HSD76

# Assessing the Carbon Footprint Profile of an Immunisation Programme Against Respiratory Syncytial Virus in Infants in the United Kingdom

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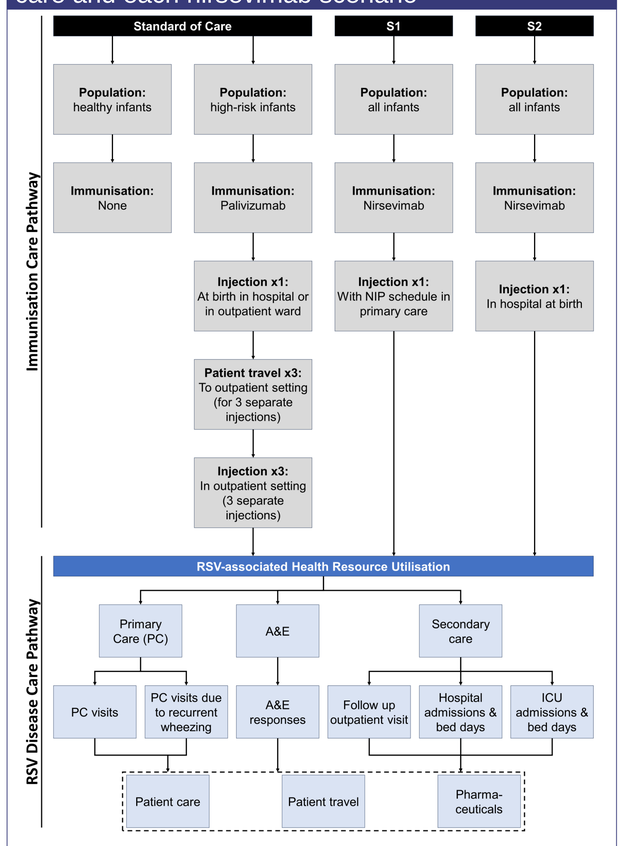
## BACKGROUND

- The healthcare system accounts for **4% of total** United Kingdom (UK) carbon emissions annually (1).
- The National Health Service (NHS) is calling for **less carbon-intensive care practices**, including **prevention** (2).
- Respiratory Syncytial Virus (RSV) is a **highly contagious infectious disease with no widespread immunisation programme currently implemented in infants** in the UK (3, 4). RSV seasonal epidemics pose a significant public health burden and lead to **substantial healthcare utilisation**, particularly in the winter months (5, 6).
- This study estimates the impact on the **carbon footprint** of an immunisation programme against RSV-related disease in all infants with **nirsevimab**, a new monoclonal antibody used in prophylaxis (7), considering the **direct patient care pathway** (PCP)

## METHODS

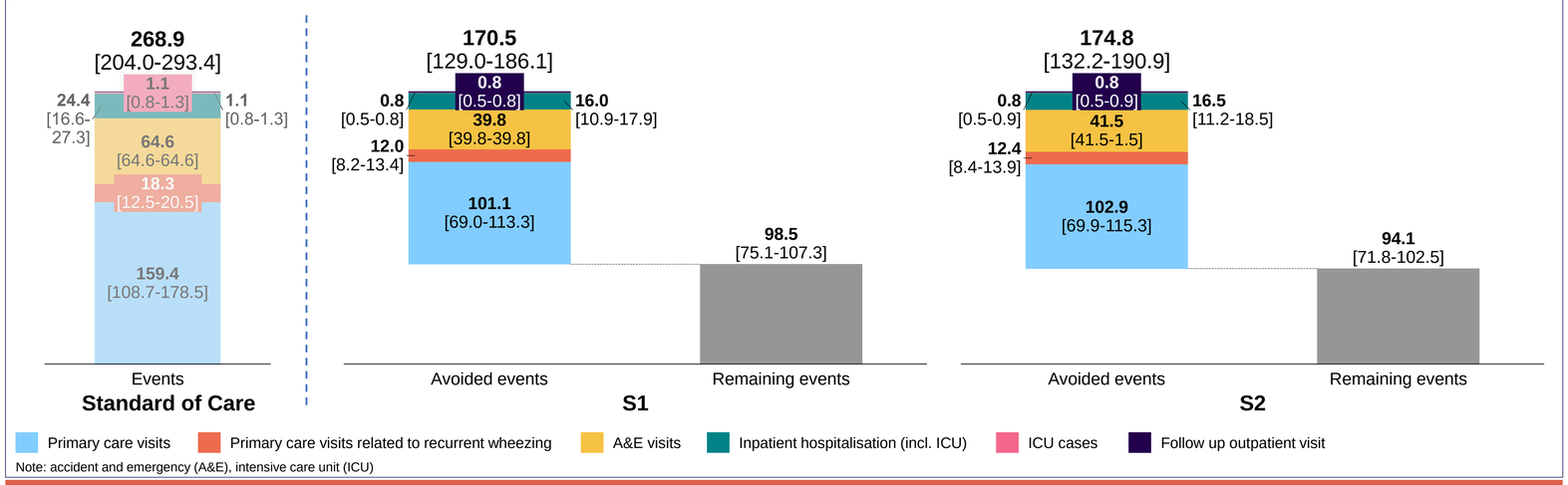
- This study focuses on immunisation against **RSV-related disease in infants under one year** of age in the UK.
- The analysis compares the **incremental environmental benefits of an intervention with nirsevimab compared to current standard of care (SoC**), characterised as intervention with palivizumab, used in ~4,000 high- risk infants per year, or no intervention in healthy infants (4).
- A **universal immunisation programme** is considered for all infants below 1 year of age with an assumed 91% uptake leading to ~650,000 individuals.
- A **novel approach** was applied, mapping RSV-related healthcare utilisation and estimating the carbon emissions from the resulting patient care pathway.
- **Figure 1** shows the immunisation pathway: note that nirsevimab requires 1 injection vs. the average of 4 for palivizumab, thus incurring less patient travel.
- To estimate carbon emissions from avoided disease burden, **NHS emission factors** taken from Tennison et al. (1) were applied to **incremental specific health outcomes** from a published health economic model **(Figure 2) (8)**
- Factors specific to the immunisation procedure amounted to 0.02 kilograms (kg) overall of carbon dioxide equivalent ($CO_2$eq) per injection.
- **Two scenarios** were considered:
  - Scenario 1 (S1) assumed infants to be immunised either, i) **at birth in hospital** if born in season or, ii) in the **existing National Immunisation Programme (NIP) appointment** closest to start of the season if born out of season. Immunity is assumed to **last 150 days** according to the licensed duration for nirsevimab.
  - Scenario 2 (S2) assumed all infants are immunised **at birth in hospital** with nirsevimab, regardless of birth month, with **immunity waning after 150 days** to 50% at 1 year (9).
- A sensitivity analysis of upper and lower boundaries based on different hospitalisation rates was performed on the disease burden input (10, 11).

Figure 1. Patient care pathways for standard of care and each nirsevimab scenario




Note: accident and emergency (A&E), average (avg.), general practitioner (GP), intensive care unit (ICU), National Immunisation Programme (NIP), primary care (PC)

Figure 2. RSV disease burden and healthcare utilisation in infants in the UK, as modelled for Standard of Care, S1 and S2, in number of healthcare events (in 000's; upper and lower boundaries in brackets)

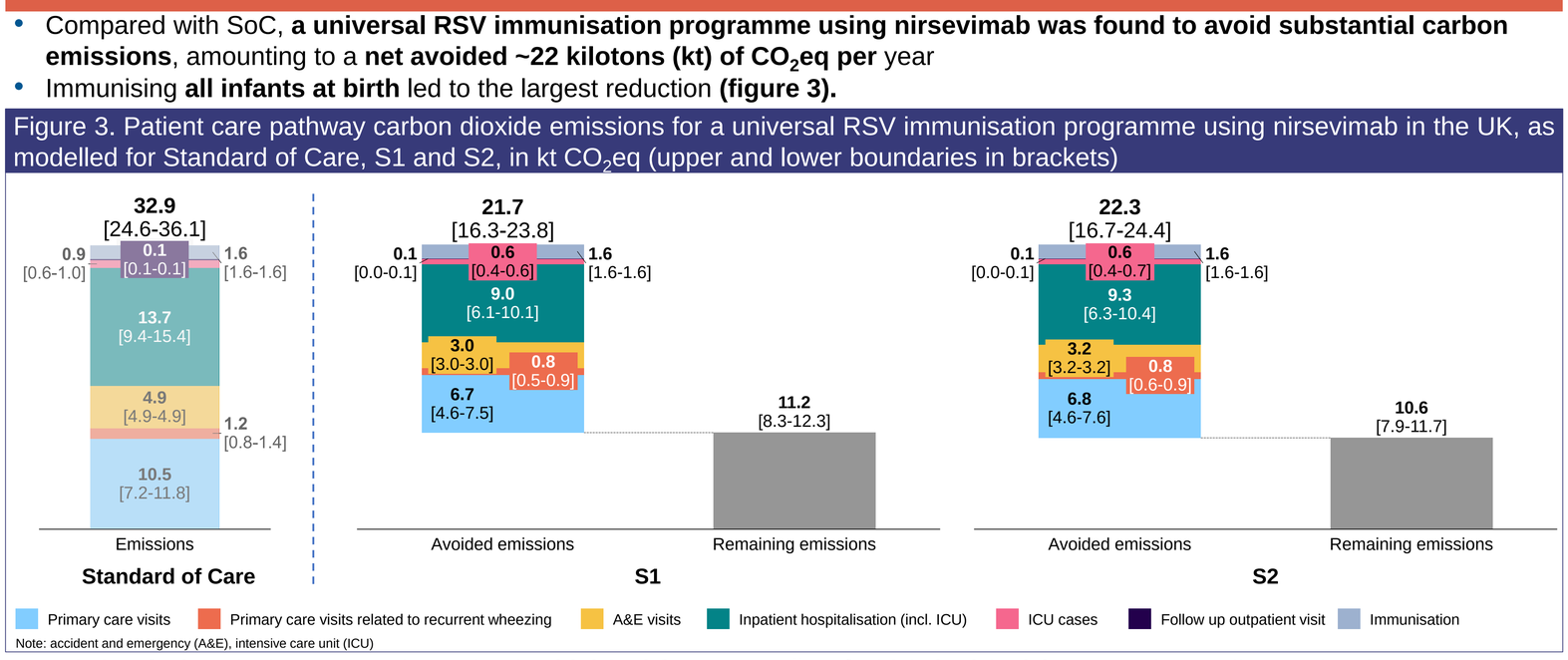



Note: accident and emergency (A&E), intensive care unit (ICU)

## RESULTS

- Compared with SoC, **a universal RSV immunisation programme using nirsevimab was found to avoid substantial carbon emissions**, amounting to a **net avoided ~22 kilotons (kt) of $CO_2$eq per** year
- Immunising **all infants at birth** led to the largest reduction **(figure 3).**

Figure 3. Patient care pathway carbon dioxide emissions for a universal RSV immunisation programme using nirsevimab in the UK, as modelled for Standard of Care, S1 and S2, in kt $CO_2$eq (upper and lower boundaries in brackets)




Note: accident and emergency (A&E), intensive care unit (ICU)

- Existing SoC emissions are estimated to be 32.9 kt $CO_2$eq annually, of which 31.3 kt $CO_2$eq are due to disease burden emissions.
- In S1, **net emissions of up to 21.7 kt $CO_2$eq could be avoided annually**. If the duration of protection is assumed to last longer than 150 days (S2), immunising all infants at birth against RSV could **avoid up to net 22.3 kt $CO_2$eq each year**.
- In S1 and S2, direct emissions due to administering the immunisation were low, amounting to 0.02 kt $CO_2$eq overall. The immunisation emissions from SoC (i.e., administering palivizumab) were assumed to be avoided as no palivizumab injections for high-risk groups were needed, which avoids ~1.6 kt $CO_2$eq.
- The **avoided direct RSV-related disease burden due to health outcomes** was **more than 20 kt $CO_2$eq** in both S1 and S2, which accounted for the vast majority **(~93%)** of $CO_2$ emissions avoided.
  - **Avoided inpatient hospitalisations** contributed most out of all health outcomes to avoided carbon emissions, with 9.0 kt $CO_2$eq avoided in S1 and 9.3 kt $CO_2$eq avoided in S2.

## DISCUSSION

- **Estimated avoided emissions from an all-infant immunisation programme with nirsevimab were ~22 kt $CO_2$eq** each year in the UK from a **PCP perspective**.
  - Equivalent to **five times** the annual carbon footprint from **operating theatres** (12) or **twice the annual fuel consumption** from the London Ambulance Fleet Service (13).
  - Most avoided carbon emissions are from the **reduction in healthcare utilisation,** especially hospitalisations.
- When divided by the total immunised population, this equates to **~30 kg $CO_2$eq avoided per immunised infant.**
- When mapping possible investments to reduce carbon footprint, healthcare organisations could consider the **carbon-intensity profile of new programmes with innovative medicines**.
  - This goes beyond traditional clinical and economic health technology assessment (HTA) to **encompass the measurement of the carbon intensity profile of new medicines from the PCP perspective** (14).
- The relationship between health and environment is increasingly documented, with c**limate change having multi-factorial public health consequences** through air pollution and many other mental and physical health risks (15).
  - Avoided carbon emissions from innovative medicines could be translated in terms of **increased life years saved (LYS) or quality adjusted life years (QALYs**) and ultimately be considered as **part of cost-effectiveness evaluations** (16).
  - However, data on healthcare utilisation emission factors are **scarce and are often not up-to-date**, **focused on a single healthcare outcome** or limited to **local case studies** (17).
- The perspective of this study is limited as the impact on the PCP **does not take into account the incremental emissions of producing and distributing the drug,** but focusses on **use phase only,** thus omitting key additional sources of carbon emissions. Other limitations include emissions factors specific to England and not specific in nature; specifically, they are not specific to RSV disease and thus capture items, such as prescribed drugs, that not all infants would receive.

## CONCLUSIONS

- **This novel approach to measuring the avoided carbon emissions of a mAb intervention using a PCP perspective for RSV in infants demonstrates one of the values of immunisation in decarbonising healthcare systems; that is, innovative immunisations can improve patient outcomes, which can have carbon saving benefits and help health care systems reach their carbon targets.**
- **Disease prevention with innovative medicines should be considered from the perspective of $CO_2$ emission reduction, in addition to traditional clinical and economic benefits.**
- **Both the LCA (lifecycle assessment) approach measuring emissions from cradle to grave and the healthcare pathway approach should be used to evaluate the carbon cost of healthcare.**
- **Multi-stakeholder collaboration, exemplified by the Sustainable Markets Initiative, will be instrumental to bridge data gaps, further explore the potential environmental benefits of medicines and align on standards to report these at an industry level.**

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## DISCLOSURES & CONTACT

RH, MC, and PT are employees of Sanofi and may hold shares or stock options in the company. TRF and FL are employees of CVA, which received consulting fees to conduct the research from Sanofi.
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Nirsevimab is being developed and commercialized in partnership between AstraZeneca and Sanofi.
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