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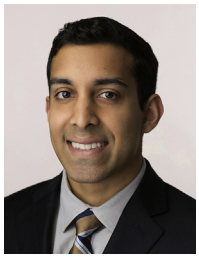
**Key Words:** education, cardiothoracic surgery residents, volume, case logs, ACGME

ADULT

## Discussion



**Mr Aakash M. Shah** (*Newark, NJ*)

**Dr Joseph A. Dearani** (*Rochester, Minn*). Thank you, Dr Keshavjee, and the AATS Committee for the invitation to participate in what has been a great Leadership and Scholarship session so far, and to discuss this important paper. I don't have any disclosures. Congratulations to you, Aakash. I hope you are strongly considering a career in cardiac surgery. Thank you for this crisp and clear presentation on a timely topic of cardiothoracic surgery education. CT surgery education has evolved dramatically in recent years to incorporate a different landscape of operative procedures that residents are involved with, as well as different educational tools that have been implemented, such as simulation.

This has also occurred in parallel with the introduction of more advanced fellowship training programs. So the discussion of resident case volumes relative to the changing backdrop of the specialty is very timely and appropriate. I appreciate receiving the slides in advance but have not yet had the opportunity to read the manuscript. So my comments will reflect the slide presentation.

Strengths of your review include an analysis of a contemporary cycle of the most recent 4 years of the traditional cardiothoracic surgery training programs. Robust numbers are present. However, they reflect really just the general categories of procedures, as opposed to specific procedures, for example, TAVR versus open aortic valve replacement.

One of the most important findings in this review is the declining number of coronary bypass grafting procedures. This is particularly important, since the STS database still documents coronary bypass grafting as the most frequent cardiovascular procedure still being performed in the United States, in the face of declining numbers nationally. And despite the reduction in the coronary bypass grafting volume, adult cardiac surgery case numbers continue to

be strong, with an overall increase in volume.

One of the most significant limitations that you refer to is the lack of the I6 numbers, which is growing in popularity for the training pathway. I appreciate the sophisticated statistics, but I will confess it is challenging to follow regression coefficients and $R^2$ values in the absence of absolute numbers of specific procedures to use as a reference point. Importantly, specific procedures such as aortic valve replacement, mitral valve repair, mitral valve replacement, etc, as opposed to just looking at general numbers in a "valve category"—residents submit absolute numbers of specific cases, and this is what is monitored to help us determine competency and to direct changes or modifications in a program. So I hope and would suggest that this type of case granularity could be available for the paper so that strategies for improvement could be applied.

I have 3 questions. Traditional programs that you have examined are either 2 or 3 years. Could you clarify if these overall numbers in these general categories are stratified by a given year of training or the total length of the program? And if it's a total length of the program, is it 2- or 3-year programs, or both? Obviously through your programs, we'll have larger numbers. This requires some clarification.

**Mr Shah.** First, I'd like to say thank you Dr Keshavjee and Dr Dearani for the kind remarks. And Dr Dearani, I appreciate your thorough analysis of the work, and I do agree that the manuscript, which we will be submitting soon, certainly needs to expanded on a little bit more. But for the sake of the presentation and the overall picture, the idea was just to look at the changing volume and the landscape.

To answer your question, this does include second- and third-year programs. That does mean that there would be a group of residents that would bring the mean a little bit higher. However, this is just looking at overall graduating cardiothoracic residents.

**Dr Dearani.** The second question would revolve around the types of cases that counted for the overall increase in cardiac numbers. This is important to understand; there should be some specifics as opposed to just the general categories—for example, "endovascular" alone is not specific enough. That, I think, would be really helpful to know where we're gaining numbers in cases; this will help the profile of a given resident in terms of whether rotations and particular procedures they need exposure to need to be modified along the way of their training pathway.

**Mr Shah.** I agree. Particularly for the endovascular procedures, the ACGME case log only reported "endovascular." However, for the other categories, they are much more detailed and itemized. This is certainly data that we will contact the organization for and see if there's a way of getting more numbers. However, from the available data that they have reported, particularly for the endovascular category, it isn't itemized, and unfortunately there is no more detail than we provided.

I'd also like to make a statement about the linear regression. The reason we chose to analyze the data with linear regressions instead of just taking the start and end and subtracting the two, was because it adds a little bit more information about the continuity and the consistency of the change. So, as you saw for the coronary atherosclerotic procedures, that line was relatively straight—versus the valvular heart procedures had more variable averages, as there was a year where it declined and then the next year it increased. The linear regression takes into consideration the nuances and variations within the data points of those 4 years.

**Dr Dearani.** Fair enough. It's just that the coefficients will mean more to somebody like you in a few years when you're in your residency and we're trying to figure out whether it's 30 coronary bypass procedures or 50. That's where it becomes practical.

For my final question: With the data that you now have, even having the privilege of having maybe some more specific data that you couldn't share in the presentation, what recommendations would you make now to the ABTS based on the findings in terms of case numbers? Is there something specific that we should be looking at, or should we be making modifications to programs in the in the foreseeable future? All of this is changing very quickly.

**Mr Shah.** Thank you for that question. If we believe that the extent of the volume increase hasn't been enough to be optimistic, I have 2 points regarding this. The first point is that we believe that volume is a proxy for resident education. But the real thing that we're looking at is quality. So even as these case numbers increase or decrease, as long as residency programs maintain the quality of the operative experience, residents will continue to have excellent training. Several techniques that residency programs have used have been simulation training sessions and expanding on the education/research component of resident training. These techniques will enhance resident exposure to cardiac techniques without patient interaction, and although they don't replace operative experience, they may supplement and strengthen the operative experience. Maybe the ABTS should continue to expand on residency and fellowships by necessitating competency in techniques in simulation labs.

And the second thing is that I think that we should really be driven by the data. I think that certain trials have shown that in certain patient populations, there is a need for more endovascular procedures. It's still a surgical procedure. CT residents and CT attendings should still be involved in those procedures; they're not easy procedures and it may require opening and other nuanced techniques that a trained CT resident or attending would be able to help with and do. Therefore, the ABTS should continue to require training in endovascular procedures, and CT surgeons must learn to be proficient in performing these procedures early.

Also, CT surgeons must get early exposure in minimally invasive techniques to become more skilled in these

procedures. These procedures will likely be more commonplace in the future, and although fellows may need addition training, early exposure will make them more confident and skilled at performing their procedures earlier in their careers. In the future, as stronger data for minimally invasive techniques are generated, the ABTS can make minimally techniques a requirement for CTS training.

However, I really think that the volume is increasing, and that's a great sign. Overall, cardiac disease is a disease of the aging population. As there an increase in the aging population, we will always have cardiac cases, and it seems that will increase over the next few years. So in terms of volume, there really isn't too much to worry about. However, we also do have to continue to focus on supplementary training sessions and on endovascular and minimally invasive techniques, as they may be very beneficial for future CT residents as they enter the field.

**Dr Dearani.** Thank you. I would encourage some of the other panelists to comment, particularly those that are involved in training programs, because this obviously is a very important topic. I'm not sure that we should rest on our laurels and think that we're okay because the cardiac numbers are increasing; we really need to see exactly what they are, and it needs to be stratified by procedure, because if many of them are endovascular or transcatheter procedures, it's going to be at the at the expense of open procedures, so I don't think that we should feel overly comfortable or confident that we're looking good right now. I think looking at the absolute numbers will help guide us moving forward.

**Dr Todd K. Rosengart** (*Houston, Tex*). I think the challenge of going from open cases to interventional or noninvasive, minimally invasive, is one that's true across all the surgical specialties, and it's a real challenge—if you think of Malcolm Gladwell's rule of 10,000 hours or the like. So one suggestion might be to look at the ACGME surveys (at a minimum) that will tell us some information about graduating residents' confidence level. We believe that they've been adequately trained, but it would provide some insight in terms of whether the residents feel they've been adequately exposed to a number of cases. We frequently discuss simulation training, but I think many of us would feel that is, unfortunately, an inadequate substitute for the actual operative experience, at least at current standards of technology.

**Mr Shah.** I thank you for that comment. And I think that's certainly an important avenue to focus on. As mentioned before, the volume was associated with increasing confidence and competency in general. So if we see that fellows are still confident and prepared for their jobs after fellowships, that would certainly be good news for CTS programs. It would also help determine the overall performance of CTS fellowship programs.

**Dr Shaf Keshavjee** (*Toronto, Canada*). Getting back to a comment Dr Dearani made, Aakash, would you have the data to divide the number of years spent in cardiothoracic training, the number of cases—sort of looking at the difference between the 2-year and 3-year programs? And it might even be an interesting metric and the I6 programs to see cardiothoracic cases performed as the resident progresses through the training.

**Mr Shah**. Certainly. Thank you, Dr Keshavjee. I unfortunately don't have the breakdown between the second-year and third-year residents. However, now that you guys have mentioned it, it's certainly an important thing we will look at in the manuscript and expand on a little bit more. I do have some additional slides about the integrated programs. They're not looking at the specific numbers, but they look at the number of residents and how they've increased over the last 5 years. If you guys would like to look at those numbers, I can certainly present that, but as mentioned, the integrated data was not released by the ACGME and we needed other approval to acquire that data.

**Dr Keshavjee.** I would leave that for your discussion with the journal in terms of what should be included. I think it would enhance the paper to have some of those other factors in; as Dr Dearani said, we really have to pay close attention to it and just looking at the numbers may falsely reassure us as to what actually is going on, because there are some programs where residents just hang around longer until they can get cases done. And I don't know if that's lost in the data.

**Mr Shah.** Certainly. We will look at that for sure.