thoughts into the equation. Your study are actually provocative in supporting something we have started doing more and more frequently, and this is an elegant using the National Inpatient Sample. This is something that we congratulate Dr Kilic and his coauthors on an important study.

Discussion

Dr T. Bruce Ferguson (Greenville, NC). I would like to congratulate Dr Kilic and his coauthors on an important study using the National Inpatient Sample. This is something that we have started doing more and more frequently, and this is an elegant analysis using that rich data resource. As well, the findings of your study are actually provocative in supporting something we have suspected for some time, while also introducing some new thoughts into the equation.

You indicated in your paper and in the presentation that 30% of the overall variability in cost is driven by the nature of the environment in which the services are delivered. You conclude that the variability, by any criteria, is excessively high. This is a health policy issue that CMS would look at and say variability is bad, and we need to figure out why.

The other part of your interesting data, however, focused on in-hospital issues related to mortality, including sepsis and some things we normally would not think of as necessarily driving health care costs in coronary bypass surgery. It is not surprising to me that the VAD patients and the ECMO patients generated the highest costs, but, fortunately, they occur infrequently.

So, I have 2 questions for you, 1 in each area. At the health policy level, if we as stewards of our specialty can look and see that there is this huge variability in the cost of coronary bypass surgery across this sampling of hospitals across the country, what can we do at the specialty level that would generate information at the health policy level that would reduce that level of the variation and excess in health care costs?

And the second question is, in terms of the in-hospital mortality and the single greatest cause of morbidity, which is sepsis, what could we do at the local level to be able to drive those costs down? Can we fix sepsis by putting central lines in safely and preventing pneumonia and doing MRSA screening and so forth? Do we really think about reducing health care costs when we do these things? And is there a point at which we say to a patient who is going to die and their family, I am sorry, we cannot really do anything else? Particularly when this occurs so infrequently?

Your study is provocative in raising these 2 important issues.
Dr Ferguson. One of the implications of your data and study in the health care environment, which is evolving in the United States, is that providers are only going to get paid for better quality care and lower-cost care. So, addressing both of those issues is going to become important if we are going to reduce the 30% variability across the providers; the alternative is that there will be many fewer places doing coronary bypass surgery.

Nice paper, and my congratulations to the authors.

Dr Kilic. Thank you.

Dr George Magovern (Pittsburgh, Pa). Would you further define how you determined cost? Is cost a function of the charges that a hospital agrees to or are they actual costs of the procedure?

Dr Kilic. Thank you for that question. The Nationwide Inpatient Sample will actually provide the charges in the data set, and the AHRQ has specific cost-to-charge ratios that they develop for each individual hospital. So, utilizing that ratio, we are able to derive actual costs, which we believe are a better reflection of actual resource utilization versus the charges, which can affect payer policies and other things not related to resource utilization.

Dr Magovern. My second question is that as you decrease the cost and increase the efficiency of coronary bypass surgery and move it out into smaller hospitals, you also then make it more difficult to innovate or improve upon an operation. Specifically, how will small-volume centers learn to do off-pump coronary surgery or robotic coronary procedures?

In conclusion, most operative procedures evolve over time. Thus, surgeons need to find a balance between lowering costs and decreasing variability on one hand and improving outcomes with improvements in the operation with minimally invasive techniques, robotics, etc.

Dr Kilic. That is an excellent point.

Dr Claudio Muneretto (Brescia, Italy). I congratulate the authors for a nice paper. I did not find atrial fibrillation as a risk factor for increasing cost. Many previous studies demonstrate that atrial fibrillation made longer the stay in the hospital, made higher the consultant cost for several physicians, and, in addition, increases significantly stroke rate, renal failure, and low cardiac syndrome. Could you comment on that?

Dr Kilic. That is a great question regarding atrial fibrillation and why that was not depicted as a predictor of cost. We actually did not include the individual diagnostic comorbidities in the mixed-effect linear regression model. Instead, what we utilized was the Charlson comorbidity score, which is a cumulative score that incorporates all those comorbidities into one index. But, I think it may be a good point to go and look back at the specific comorbidities and see which ones tend to be the drivers of cost.

Dr A. Pieter Kappetein (Rotterdam, The Netherlands). Thank you much. Excellent paper. My question is also related to the previous issue. Why did you use the Charlson comorbidity index and not, for example, the STS score? Are there certain advantages or disadvantages to one of these scores?

Dr Kilic. Ideally, we would like to use something like the STS score. Unfortunately, many of those variables that are in the STS CABG risk model are not available in the NIS registry. So, it would just simply be a limitation of the database. But, again, I do think it would be worth going back and looking at the specific comorbidities and see if there are individual ones that seem to drive costs more than the others.