

Embedding a Nudge in Echocardiogram Reports to Improve Guideline-Directed Care in Severe Aortic Stenosis: A Prospective Intervention

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Background

A significant proportion of patients do not receive timely cardiology evaluation or aortic valve replacement (AVR) after the diagnosis of severe aortic stenosis (AS)^{1,2}. These gaps are particularly pronounced when the diagnostic echocardiogram is ordered by non-cardiology providers^{2,3}. Behavioral “nudges,” are low-cost, non-interruptive prompts embedded into clinical workflows and have shown effectiveness in improving evidence-based care across a variety of health settings. Echocardiography, as the cornerstone of AS diagnosis, represents a unique opportunity to integrate such a nudge directly into diagnostic reports, simultaneously informing providers and patients of disease severity and recommended next steps. This approach is strongly aligned with the American Heart Association’s Target: Aortic Stenosis Initiative, for which the Hospital of the University of Pennsylvania and Penn Presbyterian Medical Center both participate, which emphasizes the integration of actionable clinical recommendations into echocardiogram summaries to drive timely and appropriate care.

Objectives

We evaluated whether embedding an automated, standardized, and non-interruptive nudge into the first echocardiogram reports (index echo) indicating the diagnosis of severe AS increased timely referral to a cardiovascular specialist and AVR. We further assessed whether the impact of this intervention differed by provider specialty, focusing on patients who were referred to the index echo by non-cardiac specialty providers.

Methods

Patients with a first echocardiogram diagnosing “severe AS” or “critical AS” were prospectively enrolled at the University of Pennsylvania Health System between April 2023 and April 2024. A non-interruptive nudge (Figure 1) was embedded in the summary section of all index echocardiograms (a secondary performance measure for the Target: Aortic Stenosis initiative). The nudge referenced guideline-based recommendations and included a referral pathway to cardiac specialty follow-up for both providers and patients. Patients with prosthetic valves were excluded. Endpoints included a referral to a cardiac specialist within 90 days of the index echo (a co-primary performance measure for the Target: Aortic Stenosis initiative); a composite of cardiac specialty visit or AVR within 90 days; AVR within 6 months, and AVR in one year. Baseline demographics, comorbidities, and

echocardiographic parameters were collected from the electronic health record. Provider specialty who ordered the index echo was categorized as cardiology or non-cardiac specialty provider. Endpoints were compared with a retrospective cohort of patients with a first echocardiogram documenting a diagnosis of severe AS between January 1, 2019, and December 31, 2022. Baseline characteristics were compared between cohorts using chi-square or Fisher’s exact tests for categorical variables and Student’s t-tests for continuous variables. Outcomes were compared between the pre- and post-nudge cohorts overall and stratified by provider specialty. To adjust for baseline differences, 2:1 nearest-neighbor propensity score matching was performed including demographics, symptomatic status, cardiovascular risk factors, and comorbidities.

Results

A total of 2,069 patients were enrolled (mean age:77 years, male: 54%, White: 81%, Black: 12%, pre-Nudge: 1,525 patients, post-Nudge: 544 patients). The pre- and post-nudge patients also included the patients from Target: Aortic Stenosis.

After propensity matching, 1,626 patients (Pre = 1,084; Post = 542) were well balanced across demographic and clinical characteristics. The pre- and post-nudge endpoints are summarized in Figure 2. In the matched cohort, overall referral to a cardiac specialist within 90 days was higher post nudge compared to pre-nudge (97% vs. 92%, $p < 0.001$). Rate of composite outcome were higher post-nudge (93% vs. 89%, $p = 0.015$). AVR rates were higher in the post-nudge group at both 6 months (46% vs. 39%, $p = 0.005$) and 1 year (54% vs. 46%, $p = 0.002$). In the non-cardiac provider subgroup, the effect of the nudge remained pronounced after matching, with increased referral to cardiac specialty follow-up within 90 days (95% vs 85%, $p < 0.001$), AVR at 6 months (38% vs 26%, $p = 0.004$) and 1 year (41% vs 32%, $p = 0.050$).

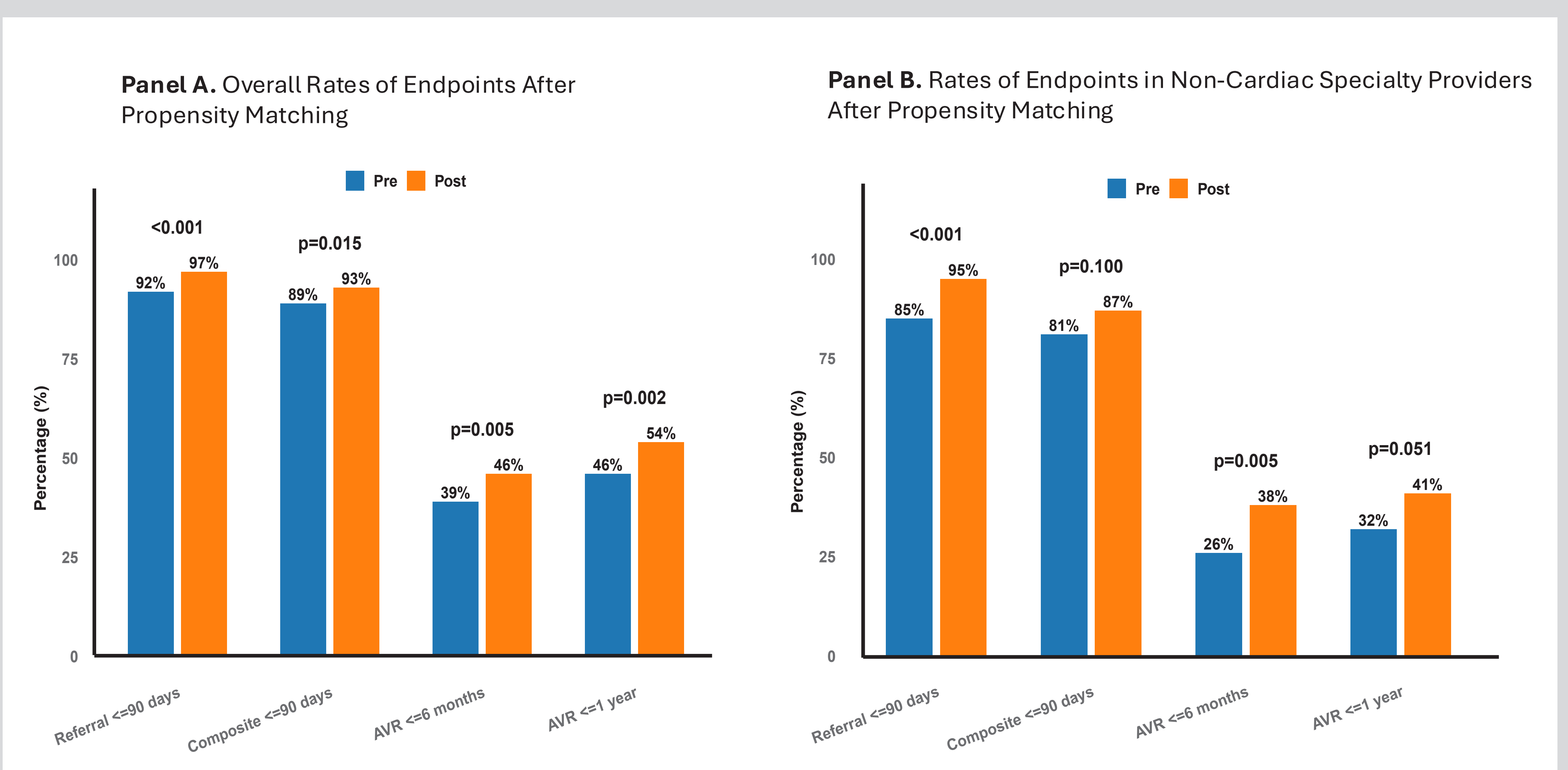
Conclusions

Embedding a non-interruptive, guideline-based nudge into echocardiogram reports significantly improved referral to cardiac specialists and rates of AVR in patients newly diagnosed with severe AS. The effect was most pronounced among patients whose index echo was ordered by non-cardiology providers. This approach is potentially scalable for other Target: AS sites to provide guideline directed care and increase both referrals and timely AVR for patients with severe AS.

Figure 1. Nudge Statement Embedded in the Echo Report Summary

- This patient has been found to have severe aortic stenosis. National guidelines recommended that she be referred to a valvular heart disease specialist for further valve evaluation and management. For providers, place CONSULT TO CARDIOLOGY (PROC6813) order in Epic, call the Penn Medicine number at 800-789-7366 or follow your existing pathway to initiate the referral process if clinically appropriate. For patients, please call the provider who has ordered the echocardiogram to discuss.

Figure 2. Rates of referral to cardiac specialists and AVR in patients pre-and post-nudge in a cohort of matched patients.



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References

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