European Centre for Disease Prevention and Control

ECDC Respiratory Virus Modelling: RespiCompass Round 1 (winter 2024-2025 scenarios)

ECDC Respiratory Viruses and Legionella group; ECDC Modelling group

Viral Respiratory Diseases (National Focal Points and DNCC) network meeting, 16 October 2024

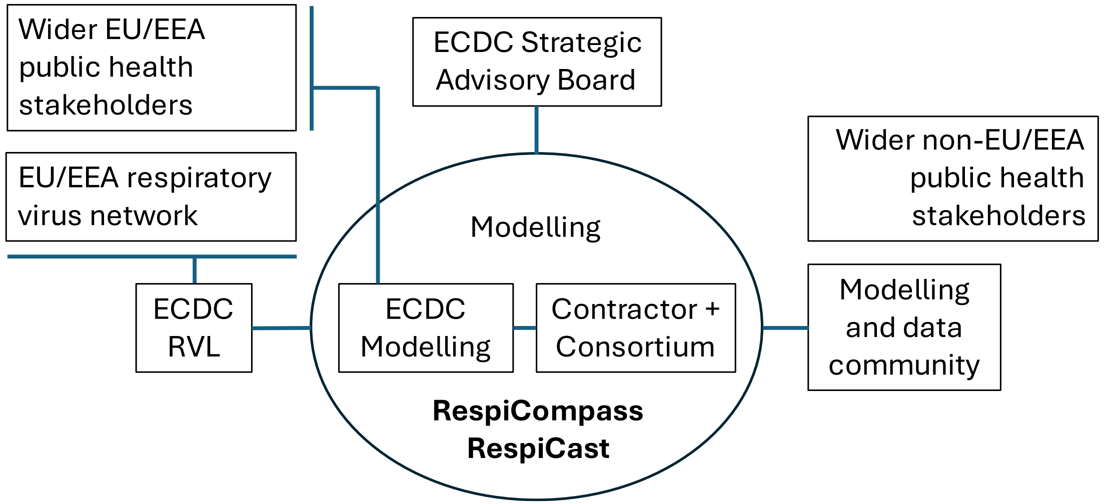
Agenda

1. **Introduction and overview of ECDC Modelling activities (5 min)**
2. **National Focal Point survey results (5 min)**
   i. Summary of headline results
3. **Country presentations (10 min)**
   i. Simon Couvreur (Sciensano, Belgium)
   ii. Katie O'Brien (Health Protection Surveillance Centre, Ireland)
   iii. Alberto Mateo Urdiales (Istituto Superiore di Sanità, Italy)
4. **Discussion (10 min)**
5. **RespiCompass Round 1 (winter 2024-2025) results (20 min)**
   i. Objectives
   ii. Scenarios, parameters, assumptions
   iii. Results
   iv. Conclusions
6. **Discussion (10 min)**

1. Overview of ECDC Modelling activities

Overview of ECDC Modelling activities

Stakeholder mapping



- **RespiCast** (short term 1-4 week ahead forecasts)
  ILI, ARI, SARI (+/- nowcasting)
- **RespiCompass** (mid-/long-term influenza + COVID-19 scenario projections)
  Disease burden (timing and scale)
  Scenarios (transmission, vaccination coverage)

Aims

- **Leverage ERVISS data and mathematical modelling to:**

  1. Support interpretation of respiratory virus surveillance data
  2. Develop early warning signals to support timely public health action
  3. (Later) methods development standardise assessment of trends

- **Increase awareness of modelling in Respiratory Virus network**

  - Engagement to understand modelling capacity, use and needs
  - Collaborative development (internally, with stakeholders)
  - Provide outputs beneficial to public health decision-making

Overview of ECDC Modelling activities

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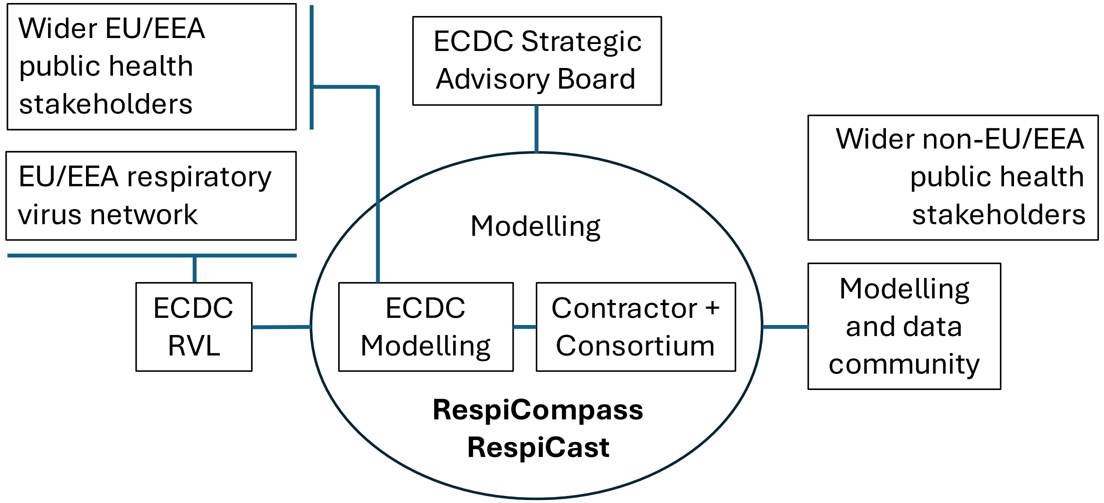

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- **Increase awareness of modelling in Respiratory Virus network**
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  - Provide outputs beneficial to public health decision-making

Addressed today

2. National Focal Point survey results

National Focal Point survey results

- Sent to NFPs for Viral Respiratory Disease
  - 18/30 (60%) responses
  - Austria, Belgium, Cyprus, Czechia, France, Iceland, Ireland, Italy, Liechtenstein, Lithuania, Luxembourg, Malta, Netherlands, Romania, Slovakia, Slovenia, Spain, Sweden

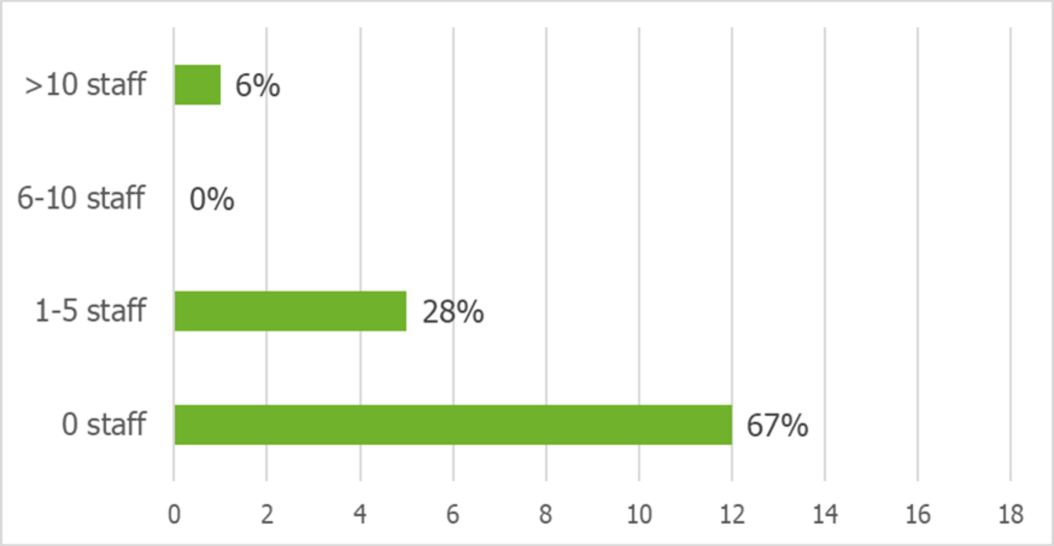
- Short summary of headline results, focussing on:

1. Modelling capacity
2. Likelihood of RespiCast or RespiCompass informing public health actions or decisions at the national level
3. Usefulness of RespiCast vs RespiCompass for decision-making at national level
4. Presence of a mechanism to integrate modelling into decision-making

National Focal Point survey results

1. Modelling capacity

How many staff do you have in your institute for mathematical modelling, irrespective of the disease area?



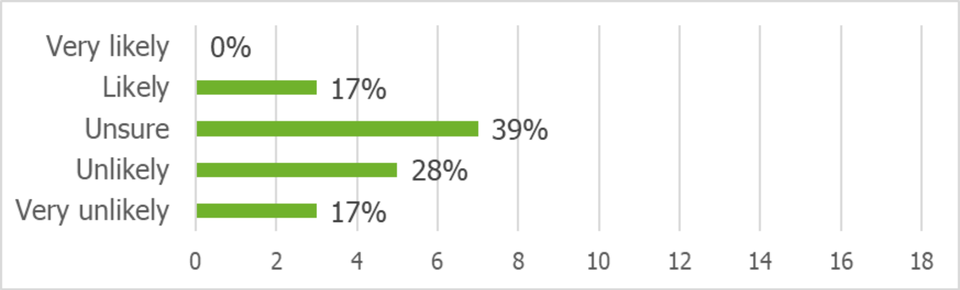
Conclusion

- Limited in-house modelling capacity in the majority of responding countries.

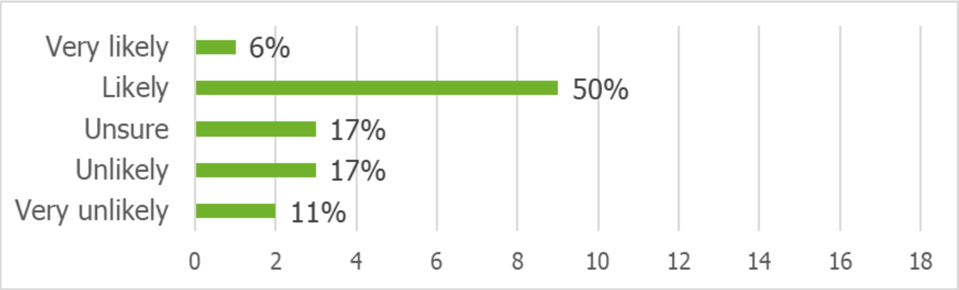
National Focal Point survey results

2. Likelihood of RespiCast or RespiCompass informing public health actions or decisions at the national level

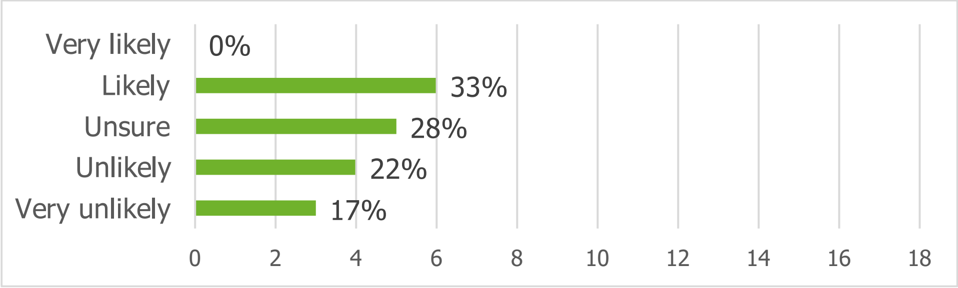
Healthcare capacity planning



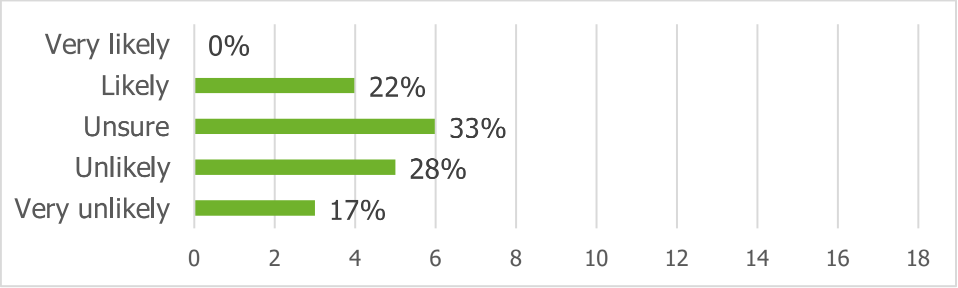
Inform surveillance activities



Planning vaccination campaigns



Planning and procurement of medical countermeasures



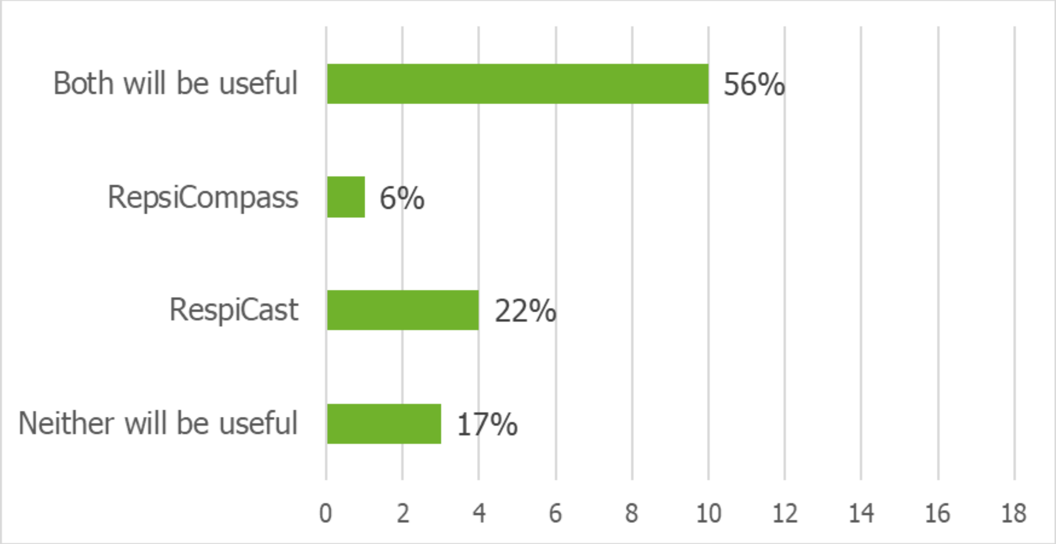
Conclusion

- Responding countries primarily see outputs informing surveillance activities, but *potentially* for vaccination campaigns.

National Focal Point survey results

3. Usefulness of RespiCast vs RespiCompass for decision-making at national level

Of the two proposed outputs, RespiCast and RespiCompass, which do you feel will be of most value for decision-making at your national institute?



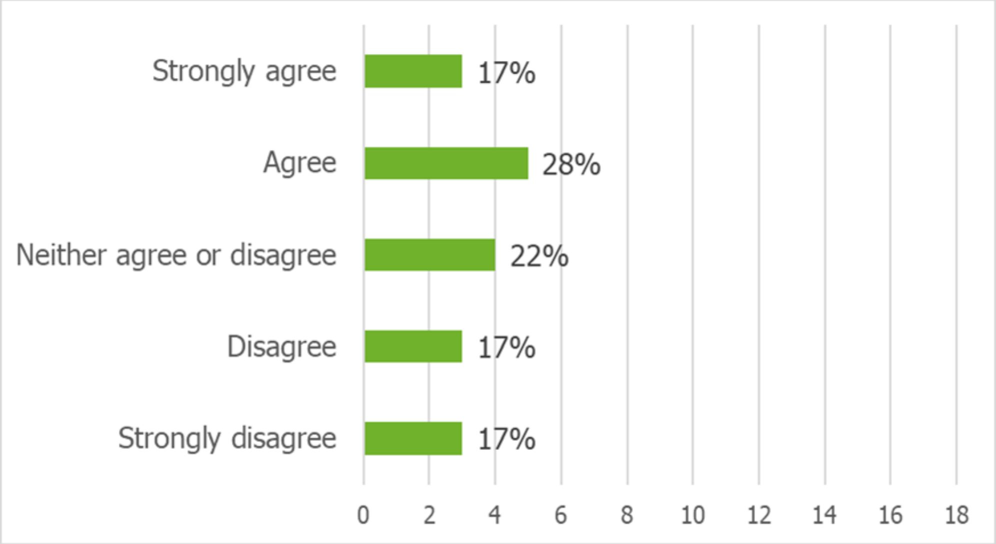
Conclusion

- Majority of responding countries see both outputs as useful, but with a ~20% selecting RespiCast alone.

National Focal Point survey results

4. Presence of a mechanism to integrate modelling into decision-making

There is a clear and consistent mechanism for integrating modelling outputs (in-house, ECDC, or other) in public health decision-making at my national institute?



Conclusion

- Only 45% of respondents agree that a mechanism currently exists.

3. Country presentations

Country presentations

We were especially interested in those countries that reported any of the following:

1. Any in-house modelling capabilities or outsourced modelling activities
2. Existing participation in ECDC RespiCast and/or RespiCompass projects
3. Established mechanisms for integrating respiratory virus modelling outputs in public health decision-making

Invited country perspectives (Belgium, Ireland, Italy) to cover:

1. How is modelling applied to inform interpretation of respiratory virus surveillance data?
2. How are modelling outputs (in-house/ECDC/other) integrated in public health decision-making at your national institute?
3. What challenges are you currently facing, or do you foresee with applying modelling to inform interpretation of respiratory virus surveillance data? What would alleviate those challenges?

Simon Couvreur (Sciensano, Belgium)

Modelling for interpretation of surveillance data

- Belgium has several systems for respiratory virus surveillance
  - Pathogen-specific laboratory surveillance
  - Waste-Water surveillance
    - Standardization (Pepper Mild Mottle Virus (PMMoV))
  - ILI (Influenza Like Illness => GPs)
  - SARI (Severe Acute Respiratory Infections => hospitals)
    - Incidence estimation through IPW
    - Exploring Nowcasting & Short-term forecasting (Respicast?)

- RespiCompass participation (by SIMID)
  - SIMID is part of a modelling consortium coordinated by Sciensano
    - Compartmental model for COVID-19
    - Also including scenarios for other countries

- Short-term predictions of COVID-19 hospital occupancy (discont.)

Modelling for public health decision-making

- Public Health decision making in Belgium

Risk assessment group

Assesses signals / epi situation & proposes measures

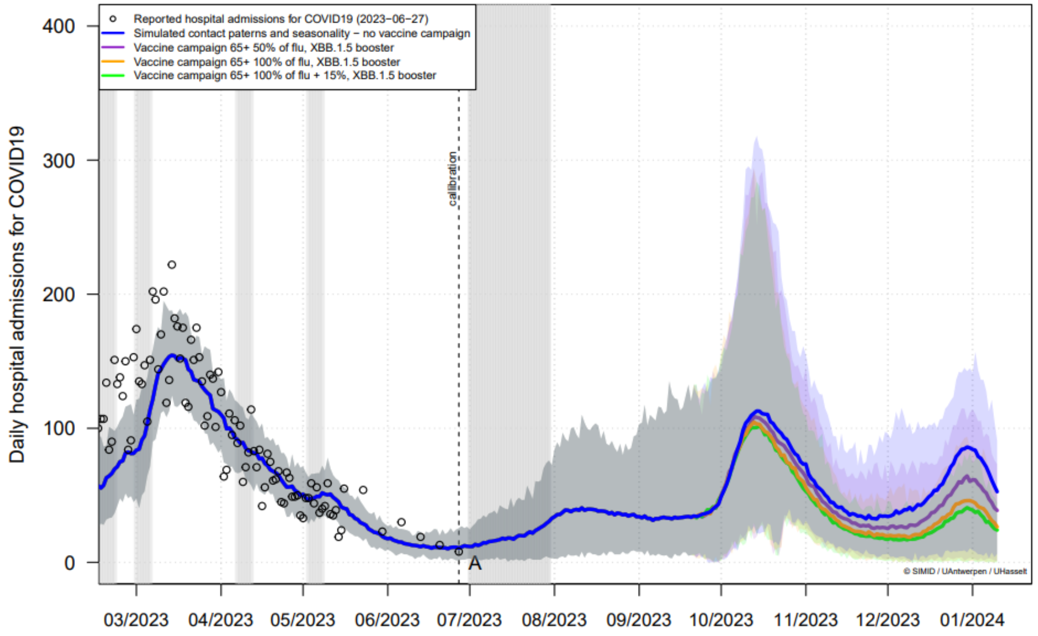
Structural representation of modelling experts

Risk management group

Translates advice into policy, coordinating federal & regional

Ad-hoc invitation of modelling experts

- Contributions of modelling experts
  - (Interpretation of) model-derived epi parameters
  - Scenario analyses



Challenges in modeling activities

- Extending COVID-19 compartmental model to multi-pathogen models
- Adapting compartmental model to non-exhaustive (sentinel) surveillance
- Nowcasting: accounting for changes (improvements) in sentinel surveillance

- Data sharing with academic partners (legal barriers)

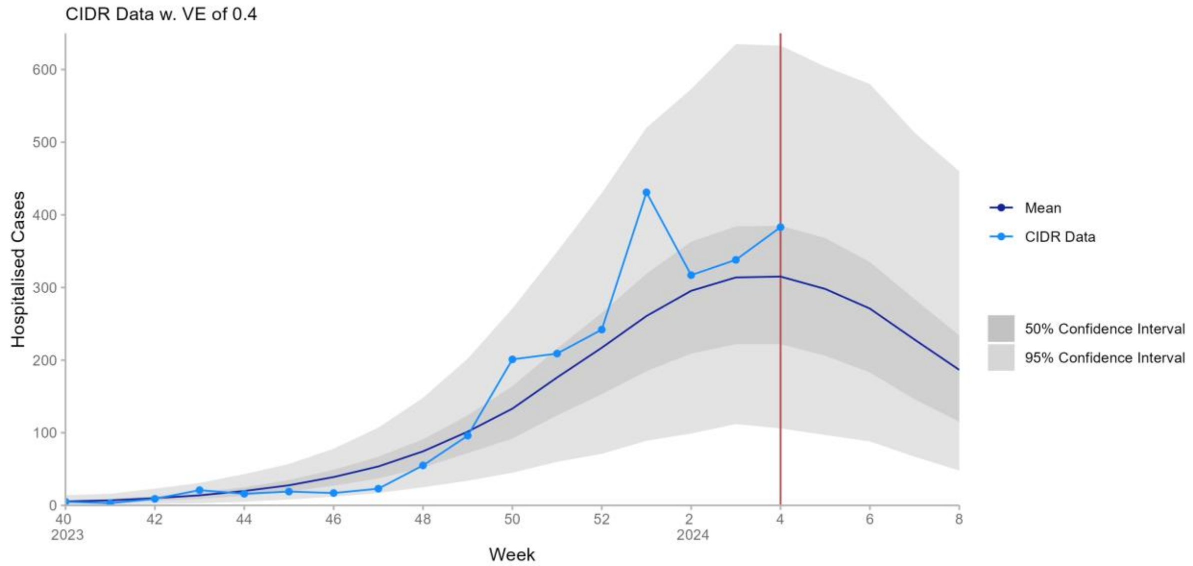
Katie O'Brien (Health Protection Surveillance Centre, Ireland)

Ireland: Application of Modelling

- How is modelling applied to inform interpretation of respiratory virus surveillance data?

Currently applied

- Monitoring growth rates of COVID-19/influenza/RSV via generalised additive models for cases and hospitalisations.
- For influenza, an SLIR (susceptible, latent, infectious, recovered model) using both sentinel GP ILI and hospitalisation data streams was utilised in winter 2023/24 to generate short term (2-3 weeks) forecasts, see figure.



Population Model run with CIDR hospitalised cases and up to and including Week 4

Models under development:

- For COVID-19, an SEIR model is under development.
- For influenza, RSV and COVID-19 use `EpiEstim` R package to model cases, estimate time-varying reproduction number and provide forecasts.

Ireland: Modelling and public health decision making

- How are modelling outputs (in-house/ECDC/other) integrated in public health decision-making at your national institute?

Modelling @HPSC

- In-house modelling outputs are shared with the HSPC respiratory virus unit, Ministry of Health and the national healthcare service to assist with decision making around winter planning.

Modelling @ECDC

- We have started to monitor ECDC RespiCast and will monitor RespiCompass.
- Outputs were not used last year for decision making, as we would need to monitor forecasts to assess their usefulness in the Irish setting.

Ireland: Challenges

- What challenges are you currently facing, or do you foresee with applying modelling to inform interpretation of respiratory virus surveillance data?
- What would alleviate those challenges?

Challenges – Irish context

- We had planned to set up a Biostatistics and Modelling unit after the COVID-19 pandemic, but due to national recruitment freeze, this has not materialised. Currently 2-3 staff with support from academic experts.
- This limits output, ability to check models, plan for unforeseen events, etc.

General model interpretation challenges

- RespiCast outputs were not used last year for decision making, as more comprehensive surveillance data and modelling was available nationally.
- Training and time to communicate with the subject matter experts regarding model inputs (data and parameters) and model outputs (interpretation).

Alberto Mateo Urdiales (Istituto Superiore di Sanità, Italy)

Modelling of RD at the ISS

- At the ISS, mathematical and statistical modelling of respiratory diseases (and others) is done within EPIQ, a joint lab ISS-Fondazione Bruno Kessler (FBK)

- The decision on what **to do** and on what **data** is decided together between the ISS, FBK and other stakeholders (e.g., MdS) when appropriate

- Mathematical modelling is usually centred around: a) identification of early warning alerts; b) pan/epidemic scenarios; c) estimation of key parameters; d) evaluation of interventions and e) prediction/forecasting

Integrating modelling outputs into the decision-making process

- Modelling outputs that result from the collaboration between ISS and FBK, as well as other outputs (e.g., INFLUCAST, ECDC….) are reviewed regularly to plan surveillance activities, compare our data with what's expected in Italy and elsewhere, and to complement our bulletins when informing relevant stakeholders (e.g., MdS, Regions…)

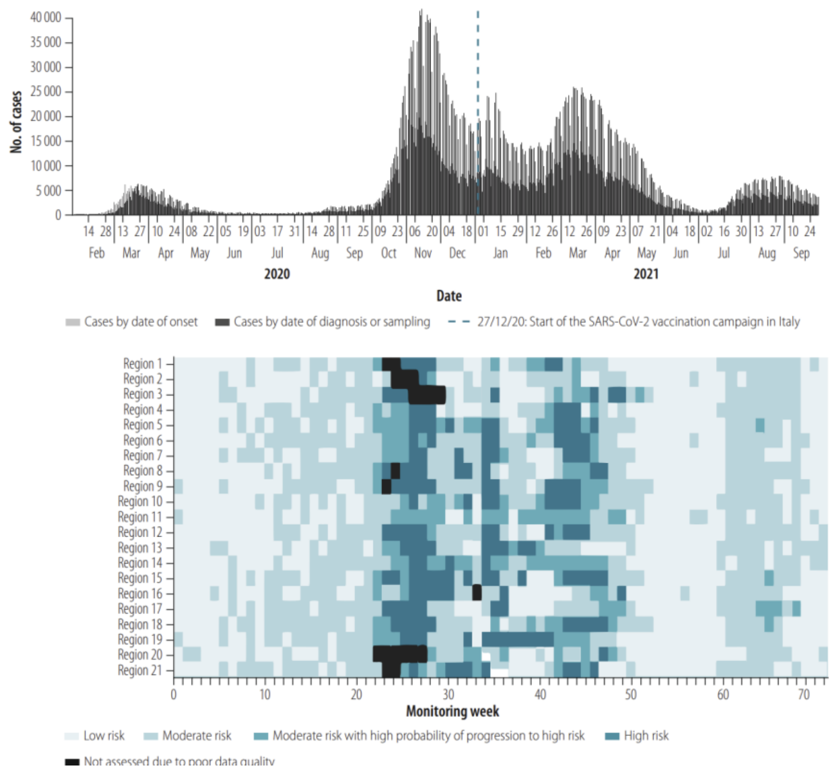
- Modelling outputs were, during the COVID-19 pandemic, and integral part of the weekly risk assessments that informed the decision-making process around NPI

- They are still a core component of pandemic preparedness plans and prevention strategies in general (e.g., identifying key groups and areas in measles)

COVID-19 response: effectiveness of weekly rapid risk assessments, Italy

Flavia Riccardo,[a] Giorgio Guzzetta,[b] Alberto Mateo Urdiales,[a] Martina Del Manso,[a] Xanthi D Andrianou,[a]

Fig. 1. **Epidemic curve and weekly risk assessment of the COVID-19 epidemic by region and autonomous province, Italy, 4 May 2020 to 27 September 2021**



Main challenges in using mathematical modelling for decision-making

- Better data would help to create better models
  - Privacy barriers prevent linking data from ED, epi, micro and administrative databases
  - Reporting delay and backlog impact on “real-time” assessment and forecasting’s accuracy

- Improving our knowledge on some key aspects of human behaviour (e.g. behavioural changes in response to perceived risk, acceptance of restrictive measures, vaccine hesitancy, etc.) would increase accuracy and reliability of mathematical models.

- Uncertainty around scenarios/forecasting still poorly understood and difficult to communicate to non-scientific audiences

4. Discussion

5. RespiCompass Round 1 (winter 2024-2025) results

RespiCompass Round 1:

Influenza and COVID-19 burden scenarios for winter 2024-2025

Please note results presented are preliminary and subject to change, pending formal publication

ECDC Modelling and ECDC Biostatistics groups

Viral Respiratory Diseases (National Focal Points and DNCC) network meeting, 16 October 2024

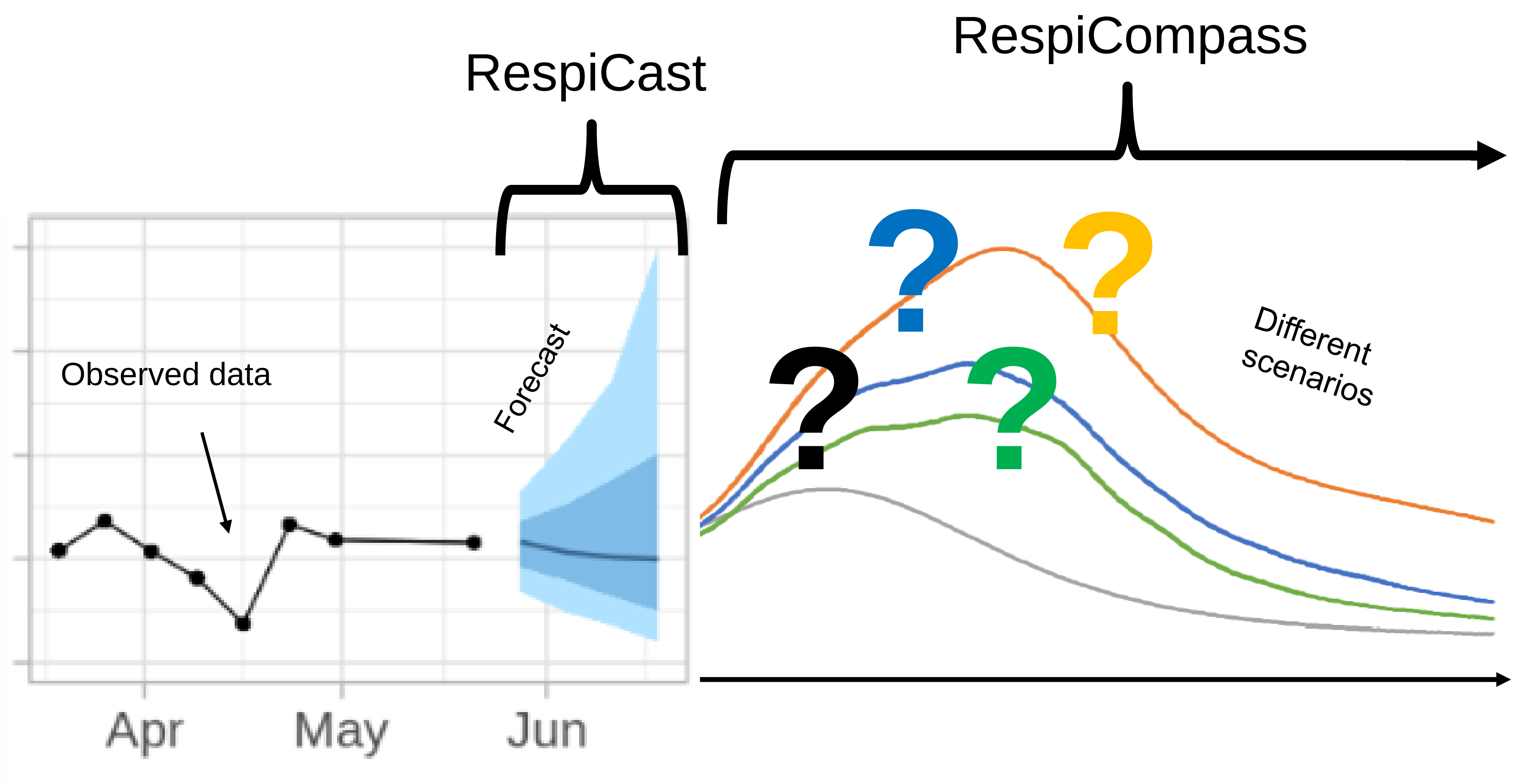
Roadmap

- Objectives
- How does RespiCompass work
- RespiCompass results
- Summary remarks and next steps

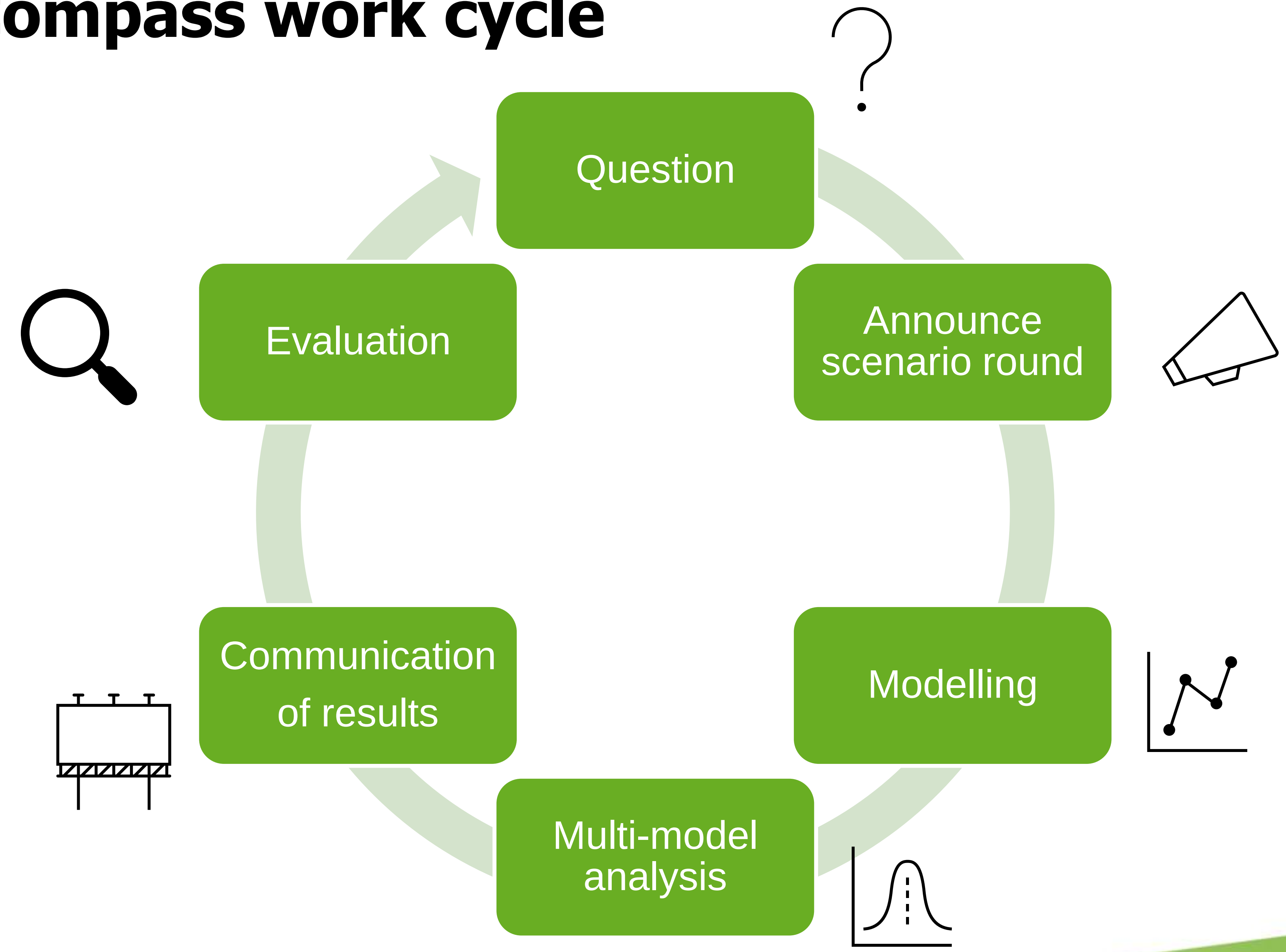
Objectives of RespiCompass 2023/24

- Anticipate COVID-19 and influenza burden and the impact of vaccination on selected indicators under pre-defined scenarios
- Strengthen modelling capacity and institutional networks in the EU/EEA

Forecasts vs scenario modelling



RespiCompass work cycle



Scenario definitions

Uncertainty axis

Uncertainty axis

	Scenario A	Scenario C	Scenario E
	Scenario B	Scenario D	Scenario F

+ Additional assumptions

Model projections targets and horizon

RespiCompass Round 1 – Influenza

Vaccination axis

Biological axis

	Optimistic vaccination Coverage in **65+yrs** is **15%** higher than in last season*	**Pessimistic vaccination** Coverage in **65+yrs** is **15%** lower than in last season*	**No vaccination counterfactual**
Typical transmission potential Influenza transmission potential is **similar** to the last three seasons, excluding COVID-19 pandemic years.	Scenario A	Scenario C	Scenario E
Pessimistic transmission potential* Influenza transmission potential is **10% higher** relative to the last three seasons, excluding COVID-19 pandemic years.	Scenario B	Scenario D	Scenario F

RespiCompass Round 1 – Influenza

Vaccination axis

Biological axis

	Optimistic vaccination Coverage in **65+yrs** is **15%** higher than in last season*	**Pessimistic vaccination** Coverage in **65+yrs** is **15%** lower than in last season*	**No vaccination counterfactual**
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Pessimistic transmission potential* Influenza transmission potential is **10% higher** relative to the last three seasons, excluding COVID-19 pandemic years.	Scenario B	Scenario D	Scenario F

VE against symptomatic infection: 40%
Vaccination in other age groups as in 23/24
No NPIs

Burden assessed:
Country-specific, weekly projections of ILI+ in 65+ age group until June 2025

ILI+ = ILI x positivity for influenza
Sentinel positivity for all countries apart from MT, IS, HR, RO, LV, FI

RespiCompass Round 1 – COVID-19

Vaccination axis

Biological axis

	Optimistic vaccination Coverage in **60+yrs** is **15%** higher than 23/24 season	**Pessimistic vaccination** Coverage in **60+yrs** is **15%** lower than 23/24 season	**No vaccination counterfactual**
Optimistic waning Vaccine-induced immunity against infection drops within **6 months** to **50%** Immunity against severe outcomes: **no waning**	Scenario A	Scenario C	Scenario E
Pessimistic waning Vaccine-induced immunity against infection drops within **6 months** to **30%** Immunity against severe outcomes: **6 months** median time to transition to **60%** of the initial immunity	Scenario B	Scenario D	Scenario F

RespiCompass Round 1 – COVID-19

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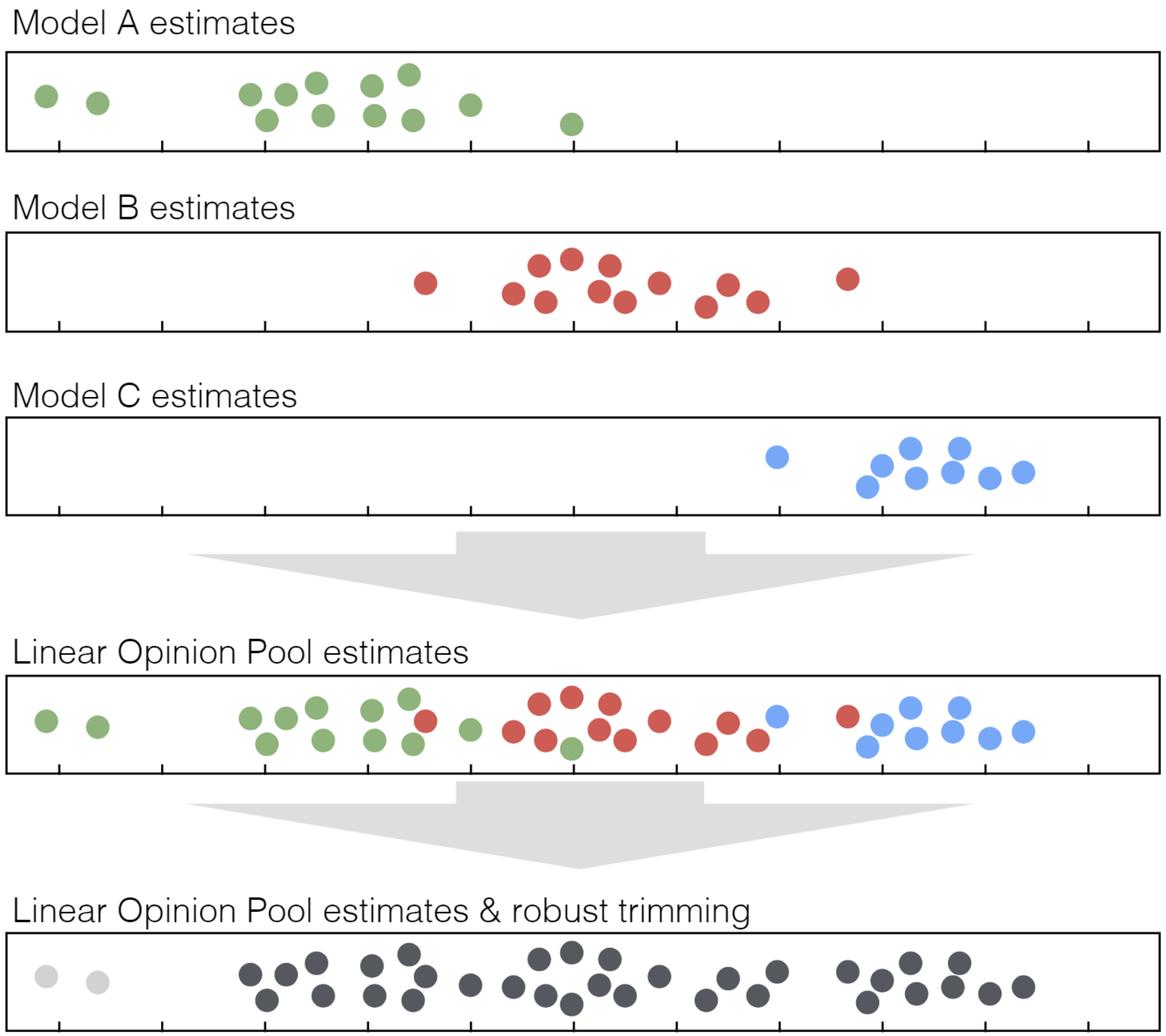
VE against infection: 50%
VE against hospitalisation: 75%
Vaccination in other groups as in 23/24
No NPIs, no game-changer variant

Burden assessed:
Country-specific, weekly projections of COVID-19 hospitalisations in 65+ age group until June 2025

Creating an ensemble estimate



Influenza

Question 1
What is the expected influenza burden for the 2024/25 season in the EU/EEA?

Answer
ILI+ burden in the 65+ is projected to be **higher in the upcoming season relative to the previous season**.

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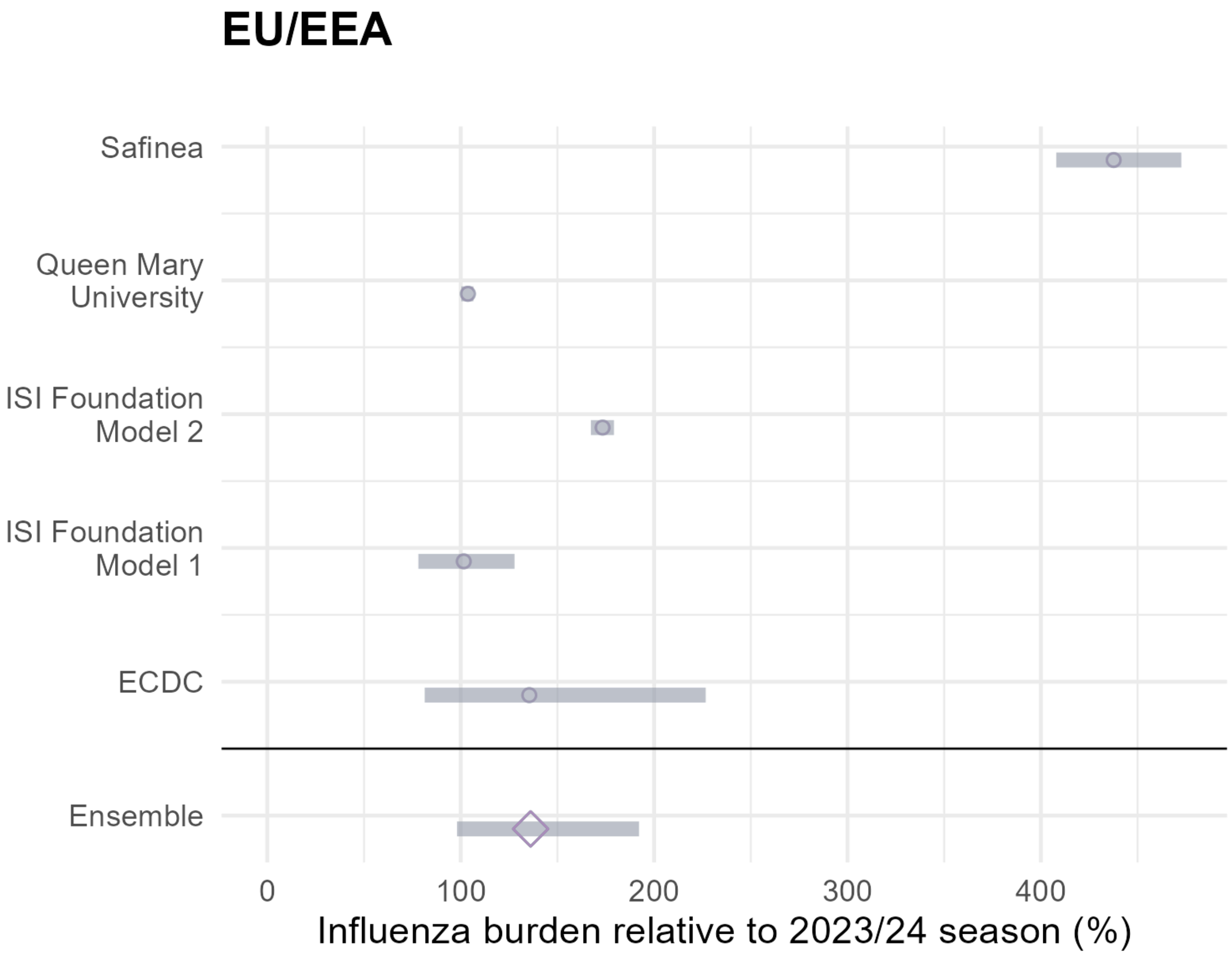
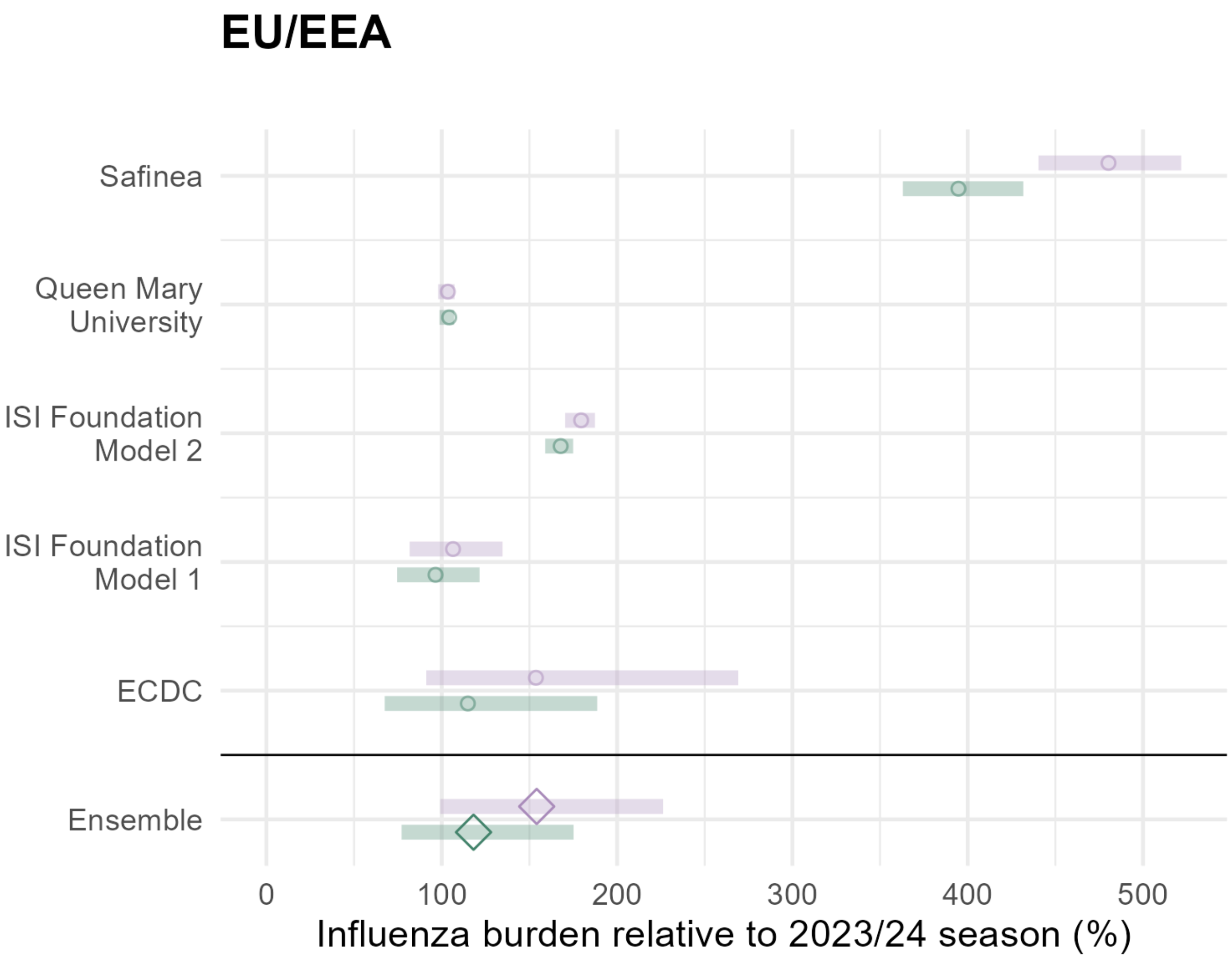
Projected ILI+ burden in 65+ relative to last season in the EU/EEA



- ILI+ burden in the 65+ age group is projected to be 136% (95% UI: 98% to 192%) in the upcoming season relative to last year's season.

ILI+ burden in the 65+ is projected to be **higher in the upcoming season relative to the previous season**.

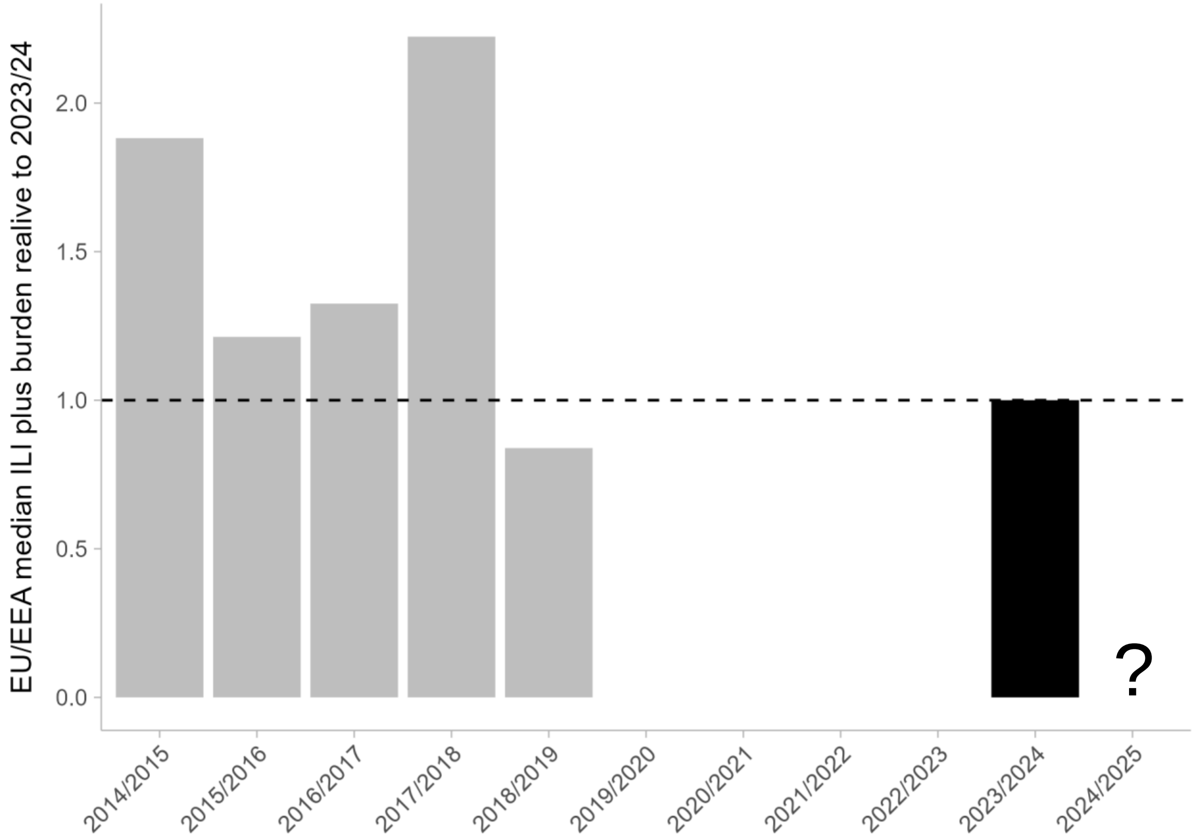
Projected ILI+ burden in 65+ age group relative to last season in the EU/EEA



- ILI+ burden in the 65+ age group is projected to be 136% (95% UI: 98% to 192%) in the upcoming season relative to last year's season.
- Results are robust across vaccine uptake scenarios: 154% (95% UI: 99% to 226%) and 118% (95% UI: 77% to 175%) for low versus high uptake, respectively.

ILI+ burden in the 65+ is projected to be **higher in the upcoming season relative to the previous season**.

Past ILI+ burden in 65+ relative to the 2023/24 season



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- Results are robust across vaccine uptake scenarios: 154% (95% UI: 99 to 226%) and 118% (95% UI: 77% to 75%) for low versus high uptake, respectively.
- **Likely explained by calibration against an –in average- higher ILI+ burden.**

What might cause a much worse season?

- Bad match of the vaccine
- Dominant subtype with higher transmission potential* and/or higher severity

Question 2

What is the impact of vaccination versus no vaccination on the 2024/25 influenza burden in the EU/EEA?

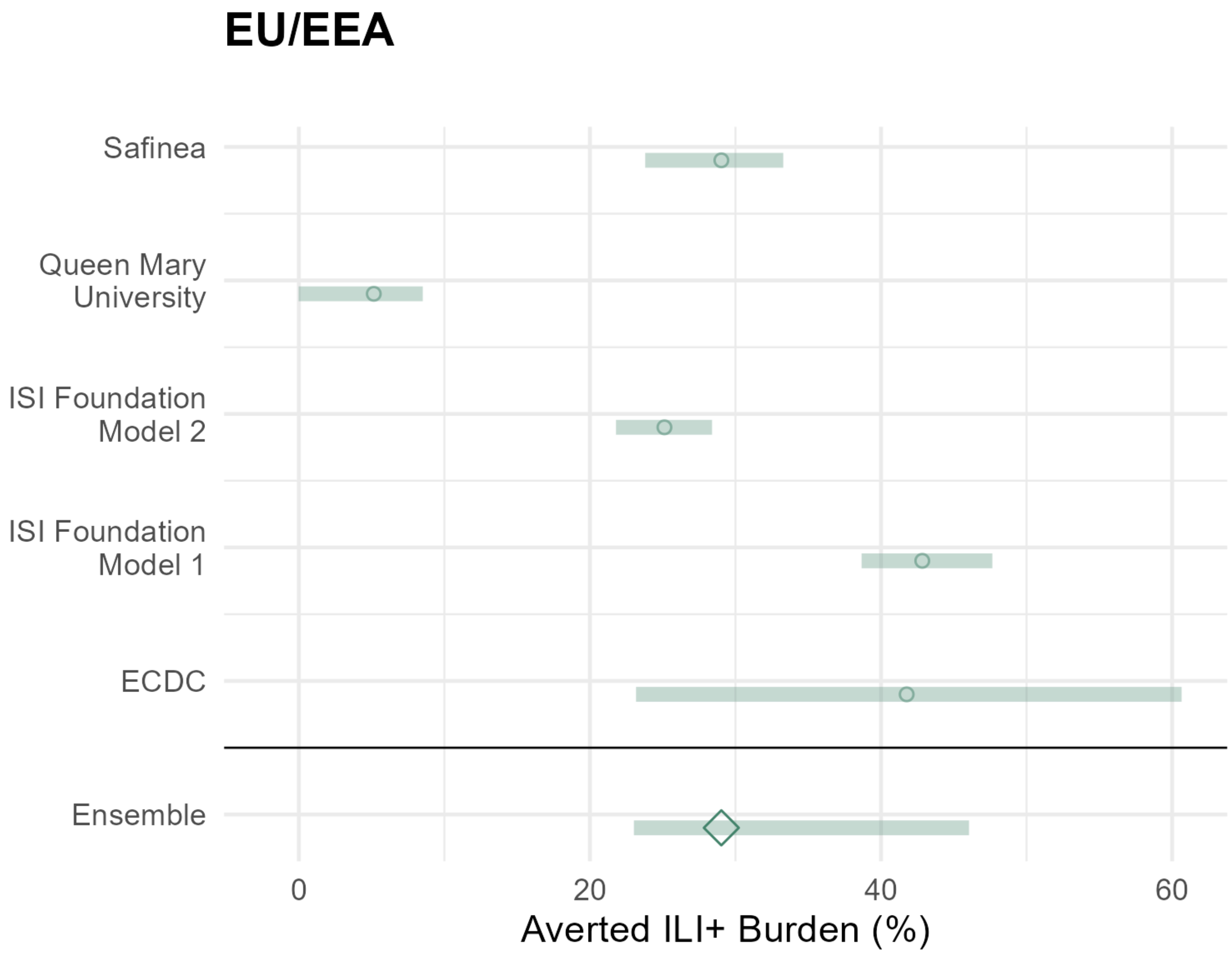
Answer

Vaccination is expected to avert between 23% and 46% of ILI+ burden in 65+ age group. The impact for a country strongly depends on its vaccine uptake.

RespiCompass insight:

Influenza vaccine impact

Expected averted ILI+ burden in the 65+ age group attributable to vaccination in the EU/EEA

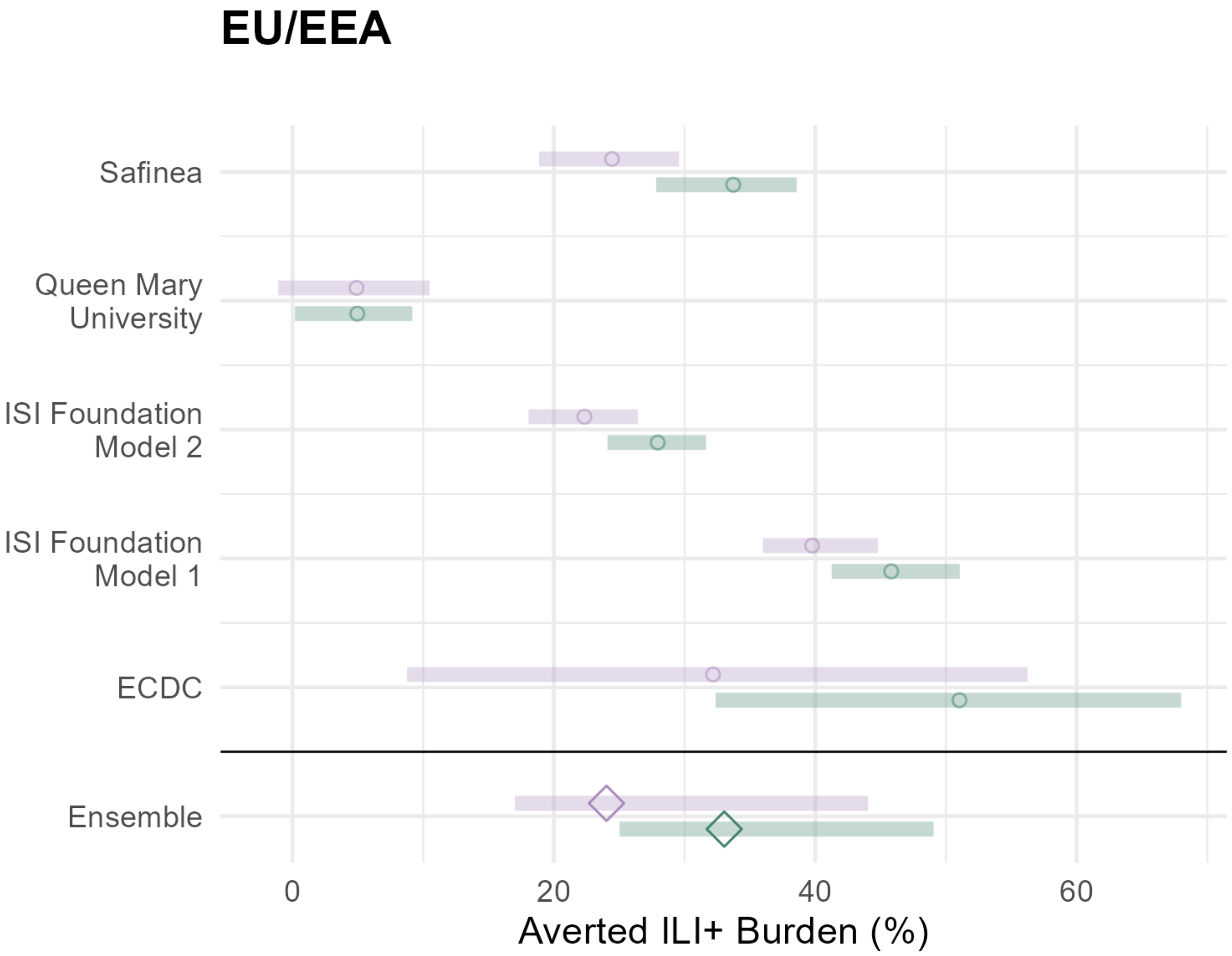


- Autumn 2024 influenza vaccination averts 29% (95% UI: 23% to 46%) ILI+ in the 65+ age group in the EU/EEA.

RespiCompass insight:

Influenza vaccine impact

Expected averted ILI+ burden in the 65+ population attributable to vaccination in the EU/EEA

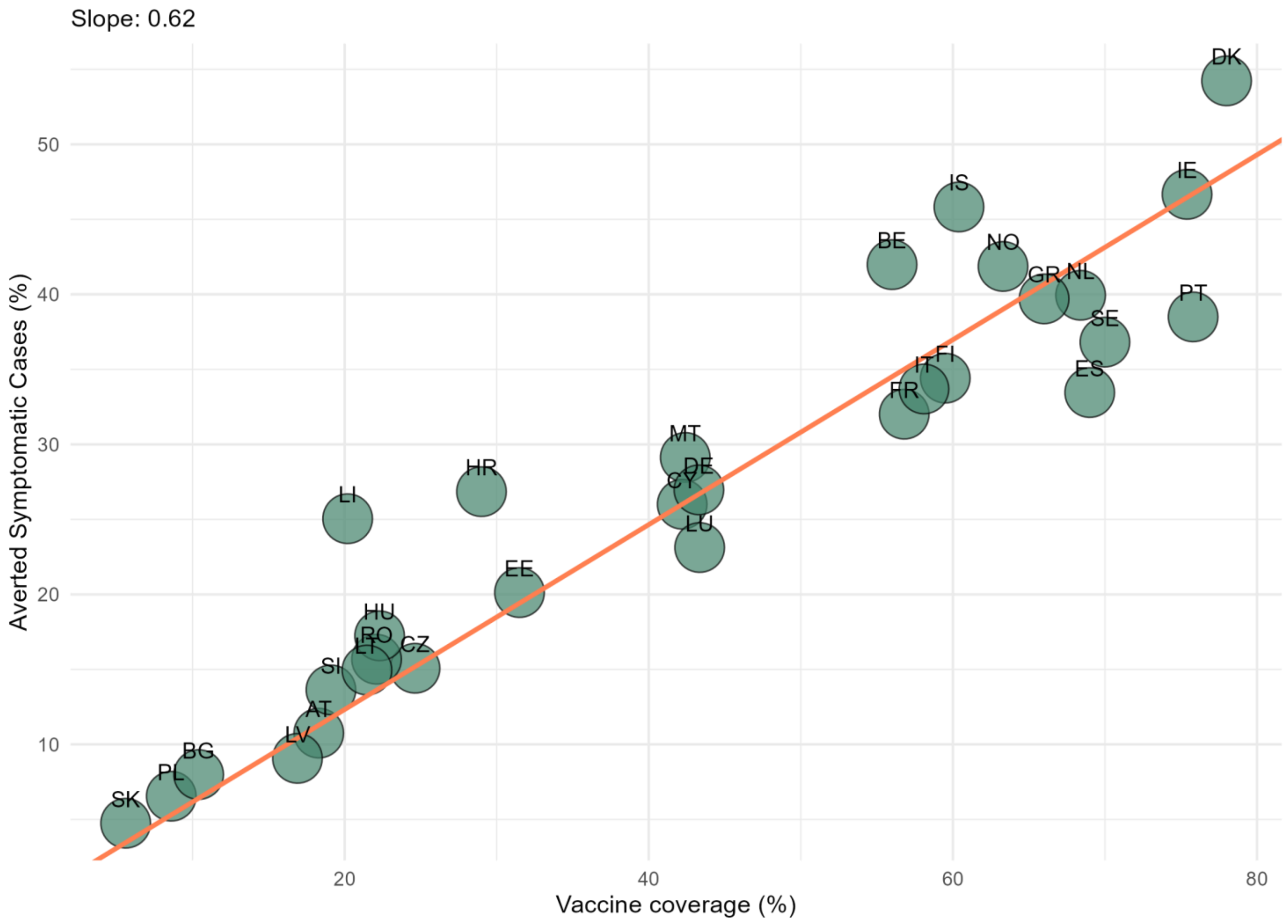


- Autumn 2024 influenza vaccination averts 29% (95% UI: 23% to 46%) ILI+ in the 65+ age group in the EU/EEA.
- Results differ for vaccine uptake scenarios: 24% (95% UI: 17% to 44%) and 33% (95% UI: 25% to 49%) for low versus high uptake, respectively.

RespiCompass insight:

Influenza vaccine impact

Averted ILI+ burden in 65+ versus vaccination coverage

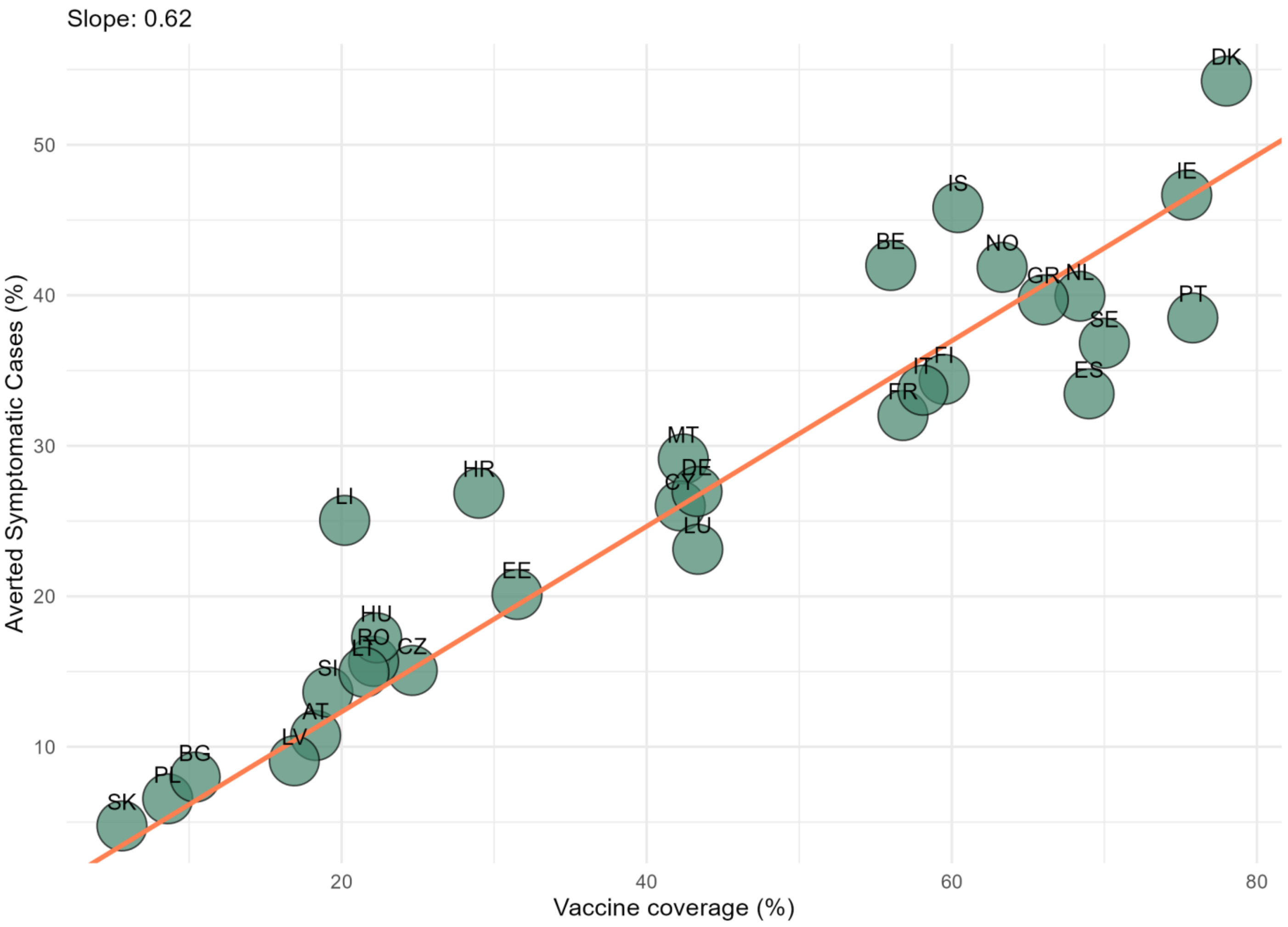


- Influenza vaccination coverage is highly heterogeneous in the EU, ranging from 5.6% to 78% uptake in 65+ age group.
- The impact of vaccines depends strongly on a country's vaccine uptake: every 10% vaccine coverage is correlated with 6.2% reduction in ILI+ burden in 65+.

RespiCompass insight:

Influenza vaccine impact

Averted ILI+ burden in 65+ versus vaccination coverage



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- The impact of vaccines depends strongly on a country’s vaccine uptake: every 10% vaccine coverage is correlated with 6.2% reduction in ILI+ burden in 65+.

What might reduce the impact from vaccines?

- Mismatch of the vaccine
- A late-season peak

COVID-19

RespiCompass Round 1 – COVID-19

Vaccination axis

Biological axis

	Optimistic vaccination Coverage in **60+yrs** is **15%** higher than 23/24 season	**Pessimistic vaccination** Coverage in **60+yrs** is **15%** lower than 23/24 season	**No vaccination counterfactual**
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VE against infection: 50%
VE against hospitalisation: 75%
Vaccination in other groups as in 23/24
No NPIs, no game-changer variant

Burden assessed:
Country-specific, weekly projections of COVID-19 hospitalisations in 65+ age group until June 2025

Question 3
What can we expect of the EU/EEA COVID-19 burden in 2024/25?

Answer
Marked lack of agreement across models leading to wide uncertainty intervals for the burden of COVID-19 hospitalisations in 65+ age group. This is due to lack of seasonal dynamics, immunity accumulated over the summer, and other unknowns.

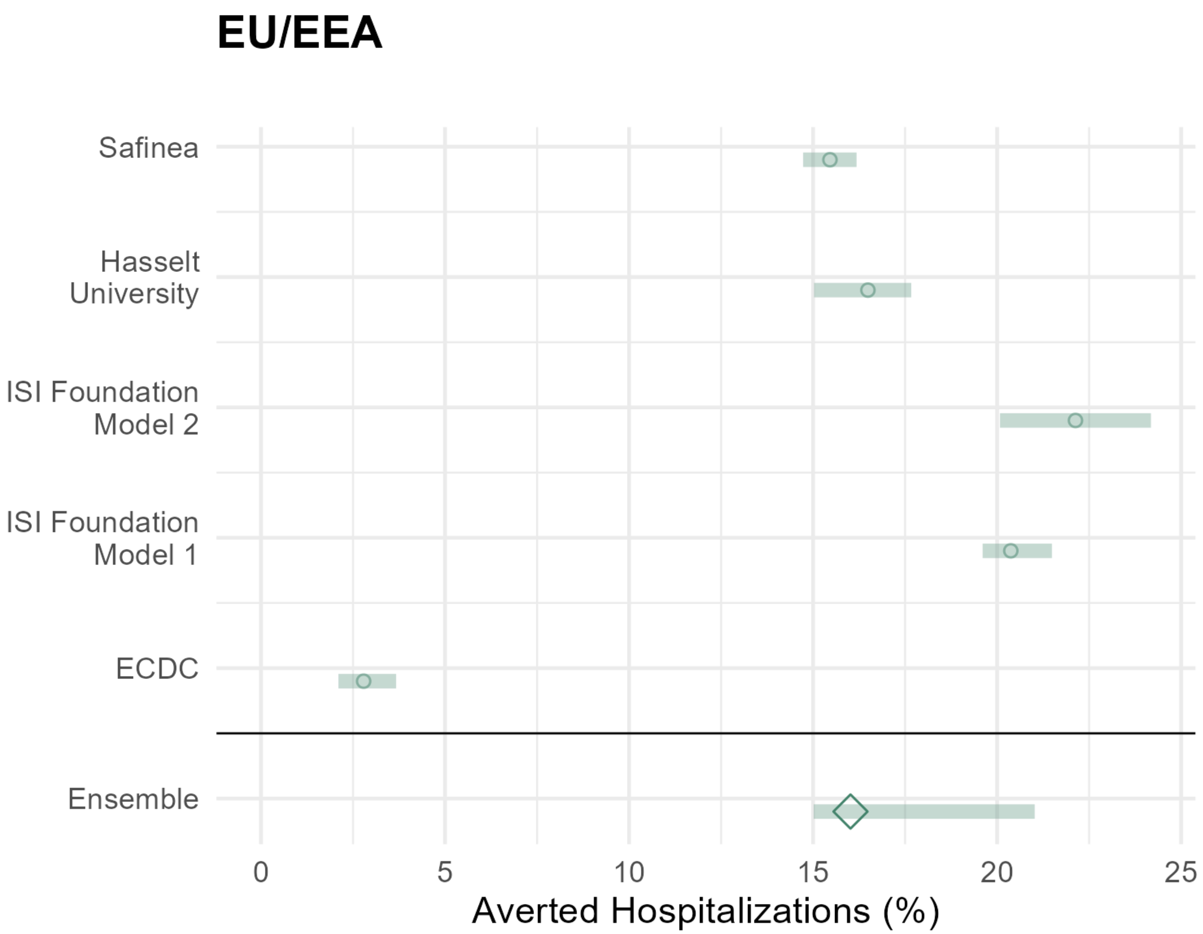
Question 4
What is the impact of vaccination versus no vaccination on the 2024/25 COVID-19 burden in the EU/EEA?

Answer
Vaccination is expected to avert between 15% and 21% of COVID-19 hospitalisations in the 65+ age group. The impact for a country strongly depends on its vaccine uptake.

RespiCompass insight:

COVID-19 vaccine impact

Averted COVID-19 hospitalisations in the 65+ population attributable to vaccination



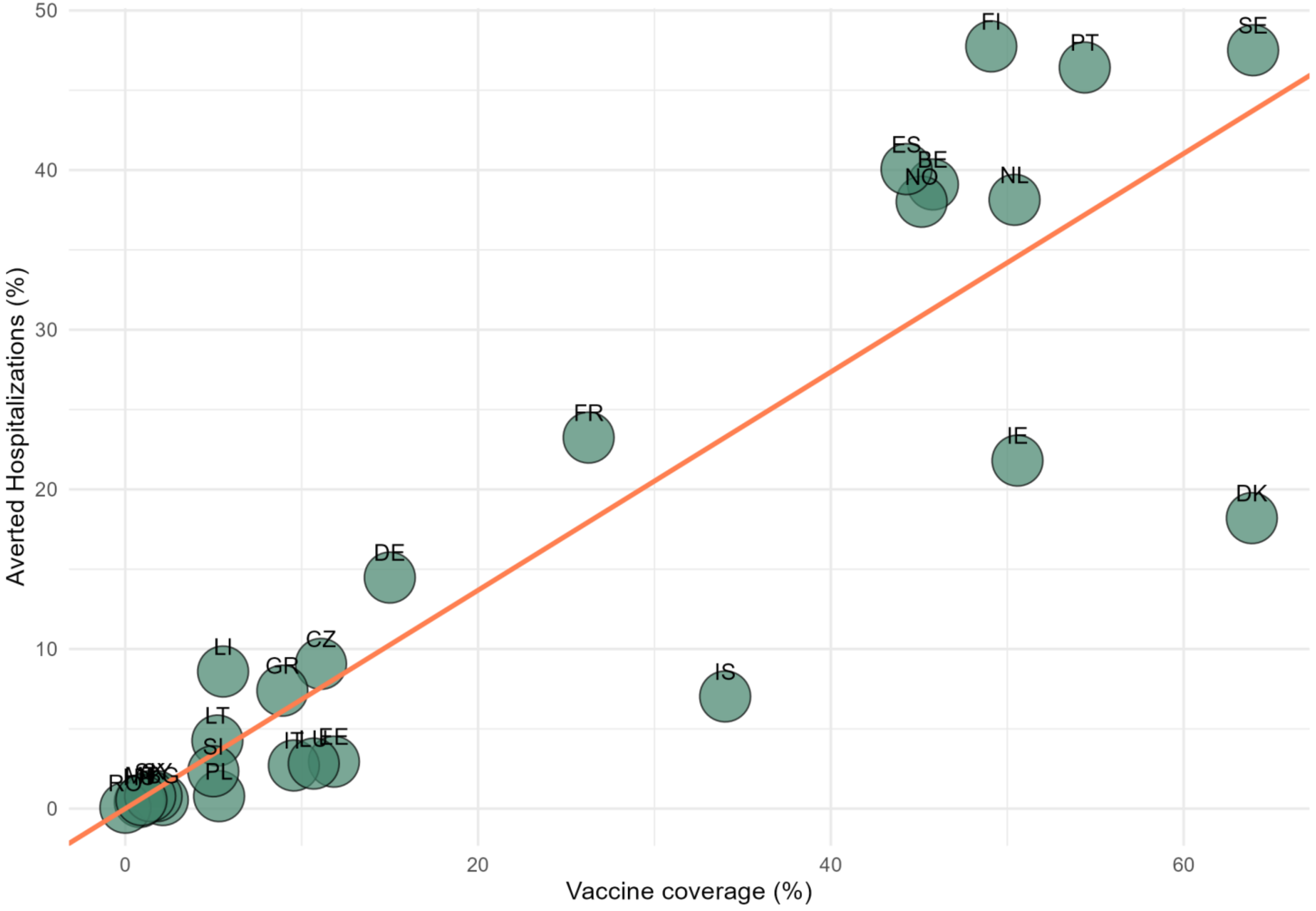
- Autumn 2024 COVID-19 vaccination averts 16% (95% UI: 15% to 21%) hospitalisations in the 65+ age group. EU/EEA region, 2024/25.
- Results are robust across scenarios of immunity waning and final vaccine uptake

RespiCompass insight:

COVID-19 vaccine impact

Averted COVID-19 hospitalisations in 65+ versus vaccination coverage

Slope: 0.68



- Seasonal COVID-19 vaccination coverage ranging from 0.01% to 63% uptake in 60+ age group.
- Every 10% increase in coverage is correlated with 6.8% reduction in hospital burden.

What might reduce the impact from vaccines?

- New variant with strong immune escape
- A late-season peak

Executive summary

- 2024/25 season burden:
  - Influenza burden (ILI+ in 65+ age group) will likely be larger than in the previous season
  - COVID-19 burden (hospitalisations in 65+ age group) remains highly uncertain

- Impact of vaccines on selected disease indicators:
  - 10% increase in uptake is associated with a 6.2% reduction in ILI+ in 65+ age group
  - 10% increase in uptake is associated with a 6.8% reduction in COVID-19 hospitalisations in 65+ age group

Developments for 2025

- Retrospective evaluation of model projections, communication and impact of RespiCompass Round 1

- Close involvement of diseases experts and RespiCompass end-users in design of modelling questions and scenarios

- Health-economic assessment of scenario round results

Acknowledgements

We are extremely grateful to:

- EU/EEA member states who collect and provide data
- Hub participants
- Contractor (consortium led by ISI foundation, Italy)
- US colleagues who provided open-source code
- All collaborating teams for their active participation in these hubs.

6. Discussion

Discussion – support questions

RespiCompass Round 1 (winter 2024-2025)

1. Do you find the burden projections useful?
2. What limitations do you see in the approach presented (e.g. scenario selection, burden assessed, communication)?
3. How could the work be improved to maximise impact?

NFP survey

1. How do you see modelling informing your surveillance activities and/or vaccination strategy?
2. What challenges are you currently facing, or do you foresee, with integrating modelling outputs in decision-making?
3. What would alleviate those challenges?

Thank you

Questions: ECDC.Influenza@ecdc.europa.eu