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Retraction and Replacement of: Provider Care Team Segregation and Operative Mortality Following Coronary Artery Bypass Grafting

RE: Hollingsworth JM, Yu X, Yan PL, Yoo H, Telem DA, Yankah EN, Zhu J, Waljee AK, Nallamothu BK. Provider care team segregation and operative mortality following coronary artery bypass grafting. *Circulation: Cardiovascular Quality and Outcomes*. 2021;14:e007778. DOI: [10.1161/CIRCOUTCOMES.120.007778](https://doi.org/10.1161/CIRCOUTCOMES.120.007778)

After evaluating the explanation provided by the authors, the American Heart Association's Scientific Publishing Committee has concluded that a retraction and correction of the article, "Provider Care Team Segregation and Operative Mortality Following Coronary Artery Bypass Grafting" which originally published April 30, 2021, and appeared in the May 2021, issue of the journal (*Circulation: Cardiovascular Quality and Outcomes*. 2021;14:e007778 DOI: [10.1161/CIRCOUTCOMES.120.007778](https://doi.org/10.1161/CIRCOUTCOMES.120.007778)) was necessary.

The authors contacted the journal to identify the errors that occurred within the article. Specifically:

The authors discovered a statistical coding error in their analytic methods specifically related to the calculation of care team segregation measures in their original article entitled "Provider Care Team Segregation and Operative Mortality Following Coronary Artery Bypass Grafting" in *Circulation: Cardiovascular Quality and Outcomes*. This coding error was first identified by the primary analyst on the original article when applying this same measure to follow-up work. The formula that appears in the Methods is correct; however, the statistical code that was made publicly available by the author team at the time of their publication in May 2021 was incorrectly written (<https://github.com/bnallamo/Hollingsworth-Circ-CQO-2021>). The authors did not receive any notification of this error by an external source.

Overall, the key change is that the correction results in less provider care team segregation observed within the hospitals under study, with the median moving from 0.89 to 0.49 (see the corrected Figure 1). This is a more modest level than originally reported. In terms of the association between mortality rate and segregation, while the predicted mortality rate for Black patients still increases as the segregation increases, the predicted mortality rate for Black patients at high segregation hospitals has decreased. In addition, the predicted mortality rate for White patients now decreases as segregation increases. Instead of observing significant differences between low and high segregation hospitals for Black patients, the corrected analysis demonstrates significant differences between low and high segregation hospitals for White patients. These new analyses point toward a more complex association between provider care team segregation and outcomes, which is reflected in the

revised article. The authors summarize these changes below and also provide highlighted changes between the original and revised articles for readers.

The Introduction and Methods for the revised article are largely unchanged.

Correction of the error, however, led to numerous changes in the Results and key changes in the Discussion. Overall, the new analyses led to new bivariate comparisons in Table 1, updated numbers in Table 2, revised Figures 1, 2, and 3, and a new Table S3. The Abstract has also been updated to reflect these changes in its text for Results and its Conclusion. These are summarized below.

At the patient level, the corrected Table 1 shows that there is no longer a significant difference in gender for patients treated at hospitals with low, medium, and high levels of segregation, and that patients treated at hospitals with high segregation are now less likely to be poor ($p < 0.01$). At the hospital level, there is no longer a significant difference in the number of beneficiaries a hospital took care of across segregation levels, however, hospitals with low segregation took care of significantly more Black patients ($p = 0.01$). In terms of the communities served by the hospitals, there are now a significantly higher number of medical specialists per 100,000 residents in communities served by hospitals with high segregation ($p < 0.01$), the total, Black, and Hispanic resident population is now significantly higher among communities served by hospitals with high segregation ($p < 0.01$ for all comparisons), and the proportion of residents living in a rural area is now significantly higher among hospitals with low segregation ($p < 0.01$).

In the corrected Table 2, the authors see consistency in the directionality and clinical significance of associations with mortality for Black patients across several sensitivity analyses, except for in 2 instances: 1) when the authors excluded providers whose care was hypothesized not to influence operative mortality and 2) among patients who died within three days of surgery.

The variability in the level of provider care team segregation across study hospitals is smaller than what was originally published (see the corrected Figure 1). The originally published segregation ranges is (0.78, 0.96), with a median of 0.89 and interquartile range of 0.850–0.904; the corrected segregation ranges in (0.35, 0.65), with a median of 0.49 and interquartile range of 0.439–0.542. The corrected segregation also has a wider range (0.3, as compared to 0.18 in the original paper) and wider interquartile range (0.103, as compared to 0.054 in the original paper).

In Figure 2, the authors also provided an illustrative example of 2 hospitals in Alabama with high vs low provider care team segregation. With the correction of segregation measures, a considerable difference in segregation remains between these two hospitals (0.570 and 0.418). Both the original and the corrected Figure 2 show that in the high segregation hospital there is a larger proportion of providers that have had Black visits only. On the other hand, the corrected display of how Black and White visits are distributed among providers now show more agreement between Black and White visits.

Figure 3 shows adjusted operative mortality rates among Black and White patients by a hospital's level of provider care team segregation. The main change in the predicted mortality rate, after the correction, is that the predicted mortality rate has decreased for Black patients at high segregation hospitals and increased for White patients at low segregation hospitals. While there is still an increasing trend for the predicted mortality rate of Black patients as the segregation level increases (see the corrected Figure 3), the corrected model demonstrates a significant difference in mortality rate between high and low segregation hospitals for White patients, instead of Black patients.

As noted above, these new analyses and findings point toward a more complex association between provider care team segregation and outcomes. To reflect this nuance, the authors' new Conclusion in the abstract now reads: "There are often unique systems of provider care teams, which treat Black patients but do not overlap with those of white patients undergoing CABG. Provider care team differences may contribute to surgical outcome variability between Black and White patients."

The authors regret these errors and appreciate the opportunity to correct the published record. All parts of the article that were affected by the error have been corrected and replaced online. An additional Data Supplement has been added that includes a version that shows the original article and the original Data Supplement marked with the changes that are present in the replacement article.