writers and understood by readers. When blood loss at the operative site is being measured, what is the relationship of that site to the remainder of the body and to the point of measurement of blood pressure? Bleeding is least when the wound is uppermost because the blood pressure in the wound is hydrostatically lower and blood is pooled in capacitance vessels in dependent portions of the body, thereby decreasing cardiac output. When pressure is measured intra-arterially in the supine patient, the pressure is usually referenced to the heart level, but not always when there is head-up or head-down tilt or when the patient is positioned laterally. When the patient is in the lateral position and blood pressure is being measured in the radial artery in the dependent arm, and the manometer referenced to that artery, then the blood pressure at heart level will be less than the reading obtained, and it will be further diminished at the level of the non-dependent hip. These variations may be exaggerated or lessened by tilt of the table. Similarly with studies of organ function: what is the level of the organ in relation to blood pressure reference? While Thompson and associates mention a mean blood pressure of 50 torr, we have no idea of the relationship of this measurement to wound or brain, or whether the relationship was always constant among the patients studied. In the reference to our 1964 work, the mean systolic blood pressure was 63 torr, but we pointed out that the patients were in a 25-degree head-up tilt; it was estimated that the average cerebral systolic blood pressure at the base of the brain was 16 torr less, or 47 torr.

Body position is likewise important in the management of ventilation during deliberate hypotension. In the supine patient with modest hypotension, spontaneous respiration may suffice. However, with body tilt or with the lateral position, both augmenting venous pooling leading to decreased cardiac output, physiologic deadspace increases and spontaneous ventilation becomes insufficient for adequate respiratory exchange. The authors' data for the deep halothane–spontaneous ventilation group demonstrate this point. Why did it not occur with the nitroprusside–spontaneous ventilation group? This question is not answerable without a better definition of body position and comparison of referenced levels of blood pressure among the groups. I can't agree that hypotension from deep halothane anesthesia results principally from cardiac depression. This minimizes other pharmacologic actions of halothane. There probably was more blood pooled in dilated capacitance vessels with deep halothane anesthesia, worsening physiologic deadspace, than was true with light halothane anesthesia and a modest dose of nitroprusside. If all other conditions of the two groups could be proven equal, then a case is made for light halothane anesthesia and nitroprusside rather than deep halothane anesthesia as the better technique for deliberate hypotension.

The principal advantage of deliberate hypotension is often thought to be the decreased need for blood replacement. This is untrue. Bleeding is lessened but this allows the surgeon to see better and to do a more definitive operation. It also allows better wound healing and less wound infection, since there is less blood, ligatures or cauterized tissue in the wound. These were the reasons Sir Archibald MacIndoe, the eminent British plastic surgeon, so encouraged the anesthetists to pursue the technique. Oddly enough, considering the advantages are mostly surgical, the reports have appeared chiefly from anesthesiologists. It is good to see that a surgeon was involved here.

JAMES E. ECKENHOFF, M.D.
Dean and Professor of Anesthesia
Northwestern University Medical School
Chicago, Illinois 60611

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Anesthesia and Surgical Care—Manpower Needs and Utilization

IT IS OPPORTUNE to have Francis Moore, M.D., Elliott Carr Cutler Professor of Surgery, Harvard Medical School, who has studied surgical manpower for many years, apply his experience, from the surgeon's perspective, to the field of anesthesiology. His article in this issue of ANESTHESIOLOGY is based on his presentation as the 1976 Rovenstine Lecturer. His correlation of the surgical data base greatly broadened by the Study of Surgical Services for the United States[1] (SOSSUS) with anesthesiology data expands our understanding of manpower issues. Dr. Moore was able to draw upon considerable demographic data about anesthesia personnel. These included the 1970 American Society of Anesthesiologists Manpower Study,[2] the 1972 ASA Study of Nurse Anesthetists,[3] the 1974 ASA Manpower Survey of Practice and Attitudes,[4] the ASA manpower material prepared for the Govern-

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ment Accounting Office in 1976,[5] and the SOSSUS geographic area studies. In addition, Dr. Moore had recent materials personally supplied to him by the American Society of Nurse Anesthetists and the ASA. Most of the conclusions of the ASA data have been statistically corroborated by Fredrick Orkin.[6]

From the ASA data prepared for the General Accounting Office, a more complete picture of the demography of nurse anesthetists has emerged. Approximately a third of nurse anesthetists function in hospitals with 100 or fewer beds, usually with no anesthesiologist providing their medical direction. They average approximately 650 cases per year, compared with an average of 950 cases per year for anesthesiologists in larger hospitals. Approximately 30 per cent of the procedures that involve nurse anesthetists are medically directed by anesthesiologists. In fact, anesthesiologists are involved in 65–75 per cent of all anesthesia administered today. Dr. Moore reiterates the oft-quoted 50 per cent figure, which is no longer applicable in 1977.

The total anesthesia personnel Dr. Moore uses in calculating ratios of anesthesia personnel to surgeons does not take into account the anesthesia care team approach. This results in a "double counting" of anesthesiologists and nurse anesthetists which, by coincidence, results in his nearly equal total anesthesia personnel ratios throughout the country. ASA data do not support this conclusion.

The geographic distribution of anesthesiologists and nurse anesthetists, as well as surgeons, is not based on an orderly planning process. It is the result of local historical happenstance, economics, and cultural interests. It is noteworthy that the number of anesthesiologists in a geographic area is directly proportional to the total number of physicians in that area, while the geographic distribution of nurse anesthetists has been inversely proportional to the total number of physicians in the area.

It should be noted that in 1975 the average percentage of foreign medical graduates for all residencies, and for surgery, was 30 per cent. The percentage of foreign medical graduates in anesthesiology training has decreased from 57.9 per cent in 1972 to 46.4 per cent in 1977, the total number of trainees having increased by 230 in the past year.[7] In anesthesiology, this decrease occurred prior to the anticipated influence of the Health Manpower Assistance Act of 1976. This new health manpower law should produce little effect on anesthesiology except for some training programs in the northeastern United States. Here, relief for individual departments need be sought as provided for under the law. The decrease in foreign medical graduates in anesthesiology resident training may be balanced out by two factors: the increasing numbers of medical school graduates, and an estimated 10 per cent cutback in available residencies in overcrowded surgical specialties.

Dr. Moore's assessment of women medical students differs from mine. I find some who are aggressive, militant, and determined to enter surgical fields on an equal basis with their male classmates. They handle their childbearing with minimal dislocation and a short leave of absence. Some may find anesthesiology a particularly satisfying and desirable field of practice. However, I would suggest that overall, their future specialty distribution is totally unpredictable.

Dr. Moore's division of practitioners into three groups is arbitrary. It appears to be contrary to his discussion of the neurosurgical consultant, who has a referral practice in a single hospital, and contrary to the geographic distribution of surgeons, who, like anesthesiologists, are located where there are hospitals and operating rooms. Surgeons and surgical specialists are necessarily hospital-associated physicians. They usually take care of hospitalized patients referred to them by primary care physicians. Others who fall in the same grouping are the physicians performing cardiac catheterization and those involved with blood banks, dialysis and transplant procedures.

A recently released study of anesthesia manpower by Roddy and Hambleton from the Bureau of Health Manpower, Department of Health, Education and Welfare,[8] explores two scenarios for anesthesia care delivery. Method one assumes that nurse anesthetists are involved in the administration of all anesthetics (800 cases annually) under anesthesiologist direction on a 2:1 ratio. On this basis they calculated a surplus of 4,275 anesthesiologists and a shortage of 9,695 nurse anesthetists by 1980. Method two, which the authors prefer, assumes that hospitals that have fewer than 100 beds require one anesthesiologist per hospital, and no nurse anesthetist, the larger hospitals functioning on the 2:1 ratio of method one. They project, under method two, a surplus of 2,674 anesthesiologists and a shortage of 6,187 nurse anesthetists by 1980. Aside from the sociological, economic and cultural effects of either of these two scenarios, the medical implications of such distribution patterns and the health planning by health service agencies to designate primary, secondary and tertiary hospital centers preclude implementation of these impractical suggestions. Perhaps these authors should examine a third method that: 1) restricts hospitals of 100 or fewer beds to only emergency surgical procedures; 2) restricts the management of surgical procedures to certified surgeons; 3) provides for nurse anesthetists under the medical direction of anesthesiologists on a 2:1 ratio for all surgery and obstetrics in secondary care hospitals; 4) restricts the management of anesthetic

procedures in tertiary care centers to anesthesiologists and anesthesiology residents. The assignment of personnel within the above-mentioned restrictions is practical and indeed feasible. Such a scenario could markedly improve the quality of surgical and anesthesia care. It would be of interest to have Roddy and Hamleton calculate a 1980 manpower projection based on this third method.

The reasons for the differences in the ratios of anesthesiologists to population throughout the world's developed countries are noted but not questioned by Dr. Moore. Is this difference in any way related to the number of surgeons or hospital beds? Are anesthesiologists in some countries more productive because surgical procedures are performed faster? Are fewer procedures performed under the control of a totally socialized medical program? Since these countries have no nurse anesthetists, are all anesthetic procedures performed on a 1:1 ratio, or do registered nurses or other personnel monitor the anesthetized patient? Dr. John Bunker's startling data comparing surgical manpower and workloads in Great Britian and the United States indicated significant differences in utilization patterns.[9] The increased utilization of medical services in the United States under the Medicare and Medicaid programs further accentuates these systematic differences.

While considerable manpower data have been collated in the United States for all specialties of medicine, and future manpower supplies predicted, little decisive information can be projected as to manpower needs and utilization. It is evident that increasing health care personnel results in increased utilization, and that the laws of economics in the market place do not truly function in the health care field. New procedures such as coronary graft surgery and total joint replacement, and new diagnostic devices such as the total-body x-ray scanner, add to the unpredictability of future medical manpower needs and utilization.

Government may have a profound positive or negative effect on such projections. The doubling of entering medical students in medical schools in this century, the liberalization of immigration laws for physicians, and the rapid expansion of the numbers and types of health professions were all stimulated by government programs, initiated in response to increased medical utilization as a result of Title 18 and 19 programs. As a result, the United States now has the highest physician-to-population ratio in the world, and government agencies have already begun to reverse this expansionist trend. Lewis,[10] in a recent article on research in health care delivery, notes, "Although advances in medicine depend on the generation of new knowledge, changes in the health care system depend on alterations in social and political values—there is little reason to expect health services research to produce major alterations in the health delivery system, since these alterations are linked to changes in the values and expectations of society."

We can continue to calculate the numbers of health professionals in the United States and plot their distribution, but unless the public is educated to the wisdom of consolidation of hospital services into an orderly program of graduated care facilities, utilization and health care costs will continue to outstrip our health planning processes and our ability to finance medical care effectively. Physicians need to lend their expertise to find effective mechanisms to control medical utilization and costs, not only to improve the quality of medical care, but to prevent oppressive government restrictions on the delivery and financing of medical care in the future.

RICHARD AMENT, M.D.
President, 1977
American Society of Anesthesiologists

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