

# Clinical Impact and Costs of Echocardiographic Screening for Rheumatic Heart Disease

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An 18-year-old lies in bed in a lower-income country. He has just experienced an embolic stroke that originated on his infected mechanical mitral prosthesis, placed 2 years prior for severe rheumatic mitral stenosis. This true story is paradigmatic of the burdens created by rheumatic heart disease (RHD) in developing nations and underserved regions of developed nations. What if this tragedy could have been prevented by simple diagnosis and treatment of streptococcal pharyngitis so he never developed RHD? What if he had been started on secondary prophylaxis for rheumatic fever after echocardiographic screening for early RHD when he was in grade school? The basic issue is whether we can prevent RHD in low-resource settings by a combination of primary prevention, screening for early disease, and secondary therapy to prevent progressive valve damage. However, there are many other public health needs and not enough funding in low-resource settings. Agencies tasked with finding best use of limited resources often have little data to help guide difficult decisions.

RHD is rare in higher-income countries but still ravages the populations of lower/middle-income countries, afflicting patients from grade school age to older adulthood. There are upwards of 33 million patients with RHD, 275 000 deaths per year, and over 9 million Disability-Adjusted Life Years lost.<sup>1</sup> The prevalence peaks between 25 and 40 years of age, with a female predominance.<sup>2,3</sup> Heart failure symptoms, infective endocarditis, sudden death, atrial fibrillation, and embolic stroke are frequent complications.<sup>4</sup> RHD is caused by repeated bouts of acute rheumatic fever with a subsequent

immunological reaction to group A *Streptococcus* infection. Damage to heart valves, most often the mitral valve, is characterized by thickening of the valve leaflets tips, fusion of the commissures between the leaflets, and chordal shortening, thickening, and fusion. Penicillin prophylaxis is indicated in patients with subclinical and clinical RHD to prevent repeat episodes of acute rheumatic fever and thereby circumvent or delay progression to more severe disease.<sup>5</sup>

In this context, echocardiographic screening for RHD makes sense: The burden of disease is considerable, there is an intervention that is indicated to alleviate the burden, and echocardiographic screening identifies more candidates for the intervention than other screening methods.<sup>6–14</sup> But money is always a factor, and the 2 papers by Cannon et al<sup>15,16</sup> in this issue of *JAHA* provide important insights into disease progression and cost utility of echocardiographic screening.

## Disease Progression

In the first study,<sup>15</sup> the authors examined a registry from the Northern Territories region of Australia with data from 1999 to 2012, focusing on 591 patients ages 5 to 24 with RHD, to investigate disease progression using a multistate model. In patients with severe RHD, there were high rates of progression to valve surgery by 2 years and death within 6 years. In patients with moderate RHD, there were equivalent rates of regression and progression. Most patients (64%) with mild RHD were stable over 10 years, though 11.4% progressed to severe RHD.

This study provides insights on RHD progression and uses a model that accounts for differences in disease state, as well as competing outcomes, unlike prior work.<sup>4</sup> The authors considered both surgical intervention (including valve repair, percutaneous mitral balloon valvuloplasty, and valve replacement) and death as poor outcomes. Atrial fibrillation, stroke, endocarditis, and heart failure were not included. The most important limitation of this study, appropriately acknowledged by the authors, is the method of determining disease severity. Clinicians subjectively assigned a level of severity, integrating

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clinical and imaging data according to Australian guidelines, but it is not clear to what extent guidelines were followed and whether different clinicians assigned different levels to the same patient over time.

## Echocardiographic Screening for RHD

In the second study,<sup>16</sup> the authors used these RHD progression data in a simulation of 2 grade-school echocardiographic screening algorithms with different populations (“Echo A”: 8- and 12-year-olds versus “Echo B”: 5 through 12-year-olds) and different timing (“Echo A”: annually versus “Echo B”: alternate years) of screening. Both models assumed that a sonographer performed the screening with a portable machine in the community, detecting findings consistent with World Heart Federation criteria for Definite RHD.<sup>17</sup> Positive scans would be reviewed by a pediatric cardiologist, who would then determine appropriate follow-up.

The authors found that “Echo B” met standard cost-effectiveness criteria for Disability-Adjusted Life Years saved, primarily by uncovering more cases of RHD at an earlier stage, with treatment reducing subsequent costs related to morbidity and mortality. Cost effectiveness was sustained despite varying multiple assumptions but was sensitive to assumptions about numbers screened and costs incurred by follow-up for positive scans. The analyses also included considerable costs for staff salaries and travel. Although these findings may not be generalizable to other settings, the fact that Echo B demonstrated favorable cost utility suggests that even greater cost effectiveness could be achieved in settings with lower travel costs and lower salaries for sonographers and pediatric cardiologists. The use of less expensive echocardiography machines by less experienced users<sup>18,19</sup> may further lower costs. However, as the authors note, such a strategy may result in more overcalls and/or inadequate images, leading to more referrals for cardiology follow-up, thus raising cost. It remains to be seen whether these increased expenses would be offset by lower follow-up costs in lower/middle-income countries.

## Conclusion

Understanding disease progression and optimal ways to identify RHD at an early stage to prevent progression will help guide public health budget processes. Ideally, future cost utility simulations that account for factors specific to individual countries could determine optimal screening algorithms. The studies by Cannon et al<sup>15,16</sup> provide important data to support echocardiographic screening. Although much work remains to be done, particularly in regard to promoting adherence to secondary prophylaxis, cost-effective

echocardiographic screening is a crucial step toward preventing the tragic and expensive sequelae of RHD for many patients.

## Disclosures

None.

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