Because of a critical shortage of anesthesia providers in Belize, the Belize Ministry of Health initiated support for the creation of a nurse anesthesia education program. Developed in collaboration with Health Volunteers Overseas and the University of Belize, the nurse anesthesia education program graduated 10 nurse anesthetists. This article describes the 24-month nurse anesthesia education program’s design, implementation, and evaluation. Challenges and opportunities experienced during the program are outlined as lessons learned for planning similar programs.

**Keywords:** Developing countries, Health Volunteers Overseas, international nurse anesthesia, international nurse anesthesia curriculum, nurse anesthesia education.

In many countries around the world, there is a pressing need to educate highly skilled healthcare professionals, including anesthesia providers, to address concerns of access to surgical services.\(^1\) In Belize, new operating rooms in the regional hospitals stood empty because of the lack of anesthesia providers, according to the chief executive officer of the Ministry of Health (oral communication with P. Allen, DDS, MPH, March 13, 2013). In March 2013, Belize had a total of 15 nurse anesthetists who provided anesthesia care for patients at 4 hospitals: Karl Heusner Memorial Hospital (KHMH) in Belize City, Northern Regional, Southern Regional, and Western Regional. In addition to covering daily elective procedures, nurse anesthetists cover all 4 hospitals after 5 PM during the week and during the weekends, according to the Deputy Director of Nursing at the Ministry of Health (M. E. Parks, oral communication, March 14, 2013). These nurse anesthetists were overworked and provided the only means of anesthetic on-call coverage (M. E. Parks, oral communication, March 14, 2013).

To address the lack of access to surgical services and the critical shortage of nurse anesthetists, officials at the Belize Ministry of Health (BMoH) collaborated with Health Volunteers Overseas (HVO) and the University of Belize (UB) to develop a nurse anesthesia program. The purpose of the program was to increase the number of practicing nurse anesthetists in Belize. The nurse anesthesia program met the requirements for a 2-year postbaccalaureate’s certificate program. This article describes the health problems, healthcare delivery systems, and surgical services in Belize. In addition, the development, implementation, and evaluation of a nurse anesthesia program in an upper-middle-income country\(^2\) with limited resources is described. Lessons learned during the implementation of this program provide insight for the future development of international nurse anesthesia programs.

**About Belize**

Belize is the only country in Central America in which English is the official language.\(^3\) The people of Belize are of diverse ethnic and cultural backgrounds. Most people are Mestizos (49%) and Creoles (25%), with others from indigenous Maya (11%); minorities include Chinese, East Indians, and Mennonites.\(^4\) Belize (formerly British Honduras) obtained independence from Britain in 1981.\(^4\)

The Belize population of 312,000 is distributed almost equally between urban and rural settings.\(^3\) The educational system in Belize is growing on all levels. Primary school is mandatory, and most public schools operate in a church-state system.\(^3\) In the past, the citizens of Belize traveled abroad for tertiary education. Many students still travel to Mexico, Jamaica, Guatemala, and Cuba for specialized education.\(^5\) The UB was established in 2000 and offers training in allied health sciences.\(^3\)

**Health Issues in Belize**

As in many middle-income countries, communicable diseases among the population include acute respiratory infections, diarrhea, malaria, dengue, Chagas disease, HIV/AIDS, and tuberculosis.\(^3\) The estimated adult prevalence of HIV is 2%, which is the highest in Central America and the third highest in the Caribbean.\(^3\)

Major noncommunicable diseases in Belize include diabetes, hypertension, tobacco use, and cancers.\(^3\) In 2007, diabetes was ranked as the primary cause of death.\(^3\) Hypertension was the seventh leading cause of death.\(^3\)
In addition, the 70% of the population in Belize is challenged with being overweight or obese. Table 1 displays a comparison among adults over 20 years old between Belize and the United States. The GOB has a policy for universal access to primary healthcare. The KHMH is a 134-bed facility located in Belize City and is the national referral hospital that works with 3 other government-supported regional hospitals. Services supported by the BMoH include emergency care, pediatrics, obstetrics and gynecology, internal medicine, and surgery. There are 2 private hospitals in Belize City and a small private hospital in the Cayo District. Medical missions, including charitable, faith-based, academic, and nonprofit organizations, regularly visit Belize, leading to the need for strengthening of mechanisms for regulation. Inadequate healthcare staffing has been identified as a fundamental weakness in Belize's healthcare delivery system. The development of essential public health functions by BMoH has focused on human resource development and has been coordinated with the UB.

**Healthcare Services**

The GOB has a policy for universal access to primary healthcare. The KHMH is a 134-bed facility located in Belize City and is the national referral hospital that works with 3 other government-supported regional hospitals. Services supported by the BMoH include emergency care, pediatrics, obstetrics and gynecology, internal medicine, and surgery. There are 2 private hospitals in Belize City and a small private hospital in the Cayo District. Medical missions, including charitable, faith-based, academic, and nonprofit organizations, regularly visit Belize, leading to the need for strengthening of mechanisms for regulation. Inadequate healthcare staffing has been identified as a fundamental weakness in Belize's healthcare delivery system. The development of essential public health functions by BMoH has focused on human resource development and has been coordinated with the UB.

**Surgical Care in Belize**

In 2000 the BMoH approached HVO to initiate a nurse anesthesia program to improve surgical access in Belize because of the lack of anesthesia care. In 2002 and 2003 two cohorts of students graduated from the BMoH-sponsored HVO nurse anesthesia program, providing 13 nurse anesthetists. Although this program was successful, it was not continued because of the lack of demand for additional anesthesia providers in Belize. An assessment by HVO in 2008 noted that all but 1 of those 13 graduates were still working in the country; that graduate moved to Great Britain to work as an anesthesia assistant.

More than 7,000 surgical procedures were performed in 2012, according to BMoH leadership (M. Parks, written communication, 2013). With 3 operating suites, KHMH performs the most surgical procedures of the hospitals in Belize. Services provided include 24-hour coverage for emergency and elective cases for the Ear, Nose, and Throat, Obstetrics and Gynecology, General and Pediatric Surgery, Orthopedics, and Neurosurgery Departments. The hospital has a 24/7 stat laboratory and a pharmacy, and offers private services besides public medical care.

Nurse anesthetists provided 60% of the anesthetics in Belize in 2012 (M. E. Parks, written communication, March 14, 2013). The BMoH realized that the shortage of nurse anesthetists was greatly affecting access to surgical services in Belize. The BMoH has cited unused infrastructure, specifically fully equipped operating rooms, with no anesthesia providers to staff the rooms (P. Allen, DDS, MPH, oral communication, March 13, 2013). The Regional Hospitals in Belize were not able to offer elective surgeries on a full-time basis, KHMH was expanding beds and services, and the population of the country was increasing. The BMoH believed that sending, at government expense, students to the University of the West Indies was cost-prohibitive and would not ensure an adequate supply of graduates.

To address the need for access to high-quality surgical services, the BMoH recommended that local healthcare professionals collaborate with international professionals to strengthen training opportunities. This recommendation led to funding for a nurse anesthesia education program. Subsequently, HVO was contacted for collaboration of development, implementation, and evaluation of the nurse anesthesia program. In 2013, the BMoH appropriated funds to support 16 registered nurses as full-time students in this program. These 16 students possessed various clinical nursing backgrounds, with an average of 5 to 7 years of nursing experience. Students for the program were selected by the BMoH.

### Table 1. Comparison of Noncommunicable Diseases in Belize and United States (percent)

<table>
<thead>
<tr>
<th>Disease</th>
<th>Belize</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td>13</td>
<td>9</td>
</tr>
<tr>
<td>Hypertension</td>
<td>29</td>
<td>33</td>
</tr>
<tr>
<td>Overweight/obesity</td>
<td>70</td>
<td>69</td>
</tr>
</tbody>
</table>

(Adapted from Centers for Disease Control and Prevention.)
Development of an International Nurse Anesthesia Curriculum

The International Federation of Nurse Anesthetists educational standards for preparing nurse anesthetists were used as the basis to guide the development of the curriculum. Designing an international nurse anesthesia curriculum is the time to strategically plan to create partnerships, respect the culture of the host country, and incorporate evidence-based science. The curriculum designed for Belize’s nurse anesthesia educational program was a collaborative effort with HVO; 95 credits were assigned to the program by the UB. One credit of lecture per week in the curriculum for 15 weeks was equivalent to a 1-credit course, and 1 credit of clinical practicum was equivalent to 40 contact hours in the clinical setting. The degree awarded by the UB at the end of the program was a postbachelor's certificate in nurse anesthesia, as designed and directed by the UB. The UB assigned the number of credits to the courses listed in Table 3.

The nurse anesthesia education program was 24 months long. Clinical experience commenced 8 months after the start of the program. Didactic instruction continued until scheduled program completion in December 2014. The curriculum was developed to prepare students to become proficient in a variety of anesthetic techniques for patients across the lifespan. Independent nursing judgment and decision making were emphasized and encouraged. The curriculum included research methods, biophysical sciences, pathophysiology, pharmacology, principles of anesthesia, and professional issues courses. The two anesthetic pharmacology courses were taught via online lectures and materials provided by John Nagelhout PhD, CRNA, FAAN. Evidence-based nursing practice was used to deliver didactic content and was emphasized during clinical study. Clinical practicum time increased throughout the program.

Implementation of the Curriculum

Volunteers from HVO traveled to Belize in 2- to 4-week intervals to provide didactic and clinical “precepting” (preceptorship) support. Didactic content was augmented by online teaching and electronic transmission of lectures. Fewer than 10 lectures were completed via teleconferencing technology. Approximately one-third of the volunteers focused more on precepting of students in the operating room. Program coordinators from HVO provided oversight, selection, and preparation of volunteers who contributed didactic and clinical instruction. Volunteer preparation was composed of communications to short-term volunteers on current student needs before their travel to Belize. Debriefing was conducted following the volunteers’ departure, to close communication loops and share with HVO on areas that were working well or required improvement. In total, HVO provided 31 volunteers to deliver the didactic and clinical components of the program. Some volunteers traveled to Belize on multiple occasions, to combine for 45 total international assignments. The dynamic nature of expert nurse anesthesia lecturers provided for a rigorous academic program.

Although HVO is a volunteer organization, there were costs to implement this educational program. The BMoH covered tuition for all students in addition to a student stipend during the program. The UB provided safe housing and in-country transportation for HVO volun-

Table 2. Millennium Development Goal Progress in Belize

<table>
<thead>
<tr>
<th>Millennium development goal</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Eradicate poverty and hunger</td>
<td>• Not on track; Belize’s poverty rate has increased from 1995 to 2009</td>
</tr>
<tr>
<td>2. Achieve universal primary education</td>
<td>• Not on track; enrollment rates in primary education decreased from 1992 to 2009</td>
</tr>
<tr>
<td>3. Promote gender equality and empower women</td>
<td>• Not on track; women in nonagricultural wage employment only increased from 39% to 42% from 1993 to 2009</td>
</tr>
<tr>
<td>4. Reduce child mortality</td>
<td>• Not on track for mortality under age 5 years; however, making slow progress</td>
</tr>
<tr>
<td>5. Improve maternal health</td>
<td>• Not on track; maternal mortality rate has increased from 1990 to 2009</td>
</tr>
<tr>
<td>6. Combat HIV/AIDS, malaria, and other diseases</td>
<td>• Unable to assess change in HIV rate, as not established before 2009</td>
</tr>
<tr>
<td>7. Ensure environmental sustainability</td>
<td>• On track to achieve target of greatly decreasing spread of malaria</td>
</tr>
<tr>
<td>8. Develop a global partnership for development</td>
<td>• On track, Belize is nearing the goal of reaching 100% access to improved water sources for urban and rural communities</td>
</tr>
<tr>
<td></td>
<td>• Belize is progressing, with increased landline phones being replaced by cellular phones</td>
</tr>
<tr>
<td></td>
<td>• Internet access has been slow to spread; as of 2008, only 11 per 100 persons had an internet connection</td>
</tr>
</tbody>
</table>
In-country transportation included transportation to and from the airport, and daily transportation to either the UB campus for didactic lectures or the hospital for clinical precepting of students. The HVO volunteers paid for airfare, travel vaccines, and teaching materials.

Tracking Student Progress
An electronic tracking system (Typhon, Typhon Group LLC), was used to monitor case numbers and student progress. Typhon allowed HVO faculty and Belizean anesthesia faculty to submit clinical evaluations electronically. With international faculty, Typhon allowed for all program leaders to easily access student clinical case numbers in a timely fashion. So that all students could meet minimum case number requirements, Typhon was used to allow students to track case numbers. Students needed 450 anesthetic clinical cases to graduate and 550 total cases to work independently. Typhon also was used to guide clinical placements to allow students to meet minimum case requirements from rotations at 4 hospitals and to best meet student clinical needs. The use of Typhon for logging of student clinical cases facilitated record keeping and allowed for prompt student access of clinical preceptor evaluations. Students could view their clinical evaluations via Typhon, while HVO coordinators and the UB coordinator could view and manage student progress.

Student Clinical Experience
Students gained experience with a variety of anesthetic techniques and skills. All students had exposure to general anesthetic techniques employing endotracheal tubes, both oral and nasal, and using laryngeal mask airways. All students had adequate exposure to spinal anesthetics for cesarean deliveries. Because of the general lack of use of epidural technique in Belize, students struggled to gain experience with epidural placement. Students at the main clinical site, KHMH, had more exposure to emergency and trauma cases, and pediatric cases. The variation in case numbers was due to differences in time in the clinical setting, as a few students were removed from clinical rotations because of lack of academic progress. These students eventually met the required clinical numbers to meet graduation requirements at the end of the remediation program.

Students gained experience caring for a variety of patients. Students provided anesthetic care to acutely and chronically ill patients, as noted by ASA class 3 and 4 case numbers. As the country’s national referral hospital, KHMH provided the most experience with high-acuity cases. Experience caring for patients with severe systemic disease was key for students, as the population in Belize is challenged with increasing rates of hypertension, diabetes, and obesity.11 The students are prepared to serve patients with these comorbidities.

Program Evaluation
After the completion of the educational program, all 10 graduates were invited to participate in an evaluation. Six students completed the anonymous online evaluation on Typhon. A Likert scale was used: strongly disagree, disagree, neutral, agree, and strongly agree. Students were
asked to rate clinical preparation for providing general anesthesia to patients of all ages and medical conditions. Two (33%) students reported that they strongly agreed, 3 (50%) students reported they agreed, and 1 (17%) student disagreed. Students were asked to rate clinical capability to use a variety of techniques, agents, drugs, and equipment. Two (33%) students reported they strongly agreed, and 4 (67%) students reported they agreed. Finally, students were asked to rate clinical preparation to provide general anesthesia to all trauma and emergency patients, and ability to function as a resource for airway management. For both items, 3 (50%) students reported they strongly agreed and 3 (50%) students reported they agreed. Table 4 displays the student responses.

Program Outcomes
At the end of the program, 7 (43.8%) of the initial 16 students completed all didactic requirements, including the successful passing of the comprehensive examination. Three (18.8%) of the 16 students completed a remediation program designed to augment didactic knowledge. Ten students (63% of the original number) completed all the graduation requirements and were available to join the Belize anesthesia workforce by the end of 2015. This represented a 67% increase in the number of nurse anesthetists in Belize.

Improving the Program
The nurse anesthesia education program delivery was completed successfully, with challenges and opportunities. Challenges identified by HVO coordinators (ie, K.A.H., S.T.B., and R.H.) included selection of students, clinical access, coordination between HVO and the university, and preceptor engagement. Opportunities to address each challenge are offered.

• Student Selection. Challenge: There were 16 students admitted to the program. During the program, 6 (38%) students dropped out because of personal, academic, or clinical performance issues. These students were selected by the BMoH without input from the UB or HVO. Opportunity: To decrease attrition and improve retention, clear admission criteria should be created for appropriate student selection. In addition, nurse anesthesia faculty from the host community or HVO will be involved in admission policies and student selection.

• Clinical Access. Challenge: The number of admitted students exceeded the capabilities of operating room cases. Each student needed 450 cases to graduate and 550 to practice autonomously, but with clinical rotations at the 4 Belizean hospitals, there was not enough surgical volume for students to meet these requirements in the 24-month program. Therefore, 6 months of clinical practice was added to the 24-month program. Opportunity: Decreasing the class size or initiating rolling program admissions could alleviate this problem in the future.

• Curriculum Implementation. Challenge: In November 2012 HVO was invited to Belize. A site visit was scheduled for March 2013. Although core courses were started at program commencement in January 2013, time was lost with starting nurse anesthesia courses and clinical cases. Although the expertise of HVO volunteers was matched with topics in the curriculum, course schedules did not match the UB academic calendar. Lecture schedules were based on timeframes for volunteers with particular expertise. Coordination of the students’ academic calendar between the UB and HVO required additional consideration by the UB registrar’s office. Registrar requirements and intermittent in-country availability of a nurse anesthesia coordinator provided additional challenges to delivery of student didactic examinations and lectures. Different perspectives on the program between outgoing and incoming deans at the university level provided inconsistent levels of university support. Didactic education was hindered by a lack of funding for student textbooks for approximately 5 months of anesthesia courses until an HVO volunteer donated an anesthesia textbook to each student. Opportunity: Future program implementation should plan for coordination between and among academic institutions and volunteer organizations to optimize student learning. Before program initiation, earlier and more thorough planning is crucial between organizations to clearly communicate student requirements and program timelines.

• Presence of an On-Site Coordinator. Challenge: Coordination of the nurse anesthesia program was at its best when there was an active on-site UB faculty member who was a nurse anesthetist. The UB coordinator was able to address day-to-day issues regarding didactic, clinical, and student issues. In addition, the coordinator was able to assist with organization of volunteers’

### Table 4. Student Satisfaction With Clinical Preparation (N = 6; No., %)

<table>
<thead>
<tr>
<th>Type of clinical preparation</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>GA to all ages and medical conditions</td>
<td>0 (0)</td>
<td>1 (17)</td>
<td>0 (0)</td>
<td>3 (50)</td>
<td>2 (33)</td>
</tr>
<tr>
<td>Variety of techniques, drugs, equipment</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>4 (67)</td>
<td>2 (33)</td>
</tr>
<tr>
<td>GA to all patients (trauma and emergency)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>3 (50)</td>
<td>3 (50)</td>
</tr>
<tr>
<td>Function as resource for airway management</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>3 (50)</td>
<td>3 (50)</td>
</tr>
</tbody>
</table>

Abbreviation: GA, general anesthesia.
transportation, housing arrangements, and licensing requirements. The coordinator worked with the UB to schedule student clinical hours and fit these rotations into the UB academic calendar. This local coordinator was not assigned to this role until September 2013, nine months after the start of the nurse anesthesia program. Coordinator absences, as mandated by the UB, disrupted program implementation. **Opportunity:** Engagement of a local nurse anesthetist as a program coordinator in the planning phase will enhance harmonization between organizations for future programs.

- **Preceptor Resistance. Challenge:** Clinical preceptor engagement in the students’ learning was another challenge. The HVO volunteers provided a precepting education session to the Belizean nurse anesthetists before student clinical practicum. Despite this education, Belizean preceptors were reluctant to precept students in the clinical setting. This reluctance required students to spend more time gaining their required clinical experiences of 550 cases. To illustrate, if there were 3 operating rooms running and 1 nurse anesthetist refused to work with students, there were only 2 operating rooms worth of surgical cases for student clinical practicum. **Opportunity:** Ways to engage preceptors in the future may include role-modeling behavior, including Belizean nurse anesthetists in the planning for the program, and addressing concerns about precepting.

**Conclusion**

The goal of this collaborative educational effort was to produce engaged, proactive Belizean nurse anesthetists who can strengthen the delivery of anesthesia care in their home country. Introducing and encouraging the use of evidence-based care will allow for continued professional growth. In a global setting, the link between education and healthcare workers must meet demands of the healthcare system. It is imperative to educate flexible professionals who will eventually participate in task shifting. This program was designed to provide a variety of clinical experiences and didactic content, to prepare students to be leaders in perioperative care in Belize.

The goal of globalization of nursing is to promote health and alleviate suffering. Crigger et al acknowledge that along with these undertakings, global nursing strives to encourage social justice for all, no matter the nation or people, and for equality of healthcare. Through engagement and collaboration, the eventual transfer of ownership shifts to the host country. As the host community is empowered and advances in capacity building are realized, sustainability is eventually achieved. In addition to capacity building, unmet surgical needs can contribute to greater disability and death in low- and middle-income countries. The goal of this program was to increase access to and quality of surgical services provided to the people of Belize by increasing access to high-quality anesthesia care. This program has created a new cohort of nurse anesthetists in Belize, ready to provide high-quality, evidence-driven anesthetic care.

The goal of the HVO/Belize Nurse Anesthesia Education Program was to create a new cohort of nurse anesthetists who would expand access to anesthesia and surgery throughout Belize. The program accomplished this goal, and much more. Experience with the first class in 2002 has shown the model could work. Despite institutional and logistical challenges and opportunities for improvement, the second class enjoyed a more sophisticated learning experience, as measured by state-of-the-art teaching methods and student satisfaction surveys. Although we do not know the extent to which these new indigenous nurse anesthetists improve anesthesia in Belize, it is fair to predict that this second class will indeed help Belize meet the stated goal of increasing access to surgical care, and thereby lessen surgical disability and death due to problems that can be treated surgically. Additionally, because the project engaged, empowered, and collaborated with Belizeans, it went a long way toward transferring ownership of anesthesia to the host country. For these reasons, we believe the HVO/Belize Nurse Anesthesia Education Program was a resounding success.

**REFERENCES**


AUTHORS
Kathleen (Durkan) Hammond, DNP, MSN, CRNA, is a full-time staff nurse anesthetist in Philadelphia, Pennsylvania. She is the associate director of the Health Volunteers Overseas Belize Nurse Anesthesia Program. Suzanne Brown, CRNA, is the prior Health Volunteers Overseas Cambodia Nurse Anesthesia Program director and the Health Volunteers Overseas Belize Nurse Anesthesia Program director.

Lisa Bernardo, PhD, MPH, RN, is an adjunct associate professor at the University of Pittsburgh School of Nursing, Pittsburgh, Pennsylvania.

Laura Palmer, DNP, MNEd, CRNA, is an assistant professor in the Department of Nurse Anesthesia at the University of Pittsburgh School of Nursing and an assistant director of the university's Nurse Anesthesia Program, Pittsburgh, Pennsylvania.

Richard Henker, PhD, CRNA, FAAN, is a professor in the Department of Nurse Anesthesia at the University of Pittsburgh School of Nursing and a consultant to the Health Volunteers Overseas Belize Nurse Anesthesia Program.

DISCLOSURES
The authors have declared they have no financial relationships with any commercial interest related to the content of this activity. The authors did not discuss off-label use in this article.

ACKNOWLEDGMENTS
Kathleen Hammond was a 2013 American Association of Nurse Anesthetists Foundation Doctoral Fellowship recipient. The authors thank all the clinical and didactic volunteers from Health Volunteers Overseas who donated their time and efforts to teach the Belizean student registered nurse anesthetists. The authors acknowledge Lecia Bevans, University of Belize Nurse Anesthesia Program coordinator, for her dedication to the students, educational program, and the nurse anesthesia profession. The authors thank John Nagelhout, PhD, CRNA, FAAN, for his contributions of materials for the delivery of two pharmacology courses.