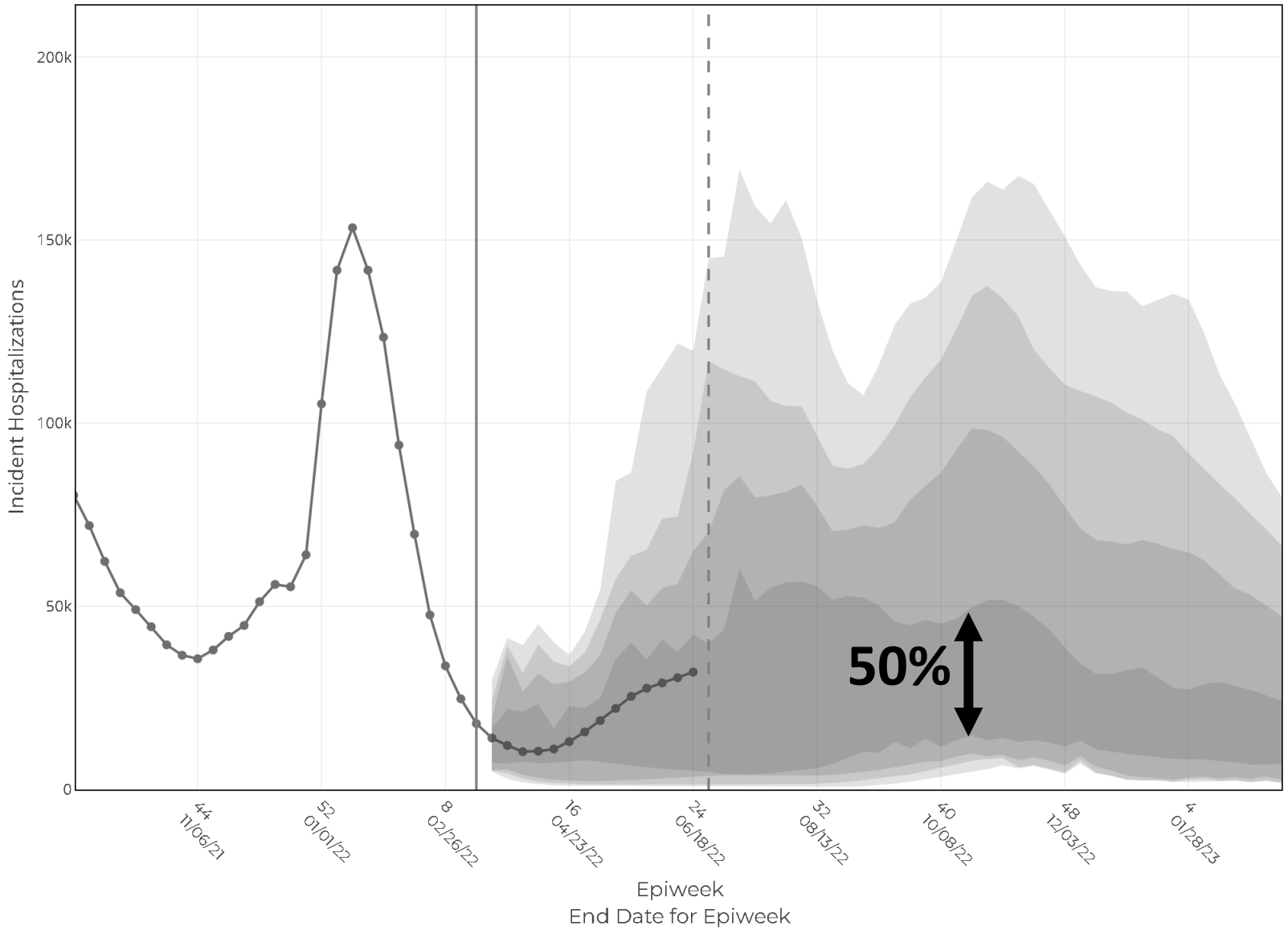
See detailed notes on each scenario below	**No new variant.** Projections are initialized with the mix of strains circulating at the start of the projection period.	**New variant X** emerges on **May 1st, 2022.** There is a **continuous influx of 50 weekly infections** of variant X for the following **16 wks.** Variant X has **30% immune escape**, and the **same intrinsic transmissibility and severity** as Omicron.
Optimistic waning of protection against infection: ● **Slow immune waning, median** transition time to partially immune state **= 10 months** ● In the partially immune state, there is a **40% r**eduction in protection from baseline levels reported immediately after exposure (vaccination or infection)	**Scenario A**	**Scenario B**
Pessimistic waning of protection against infection: ● **Fast immune waning, median** transition time to partially immune state = **4 months** ● In the partially immune state, there is a **60%** reduction in protection from baseline levels reported immediately after exposure (vaccination or infection).	**Scenario C**	**Scenario D**

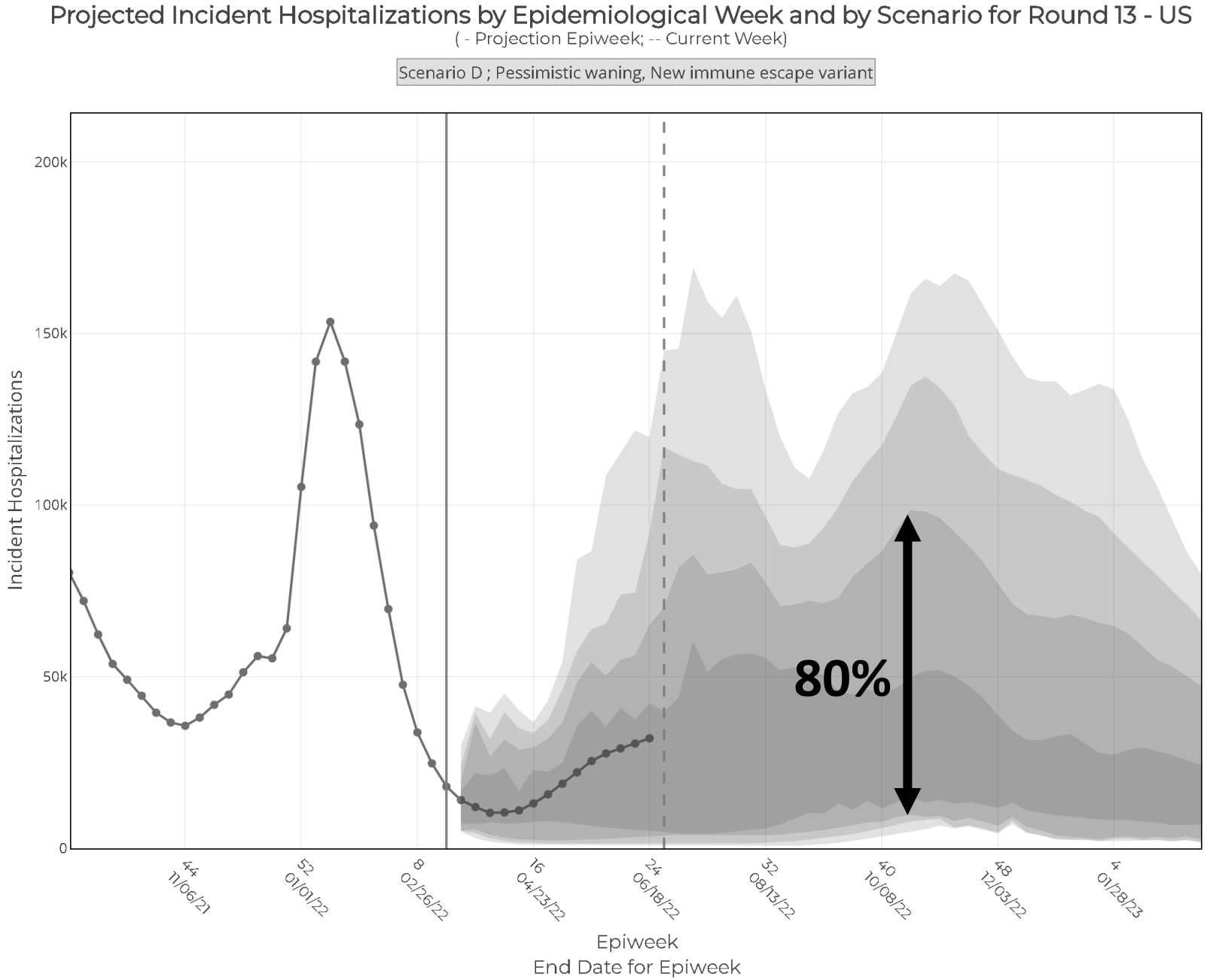

Projected Incident Hospitalizations by Epidemiological Week and by Scenario for Round 13 - US
(- Projection Epiweek; -- Current Week)
Scenario A ; Optimistic waning, No immune escape variant
Scenario B ; Optimistic waning, New immune escape variant
Scenario C ; Pessimistic waning, No immune escape variant
Scenario D ; Pessimistic waning, New immune escape variant
View:
Ensemble
Incident Hospitalizations
200k
150k
100k
50k
0
44 11/06/21
52 01/01/22
8 02/26/22
16 04/23/22
24 06/18/22
32 08/13/22
40 10/08/22
48 12/03/22
4 01/28/23
Epiweek
End Date for Epiweek

Projected Incident Hospitalizations by Epidemiological Week and by Scenario for Round 13 - US

(- Projection Epiweek; -- Current Week)

Scenario D ; Pessimistic waning, New immune escape variant

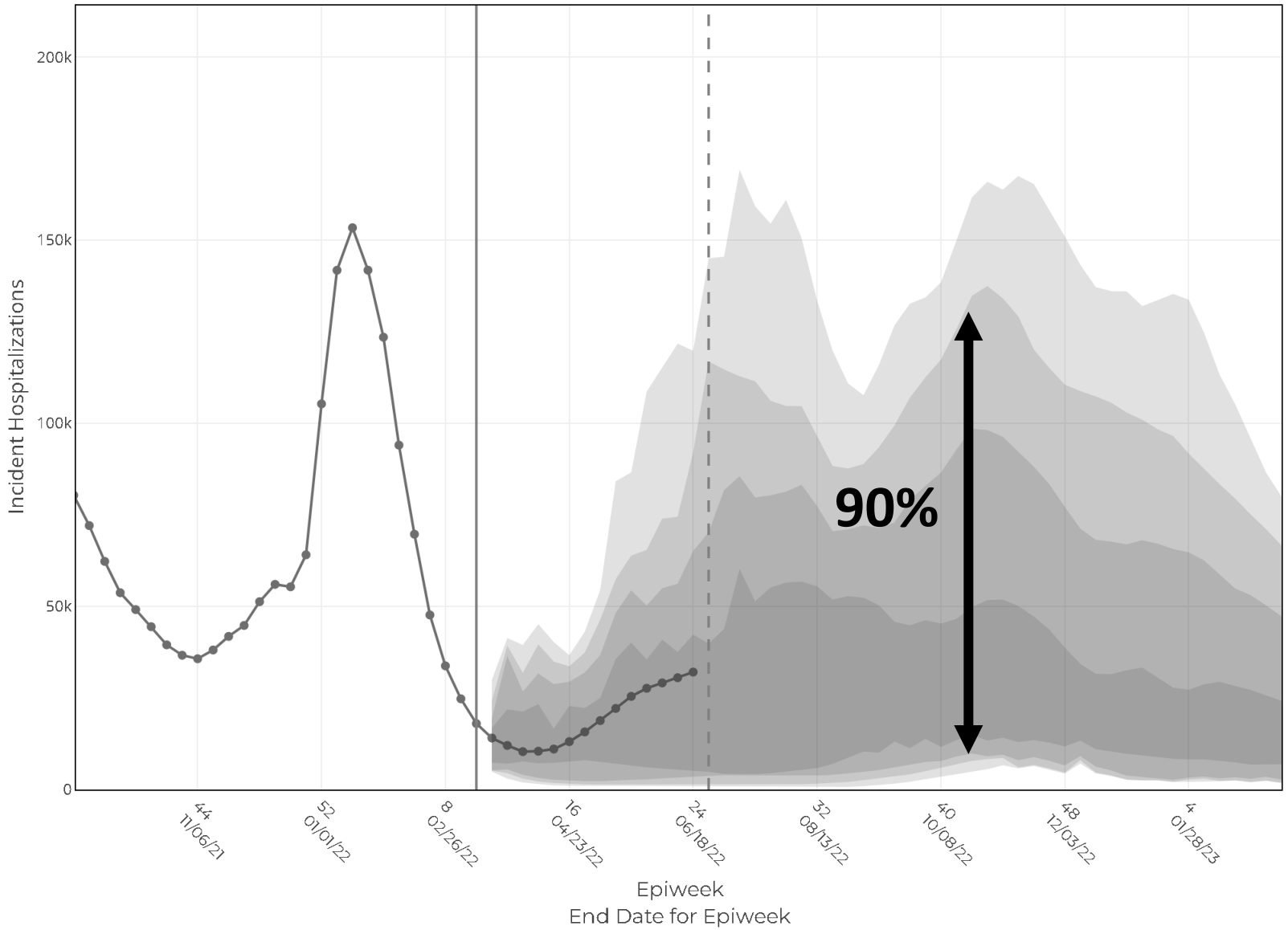


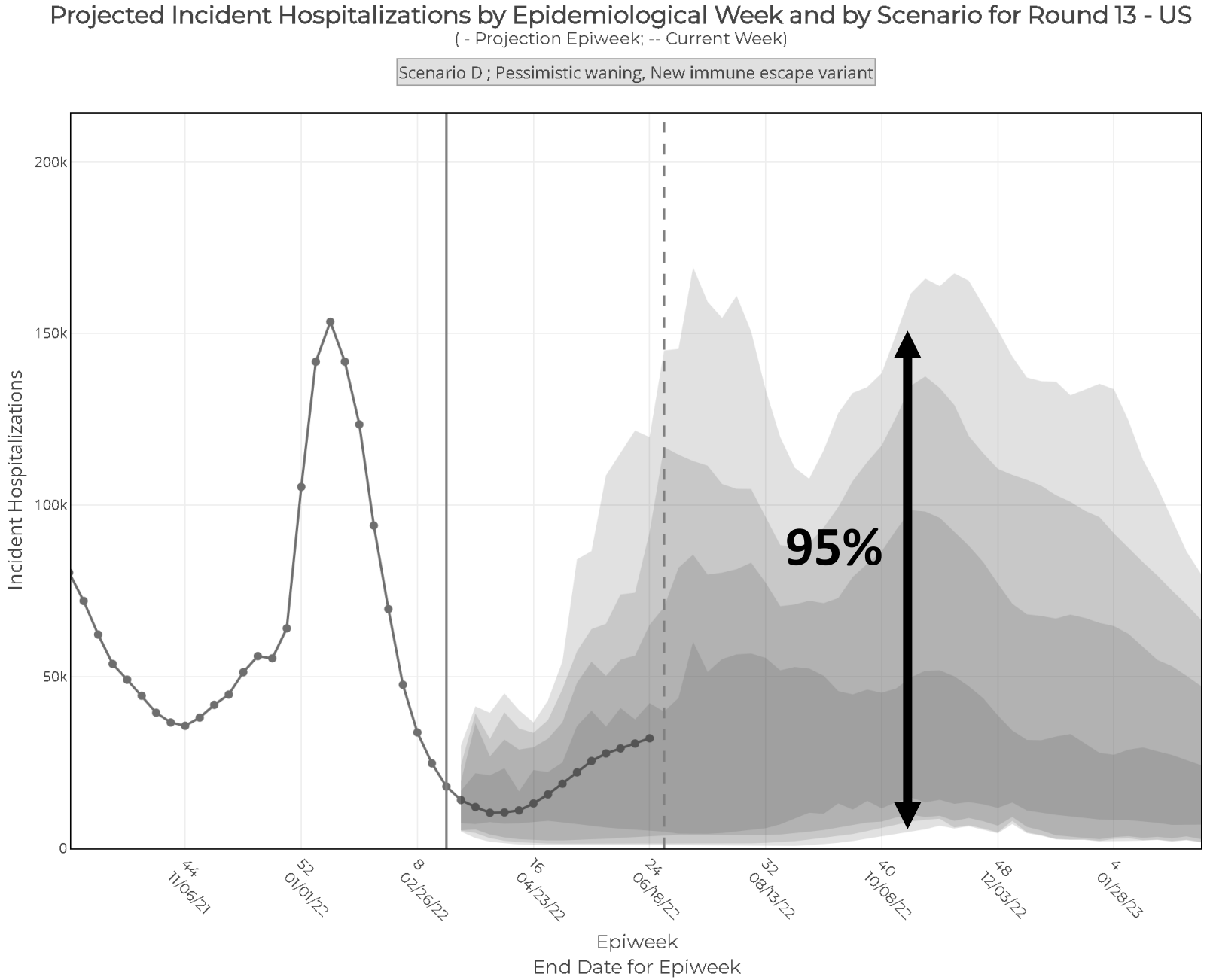

Projected Incident Hospitalizations by Epidemiological Week and by Scenario for Round 13 - US
(- Projection Epiweek; -- Current Week)
Scenario D ; Pessimistic waning, New immune escape variant
Incident Hospitalizations
200k
150k
100k
50k
0
80%
44
11/06/21
52
01/01/22
8
02/26/22
16
04/23/22
24
06/18/22
32
08/13/22
40
10/08/22
48
12/03/22
4
01/28/23
Epiweek
End Date for Epiweek

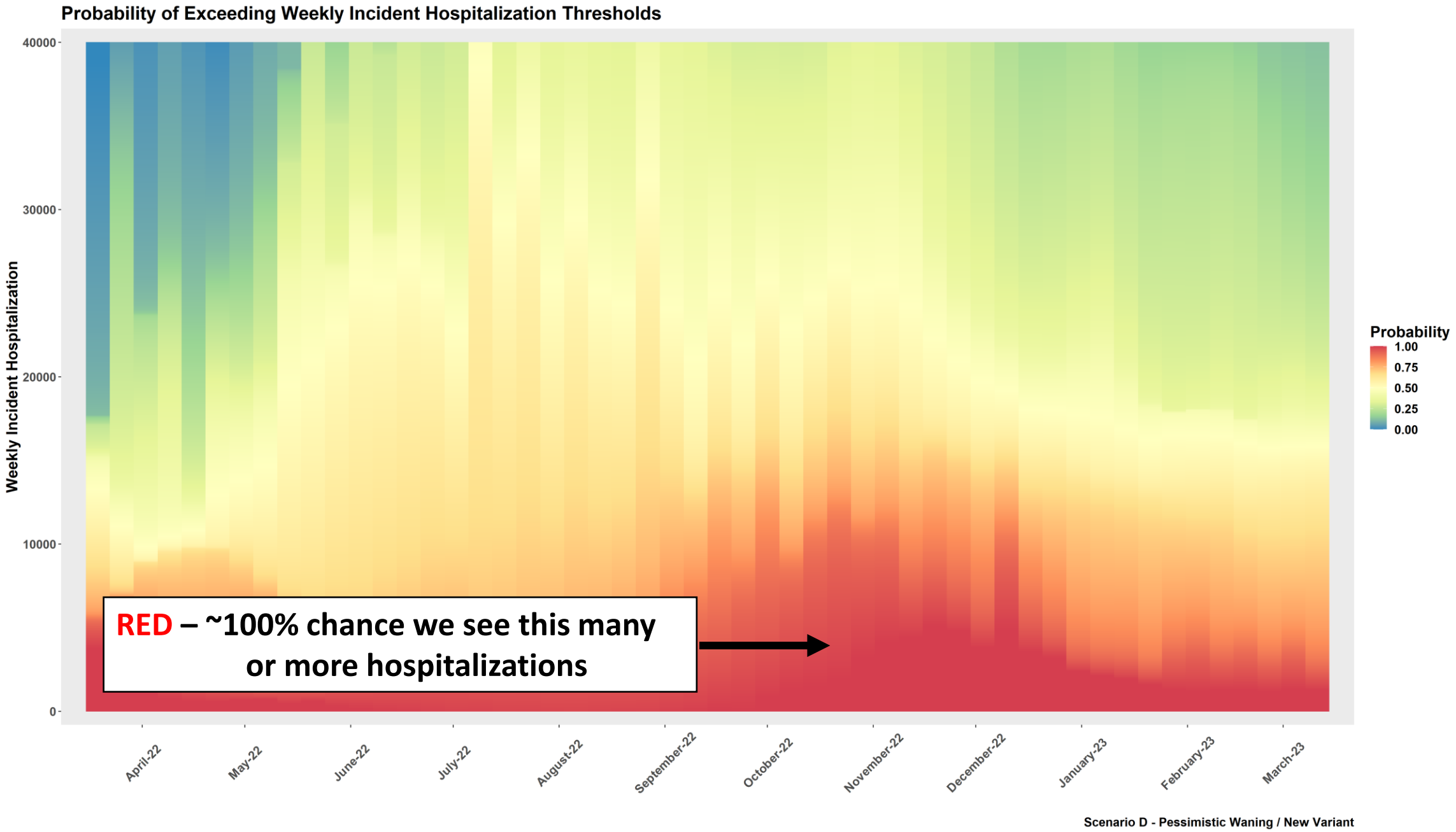
Projected Incident Hospitalizations by Epidemiological Week and by Scenario for Round 13 - US

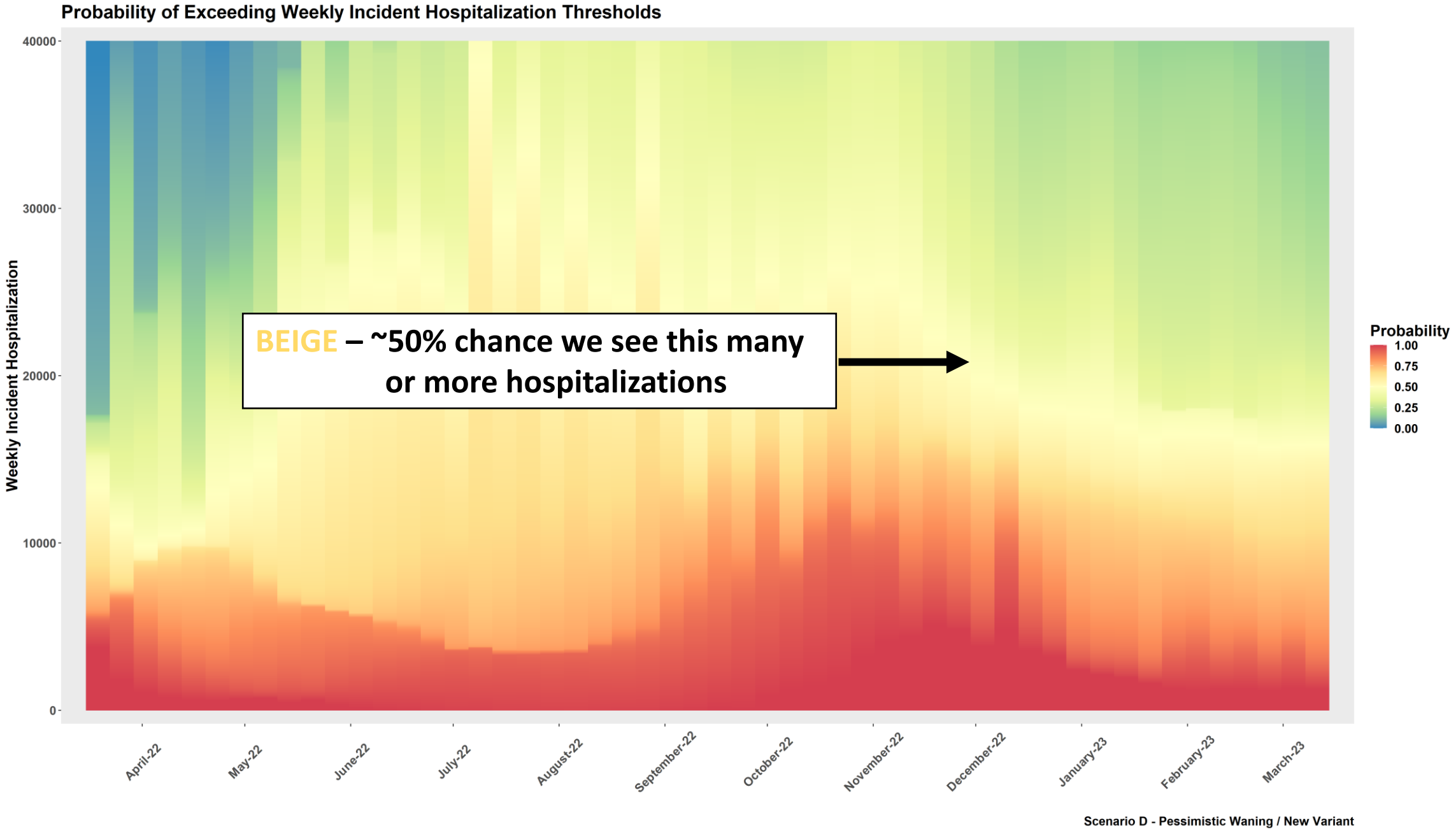
(- Projection Epiweek; -- Current Week)

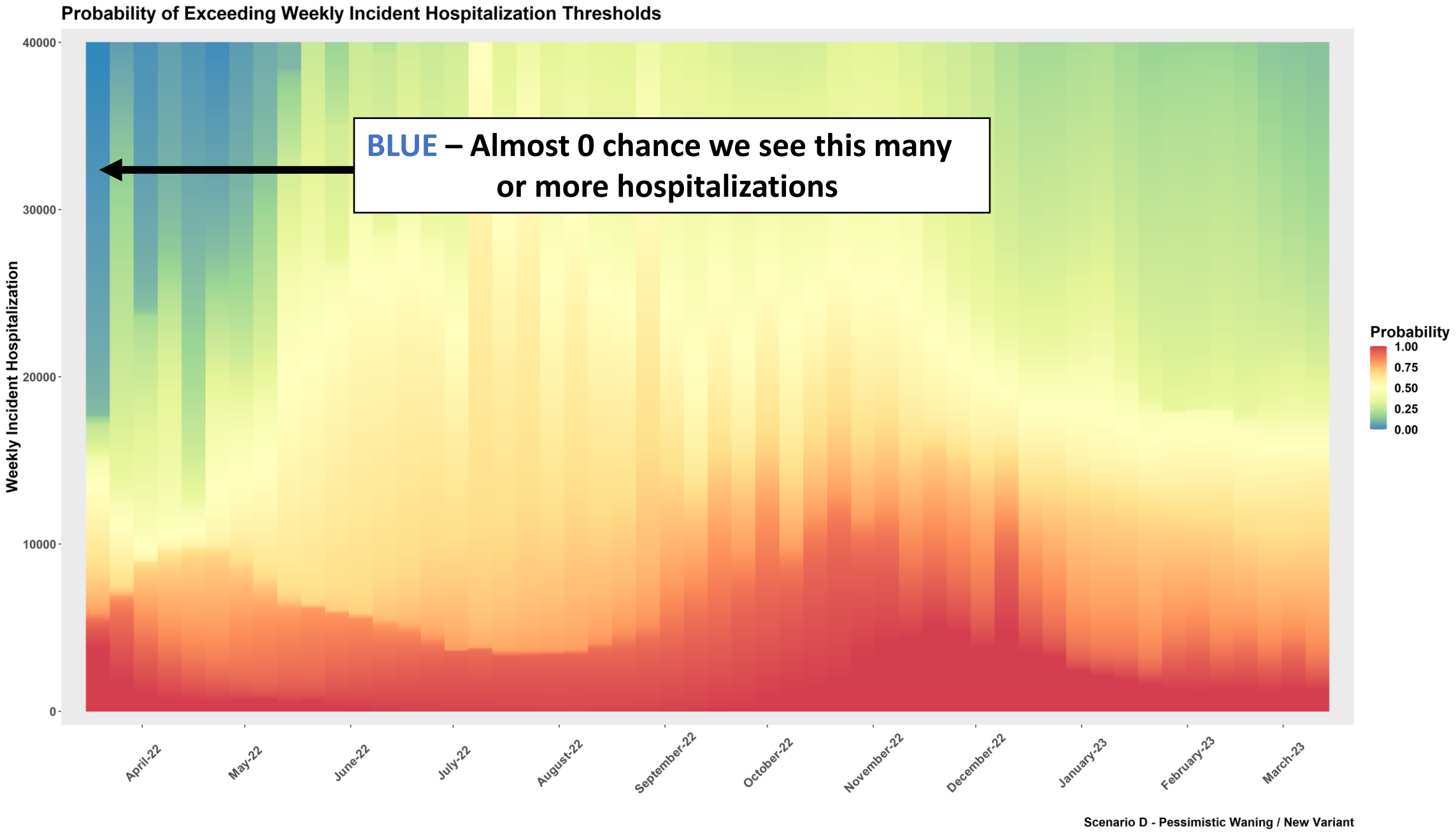
Scenario D ; Pessimistic waning, New immune escape variant

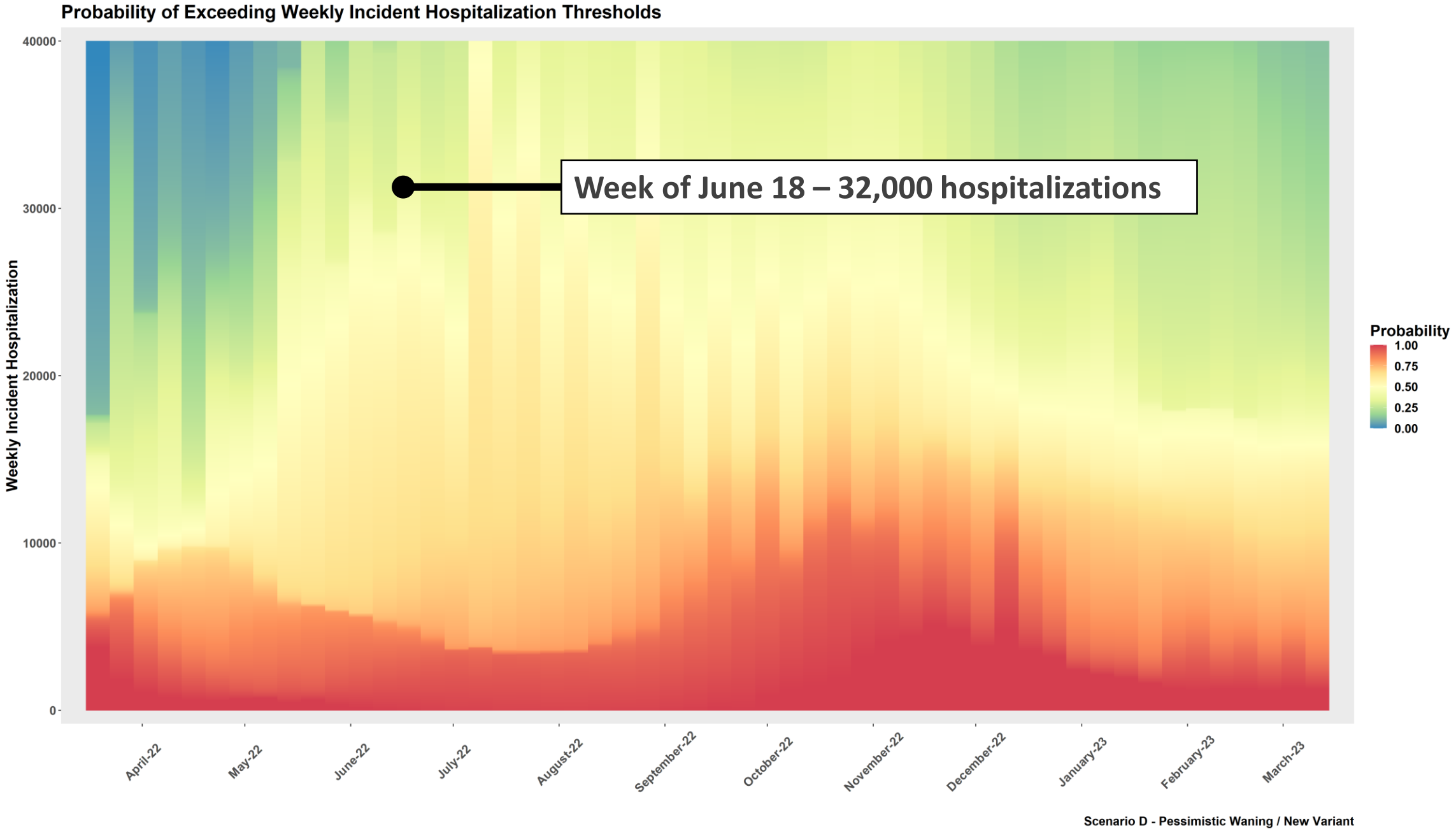


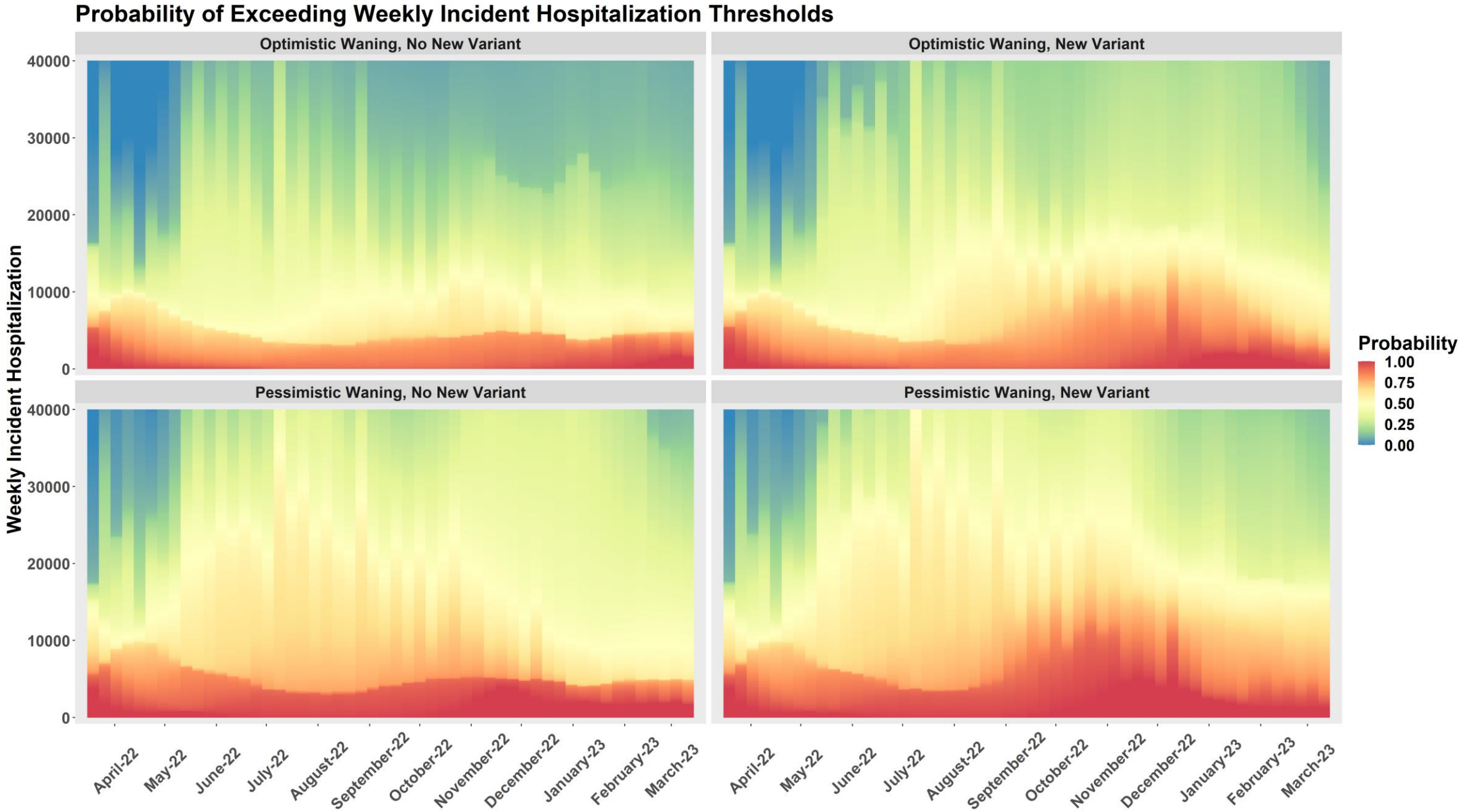

Projected Incident Hospitalizations by Epidemiological Week and by Scenario for Round 13 - US
(- Projection Epiweek; -- Current Week)
Scenario D ; Pessimistic waning, New immune escape variant
Incident Hospitalizations
200k
150k
100k
50k
0
95%
44
11/06/21
52
01/01/22
8
02/26/22
16
04/23/22
24
06/18/22
32
08/13/22
40
10/08/22
48
12/03/22
4
01/28/23
Epiweek
End Date for Epiweek

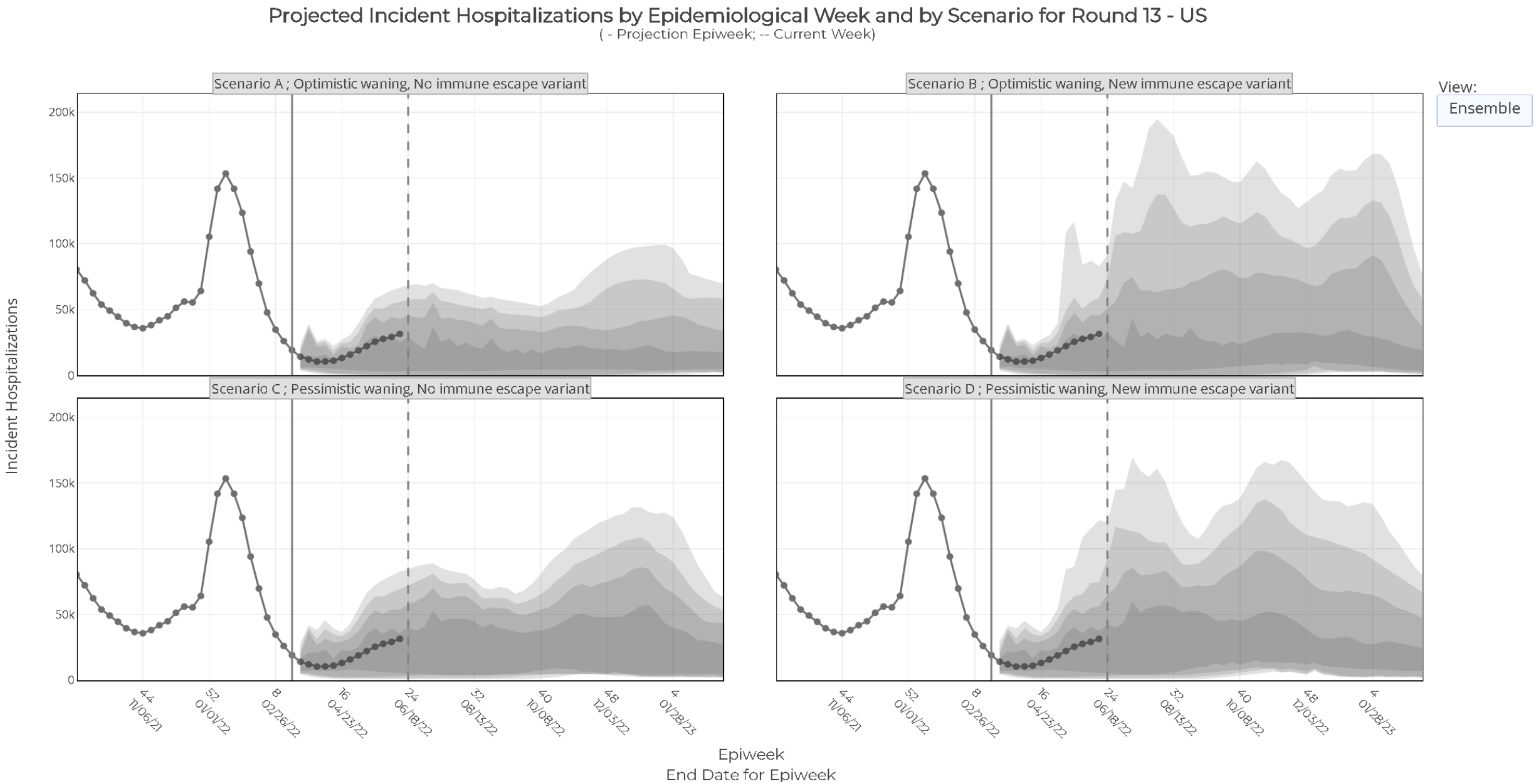

Probability of Exceeding Weekly Incident Hospitalization Thresholds
Weekly Incident Hospitalization
40000
30000
20000
10000
0
April-22
May-22
June-22
July-22
August-22
September-22
October-22
November-22
December-22
January-23
February-23
March-23
Probability
1.00
0.75
0.50
0.25
0.00
RED – ~100% chance we see this many or more hospitalizations
Scenario D - Pessimistic Waning / New Variant


Probability of Exceeding Weekly Incident Hospitalization Thresholds
Weekly Incident Hospitalization
40000
30000
20000
10000
0
April-22
May-22
June-22
July-22
August-22
September-22
October-22
November-22
December-22
January-23
February-23
March-23
BEIGE – ~50% chance we see this many or more hospitalizations
Probability
1.00
0.75
0.50
0.25
0.00
Scenario D - Pessimistic Waning / New Variant


Probability of Exceeding Weekly Incident Hospitalization Thresholds
BLUE – Almost 0 chance we see this many or more hospitalizations
Weekly Incident Hospitalization
40000
30000
20000
10000
0
April-22
May-22
June-22
July-22
August-22
September-22
October-22
November-22
December-22
January-23
February-23
March-23
Probability
1.00
0.75
0.50
0.25
0.00
Scenario D - Pessimistic Waning / New Variant


Probability of Exceeding Weekly Incident Hospitalization Thresholds
Week of June 18 – 32,000 hospitalizations
Weekly Incident Hospitalization
40000
30000
20000
10000
0
April-22
May-22
June-22
July-22
August-22
September-22
October-22
November-22
December-22
January-23
February-23
March-23
Probability
1.00
0.75
0.50
0.25
0.00
Scenario D - Pessimistic Waning / New Variant


Probability of Exceeding Weekly Incident Hospitalization Thresholds
Optimistic Waning, No New Variant
Optimistic Waning, New Variant
Pessimistic Waning, No New Variant
Pessimistic Waning, New Variant
Weekly Incident Hospitalization
40000
30000
20000
10000
0
April-22
May-22
June-22
July-22
August-22
September-22
October-22
November-22
December-22
January-23
February-23
March-23
Probability
1.00
0.75
0.50
0.25
0.00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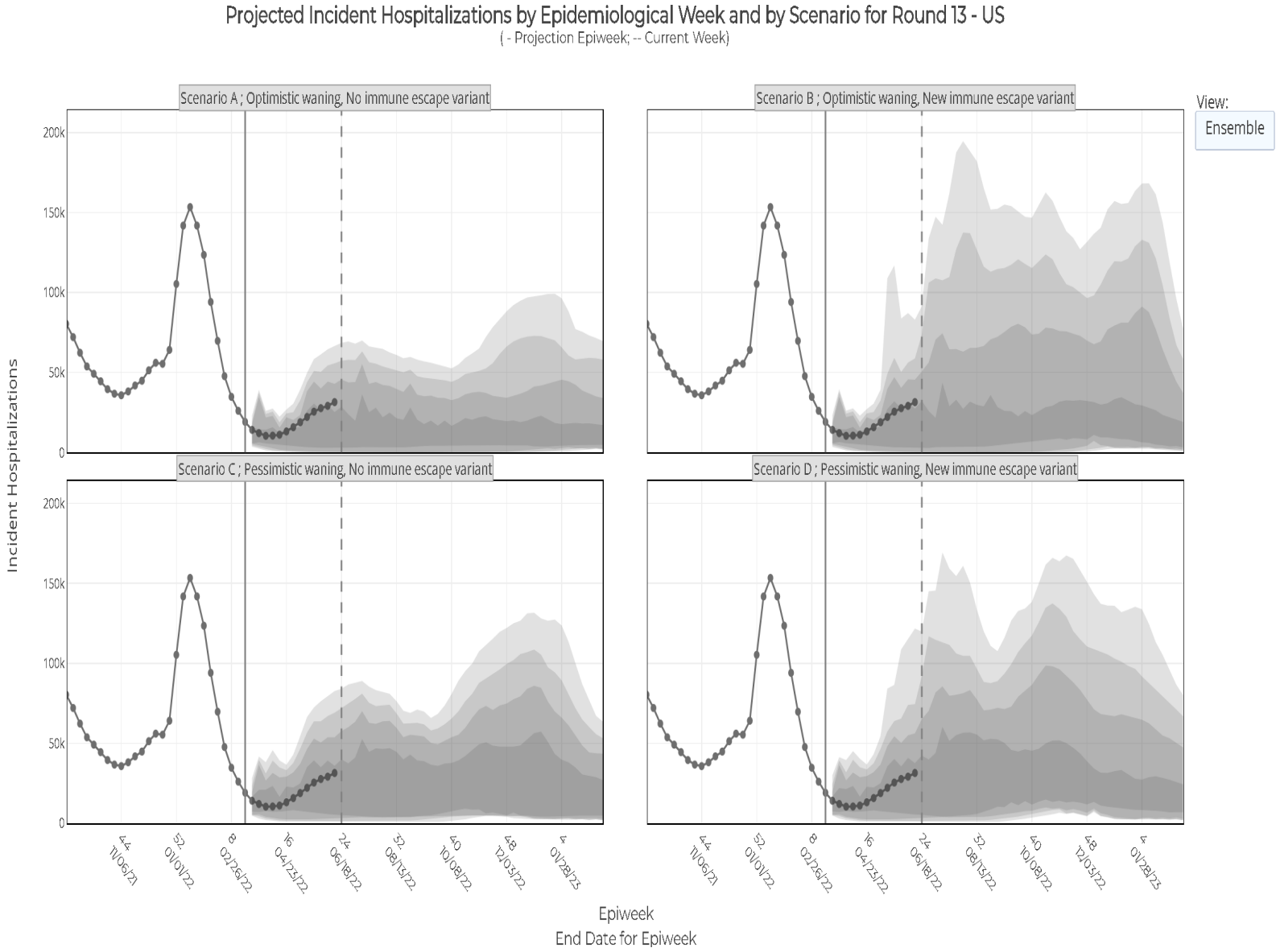
Epiweek
End Date for Epiweek

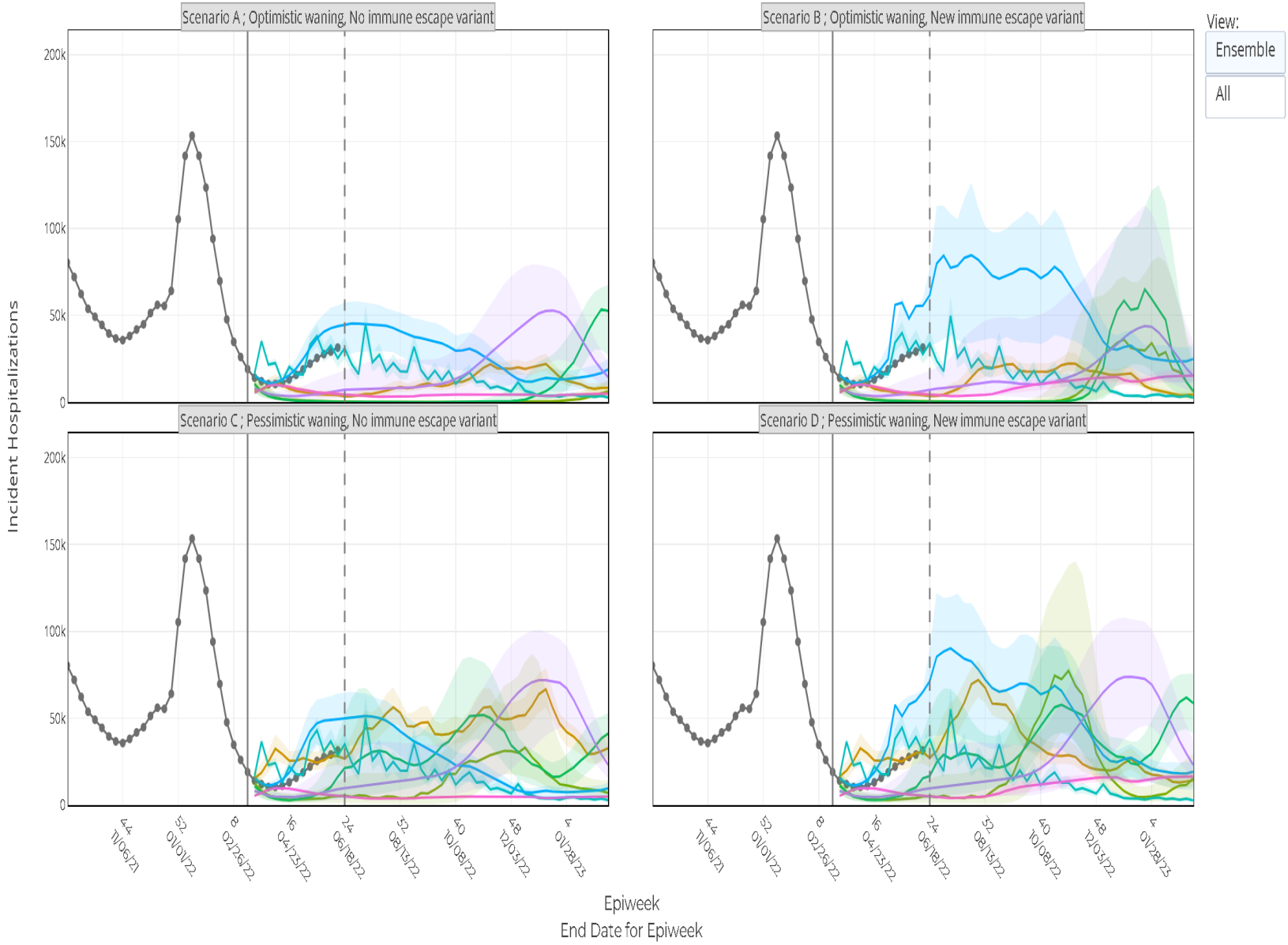
Results

- Incidence is tracking with more pessimistic scenarios (scenarios C,D)
- faster waning (C,D) and new variants (A,D) increase expected hospitalizations
- Variant leads to earlier resurgences. (A, D)
- Under the most pessimistic scenarios weekly hospitalizations are projected to remain under 170k and will likely be between 13k-52k



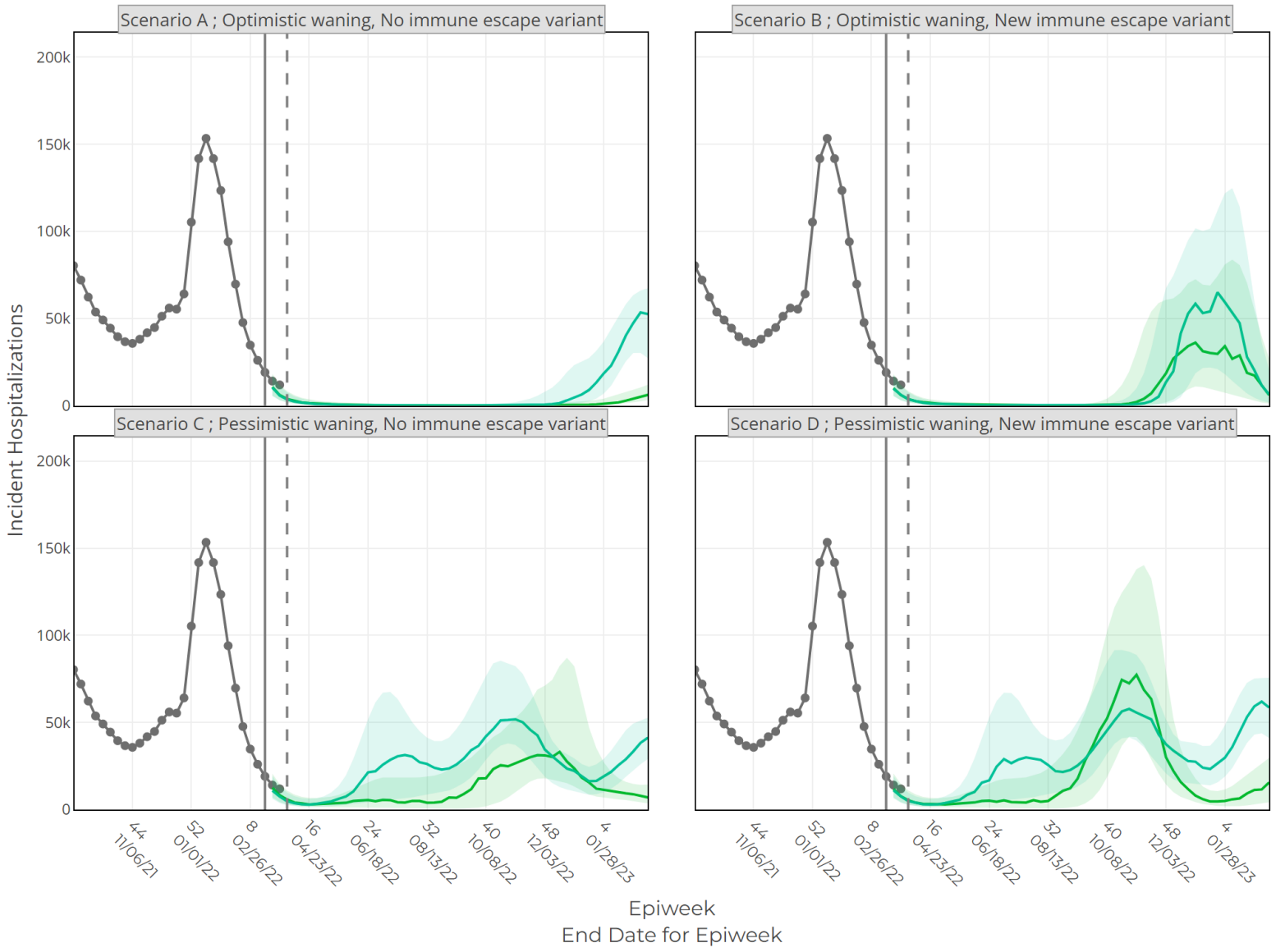
Results – Highly Variable Trajectories

- This is an aggregate o highly variable projections across models.
- There is not a great consensus trajectory for the ensemble to capture.



Results – Highly Variable Trajectories

- There is high sensitivity to individual model assumptions in these scenarios.
- For instance, a change in the shape of waning, even with the same median time meaningfully changes projections.



Conclusions

- Between March 2022-23 95,000 (95% PI 9,000-324,000) cumulative deaths are projected to occur in the most optimistic scenario. In the most pessimistic, 211,000 (95% 52,000-466,000) deaths are projected
- In the most pessimistic scenario there is a >5% risk of exceeding delta hospitalization peaks in 10 of 52 projections weeks (19% of weeks). This is true for no weeks in the most optimistic scenario.
- Lots of uncertainty in precise trajectory and sensitivity to exact assumptions around waning of protection against infection.
- New variant would lead to larger and earlier peaks in most but not all models.

Caveats

- Substantial heterogeneity in projections between models reflects substantial scientific uncertainty, perhaps greater than captured by the ensemble.
- The mains scenario axes represent things on which there is substantial underlying uncertainty (e.g., speed of waning projection, nature of new variants)
- Four out of six national models include BA.2 and in some cases behavior change. Three of these four show a small resurgence in April-May time frame.
- Reporting of cases and other metrics are undergoing significant changes, making it difficult to project into the future.
- While the modeled variant is not completely dissimilar to BA4/5, it is in no way based on these variants.

Coordination Team: Katriona Shea, Justin Lessler, Cécile Viboud, Rebecca Borchering, Emily Howerton, Shaun Truelove, Claire Smith, Michelle Qin, Nicholas Reich, Michael Runge, Lucie Contamin, John Levander, Jessica Kerr, Harry Hochheiser, Luke Mullany

Modeling Groups Contributing Projections

- Columbia University – Age-Stratified Model: Marta Galanti, Teresa Yamana, Sen Pei, Jeffrey Shaman
- Institute for Health Metrics and Evaluation – IHME COVID
- John Hopkins University-APL: Matt Kinsey, Kate Tallaksen, R.F. Obrecht, Laura Asher, Cash Costello, Michael Kelbaugh, Shelby Wilson, Kaitlin Lovett
- John Hopkins University-IDD-COVIDSP: Joseph C. Lemaitre, Juan Dent Hulse, Kyra H. Grantz, Joshua Kaminsky, Stephen A. Lauer, Elizabeth C. Lee, Justin Lessler, Hannah R. Meredith, Javier Perez-Saez, Shaun A. Truelove, Claire P. Smith, Lindsay T. Keegan, Kathryn Kaminsky, Sam Shah, Josh Wills, Pierre-Yves Aquilanti, Karthik Raman, Arun Subramaniyan, Greg Thursam, Anh Tran
- North Carolina State University-COVSIM: Erik Rosenstrom, Jessica Mele, Julie Swann, Julie Ivy, Maria Mayorga
- Northeastern University MOBS GLEAM COVID: Matteo Chinazzi, Jessica T. Davis, Kunpeng Mu, Xinyue Xiong, Ana Pastore y Piontti, Alessandro Vespignani
- University of Florida – ABM: Thomas Hladish, Alexandar Pillai, Kok Ben Toh, Ira Longini Jr.
- University of North Carolina at Charlotte – UNCC-hierbin: Shi Chen, Rajib Paul, Daniel Janies, Jen-Claude Thill
- University of Notre Dame - FRED: Guido Espana, Sean Cavany, Sean Moore, Alex Perkins
- University Southern California SlkJalpha: Ajitesh Srivastava, Majd Al Aawar
- University of Texas at Austin-ImmunoSEIRS: Anass Bouchnita, Spencer Fox, Michael Lachmann, Lauren Ancel Meyers, UT COVID-19 Modeling Consortium
- University of Victoria: Dean Karlen
- University of Virginia-adaptive: Przemyslaw Porebski, Srini Venkatramanan, Anniruddha Adiga, Bryan Lewis, Brian Klahn, Joseph Outten, James Schlitt, Patric Corbett, Pyrros Alexander Telionis, Lijing Wang, Akhil Sai Peddireddy, Benjamin Hurt, Jiangzhou Chen, Anil Vullikanti, Madhav Marathe
- University of Virginia-EpiHiper: Jiangzhuo Chen, Stefan Hoops, Parantapa Bhattacharya, Dustin Machi, Bryan Lewis, Madhav Marathe

Collaborators: Matthew Biggerstaff, Michael Johansson, Rachel Slayton, Jessica Healey (CDC); Nicole Samay (Northeastern University)

https://covid19scenariomodelinghub.org

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https://github.com/midas-network/covid19-scenario-modeling-hub