Modelling the Multidimensional Value of Dupilumab for Singapore COPD Patients: from Healthcare Systems to Planetary Health (EE105)

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Background

- Chronic obstructive pulmonary disease (COPD) impacts morbidity, mortality, healthcare resource utilisation (HCRU), and care pathway-related carbon emissions.
- Specific COPD patients still lack effective treatments in addressing frequent exacerbations.
- Dupilumab has demonstrated significant reductions in exacerbation, improves lung function and quality of life.

Objectives

- To estimate the reduction in HCRU associated with dupilumab treatment.
- To quantify the corresponding reduction in patient care pathway (PCP)-related carbon emissions.

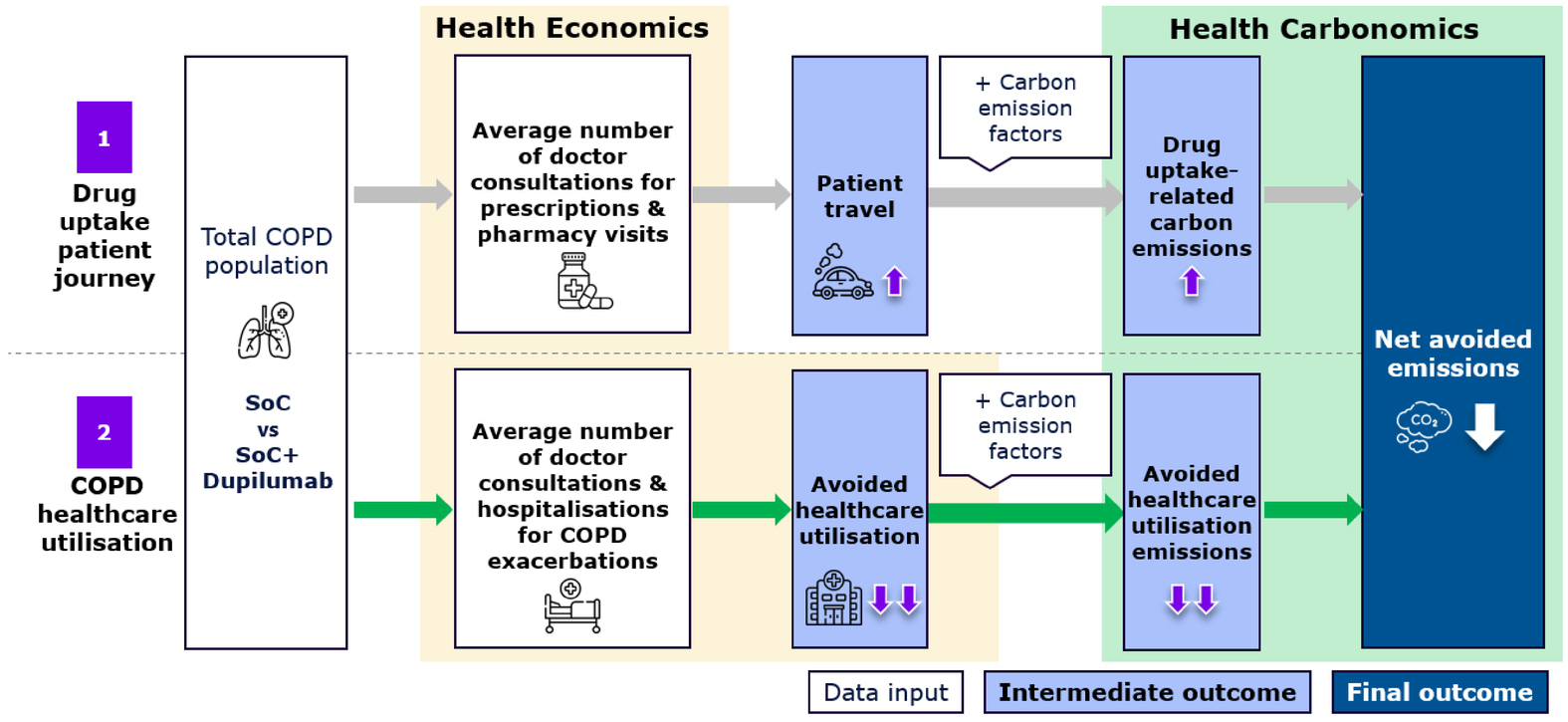

Figure 1: Models Structure

Methods

- **Modelling (Figure 1)**: Two models were employed: a health economic model to quantify HCRU impact, and a health carbonomics model to estimate associated greenhouse gas (GHG) emissions alongside the patient care pathway. A 100% acceptance rate is considered for the analyses.
- **Treatment Comparison**: Dupilumab + Standard of Care (SoC) was compared with SoC alone. SoC included triple therapy (long-acting muscarinic antagonist (LAMA)/long-acting β2-agonist (LABA)/inhaled corticosteroid (ICS)) or dual bronchodilator therapy (LABA/LAMA).
- **HCRU Inputs**: Outpatient (primary care, specialist) visits, emergency room (ER) visits, hospital stays, and intensive care unit (ICU) admissions, which were synthesized from local real-world studies, clinical trials and local clinician opinion.
- **Carbon Emission Inputs**: Dupilumab lifecycle emissions were adapted from Germany to Singapore, while HCRU emission factors were transported from the United Kingdom to Singapore via adjustment of Singapore-specific healthcare carbon intensity ratios.

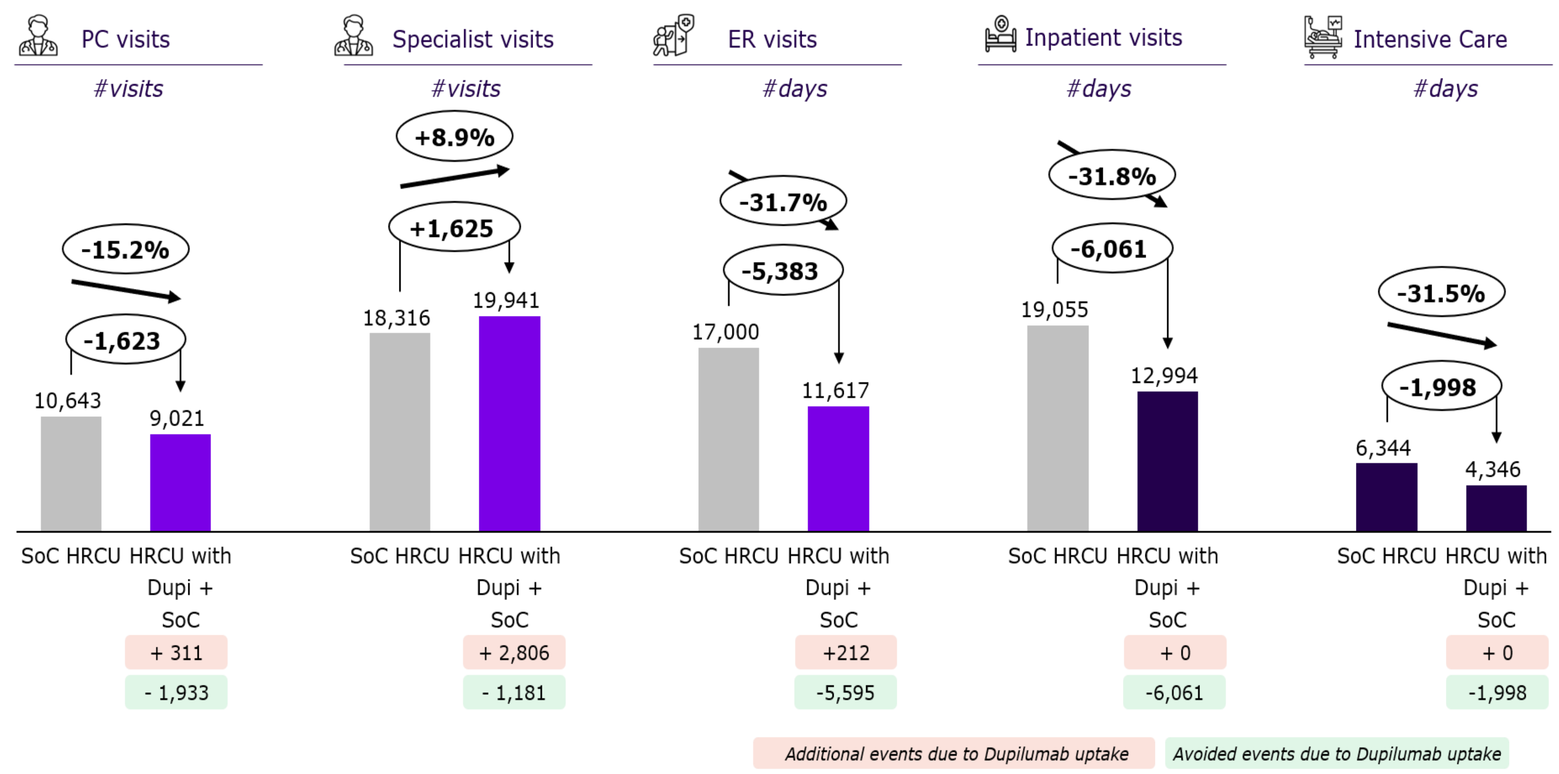

Figure 2: HCRU Outcomes with Dupilumab intervention – total events in Singapore per year

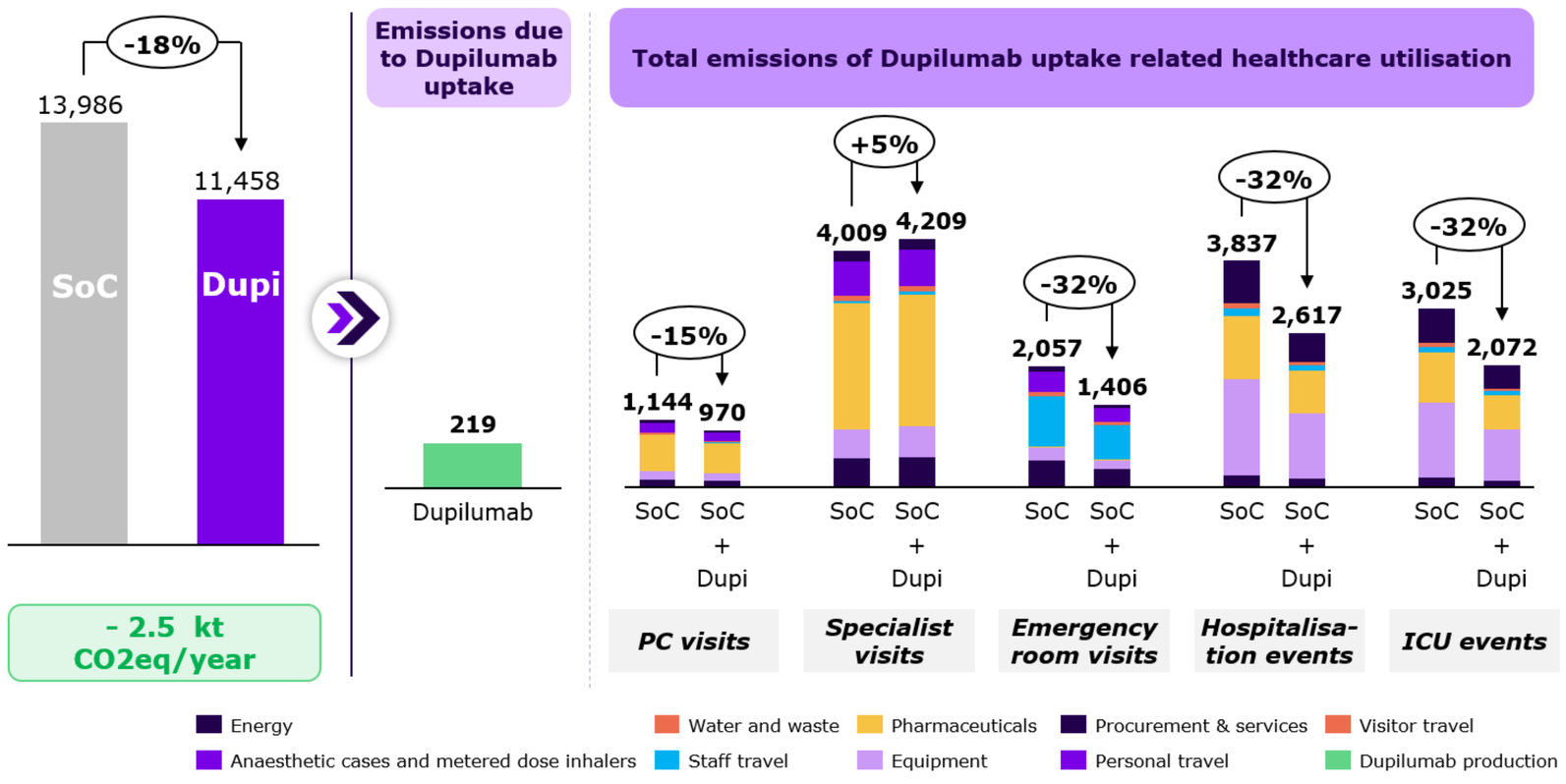

Figure 3: Care pathways emissions with Dupilumab intervention vs SoC, in tCO_2eq/year for total COPD population in Singapore (1 tCO_2eq = 6,400 km of gas car travel)

Results

Reduced HCRU with dupilumab (Figure 2)

- Primary care visits **reduced by 15.2%** with Dupilumab + SoC predominantly due to avoided events.
- Specialist visits **increased by 8.9%** due to enhanced disease management, not clinical deterioration.
- **Acute and high-acuity healthcare utilization saw significant decreases due to avoid events**: ER days by 31.7%, inpatient days by 31.8%, and ICU days by 31.5%.

Reduced healthcare carbon footprint with dupilumab (Figure 3)

- Healthcare carbon emissions **decreased by 18% with SoC + Dupilumab, equivalent to a net 2.5 kt carbon dioxide equivalent (CO_2eq) reduction per year in Singapore's total COPD population**, similar to 16 million km of gas car travel.
- Emissions reductions were most pronounced for **high-intensity care settings**: ER (−32%), hospitalisation (−32%), and ICU (−32%), consistent with the HRCU reductions observed in Figure 2.

Conclusion

- By reducing exacerbation-related HCRU, dupilumab may lower ER visits, hospitalisations, ICU admissions, and associated costs.
- By lowering resource-intensive care along the COPD PCP, dupilumab may contribute to healthcare decarbonisation in Singapore, highlighting the potential role of targeted biologics in delivering both patient and environmental value.

References: 1. Yii et al., Int J Chron Obstruct Pulmon Dis, 2023, 2. Juang et al., Int J Chron Obstruct Pulmon Dis, 2026, 3. Lum et al., J Clim Chang Health, 2025, 4. Bhatt et al., N Engl J Med, 2023, 5. Wilkinson et al., Adv Ther, 2022

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