Authors have nothing to disclose with regard to commercial support.

PROGRESS COMES IN SMALL STEPS

To the Editor:

We appreciate the commentary by Drs Hui and Lee¹ regarding our work using 3-dimensional printing technology in hypertrophic cardiomyopathy. We recognize the myriad limitations of this work starting with the n of 2. The article presented what can be classified only as “pilot data,” yet is, at the very least, a unique application of a rapidly emerging medical technology.²

We acknowledge that the term “interactive model” could be considered a misnomer. At the same time, this model is not purely static and provides the user valuable information, such as volume resected and septal morphology after resection. The concept that a 3-dimensional printed model somehow could provide hemodynamic data requires multiple technologic leaps yet to be accomplished. Agreeably, we have not yet used the resected model volumes to influence behavior in the operating room because we thought clinical decisions made at the sharp end of a scalpel should not be based on an $n = 2$. This has been clearly acknowledged in the article.

Our use of the term “disruptive technology” also may be imperfect. However, despite the prediction of a bear market by Drs Hui and Lee,¹ disruptive technologies often are viewed in this manner at the outset, because their development and profitability detract from maintenance of the status quo. We would counter that if a policy of referral to a centralized ultraspecialized surgeon were applied true to fact, it could result in limiting the number of practicing surgeons equal to the number of described operations. Although a small minority of patients are able to canvas the country for specialized care, most patients choose to undergo treatment close to home for a variety of reasons. This disruptive technology may allow for increasingly competent surgeons to be available for the majority of patients.

Finally, as we train the next generation of surgeons, tools and technology that can help us teach and more realistically simulate real operations may have important benefits, which we are just beginning to realize. We believe that this model may bring us one step closer to that goal.

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OF BUZZWORDS AND BUZZKILLS

Reply to the Editor:

Dr Hermesen is correct that disruptive technologies are often viewed with skepticism at the outset; it is in fact one of the cardinal features.¹ We fully believe that innovation and technology that improve patient care and outcomes should be embraced, and we commend Dr Hermesen and his colleagues for their work in this realm. However, the classification of 3-dimensional (3D) printing as “disruptive technology” a priori (ie, based on limited pilot data) is premature. Further, what their original manuscript proposed are in fact disruptive practices. The clinical application of nascent technologies should be viewed with circumspection. To extend such practices to the armamentarium of the routine surgeon for highly complex cases is more than several steps beyond what the authors have achieved thus far. We echo Dr Christensen’s opinion that, as of late, the term “disruptive innovation” has been misunderstood and loosely used (Figure 1),¹ and that “different types of innovations require different strategic approaches.”² Although 3D printing may ultimately prove useful in straightforward and more commonly performed operations, the concept that a rarely performed operation

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THE UBIQUITOUS “DISRUPTIVE INNOVATION”

“Disruptive innovation” and “disruptive technology” are now part of the popular business lexicon, as suggested by the dramatic growth in the number of articles using those phrases in recent years.

FIGURE 1. Factiva analysis of a wide variety of English-language publications. (Reprinted with permission from Christensen CM, Raynor ME, McDonald R. What is disruptive innovation? *Harvard Bus Rev.* 2015;93:44-53. Copyright ©2015 by Harvard Business Publishing.)

can be more broadly dispersed through unproven technology runs counter to the current prevailing philosophy that complex operations are best achieved at high-volume centers with a legacy of experienced surgeons. It is changes to this strategic approach that need to be evaluated.

Our commentary was not intended to be a buzzkill, nor to maintain the status quo for its own sake, but a sobering reminder that innovation, when applied with insufficient evidence, can have harmful consequences. The ongoing conversation about innovation, safety, and efficacy is a complex one, of which there are many stakeholders.³ From the 30,000-foot view, pilot data of $n = 2$ are not yet proof of an aircraft ready to take off.

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