contains over 1,200 reports since January 1995 and again approximately 90% of these were self-reported by the anesthesiologists.

We agree with Cooper that at least two steps are necessary for effective self-reporting: (1) demonstrate the value of reporting, and (2) change the culture that attributes error to negligence.[2] W. Edwards Deming, an industrial quality manager, published these ideas over a decade ago.[4] At our institution, adverse outcomes are analyzed by a structured peer review process and statistical process control is applied to the adverse outcomes as a measure of the quality of our perioperative care. The outcomes data is also used by members of the department for clinical investigations which are considered part of our quality management program and have resulted in improved care. This leads us to further disagree with Cooper who writes that "the benefit to patient care of anesthesia QA systems has not been established rigorously. . . ."[2] In fact, several authors have demonstrated the benefit of quality management programs to perioperative patient care.[5-7]

The difference between our experience and that of Sanborn may lie in the nature of the quality management programs. Our peer review process looks at errors in the system as critically as we look at human errors. Thus, peer review is less threatening thereby encouraging anesthesiologists to share the responsibility with management for delivering quality health care. This does not appear to be one of the objectives of the quality management program described by Sanborn which excluded incidents detected by his automated record if they were part of the system's limitations (*e.g.*, the patient's clinical condition or other factors necessitating acceptance of deviations in physiologic variables).[1] In our experience, system errors account for the vast majority of all adverse outcomes. Because human error contributes only a small portion to adverse outcomes (5–15%), programs which focus QA measures on human error to the exclusion of system error may misdirect resources.

In summary, we have published evidence that demonstrates reliable self-reporting of adverse outcomes originating from active participation in a nonthreatening quality management program. Our results show that such a system functions best when dependent upon self-reporting by anesthesiologists.

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In Reply:—Dr. Lagasse's correspondence begins by stating that Sanborn *et al.*[1] "suggests that automated anesthesia records can identify, track and report deviations from specific limits for physiologic variables and that this might be preferable to self-reporting of adverse events." He disagrees, and supports his disagreement by reference to his own data, based on review of hand-kept records, which have been demonstrated to be notoriously unreliable.[2,3]

In fact, we demonstrated that automated anesthesia records can identify, track and report deviations from specific limits for physiologic variables but we never stated that this might be preferable to self-reporting of adverse events. We do not dispute that voluntary self-reporting of intraoperative incidents is the centerpiece of QI programs in anesthesia. Indeed, in order to emphasize that electronic detection of intraoperative incidents is only useful for a limited set of patient variables, we stated that

"While events such as cardiac arrhythmias, repeated attempts at intubation, mechanical failures, nerve injury, intraoperative awareness, failed regional block, bronchospasm, vomiting and many others may all be important to patient outcome, they are not readily detectable by electronic scanning of an AAR (automated anesthesia record) database." (page 984)

Our scientific goals were clearly stated in the introduction. The purpose of our report was not to evaluate our QI program, or to compare it to Dr. Lagasse's QI program. Misunderstanding this, Dr. Lagasse presents readers with a comparison of his QI program, based on outcome measures and dependent upon hand-kept records, versus our study of selected process measures, us-

ing automated records. However important outcome is to QI, analysis of process measures is required by JCAHO.*

We appreciate Dr. Lagasse's enthusiasm for better QI, and we agree with his opinions about the importance of voluntary reporting. However, we cannot share his faith in QI systems which place the total burden of recording and reporting on us imperfect humans.

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In Reply: — Dr. Lagasse makes an excellent point in reminding us of the quality control program he described in ANESTHESIOLOGY.[1] His department seems to have created the kind of atmosphere that is required to encourage honest reporting of critical events and has correctly focused on the system problems that account for most adverse outcomes. Unfortunately, one apparently good QI system does not speak for the universe of anesthesia groups nor for those in other disciplines. I suppose we have an argument that cannot be settled by the available data. I maintain, from my reading of the literature and subjective interpretation of anecdotes told to me by many practitioners, that the system Dr. Lagasse describes is the exception to the rule. Rather, an inference from Sanborn *et al.*[2] and similar in principle to some accounts of medication-error reporting,[3,4] more likely represents the reporting in most departments — incomplete and only slightly useful for improving the quality of care.

Perhaps Dr. Lagasse' s disagreement with the statement ". . . the benefit to patient care of anesthesia QA systems has not been rigorously established" rests in the interpretation of the word "rigorous" in this context. None of the studies he cites provides evidence of the cost benefit or substantive improvement in anesthesia related outcomes.[5–7] Only one actually measured benefits and it concluded that the financial savings were greater than the expense to achieve that result.[6] After searching the literature for evidence of the cost effectiveness of QA programs, the authors of that study concluded that the paucity of information is disturbing.[8] In Dr. Lagasse's study, no example is given to illustrate that their program improved care or reduced the rate of common-cause or special-cause events. The absence of measurable, substantive cost and quality benefits is but one of the factors hindering the development and implementation of effective QI or QA programs (Other reasons were discussed in the editorial). An effective program must be based on open, honest reporting of the circumstances of adverse events. I strongly believe that is the right thing to do even in the absence of rigorous experimental proof.

It would be useful to know more about compliance and quality of event reporting and about the utility of quality improvement as implemented by anesthesia practice groups. If this could be studied, I suspect the result will indicate that most programs are not highly effective; I'd be pleased to be proven wrong. But, it will be difficult if not impossible to measure the benefits of adverse event reporting using conventional statistical approaches. Because catastrophic events are rare, statistical significance has a chance of being achieved only for measures of changes in surrogates of the important outcomes. Perhaps qualitative research methods will be more effective for extracting the information needed to convince people that quality improvement programs can work.

As I mentioned in the editorial, I do believe that reporting systems should continue to operate because they identify some problems that can be corrected. But, we have a long way to go before our quality systems routinely reveal those important details of critical events that will lead to design of effective methods to prevent system and human errors.

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