



Flu ScenarioModelingHub

Flu Scenario Modeling Hub Report

27 September, 2023

Scenario Modeling Hub Team¹

Key Takeaways

Full scenario specifications can be found [here](#).

Key Takeaways from the First Round of 2023-24

In the first influenza round of 2023-24, we generated pre-season projections for the 39-week period Sep 3, 2023 to June 1, 2024. We considered 6 scenarios representing the impact of 3 different levels of vaccine coverage (20% higher than in the 2021-22 reference season, similar to the reference season, and 20% lower than the reference season), combined with the dominance of the influenza A/H3N2 or A/H1N1 subtype. Ensemble projections are based on contributions from 10 teams (including 9 contributing national projections) using the untrimmed linear opinion pool approach.

Our main findings include:

- The hospitalization and death burden of the next influenza season will be more heavily driven by the dominant subtype than by vaccination coverage, with an A/H3N2-dominant season projected to have moderate to high impact, and A/H1N1 low to moderate impact, compared to influenza epidemics in the past decade.
- In our most optimistic scenario (scenario B, high vaccine coverage, A/H1N1 dominance), median weekly hospitalizations would peak at 10,400 (95%PI 900-22,600). In our most pessimistic scenario (scenario E, low vaccine coverage, H3N2 dominance), weekly hospitalizations would peak at 24,100 (95%PI 1,300-41,700). Cumulative hospitalizations at the end of the season are projected to reach 207,200 (95%PI 42,100 - 438,200) for the most optimistic scenario, and 347,500 (95%PI 47,500-656,000) for the most pessimistic scenario. We project 10,400 (95%PI 1,300-35,600) cumulative influenza deaths for the most optimistic scenario, and 19,000 (95%PI 2,400-44,100) cumulative deaths for the most pessimistic scenario.
- In all scenarios, ensemble projections suggest a prolonged period of high influenza activity before and after the New Year, in part due to differences in projected peak timing across models. Periods of high influenza activity tend to occur earlier in A/H3N2 projections while A/H1N1 projections have more protracted activity lasting into the Spring.
- A 20% relative increase in vaccine coverage, compared to usual, would avert 9% (95% CI 3%, 16%) of influenza-related hospitalizations in the H3N2 scenario, and 9% (0.5-18%) in the H1N1 scenario. A 20% drop in vaccine coverage compared to usual, potentially fueled by a rise in vaccine hesitancy, would increase influenza-related hospitalizations by 10% (95% CI 4-15%) in the H3N2 scenario, and 12% (95%CI 5-19%) in the H1N1 scenario. Projected percent changes in deaths are less pronounced than in hospitalizations. In absolute terms, this represents differences in the order of 22,000 to 34,000 hospitalizations and 800-1,400 deaths (range across medians).
- Based on median ensemble projections, the combined impact of influenza and COVID-19 on hospitalizations would remain below that seen last season (2022-23), irrespective of the flu scenario. This is based

¹Compiled by Sara Loo, Cecile Viboud, Lucie Contamin.

on the assumption of high immune escape for COVID-19, and moderate COVID-19 booster uptake in all age groups (Round 17 scenario A, <https://covid19scenariomodelinghub.org/>). This combined impact is based on the median of both flu and COVID19 scenarios and there is considerable variability within these projections that is not captured by the median.

- There is considerable variability between models as regards projected timing and severity of epidemics, in part due to differences in underlying assumptions regarding seasonality and seeding. This variability is compounded by the absence of early season influenza calibration data.

A few caveats are worth noting:

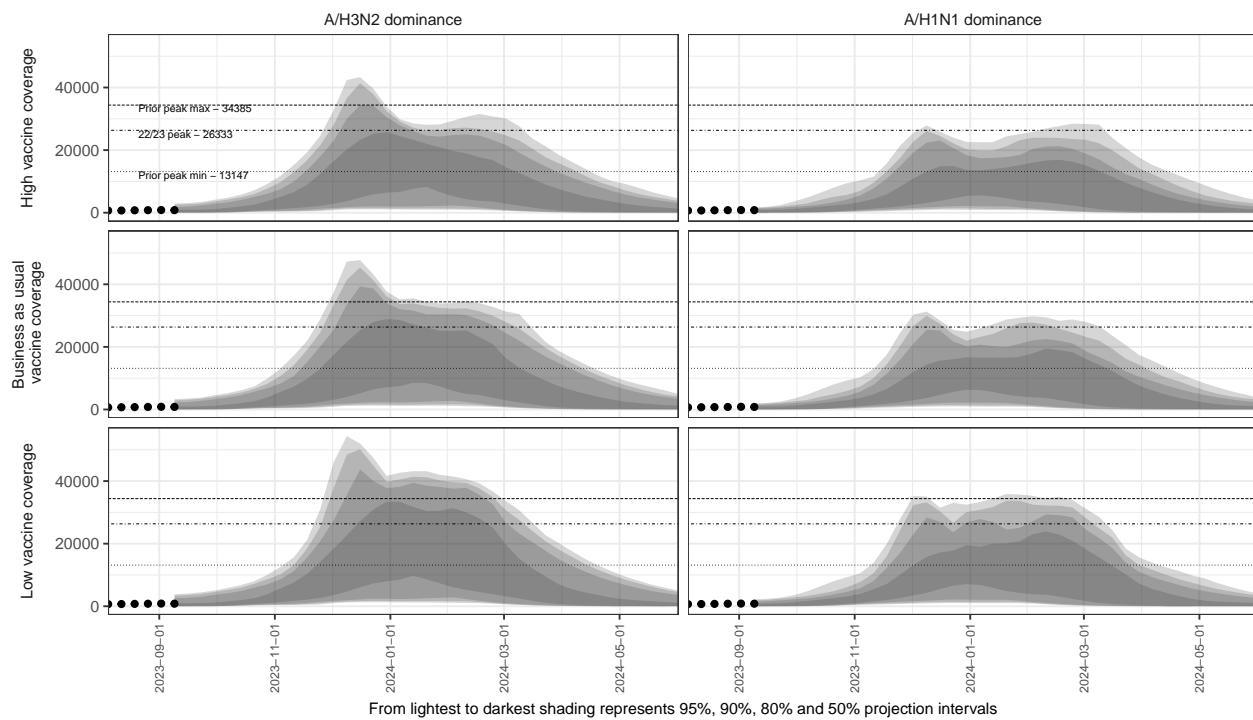
- We assumed a fixed VE of 40% against medically attended illnesses in all flu scenarios, which anticipates a good match between circulating viruses and vaccine strains.
- These are pre-season projections, and hence there is no calibration data on the dynamics of the upcoming epidemic. These projections are primarily based on the historical dynamics of H3N2 and H1N1 epidemics.
- Assumptions about the age distribution of influenza hospitalizations were based on the 2019-20 season for H1N1, and the 2017-18 season for H3N2. There is some variability in the age distribution of severe cases between seasons, even within the same subtype. And while these historic seasons should have only been used to set the age distribution and severity of influenza given infection, it is possible that the choice of a large H3N2 season like 2017-18 affected the projected severity of the 2023-24 season under the H3N2 scenarios.
- Only 7 participating models contributed national death projections. Together with more limited calibration data available for deaths, our projections for deaths may be somewhat less reliable than for hospitalizations.
- Testing practices continue to evolve in the wake of the COVID19 pandemic, including increased use of multi-pathogen testing in clinical settings, which may affect reported hospitalizations in the HHS protect system. This in turn will affect comparison with our projections and with prior year hospitalization data.

Round 1 - 2023-2024 Scenario Specifications

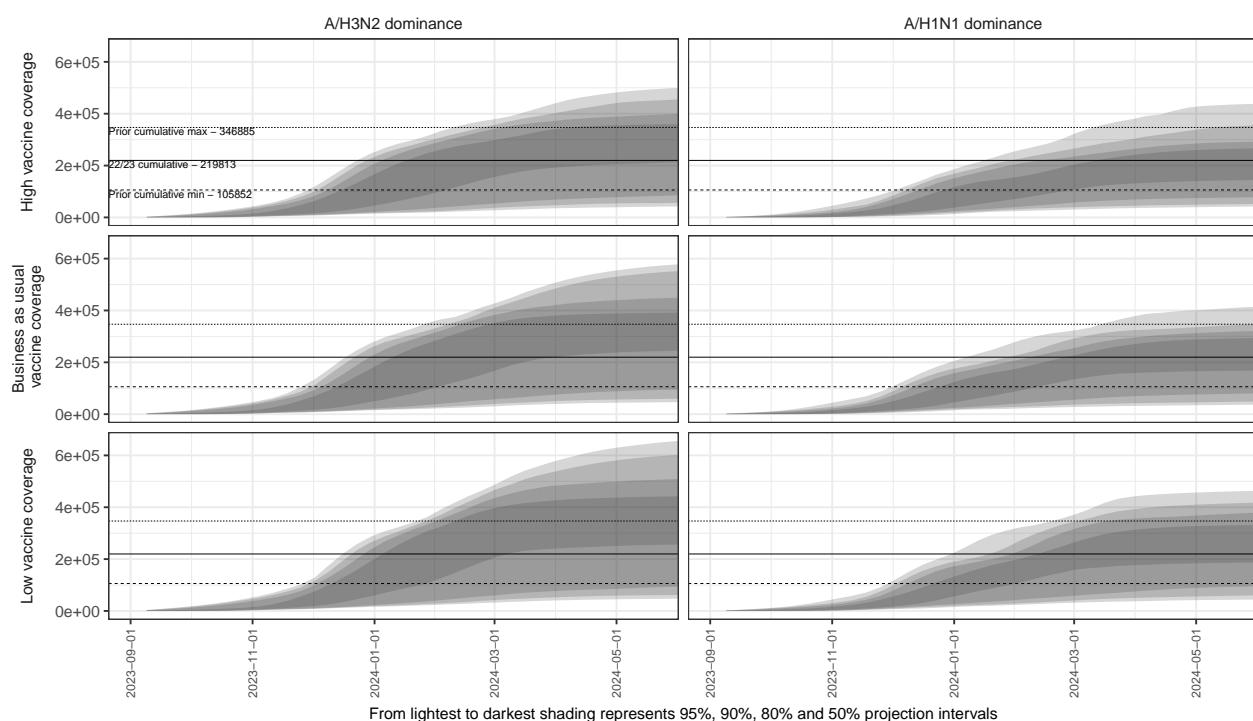
	<p>Season dominated by influenza A/H3N2, indexed on age distribution of 2017-18 season.</p> <p>VE = 40% against medically attended illnesses and hospitalizations, VE drops in older age groups</p>	<p>Season dominated by influenza A/H1N1, indexed on age distribution of 2019-20 season.</p> <p>VE = 40% against medically attended illnesses and hospitalizations, similar VE across all age groups</p>
Higher than Usual Vaccine Coverage <ul style="list-style-type: none"> Vaccine coverage is 20% higher than in the 2021-22 flu season in all age groups and jurisdictions. (20% is a relative change, ie a 50% coverage for age group a and jurisdiction j in 2021-22 translates to a $50\% * 1.20 = 60\%$ coverage for 2023-24). Overall, the US coverage is about 60% in this scenario. 	Scenario A	Scenario B
Business as Usual Vaccine Coverage <ul style="list-style-type: none"> Vaccine coverage is the same as in the 2021-22 flu season in all age groups and jurisdictions. Overall, the US coverage is about 50% in this scenario. 	Scenario C	Scenario D
Low Vaccine Coverage <ul style="list-style-type: none"> Vaccine coverage is 20% lower than in the 2021-22 flu season in all age groups and jurisdictions. Overall, the US coverage is about 40% in this scenario. 	Scenario E	Scenario F

Ensemble projection intervals

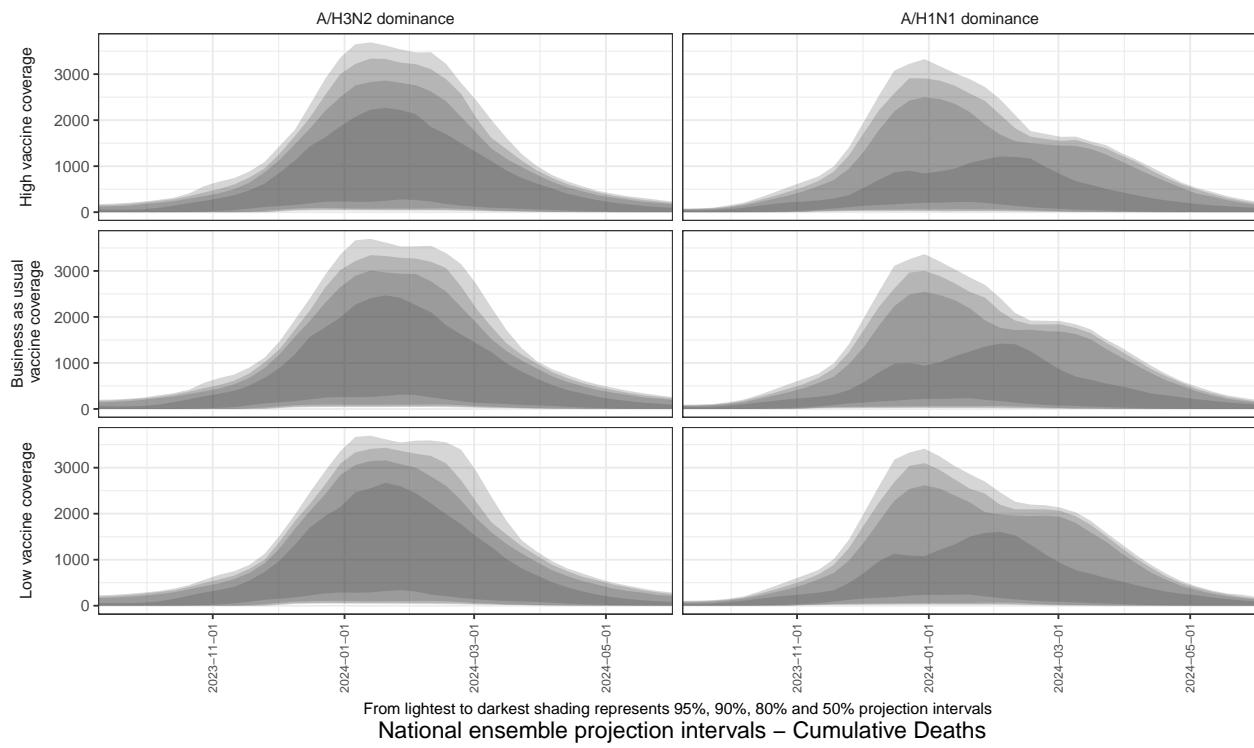
National ensemble projection intervals – Hospitalizations



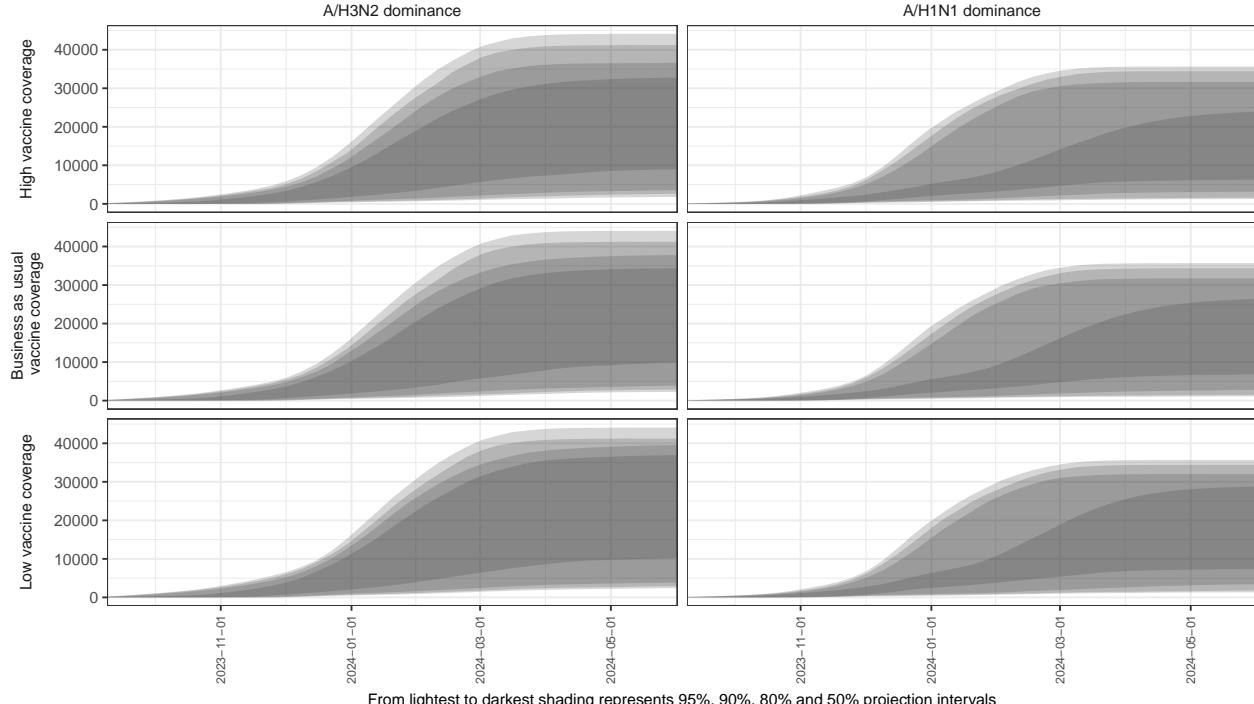
National ensemble projection intervals – Cumulative Hospitalizations



National ensemble projection intervals – Deaths



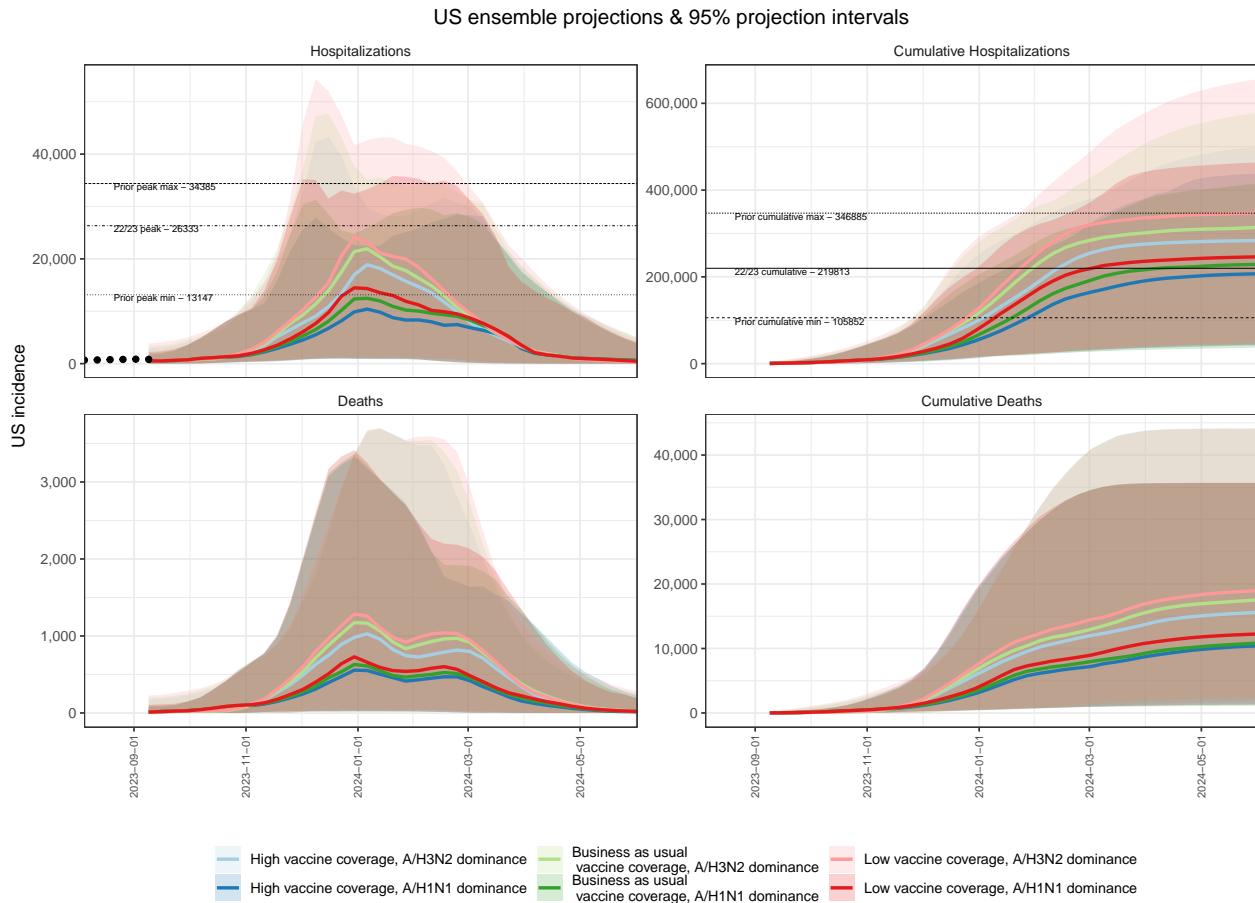
National ensemble projection intervals – Cumulative Deaths



Horizontal lines are given for prior peak incident and cumulative hospitalizations, from seasons from 2012-13 to 2019-20. The minimum and maximum peaks across these seasons are taken from FluSurv-NET (which is used as a proxy for hospitalizations). Nationally, the highest value is from the 2017-18 season, and the lowest from 2015-16. The 2022-23 flu season based on HHS data is also included to mark a small season.

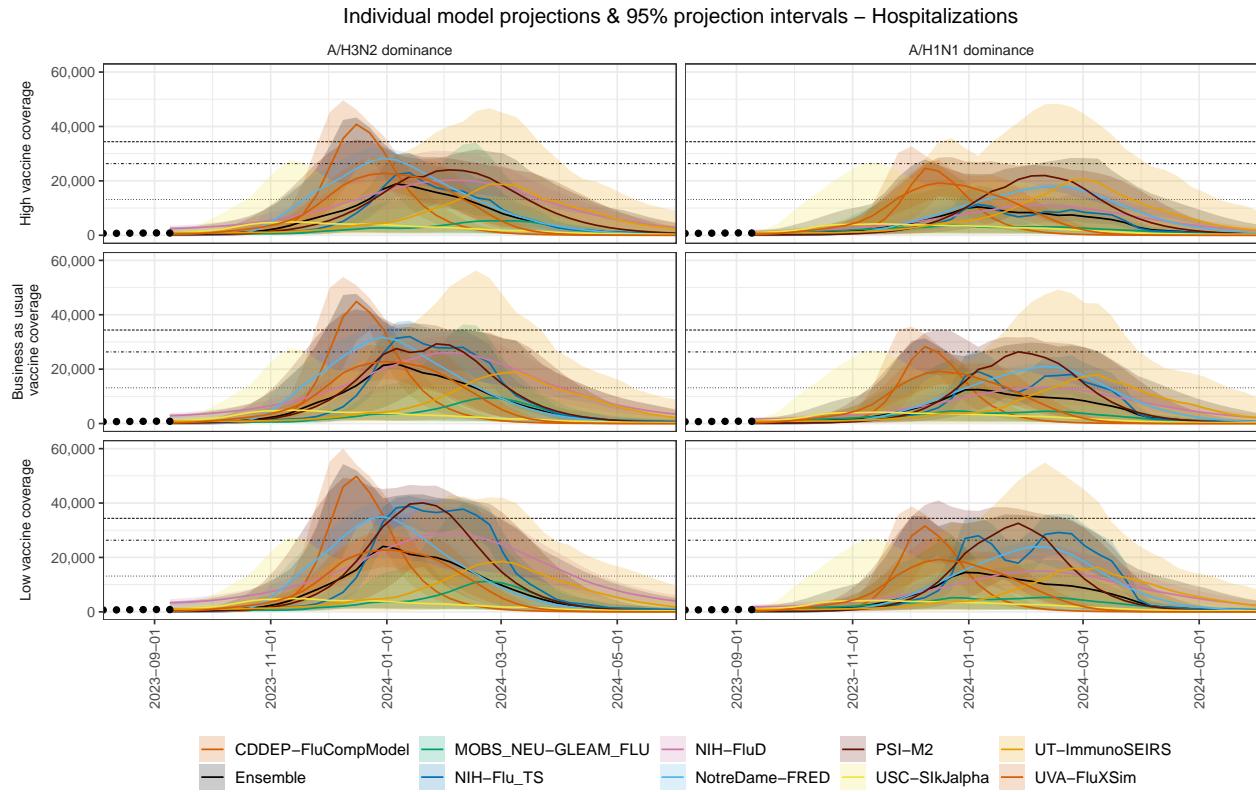
National ensemble projections

Ensemble projections for national incident and cumulative hospitalizations and deaths separated by scenario.

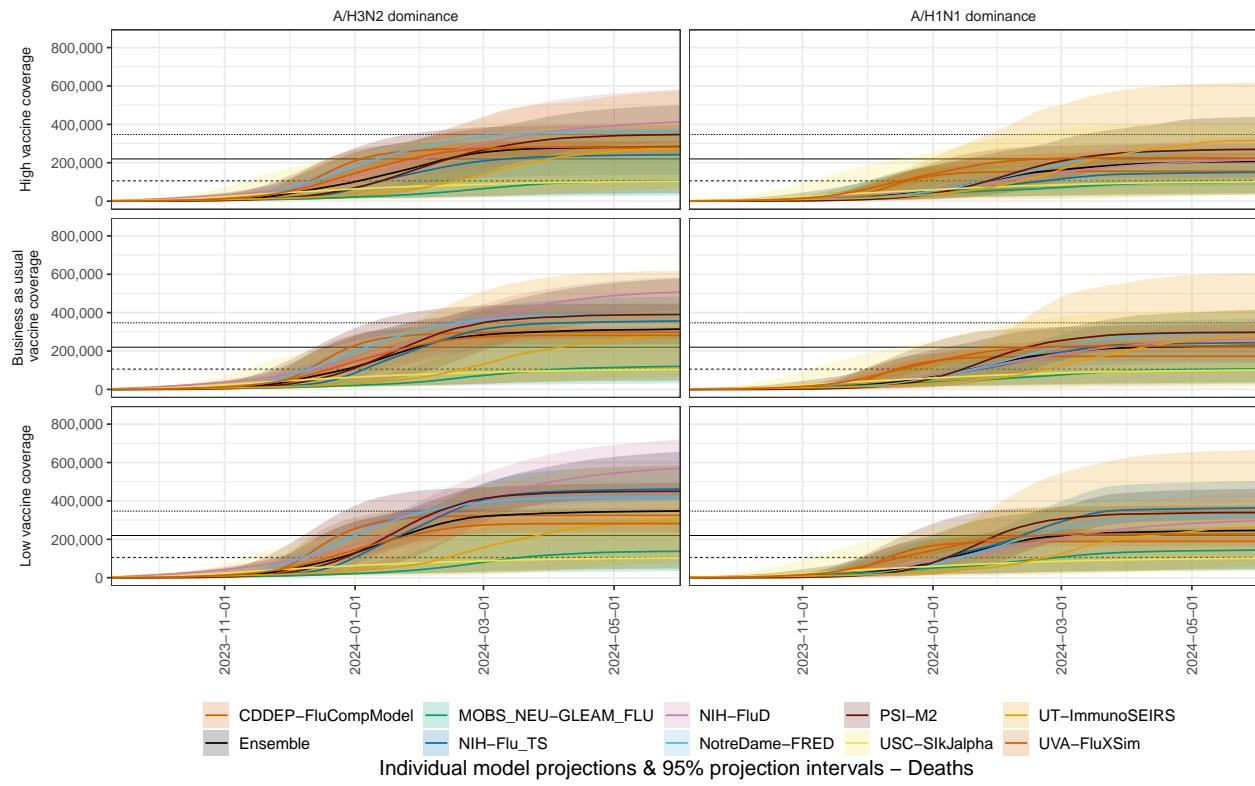


National individual model projections

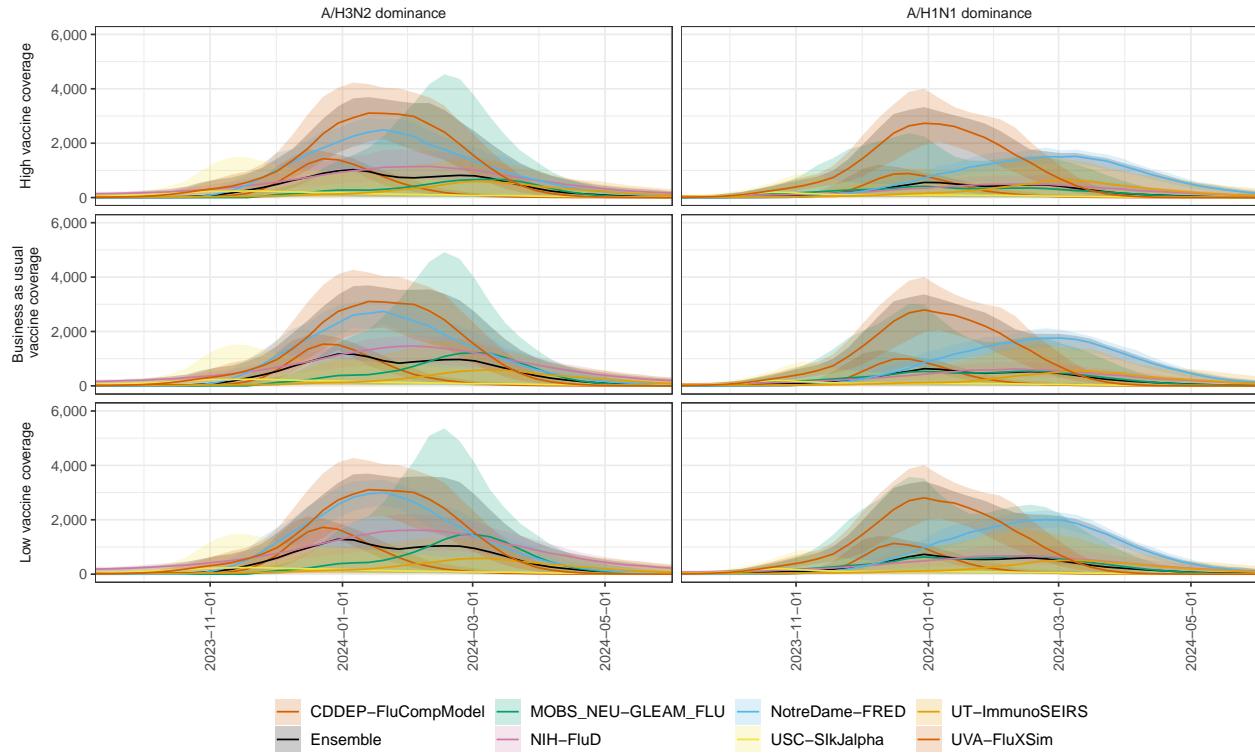
Individual model projections and ensemble by scenario for national hospitalizations, deaths and cumulative hospitalizations. For visualization we set axes limits; full confidence intervals are shown as a supplemental plot on page 17-18.



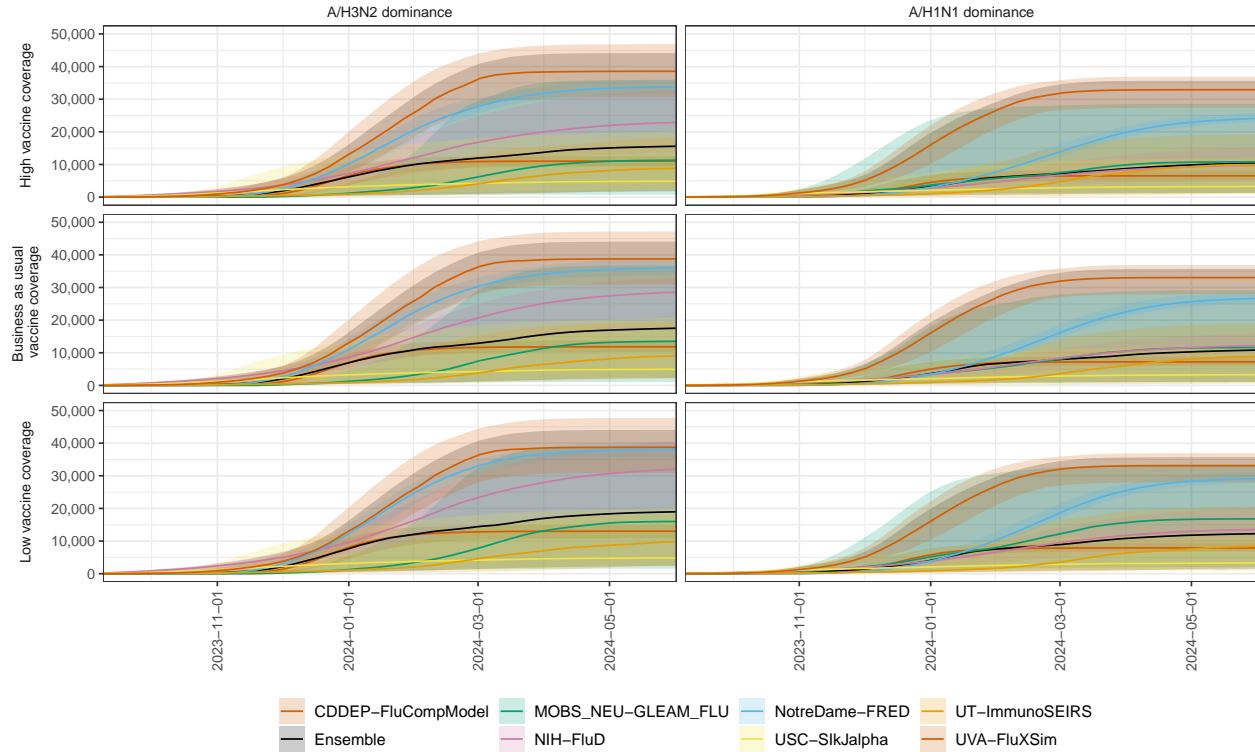
Individual model projections & 95% projection intervals – Cumulative Hospitalizations



Individual model projections & 95% projection intervals – Deaths

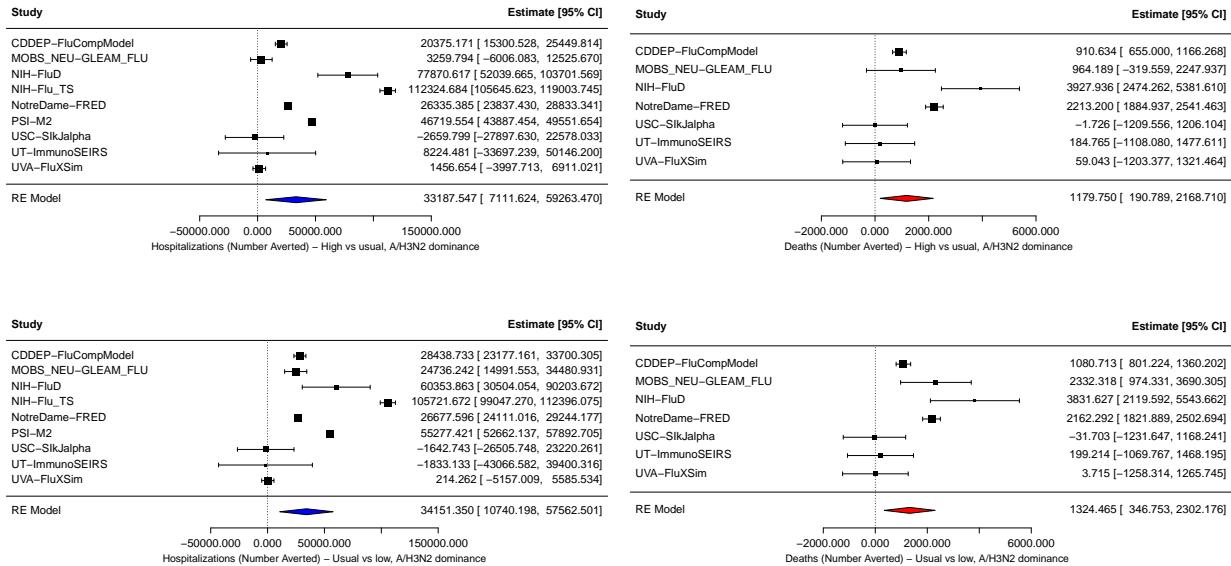


Individual model projections & 95% projection intervals – Cumulative Deaths



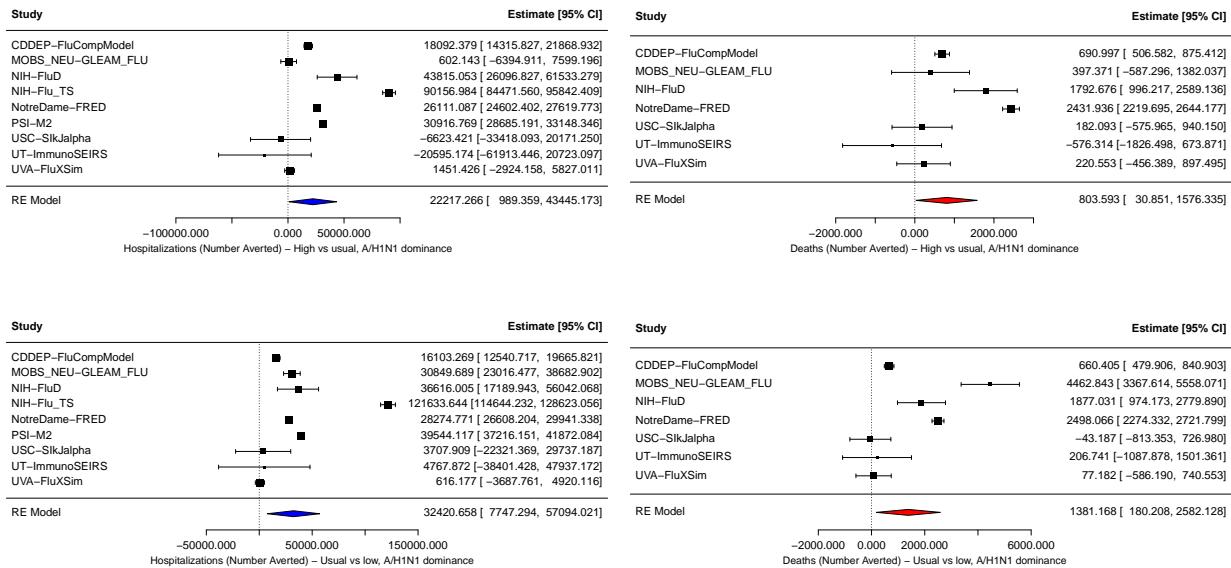
Estimates of hospitalizations and deaths averted by vaccination for H3N2 scenarios (absolute estimates)

Estimates averted by contrasting cumulative projections at the end of the season for high vs usual vaccine coverage scenarios (top) and usual vs low vaccine assumptions (bottom), for hospitalizations (left) and deaths (right).



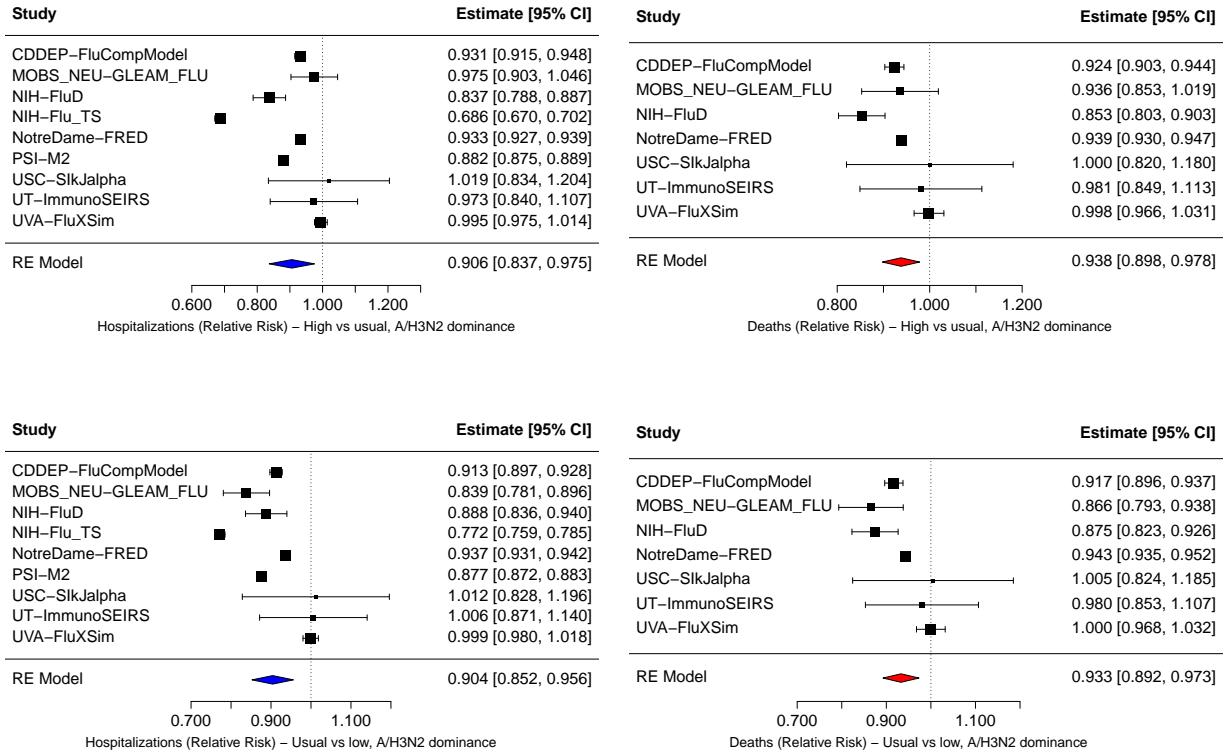
Estimates of hospitalizations and deaths averted by vaccination for H1N1 scenarios (absolute estimates)

Estimates averted by contrasting cumulative projections at the end of the season for high vs usual vaccine coverage scenarios (top) and usual vs low vaccine assumptions (bottom), for hospitalizations (left) and deaths (right).



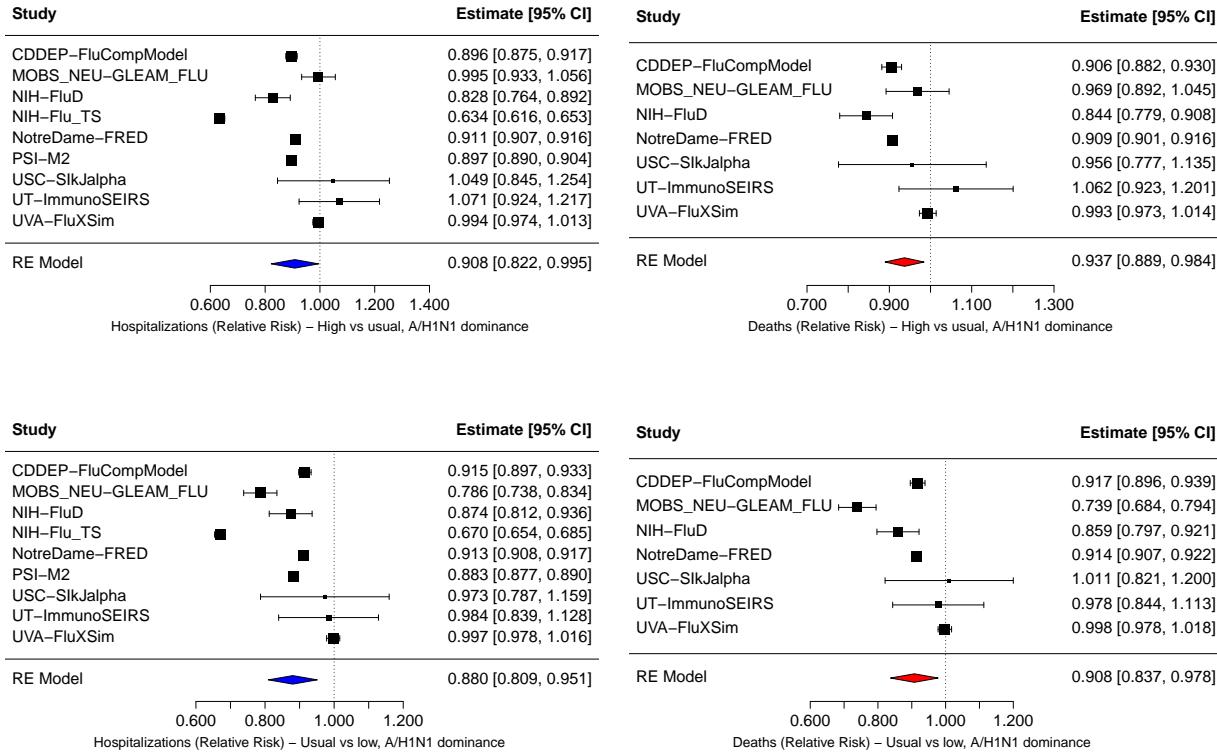
Estimates of hospitalizations and deaths averted by vaccination for H3N2 scenarios (relative estimates)

Relative change in cumulative projections at the end of the season for high vs usual vaccine coverage scenarios (top) and usual vs low vaccine assumptions (bottom), for hospitalizations (left) and deaths (right).



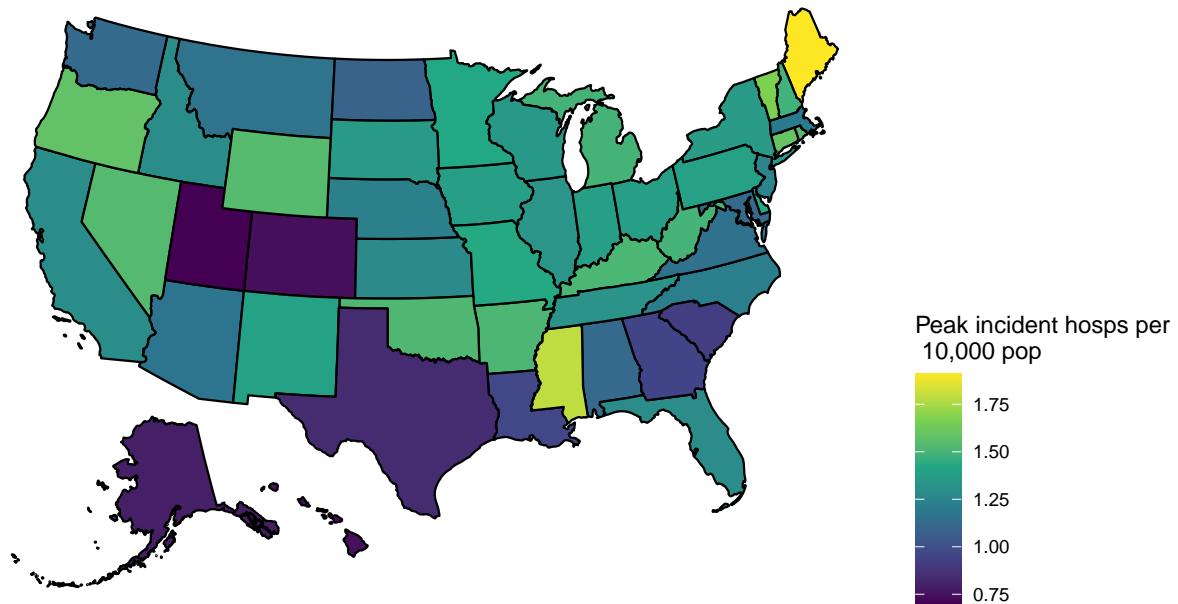
Estimates of hospitalizations and deaths averted by vaccination for H1N1 scenarios (relative estimates)

Relative change in cumulative projections at the end of the season for high vs usual vaccine coverage scenarios (top) and usual vs low vaccine assumptions (bottom), for hospitalizations (left) and deaths (right).

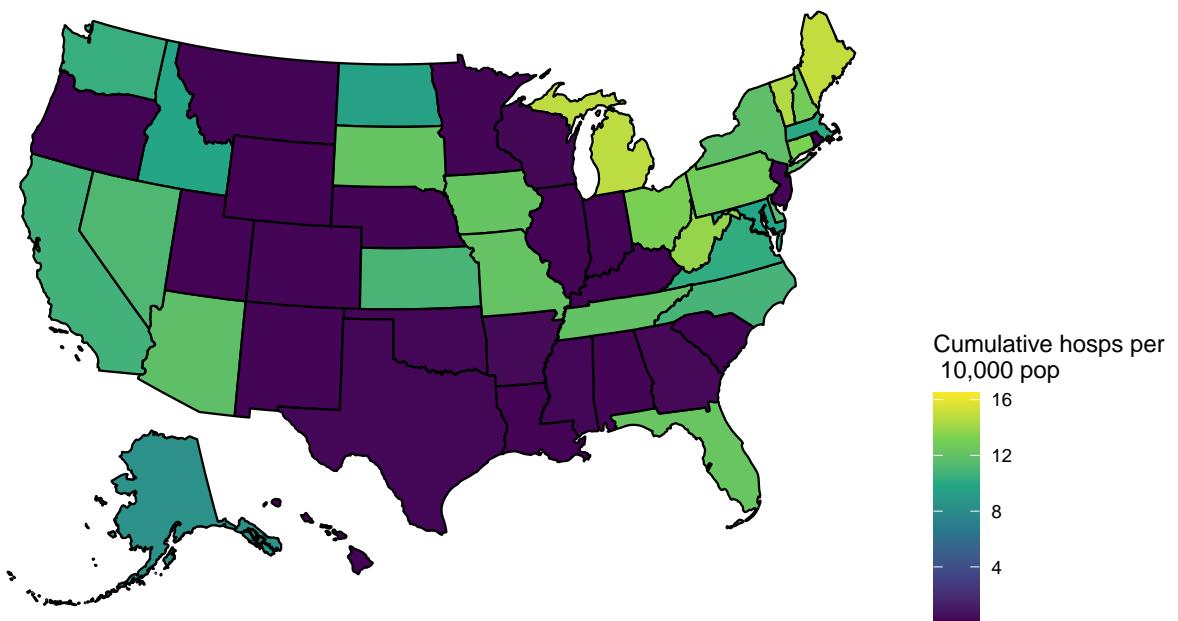


Risk maps

Peak incident reported hospitalizations per 10,000 population in scenario with Low vaccine coverage, A/H3N2 dominance: August 14, 2023 to June 01, 2024

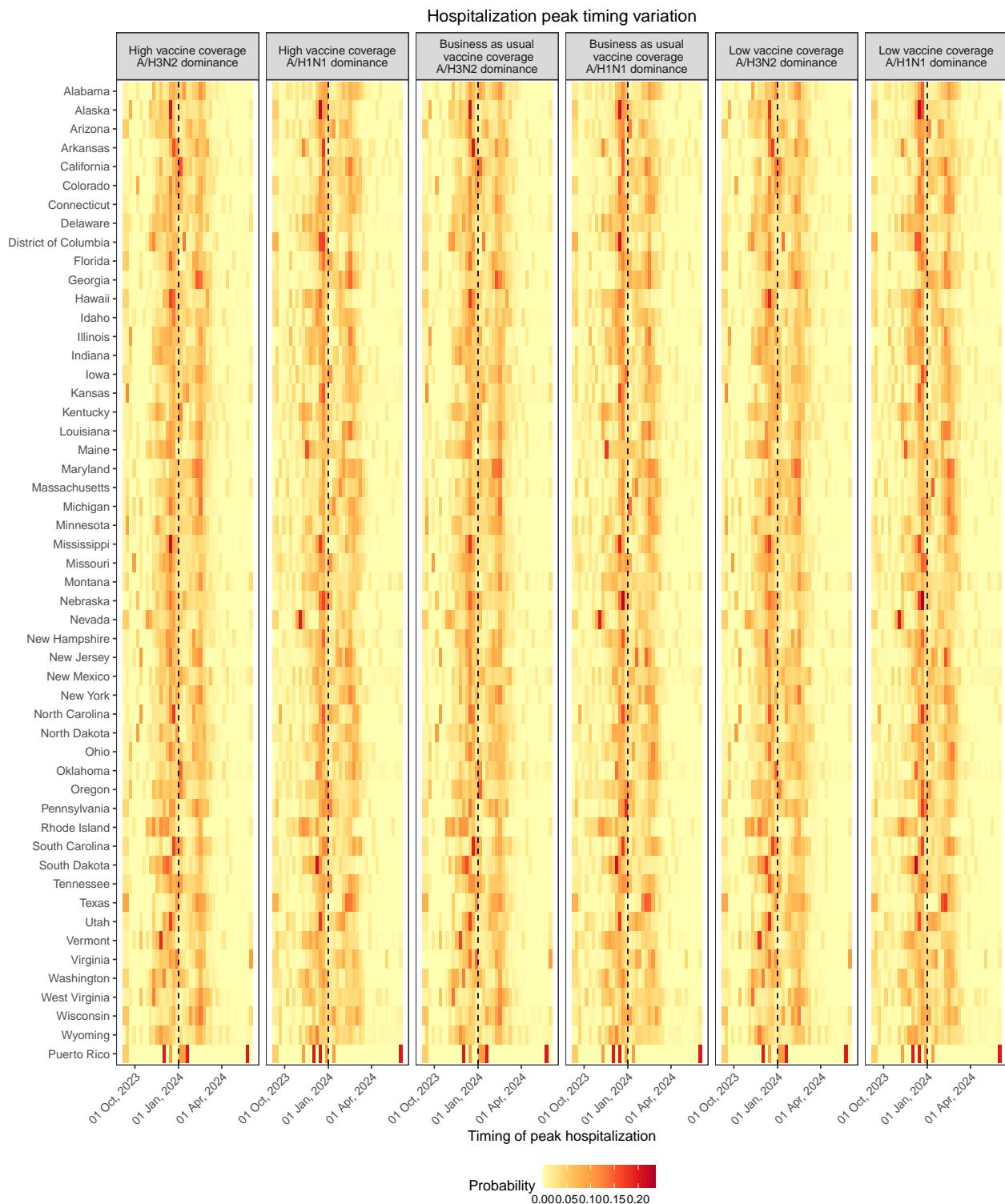


Cumulative reported hospitalizations per 10,000 population in scenario with Low vaccine coverage, A/H3N2 dominance: August 14, 2023 to June 01, 2024



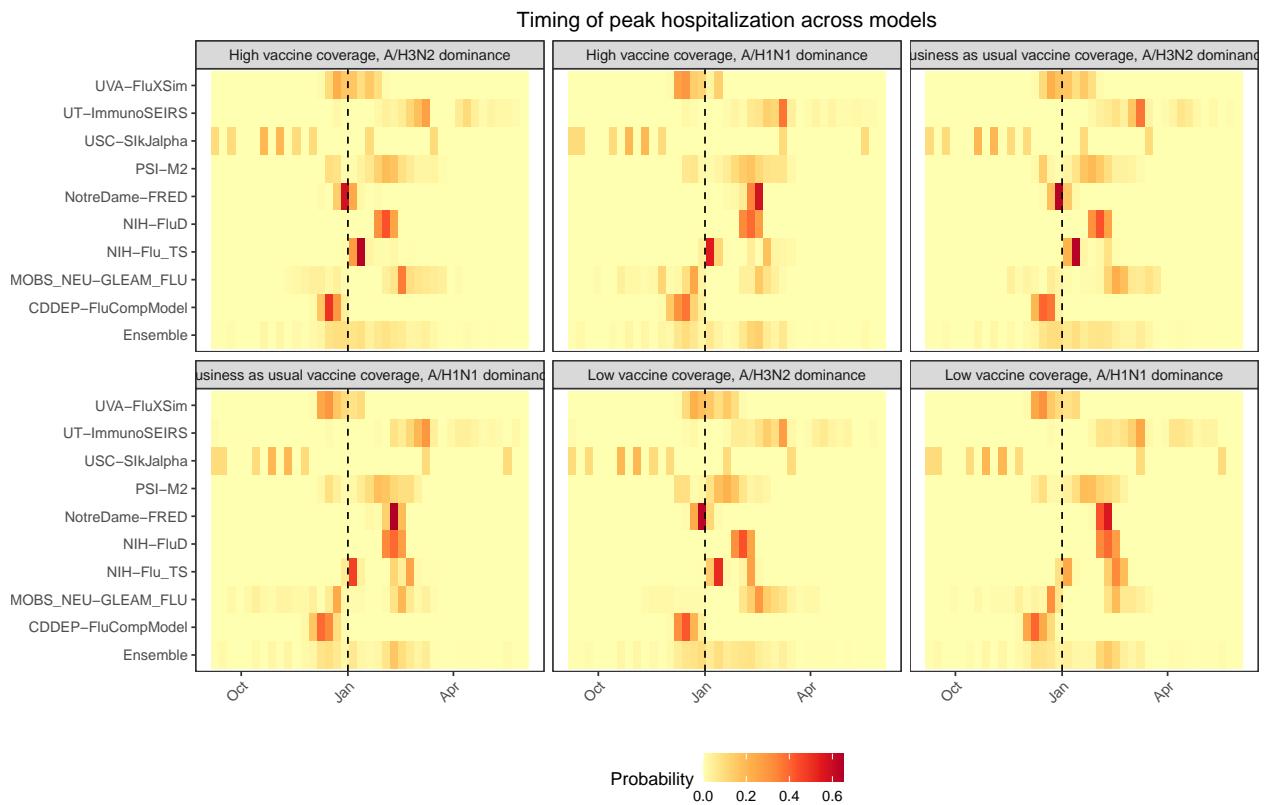
State variability in peak timing

Ensembles projections for state-level timing of peak hospitalization incidence.



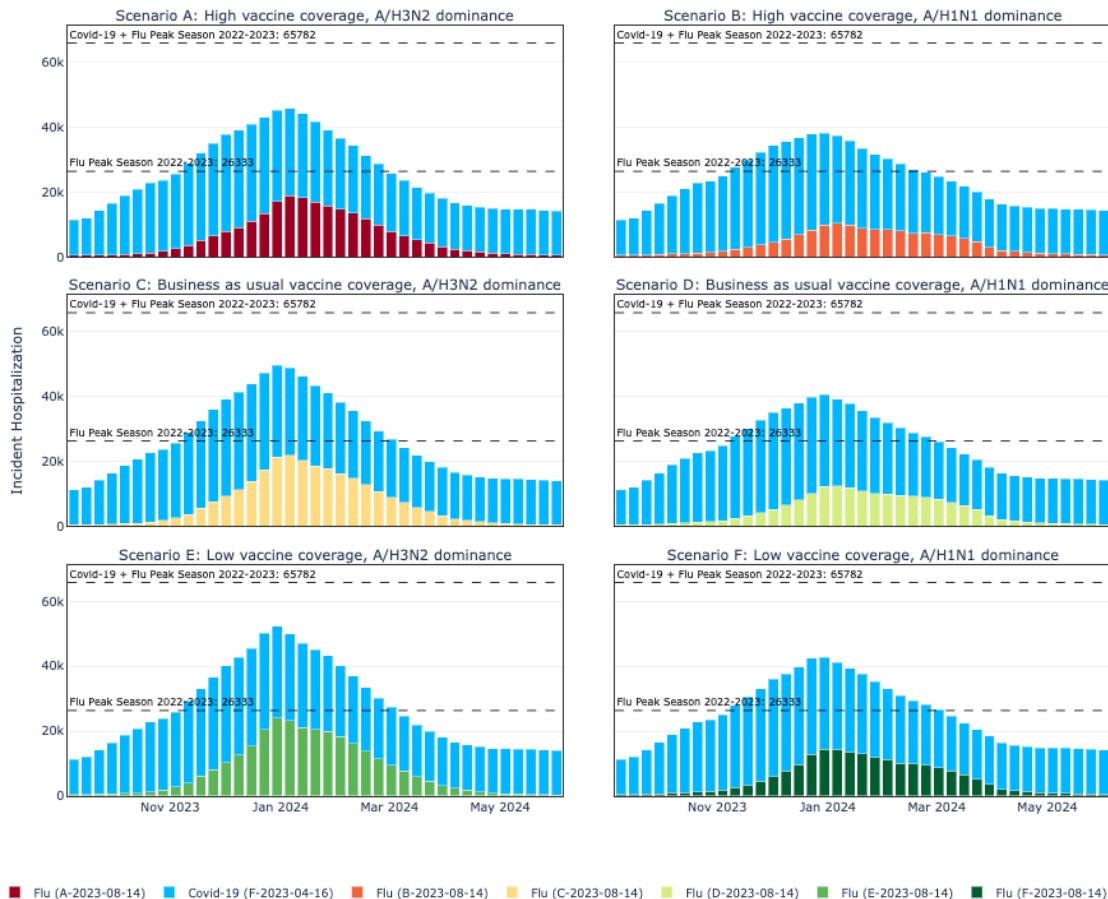
Peak hospitalizations timing

Individual model probabilities for national timing of peak hospitalizations.



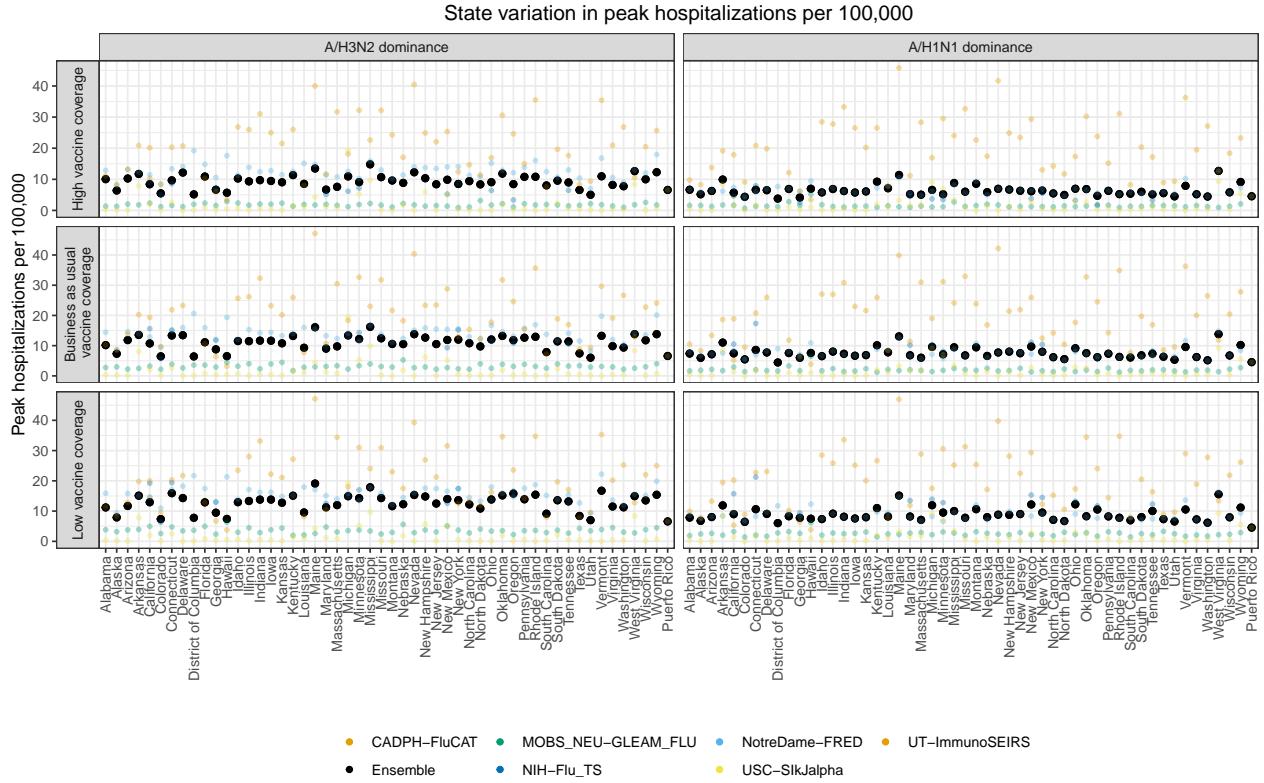
Ensemble hospitalization projections for the combined impact of influenza and COVID19 in 2023-24.

Plots using SMH Round 17 COVID-19 projections from scenario F, high immune escape and boosters for all age group (blue bars) and the 6 influenza scenarios described in this report (all colors except for blue). Median projections are represented for both pathogens.

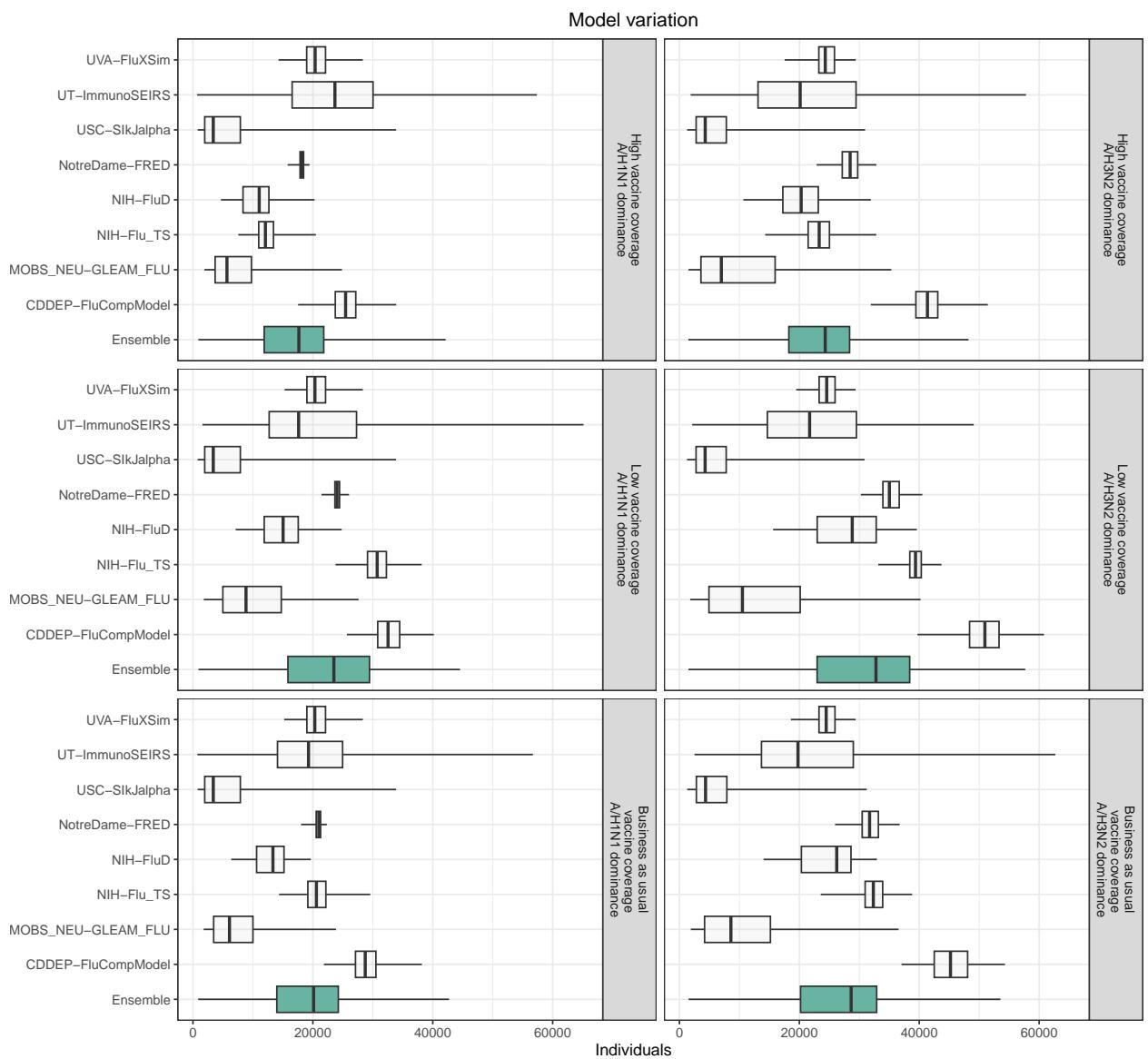


State-level deviation in hospitalization incidence

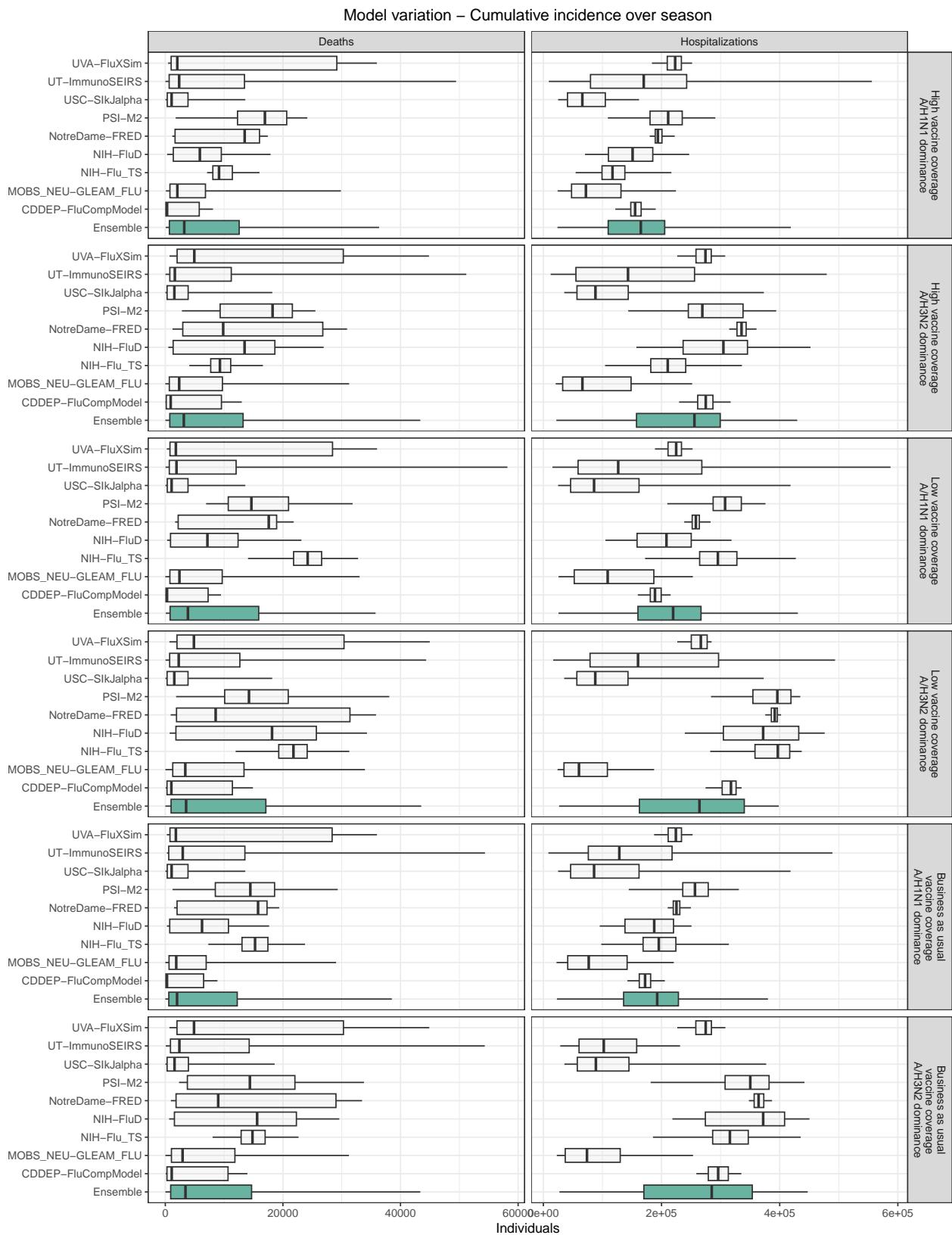
Individual model and ensembles projections for state-level peak hospitalization incidence.



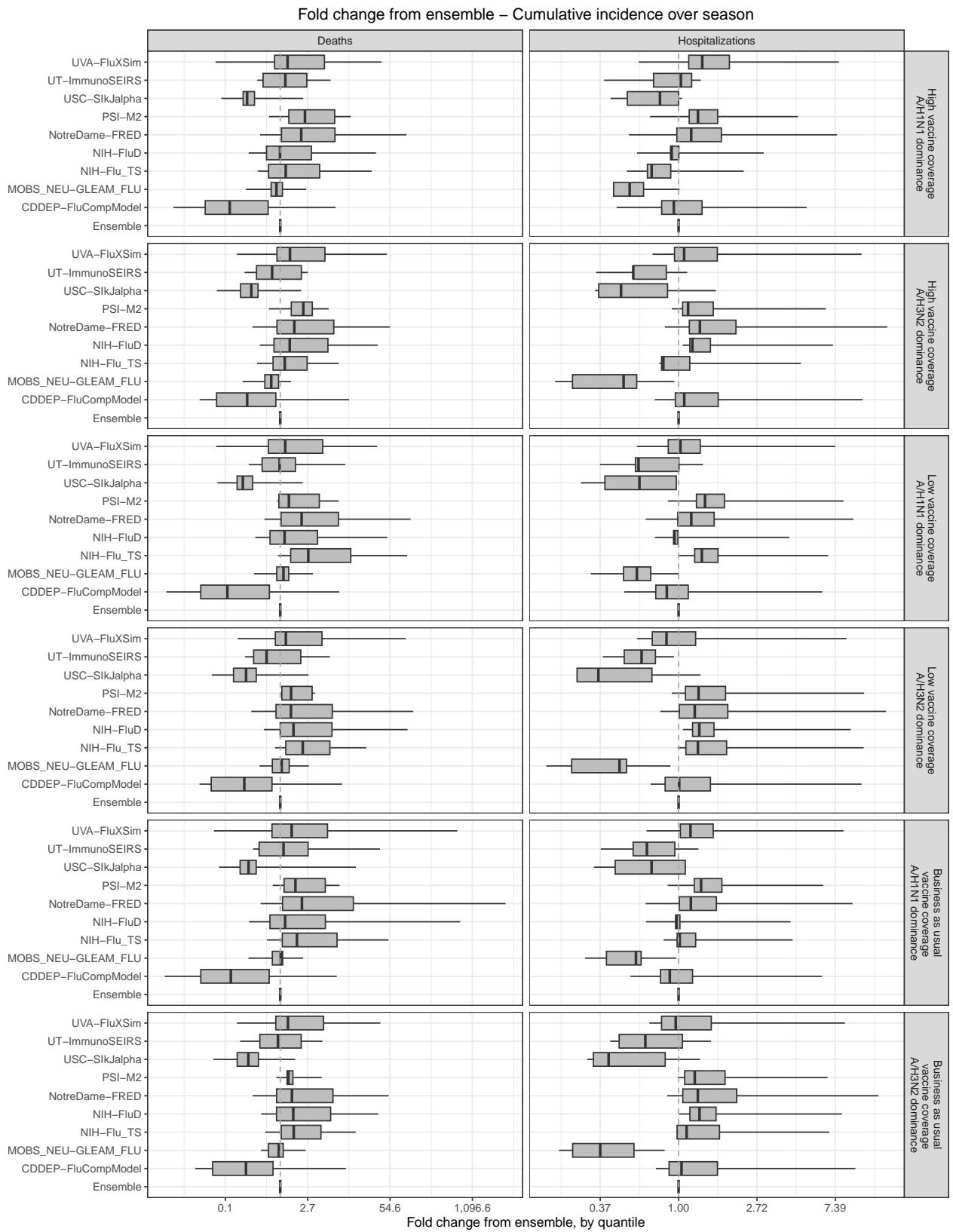
Model Variation in National Peak Size



Cumulative incidence over season by model

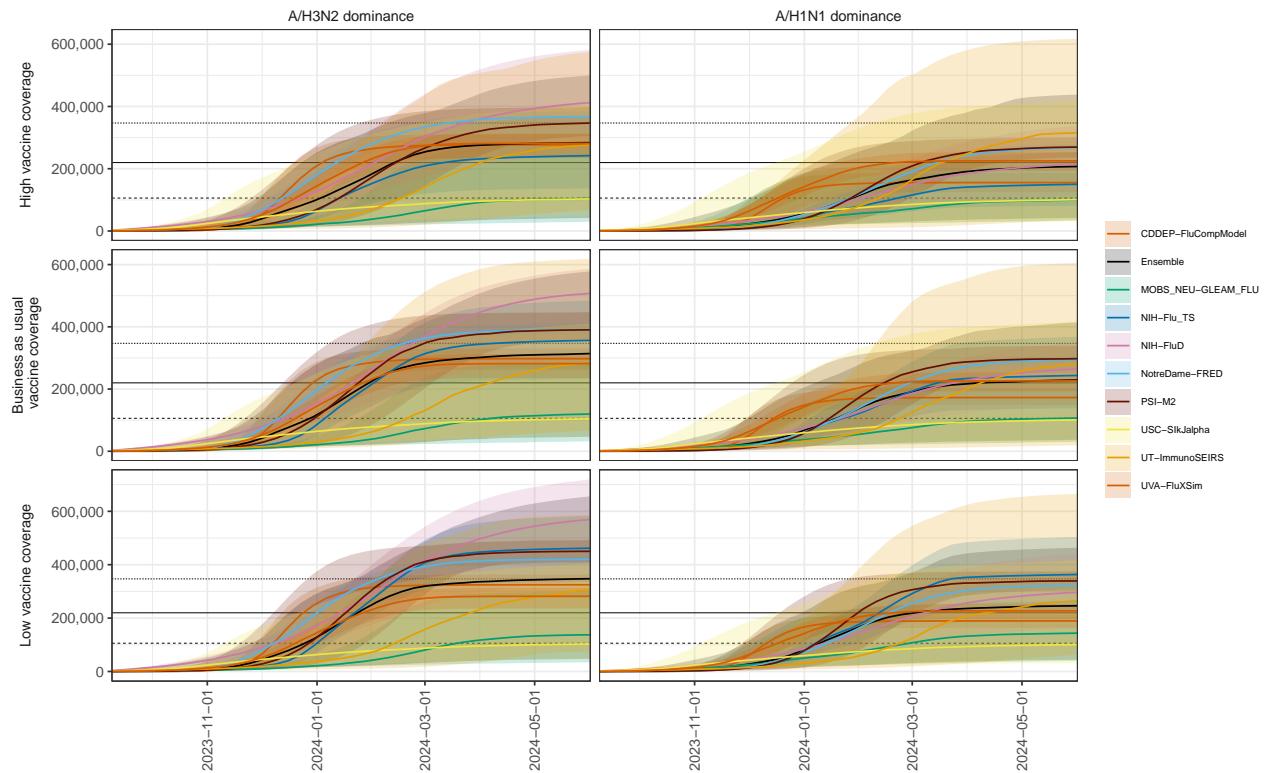
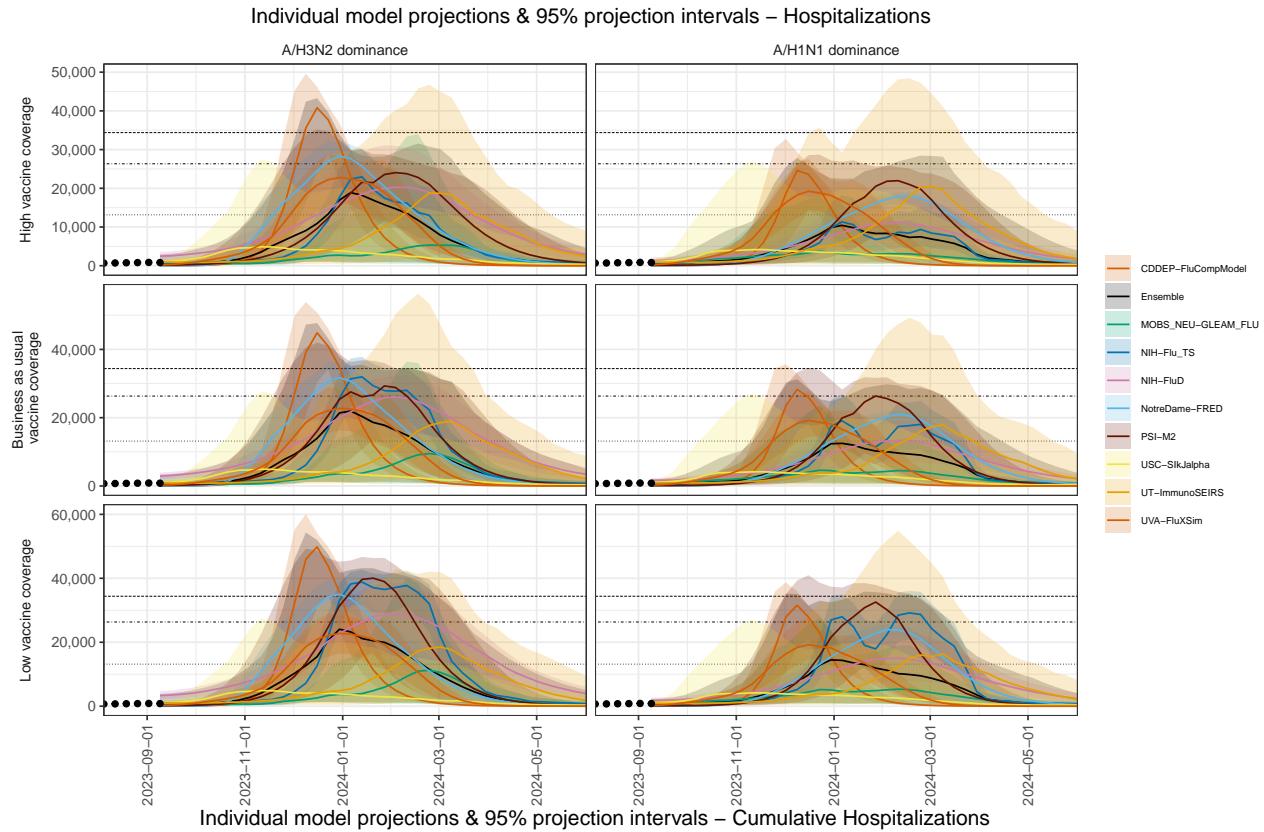


Difference between model and ensemble distributions

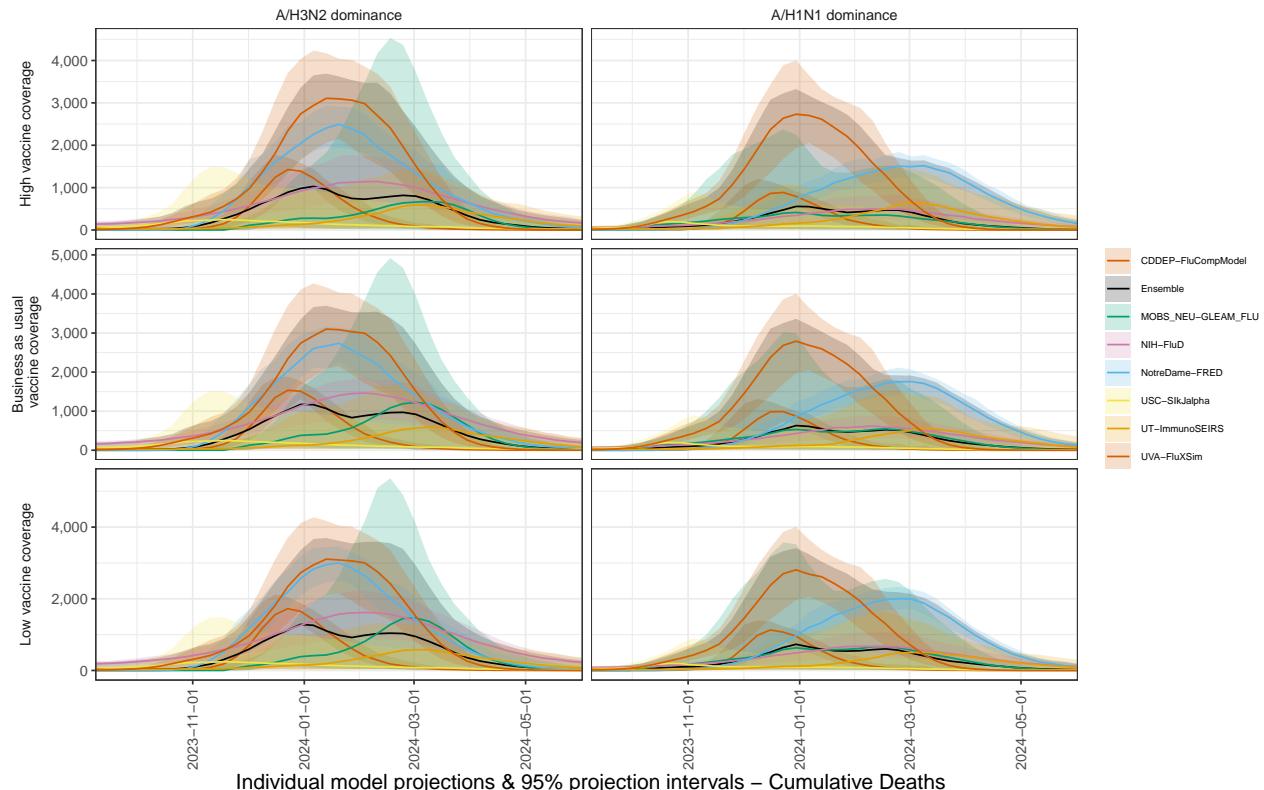


Supplemental Plots

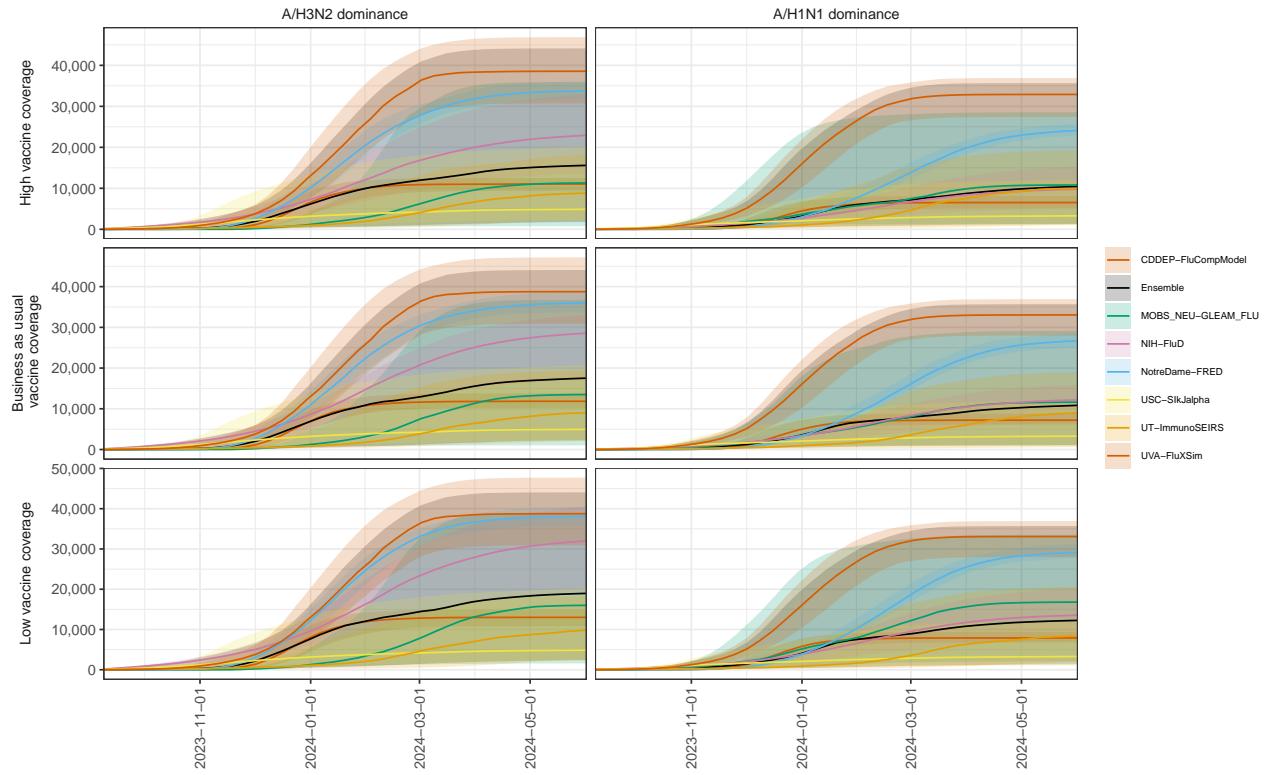
National individual model projections - full confidence intervals



Individual model projections & 95% projection intervals – Deaths



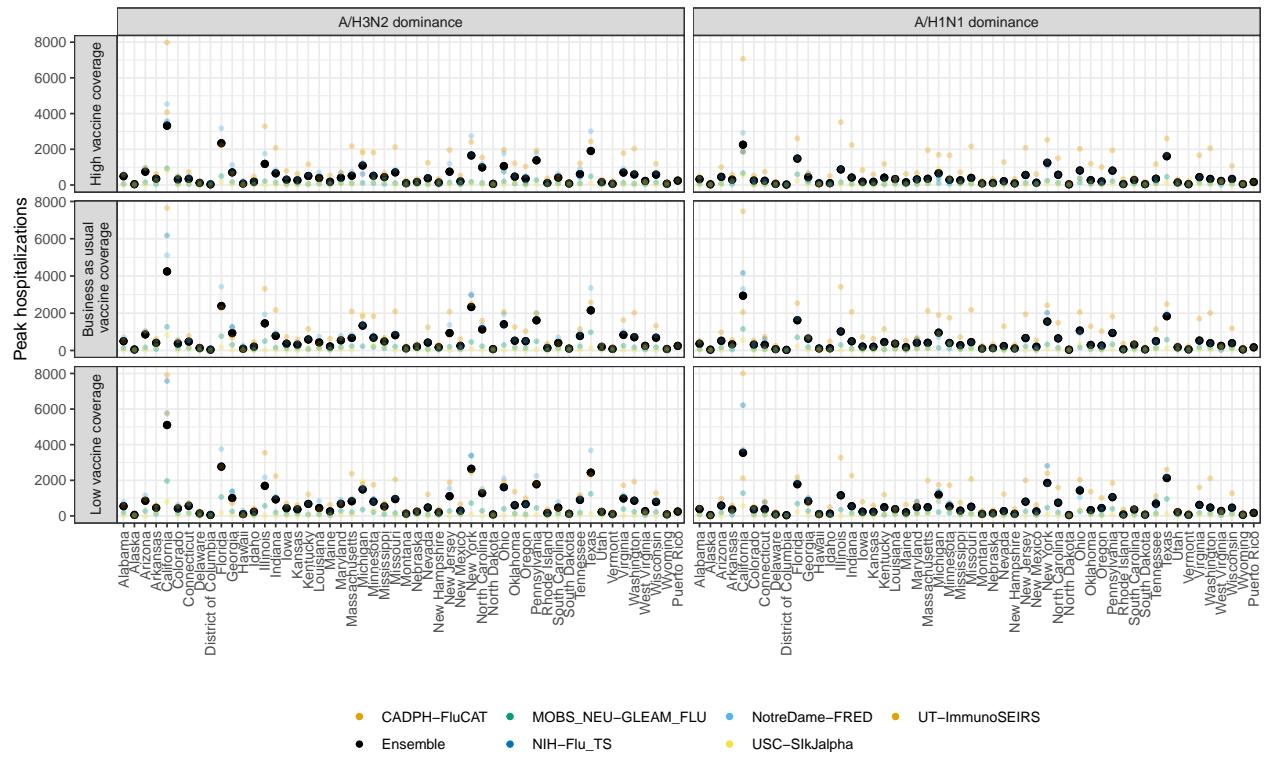
Individual model projections & 95% projection intervals – Cumulative Deaths



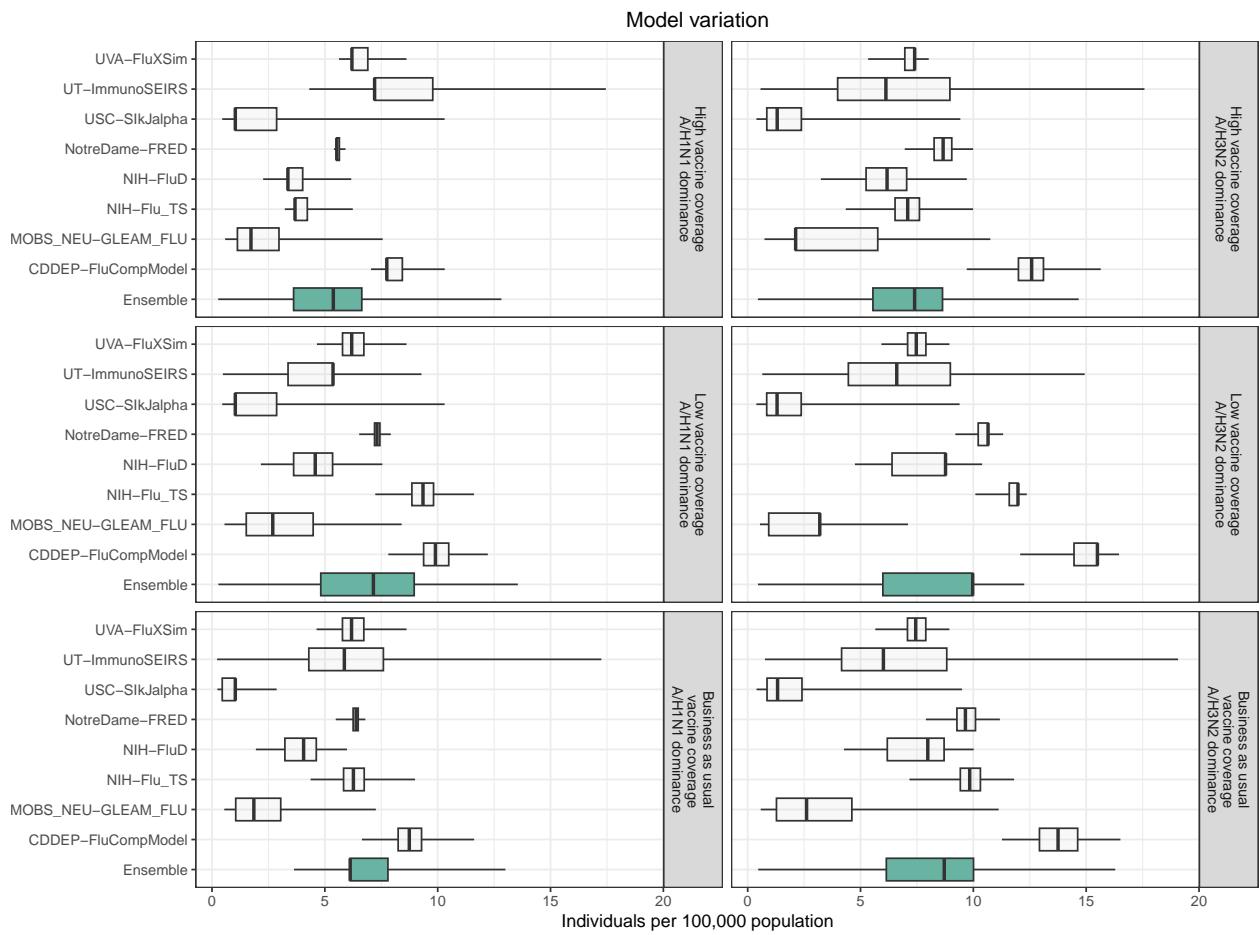
State-level deviation in hospitalization incidence

Individual model and ensembles projections for state-level peak hospitalization incidence.

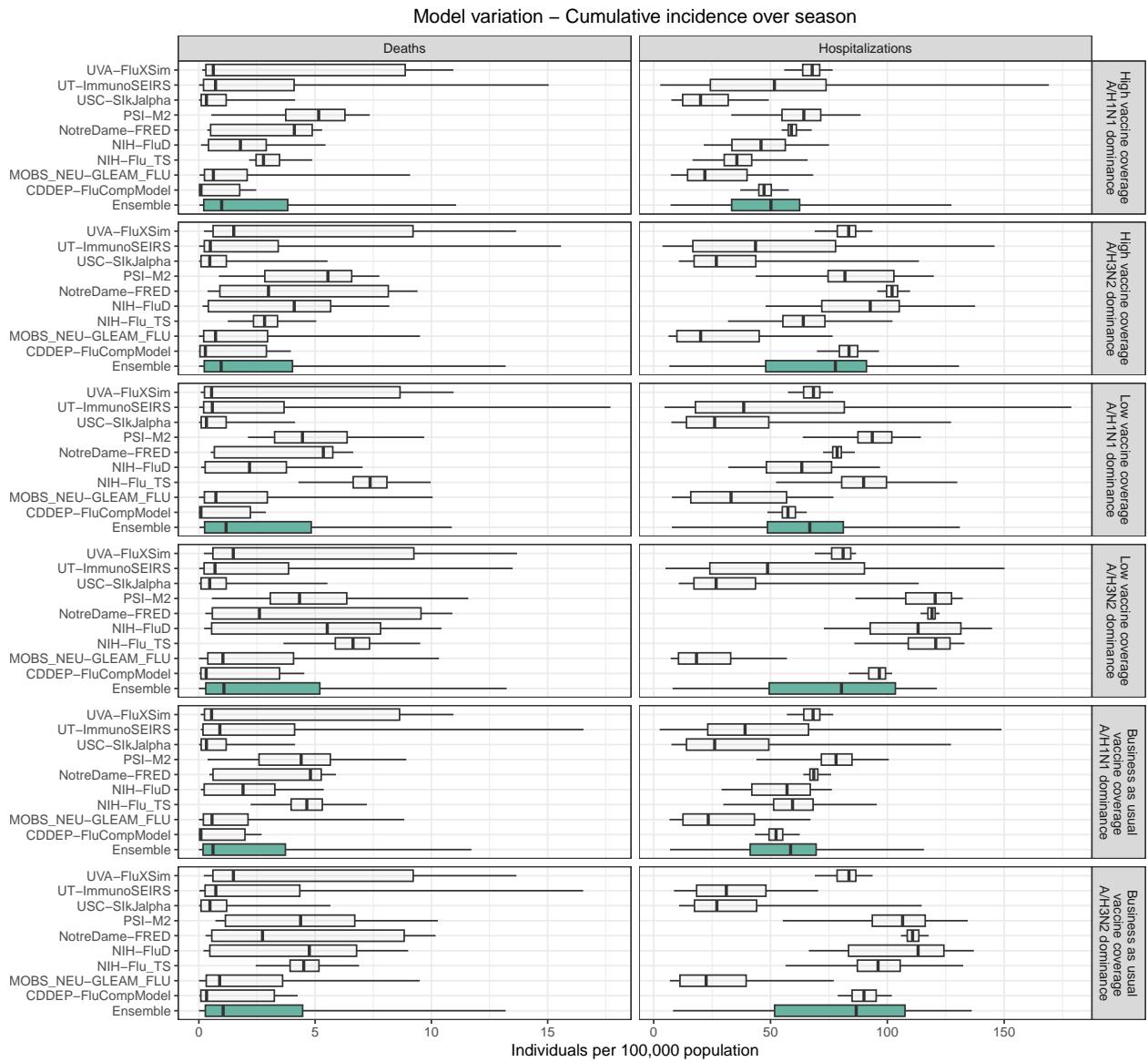
State variation in peak hospitalizations



Model Variation in National Peak Size - rates per 100,000 population

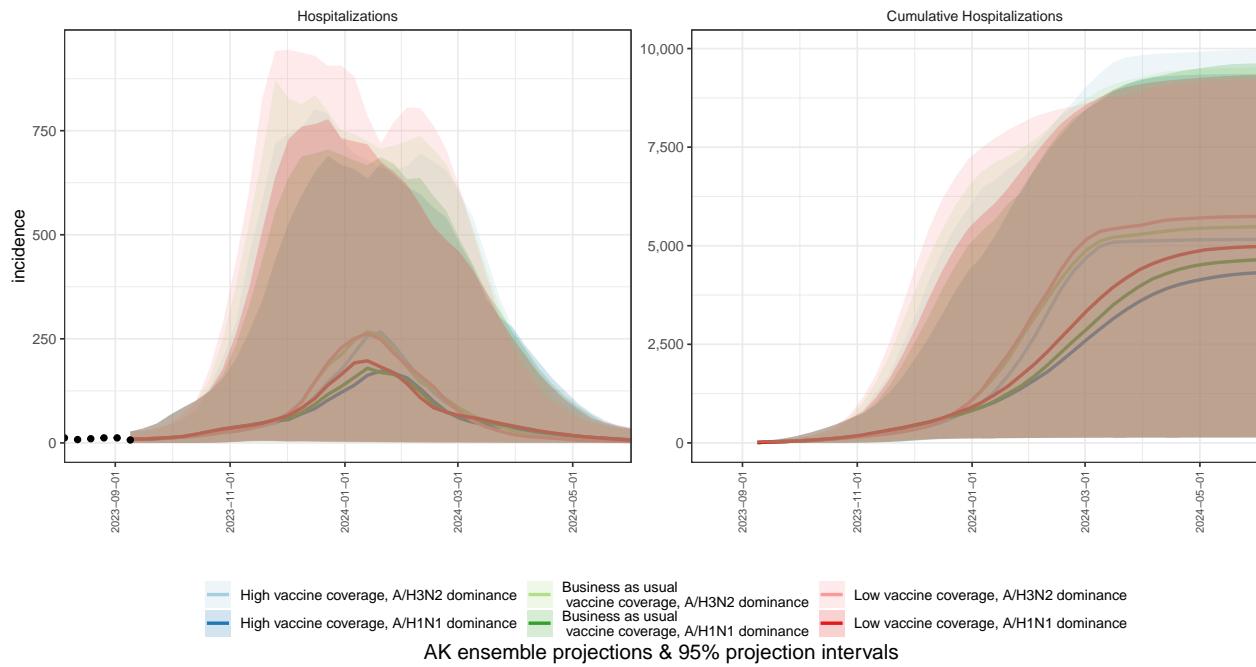


Cumulative incidence over season - rates per 100,000 population

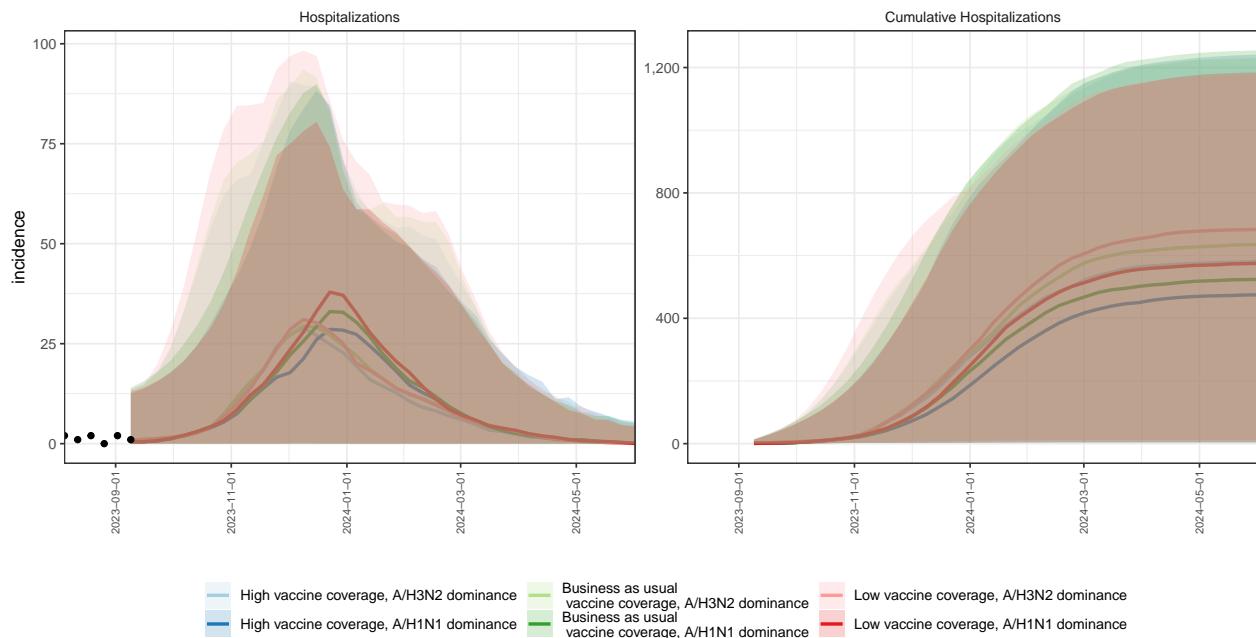


State-level ensemble plots

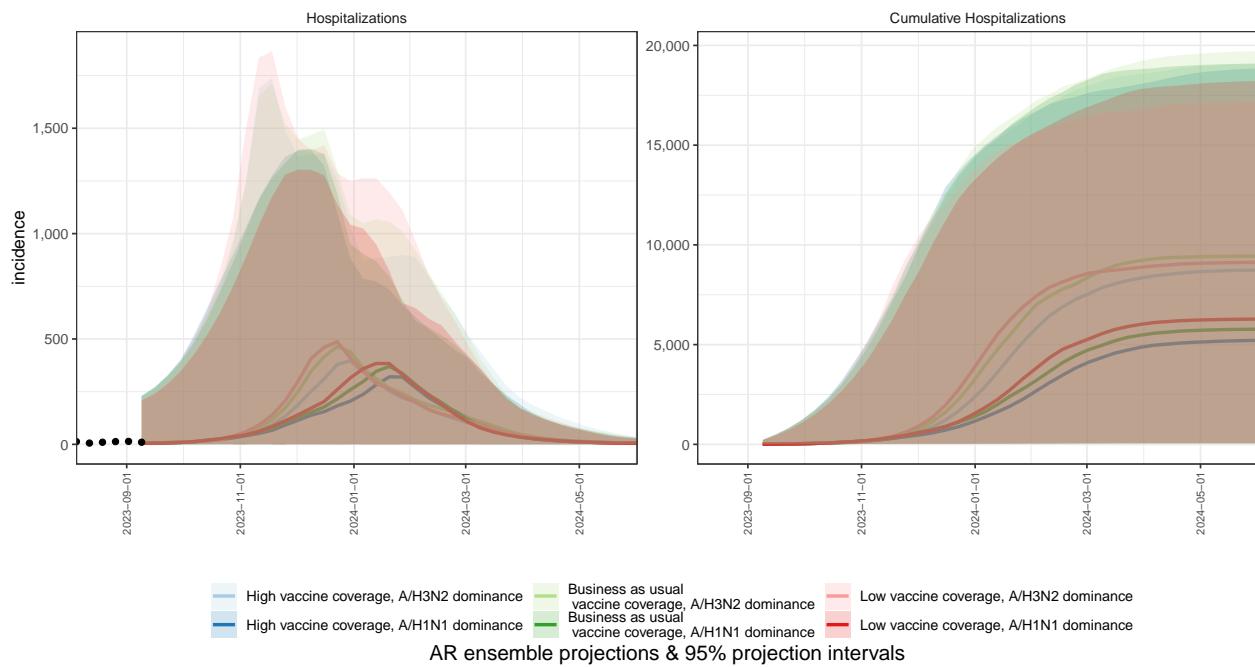
AL ensemble projections & 95% projection intervals



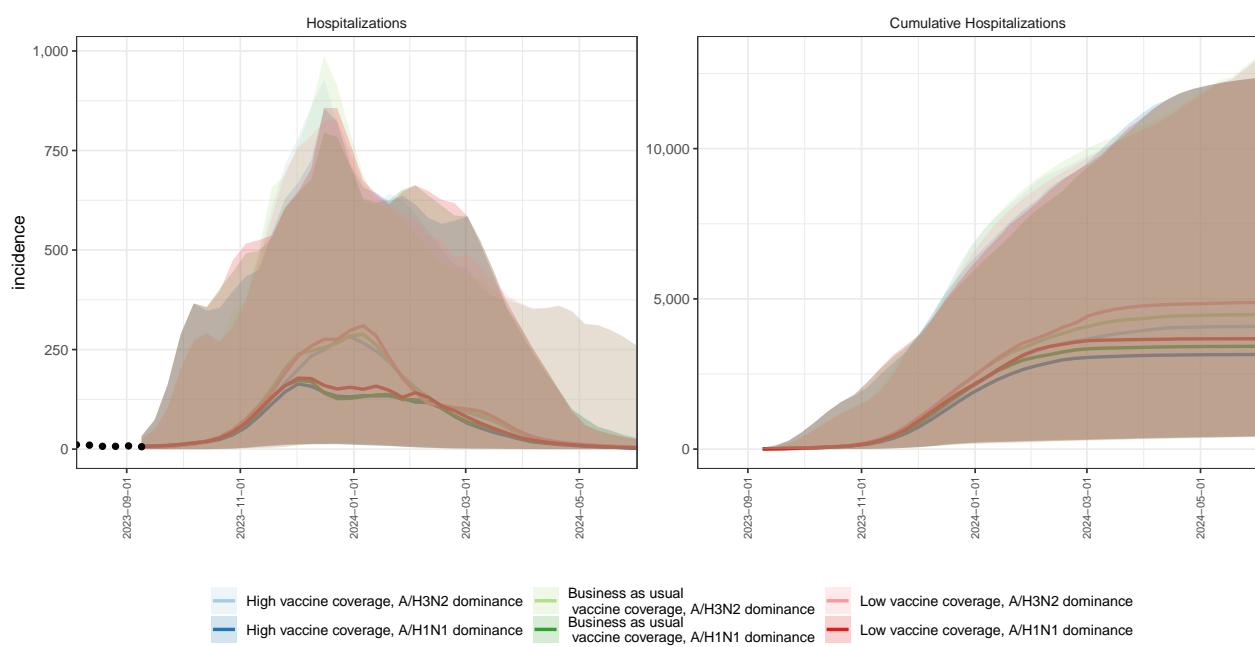
AK ensemble projections & 95% projection intervals



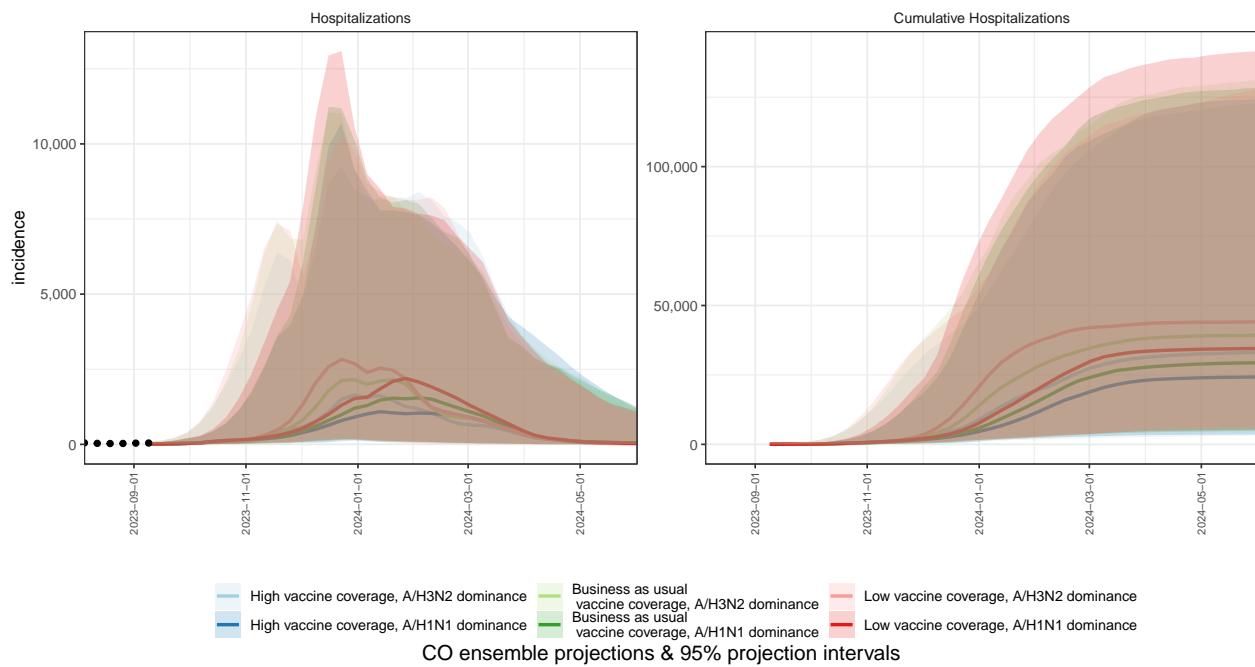
AZ ensemble projections & 95% projection intervals



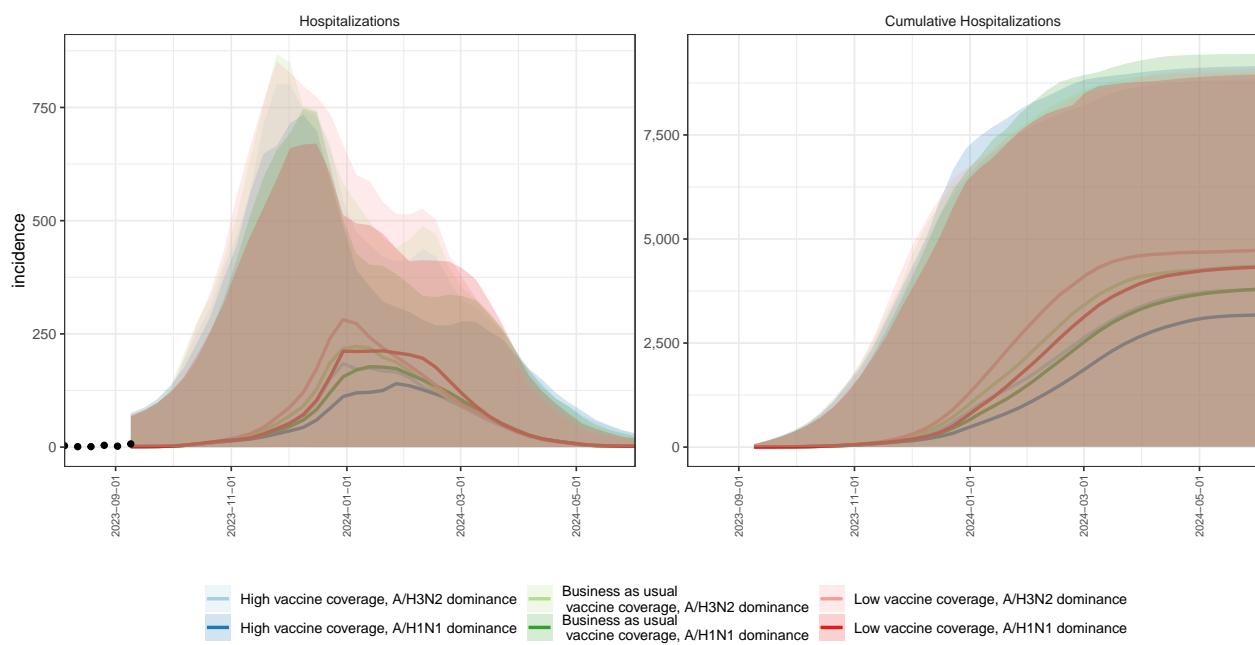
AR ensemble projections & 95% projection intervals



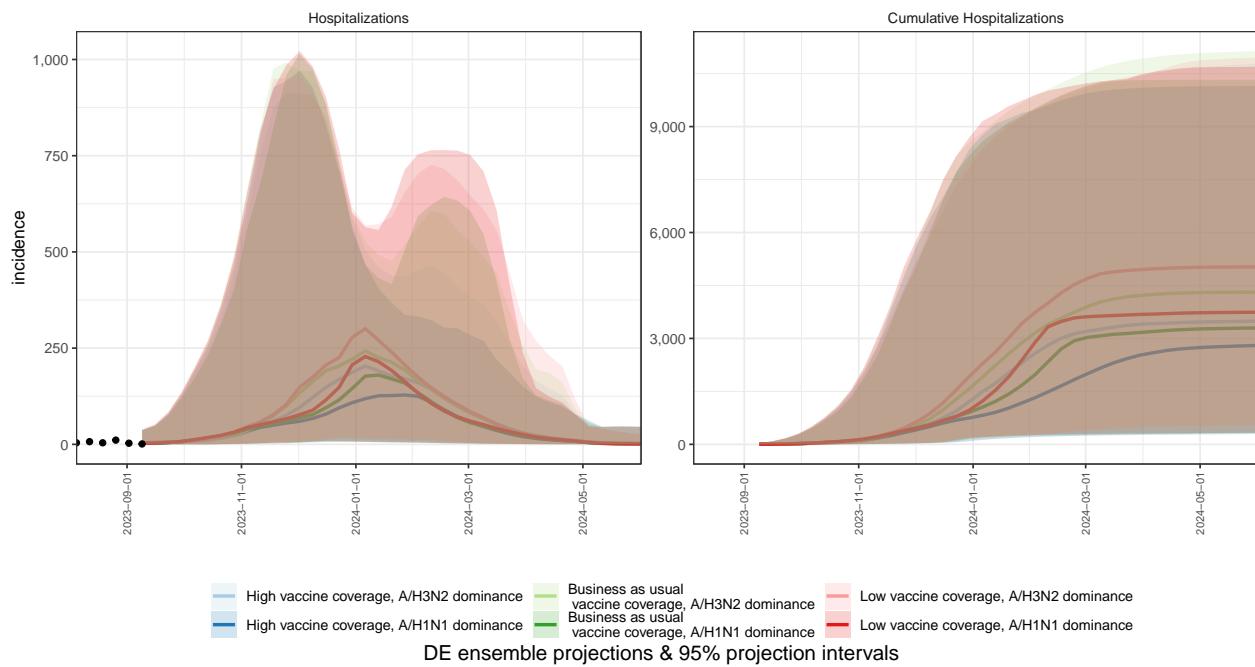
CA ensemble projections & 95% projection intervals



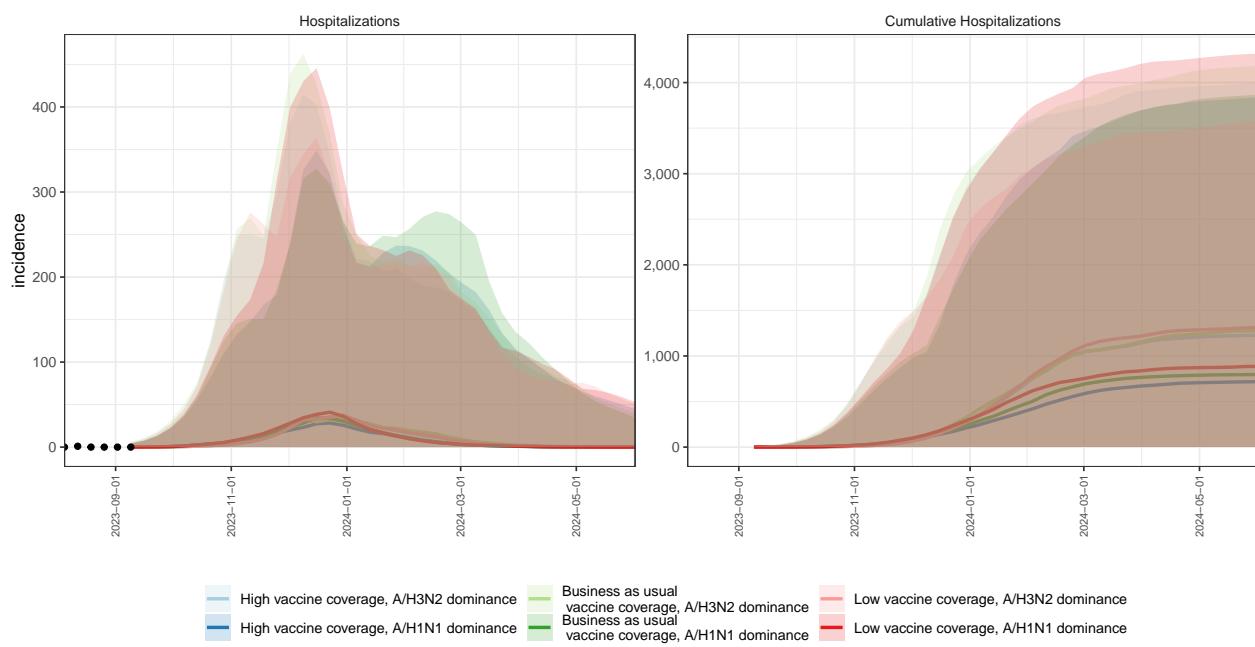
CO ensemble projections & 95% projection intervals



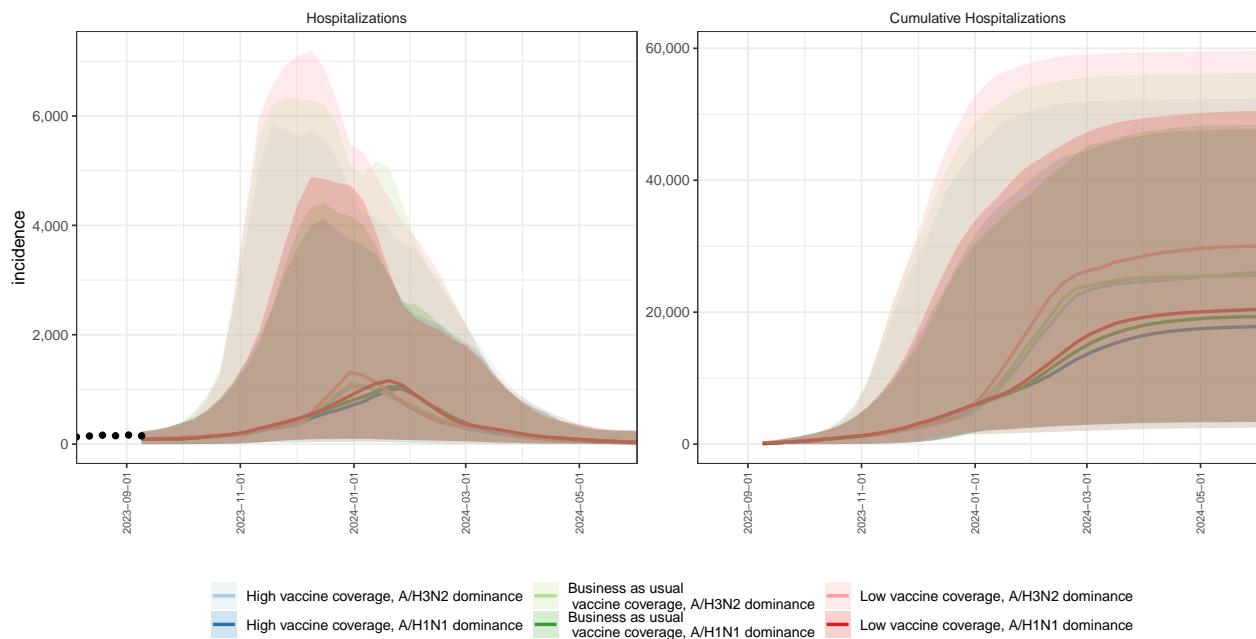
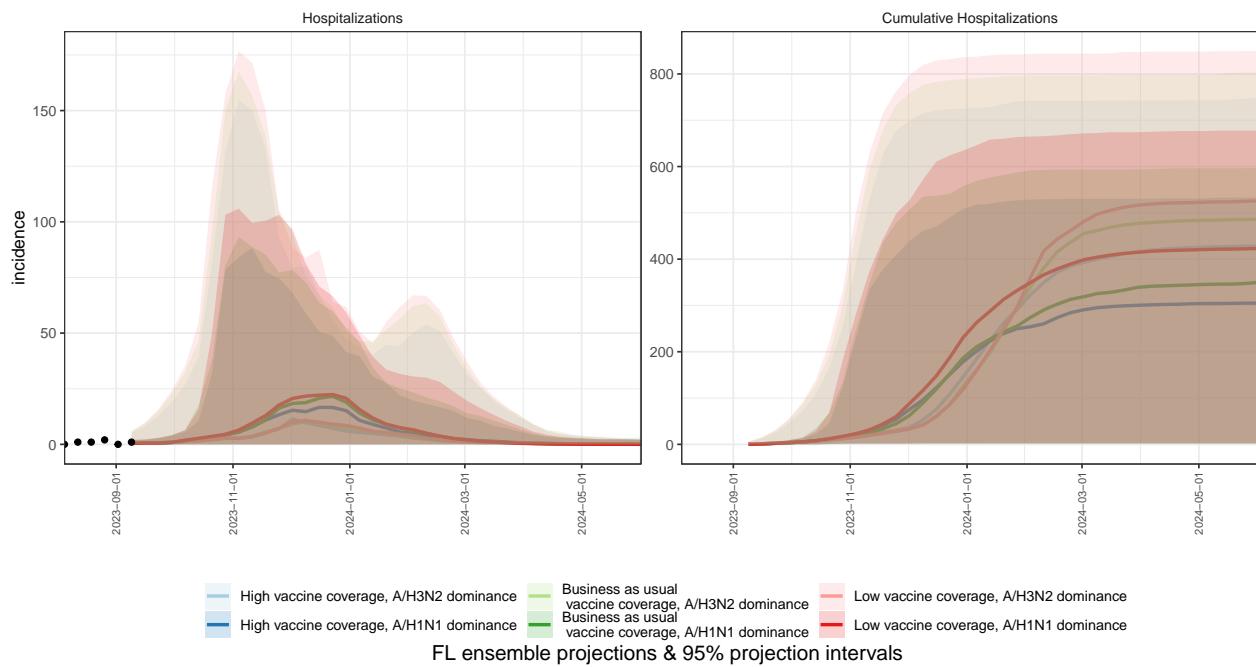
CT ensemble projections & 95% projection intervals



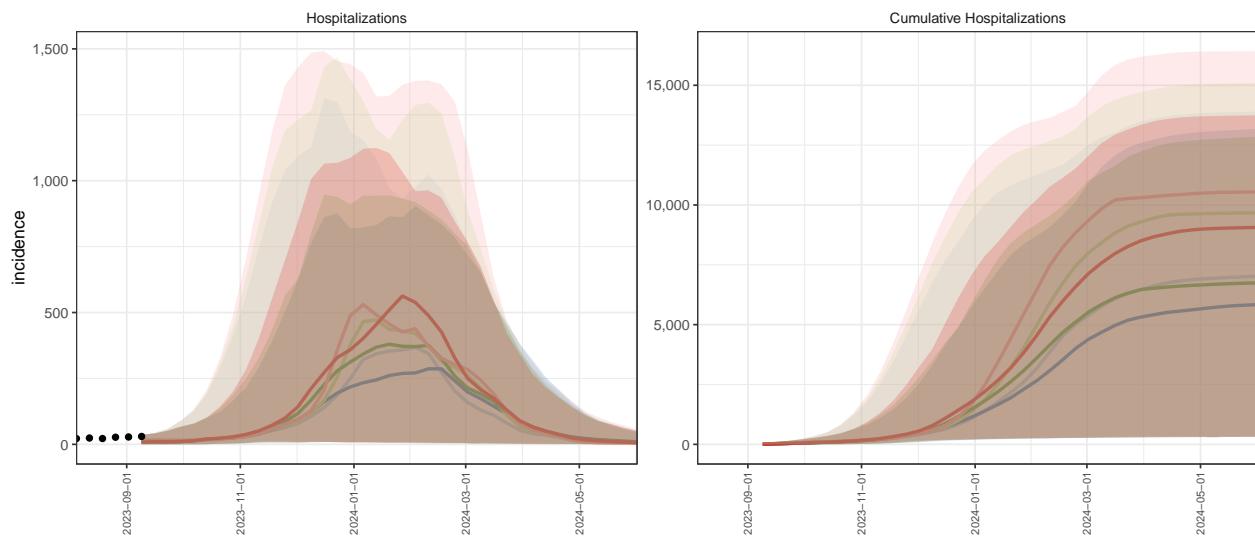
DE ensemble projections & 95% projection intervals



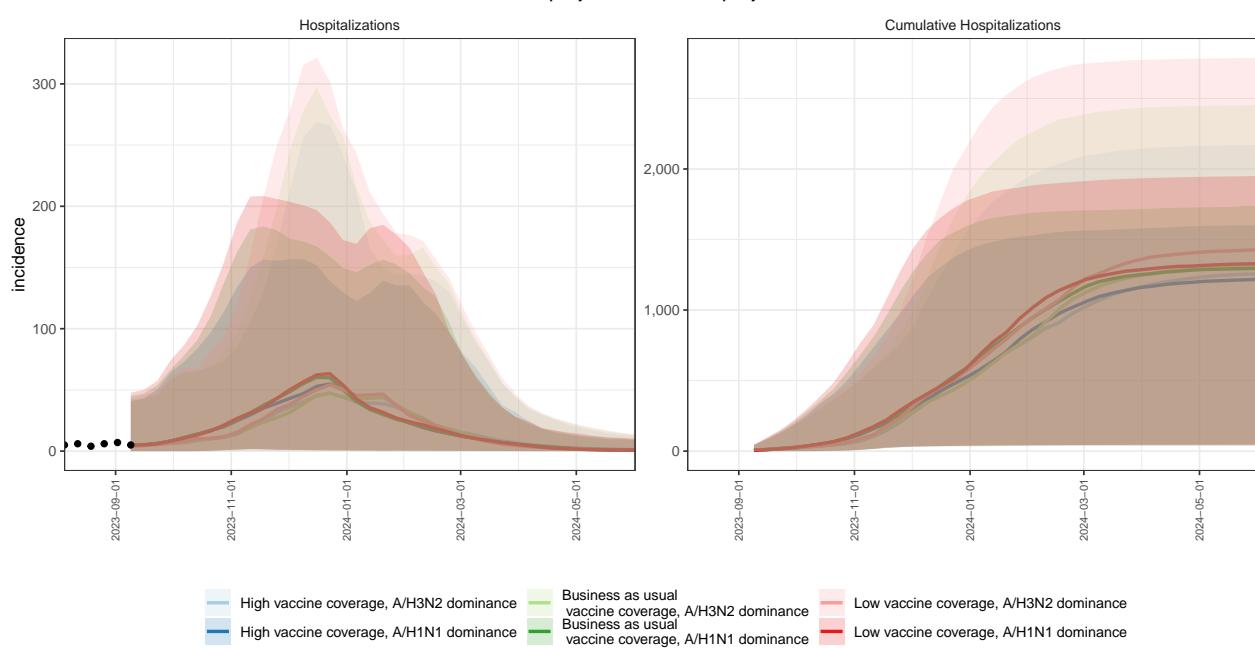
DC ensemble projections & 95% projection intervals



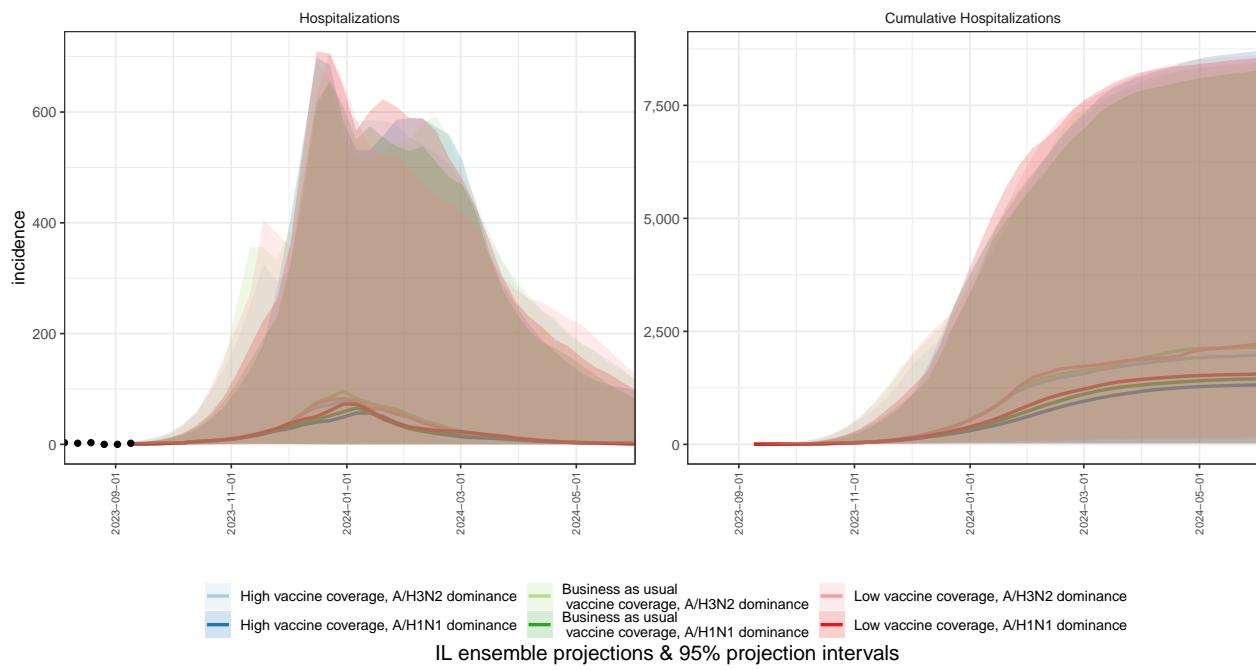
GA ensemble projections & 95% projection intervals



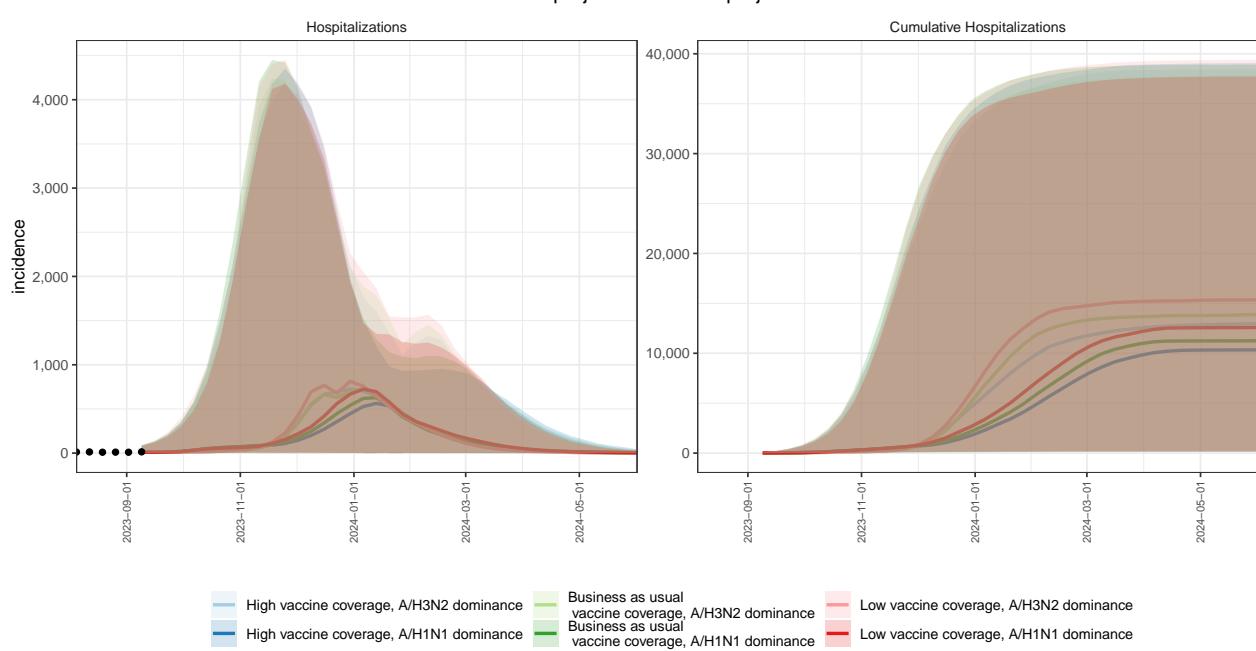
HI ensemble projections & 95% projection intervals



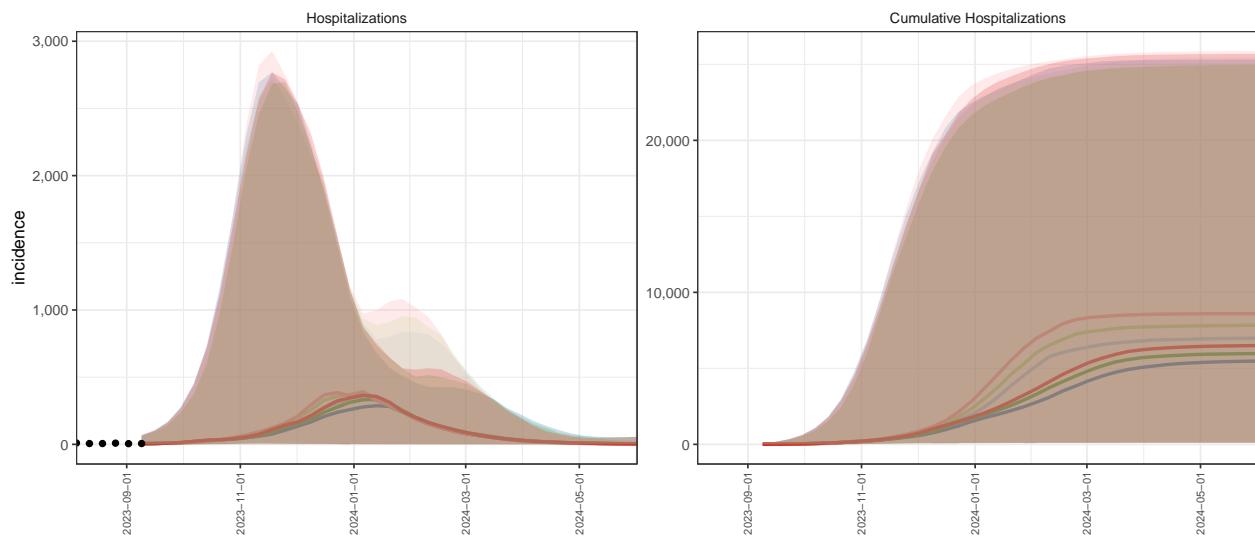
ID ensemble projections & 95% projection intervals



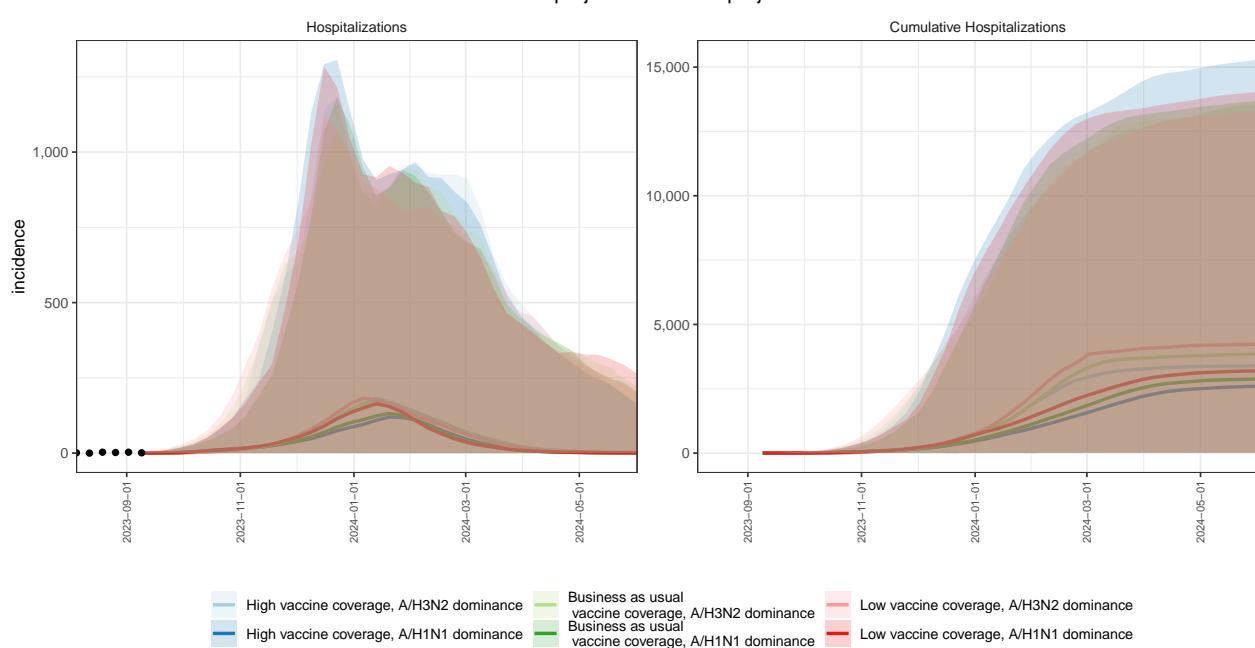
IL ensemble projections & 95% projection intervals



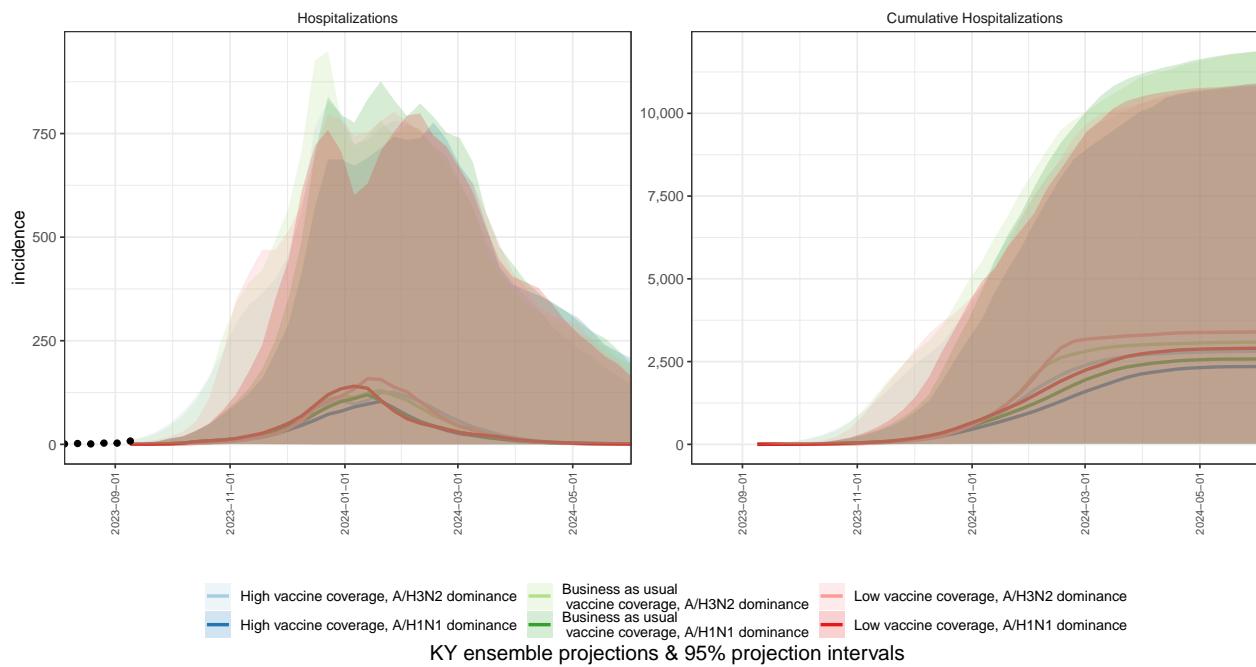
IN ensemble projections & 95% projection intervals



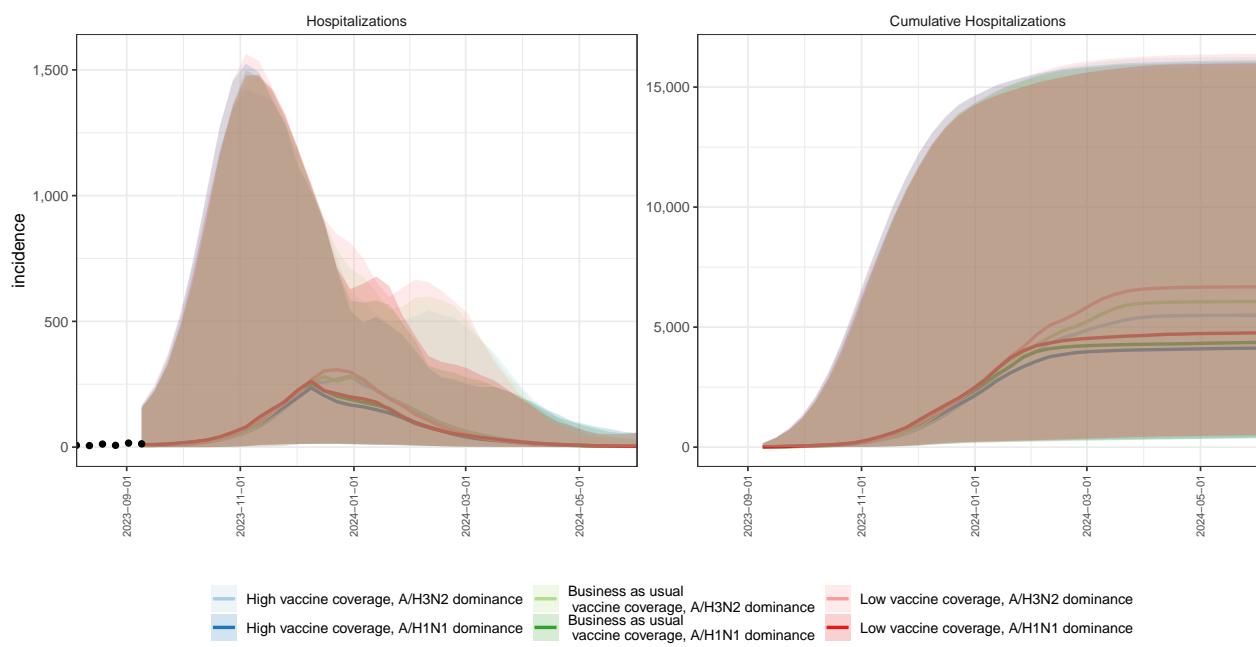
IA ensemble projections & 95% projection intervals



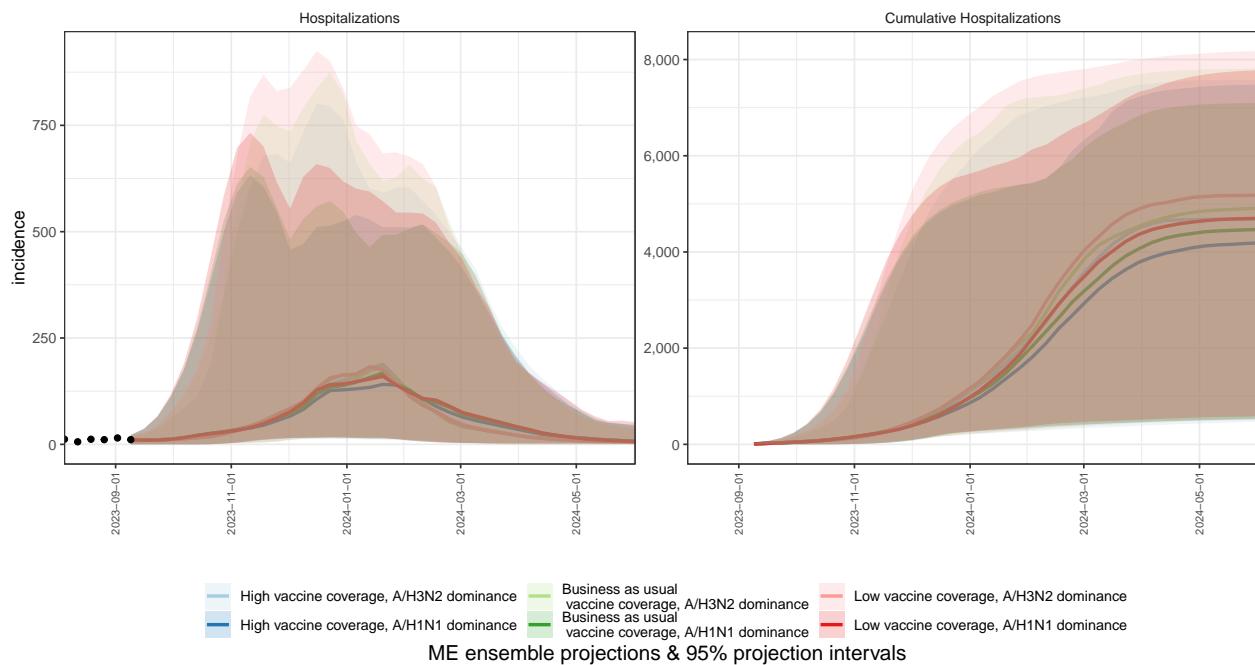
KS ensemble projections & 95% projection intervals



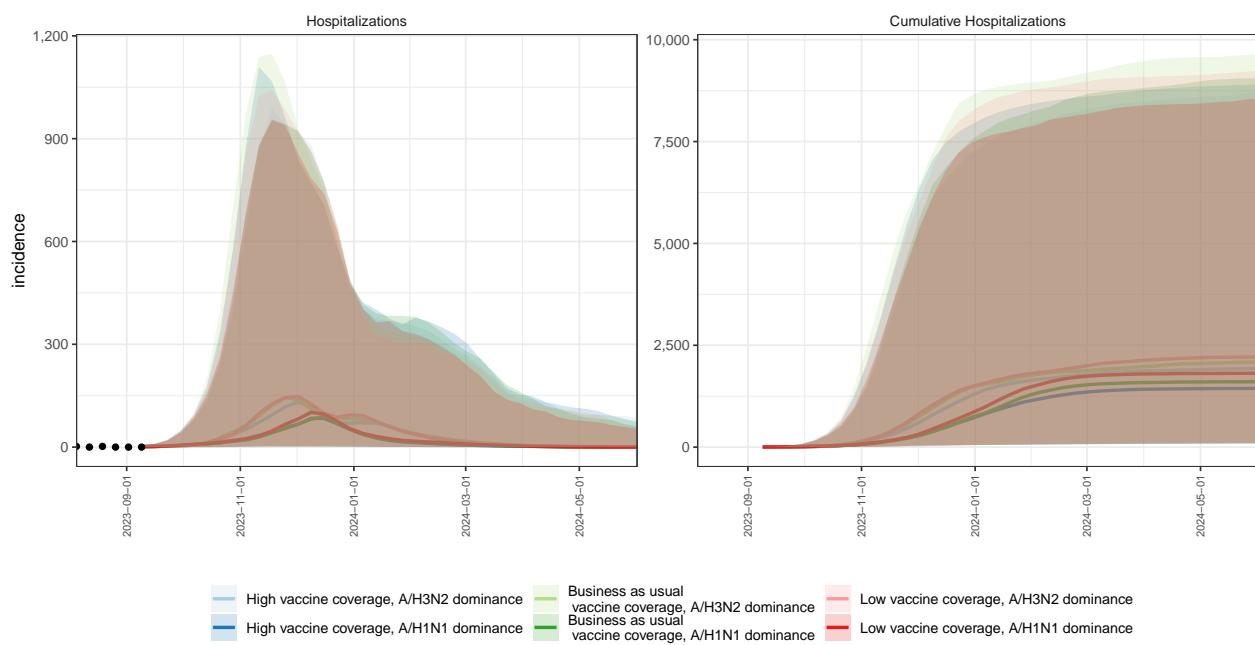
KY ensemble projections & 95% projection intervals



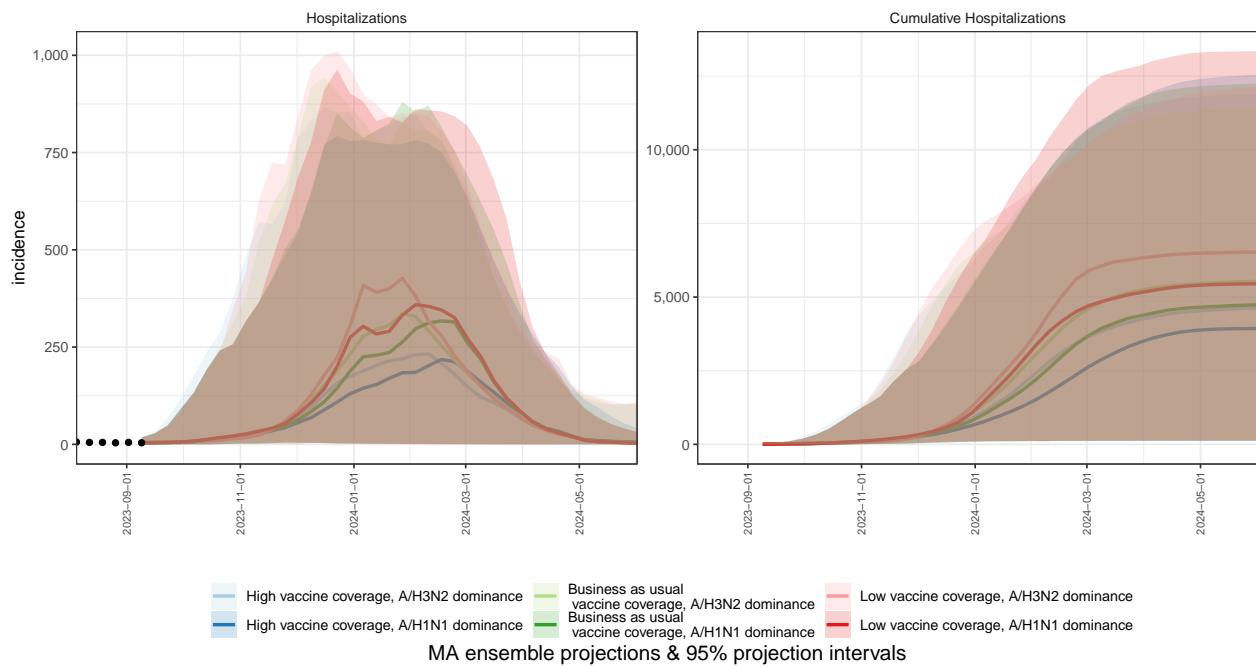
LA ensemble projections & 95% projection intervals



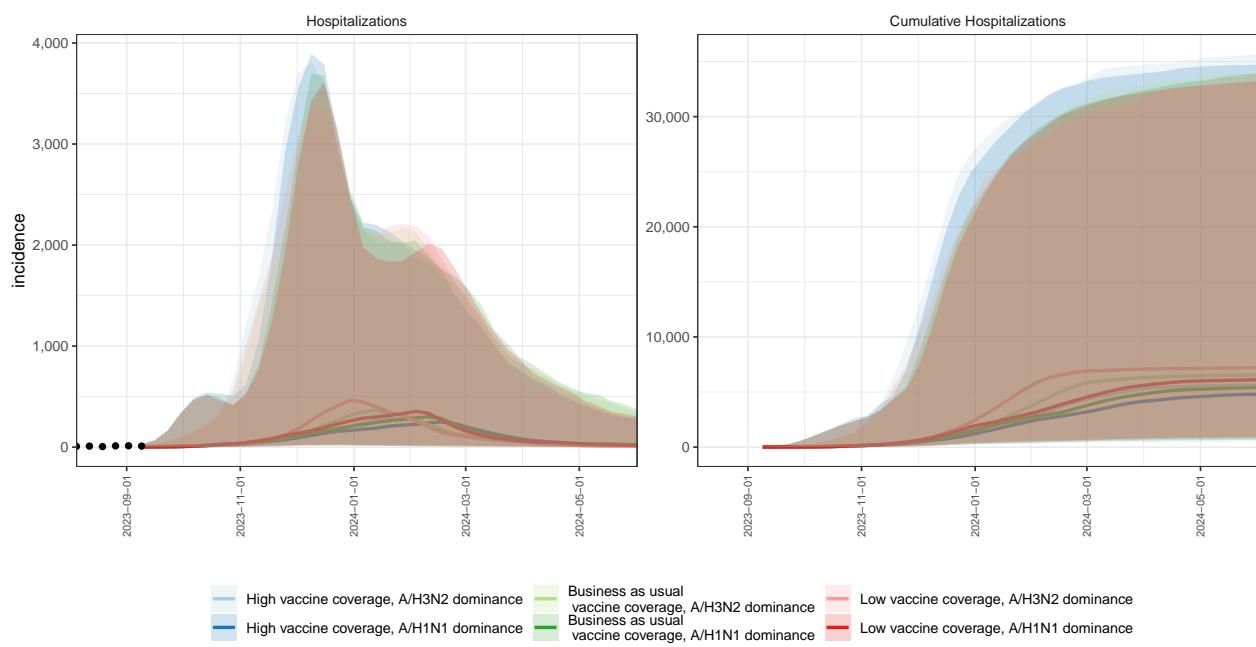
ME ensemble projections & 95% projection intervals



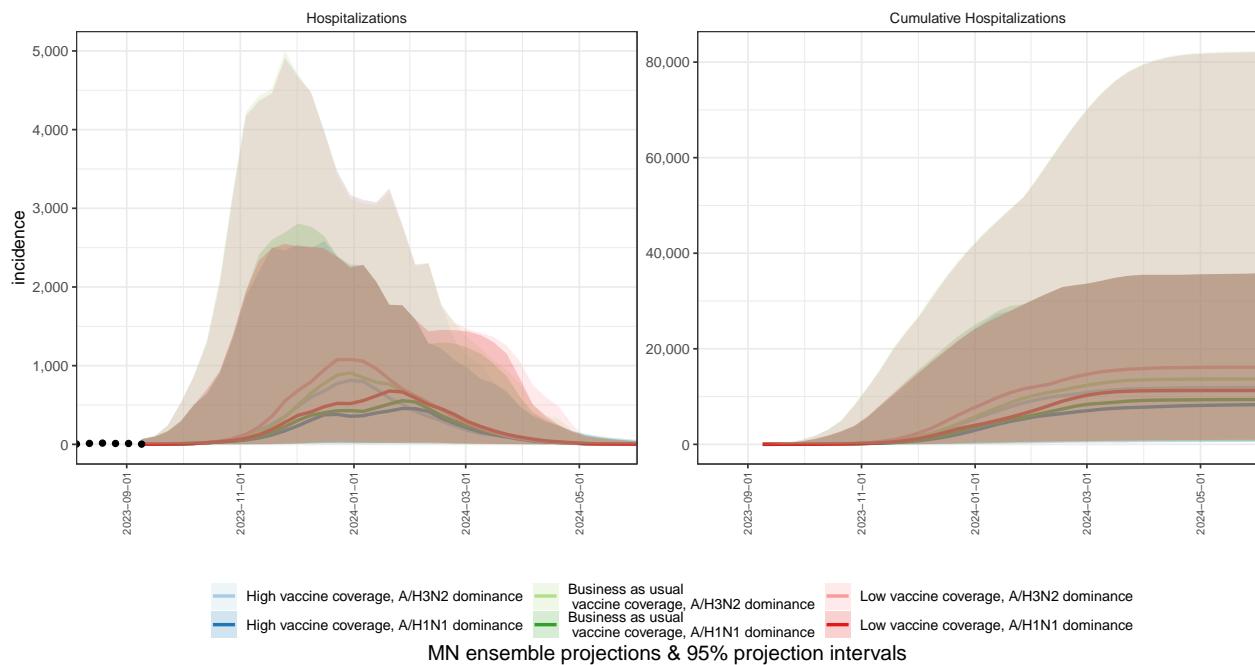
MD ensemble projections & 95% projection intervals



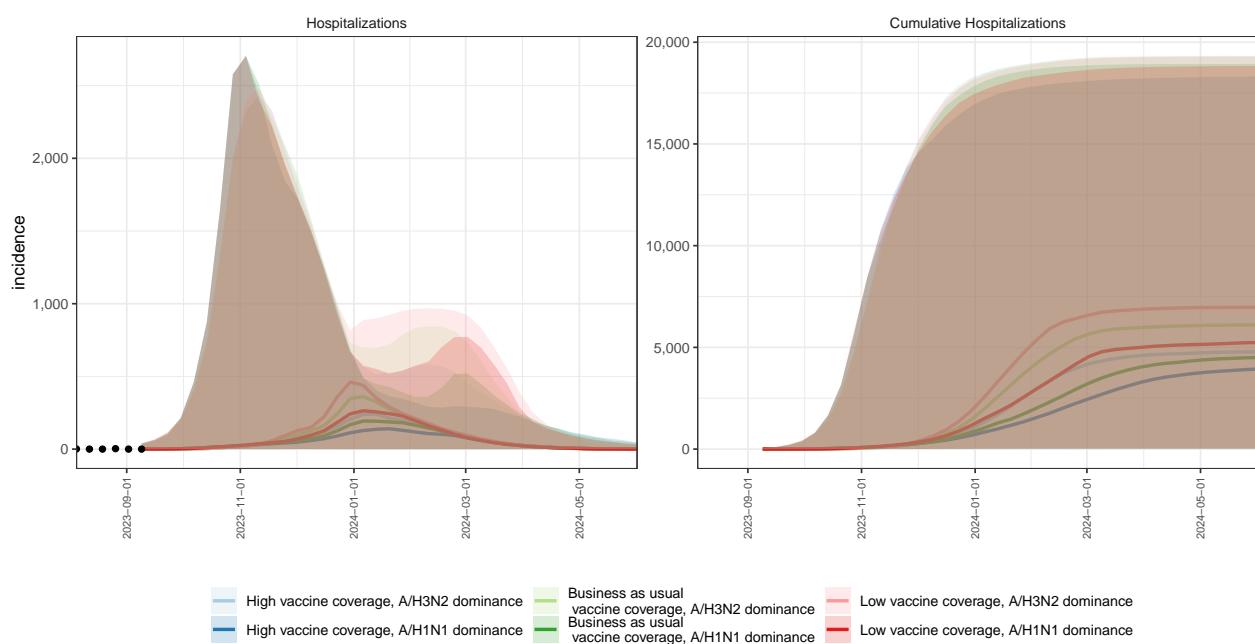
MA ensemble projections & 95% projection intervals



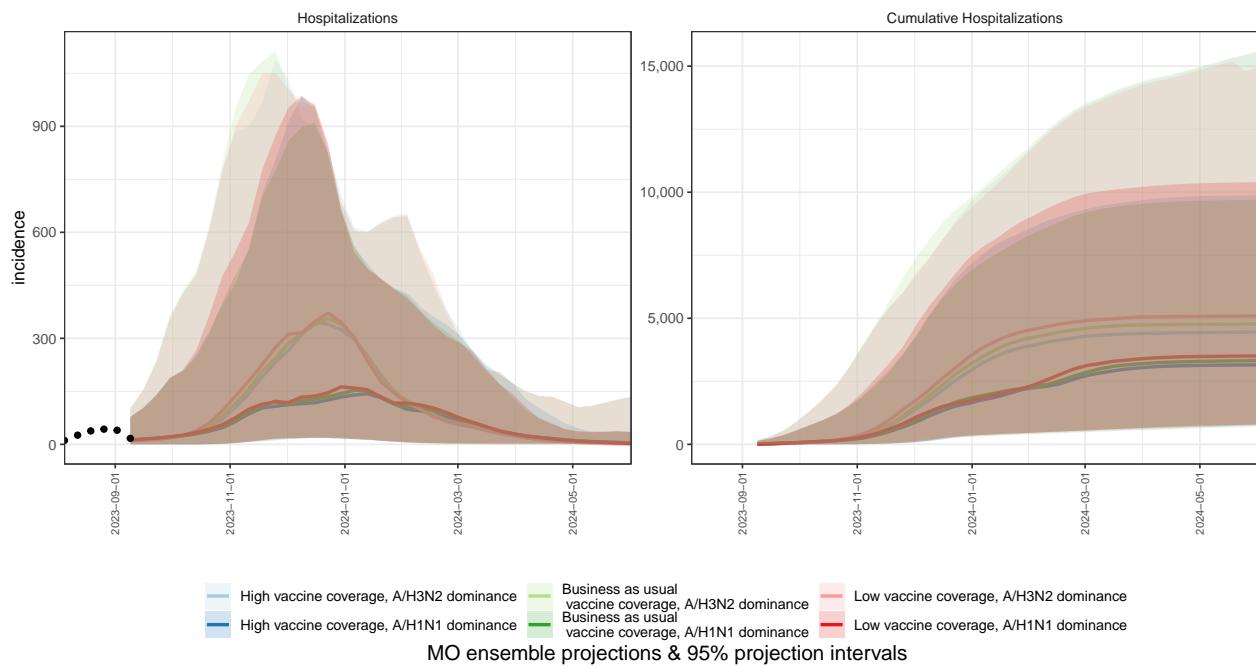
MI ensemble projections & 95% projection intervals



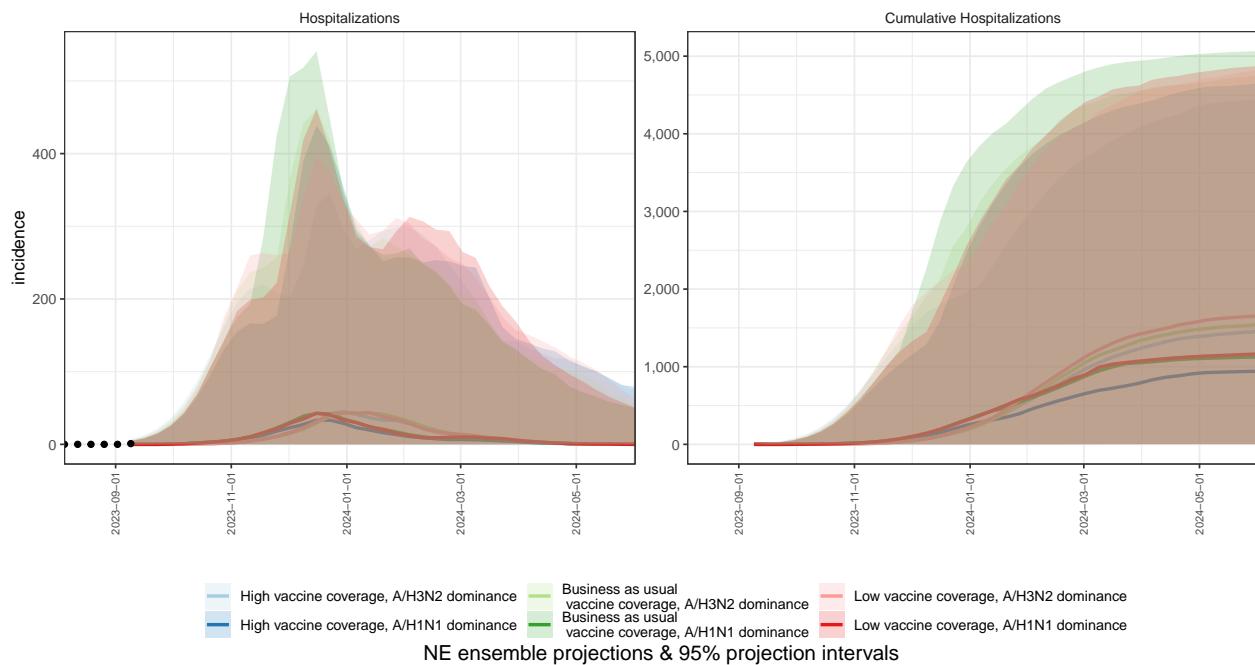
MN ensemble projections & 95% projection intervals



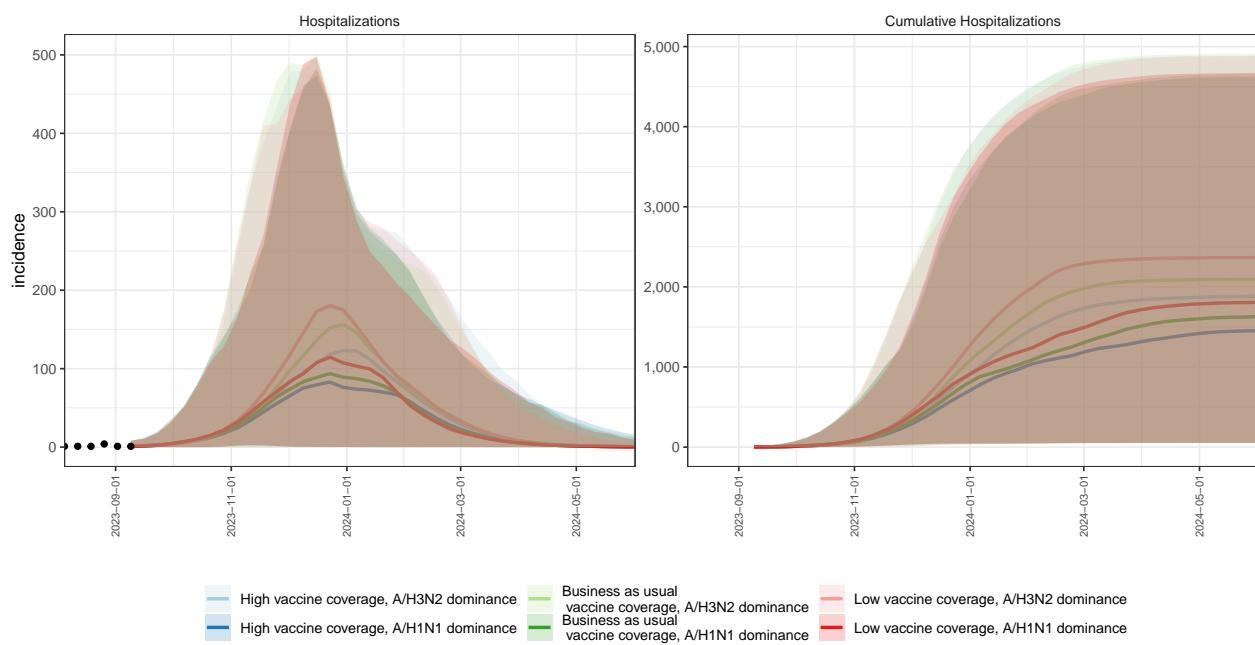
MS ensemble projections & 95% projection intervals



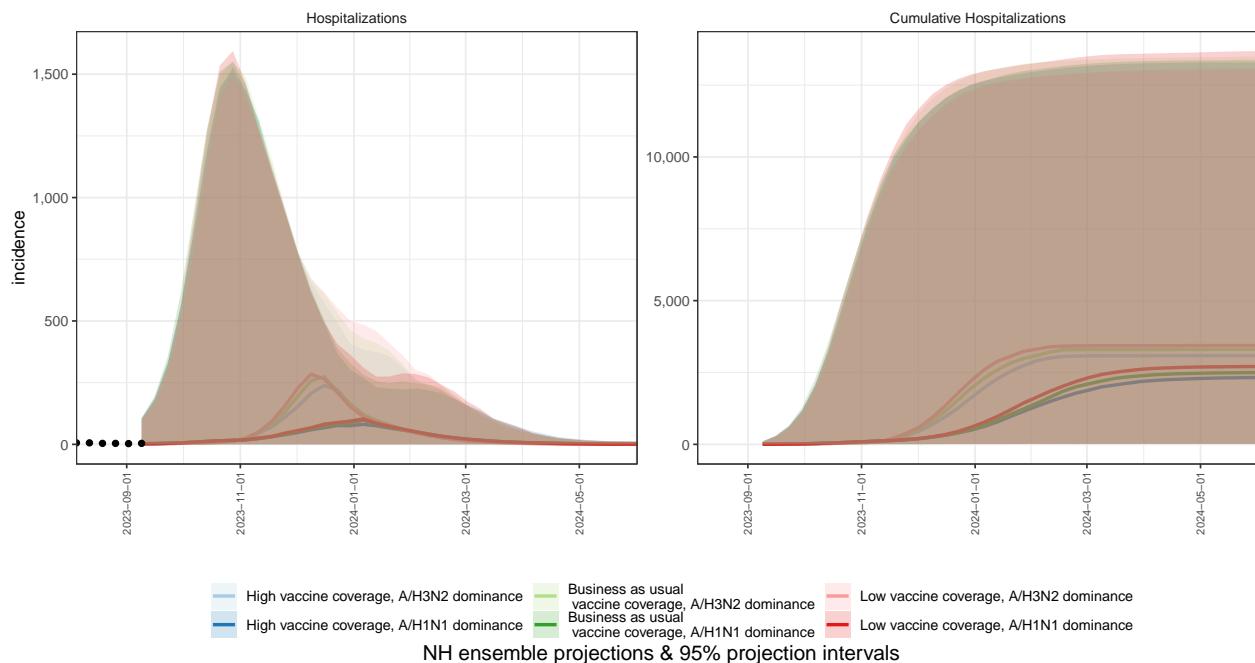
MT ensemble projections & 95% projection intervals



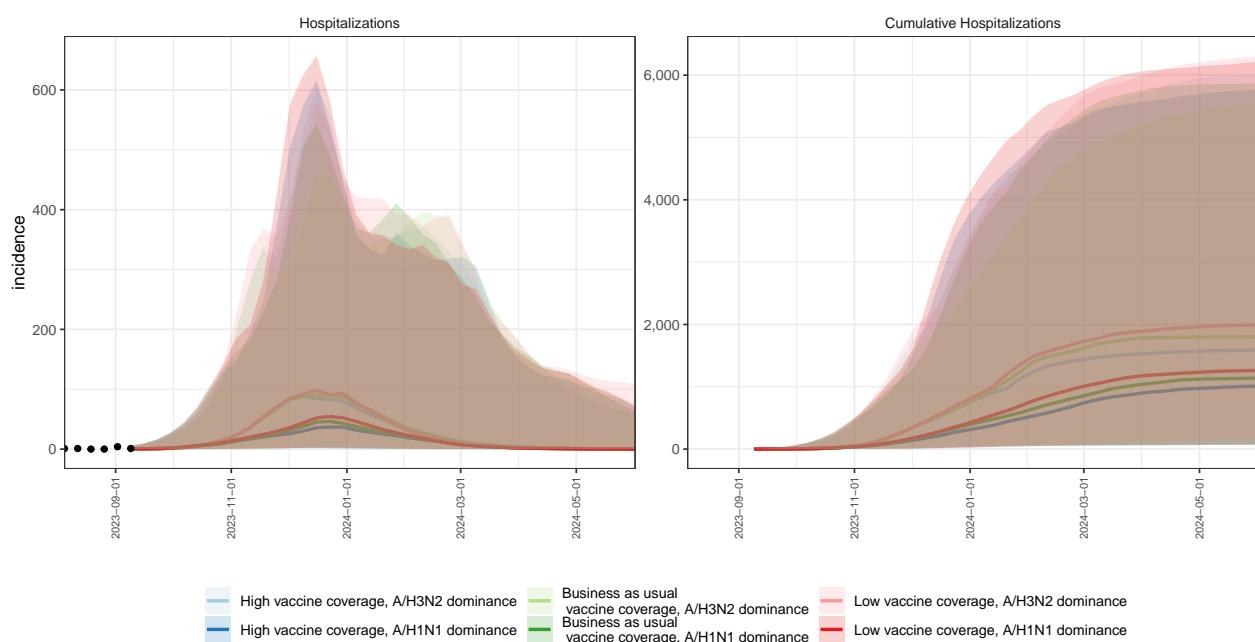
NE ensemble projections & 95% projection intervals



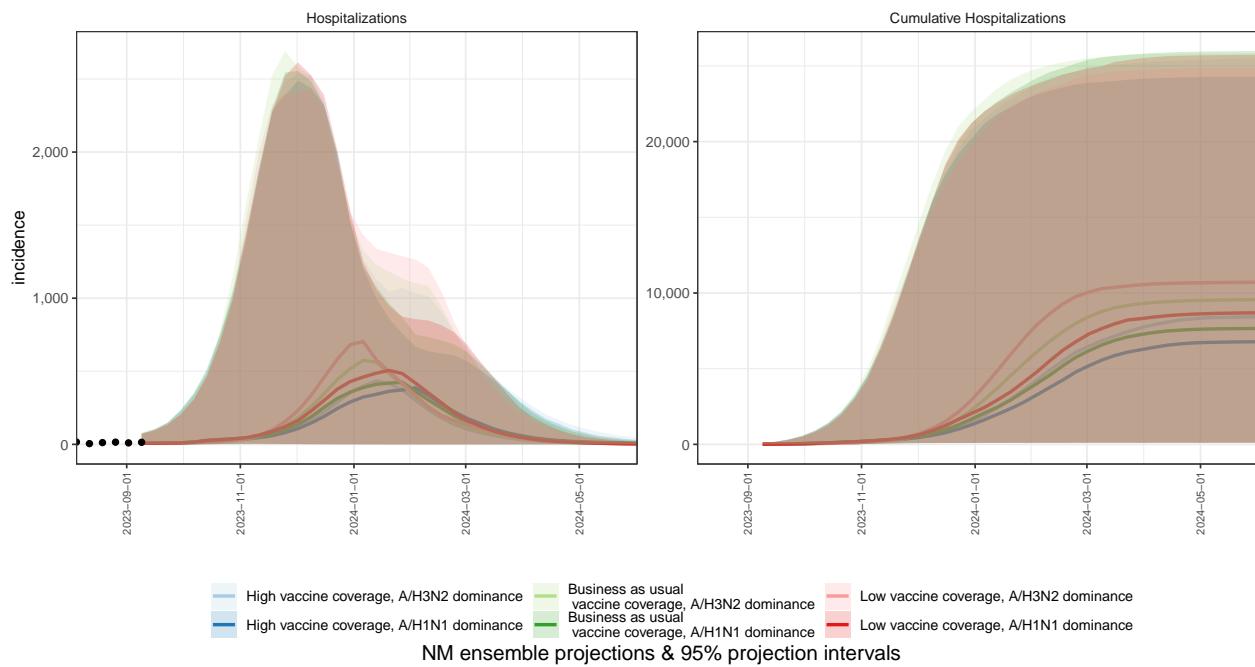
NV ensemble projections & 95% projection intervals



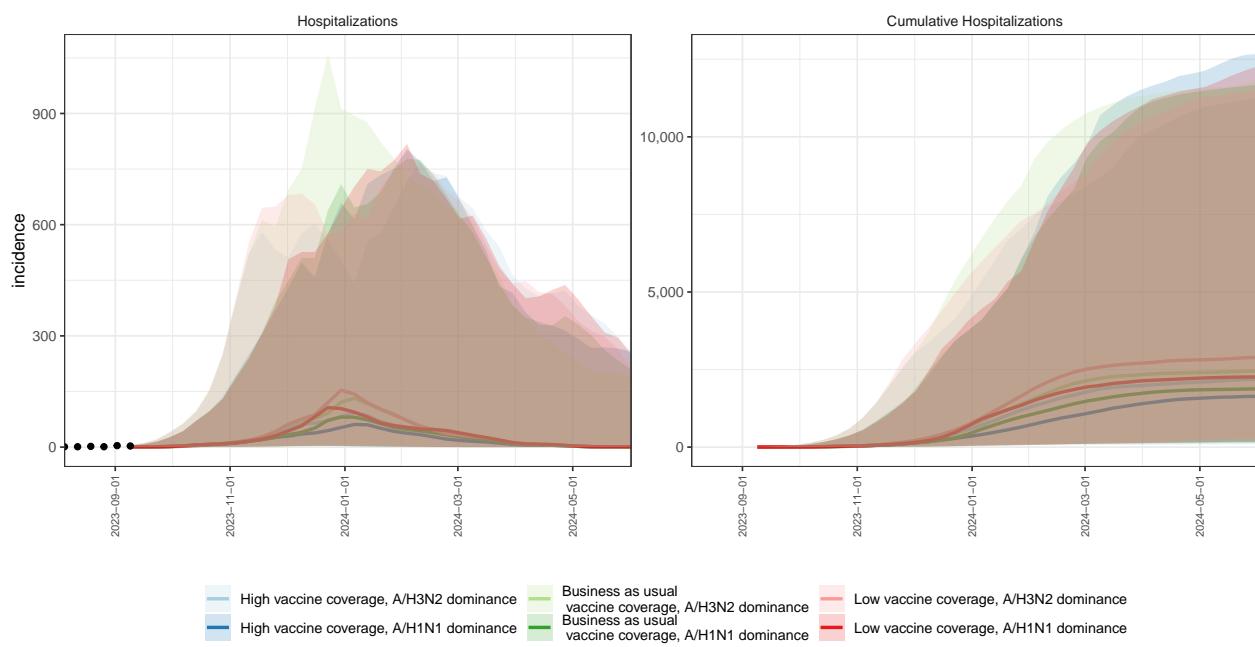
NH ensemble projections & 95% projection intervals



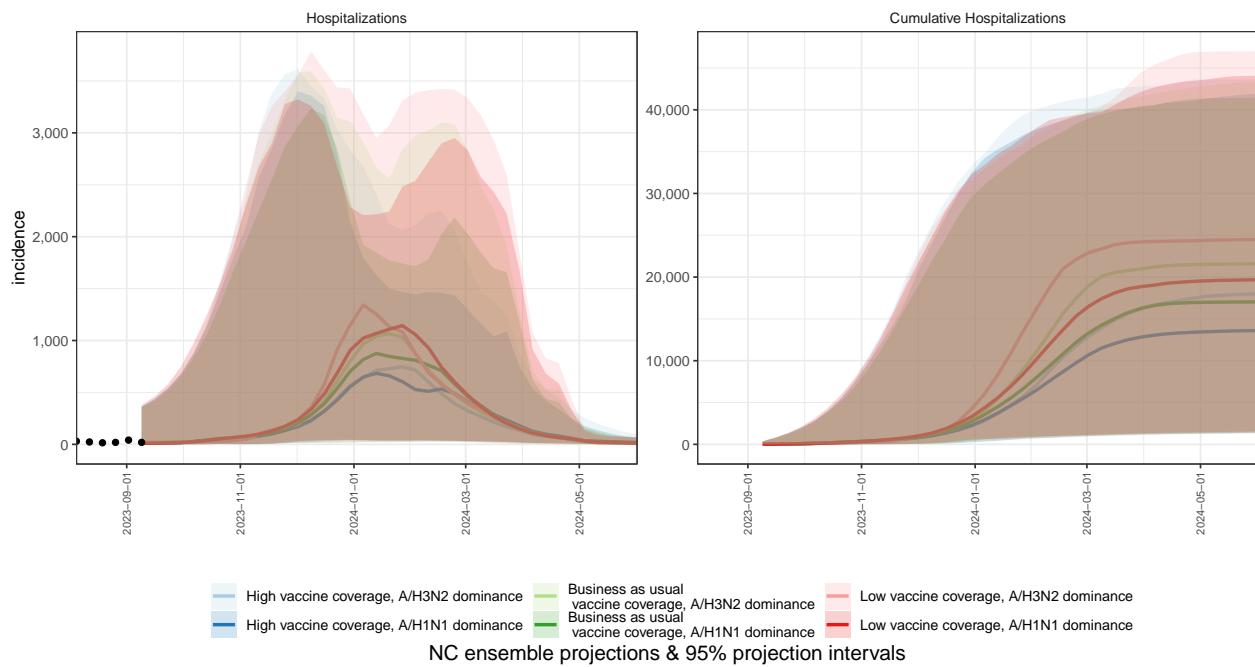
NJ ensemble projections & 95% projection intervals



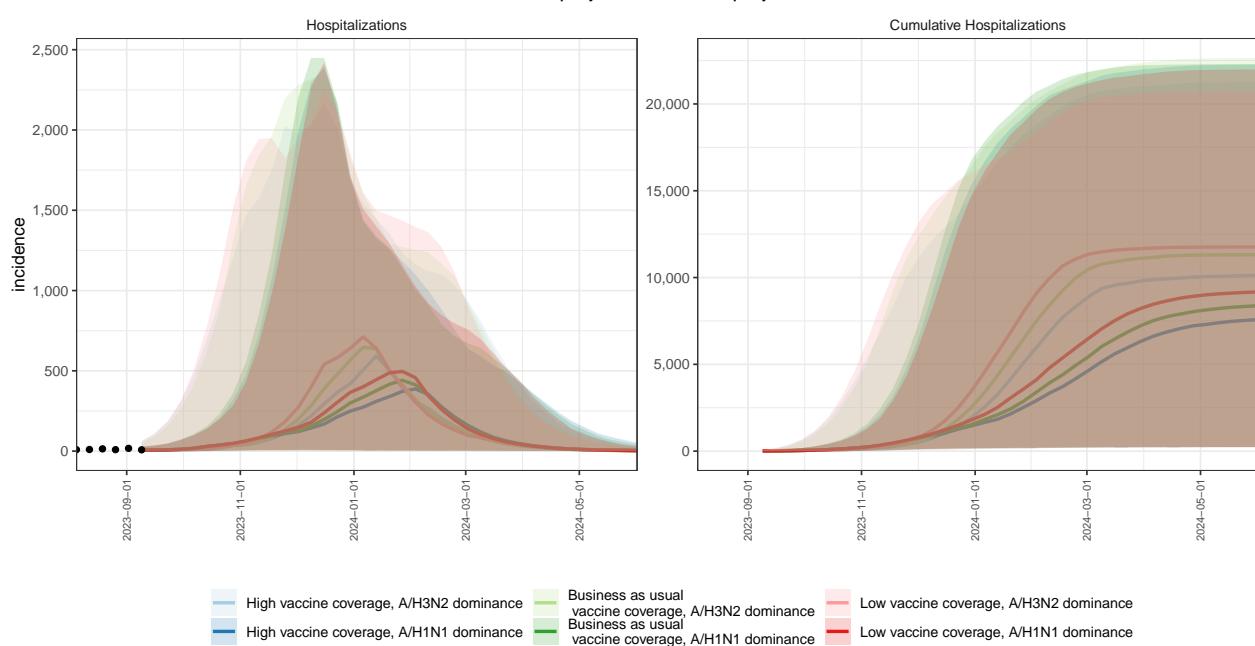
NM ensemble projections & 95% projection intervals



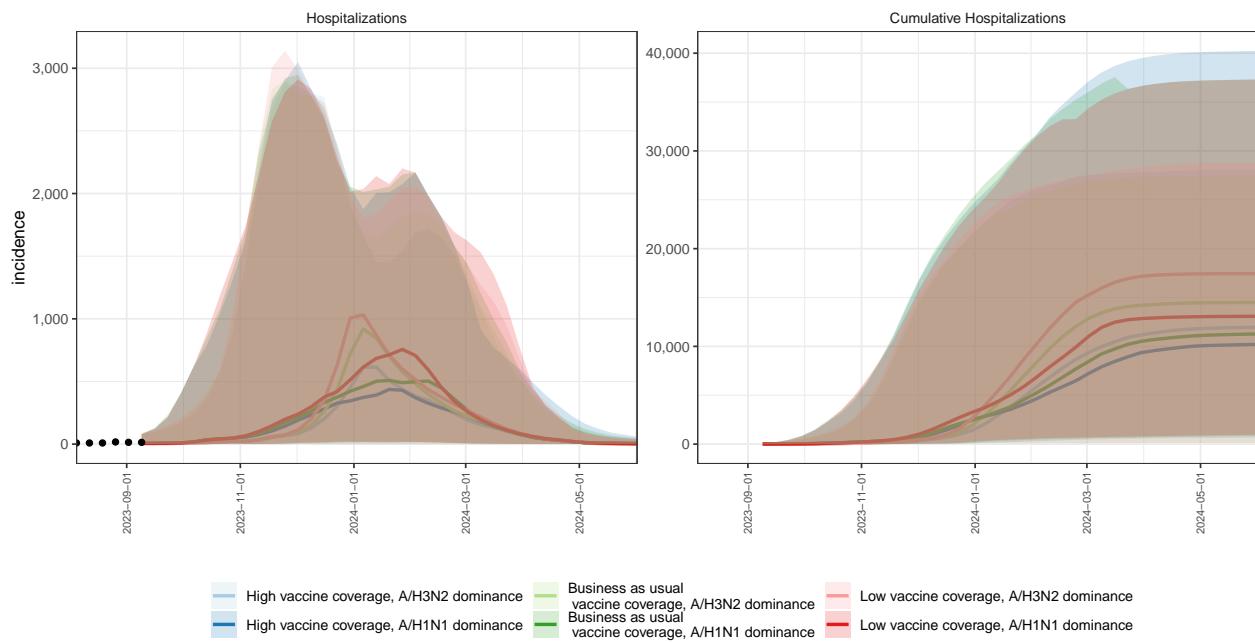
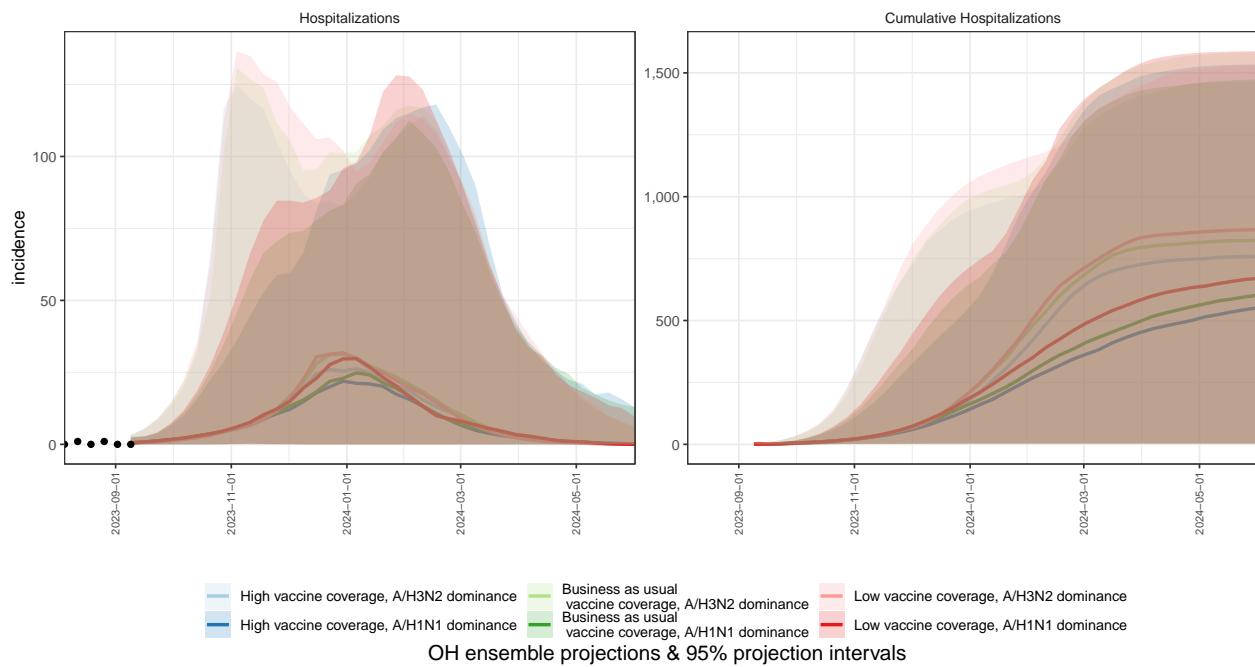
NY ensemble projections & 95% projection intervals



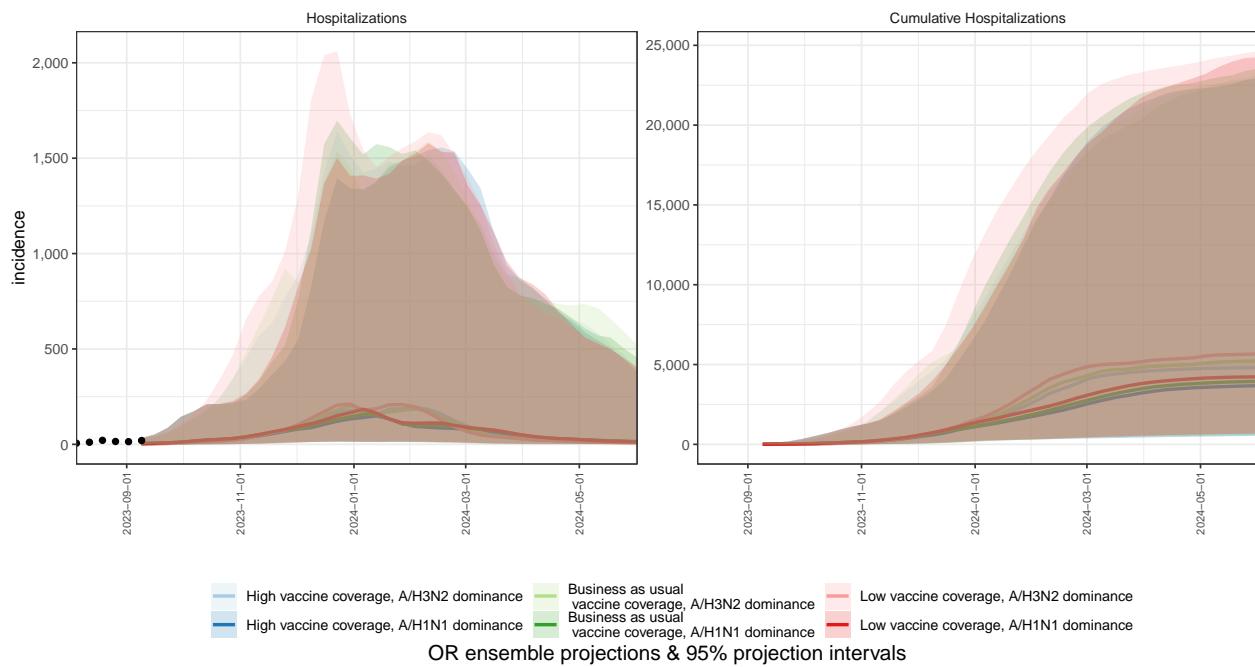
NC ensemble projections & 95% projection intervals



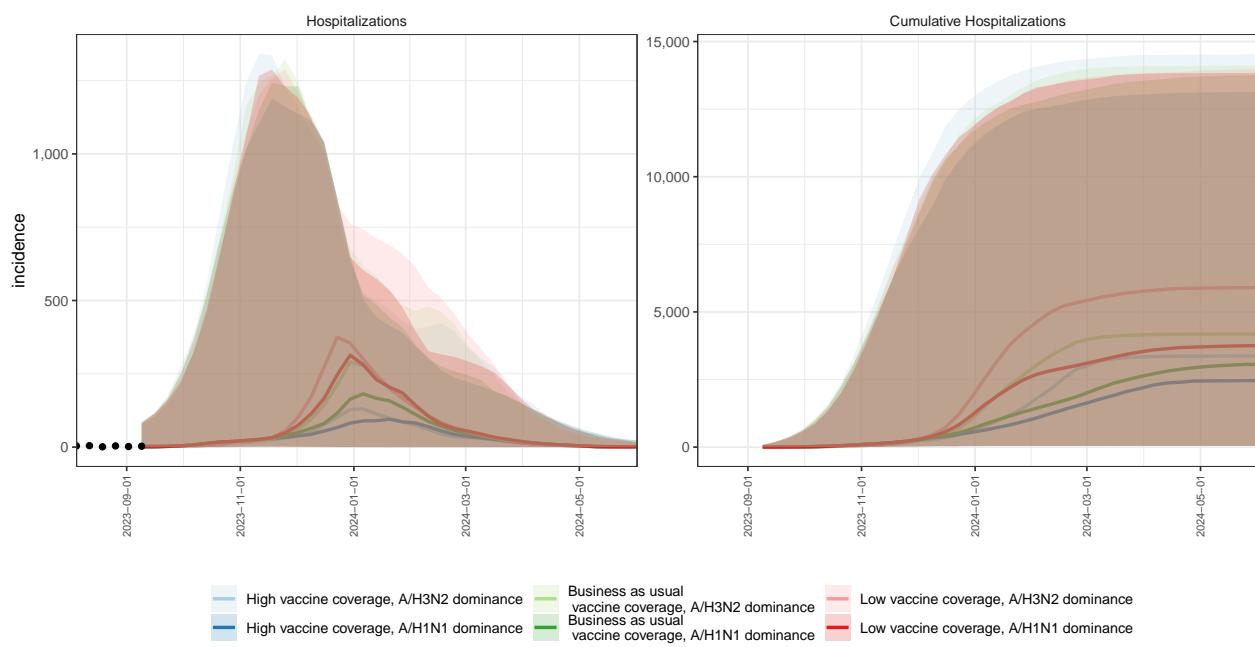
ND ensemble projections & 95% projection intervals



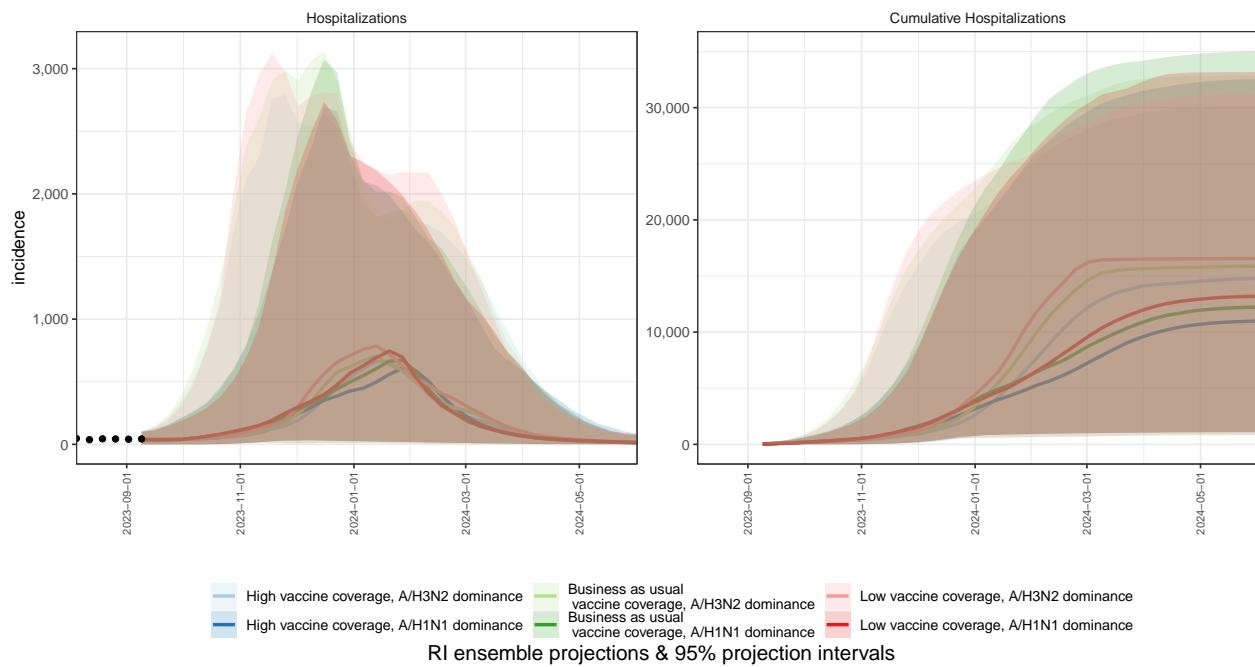
OK ensemble projections & 95% projection intervals



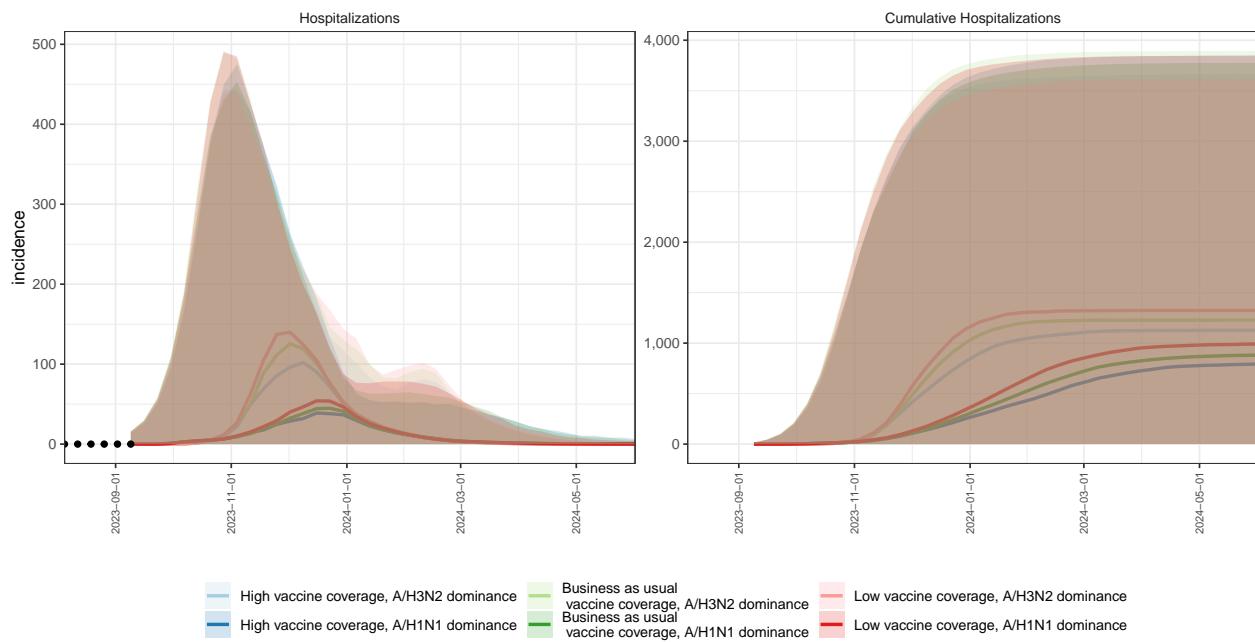
OR ensemble projections & 95% projection intervals



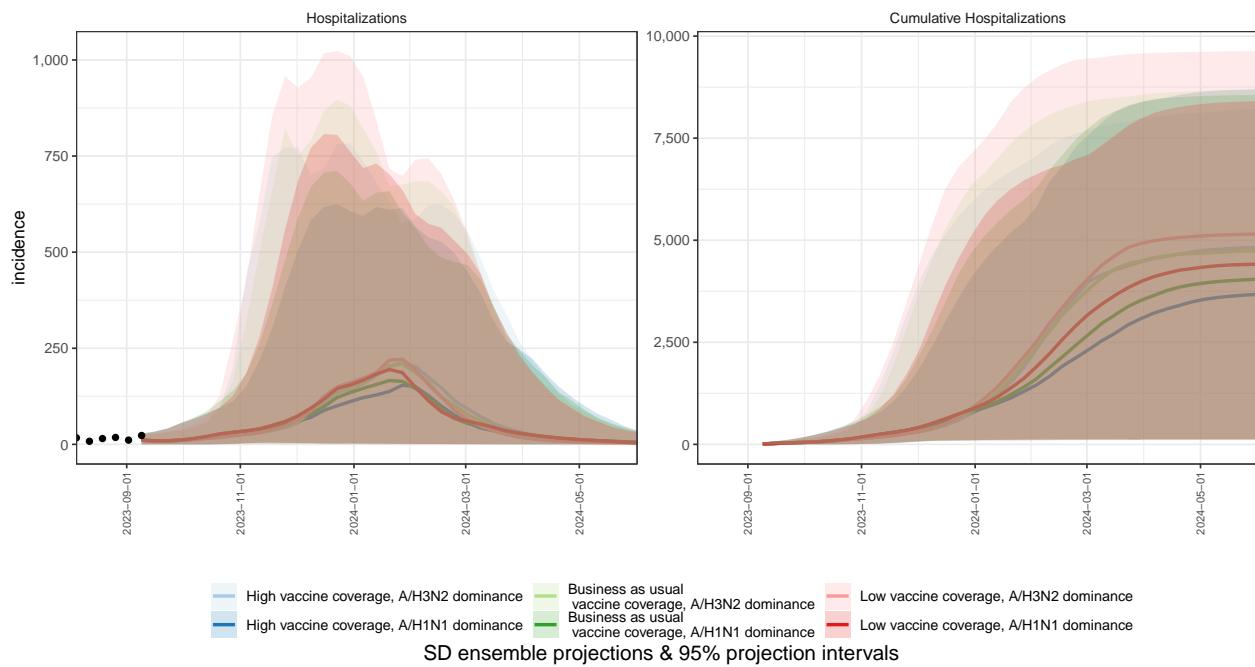
PA ensemble projections & 95% projection intervals



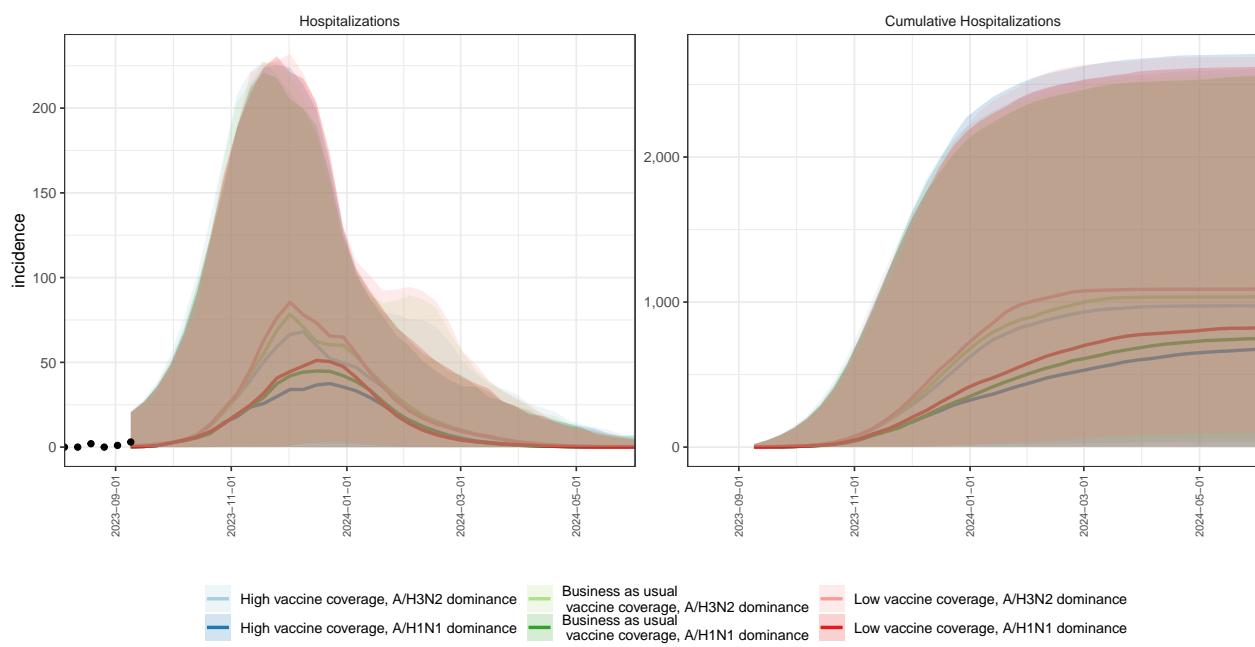
RI ensemble projections & 95% projection intervals



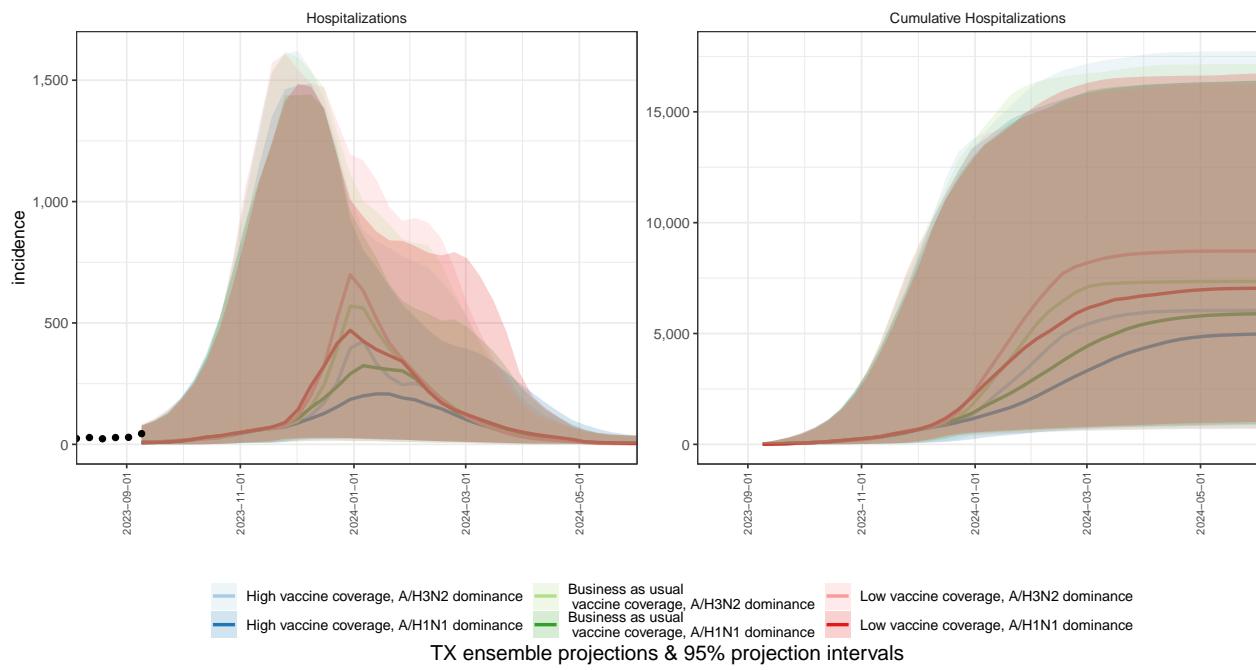
SC ensemble projections & 95% projection intervals



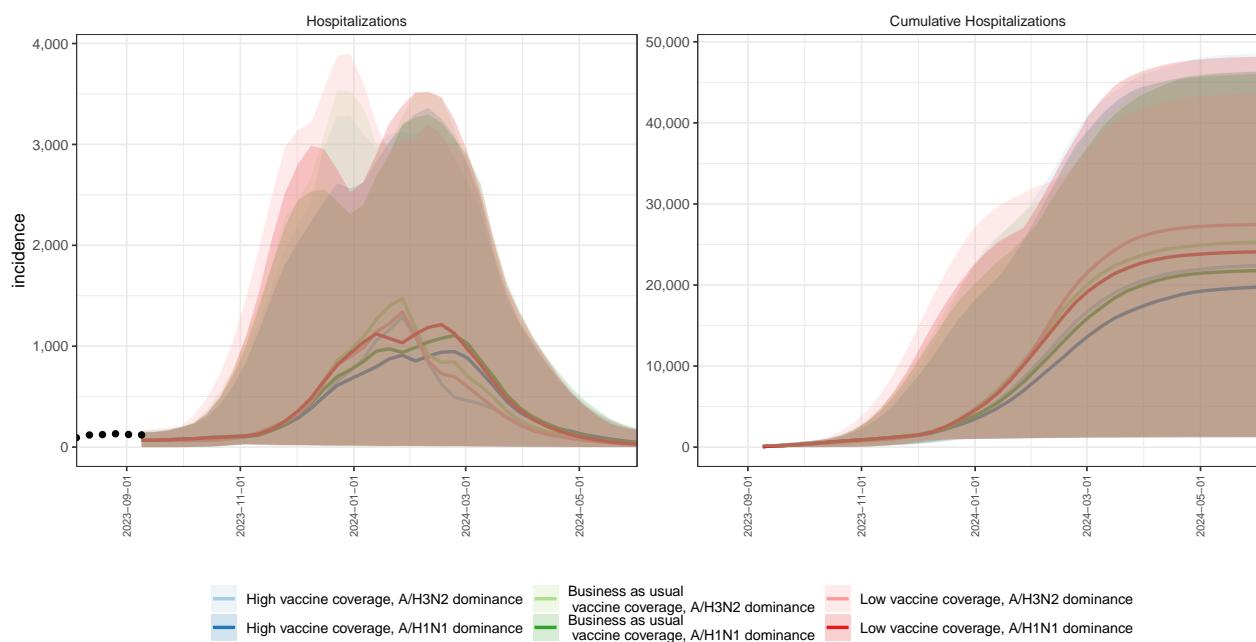
SD ensemble projections & 95% projection intervals



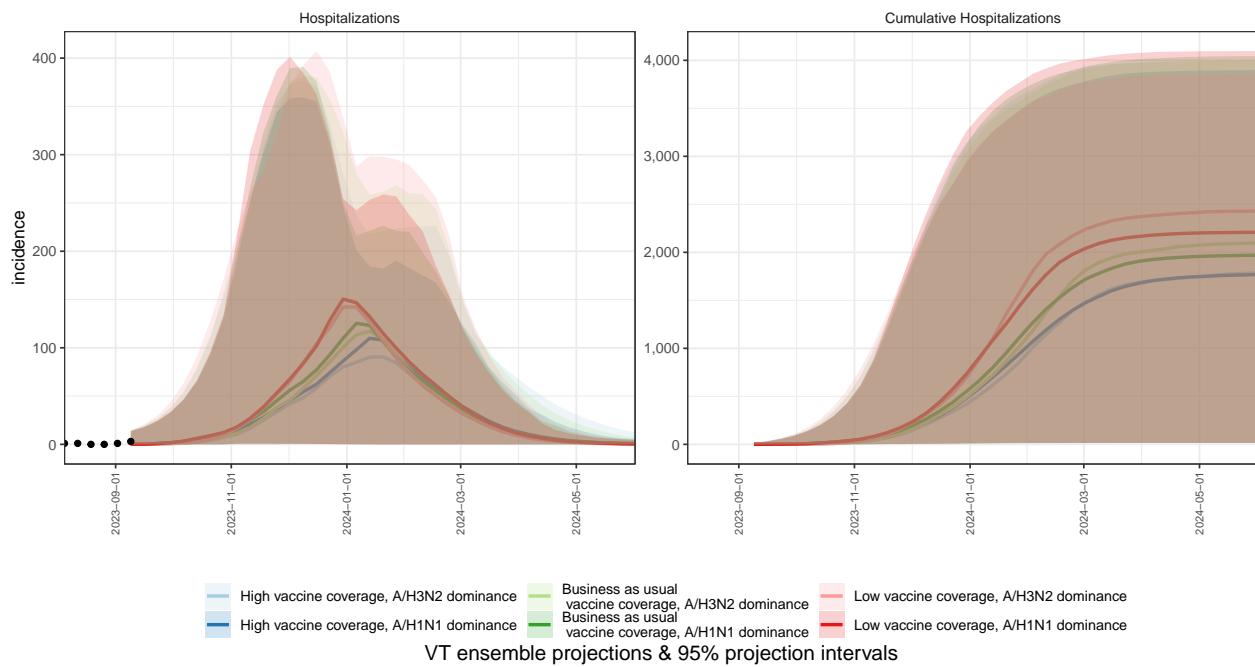
TN ensemble projections & 95% projection intervals



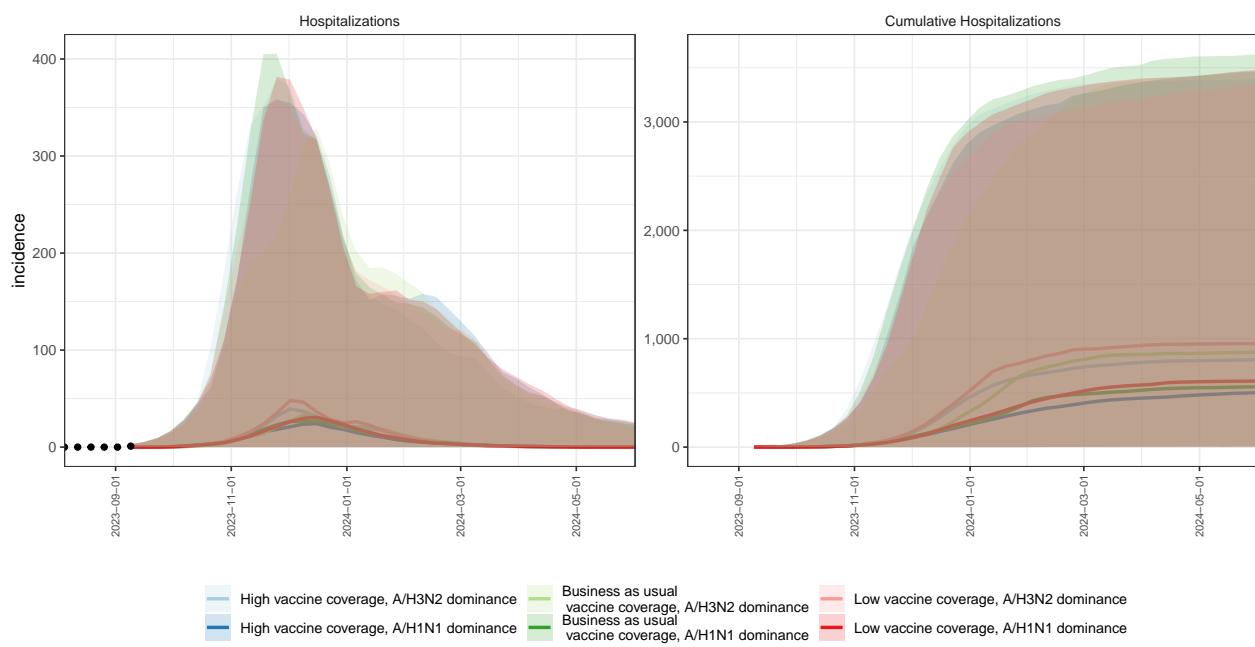
TX ensemble projections & 95% projection intervals



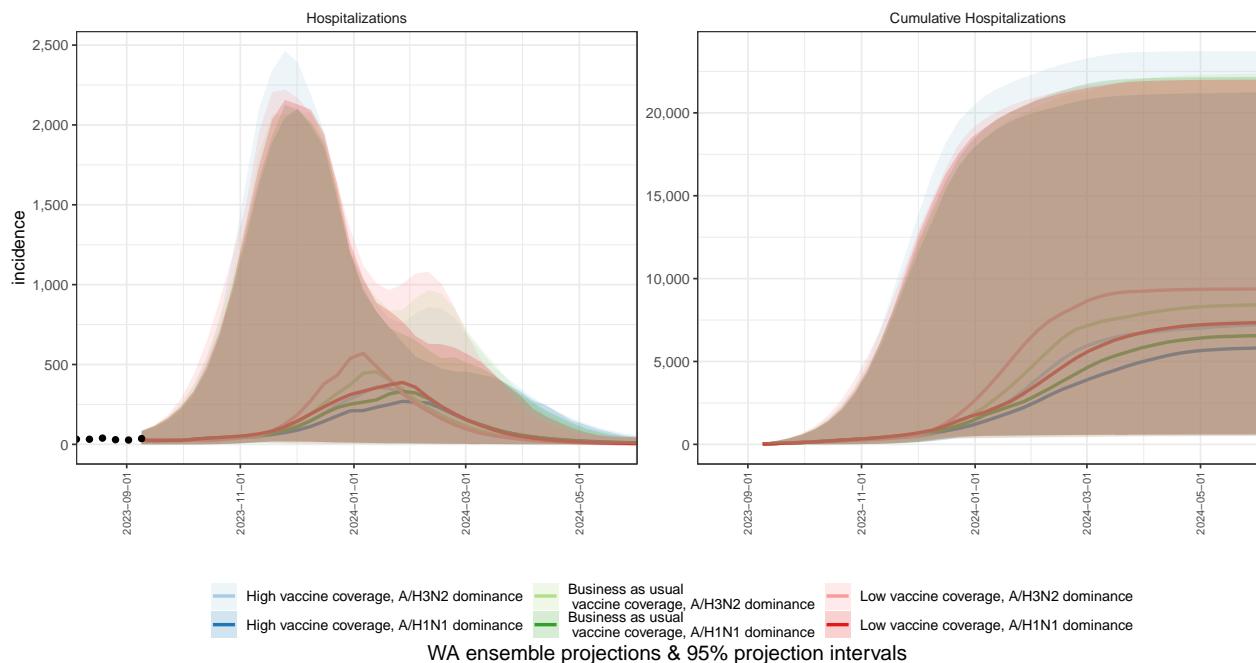
UT ensemble projections & 95% projection intervals



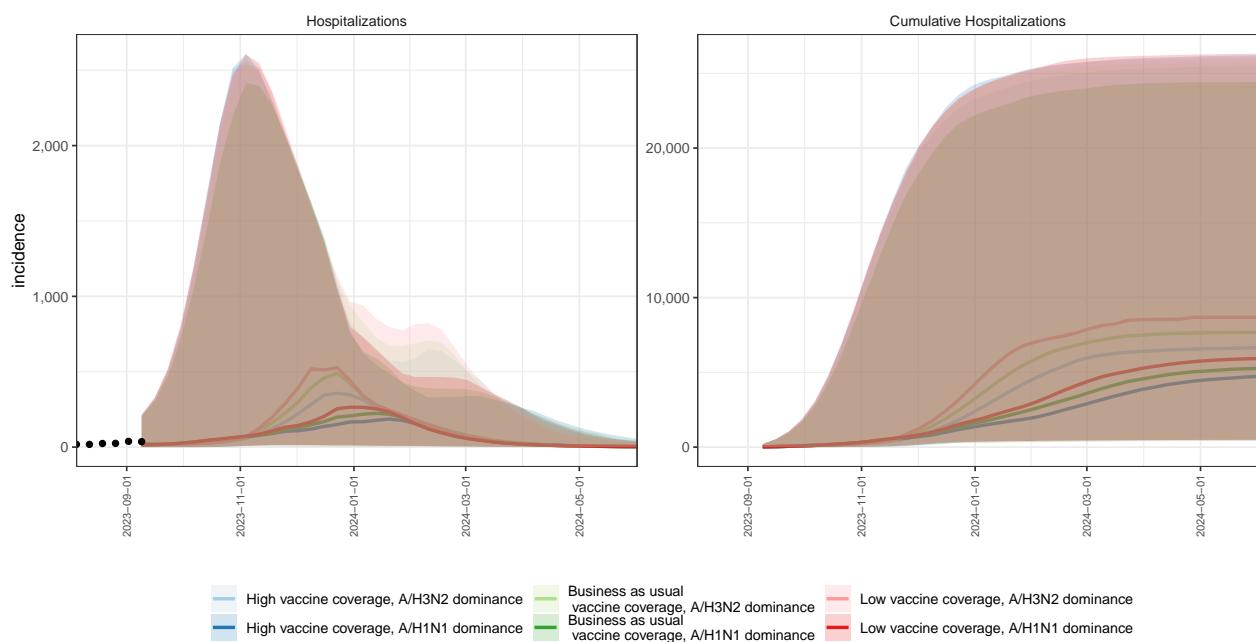
VT ensemble projections & 95% projection intervals



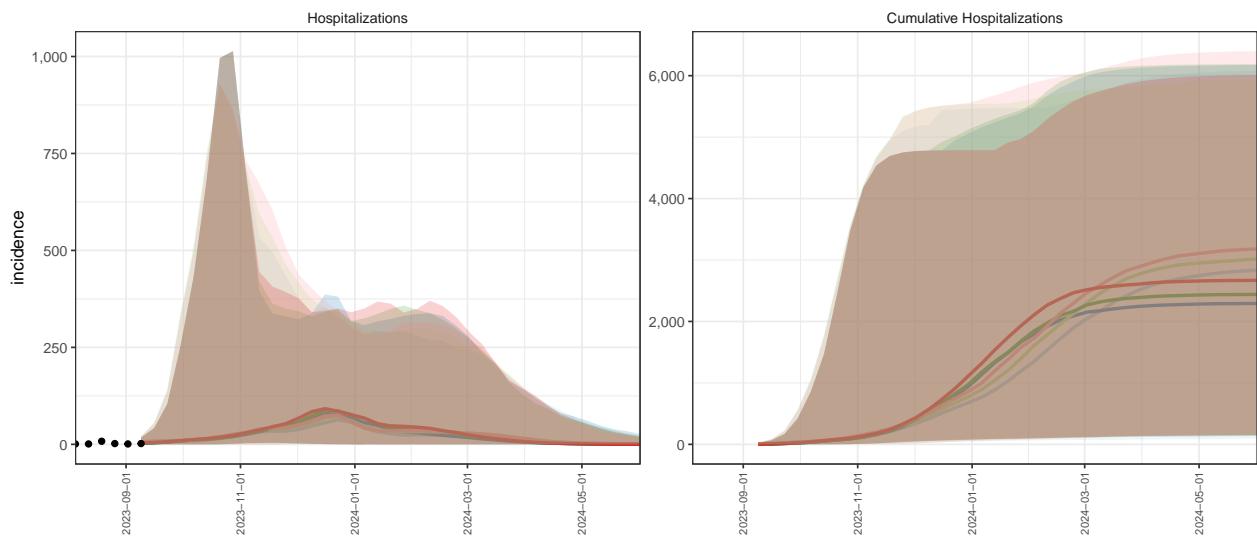
VA ensemble projections & 95% projection intervals



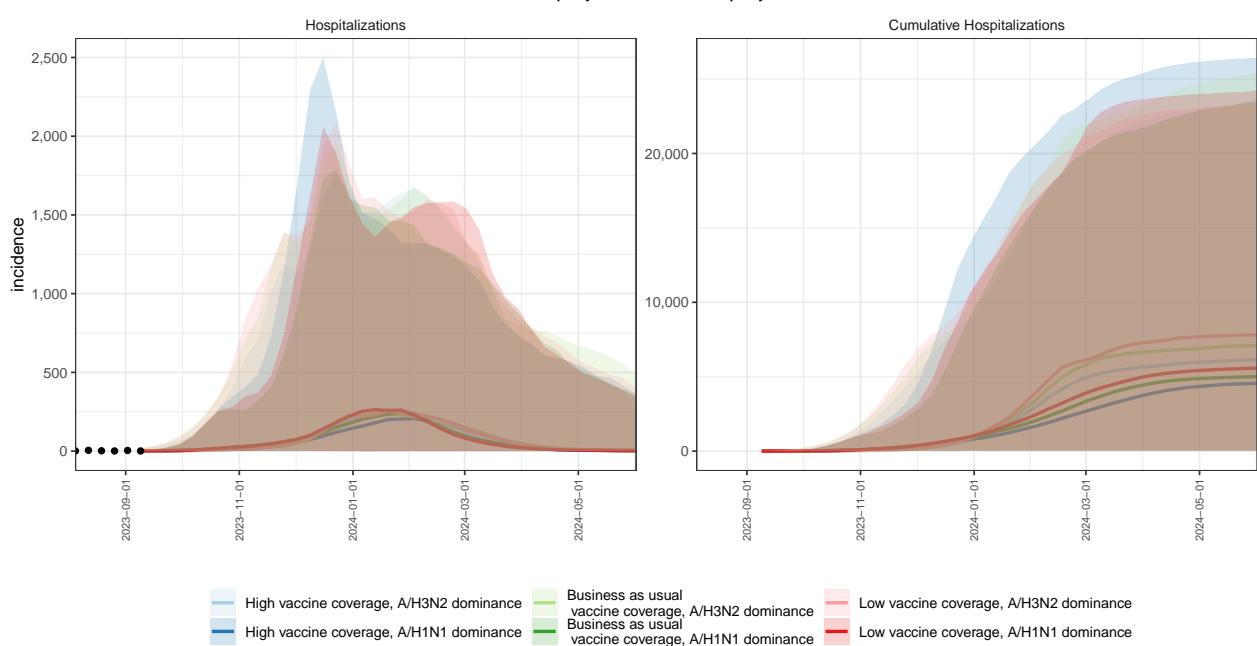
WA ensemble projections & 95% projection intervals



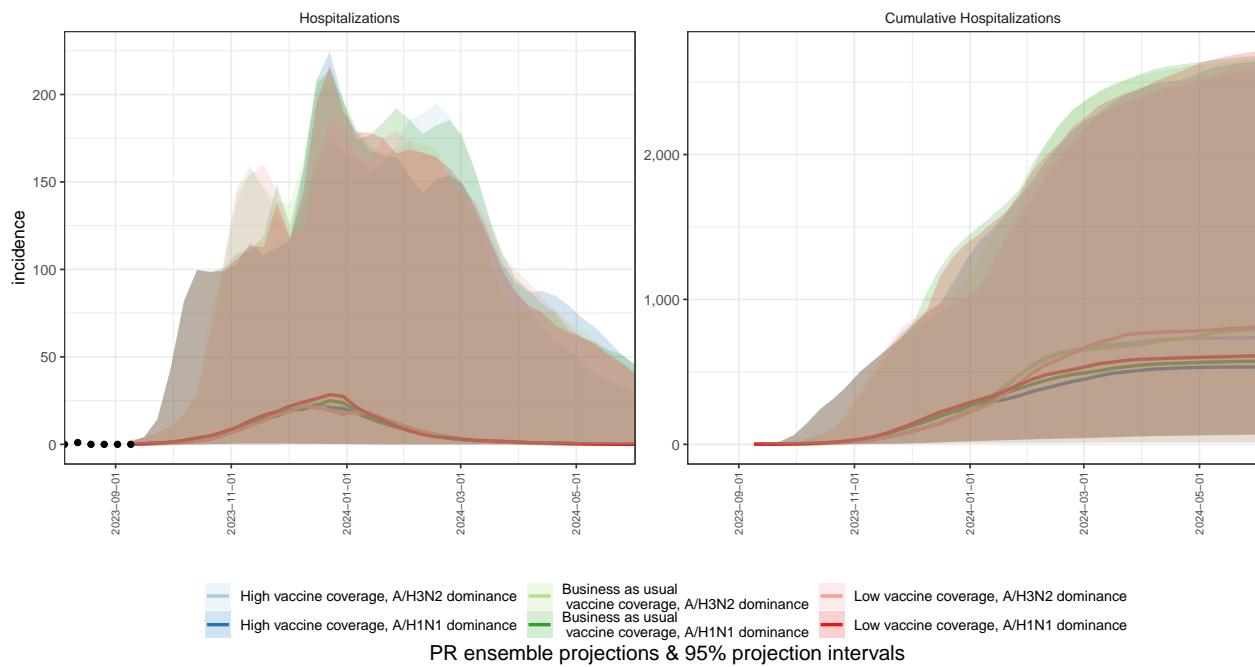
WV ensemble projections & 95% projection intervals



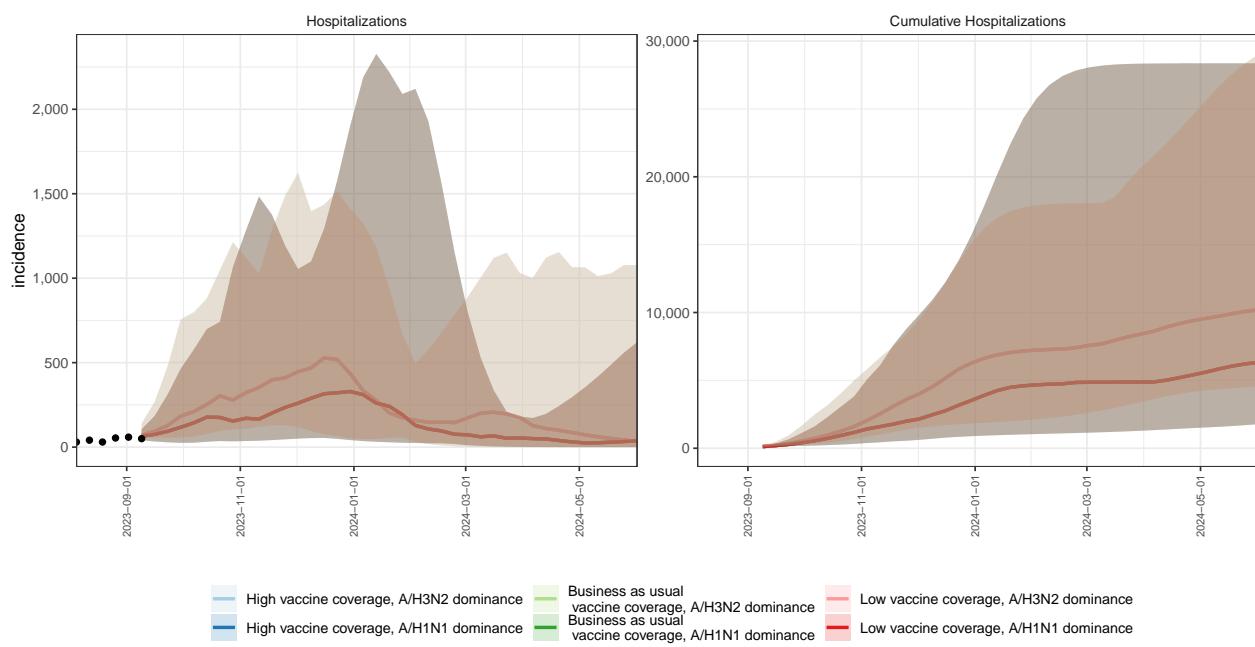
WI ensemble projections & 95% projection intervals



WY ensemble projections & 95% projection intervals



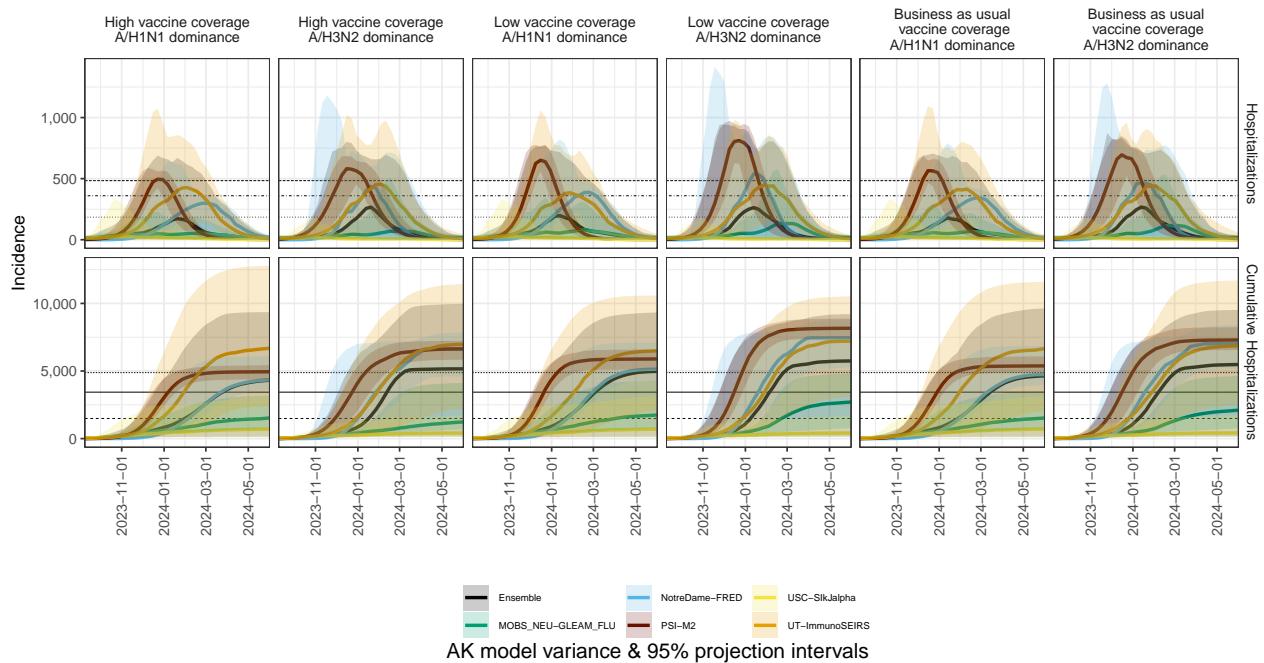
PR ensemble projections & 95% projection intervals



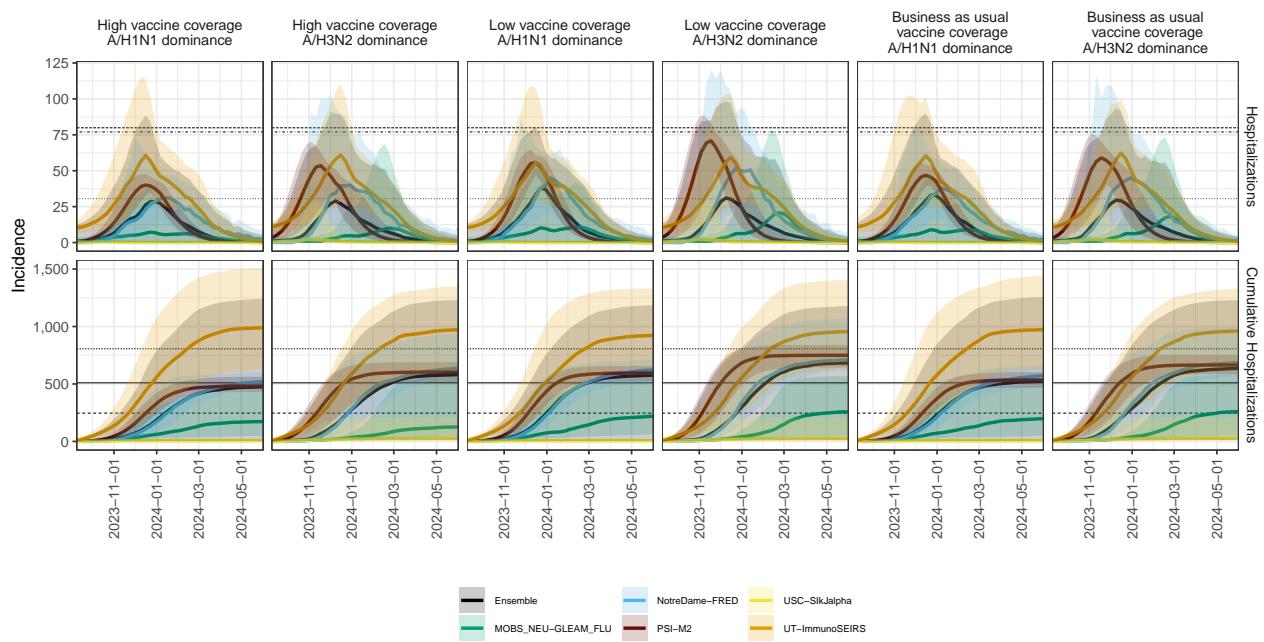
State-level model variation

National model variation for all scenarios.

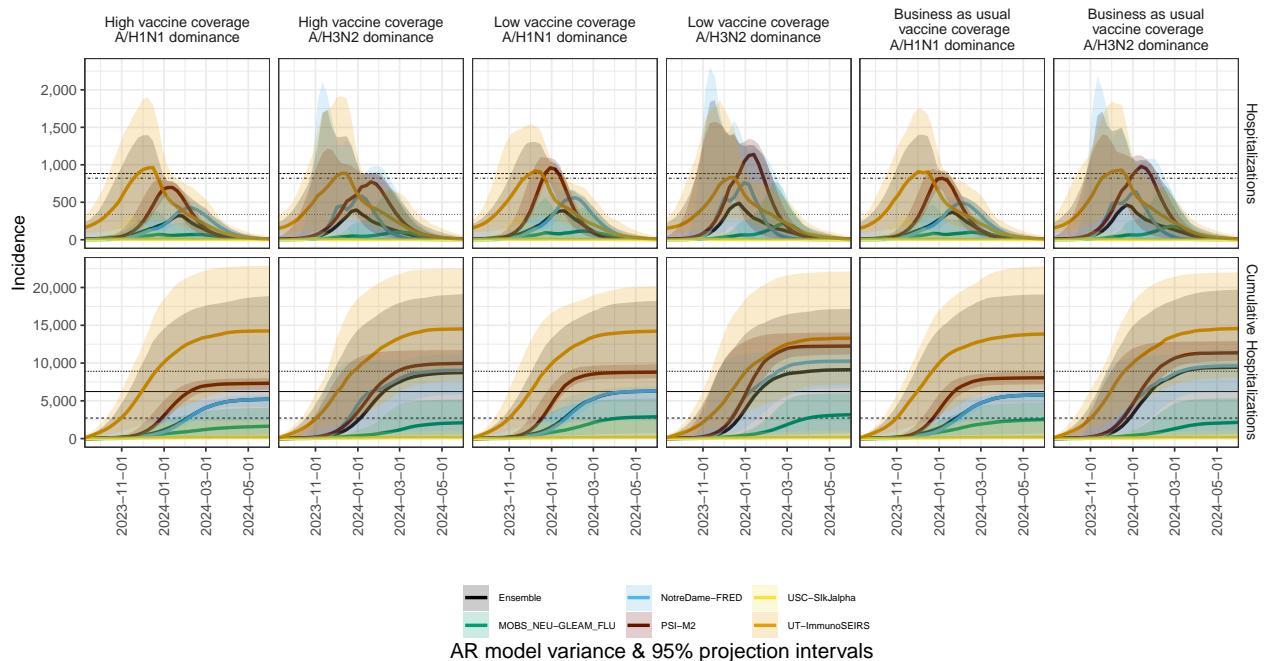
AL model variance & 95% projection intervals



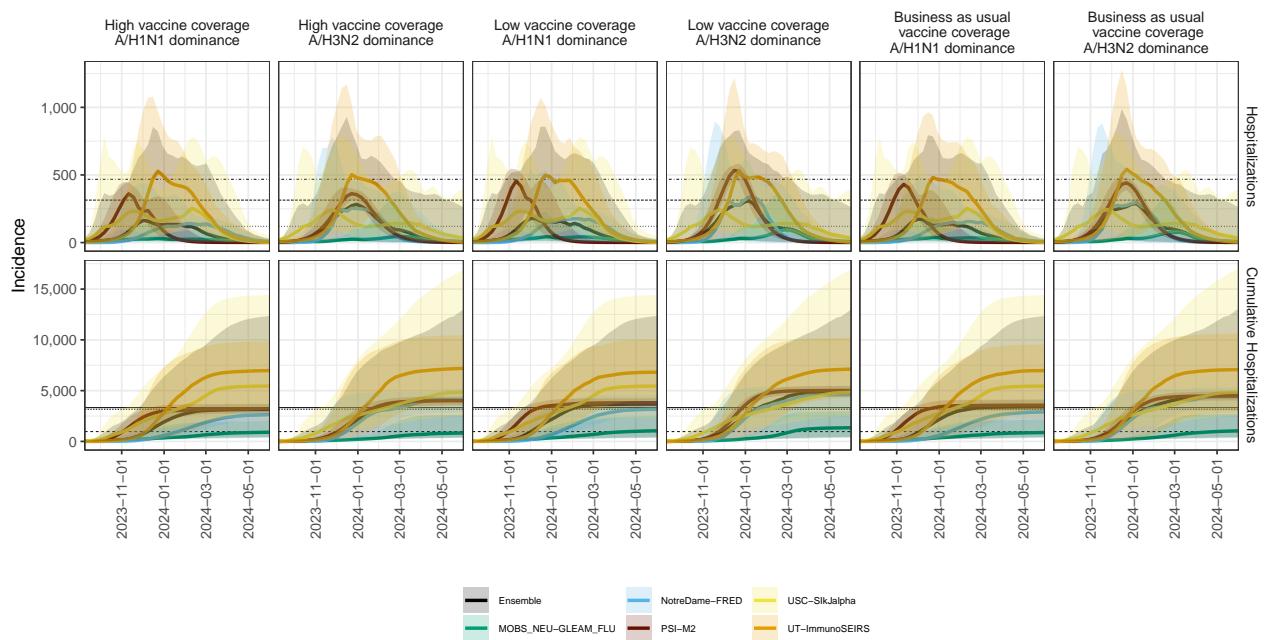
AK model variance & 95% projection intervals



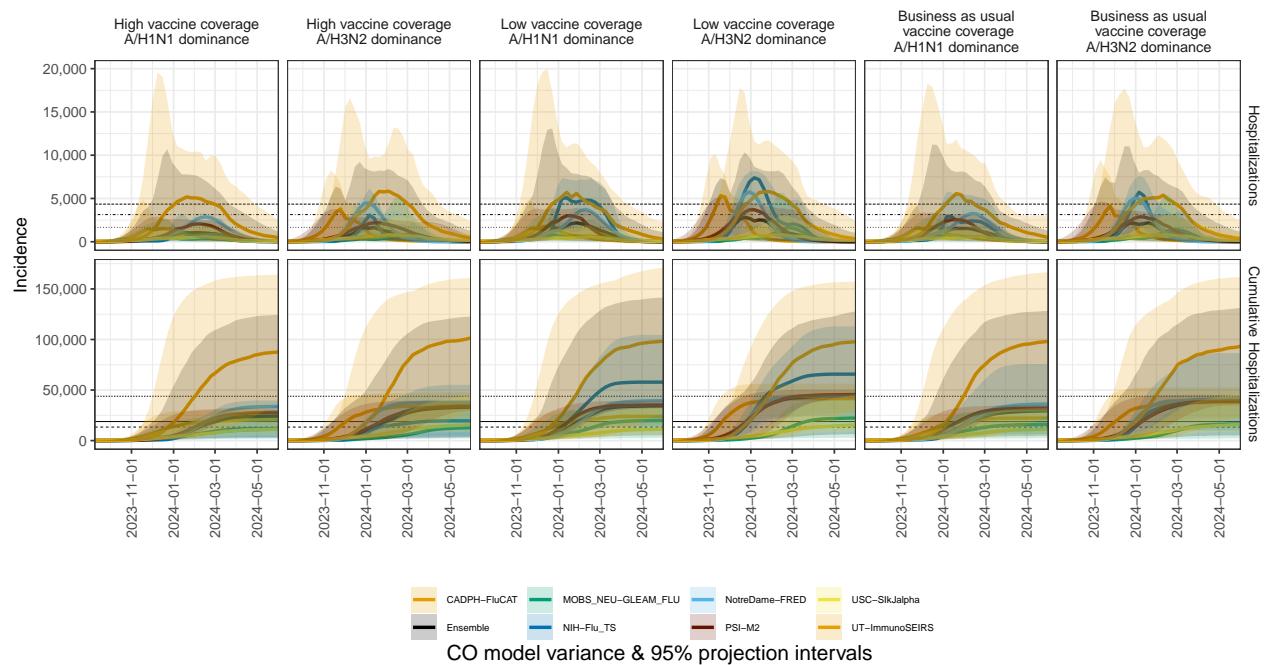
AZ model variance & 95% projection intervals



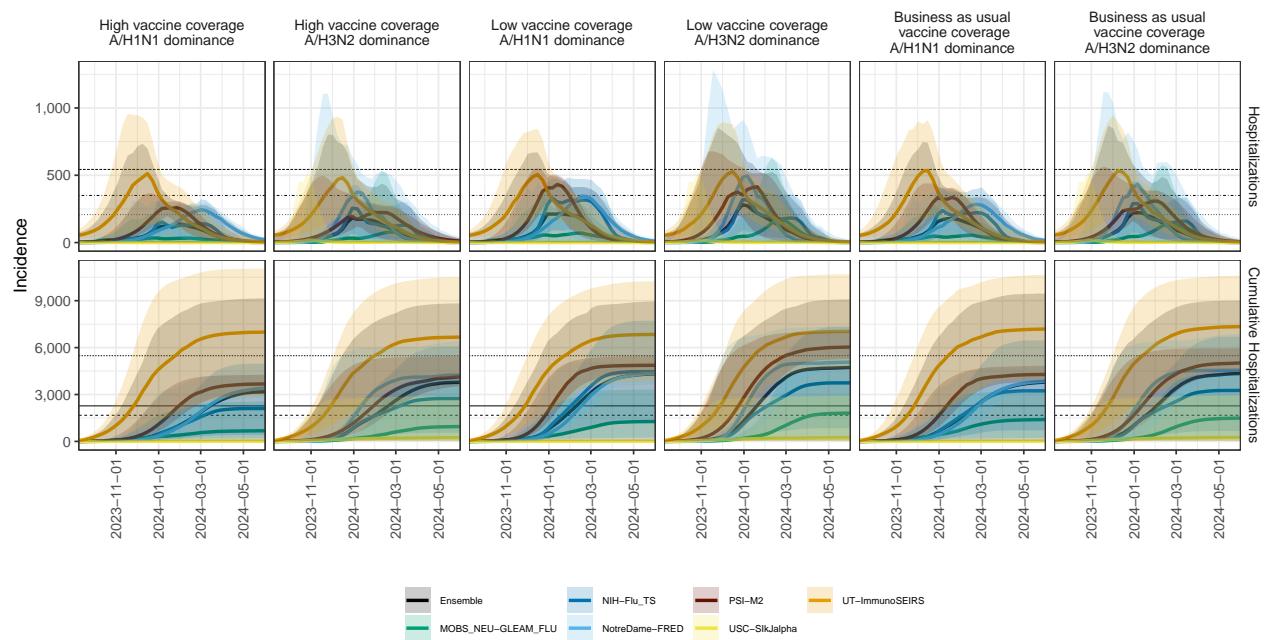
AR model variance & 95% projection intervals



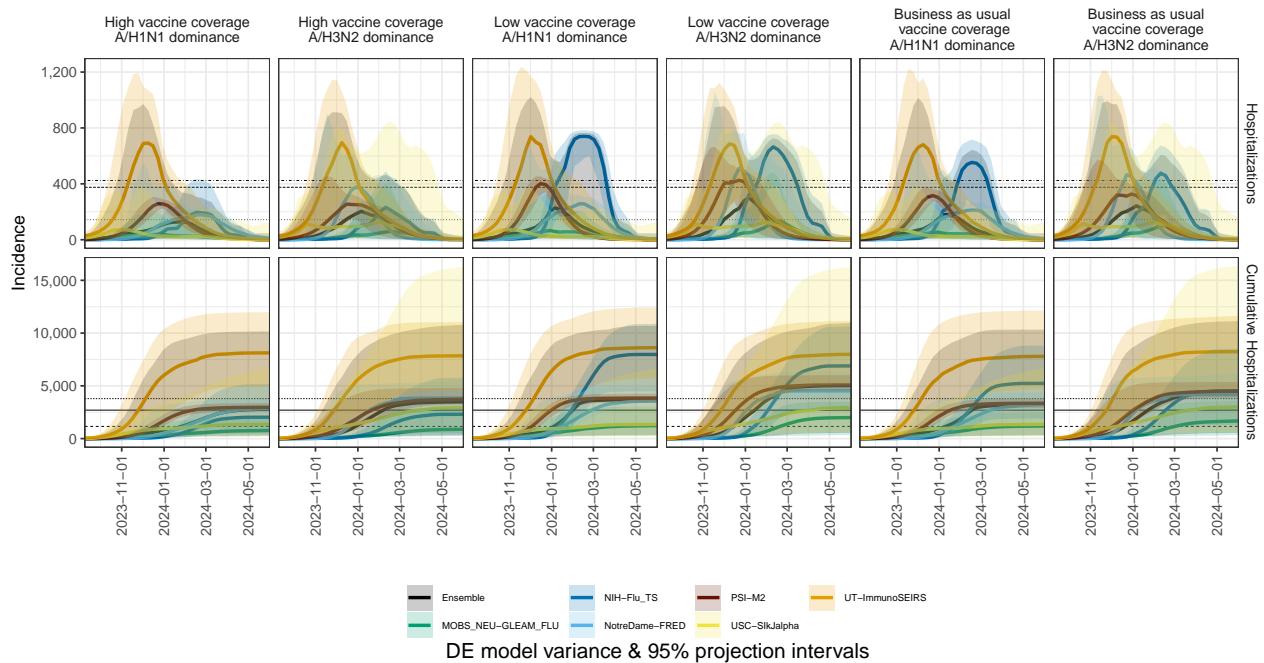
CA model variance & 95% projection intervals



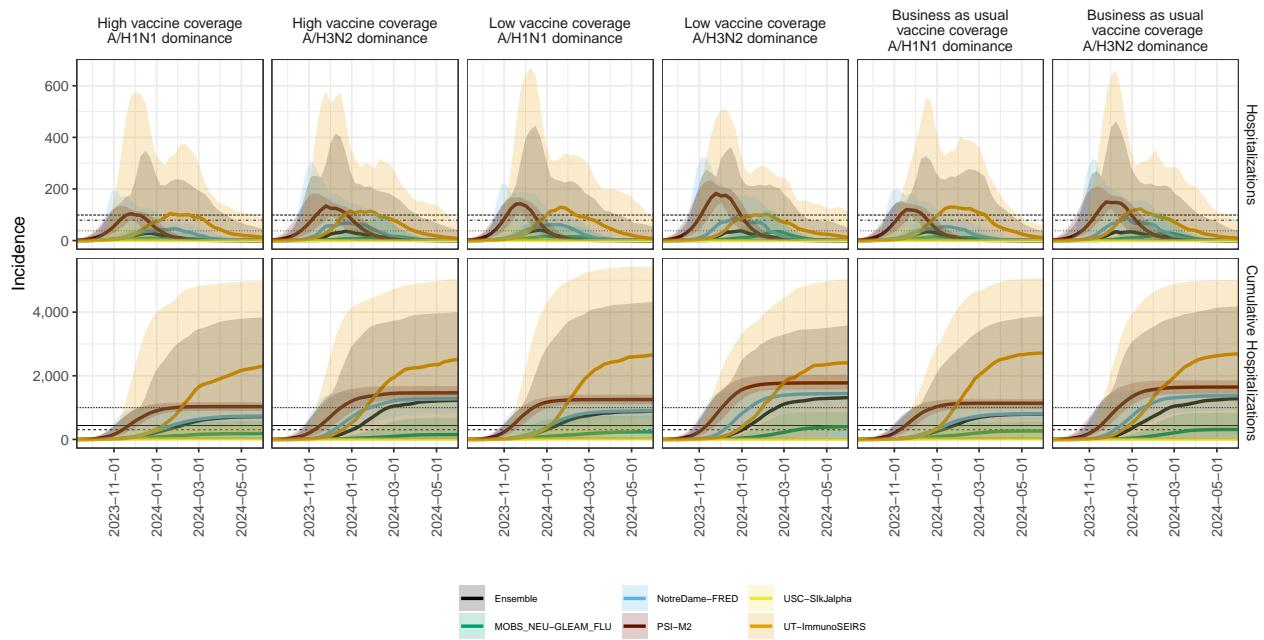
CO model variance & 95% projection intervals



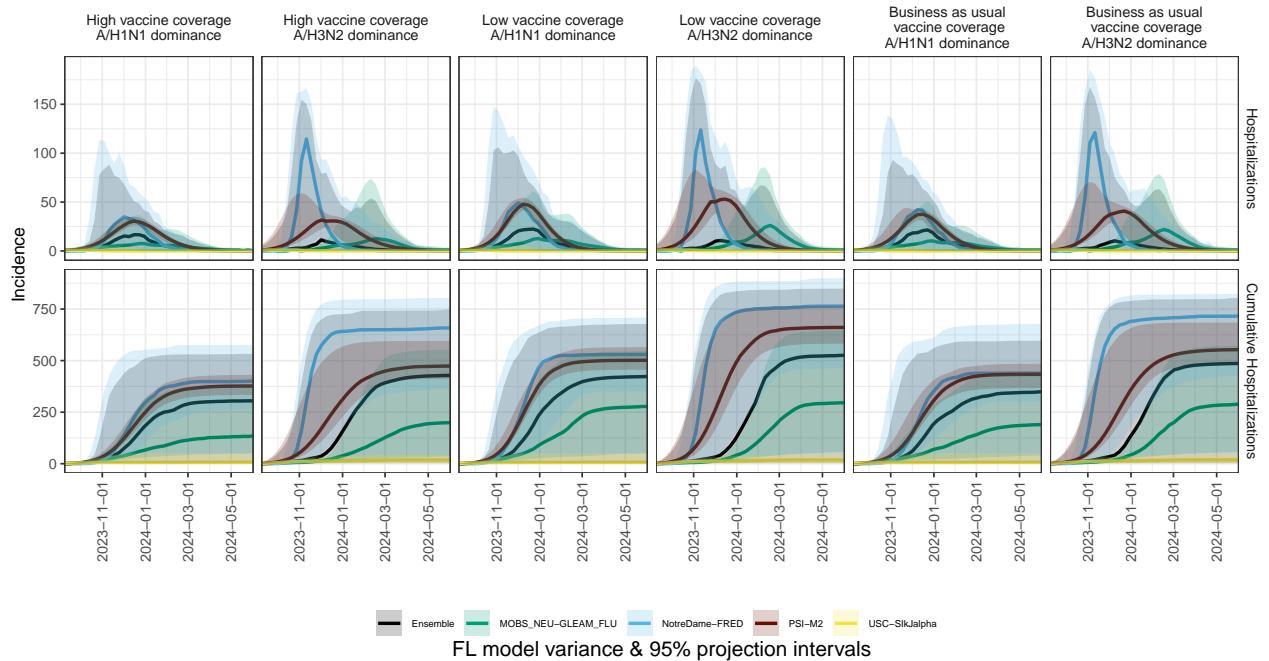
CT model variance & 95% projection intervals



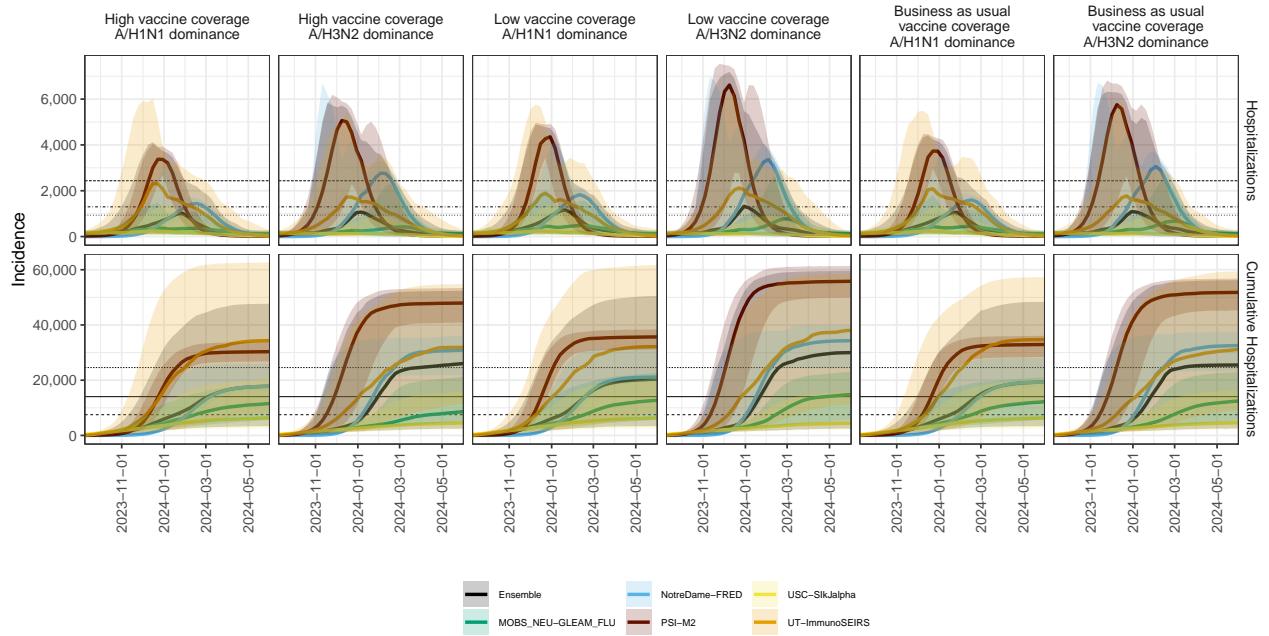
DE model variance & 95% projection intervals



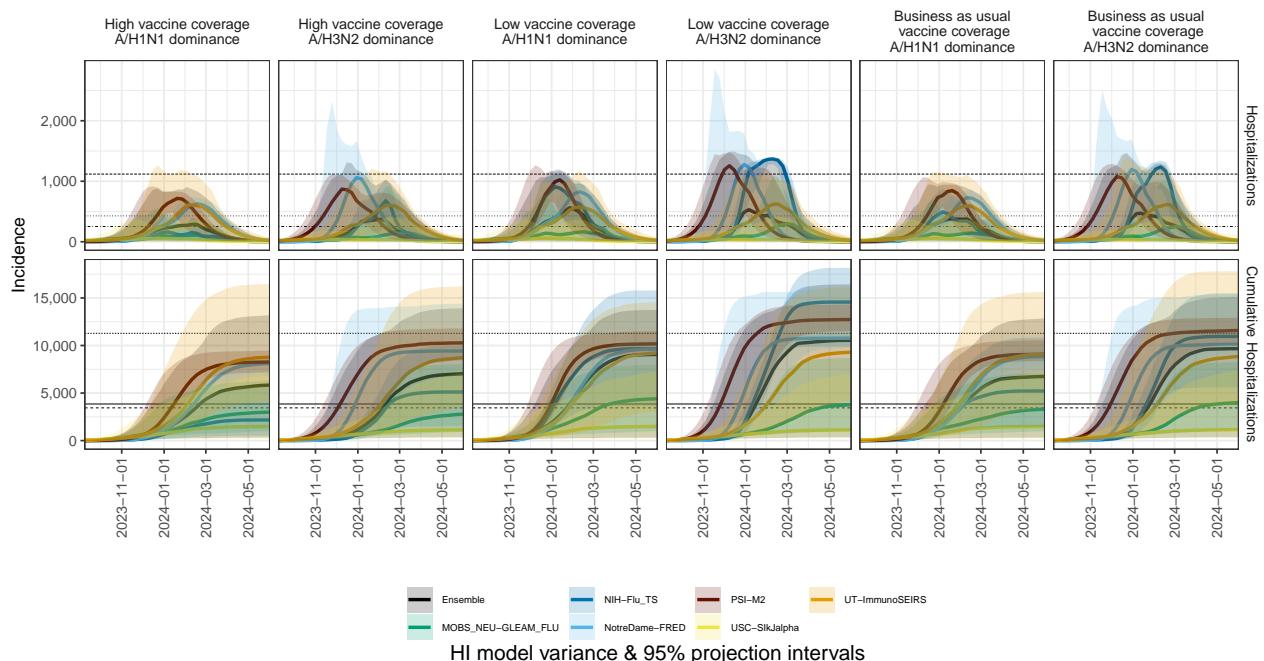
DC model variance & 95% projection intervals



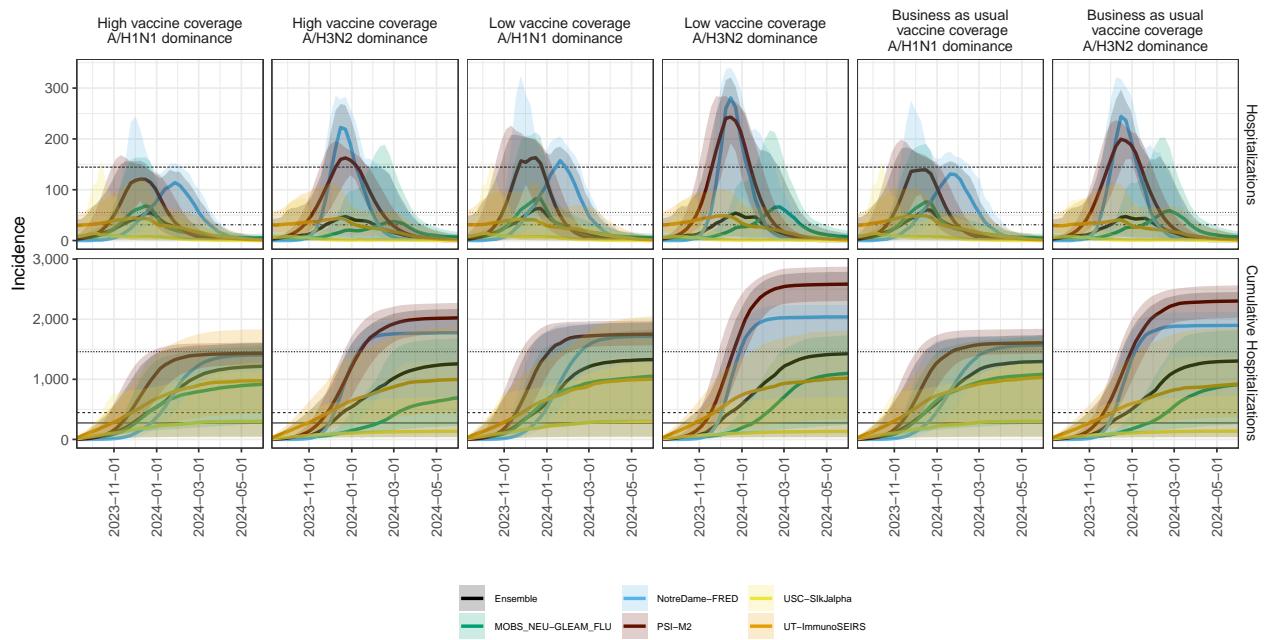
FL model variance & 95% projection intervals



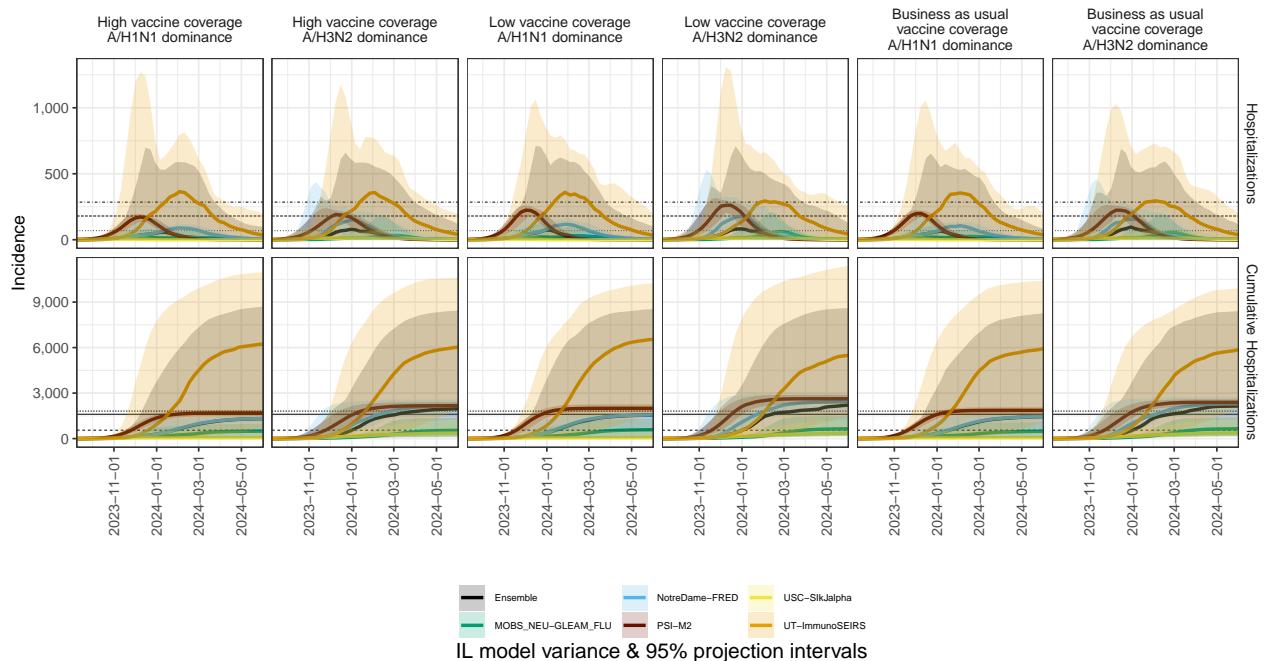
GA model variance & 95% projection intervals



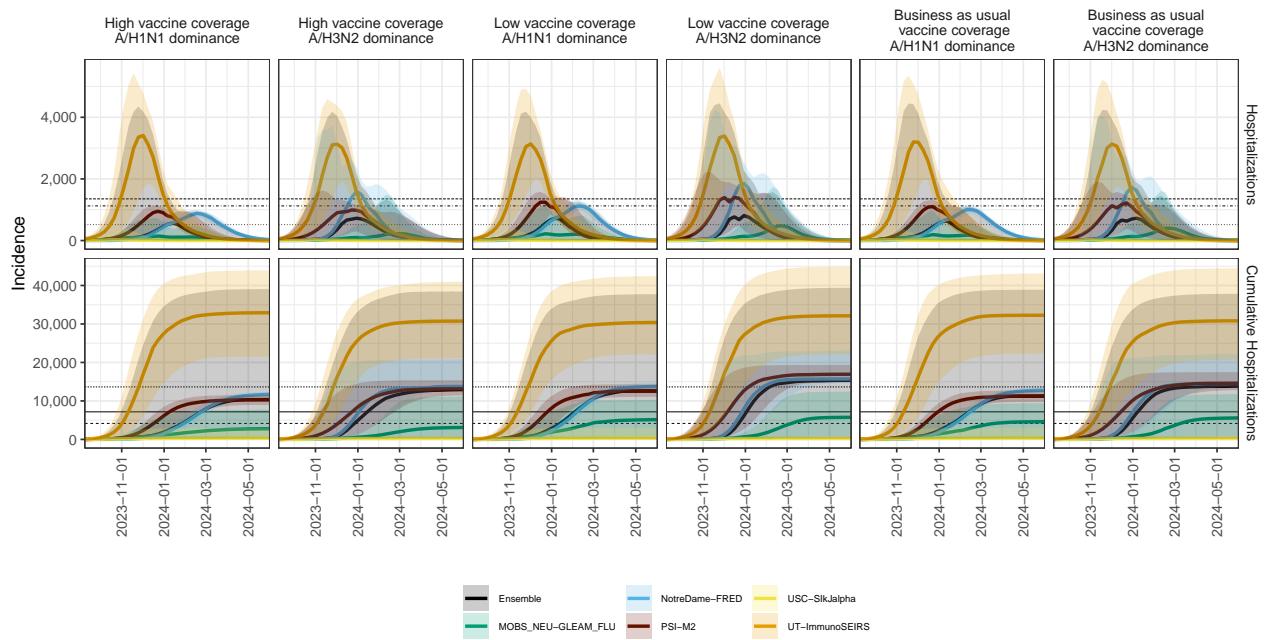
HI model variance & 95% projection intervals



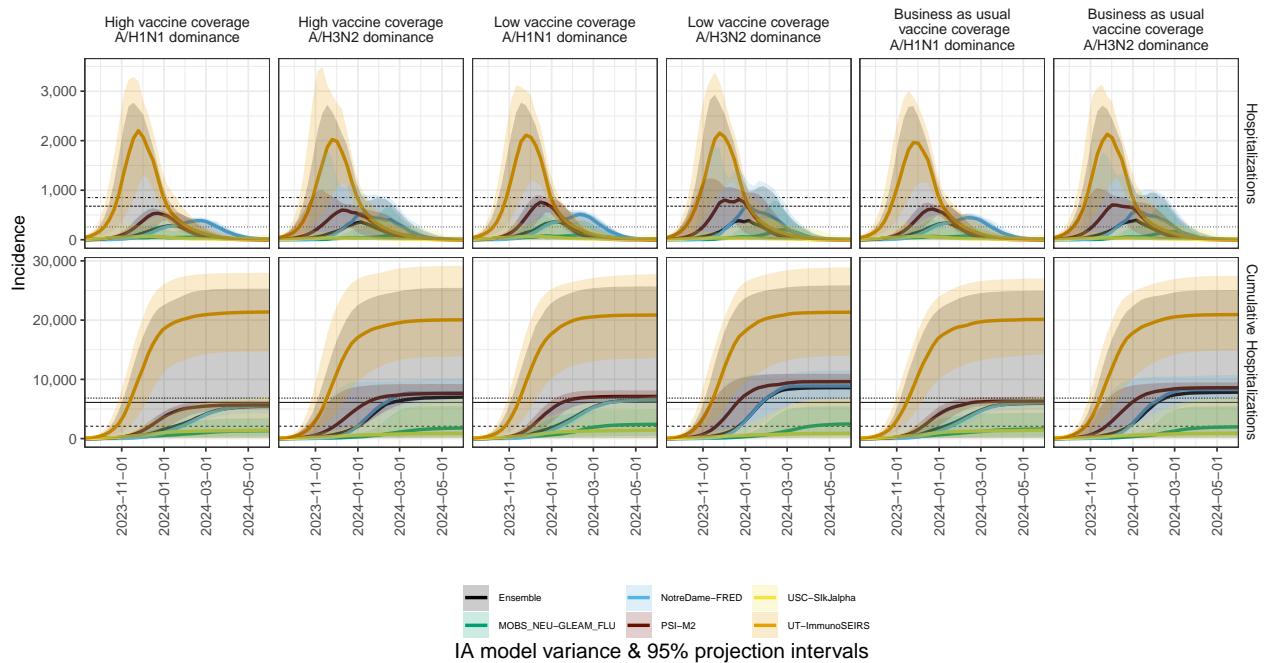
ID model variance & 95% projection intervals



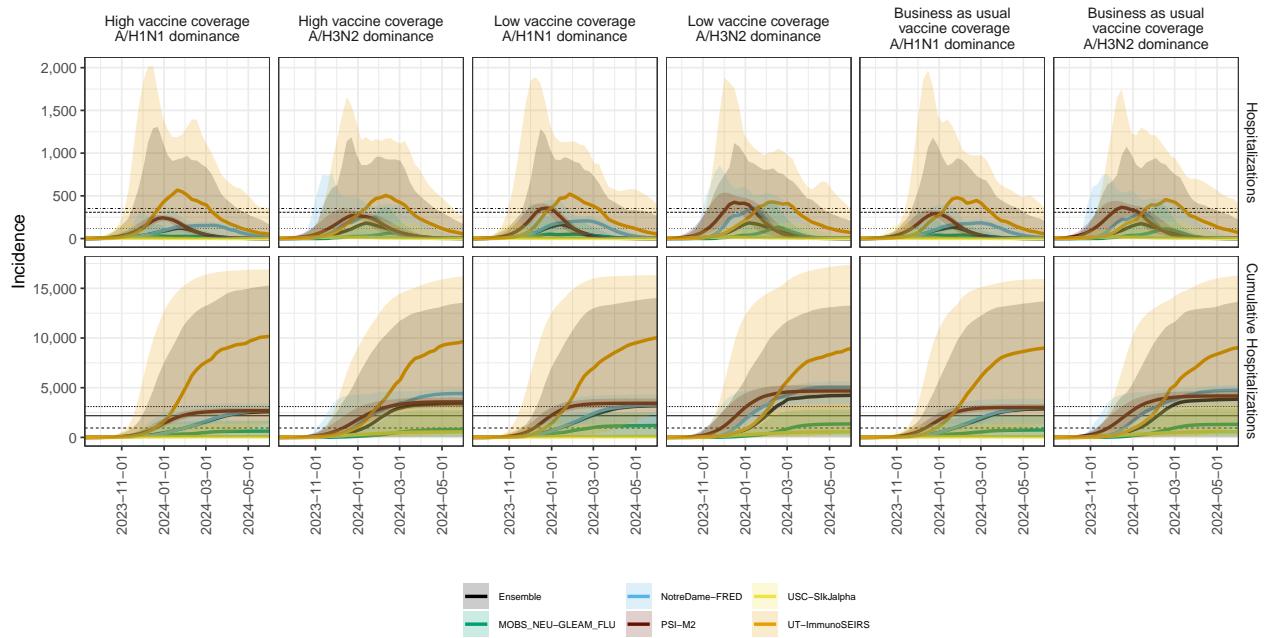
IL model variance & 95% projection intervals



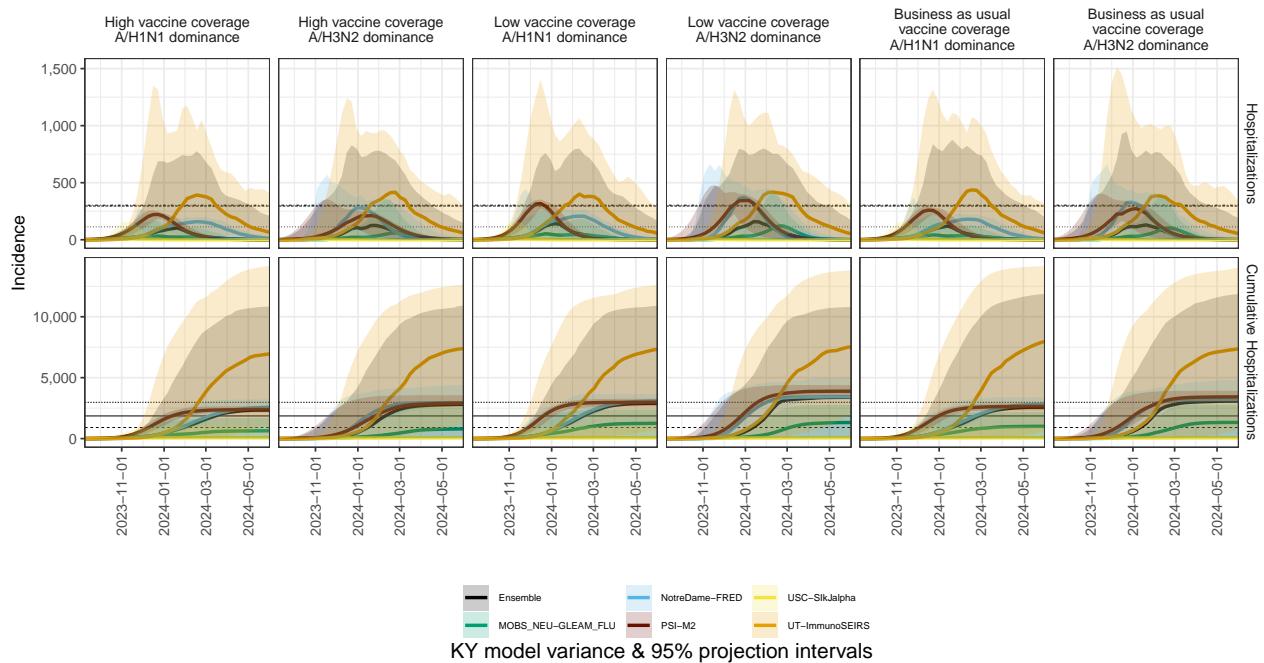
IN model variance & 95% projection intervals



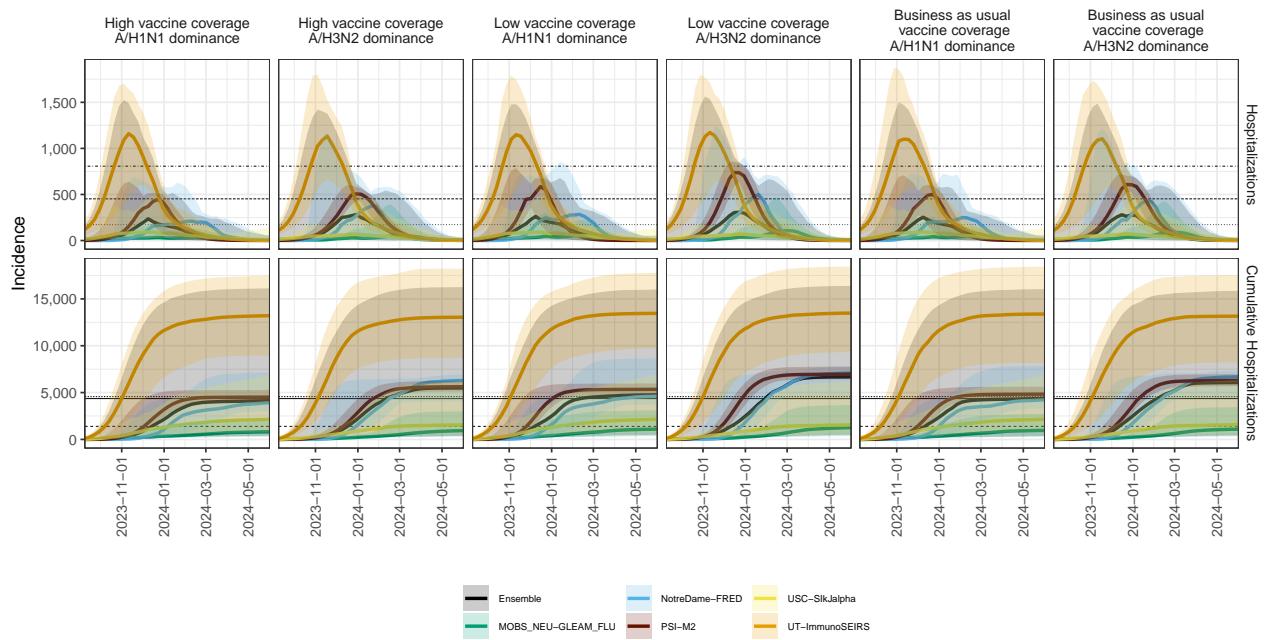
IA model variance & 95% projection intervals



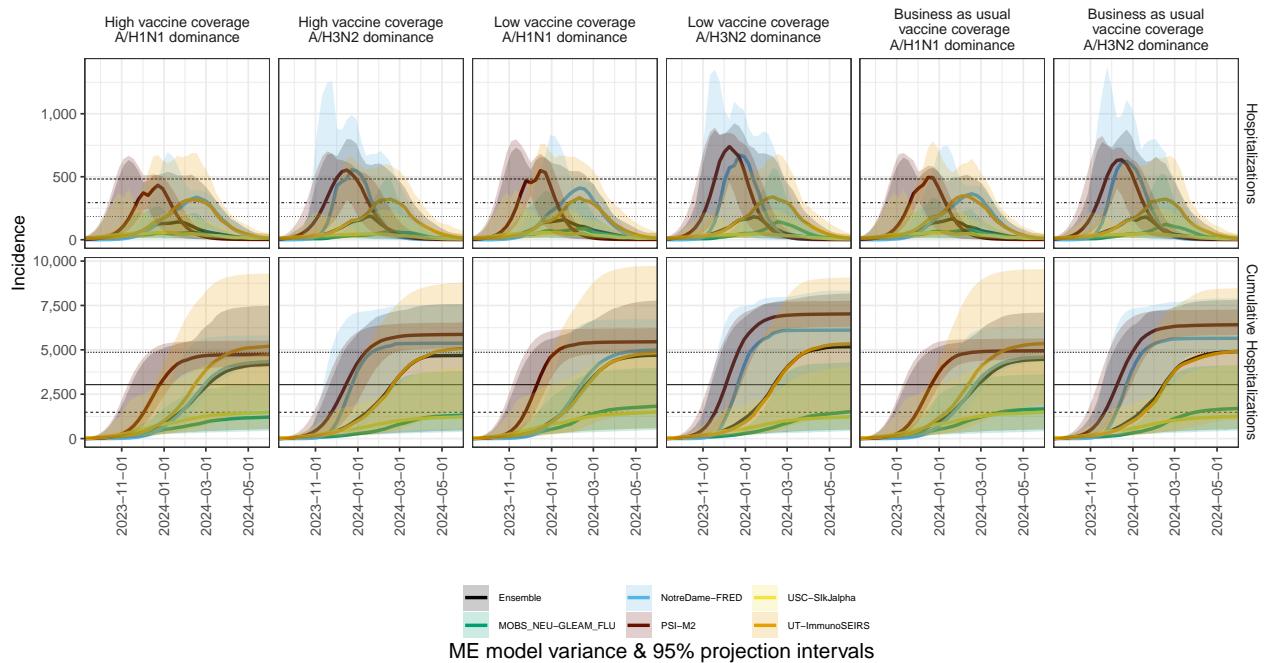
KS model variance & 95% projection intervals



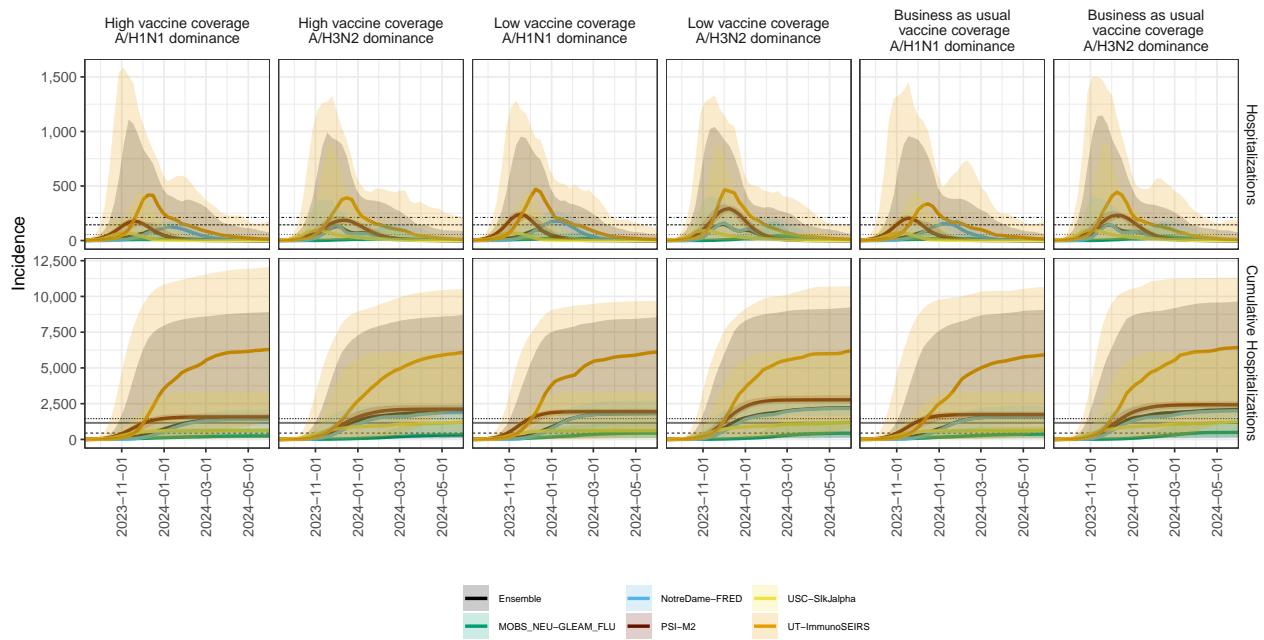
KY model variance & 95% projection intervals



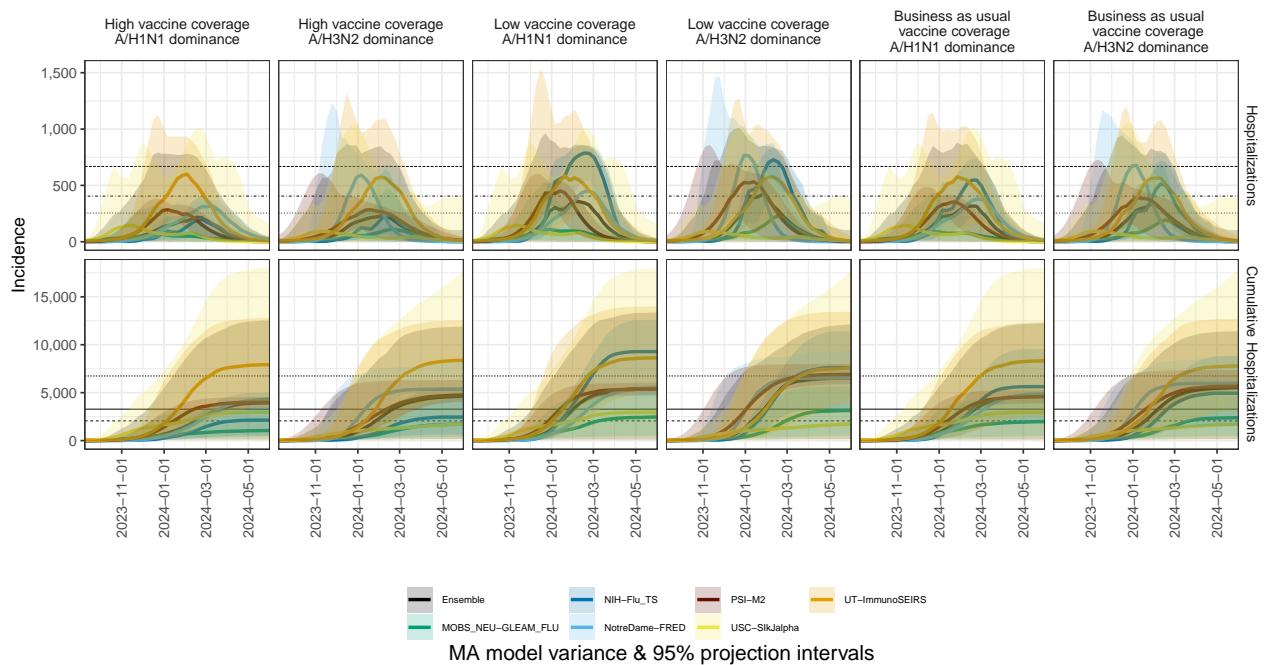
LA model variance & 95% projection intervals



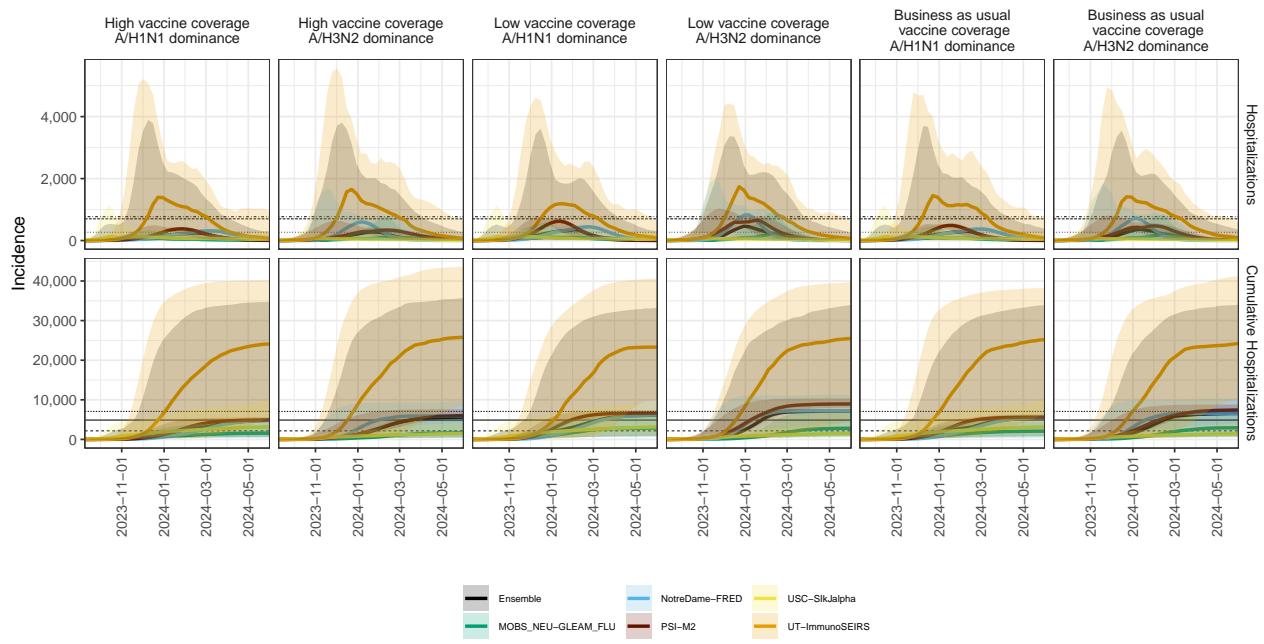
ME model variance & 95% projection intervals



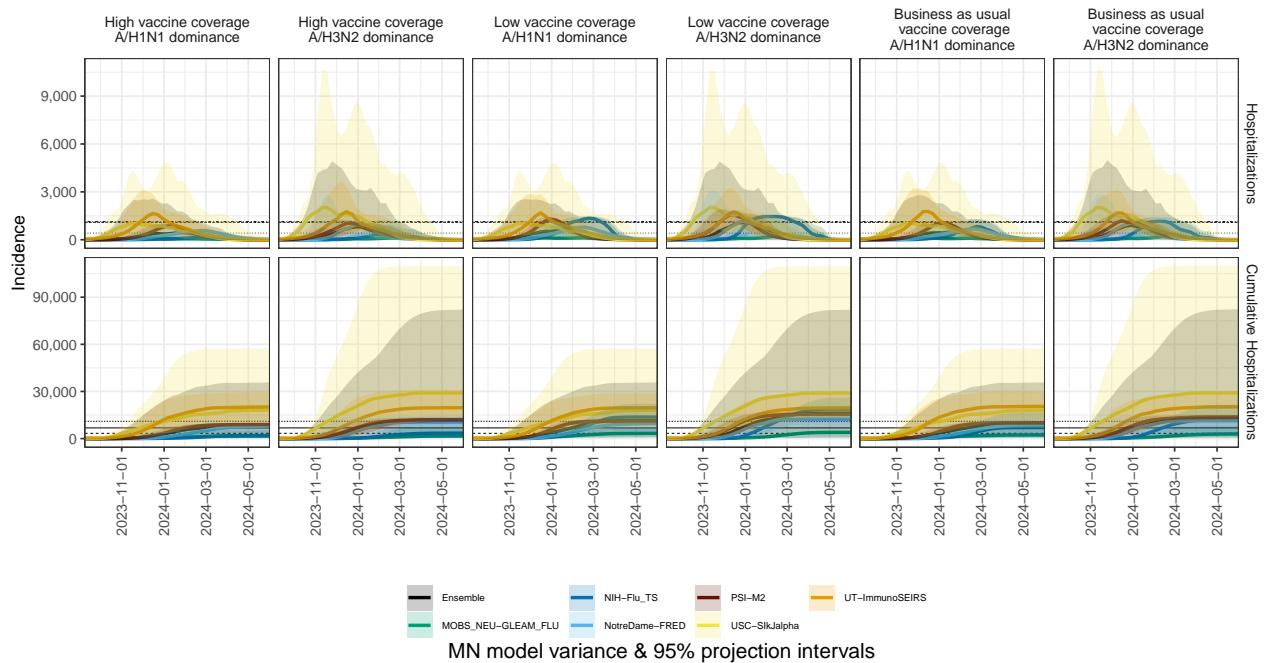
MD model variance & 95% projection intervals



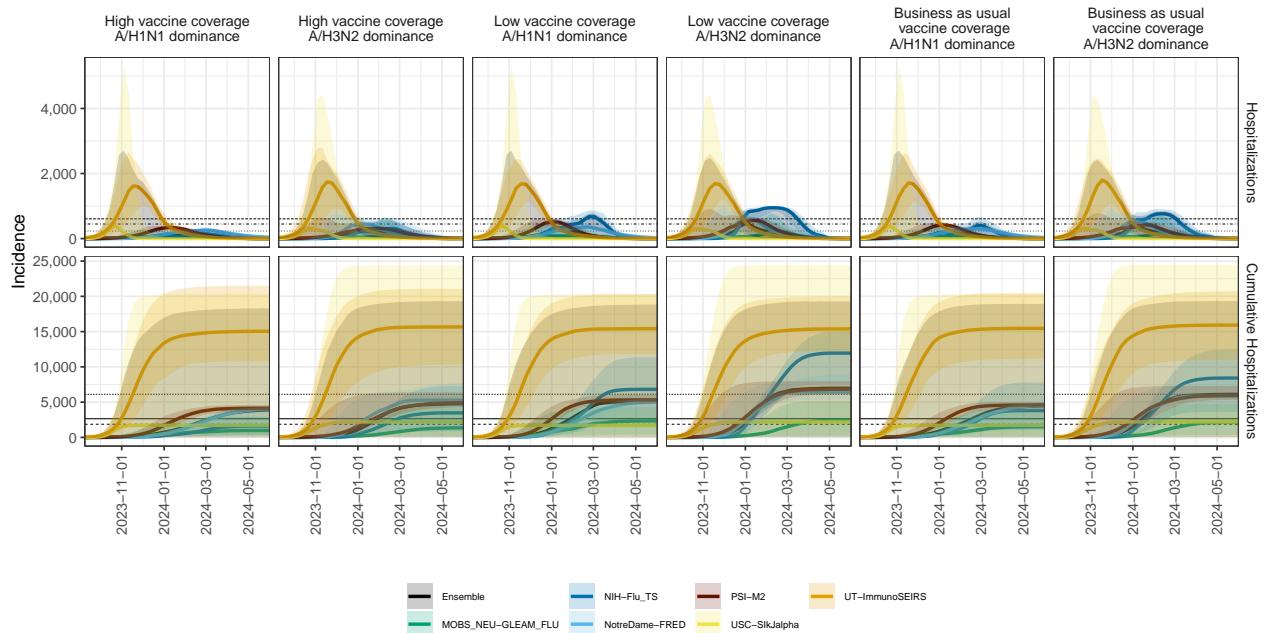
MA model variance & 95% projection intervals



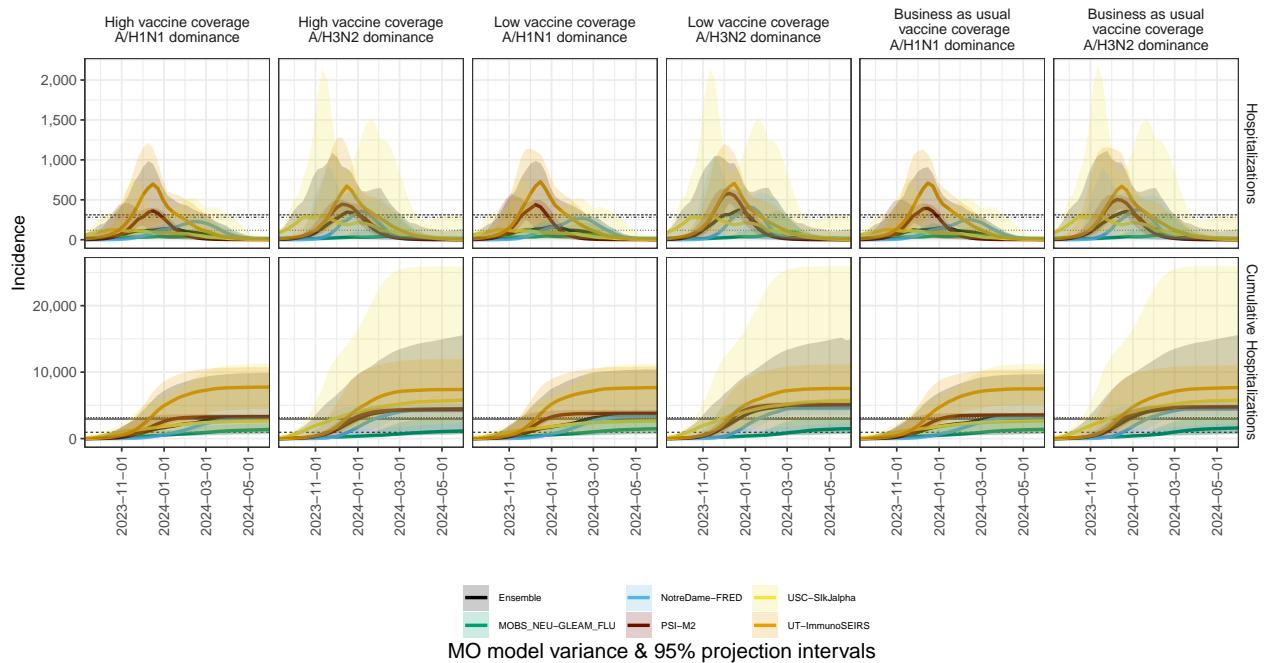
MI model variance & 95% projection intervals



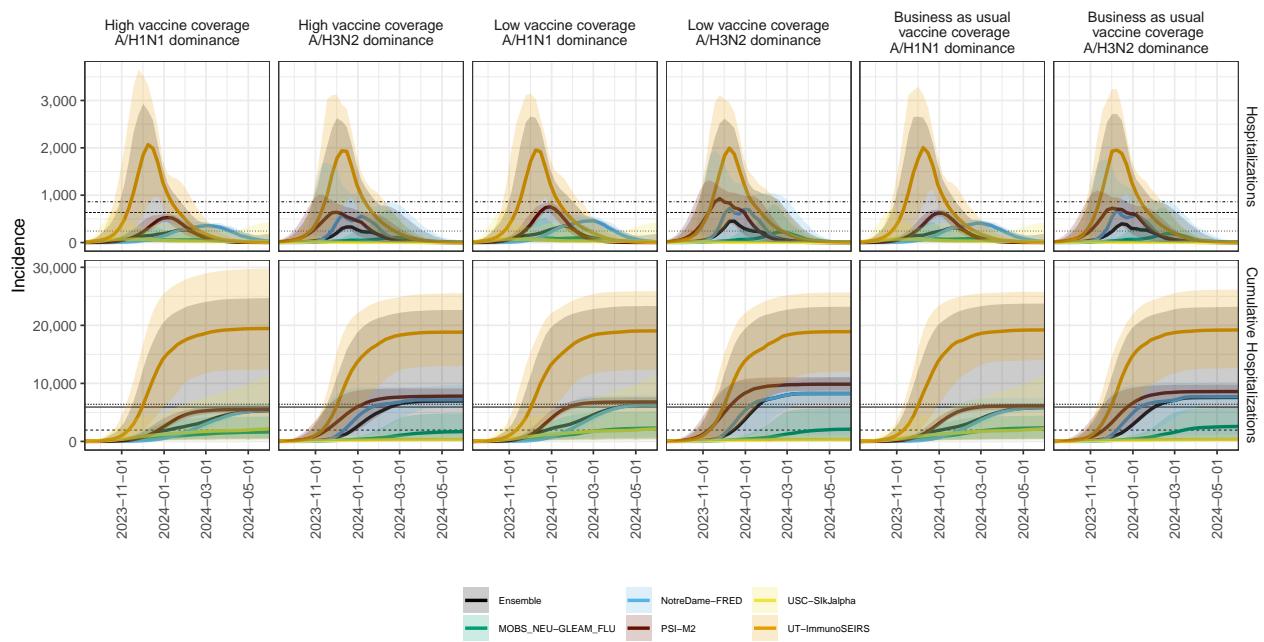
MN model variance & 95% projection intervals



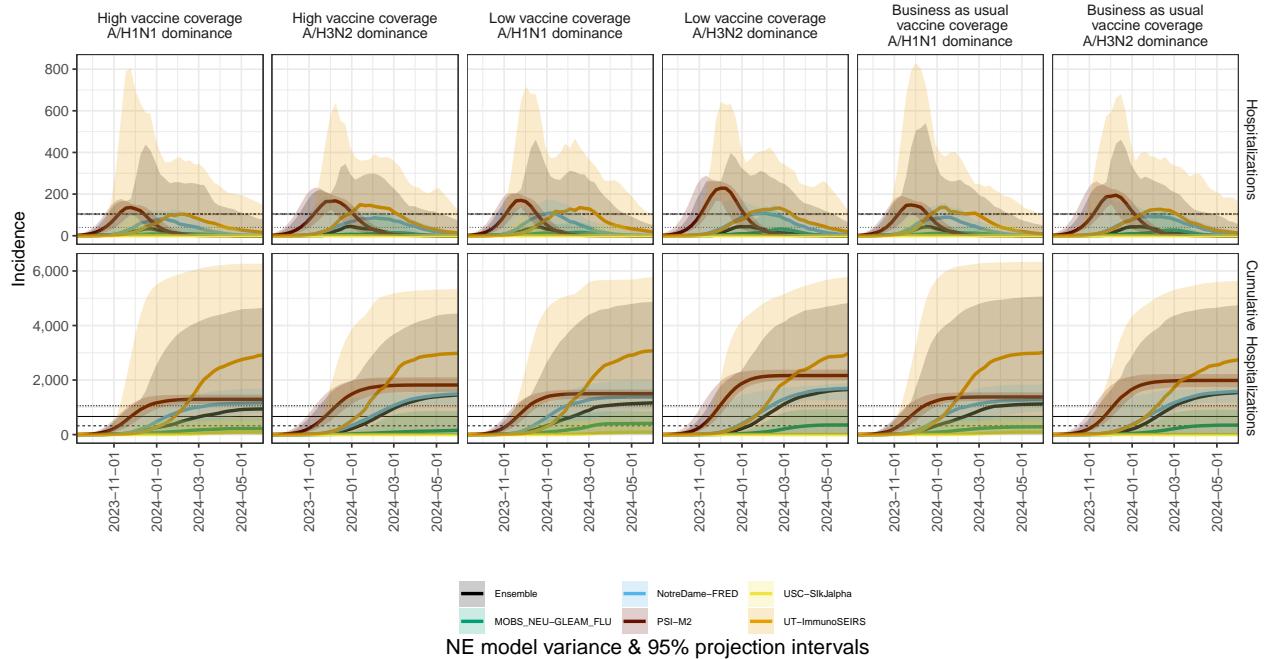
MS model variance & 95% projection intervals



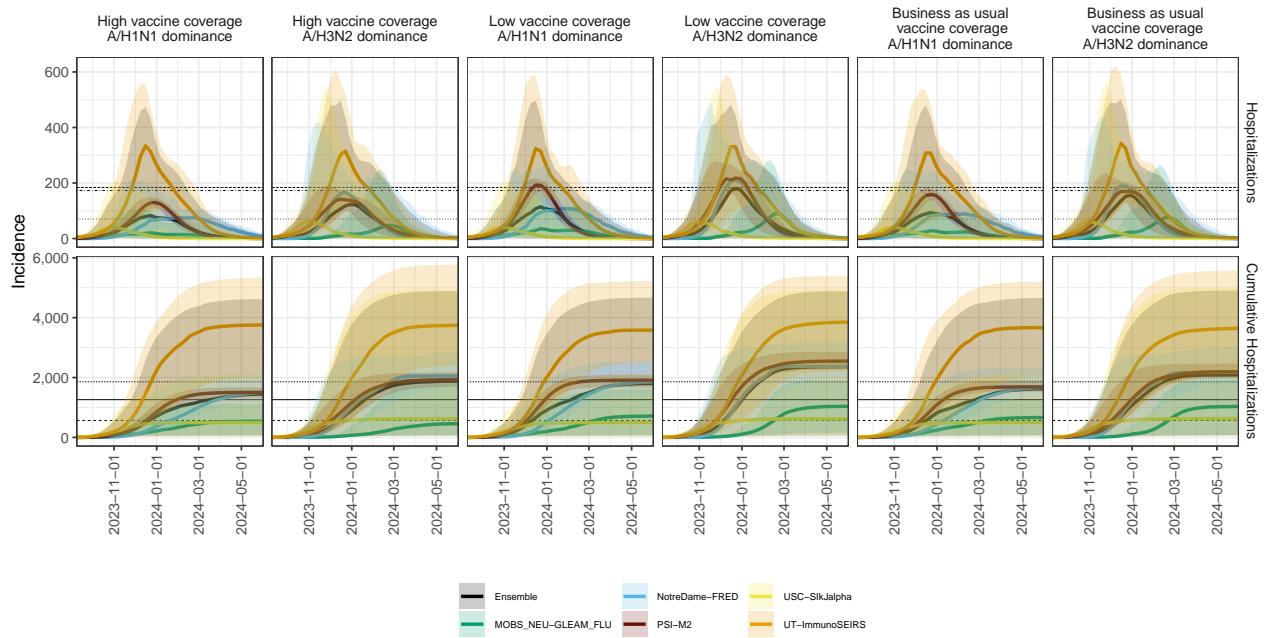
MO model variance & 95% projection intervals



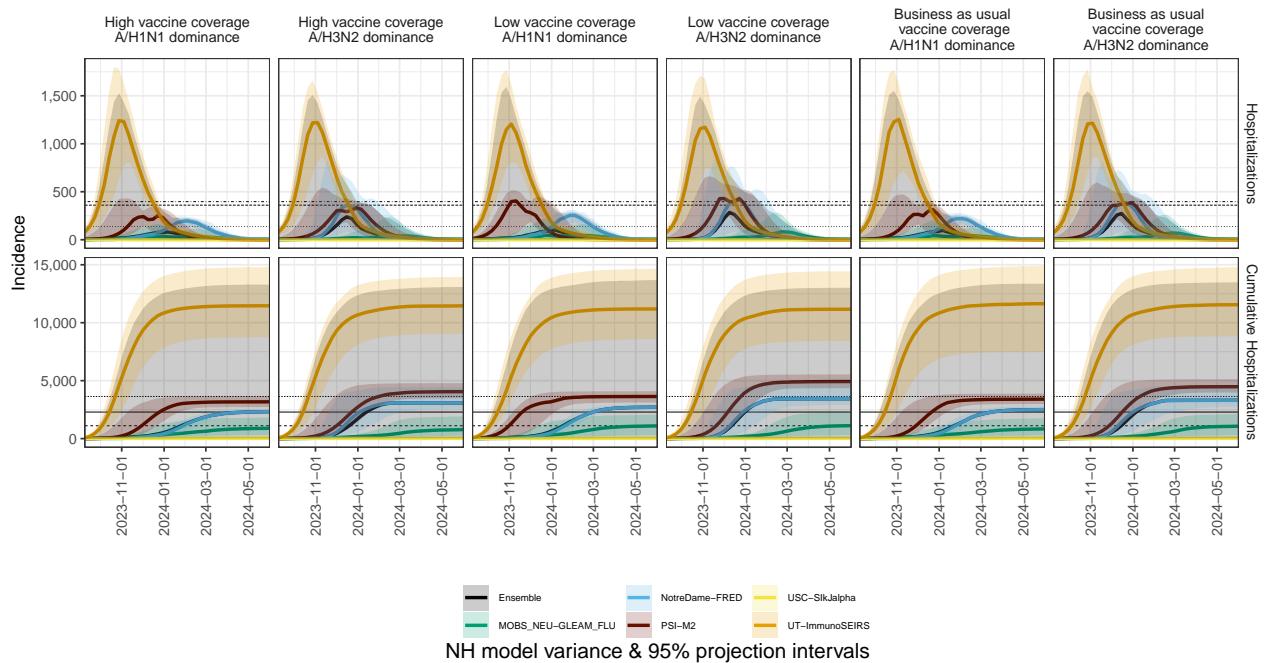
MT model variance & 95% projection intervals



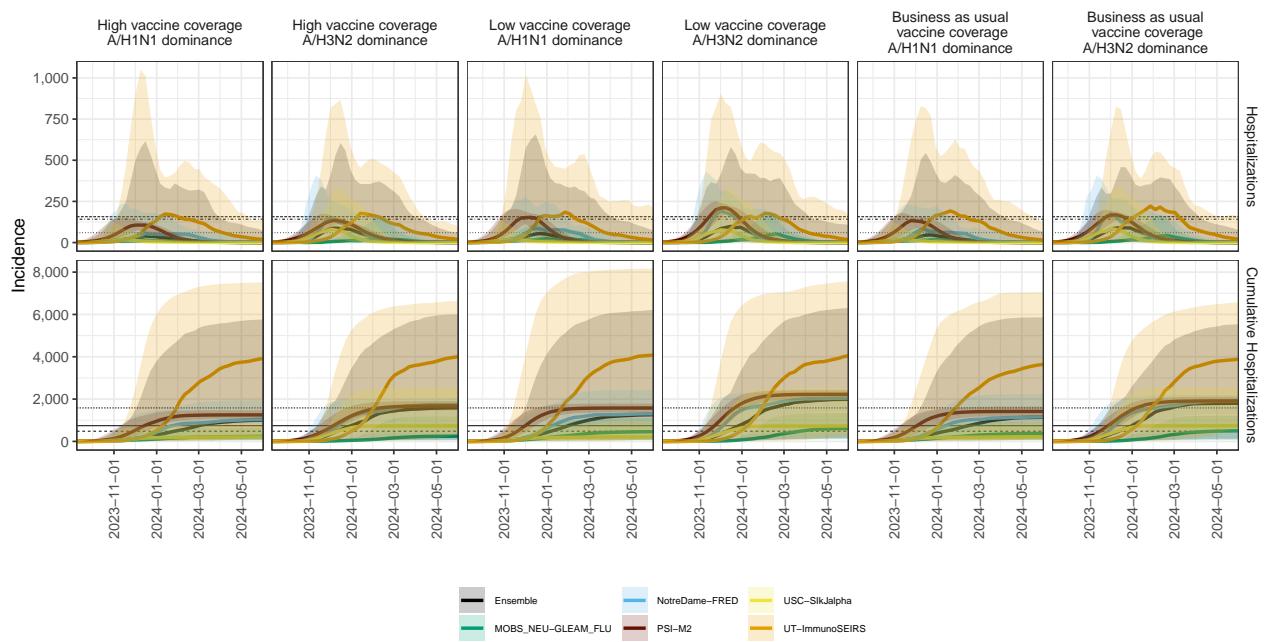
NE model variance & 95% projection intervals



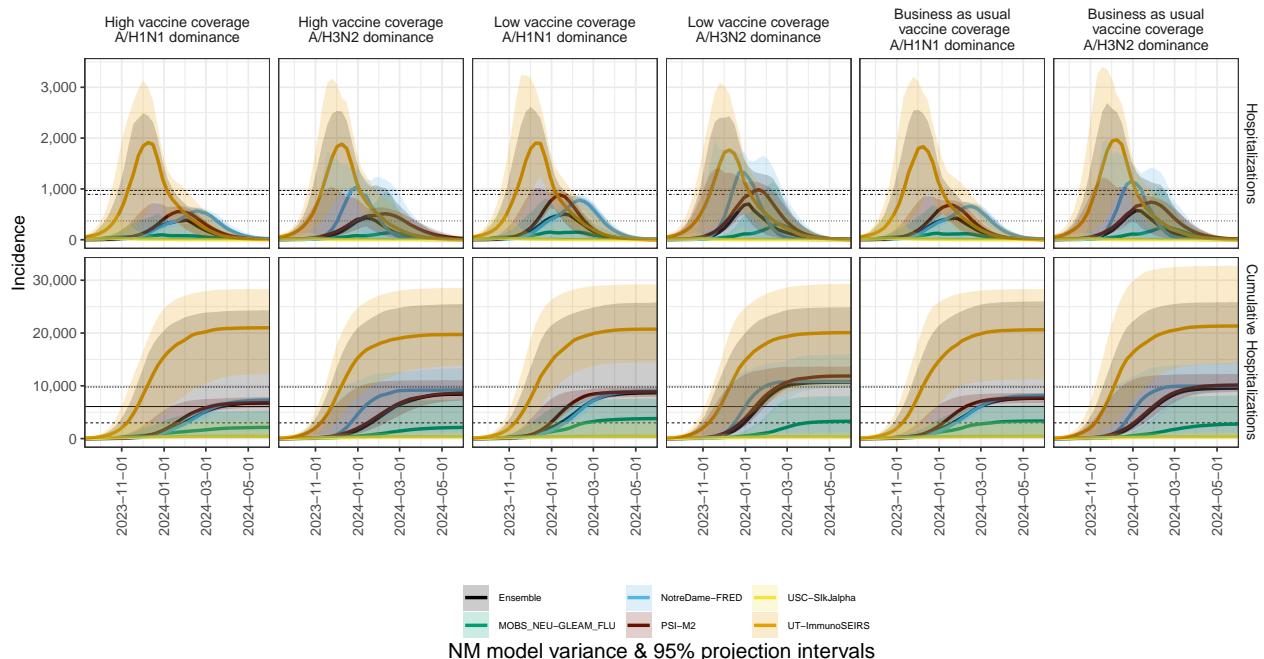
NV model variance & 95% projection intervals



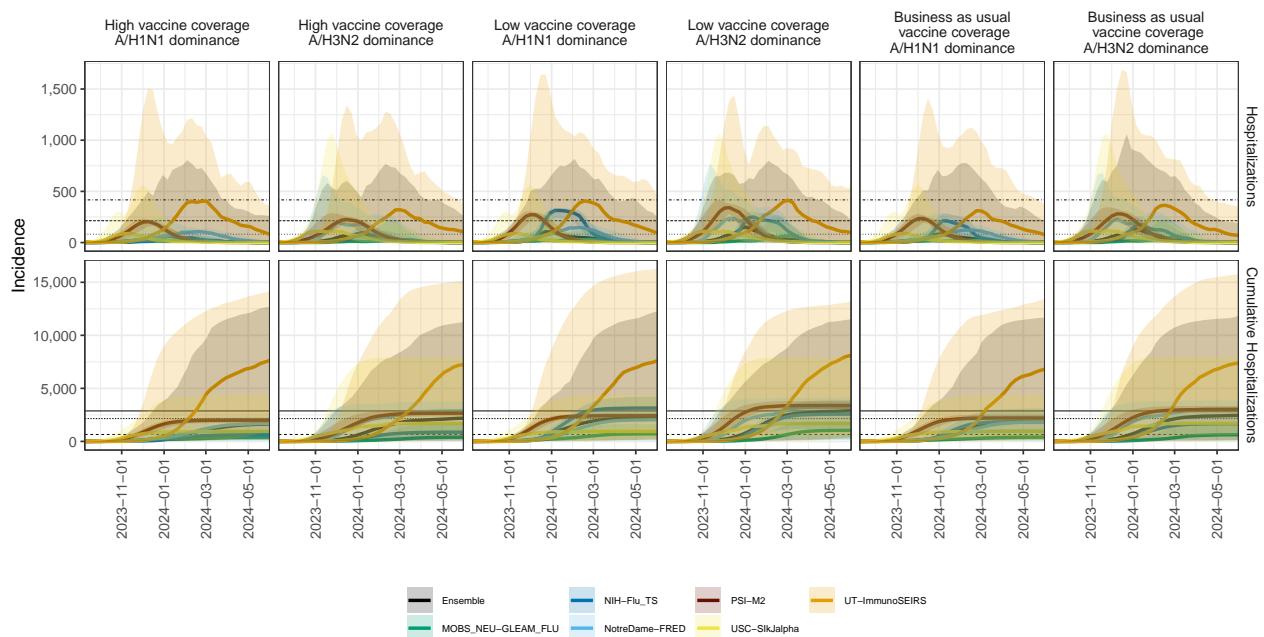
NH model variance & 95% projection intervals



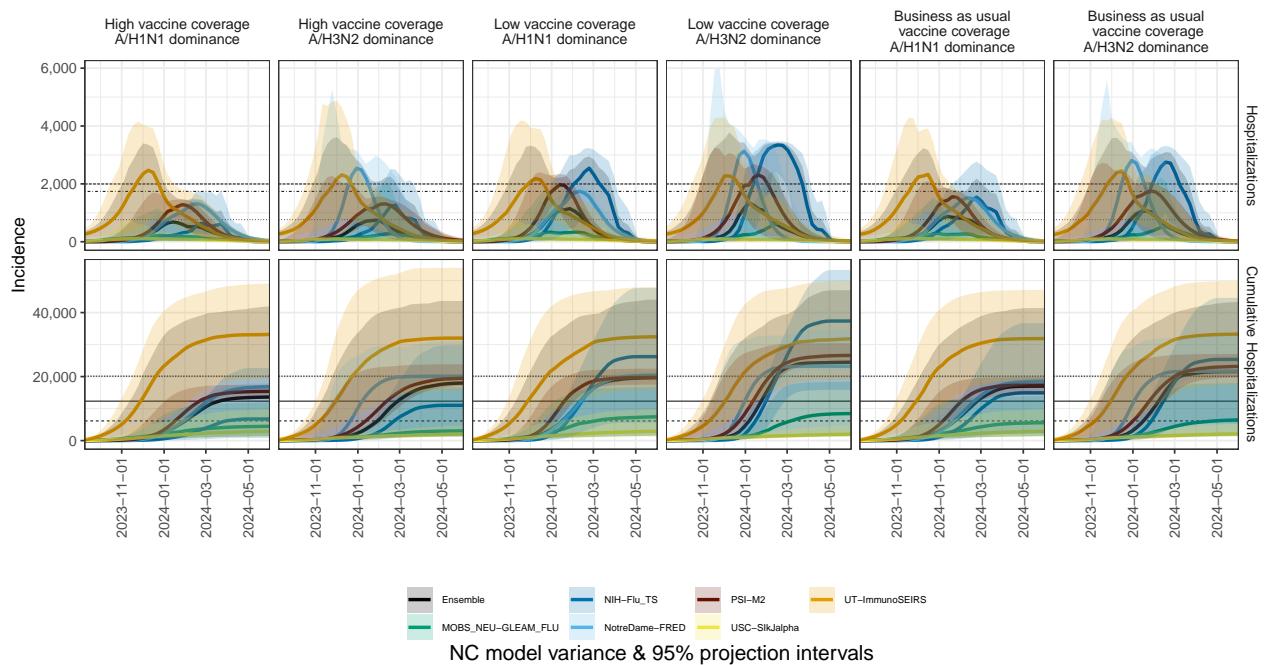
NJ model variance & 95% projection intervals



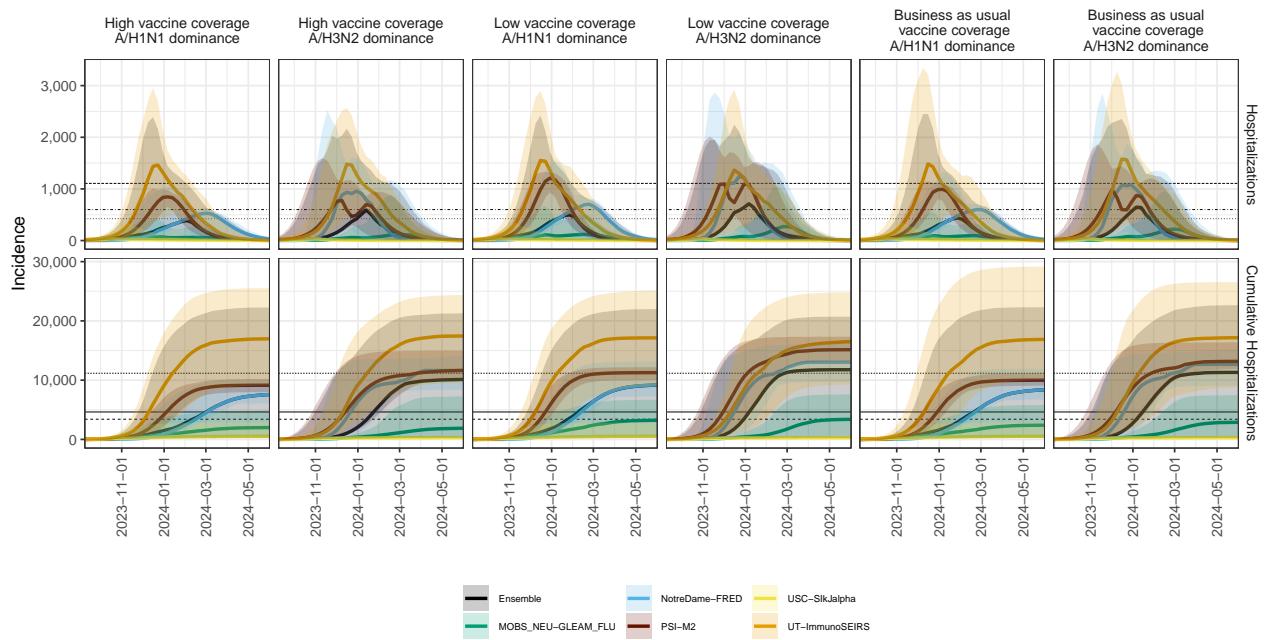
NM model variance & 95% projection intervals



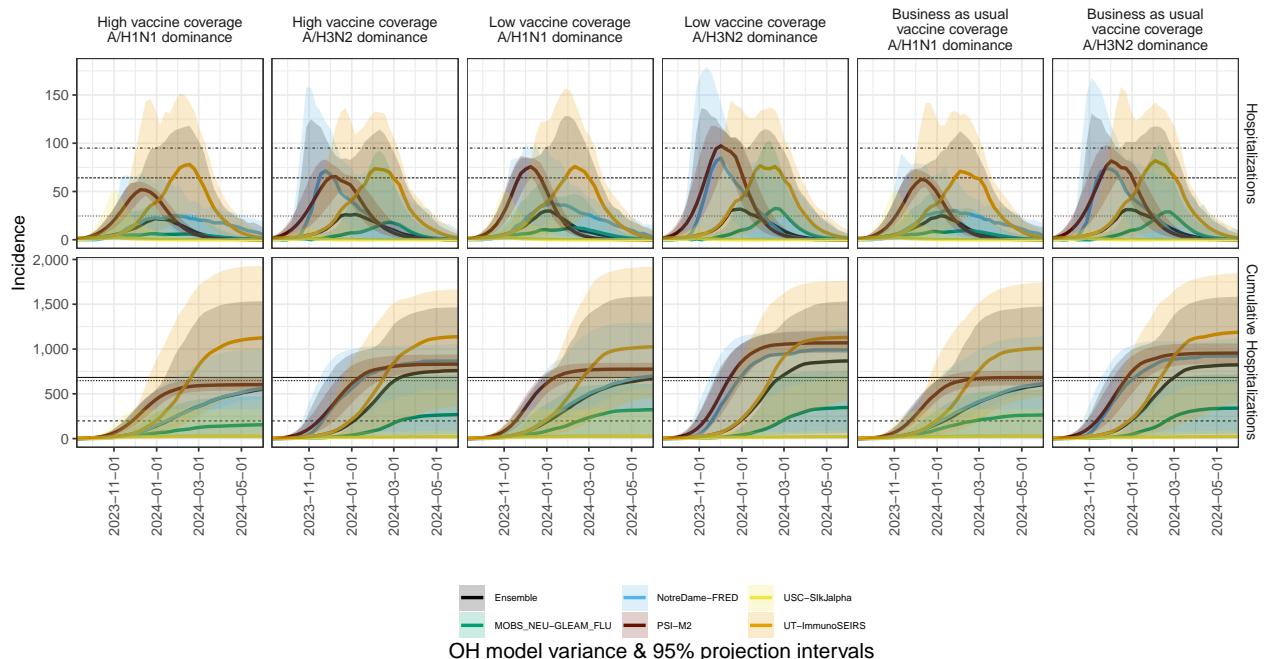
NY model variance & 95% projection intervals



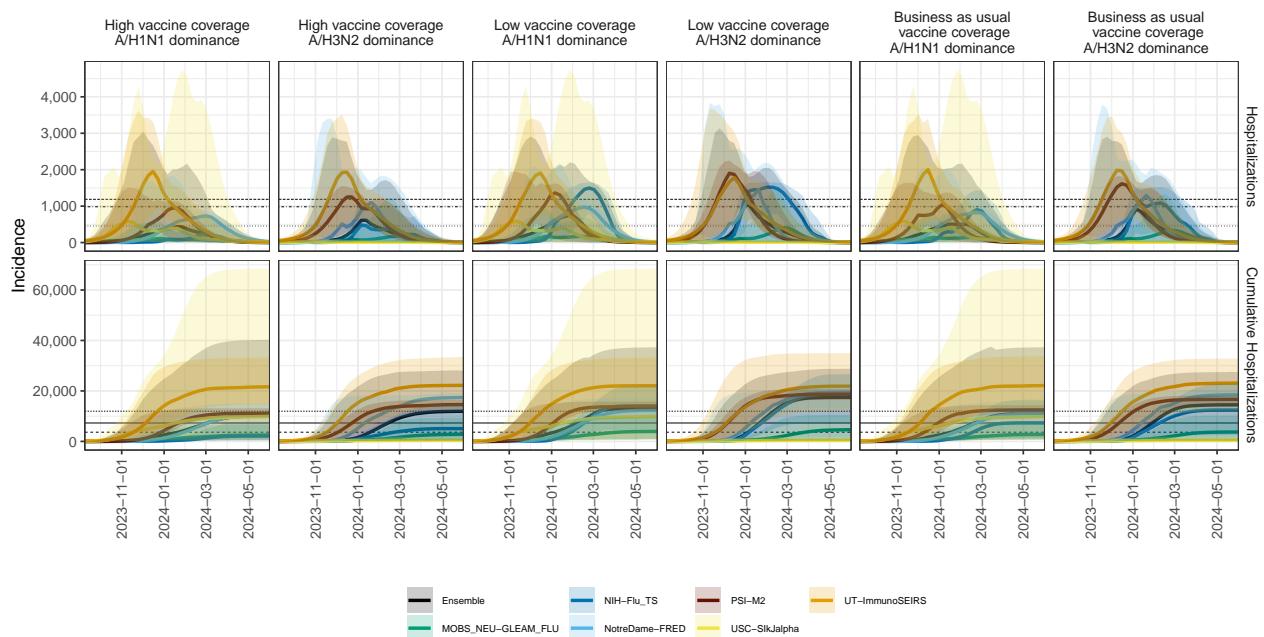
NC model variance & 95% projection intervals



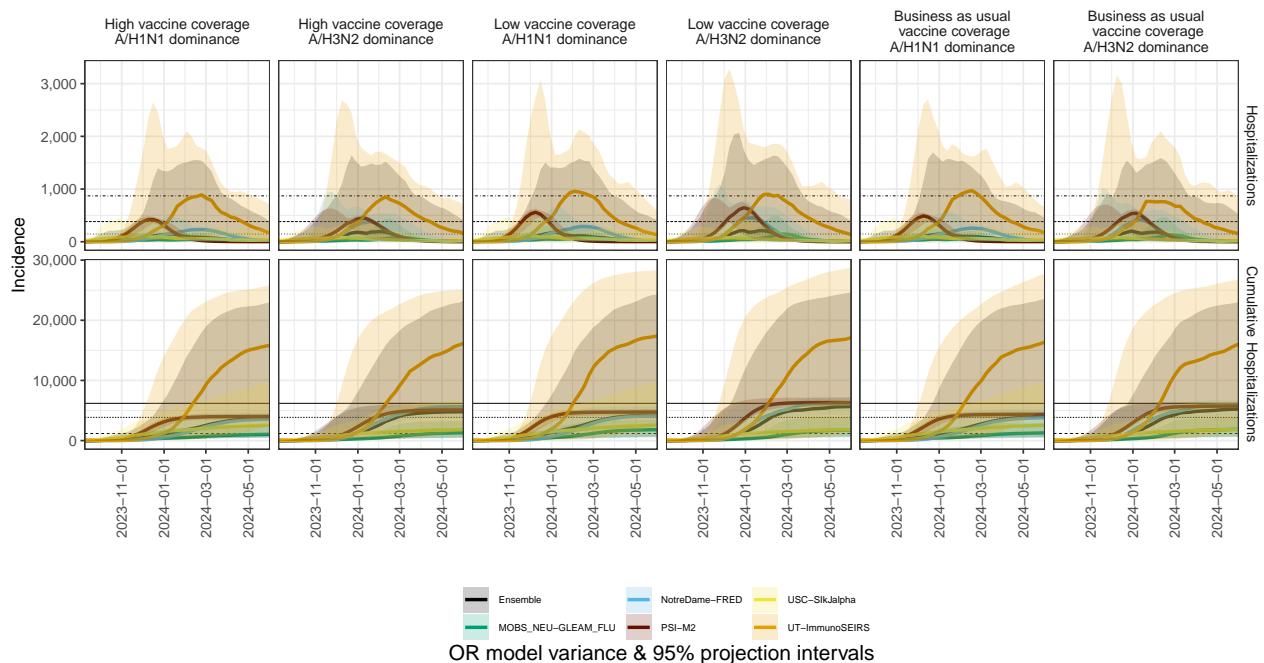
ND model variance & 95% projection intervals



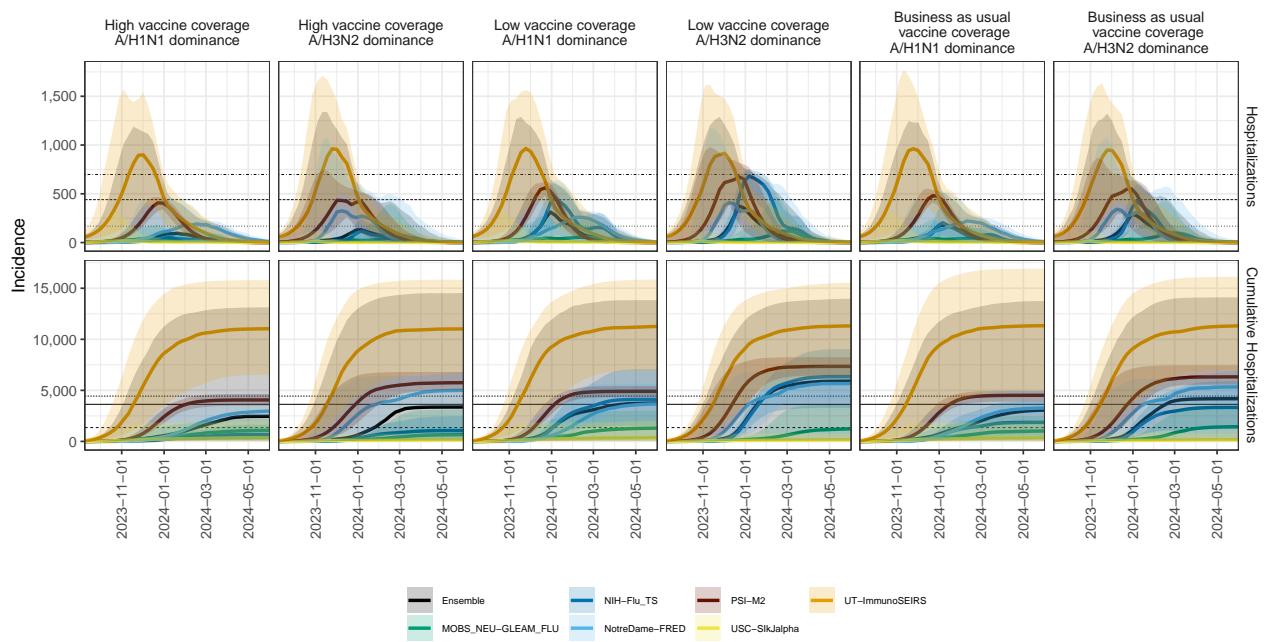
OH model variance & 95% projection intervals



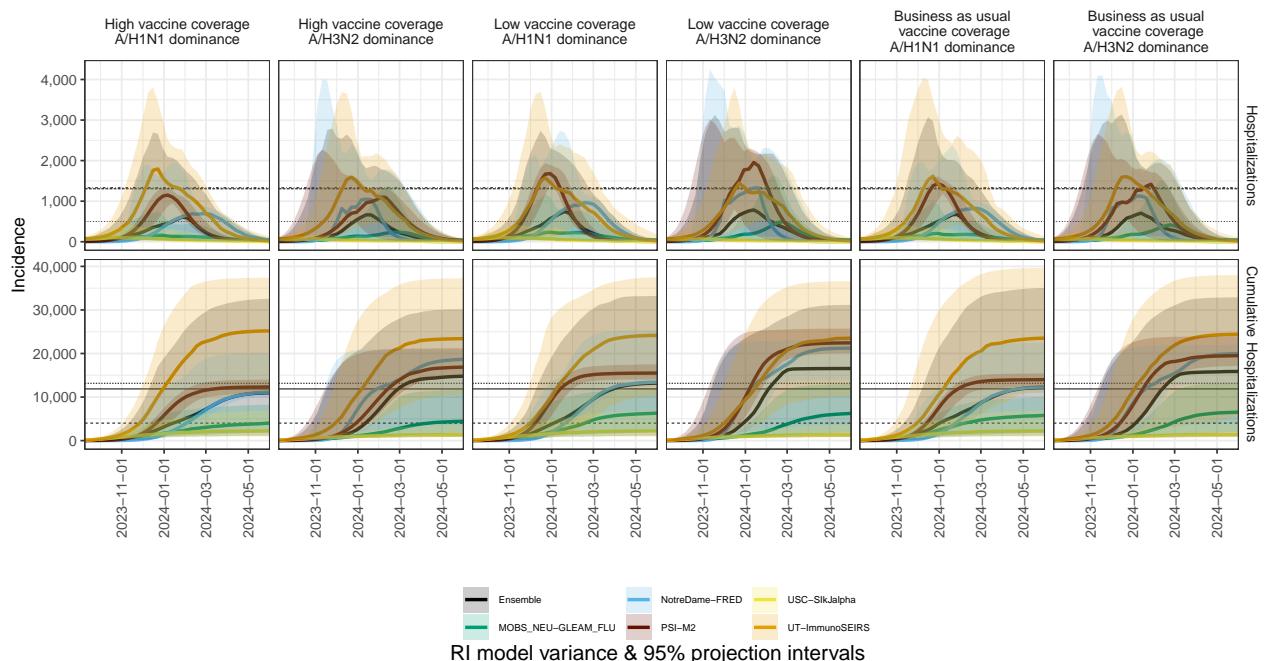
OK model variance & 95% projection intervals



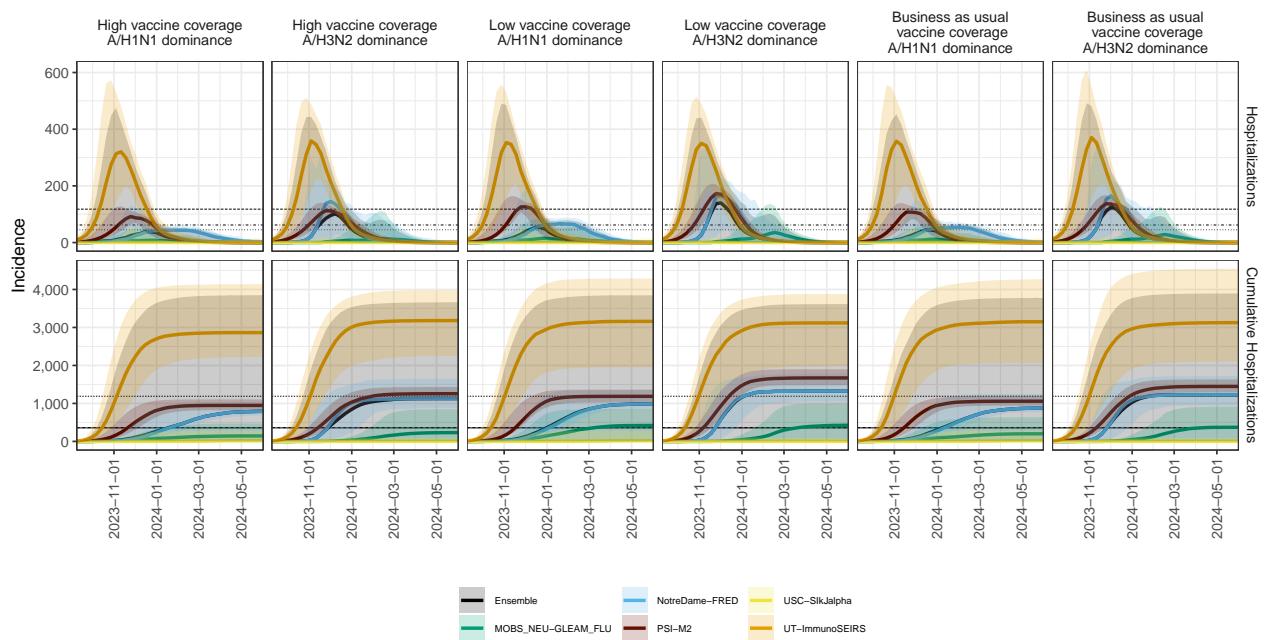
OR model variance & 95% projection intervals



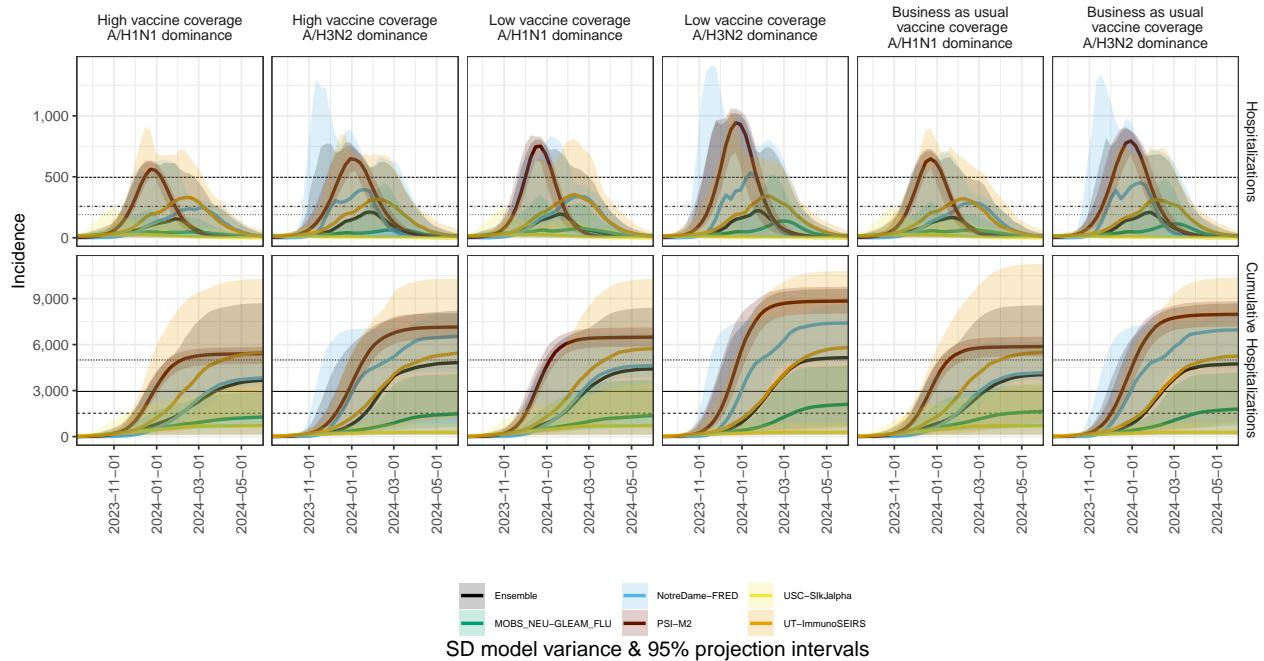
PA model variance & 95% projection intervals



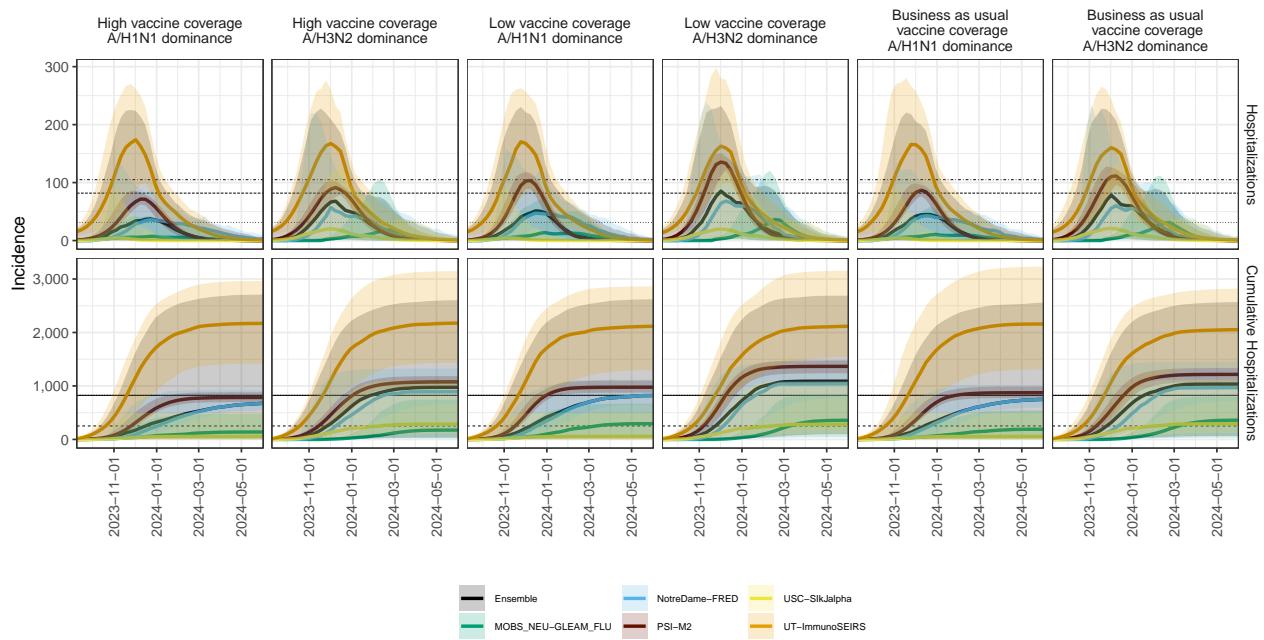
RI model variance & 95% projection intervals



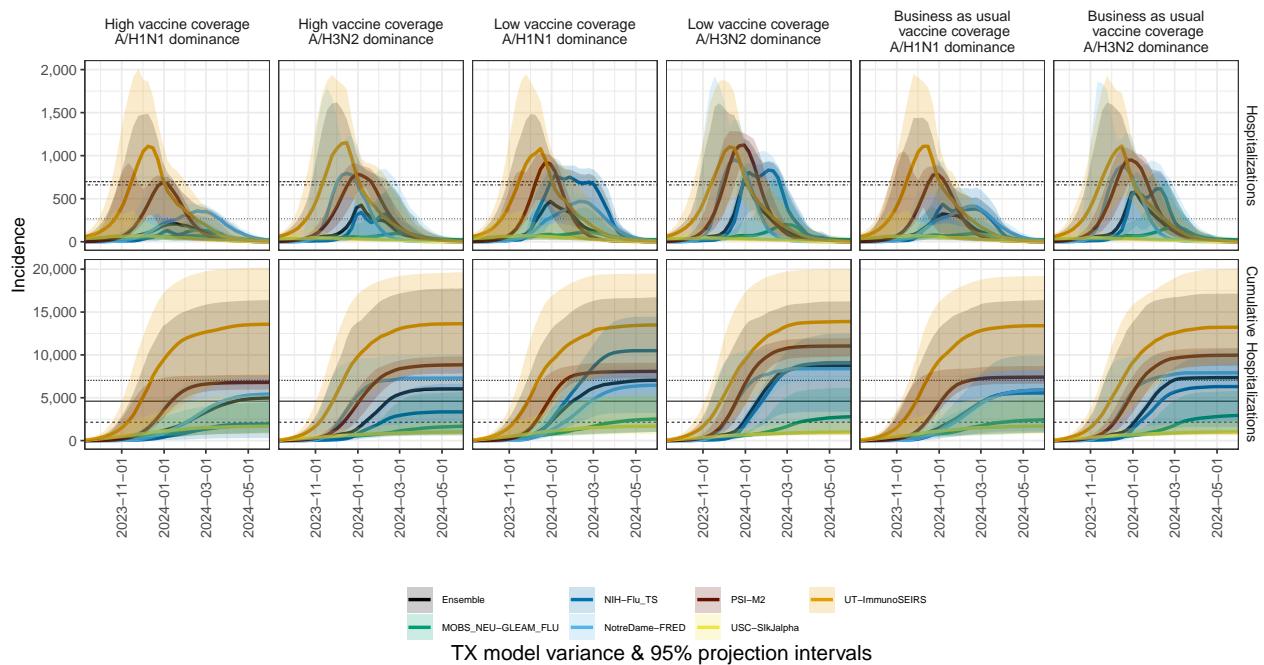
SC model variance & 95% projection intervals



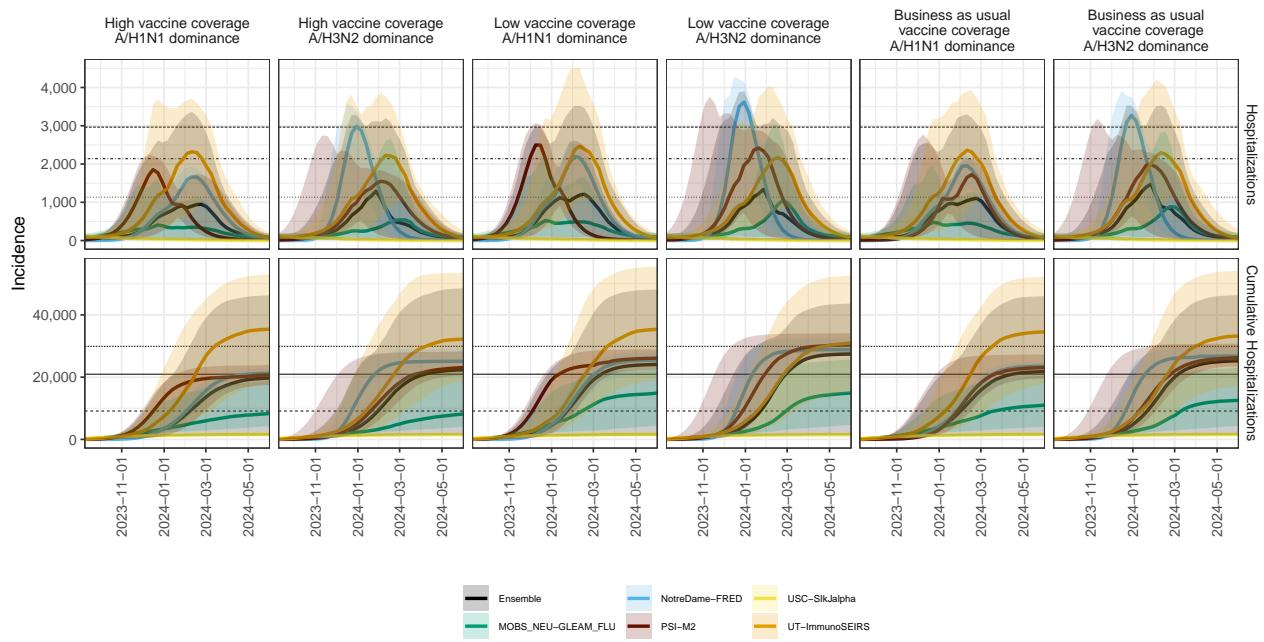
SD model variance & 95% projection intervals



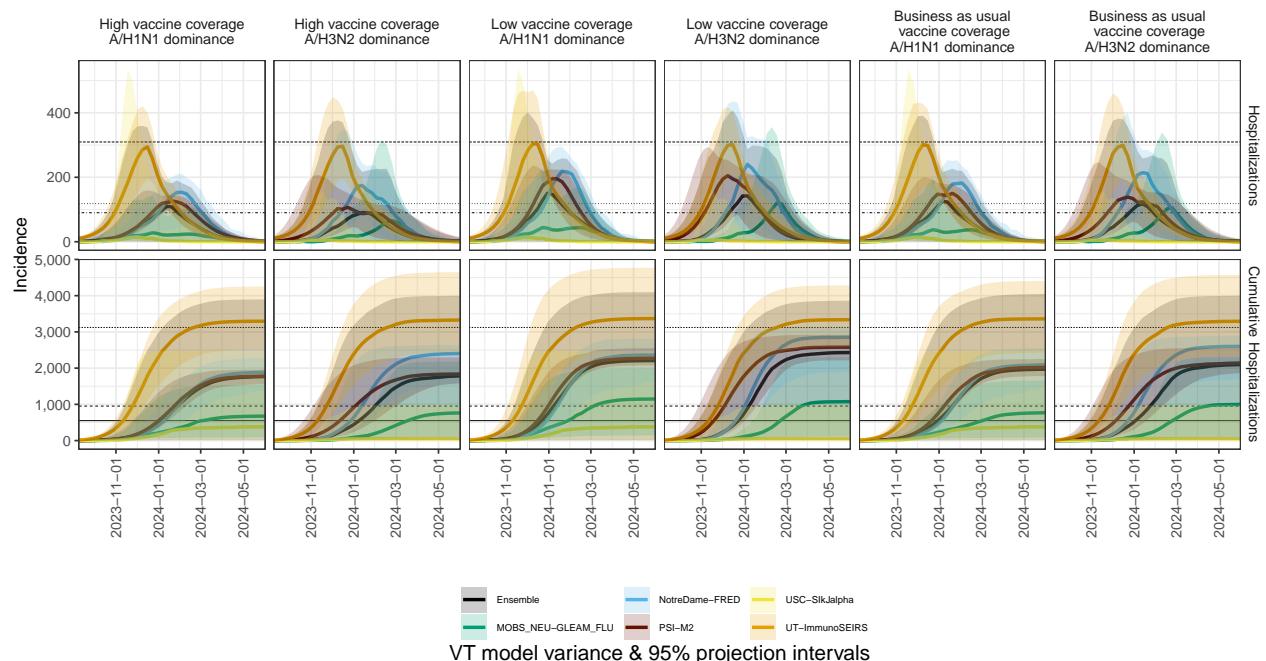
TN model variance & 95% projection intervals



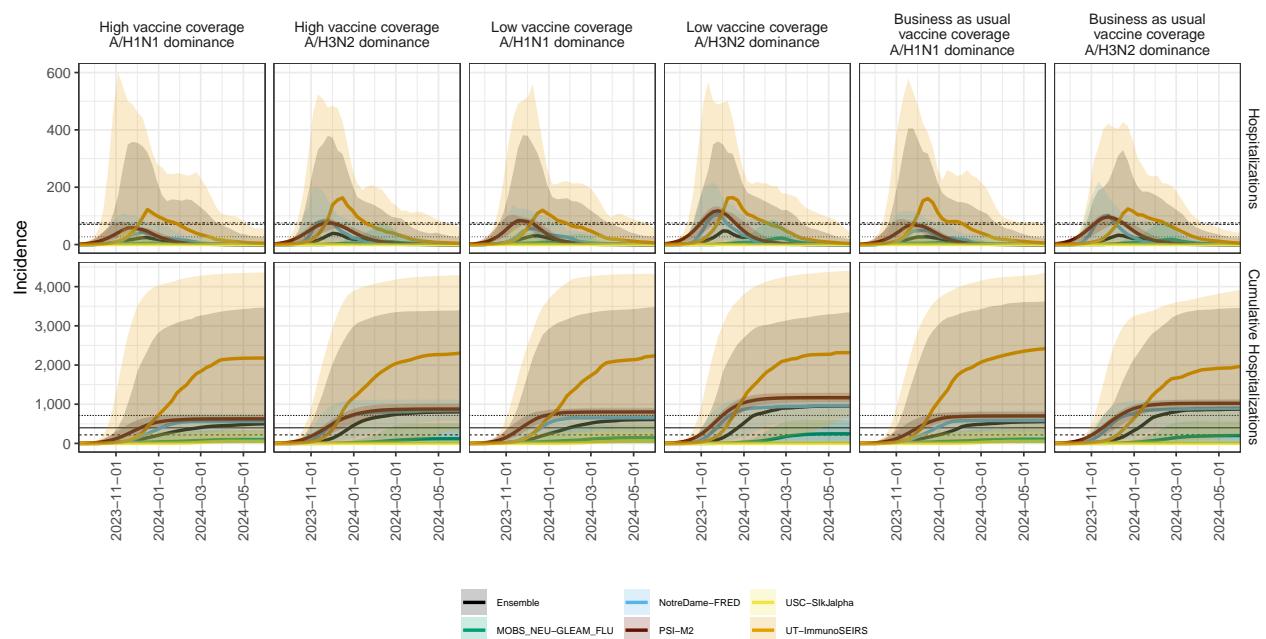
TX model variance & 95% projection intervals



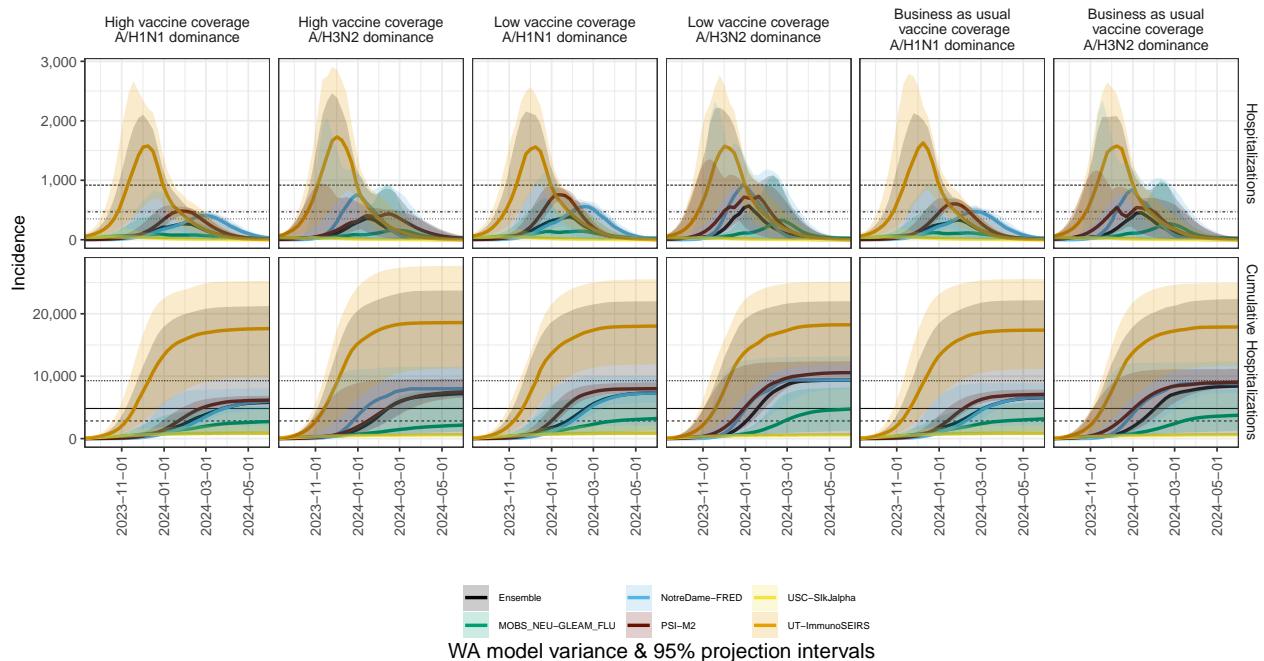
UT model variance & 95% projection intervals



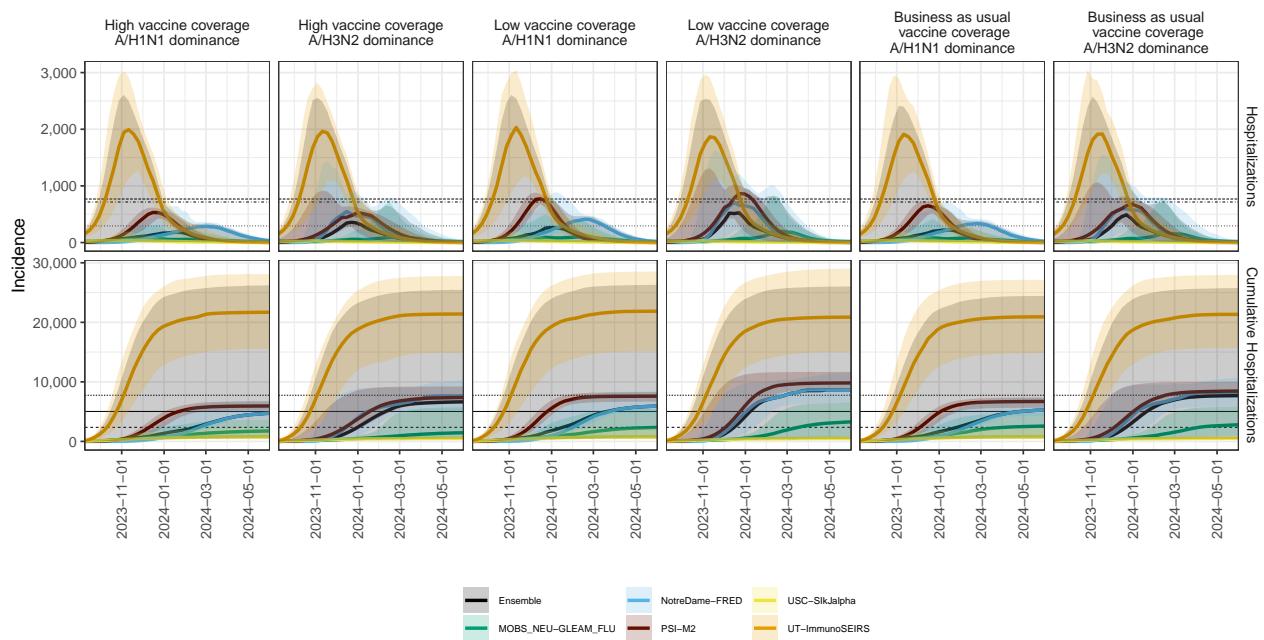
VT model variance & 95% projection intervals



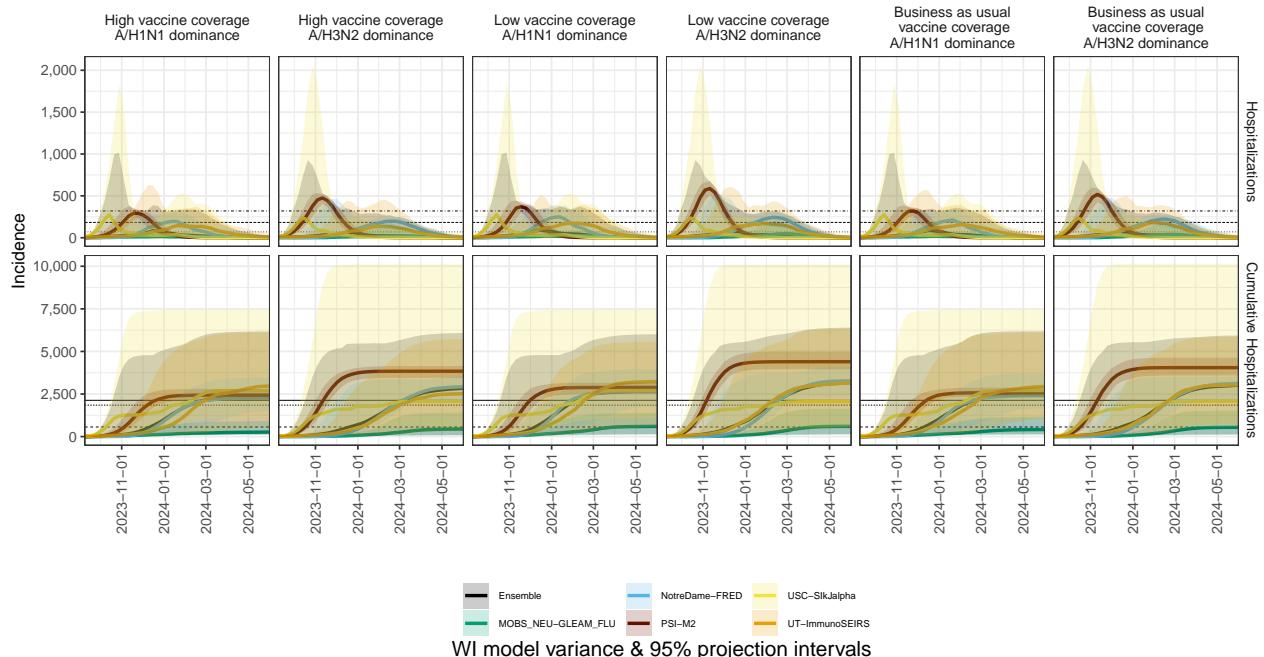
VA model variance & 95% projection intervals



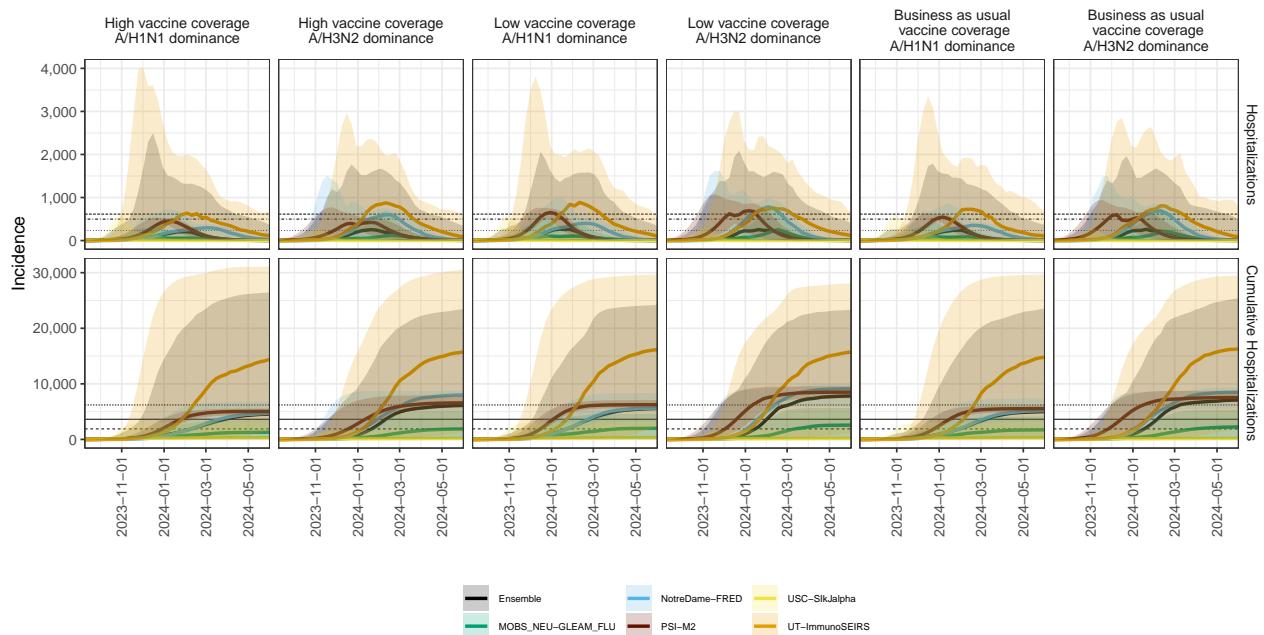
WA model variance & 95% projection intervals



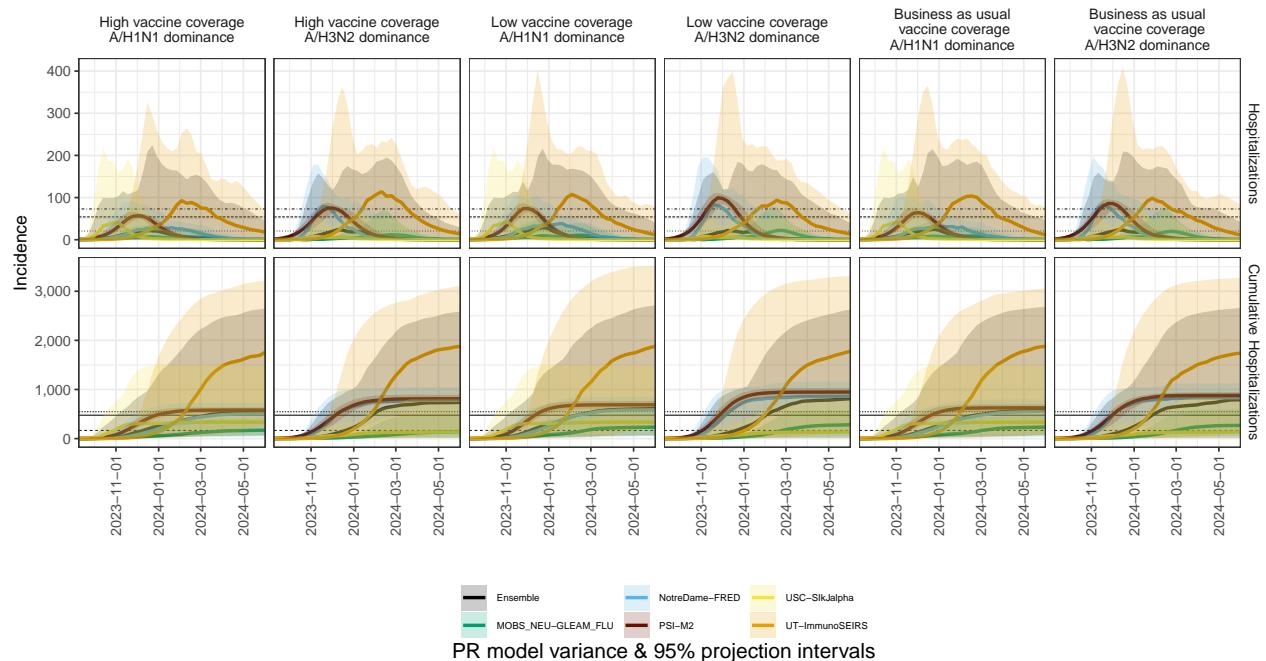
WV model variance & 95% projection intervals



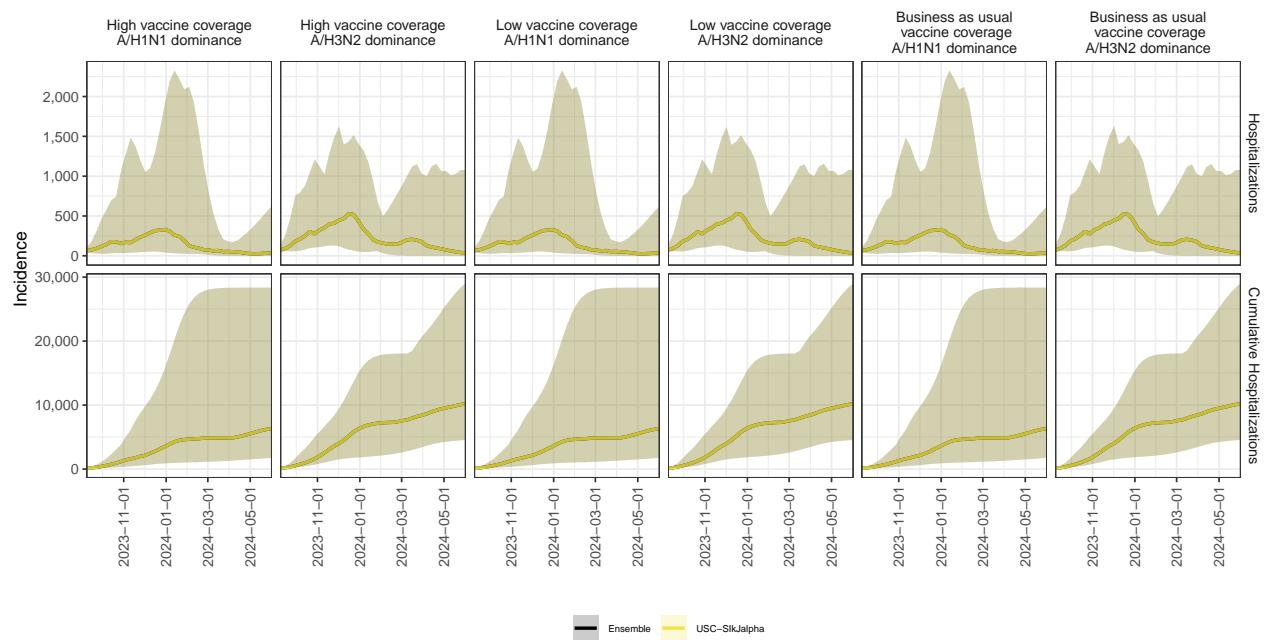
WI model variance & 95% projection intervals



WY model variance & 95% projection intervals



PR model variance & 95% projection intervals



Teams and models

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 - White, L.A. (CADPH), Murray, E. (CADPH), Leon, T.M. (CADPH)
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- University of Notre Dame — FRED
 - Guido Espana, Sean Moore, Alex Perkins
- University of Southern California — SIkJalpha
 - Ajitesh Srivastava, Majd Al Aawar
- University of Texas — ImmunoSEIRS
 - Kaiming Bi (The University of Texas at Austin), Anass Bouchnita (The University of Texas at El Paso), Spencer J. Fox (The University of Georgia), Lauren Ancel Meyers (The University of Texas at Austin), UT COVID-19 Modeling Consortium.
- University of Virginia Biocomplexity Institute — FluXSim
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- Predictive Science — M2
 - Ben-Nun M (Predictive Science), Turtle J (Predictive Science), Riley P (Predictive Science)

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