

surgery, diabetes mellitus, dyslipidaemia, hypertension, renal failure, and liver disease showed a significant association of the presence of AF with in-hospital mortality for AS patients who underwent TAVR (OR: 1.394; 95% CI: 1.138 to 1.707;  $p < 0.001$ ) and no-AVR (OR: 1.344; 95% CI: 1.301 to 1.388;  $p < 0.001$ ), but not for SAVR (OR: 0.896; 95% CI: 0.778 to 1.031;  $p = 0.125$ ).

We observed worse in-hospital complications and 6-month in-hospital mortality for AS patients with than without AF. AS patients with AF had better outcomes with AVR than with no-AVR. We also found that the outcomes of TAVR patients were better than for SAVR patients. This may be reasonable because valve replacements are being achieved for AS patients through a lesser invasive transcatheter approach. Not surprisingly, out of the treatment strategies analyzed, the incidence of bleeding was most frequently seen in SAVR patients. Medically optimizing modifiable risk factors like AF before AVR may help lower the rates of in-hospital complications and readmission, thereby also lowering the cost of hospitalization to the patient. This reflects a need for incorporating AF into the decision-making algorithm for AVR.

This study has limitations relating to the data source, which lacks data on the duration of AF and the severity of AS. However, AF has been shown to be an independent predictor of worse outcomes and a major predictor of mortality in patients regardless of its duration or the severity of AS.<sup>4</sup>

In conclusion, this nationwide study showed that AF increases the risk of complications for AS patients irrespective of the treatment strategy. Moreover, outcomes of AS patients with AF were better with AVR than without AVR.

#### Declaration of Interests

The authors declare that they have no known competing financial interests or personal relations that could have appeared to influence the work reported in this study.

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#### Ten Years Mortality Trends of Tricuspid Regurgitation in the United States, 2008 to 2018

Tricuspid regurgitation (TR), particularly secondary or functional TR, is the most prevalent right heart valvular lesion associated with significant morbidity and mortality.<sup>1</sup> Moderate-to-severe functional TR affects approximately 1.6 million people in the United States, with only 8,000 undergoing

surgical repair, yearly, often in the setting of left heart surgery, as surgical repair is limited to severe TR based on current guidelines (Class I, Level of Evidence – C).<sup>2,3</sup> Currently, heart failure (HF) is associated with a high prevalence of 5.7 million in the United States, with an alarming projection of 46% increase in prevalence by the year 2030.<sup>4</sup> Despite these concerning epidemiological estimates, the data outlining the mortality burden of non-rheumatic TR which includes functional TR in the United States is not known, but relevant in the context of clinical care, patient education, guideline development and policy-related changes. This study aimed to assess the burden of mortality from non-rheumatic TR using national representative data assessing death certificates in the United States.

The present analysis utilized deidentified records from the public-use “Multiple Cause of Death data” via the Centers for Disease Control and Prevention Wide–Ranging On-line Data for Epidemiologic Research (CDC WONDER) datasets, 2008 to 2018. The Multiple Cause of Death data comprises of national mortality and population data based on death certificates containing a single underlying cause of death, up to 20 additional multiple causes, and demographic data for the United States counties. Deaths associated with non-rheumatic TR were identified using the International Classification of Disease, tenth revision (ICD-10) code I36.1 as either underlying or contributing cause of death. This analysis was restricted to patients with age over 45 years so as to reflect patients whose deaths were most likely due to functional TR. Non-rheumatic TR deaths per 100,000 major cardiovascular deaths (I00-I78) were calculated. Crude death rates and age-adjusted death rates per 100,000 population were also computed for each year with a confidence interval of 95%. Age-adjusted death rates with a 95% confidence interval (CI) were calculated using the population of year 2000 as the standard population. We used Jointpoint Regression Program version 4.7.0.0 to analyze temporal trends in mortality from 2008 to 2018. Average annual percentage change with 95% CI was calculated for crude and age-adjusted mortality rate trend lines to provide a summary estimate of trend. The trend was considered increasing or decreasing



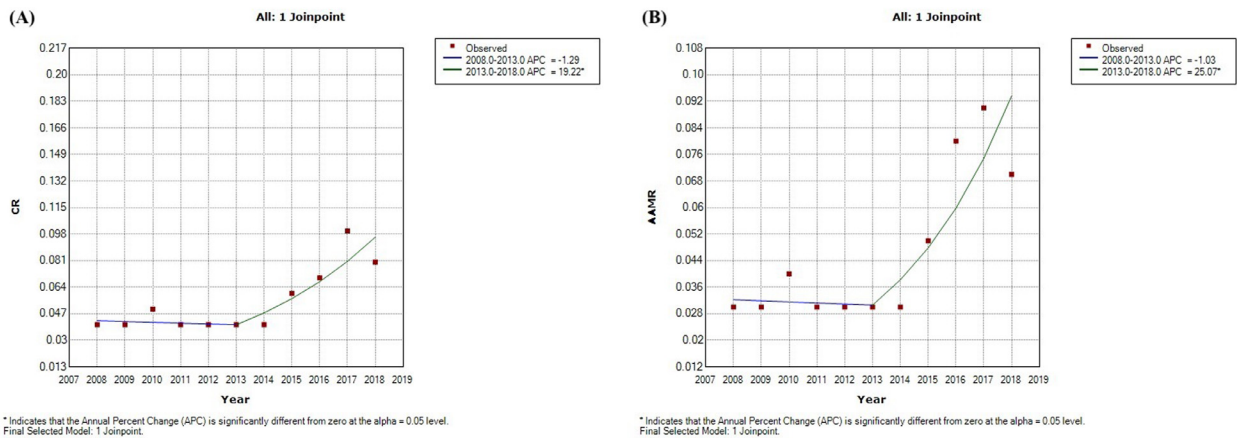


Figure 1. (A) Trend of crude mortality rate due to non-rheumatic tricuspid regurgitation. The trend plot depicts a significant increase in the trend of crude mortality from 2013 to 2018. (B) Trend of age-adjusted mortality rate due to non-rheumatic tricuspid regurgitation. The trend plot depicts a significant increase in the trend of age-adjusted mortality from 2013 to 2018.

if the slope of the trend line differed significantly from zero with an alpha level set at 0.05. The statistical significance was determined by 2-sided t-testing.

A total of 776 deaths were attributed to non-rheumatic TR from 2008 to 2018. The crude and age-adjusted mortality rates in 2008 were 0.08 (95% CI: 0.07 to 0.10) and 0.03 (95% CI: 0.02 to 0.04), respectively. In the year 2018, the crude and age-adjusted mortality rates were 0.03 (95% CI: 0.02 to 0.04) and 0.07 (95% CI: 0.06 to 0.08), respectively. The trend of crude and age-adjusted non-rheumatic TR mortality remained similar from the year 2008–2013. However, there was a significant increase in the trend of crude and age-adjusted mortality attributed to non-rheumatic TR from the year 2013–2018 per 100,000 major cardiovascular deaths; average annual percentage change for crude mortality of 19.22 (95% CI: 5.4 to 34.8; Figure 1) and for age-adjusted mortality of 25.07 (95% CI: 4.3 to 49.9; Figure 1).

This present analysis provides a cross-sectional overview of non-rheumatic TR-related deaths in the United States, and highlights a significant increase in the trend from the year 2013–2018. This increase in mortality attributed to non-rheumatic TR could be due to increasing prevalence of TR secondary to epidemiologic increase in HF incidence, increased pacemaker implantation, increased diagnostic techniques and modalities, increased incidence of cor pulmonale and emergence of left ventricular assist device in the past decade which exacerbates mild TR by causing interventricular septal shift.<sup>5–7</sup>

As these findings also correlate with a concomitant increase in incidence of tricuspid valve disease,<sup>8</sup> our focus on tricuspid valve management should continue and aggressive measures to treat TR may be necessary to improve the national mortality burden. While, previous studies have reported an increased mortality among HF patients with concurrent TR, better and less invasive treatment strategies to treat TR are deemed necessary.<sup>9</sup>

### Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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