Reply to the Editor:

We thank the authors for their critique of our study, "Cumulative team experience matters more than individual surgeon experience in cardiac surgery."¹ This study, which analyzed the effect of team experience on operative efficiency, found that the impact of team experience on reductions in cardiopulmonary bypass (CPB) and crossclamp (X-clamp) time far exceeded that of surgeon experience over the course of a career. Given the retrospective nature of this study, our ability to understand the impact and dynamics of each variable is limited. We do believe that there is substantial evidence to show that the impact of cumulative team experience far outweighs that of individual surgeon experience in coronary artery bypass grafting procedures.

In response to the authors' questions, we chose to use CPB and X-clamp times to assess the attending surgeon and team learning curve for several reasons. First, operative time (or, in this case, CPB and X-clamp times) provide an effective and highly granular means to assess changes in performance. Although we agree that clinical outcomes lend themselves to a higher impact assessment, these analyses are limited by several issues, including relatively low incidences (of adverse clinical outcomes) and confounding clinical factors (ie, patient acuity and comorbidities) that are difficult to control for in a series with an average of 10 cases per unique pair of attending surgeon/fellow. In addition, in contrast to other learning curve studies that also use operative time as the dependent variable, CPB

and X-clamp times have a well-established and direct correlation with clinical outcomes. In summary, by choosing these variables, we were able to maximize statistical power while maintaining relevance to clinical outcomes.

Recognizing that controlling for patient anatomy and patient acuity/clinical status is critical in assessing the true association by eliminating "the noise," we took great care in developing a multivariate model that allowed us to control for all factors independently associated with CPB and X-clamp time. Simply, this model design allowed us to control for all clinical and technical factors associated with our dependent variables of interest, thereby paving the way to determine the true association between cumulative experience, surgeon experience, and CPB/X-clamp times.

Although it is plausible that speed could be inversely related to outcomes, this finding tends to occur in extreme circumstances and is not applicable to our cohort of attending surgeons. In fact, we performed preliminary comparative analyses on the clinical outcomes by surgeon included in our study (mortality and postoperative complications, as captured by the Society of Thoracic Surgeons database) and found no significant statistical difference. Thus, although that author's assertion that increasing speed and efficiency may be detrimental to patient outcomes, this is merely a theoretical claim that simply does not apply to this study.

Finally, the authors claim that the lack of correlation between attending

experience and operative efficiency is more likely to indicate that attending surgeons become even "more proficient during the course of their career by, teaching more, achieving excellent technical and clinical outcomes despite increasingly challenging cases." We fundamentally disagree with this assertion because it lacks no factual backing. Although it is impossible to measure the amount of teaching or the extent to which a fellow operates independently, the fact remains that when controlling for all other clinical factors (including technical complexity), the time it takes to perform the critical portion of an operation by the same attending and fellow decreases with each subsequent case at a rate that far surpasses each additional year of attending surgeon experience. We simply did not find any evidence that there was increased teaching over the course of an attending surgeon's career, nor were cases more technically complex given that we were specifically controlling for case mix complexity in the analysis.

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Reference

1. ElBardissi AW, Duclos A, Rawn JD, Orgill DP, Carty MJ. Cumulative team experience matters more than individual surgeon experience in cardiac surgery. *J Thorac Cardiovasc Surg.* 2013;145:328-33.

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