In Phase I of this international study, we systematically identified, for the first time, that nurses were providing anesthesia services in more than 100 countries, which is about 60% of all member states of the World Health Organization. The purpose of Phase II reported here, was to describe nurse anesthesia practice, education, and regulation in those countries. Data were collected from 96 countries, in all world regions, and at four levels of development, then were analyzed for commonalities and differences.

It was found that the use of nurses to provide anesthesia is not related to a country’s level of development; nurses provide anesthesia in two thirds of developed, developing, and least developed countries, working with or without anesthesiologists. They perform all the critical tasks required in the administration of anesthesia. Nurse anesthetists worldwide are making a significant contribution to health.

These data can serve as a basis for future decisions about human, fiscal, and government resources required to make anesthesia services available to each country’s population. They can also provide opportunity to identify educational requirements to assure the safety and well-being of patients worldwide requiring anesthesia services.

Key words: Anesthesia, international, nurse anesthesia, World Health Organization.

Introduction

Health for all in the 21st century, a 1977 goal of the World Health Organization, requires identifying and implementing cost-effective strategies for delivering health services to all people.1 The diversity of people, needs, economies, health workforce mix, and resources to achieve such a goal throughout the world is staggering. Yet, many people are dedicated to making health for all a reality. Some developing countries are insufficiently wealthy to have modern state-of-the-art health systems, and developed countries have found their healthcare delivery systems are overly costly and often provide limited access.

World leaders in public health believe that nurses are a key to achieving health for all because they are usually cost effective.2 As a foundation for good health, these leaders advocate educating people about good nutrition, about how to maintain health and prevent disease, and about the importance of clean air and water and adequate housing. Further, some advocate limiting the number of physicians and their services to those which only physicians are qualified to provide.3
Nurse anesthetists in the United States date to the late 1870s when there were too few physicians willing to devote their medical practice to anesthesia. Surgeons invited nurses to enter the field and make it a career specialty—enhancing the safety of anesthesia. Surgeons found professional nurses not only up to the task, but also highly capable of learning and managing the complexities of practice as anesthesia and medical interventions grew more complex. Even in 1998, with an expanded anesthesiologist supply in the United States, Certified Registered Nurse Anesthetists (CRNAs) provide at least 65% of the anesthesics working with and without anesthesiologists. They are the sole anesthesia providers in more than 75% of rural hospitals. The provision of anesthesia care by nurses is not unique to the United States. As found in Phase I of our research, nurses administer anesthesia in at least 107 countries, and respondents suggested that in some countries nurses may be providing nearly 90% of all anesthetics. Yet little has been written about these nurses. An extensive review of the literature failed to reveal any previously reported comprehensive, systematic studies.

**Background and framework**

Late in the 19th century, nursing leaders saw the need to establish an organization whereby nurses worldwide could come together to discuss and plan for nursing's future. That organization became the International Council of Nurses (ICN). It was established in 1899, and had its first meeting in New York in 1901. Late in the 20th century, with the advancement of nursing specialties worldwide, the ICN recognized and defined the role of the nurse specialist as an advanced practice nurse (APN). APNs are nurses who have substantial theoretical knowledge in a specialty and who proficiently use that knowledge to implement independent decisions. For APNs, the advanced level of knowledge and skill required is much greater than can be acquired in basic nursing education.

Agatha Hodgins, CRNA, the founder of the American Association of Nurse Anesthetists (AANA), also thought globally and first proposed the organization of the International Association of Nurse Anesthetists to ensure that alumni from nurse anesthesia educational programs within the United States, working in India, China, Mexico, South America, and other places would be eligible for membership. They later settled on the National Association of Nurse Anesthetists, subsequently to become the American Association of Nurse Anesthetists.

In 1978, two nurse anesthetists, one Danish and the other Swiss, came to the United States to attend the AANA Annual Meeting in Detroit and approached the AANA Board of Directors with the idea of an international organization for nurse anesthetists. Ronald Caulk, CRNA, who at the time was AANA president, and the AANA Board of Directors voted its support. However, it was not until 1989, after two international symposiums for nurse anesthetists had been held, that the International Federation of Nurse Anesthetists (IFNA) was formed with 11 charter member countries. Membership in IFNA was restricted to countries who had national nurse anesthetist organizations and met selected criteria. The purpose of IFNA includes identifying countries where nurse anesthetists practice and the nurse anesthetists' needs, then to assist these nurses to develop their competencies and capabilities in meeting anesthesia and related health needs of people worldwide.

Early in its development, IFNA conferred with several international organizations including the European Economic Community, which was working on joint standards for nursing for member countries; the ICN, because of its position and knowledge of nursing worldwide; and the World Health Organization, whose efforts are principally directed at assisting developing countries in promoting health and establishing health delivery systems.

The IFNA defines nurse anesthesia as the specialty in which nurses provide, or participate in the provision of, advanced specialized nursing and anesthesia services to patients requiring anesthesia, respiratory care, cardiopulmonary resuscitation, and other emergency, life-sustaining services. The IFNA educational standards require that nurse anesthetists complete a program of basic nursing education, as well as a program of basic nurse anesthesia education.

The IFNA has further determined that since specialization in nurse anesthesia incorporates the biological and behavioral sciences, educational programs for nurse anesthetists should require both theory and practice. The minimum prerequisites for these programs, according to IFNA, include completion of a basic nursing education program of at least 36 months and 1 year of nursing practice in an acute care setting. The minimum length of anesthesia education programs should be 12 months, but 18 to 24 months is encouraged. In addition, IFNA recommends that while faculty may include professionals from several disciplines, nurse anesthesia education should be directed by nurses who are anesthetists.

The ICN recognizes the current variability throughout the world in the educational preparation of nurse specialists. Examples of the diversity in nurse specialty education include (1) nurses with
Advanced practice nurses, including nurse anesthetists, are a cost-effective alternative to physicians and can help increase access to healthcare in many regions of the world.\textsuperscript{1,13} Advanced practice nurses are effective not only in terms of the services they provide, but also in terms of the cost of their educational preparation as compared with physicians.\textsuperscript{1,13-15}

Phase I of this study puts to rest the idea that nurses who provide anesthesia services are unique to the United States.\textsuperscript{6} We found nurses who practice anesthesia in 107 countries in all geographic regions and at all levels of development. From those countries we identified the names and addresses of 624 nurse anesthetists. Phase II was designed to describe commonalities and differences in nurse anesthesia practice, education, and governmental regulation in all countries and regions. Specifically, Phase II was designed to answer the following questions:

1. What is the scope of practice of nurses who provide anesthesia services in member states of the World Health Organization (WHO)?
2. What is the experiential and educational background of nurses delivering anesthesia care?
3. What regulatory and legislative issues affect nurses providing anesthesia care?
4. What changes, if any, would improve the anesthesia practice of nurses?

**Method**

A descriptive cross-sectional design was used in this comprehensive international survey of the practice, education, and regulation of nurses in the provision of anesthesia care. To answer the research questions, a questionnaire was designed containing 123 items to elicit data about practice (80 items), education (16 items), and regulation (17 items). A glossary was included with 22 definitions of key terms. The questionnaire was translated from English to French, German, and Spanish by linguistic experts. Content validity for the instrument was strengthened by sending the survey, with the study aims and research questions, to bilingual nurse anesthetists in France, Germany, the United States, and Switzerland. Each specialist was asked to determine the appropriateness, accuracy, and representativeness of the content coverage in relation to the research questions and to comment on the quality of the translation. Based on the critiques, modifications and revisions of the instrument were made in the final version.

The population of interest was all nurse anesthetists from member states in WHO.\textsuperscript{16} At the time of this study, in 1992, there were 177 member states in the World Health Organization located in the

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less than a secondary school education to which has been added a 2- to 3-year basic specialty program, (2) registered generalist nurses with limited formal postbasic education in nursing but vast first-hand clinical experience in an area specialty, and (3) clinical nurse specialists with master's or doctoral degrees. ICN maintains that multiple career pathways should exist, be sanctioned, and encouraged. However, ICN seems to share with IFNA the philosophy that some form of formal postbasic or postgraduate education should be required for nurse specialists.\textsuperscript{9}

The ICN places the prime responsibility for nurse specialists regulation and standards setting, for both education and practice, with nurses. Specifically, ICN recommends that standards should be set for both practice and education by professional nurses' associations. The IFNA recognizes that a characteristic of any profession is being accountable to the public for developing standards whereby the quality of practice can be judged. Therefore, IFNA has developed standards of practice based on the profession's philosophy, theory, science, and research.\textsuperscript{12}

When, in 1991-1992, international practice and educational standards were created, the extent to which the practice of nurse anesthesia occurred worldwide was largely unknown. It was not known, for example, in which countries nurses administer anesthesia, how much anesthesia they administer, what specific tasks they perform, the content of their educational programs, or how their practice is regulated.

According to ICN, one goal of nursing resource planning for every country should be to ensure the public that nurses have the right qualifications, function in the right role, are employed in the right place, and perform with proper authority and recognition. For healthcare policy makers to plan cost-effective health systems that ensure access to care for all, they must know the number, quality, and education of various categories of healthcare workers, and they must be aware of the practice, education, and regulation of the main categories of healthcare providers.

Health for all requires that countries use cost-effective strategies including efficient use of human resources. A recent worldwide trend is to educate APNs to give much of the primary healthcare once provided by family practice physicians only. In many situations, APNs (family, pediatric, and women's health nurse practitioners, for example) can be cost-effective alternatives to physicians.\textsuperscript{8} Although the practice of nurse anesthesia predates the emergence of APNs, nurse anesthetists are often defined as APNs.
six WHO regions and at four levels of development also as defined by WHO.

The nominated convenience sample was all 624 practitioners identified in Phase I. The observational unit of analysis for data collection was individual nurse anesthetists who administer anesthesia in rural and urban areas of these countries. For comparisons, responses were analyzed by:

2. Four WHO country levels of development including developed market-economy countries, developing countries, least developed countries, and countries in transition.
3. Practice settings which were defined as rural or urban.

**Procedure**

The questionnaire, along with an invitational letter to participate, was sent in 1994 to the 624 nurse anesthetists; 40% responded. A reminder letter was sent 4 months later inquiring if nonrespondents had received the questionnaire and requesting they complete and return an attached form if they desired to participate in the study. For the final analysis, a total of 293 (49%) surveys were completed and returned by those from 94 (53%) WHO member nations and associate member states and 2 nonmember countries.

**Sample**

The majority (92%) of the respondents indicated they were nurse anesthetists. Some indicated they were physician anesthetists (2%) or anesthesia assistants (2%). Others described themselves as operating room nurses, anesthesia technicians, or anesthetic sisters. In our study, the term “physician anesthetist” was used instead of “anesthesiologist” or the British term “anaesthetist” to avoid ambiguity.

Distribution of the sample by WHO region is in Table I; 71% were from the African and European regions. The sample consisted of 42% men and 58% women.

Subjects were from 96 countries in all regions of the world. The number of respondents from the American, Southeast Asian, and Western Pacific regions was sufficient to make comparisons by regional groupings. The number of responses from the Eastern Mediterranean region was lowest, therefore, findings, especially from this region, should be interpreted with caution.

Distribution by country level of development is in Table II. Respondents were from countries at each level of development.

Most subjects (76%) indicated working in the urban areas of their countries. The facility size in bed number where respondents work is shown in Table III. European participants most often reported working in large hospitals of 700 beds or more, while subjects from other regions were more evenly distributed in small, medium, and large hospitals.

![Table I](https://example.com/table1.png)

**Table I**

<table>
<thead>
<tr>
<th>Region</th>
<th>Respondent sample distribution</th>
<th>Country sample distribution</th>
<th>Country WHO distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>African</td>
<td>111 (38%)</td>
<td>33 (34%)</td>
<td>45 (25%)</td>
</tr>
<tr>
<td>American</td>
<td>31 (10%)</td>
<td>13 (14%)</td>
<td>35 (20%)</td>
</tr>
<tr>
<td>Eastern Mediterranean</td>
<td>6 (2%)</td>
<td>4 (4%)</td>
<td>22 (12%)</td>
</tr>
<tr>
<td>European</td>
<td>98 (33%)*</td>
<td>29 (30%)*</td>
<td>42 (24%)</td>
</tr>
<tr>
<td>Southeast Asian</td>
<td>26 (9%)</td>
<td>5 (5%)</td>
<td>11 (6%)</td>
</tr>
<tr>
<td>Western Pacific</td>
<td>21 (7%)</td>
<td>12 (12%)</td>
<td>22 (12%)</td>
</tr>
<tr>
<td>Total</td>
<td>293</td>
<td>96</td>
<td>177</td>
</tr>
</tbody>
</table>

*Four respondents from two nonmember countries.

![Table II](https://example.com/table2.png)

**Table II**

<table>
<thead>
<tr>
<th>Level of development</th>
<th>Respondent sample distribution</th>
<th>Country sample distribution</th>
<th>Country WHO distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed</td>
<td>69 (23%)</td>
<td>18 (18%)</td>
<td>26 (15%)</td>
</tr>
<tr>
<td>Developing</td>
<td>118 (40%)</td>
<td>39 (41%)</td>
<td>88 (49%)</td>
</tr>
<tr>
<td>Least developed</td>
<td>75 (26%)</td>
<td>28 (29%)</td>
<td>46 (26%)</td>
</tr>
<tr>
<td>Countries in transition</td>
<td>27 (9%)</td>
<td>9 (9%)</td>
<td>17 (9%)</td>
</tr>
<tr>
<td>Other</td>
<td>4 (1%)</td>
<td>2 (2%)</td>
<td>—</td>
</tr>
<tr>
<td>Total</td>
<td>293</td>
<td>96</td>
<td>177</td>
</tr>
</tbody>
</table>

**Findings**

- **Scope of practice.** Most countries do not keep national statistics on the number or types of healthcare services provided annually. Therefore, to try to quantify anesthesia given by nurses, we included three items asking subjects to estimate the percentage of anesthetics nurses administer in rural and urban settings in their country. As shown in Figure 1, respondents estimated that in rural areas, nurses administer 75% of anesthetics; 53% of these
Table III

Number of beds where subjects employed by region

<table>
<thead>
<tr>
<th>Region</th>
<th>0-100</th>
<th>101-200</th>
<th>201-400</th>
<th>401-700</th>
<th>&gt;700</th>
</tr>
</thead>
<tbody>
<tr>
<td>African region (n = 102)</td>
<td>22%</td>
<td>21%</td>
<td>28%</td>
<td>19%</td>
<td>12%</td>
</tr>
<tr>
<td>American region (n = 25)</td>
<td>20%</td>
<td>20%</td>
<td>32%</td>
<td>12%</td>
<td>16%</td>
</tr>
<tr>
<td>Eastern Mediterranean region (n = 5)</td>
<td>40%</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>24%</td>
</tr>
<tr>
<td>European region (n = 94)</td>
<td>5%</td>
<td>17%</td>
<td>17%</td>
<td>20%</td>
<td>41%</td>
</tr>
<tr>
<td>Southeast Asian region (n = 25)</td>
<td>32%</td>
<td>20%</td>
<td>12%</td>
<td>12%</td>
<td>24%</td>
</tr>
<tr>
<td>Western Pacific region (n = 20)</td>
<td>30%</td>
<td>5%</td>
<td>35%</td>
<td>20%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Numbers are expressed as percentage of total responses for the category.

Anesthetics are given independently, that is, without assistance from physician anesthetists.

For rural areas, respondents from countries at all levels of development estimated that nurse anesthetists administer the majority of anesthetics (Figure 2). They independently administer 20% of anesthetics in the rural areas of developed countries, a number that increases from 65% to 85% of anesthetics in the developing and least developed countries. The majority (56%) of anesthetics in rural areas of developed countries were reported to be given by nurse anesthetists working with physician anesthetists. When analyzed by region, we found that most of the "combined practice" (nurse anesthetists administering anesthesia with physician anesthetists) in developed countries, was in countries in the European region.

For urban areas, as shown in Figure 3, respondents estimated that nurse anesthetists provide 77% of all anesthetics, administering 38% of these independently. The percentage of anesthetics administered by physicians alone was estimated to be 11%. Respondents estimated that nurse anesthetists give anesthesia with physician anesthetists for about 39% of all cases in urban areas, as compared to 22% of all cases in rural areas.

Analyzed by region, subjects from countries in the African region estimated that nurse anesthetists are the sole providers of anesthesia in urban areas for 71% of all anesthetics (Figure 4). Subjects from countries in the American region estimated nurse anesthetists are the sole providers of anesthesia for 44% of all anesthetics; respondents from the Americas also reported a larger physician anesthetist presence in urban areas (estimating that
31% of the anesthetics in urban areas are given by physician anesthetists alone. In contrast, respondents from countries in the European region reported that, in urban areas, the majority of anesthetics are administered by nurse anesthetists working with physician anesthetists, and that few nurse or physician anesthetists administer anesthesia independently.

- Involvement in obstetric anesthesia. Subjects reported involvement in all three stages of maternal care. The percentages of respondents reporting involvement in prenatal, delivery, and postnatal care were 38%, 61%, and 59%, respectively. Subjects reported that where they work, 85% of all anesthetics for cesarean sections are administered by nurse anesthetists, as shown in Figure 5. In 53% of these cases, the anesthetics are administered by nurse anesthetists working alone.

When analyzed by region, respondents from countries in the African region reported that, where they work, 86% of the anesthetics given for cesarean sections are given by a nurse anesthetist working alone (Figure 6). In contrast, respondents from the European region reported that, where they work, 75% of all anesthetics are given by nurse anesthetists working with physician anesthetists. Few physician anesthetists in European countries administer anesthesia without a nurse anesthetist.

- Anesthetics delivered. When asked: Where you work, who administers the anesthetics for surgical cases other than cesarean sections?, respondents reported that 83% of the anesthetics are given by nurse anesthetists, with 51% of these given independently (Figure 7).

Nurse anesthetist involvement in anesthesia care is high in every region, as shown in Figure 8. Respondents from countries in the African region reported that, where they work, 92% of the anesthetics are given by nurse anesthetists; respondents from countries in the American region reported 66%; from the Eastern Mediterranean region, 57%; the European region, 82%; the Southeast Asian re-
Figures 6 and 8: Providers of anesthesia for cesarean sections by region and Anesthesia administered by provider.

Table: Providers of anesthesia for cesarean sections by region

- **AFR** - African region
- **AMR** - American region
- **EMR** - Eastern Mediterranean region
- **EUR** - European region
- **SEA** - Southeast Asian region
- **WPR** - Western Pacific region

<table>
<thead>
<tr>
<th>Region</th>
<th>AFR</th>
<th>AMR</th>
<th>EMR</th>
<th>EUR</th>
<th>SEA</th>
<th>WPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>93</td>
<td>24</td>
<td>2</td>
<td>73</td>
<td>23</td>
<td>14</td>
</tr>
</tbody>
</table>

- Nurse anesthetist alone
- Nurse anesthetist with physician anesthetist
- Physician anesthetist alone
- Other

Figure 7: Anesthesia administered by provider

- Physician anesthetist alone: 8%
- Nurse anesthetist with physician anesthetist: 32%
- Nurse anesthetist alone: 51%
- Other: 10%

n = 232

Figure 8: Regional distribution: Anesthetics administered by provider

These data clearly suggest that nurses may be administering much anesthesia in the majority of countries. Some administer anesthesia independently; others work with a physician anesthetist in a "combined practice." To more fully understand the overlap of practice between the two providers, several procedure-related items were included in the survey to determine who performs the tasks required for the administration of anesthesia. As shown in Figure 9, nurse anesthetists are the primary providers of all the essential tasks involved in giving anesthetics. Their scope of practice spans the entire anesthetic process from evaluation of patients preoperatively and ordering required laboratory tests and preoperative medications, to administering general and regional anesthetics and managing patients in the immediate postoperative period. Nurse anesthetist involvement in these key functions may exceed physician only involvement for all tasks with the exception of ordering preanesthetic evaluations.
operative medications. Physician involvement was lowest for anesthesia tasks performed inside operating rooms, such as general anesthetic induction, the administration of spinal anesthesia, and tracheal intubation.

- Anesthesia practice and nurse surgeons or pain clinics. A few nurse anesthesia providers (9%) reported working with nurse surgeons; however, 91% reported they did not. An interesting finding was that nearly 20% reported that nurse anesthetists work in pain clinics, indicating they have a role outside operating rooms.

To more fully understand anesthesia practice, data were also collected relating to the patient monitors used while administering anesthesia, as shown in Table IV. The most frequently reported patient monitor used was the electrocardiogram, followed by manual blood pressure cuffs, and precordial stethoscopes. As expected, basic monitors were available and used to a greater extent than sophisticated monitoring technologies in many developing and least developed countries. When respondents were asked to identify which monitors were most unavailable to them, they identified mass spectrometers and capnographs, followed by esophageal stethoscopes, oxygen analyzers, automatic blood pressure monitors, and pulse oximeters.

- Nurses’ education and experience. The majority (58%) reported their basic nursing education lasted 2 to 3 years, with 21% reporting their basic nursing education was 3 years or longer. Responses were consistent by region; however, when analyzed by country development level, the most frequent

---

### Table IV

<table>
<thead>
<tr>
<th>Monitors used in the administration of anesthesia</th>
<th>Used routinely with general anesthetics</th>
<th>Used routinely with regional anesthetics</th>
<th>Not available for use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrocardiogram</td>
<td>71%</td>
<td>63%</td>
<td>26%</td>
</tr>
<tr>
<td>Temperature monitors</td>
<td>38%</td>
<td>20%</td>
<td>21%</td>
</tr>
<tr>
<td>Automatic blood pressure</td>
<td>51%</td>
<td>26%</td>
<td>39%</td>
</tr>
<tr>
<td>Manual blood pressure</td>
<td>75%</td>
<td>50%</td>
<td>2%</td>
</tr>
<tr>
<td>Precordial stethoscope</td>
<td>56%</td>
<td>22%</td>
<td>11%</td>
</tr>
<tr>
<td>Esophageal stethoscope</td>
<td>9%</td>
<td>–</td>
<td>48%</td>
</tr>
<tr>
<td>Oxygen analyzer</td>
<td>31%</td>
<td>11%</td>
<td>43%</td>
</tr>
<tr>
<td>Pulse oximeter</td>
<td>43%</td>
<td>23%</td>
<td>33%</td>
</tr>
<tr>
<td>Capnograph</td>
<td>18%</td>
<td>2%</td>
<td>58%</td>
</tr>
</tbody>
</table>
response for each grouping was 2 to 3 years with a notable exception from respondents from countries in transition where the majority reported their basic nursing education was 2 years or less.

- Educational programs. Nearly all subjects reported they had educational preparation to give anesthesia. Respondents from 62 countries reported programs exist in their countries to prepare nurses to give anesthesia. We inferred that about one fourth of the respondents studied in countries other than their country of employment to receive their anesthesia education. There are, however, some educational programs for nurse anesthetists in countries in every region of the world.

There was a wide variation in the duration of anesthesia preparation; nearly two fifths reported they had 12 months or less; 18% reported 12 to 22 months; however, most (40%) reported more than 22 months. When analyzed by region and development level, respondents who reported having 10 months or less of anesthesia education were largely from countries in transition, which was also the group reporting the highest level of physician anesthetist supervision.

Inquiring about types of educational experiences, data about classroom instruction in anesthesia were sought: 91% indicated they had formal classroom instruction, and most indicated that they had formal courses in basic principles of nurse anesthesia practice (91%), advanced anatomy and physiology (81%), advanced pharmacology (87%), and chemistry and physics of anesthesia (65%).

All respondents indicated they had clinical anesthesia training: 18% indicated their clinical training lasted 5 months or less; 23% indicated 6 to 10 months; 19%, 11 to 14 months; 17%, 15 to 22 months; and 23% indicated clinical training was more than 22 months.

- Continuing education. Only half the respondents reported having access to continuing nurse anesthesia education. When analyzed by region, continuing education was reported to be most available to those from countries in the European region and least available to nurses from the African and Southeast Asian regions.

By development level, not surprisingly, availability of continuing nurse anesthesia education was highest for developed countries, slightly less available in developing countries, and only rarely available in the least developed countries. Respondents from countries in transition reported a relatively high availability of continuing education.

This, along with several other items, suggests that a very different educational model, perhaps one with more on-the-job training, may be in use by countries in transition.

We asked how many hours of continuing nurse anesthesia education respondents accrued each year; about one third (36%) reported none; 19% reported 20 hours or less; 27%, 21 to 40 hours; 10%, 41 to 60 hours; and 8% reported participating in more than 60 hours of continuing education annually. All indicated there is a need for nurse anesthesia continuing education programs in their countries.

Regulation and legislation

Ninety-three percent reported special license or certification requirements exist in their countries to practice as a nurse. Most (78%) reported their countries also have requirements for special certification or licensure to practice as nurse anesthetists. This was a fairly consistent finding by region and country level of development. Nearly three fourths (74%) reported their special licenses or certifications do not have to be renewed periodically.

Eighty-three percent reported there are no license or certification requirements for anesthesia assistants or for non-nurse, non-physician anesthetists (86%). However, 93% indicated that their countries have special license or certification requirements for physician anesthetists. Fifty-nine percent reported the existence of governmental regulations that guide the anesthesia practice of nurses. Nearly three quarters (74%), reported that hospital regulations guide the practice of nurse anesthesia.

Medical supervision

Five items were included to assess the supervision of nurse anesthetists. Recognizing that “supervision” has several interpretations, we nonetheless used the term without defining it. We sought to elicit an overall response by allowing respondents to interpret “supervision” contextually, then the amount of supervision was estimated by the number of nurse anesthetists that a physician anesthetist supervises.

First, participants were asked, where they work, if they are required to have physician anesthetists supervise their anesthesia administration. While 43% reported that supervision is required, more than half (57%) reported supervision is not. When analyzed by world region, some nurse anesthetists from countries in every region reported a requirement for physician anesthetist supervision. Most notable was that 85% of nurse anesthetists from countries in the European region reported having

*These courses have been determined by IFNA to be minimal educational requirements for nurse anesthesia practice; each was defined in the glossary.
this requirement, which correlated highly with other items in which the majority of nurse anesthetists from European countries reported the most common form of clinical practice was "combined" physician-nurse practice. What did not correlate well were responses from nurse anesthetists in countries in the African region. Nearly 30% of the subjects from African countries reported they are required to have physician anesthetist supervision, yet on nearly all practice items, more than 90% of these same respondents reported that nurse anesthetists provide anesthesia independently. These participants were from many of the same countries where there are very few physician anesthetists; in some, reportedly there are only six or fewer physician anesthetists for the entire country. The discrepancies between the reported requirement for physician anesthetist supervision and the high independence of nurse anesthesia practice may indicate that nurse anesthetists' scope of practice and subsequent supervision requirements have outgrown the existing regulations.

We asked: Where you work, how many nurse anesthetists does one physician anesthetist supervise at one time, if any? No physician anesthetist supervision was reported by 22%, and 29% reported a supervision ratio of one physician anesthetist to one nurse anesthetist. However, 39% reported a supervision ratio of two to five nurse anesthetists to one physician anesthetist, with 10% reporting a ratio of five or more nurse anesthetists to one physician anesthetist. When analyzed by region, we found that in five of the six regions, often physician anesthetists do not supervise at all, and if they do, most often the ratio of supervision is one physician anesthetist to three or more nurse anesthetists. Many (25%) from the African and American regions reported a supervision ratio of greater than one to four, and respondents from every region reported a ratio of one to five or more.

When analyzed by country development level, all ratios of physician anesthetist supervision were reported at every level. It was subjects from the countries in transition (in this sample, Armenia, Belarus, Bulgaria, Czechoslovakia, Hungary, Latvia, Lithuania, Poland, and Romania) who reported a one-to-one physician anesthetist to nurse anesthetist supervision ratio. However, as stated earlier, these respondents also reported a basic nursing education of only 2 years or less in duration, anesthesia education of 10 months or less, and the highest availability of continuing education.

**Professional organizations**

Forty-three percent reported that in their country, nurse anesthetists have a professional organization. Those from developed countries reported having professional organizations most often, followed by those from developing and least developed countries (Figure 10).

When asked: In your country, if nurse anesthetists are not organized in some way, are they represented by a special section within their national nurses' organizations?, 73% reported no. When analyzed by region, it was found that nurse anesthetists are not usually represented by national nurses' organizations, with the exception of some representation by national nurses' organizations for countries in the European region. When analyzed by development level, more subjects from developed countries reported having representation of nurse anesthetists by national nurses' organizations than respondents from developing countries and countries in transition.

**Changes to improve anesthesia practice**

To further increase understanding of anesthesia practice of nurses worldwide, several open-ended questions were asked. The first was: In your country, what changes would improve the anesthesia practice of nurses? There was a 75% response rate with 397 responses. All comments were translated into English. Improved access to continuing nurse anesthesia education was the most frequent
response, followed by governmental recognition of nurse anesthesia practice. The narratives were grouped as education, practice, and regulation.

The following, in descending order of frequency, were the most frequently cited suggested changes: for education, the changes were greater access to continuing education (48%); improved nurse anesthesia education (30%); improved nurse educational structure (16%); and current anesthesia books and journals (5%). For practice, the changes were access to more resources (35%); improved working conditions (34%); need for professional autonomy (15%); and for better policies to guide practice (11%). For regulation, the changes were governmental recognition, supportive legislation, need for governmental protection (42%); need for professional affiliations (16%); improved licensing/certification requirements (16%); improved practice structure (4%); and improved public relations (9%).

Next subjects were asked if they had any information about anesthesia services in neighboring countries. Nearly two thirds (63%) stated they do not know about anesthesia services in neighboring countries or provided no response. Third, subjects were asked to provide additional information to improve understanding of anesthesia practice in their countries. This question was to encourage respondents to comment about any aspect of their work they believed would be most helpful in improving understanding of their practice without imposing, a priori, any set categories, classifications, or responses. The content generally fell into one of four categories: responses about education, practice, regulation, and unmet needs—the latter mostly referring to insufficient human and fiscal resources.

There was an equal percentage of responses by region describing nurse anesthesia education. It is notable, however, that subjects from countries in the European and American regions had a larger percentage of responses about “practice” and “regulation,” and relatively fewer “unmet needs.” In contrast, subjects from countries in the African, Southeast Asian, and Western Pacific regions had a larger percentage of responses pertaining to scarce resources. Not surprisingly, when analyzed by level of country development, there were notable differences for each level. Respondents from the developing and least developed countries provided a greater percentage of responses concerning unmet needs (specifically, drugs, equipment, personnel, books, and journals), while respondents from developed countries expressed more concern about professional recognition, professional associations, and governmental legislation.

Discussion

In this study, it was found that nurse anesthetists are the primary providers of anesthesia care in many countries, administering, on average, 83% of all anesthetics where they work, more than half of these independently. Respondents reported working in small, medium, and large hospitals, and in urban and rural settings. Most however, (76%) indicated working in the urban areas of their countries, a similar statistic for the United States, where 63% of nurse anesthetists report working in cities, 27% in towns, and 10% in rural locales of less than 10,000 population.

The percentage of male respondents was surprising. The sample consisted of 42% men and 58% women. This gender distribution is equivalent to that in the United States. In the United States, there are more men in nurse anesthesia than any other nursing specialty. These data may indicate that anesthesia is a nursing specialty that worldwide attracts men as well as women.

In many countries, the practice of nurses administering anesthesia is not a new phenomenon, as there were respondents from countries in each region who had been providing anesthesia services for more than 20 years. Also, there are nurse anesthesia professional organizations in each region.

Respondents indicated they perform all the tasks associated with the administration of an anesthetic, from preanesthetic patient evaluations to administering general, spinal, and epidural anesthetics. Most tasks performed by physician anesthetists are, reportedly, those performed outside the operating room, leaving a high level of involvement in anesthesia-related tasks to nurse anesthetists. However, a moderate level of involvement in prenatal care and in pain clinics indicates that some nurse anesthetists may have a broader range of primary nursing practice.

The amount of supervision by physician anesthetists appeared to be regional rather than related to country level of development. Most of the reported one-to-one nurse anesthetist to physician anesthetist practice was by respondents from the European region, the region with the greatest number of large hospitals, where it is reportedly uncommon for either nurse or physician anesthetists to administer anesthesia independently. In the United States, this absence of independent functioning is considered by some to be costly and inefficient for anesthesia practice. This may be true of other countries as well.

The amount of supervision in other regions ranged from no physician anesthetist supervision (22%) to five or more nurse anesthetists to one physician anesthetist. Discrepancies between the re-
ported requirements for physician anesthetist supervision and the reported high amount of independent practice with respect to tasks performed in the administration of an anesthetic suggest that in some places, the regulations requiring supervision may not reflect current practice.

The 1991 IFNA Standards of Practice for nurse anesthetists state that nurse anesthetists will monitor psychological and physiological responses of patients who receive both general and regional anesthesia using invasive and noninvasive modalities to interpret data and take corrective action to maintain or stabilize a patient's condition. The majority of participants reported using noninvasive monitors for most cases. Noninvasive monitors not routinely used were the more expensive "high technology" pulse oximeters and capnographs. Many respondents from the developing and least developed countries reported these are simply unavailable.

Essentially, all nurse respondents met the IFNA requirement of having basic nursing education prior to specializing in nurse anesthesia. The basic education in nursing for 21% of the sample met the recommendation for an educational program of at least 36 months. Most had a basic educational program of 24 months duration, followed by an advanced anesthesia education of more than 22 months. Respondents from countries in transition reported a different model of education. This consisted of a basic nursing education of only 2 years or less in duration and anesthesia education of 10 months or less. These respondents also reported the highest availability of continuing education. These findings have led us to infer that education of nurse anesthetists in countries in transition may emphasize on-the-job training with direct clinical supervision by physicians.

The IFNA has a standard that nurse anesthetists maintain continued proficiency. While there may be many ways to ensure continued competency in a field, formal continuing education programs are frequently used. Yet, nearly half the sample reported a lack of access to continuing education. Again, most of these were from the developing and least developed countries where resources are scarce. Greater access to continuing education and governmental support were the most frequently cited required changes to improve the practice of anesthesia by nurses throughout the world.

One of the interesting findings of our research is that regardless of sociocultural differences, it appears that nurse anesthetists worldwide are more similar than dissimilar. Although there are some differences based on region and level of development, there was a surprising degree of similarity about practice, education, and regulation, indicating that the practice of nurse anesthesia may have evolved in similar ways in many parts of the world, with two notable differences. First, as mentioned previously, respondents from countries in the European region reported the most common practice model is one where a nurse and physician anesthetist work together, with each present for every patient. Most other respondents reported a practice pattern that was either independent of physician anesthetists (22%) or collaborative (51%) with two to more than five nurse anesthetists working with one physician anesthetist. Second, respondents from countries in transition reported not only the highest amount of physician supervision, but also the least formal education, and yet the greatest access to continuing education. A widespread similarity is that 42%, from countries in all regions, stated their contribution to healthcare often goes unrecognized by governments, and more economic and legislative support is required for their practice and education.

Study strengths and limitations

A strength of the study is that subjects from 94 of the 177 (53%) member states in the World Health Organization were included. The sample was derived systematically with the assistance of ministries of health and professional organizations. Phase II responses validated Phase I findings, that is, they confirmed that nurse anesthetists administer anesthesia in 96 of the 107 countries identified in Phase I.

Steps were taken to ensure content validity and conceptual equivalency (in four languages) of the survey instrument and items using an expert panel and glossary. It is possible that some potential subjects may have received a survey in a language with which they were unfamiliar and, because of this, did not participate. Also, the survey was lengthy and time consuming; some may have declined to participate for this reason, thus biasing the findings.

A strength was that 92% of the informants were nurse anesthetists, more than 80% of whom had practiced anesthesia for at least 6 years, and there were nurse anesthetists from countries in every world region and at all levels of development who had been practicing anesthesia for more than 20 years.

Although the study instrument was designed to be quantitative, for each survey item, narrative responses were also encouraged, and more than 75% of the informants provided narratives, which proved to be a rich source of explanatory data.
Responses to three open-ended questions, as well as all the additional materials submitted, were translated to English and analyzed.

As noted, a study limitation was the low number (n = 6) of respondents from only 4 of the 22 countries in the Eastern Mediterranean region. Another limitation was that surveys were sent to all who were nominated in Phase I; therefore, in some cases there was only one respondent per country, and in others there were 2 to 10.

Understanding that within-country variations in practice occur, a judgment was made to include all respondent data equally in analyses, rather than aggregating respondent data for each country, then using the country as the unit of analysis. While the latter strategy may have allowed us to refer more confidently to country-related findings, the former allowed for more powerful analyses and statements from individuals. The sample was not large enough to analyze "countrywide" variations with any degree of accuracy. For example, from Germany we received responses stating that in some geographic areas nurse anesthetists provide most of the anesthetics, while respondents from other German locales reported that the administration of anesthesia by nurses is not allowed by law. From Malaysia, respondents from some locales stated that nurses are allowed to function only under the supervision of physician anesthetists, while those from other locales reported that 90% of the anesthetics are currently given by nurse anesthetists independent of physician anesthetists. Intra-country variability can be investigated with a much larger, more in-depth future study.

The study was cross-sectional and descriptive, no relationships were predicted; however, associations among several demographic and study variables were explored. A longitudinal study (now in progress) will provide more information about change over time.

Conclusions
Today, few countries have a manpower distribution pattern that conforms to community needs and the goal of health for all, whether such a distribution is by geographical area, occupation, specialty, or type of healthcare. If health for all citizens of the world is to be realized, qualified healthcare providers, such as nurse anesthetists, must be supported by governments economically, legislatively, and politically.

It costs less to prepare APNs when compared to physicians, and it costs less to prepare a nurse anesthetist than to prepare a physician anesthetist. In one U.S. study, it was demonstrated that for the cost of preparing one physician anesthetist, 10 nurse anesthetists can be educationally prepared and cumulatively provide 35 to 40 years of nursing and nurse anesthesia services to a community. A similar education cost differential may exist in other developed countries. (However, the educational cost per university student in developing countries has been estimated to be to be as much as seven times that of developed countries.)

Over-investment, in terms of time, money, and education, depletes the resources necessary for adequate access to healthcare. This resource investment problem can be remedied, in part, by ensuring a better match of providers with educational requirements for specific types of work and appropriate educational planning. Re-balancing human resources can go a long way toward ensuring accessible, effective health services for the millions of underserved people on earth.

In a review of nurse-to-doctor ratios globally, the World Development Report (1993) advocated a restructuring of health personnel models to provide more cost-effective healthcare delivery. The report suggested that although doctors are needed for some supervising of clinical care and handling of complications, most of the services in the proposed minimum package of health services can be provided by nurses and midwives.

Our research suggests that in one area of healthcare — the administration of anesthesia — nurses worldwide are currently providing a large portion of direct patient care. Moreover, nurse anesthesia is not a newly emerging advanced practice specialty; many in the study reported practicing for more than 20 years.

Nurse anesthesia may be the first advanced practice specialty in many countries and as such can serve as an exemplar of how nurses can contribute to more cost-effective healthcare delivery. Health policy makers should be aware of the role, functions, education, numbers, and patterns of utilization of all health professionals, including nurse anesthetists, to plan cost-effective healthcare systems that can ensure access to healthcare for all.

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