Noninvasive imaging has become a cornerstone of the practice of cardiovascular medicine. When properly applied, the information obtained from cardiac imaging studies, integrated with overall clinical assessment, can be used to diagnose disease, determine its functional and physiological impact, assess prognosis, and guide therapeutic decisions. The last 2 decades have seen enormous growth in all medical imaging procedures.\(^1\) A major component of this increased utilization was in stress nuclear myocardial perfusion imaging (MPI) single-photon emission-computed tomography (SPECT), which has become one of the most commonly used and effective methods to assess patients with known or suspected coronary artery disease. The reasons for this growth have been, and will continue to be, debated for some time. On the more “positive” side, this growth may have been stimulated by a substantial body of research demonstrating the utility of MPI in a wide variety of clinical scenarios. Moreover, advancements in imaging technology and improved access to care may have been contributory. On the “negative” side, some argue that the growth in imaging has been fueled by misguided financial incentives and the practice of “defensive” medicine. One fact, however, is indisputable: Imaging accounts for a large amount of overall healthcare expenditures, and despite the potential for imaging to reduce downstream costs, control of this escalating cost has become central to public healthcare policy. Accordingly, constraint of this growth of cardiac imaging has become a major effort of the government, medical insurers, and professional societies. What is the best method for controlling the proliferation of cardiac imaging, and how should these methods be used to effect change in physician behavior?\(^2\)

In this issue of Circulation, Gibbons and colleagues\(^3\) report on their experience in the implementation of one such methodology, the appropriate use criteria (AUC) for SPECT MPI, in an effort to reduce the number of inappropriate studies performed at Mayo Clinic. The implementation of the AUC consisted of a series of educational interventions (lectures, meetings, and printed materials) focused on gaps in knowledge that were determined by application of the AUC at a baseline time point. The authors then reassessed the rates of appropriate, uncertain, and inappropriate studies after the educational intervention and compared these rates with those that had been reported previously from the same institution several years earlier. They found no effect of this educational intervention on the rate of inappropriate SPECT MPI studies at this single large, tertiary care medical center. This study highlights the complexities associated with quality improvement initiatives aimed at changing physician behavior.

The foundation of all such initiatives is development of consensus documents aimed at guiding medical practice and establishing benchmarks of performance. The AUC for SPECT MPI, which were developed by the American College of Cardiology with input from other professional organizations, represent a major step forward in developing tools that can be used to improve quality.\(^1,3\) The first AUC developed for SPECT MPI, published in 2005, was intended to guide physicians in selecting the appropriate test for the most common clinical scenarios.\(^3\) As a potential performance measure, the American College of Cardiology’s AUC meet most of the key features outlined by the Institute of Medicine for such measures: “purposeful, comprehensive, efficient, and transparent.”\(^5\)

Since the initial development of clinical guidelines in medicine, and now with the more recent development of the AUC, the real challenge is the development of effective methods for their implementation. Early in the era of the development of consensus documents to improve the quality of healthcare, it was observed that development of the documents alone had little effect on changing physician behavior.\(^6\) The reasons for failure were varied, ranging from the influence of confounding nonscientific factors (eg, systematic factors that may affect clinical practice) to selection of inappropriate targets (eg, when compliance is already so high at baseline that improvement would be difficult to detect). After a comprehensive analysis of some of the first National Institutes of Health–sponsored consensus panel recommendations, Kosecoff et al\(^6\) concluded that unless the guideline is “coupled with follow-up programs that help translate the message into local or individual action and with monitoring to determine appropriate change is occurring, its impact will be limited.” Thus, it would not be expected that the mere development and publication of the AUC alone would result in measureable improvements in physician performance.

The next relevant question is, what are effective methods to affect physician behavior and improve compliance to guidelines? Continuing medical education activities, which became a routine requisite for physician licensure and credentialing,
were the subject of several extensive systematic analyses of published research between 1975 and 1999.7–9 It is astounding-ingly clear from these analyses that methods that most of us would describe as traditional in continuing medical education activities, such as didactic conferences or printed materials, are utterly ineffective in changing physician behavior or performance. Although these educational activities may affect physician attitude or knowledge, the studies suggest that in order for education to affect behavior, it must be active rather than passive, centered on the individual, relevant to the learner’s knowledge gaps, engaging, and reinforcing.8 More recent studies, performed at major academic medical centers, continue to demonstrate the relative lack of efficacy of rather simple educational interventions.10,11 A study by Sclafani and colleagues11 is particularly illustrative. In this study, a didac-tic intervention that included lectures and printed material was performed at an academic military institution targeted to achieve a reduction in neuroimaging studies in patients presenting with syncope.11 Despite the fact that the baseline data indicated that neuroimaging studies had a diagnostic yield of only 2%, the didactic intervention failed to produce a reduction in the rate of utilization. The authors concluded that local hospital education alone is not sufficient to effect change. A consistent finding in the literature, then, is that simple educational approaches that use conferences and passive learning methods are not effective in altering provider behavior.

Luckily, the literature also provides us with important clues as to some key elements needed to optimize educational efforts to change provider behavior. An extensive review by the Agency for Healthcare Research and Quality, a branch of the US Department of Health and Human Services, indicated that the number of studies in this area is large, but the studies are quite heterogeneous with regard to outcomes measures (eg, knowledge, attitude, behavior), control groups, and methods of intervention.12 Nonetheless, a number of consistent observations regarding key aspects of successful programs that are targeted to changing physician behavior emerge based on this and other extensive reviews.7,8,12–14 First, multifaceted or multimedia approaches work better than single-format approaches. Second, interactive approaches such as case discussions, practice sessions, role playing, and didactic activities that permit peer discussion and case-based learning are preferred over passive forms of learning. Third, sequential or longitudinal efforts are more successful than interventions that occur at a single point in time. Educational interventions that are single-time interventions, even if multi-faceted, may have positive effects, but these effects may disappear over time.15 Fourth, an intervention that includes techniques that reinforce the targeted behavior, such as reminders, audits, or periodic feedback, is more effective. In particular, ongoing personalized feedback appears to be an effective way to maximize the chances of making a lasting impact.10 Finally, “enabling” strategies, which sometimes involve modification to the system of healthcare delivery, may help to facilitate implementation in the clinical practice setting.

An example of an initiative focused on improving quality of care that used many of the above principles is the “Guidelines Applied in Practice” (GAP) project, which was developed by the American College of Cardiology in partnership with the American Heart Association. The focus of the initial project was to improve adherence to guidelines for treatment of acute myocardial infarction in the Michigan area.16 The multifaceted intervention included live presentations, creation of a GAP “tool kit” based on the American College of Cardiology/American Heart Association guide-lines, involvement of local opinion leaders, and repeated measures of quality indicators. The GAP tool kit was intended to facilitate implementation of guidelines and included aids such as standard order sheets, pocket cards, and performance charts. The study demonstrated a modest but significant positive effect of the intervention on several quality indicators. Several lessons were learned from this study. First, quality improvement is best achieved by systematic approaches with multiple targets. Next, the development of specific tools aimed at key points in the process is particularly helpful. Building partnerships with local thought leaders was an essential component of the project. Finally, control groups were important in such studies; the control group hospitals in this study also demonstrated improvement in several parameters over the same period, albeit usually not to the same degree as the study group hospitals. This likely represents efforts of professional societies to disseminate the guidelines, as well as local hospital efforts to improve quality of care locally. Thus, focused projects such as the GAP initiative, although much more complex than what we may be used to in medical education, are feasible to implement and may be successful in improving quality of care. Recent development of a new initiative by the American College of Cardiology, the “Imaging in FOCUS” project, which consists of easy-to-use AUC assessment tools and online education, may provide additional tools for us to move quality initiatives in imaging forward by facilitating the implementation of AUC.

There may be a number of reasons why the study by Gibbons et al12 did not result in a positive effect on the rate of inappropriate SPECT MPI studies. The baseline rate of inappropriate studies was only 7%, and this was measured approximately 15 months before the intervention. Although there is variation among institutions, data suggest that the rate of inappropriate studies at major hospitals is approximately 13% to 14%,16,17 Improving on a baseline inappropriate rate of 7% with a relatively simple educational intervention is unlikely. Also, the time period between the intervention and assessment was quite short, and may not have permitted the change in culture needed to effect the change. Finally, relatively few of the components necessary for successful educational interventions were used. A multimedia approach was used. Although some of the meetings with clinic directors or clinical departments may have been interactive in part, it is unclear whether these interactions used case-based approaches, or whether the groups were small enough to encourage robust interaction. The intervention did not include sequential/longitudinal components, used no reinforcing tech-niques, and did not involve enabling strategies such as use of tools to assist in implementation. Thus, this study adds to the existing data that indicate that relatively simple educational interventions are not likely to change provider behavior. The
authors conclude appropriately that additional measures will likely be needed to implement the AUC to their full potential.

What are the next steps for the cardiology community to ensure the appropriate application of cardiac imaging in clinical practice, for the many reasons that this goal is … well, appropriate? Although the AUC are a major step forward in promoting quality improvement in cardiac imaging, additional research is needed to utilize them to their full potential. At present, the AUC are used to provide the most basic measure of provider quality: percent compliance. Institutions or providers can be assessed for the percentage of studies performed or ordered that fall within the various AUC categories; this approach assumes that the smallest number of “inappropriate” studies is good.

Although this information is useful, the development of more complex measures of quality using AUC is warranted. Since their inception, it has never been envisioned that an inappropriate rate of 0% is a “best practice.” The initial AUC for nuclear cardiac imaging stated, “the rating of an indication as inappropriate should not preclude a provider from performing nuclear cardiology procedures when there are patient- and condition-specific data to support that decision.” Moving beyond mere “percent compliance” measures to patient- and condition-specific data to support that decision is good. It is in this arena that the study by Gibbons et al has enhanced our understanding of the development of effective quality improvement initiatives by demonstrating the ineffectiveness of a rather simple physician education approach.

Educational interventions should be multifaceted, buoyed by the enhancements described above, to maximize and maintain their impact. Education is not dead; like everything else, it’s just a little more complicated than it used to be.

Disclosures
Dr Arrighi is a member of the speakers’ bureau for Astellas Pharma.

References

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Educational Initiatives for Quality Improvement Projects: Can You Teach an Old Dog New Tricks?
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