The June 1996 article in Anesthesia and Analgesia by Abenstein and Warner entitled "Anesthesia Providers, Patient Outcomes, and Costs" presents important information about anesthesia services, but it contains a number of errors and questionable interpretations that could lead to inappropriate programs and policies. Among the most important points of fact we clarify in our paper are:

1. Three organizations that accredit, certify, and govern nurse anesthetists are organized in similar fashion to three comparable bodies governing anesthesiologists. There is no justification for the implication that the AANA somehow controls the accreditation and certification of CRNAs.

2. The conclusion that anesthesiologist-led care teams are the preferred model for all anesthesia services and settings because of improved patient outcomes is overly simplistic and is not borne out in the literature.

3. The attribution of reduced mortality from anesthesia over the past 40 years to the increase in numbers of anesthesiologists is not justified. Many other factors, including new anesthetic agents and improved patient monitoring, also are important.

4. The use of a hypothetical example related to Medicare reimbursement in New York to justify the implication that CRNA-delivered services are more costly than anesthesiologist-delivered services is misleading and not borne out in the literature.

We hope that planners and policy makers will read the article by Abenstein and Warner with extreme caution. Taking some of their statements and conclusions seriously could lead to policies and programs that are not focused in science.

Key words: Anesthesia costs, anesthesia providers, methodology, patient outcomes.

Introduction

The MinnesotaCare Act of 1994 mandated that the Commissioner of Health submit to the Legislature a report on anesthesia services provided in healthcare facilities by physicians and nurse anesthetists. The resulting report, prompted by concerns about the rapid changes in the market for anesthesia services in Minnesota, dealt with a wide range of issues and topics. The report by the Commissioner was based in part on documents submitted by the Minnesota Association of Nurse Anesthetists (MANA) and the Minnesota Society of Anesthesiologists (MSA).

The present paper critiques a recent article in Anesthesia and Analgesia by Abenstein and Warner, which is "an abridged version of the document sub-
mitted by the MSA to the Minnesota Commissioner of Health.46 "Physicians who hold unrestricted medical licenses . . . Anesthesiologists train to be generalist physicians . . . In many ways, anesthesiologists function as primary care physicians . . ." [emphasis ours].46 Anesthesiologists are referred to as "physicians who hold unrestricted medical licenses. . . . Anesthesiologists train to be generalist physicians. . . . In many ways, anesthesiologists function as primary care physicians. . . ." [emphasis ours].46 It is true that language in Medical Practice Acts vary by state, but all are broad, allowing physicians who possess medical licenses wide scope of authority to practice. This scope of authority does not, however, convey an unconditional right to practice without restrictions.

The Accreditation Council for Graduate Medical Education (ACGME) has specific requirements for specialization and certification in practice. The guidelines specify, "Anesthesiology is a discipline within the practice of medicine specializing in the medical management of patients who are rendered unconscious or insensible to pain and emotional stress during surgical, obstetrical, and certain other medical procedures." [emphasis ours]5 Thus, in contemporary society, it would be unacceptable for a physician to practice anesthesiology without first completing a residency in anesthesiology, just as it would be unacceptable for a physician to practice, say, cardiology without appropriate education and training.

Actually, none of this would be particularly important except Abenstein and Warner go on later to make the case that one reason anesthesiologists are "bargains" is because they do not need to consult with cardiologists or other specialists, as do CRNAs.46 We are aware of no studies that would justify a claim anesthesiologists are less likely to consult with other specialists than are CRNAs or that provide estimates of the extent to which either provider seeks consultations. As a practical matter, if a patient's condition warrants cardiology consultation and clearance, it seems likely a responsible anesthesiologist and CRNA would delay surgery until consultation and clearance were obtained.

In their discussion of credentials and licenses of CRNAs, the authors make several statements that are incorrect and/or misleading. Their statement that "Nurse anesthetists are registered nurses who hold licenses limited to nursing"46 obscures the point that CRNAs are professionals who have taken additional specialized education and training to prepare them to provide anesthesia services. CRNAs practice according to their expertise, state statutes and regulations and institutional policy. Contrary to the claim by Abenstein and Warner, CRNA activities are not confined to the operating room. Many also work in preoperative assessment units, manage acute and chronic pain, and insert intravenous catheters and invasive monitors outside the operating room. Some attend patients during diagnostic and chemotherapeutic procedures, respond to cardiopulmonary resuscitation calls, and consult in emergency departments and intensive care units. Whether CRNAs practice with anesthesiologists or alone, they personally administer at least 62% (approximately 70% in the rural setting) of the estimated 25 million anesthetics provided in this country.6,7

Statements by Abenstein and Warner about certification and accreditation also contain a number of inaccuracies.46 They state, "the consolidation of education program accreditation, individual certification of professional aptitude, and political functions of nurse anesthetists [into a single organization] sharply contrasts with the unique functions of the Residency Review Committee for Anesthesiology of the ACGME, the American Board of Anesthesiology (ABA), and the American Society of Anesthesiologists (ASA)." In fact, a similar trio exists for CRNAs. The 91 nurse anes-
The statements related to anesthesia services and anesthesia departments deserve careful attention. We do not take issue with the notion that a team of anesthesia providers may be the best service delivery model in some settings, but the arguments for this presented by Abenstein and Warner are far from conclusive. The value of teams may have more to do with the pooled knowledge, talents, and experience of team members who can easily be called on for advice and assistance than with the mix of members on the teams.

The statement that “CRNAs working alone are involved with significantly less complex and shorter procedures on healthier patients” lacks factual substantiation. A 1990 Office of Technology Assessment publication demonstrates that despite lower mortality rates (except with regard to accidents), the rural population has a higher percentage of elderly patients and a higher incidence of such chronic diseases as cardiac, pulmonary and renal failure, and diabetes. Further, the demands of practice in small rural hospitals on anesthesia providers often are as great, or greater, than those in tertiary care facilities located in urban and suburban areas.

Patient outcomes and anesthesia care

Abernstein and Warner present a variety of interesting statistics on patient outcomes related to anesthesia care. The most striking fact is over the 42 years covered by their review (1948 to 1990), mortality rates due to anesthetics have declined dramatically to fewer than 1 in 160,000 cases. They cite similar declines in morbidity over the same period. They also cite significant declines in medicolegal claims between 1975 and 1990. These improvements in clinical performance are a testament to the continuing efforts of clinicians, researchers, and administrators to improve the quality of patient care. The authors imply the decline is primarily related to the number of American-educated anesthesiologists and ignore potential impacts of other factors.
For example, adverse respiratory events, such as inadequate ventilation, esophageal intubation, and hypoxia, were identified by an ASA Closed Claims Study as the most common causes of adverse outcome precipitating malpractice claims.\(^\text{17}\) However, many of the adverse respiratory events (72\%) were characterized as potentially preventable with the use of pulse oximetry, capnography, or both. In a recent paper, Guyton and Eichhorn point to a triad of factors in patient safety that have had an effect on the quality of anesthesia practice.\(^\text{18}\) It is likely new monitoring modalities, the pharmacokinetics and pharmacodynamics of contemporary anesthetics agents, and improved knowledge about the process of anesthesia, including education preparation of anesthesia providers, all have contributed to better patient outcomes.

Patient outcomes and anesthesia providers

Abeinstein and Warner correctly point out that attributing the causes of perioperative deaths is "problematic," with huge numbers of cases required for statistically valid assessments.\(^\text{4(6177-1779)}\) We are therefore concerned that they aggressively pursue this attribution question, concluding both that physician-led anesthesia teams are the best model for delivering anesthesia services and that "the increase in the number of physicians engaged in the practice of anesthesiology is primarily responsible for the dramatic improvement in perioperative outcomes."\(^\text{4(6177)}\)

We do not take issue with the premise that, everything else being equal, a team of providers may be the best way to deliver care in certain settings. However, the three studies cited to substantiate the premise that the anesthesia care team is the best model for delivering anesthesia services are misrepresented. The study by Bechtoldt reviewed deaths that occurred from 1969 to 1976, during the conduct of more than two million anesthetics administered in North Carolina.\(^\text{19}\) From Bechtoldt's findings, Abenstein and Warner concluded the lowest death rate occurred for cases with an anesthesia care team and the highest death rate occurred for cases in nurse anesthetist-only settings. While Bechtoldt reported "... when we calculated the incidence of anesthetic-related deaths for each group which administered the anesthetic, we found the incidence among the three major groups (CRNA 1:20,723; anesthesiologist 1:24,500; and combination of CRNA and anesthesiologist 1:28,166) to be similar. Although the CRNA working alone accounted for about half of the anesthetic-related deaths, the CRNA working alone accounted for about one-half of the anesthetics administered. Numerically, about one death occurred for about 24,000 anesthetics for each of these major groups." [emphasis ours].\(^\text{19(6177)}\)

These data were not subjected to statistical analysis, but the differences among the groups would not be statistically significant.

The second study, which was conducted from 1973 to 1974, reviewed 8,593 charts of patients who underwent 15 surgical procedures under the care of two groups of anesthesia providers: anesthesiologists and nurse anesthetists. In nine hospitals, anesthesiologists were the primary providers, and in seven hospitals nurse anesthetists were the primary providers. The study did not include a group in which anesthesiologists and nurse anesthetists practiced in the anesthesia care team.\(^\text{20}\) Each patient was assigned a weight based on progression or stage of disease at the time of surgery and the probability of adverse outcome. Although the researchers determined physicians had fewer predicted adverse events than nurse anesthetists, "when the data were subjected to statistical analysis, the differences between the two groups were not statistically significant." [emphasis ours].\(^\text{19\text{p1779}}\) Based on these findings, we wonder then how anyone could suggest one practice setting or delivery model yields better outcomes. Abenstein and Warner advance these suggestions even further when they created from the data a third practice group (the anesthesia care team) that was not even part of this study.\(^\text{8(6177), Table 7}\)

The third study, a review of hospital and patient characteristics associated with death after surgery, examined the medical records of 5,972 patients who underwent cholecystectomy or transurethral prostatectomy in seven states to determine predictors of mortality and complications.\(^\text{21(p2139)}\) When the total number of anesthesiologists and the total number of board certified anesthesiologists were included as explanatory factors, it was concluded that board certification was associated with significantly lower numbers of deaths and complications [emphasis ours].\(^\text{21(p2139)}\) Despite the fact the study made no mention of anesthesia care teams, CRNAs, residents in anesthesia, or graduate students in nurse anesthesia education programs, Abenstein and Warner cite this study to support their position that better outcomes are achieved with the anesthesia care team service model.\(^\text{1(p1200)}\)

In discussing their Figure 4, which displays the relationship of the number of physicians engaged in anesthesiology to the mortality related to anesthesia, Abenstein and Warner conclude that "These associations do not necessarily imply a cause-effect relationship between the changing proportion of anesthesia providers and improved outcomes, but they are consistent with the premise that the increasing involvement of physicians in anesthesia care has contributed to improved out-
comes. We feel obliged to point out that the same pattern would hold if the number of CRNAs were substituted for the number of ASA members in their Figure 4. This fact was demonstrated in a recent editorial by Zambricki who identified the growth in ASA membership was paralleled by similar growth in the number of CRNAs. The point is that mortality rate due to anesthesia has declined for a variety of reasons cited earlier, not least of which are new anesthetic agents, better patient monitoring, and improved education programs, not because there are more practitioners of one kind or other in the United States.

Cost implications of anesthesia care

We agree with Abenstein and Warner that "The cost implications of anesthesia care are complex." We were therefore disappointed by their simplistic approach to costs based on reimbursement policies and hypothetical practice arrangements. They provide no new insights and facts that can help policymakers to make better decisions about anesthesia services and costs.

We do not take issue with their premise that "The anesthesiologist-led care team can be cost-effective. . . .," especially in large hospitals, medical centers, and health maintenance organizations (HMOs). The fact that Kaiser Permanente has chosen the team approach is interesting, but we believe the CRNA-only model would prove cost-effective as well. This is clearly a subject amenable to careful empirical analysis. Unlike the problem of comparing minuscule mortality rates which would require enormous sample sizes, anesthesia costs could be studied and compared with much more modest samples, even when controlling for factors like type of surgery, type of anesthetic agents used, type and composition of anesthesia providers, etc. Our Table I suggests one possible research design that could be used.

Abenstein and Warner point out that "From a payor's perspective, . . . true costs (expenses) related to the delivery of anesthesia care are somewhat irrelevant." However, true costs are very relevant from a provider's perspective. And ultimately, unless a provider or payor decides to subsidize a particular service, the actual costs will drive the payments and reimbursements.

The use of a hypothetical Medicare reimbursement example for the state of New York does little to clarify the issue of costs of anesthesia services, and probably confuses matters. The example does illustrate that caution must be taken in any careful study of costs, but it is far too simplistic to use as the basis for any conclusions about what practice structure a hospital or HMO should select, because the conclusions reached are not based in fact. The conclusion that the CRNA-only model would drive up total charges as a result of consultation fees is certainly not justified. To our knowledge, no study has carefully examined the extent to which different anesthesia providers seek consultations, whether consultation during the peri-

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<th>Table I</th>
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<td>A research design to examine anesthesia costs</td>
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<td>Whereas a statistically sound study comparing mortality and morbidity rates for different anesthesia delivery models would be prohibitively expensive due to the large sample sizes needed, a study of the costs of different anesthesia delivery models could be mounted with more modest funding. The costs could be defrayed even further by examining different delivery settings or types of illnesses (e.g., tertiary care hospital operating rooms, small rural hospitals, freestanding clinics) in separate studies. The basic research design we envision would be structured as follows:</td>
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<tr>
<td><strong>Hypotheses</strong></td>
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<td>No differences in costs of surgeries or anesthesia services attributable to type of anesthesia model, controlling for other independent factors.</td>
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<td><strong>Observation points</strong></td>
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<td>Individual surgeries at a number of hospitals and other facilities where surgeries are performed and anesthesia services are provided. Multiple hospitals may be required if there are insufficient variations in practices for individual hospitals.</td>
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<tr>
<td><strong>Number of observations</strong></td>
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<td>Depending on the number of independent variables used, several hundred observations would be required to test the hypotheses. Stratified sampling may be required to assure sufficient numbers of cases for some categories.</td>
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<tr>
<td><strong>Dependent variables</strong></td>
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<tr>
<td>Total costs of surgeries, costs of anesthesia services associated with surgeries.</td>
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<tr>
<td><strong>Independent variables</strong></td>
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<tr>
<td>Type of surgery (e.g., thoracic, extremity), patient demographics (e.g., age, gender), source(s) of payments (e.g., Medicare), patient diagnosis of injury, illness severity, type of anesthesia model (e.g., CRNA-only, team), presence of medical complications, duration of surgery, types of anesthetics used, emergency status, type of facility.</td>
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<td><strong>Analysis techniques</strong></td>
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<td>Analysis of covariance or multiple linear regression. The latter would have the advantage of providing a basis for numerical estimates of the relationships among the variables. Although this study of costs would not be a trivial one, it would be nowhere as difficult to mount as a study of mortality. Something of this scope would be required to provide policymakers with information and insights that could guide the design of more cost-effective anesthesia delivery.</td>
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operative period is initiated by the anesthesia provider or surgeon, and whether there are significant differences in consultation patterns across types of providers.

Conclusions

We have examined carefully the article by Abenstein and Warner, pointing out a number of specific weaknesses and shortcomings. We conclude with several more general concerns we have about the article.

1. Although the original Minnesota report is interesting, its relevance to national policies and recommendations is not clear. It is interesting that Abenstein and Warner neglect to mention two of the major conclusions in the executive summary of the Minnesota Commissioner of Health’s final report.2

- Limitations of the study made it impossible to evaluate fully the cost of service provided under each type of employment arrangement.
- There are no studies, either national in scope or Minnesota-specific, which conclusively show a difference in patient outcomes based on type of anesthesia provider.

2. In general, the authors reconfigure statistics and findings in the literature concerning outcomes of anesthesia care based on provider. If the best available research studies did not support their position, we feel it was inappropriate and misleading to reconfigure data upon which recommendations for policy decisions were made.

3. The tendency to extend their recommendations to all states and practice settings ignores the "wide spectrum of health care facilities throughout the United States" they have themselves acknowledged.4(p1279) We agree that all relevant data and expertise should be brought to bear on critical healthcare issues, but the relevance must be based on sound scientific methodology.

4. The practice of anesthesia continues to move forward rapidly, and great care must be taken to account for these advances in the development of policy recommendations. As a consequence, contemporary anesthesia practice patterns and environments must be considered when outcome studies are defined.

5. In their discussion of costs, Abenstein and Warner neglect to discuss all elements of total costs. Specifically, they fail to include education preparation and salaries, both of which are major elements in the total cost of anesthesia services.

Almost as interesting as what is stated and summarized in their article is the fact that they fail to mention at all the emerging concerns about changing employment opportunities for anesthesiologists and CRNAs. The impact of managed care, changes in the extent to which the federal government will support graduate medical and nursing education in the future, and projected patient demand for surgery, though not directly relevant to some of their points, certainly deserve some mention.

We agree with the editor of Anesthesia and Analgesia that Abenstein and Warner have addressed timely and important issues.23 This makes it doubly disappointing that their article contains so many errors. We hope our paper clears up some of the misconceptions so that informed discussions and debates can proceed about the delivery and financing of anesthesia services.

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