exposed and not/minimally exposed children on their annual rate of changes in blood pressure from 3 to 9 years after the fire.

Results: At the 9-year follow-up, each 10 μg/m^3 increase in *mean* fire-related $PM_{2.5}$ was associated with a 2.48 mmHg increase in central DBP (95% CI: 0.73, 4.88) among children exposed during infancy. Being exposed to fire smoke during infancy was also associated with an annual increase from 3 to 9 years after the fire in brachial SBP (2.18 mmHg [95% CI: 1.11, 3.24]), brachial DBP (1.90 mmHg, [95% CI: 0.95, 2.86]), central SBP (1.58 mmHg [95% CI: 0.59, 2.56]) and central DBP (1.86 mmHg [95% CI: 0.85, 2.88]) than for the not/minimally exposed group.

Conclusions: Exposure to high levels of air pollution during infancy was associated with long-term increased blood pressure in later childhood.

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020

Mortality Rates in Adults With Severe Congenital Heart Disease: Insights From the National Congenital Heart Disease Registry of Australia

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Aim: Due to advances in medical and surgical care, more individuals with congenital heart disease (CHD) are surviving into adulthood. However, the relative rarity and heterogeneity of CHD makes prognosis challenging. We used the large Bi-National Congenital Heart Disease Registry of Australia and New Zealand, alongside a bespoke complexity stratification tool, to determine prognosis in severe CHD.

Method: An in-house algorithm analysed the diagnoses and procedures of 71240 registry patients to identify 6990 with sufficient diagnostic data to be classified as "severe CHD" (as per European Society of Cardiology guidelines) and who survived to at least 16 years of age. Of these, 2,538 were classified as single-ventricle and 4,452 as double-ventricle, using a combination of diagnostic and procedural information. We then plotted Kaplan–Meier curves and performed log-rank testing to characterise mortality risk.

Results: Among adults with severe CHD, the 85% survival point was 45.5 years (95% CI 44.6–46.3). Single-ventricle patients had an 85% survival of 42.0 years (95% CI 41.2–42.9), versus 46.0 years (95% CI 45.2–46.9) in the double-ventricle group. Log-rank testing demonstrated significantly higher mortality in the single-ventricle cohort ($p<0.001$; **Figure**).

Conclusions: Despite substantial improvements in CHD management, adults with severe lesions, particularly single-ventricle physiology, remain at high risk of premature mortality (with 15% mortality between ages 16 years and their mid-40s). These findings highlight the need for ongoing surveillance, improved risk stratification, and targeted interventions to enhance long-term outcomes in this growing patient population.

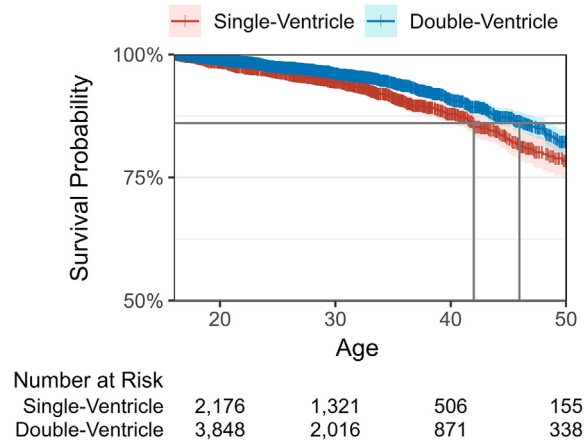

Figure. Kaplan–Meier curves for survival in severe congenital heart disease patients with single-ventricle versus double-ventricle physiology

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021

Optimising Resource Allocation Through Predictive Modelling: A Hybrid Ensemble Machine Learning Approach for Length of Stay Prediction in ST-Elevation Myocardial Infarction Patients

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Aim: Despite substantial advancements in interventional cardiology and reperfusion strategies, the accurate forecasting of healthcare resource utilisation for STEMI patients remains an elusive challenge within Australian tertiary centres. We aimed to develop a novel hybrid ensemble learning model for predicting length of stay (LOS) in STEMI patients, addressing the critical need for precision resource management.

Method: We analysed 37,684 STEMI admissions from Canberra Hospital using ICD-10 codes I21.0-I21.3 supplemented with hierarchical comorbidity classifications. A comparative evaluation of five distinct machine learning paradigms (Neural Network, Random Forest, XGBoost, CatBoost, LightGBM) was performed against our novel Hybrid Ensemble Method (Hybrid-EM), which synergistically integrates the algorithmic strengths of CatBoost and LightGBM (**Table**). Model performance was assessed using R-value, Explained Variance Score, accuracy, and Mean Absolute Error (**Figure**).

Results: The Hybrid-EM model achieved 79% accuracy with a Mean Absolute Error of 1.6 days. Demographic analysis revealed 16% higher admission rates for males, with peak admission ages of 80 years for men versus 85 for