



FORMATION / TRAINING PROGRAM

MODEL 5 YEAR CARDIOTHORACIC SURGERY RESIDENCY PROGRAM IN HO CHI MINH CITY, VIETNAM / MODÈLE DE FORMATION DE 5 ANS EN CHIRURGIE CARDIO-THORACIQUE À HO CHI MINH, VIETNAM

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Summary

Given the increasing incidence and prevalence of cardiothoracic disease in Vietnam, and the need for more CT surgeons to meet the need, an updated, improved, and organized CT surgery residency program is recommended. It is hoped that this program will not only increase the quantity, but the quality of CT care, as well as becoming a more attractive specialty for future CT surgeons. This may well be a model for other postgraduate residency programs. However, the ultimate success of this program rests with the local Vietnamese parties involved. This includes the national ministers of health and education, the local university and hospital administrators, and the individual heads and faculty of cardiac, vascular, thoracic, and general surgery.

Introduction

The ready access, availability, and growth of cardiac surgery continues to favor the developed countries (Figure 1)¹. The growth in the developing countries and emerging countries, though slower, parallels the growth domestic product (GDP)². There are many factors for this. One of them is a need for qualified cardiac

surgery teams, as well as in situ education/training programs for cardiothoracic surgeons³. At present there is no international cardio-thoracic (CT) surgery program that coordinates or certifies resident candidates⁴. The present report summarizes the attempt to start a de novo CT surgery residency program in Vietnam. Lessons from a similar effort in China provided a valuable experience and background for this attempt⁵.

Project Formation

The author has been intermittently involved with cardiac surgery development in Vietnam for the past 21 years. In July, 2010 a survey of the active cardiac surgery centers was made. This one month project, sponsored by the Vina Capital Foundation (<http://vinacapitalfoundation.org/>), involved visits to most of the cardiac centers in Vietnam to gain basic data that included number of staff, infrastructure, and annual caseloads. Interviews were conducted with residents and

both junior and senior CT surgeons. It was clear changes were needed in the structure of CT surgery education and training. Over a one year period correspondence was exchanged with Cho Ray General Hospital in Ho Chi Minh City, Vietnam, the major medical teaching center in the south, to develop a model education/training program. In collaboration with the training department, and the NGO Hearts Around the World Inc. (www.hearts-aroundtheworld.org), a 6 month project was started in July, 2012. A. Thomas Pezzella MD, the Founder/Director of the

International Children's Heart Fund (<http://www.ichfund.org>), conducted the project. The project was approved and accepted by the education and training department at Cho Ray Hospital. The results of this project are presented.

Background

Vietnam, a vibrant country of more than 90 million people in Southeast Asia, has made significant strides in the political and economic sectors, and slower but steady progress in the education and healthcare sectors since reunification in 1975 (Table 1)^{6,7,8}. Health care spending is less than five percent of GDP and remains socialized with progressive attempts to provide health insurance programs and encourage privatization. 80% of healthcare spending remains "out of pocket". Yet, there has been a progressive increase in government financed health care insurance, as well as significant improvements in public health and the hospital access sectors. Life expectancy in 2012 is 73 years for males and 77 years for females^{6,7,8}. The under- five mortality rate was 150 per 1,000 live births in 2005^{6,7,8}. This has decreased to 23 in 2012⁸. The Health Development Index (HDI) for Vietnam in 2012 is 0.531 (ranked 71 of 132 countries)⁹. This ranking is based on life expectancy; adult literacy; primary, secondary, tertiary gross school enrolment; and GDP per capita (Low is <0.499; Medium 0.500-0.799; and High 0.800-899).

In Vietnam the curative healthcare system pathway or referral is the communal, district, provincial, and national major city medical center levels with efficiency and progressive flow through the system dependent on geographical location, bureaucracy, and complexity of illness. Communication and transportation access remain major issues. This is especially true for trauma, critical, and complex medical conditions.

The development and growth of cardiac surgery has accelerated since 1991 with the opening of the Carpentier Heart Institute in Ho Chi Minh City (formerly Saigon). In 1994 the open heart program was restarted at Viet Duc Hospital in Hanoi. As of August, 2010, there were 21 centers performing cardiac surgery in Vietnam (7 in Hanoi; 9 in Ho Chi Minh City; 1 in Haiphong; 1 in Hue; 2 in DaNang, and 1 in Rach Gia city in the Mekong delta, in Kien Giang province). Several more have now opened in the past 2 years. Yet only 10 centers performed >100 cases/year. It is now estimated that over 100 cardiac surgeons (senior, junior, assistants) perform more than 7,000 procedures annually in Vietnam. Yet the estimated prevalence of patients presently in

need of adult or pediatric open heart cardiac surgery or intervention is 50-80,000, with an added annual incidence of >6,000 cases.

In Vietnam, the basic educational system for the cardiac surgeon includes 12 years of primary or elementary school, followed by the 6 year university bachelor of medicine degree. Ho Chi Minh City (HCM) Medical University is the primary medical school in the south, and the center for postgraduate medical residency programs in the south. Following medical school with a bachelor's degree in medicine, there is an additional alternative academic pathway of 4-6 years to obtain the Masters and Doctor of Medicine degree. There is no country wide Minister of Health or Minister of Education centrally coordinated or monitored clinical residency system in Vietnam (Graduate Medical Education-GME). For those who qualify for medical school the tuition is negligible, thus minimizing financial debt.

There are only 4 established structured unofficial cardiac surgery "in house" cardiac surgery training programs in Vietnam. Viet Duc University hospital in Hanoi has a 3-5 year program that combines general and cardiothoracic surgery. There is also a training program in Hue city, the ancient capital of Vietnam. Cho Ray General Hospital in HCM city has a 3 year cardiac surgery training program in collaboration with the HCM city medical university. They also have a separate Specialty I and II program.

The HCM city Heart Institute, started in 1991, has the oldest program for education/ training of the entire cardiac care team, including the cardiac surgeon¹⁰. At present, their initial system of selection of cardiac surgery residents includes a written and oral examination for the graduating medical student. This is followed by a 3-6 month observational period wherein the resident is evaluated. If selected, the aspiring resident receives 3.5 years of additional training. Following this period, an additional 3-5 years is spent as a junior staff member, before selection to senior staff, or recommendation as senior surgeon to another institution.

Currently, many of the practicing cardiac surgeons have spent varying periods of time at the Carpentier Heart Institute. In addition, many have received 1-2 years of formal non-accredited training abroad, or 1-3 month observational training periods abroad. Presently there is no consensus amongst those interviewed regarding the immediate or future needs of cardiac surgeons in Vietnam. Also, there is no consensus in Vietnam regarding the annual number of needed CT surgeons to fill the available job

opportunities. The newly formed Vietnam Association of CT Surgery meets once per year, and is gradually addressing some of these issues. The recent quarterly publication of a dedicated Vietnam CT surgery journal has enhanced the increased academic activity. There is not much basic or clinical research aside from the clinical thesis required for the Master's or PhD degrees.

In all, there are 5 teaching hospitals in HCM city affiliated with the HCM City medical university. These include Cho Ray hospital, HCM Heart Institute, Children's hospital 1, the TB/Chest hospital, and the University Hospital. Only Cho Ray has a defined 3 year post medical CT surgery residency program. Combining the 5 centers to establish an organized 5 year program under the umbrella of the medical school is the major goal of this project.

More than 80% of the annual caseloads are valve (primarily rheumatic mitral), and congenital heart operations. Pulmonary hypertension in both groups is a significant risk factor. This is a reflection of delayed presentation, incomplete evaluation, or late referral. Rheumatic fever and rheumatic heart disease (RHD) remain prevalent, yet are slowly decreasing in incidence in younger children, secondary to an aggressive government prevention program. Yet, there are still more than 5,000 patients requiring surgical treatment for RHD.

The incidence and prevalence of congenital heart disease is growing secondary to increased objective (2D ECHO) recognition, especially in neonates. In most of the cardiac centers the average surgical caseloads include >50% congenital heart disease. Neonatal congenital cardiac operations (<1month) or weight <5 kg are increasing, yet done in only 5 centers. This includes the National Children's hospital in Hanoi, the medical center in Hue, HCM City Heart Center, and both Children's 1 and 2 in HCM city. There is current debate regarding the number and future location of other neonatal cardiac surgery centers.

Coronary artery disease, which is steadily increasing, is treated primarily with angioplasty/stenting. Interestingly, each coronary stent costs around \$1,000 US. Off pump (OPCAB) coronary artery surgery is increasing. The average "out of pocket" cost for heart surgery in Vietnam is \$1,500-\$4,500 for congenital heart disease and \$2,000- \$5,000 for valve surgery (the average prosthetic mechanical valve costs about \$1,200). A government mandated insurance scheme requires all children to have insurance, and, in 2009, 62% of children under 6 were covered. This plan usually contributes

approximately one fourth to one third of the actual cost of surgery. Cardiac surgeons are employed by the central or local government with a monthly salary ranging from \$200 to \$400. Salaries are supplemented by performing other operations or working in private hospitals or clinics. The majority of centers are government or public, with only a few private centers.

Historically, a number of individual foreign surgeons, non-government organizations (NGO's), and international centers have been engaged with projects in Vietnam over the past 21 years. Many countries have been involved, including the USA, France, Japan, Singapore, Malaysia, Thailand, Australia, New Zealand, Taiwan, Germany, Switzerland, and others. Vina Capital Foundation, East Meets West, Atlantic Philanthropy, and Children's Heart Link are large NGO's with a long relationship in Vietnam, and continue to be actively involved. Yet there is little or no communication, cooperation, or collaboration amongst the NGO's. This is unfortunate since a lot of time and money could be better utilized.

In summary, the present and future challenges facing cardiac surgery, as well as all healthcare services in Vietnam include:

- increasing governmental funding for cardiac services to allow increased access and availability. This includes increased patient health insurance coverage, and improved salary/benefits for hospital doctors and staff.
- improved referral system for critical and complex cases, especially with regards to communication and transportation (there is no medical air transport system). Bus, care, and motorcycle are the primary modes of transportation. Train, helicopter, and airline services are not readily available.
- continued improvements in hospital infrastructure, and updated and new equipment and resources.
- improved procurement system from distributors of needed disposables (especially perfusion cannulas, perfusion packs, and oxygenators), and specialized drugs, eg. PGE1 and Milrinone.
- availability of sophisticated or more advanced cardiac surgical techniques
- phased development and increase in neonatal cardiac surgery at designated centers
- increasing and retaining well trained healthcare personnel both at home and abroad
- assessment of immediate and future cardiac care personnel needs, especially cardiac surgeons, intensivists, perfusionists, nurses, cardiology, and anesthesia

- development of regional neonatal cardiac surgery centers in Hanoi, Hue, and HCM City
- the establishment of both clinical and basic research/development initiatives
- the slow emergence and development of private practice initiatives. and/or joint cooperation, to allow reasonable salary structures for doctors, nurses, and allied healthcare staff. This would significantly decrease foreign and domestic migration or poaching, as well as changing careers
- a national registry of neonates, infants, children, adolescents, and adults with congenital or acquired heart disease in need of heart surgery
- acceptance of the fact that an organized national post graduate residency education/training program is necessary in all specialties, not just CT surgery, and that graded responsibility is not dangerous to the patients¹¹.
- increased collaboration amongst the international NGO's working in the cardiac care sector to improve the quantity and quality of CT surgery. There are several models to explore¹²⁻¹⁵.

Proposed Model 5 Year CT surgery Residency Education/Training Project Background

In the USA, all Graduate Medical Education (GME) is financed by the federal government through the Medicare program¹⁶. In 2004, Direct-GME funding was 2.7 billion dollars, and Indirect-GME funding 5.8 billion dollars. Medicare controls the total number of resident positions in accredited residency programs. This has become a debated area since the number of residency positions exceeds the annual number of medical school graduates. Given the need of doctors in primary care, as well as selected specialty areas, the shortfall has been filled by foreign medical graduates.

Also, in the USA, the non-profit independent Accreditation Council for Graduate Medical Education (ACGME), established in 1981, controls and coordinates the 8,355 ACGME residency programs, covering 126 specialties and subspecialties, and 106,245 residents¹⁷. Each specialty board, like the American Board of Thoracic Surgery (ABTS), coordinates the criteria, selection, residency programs, and certification processes. At present there are 72 approved CT surgery residency programs in the USA with a total of 102 training positions¹⁸.

Historically, the German triangle or pyramid surgical training system was brought to the USA by Dr. William Halsted to Johns Hopkins Hospital

in Baltimore, Maryland in 1889³. This system produced a number of gifted surgeons who became chiefs at many academic centers, but failed to satisfy the need of more qualified surgeons to meet the rising demand. It was basically a modification of the master/apprentice philosophy. In 1931 Dr. Edward Churchill redesigned the system to a more horizontal system that increased the overall number of qualified and capable surgeons. The model was based on the creation of a group of master surgeons with an institutional team approach to education and teaching³. This system currently persists in the USA.

In contrast, the Vietnamese triangular or pyramid system is problematic and likely to fail, since there are only a limited number of vacancies in the hospitals, with the best candidates competing for the few positions in the larger centers. In addition, promising candidates will be dissuaded from pursuing a long and arduous career in favor of more lucrative careers in other areas. To use the airline example, as Vietnam airlines increases its flights and routes, buying more Boeing and Airbus planes, they urgently need more trained pilots.

"VIETNAM AIRLINES TRAINS OWN PILOTS"

"THE NATIONAL CARRIER VIET NAM AIRLINES HAS BEEN ABLE TO TRAIN PILOTS LOCALLY, AND HAS NOT SENT THEM ABROAD. THE FIRST 20 PILOTS IN THE PROGRAMME WERE GRANTED FLYING LICENSES ON FRIDAY IN CAM RAHN CITY IN THE CENTRAL PROVINCE OF KHANH HOA."

Vietnam News, Monday September 10, 2012.

This mandates quantity and quality in a shorter time period. Foreign pilots are a short term measure. Long term, native Vietnamese pilots are needed.

CT surgery is growing in Vietnam, given the increase in centers, and more patients with public funding, insurance, or ability to self-pay for specialized services. This mandates an increase in qualified Vietnamese CT surgeons. Vietnam has well trained and capable mentors and teachers. Systemic change is necessary and a paradigm shift to accelerate the experience and responsibility of the aspiring Vietnamese CT surgery residents will help alleviate the problem (Figure 2). If this does not occur, then fewer candidates will pursue a career that is critical for Vietnam's balanced healthcare growth, but that is low in salary, long in training, and therefore professionally unfulfilling. In interviewing a

number of Vietnamese medical students and residents, the three major desires and/or needs included: the opportunity to do what they were trained to do; to secure a job with a reasonable salary/benefits; and personal time for family and personal interests. Residency is an essential dimension of the transformation of the medical student to the independent practitioner along the continuum of medical education. It is physically, emotionally, and intellectually demanding, and requires longitudinally-concentrated effort on the part of the resident.

The specialty education of physicians to practice independently is experiential, and necessarily occurs within the context of the health care delivery system. Developing the skills, knowledge, and attitudes leading to proficiency in all the domains of clinical competency requires the resident physician to assume personal responsibility for the care of individual patients. For the resident, the essential learning activity is interaction with patients under the guidance and supervision of faculty members who give value, context, and meaning to those interactions. As residents gain experience and demonstrate growth in their ability to care for patients, they assume roles that permit them to exercise those skills with greater independence. This concept – graded and progressive responsibility – is one of the core tenets or competencies of American graduate medical education (Table 2).

Supervision in the setting of graduate medical education has the goals of assuring the provision of safe and effective care to the individual patient; assuring each resident's development of the skills, knowledge, and attitudes required to enter the unsupervised practice of medicine; and establishing a foundation for continued professional growth.

The primary model of the revised program being proposed is a modified version of the American Board of Thoracic Surgery (ABTS). At present there are 3 pathways for USA CT surgery resident candidates¹⁹: (1) a full general surgery residency followed by 2-3 years of CT surgery residency; (2) a 4 year general surgery program with 3 subsequent years of CT surgery residency in a joint training program; and (3) a 6 year integrated general and CT surgery residency program. Our model is a 2 year general surgery program with 3 year CT surgery residency model.

Specific Aspects of the Model Program Recommendations

Present system

6 years of medical university ending in May or June calendar year

Free time to study for examination, vacation, etc.

3 pathways: (all political, bureaucratic, inefficient, and counterproductive)

- residency program x 3 years—exam—Residency degree, Specialty 1, Master's degree- go to PhD degree x 3 years.

- Master's program x 2 years—exam- Master's degree x 3 years- exam- PhD program x 3 years- exam.-work 2 years—exam—Specialty 1 program x 2 years----degree—work 3 years--- go to Specialty 2 for 3 additional years.

Proposed Revised System

University based with 4 Teaching Hospitals:

Cho Ray Hospital

HCM Children's Hospital #1

HCM City University Medical Center

HCM City Heart Institute

TB/Chest Hospital

The University is responsible for the program.

The four participating clinical hospitals share in that responsibility.

Program Director/Coordinator

The University Chief of CT Surgery will designate the program director or coordinator. The program coordinator should be a CT surgeon and must have a defined job description. He/she reports to the chief of CT surgery who then reports to the Dean/Director of medical university. The major responsibilities include: the candidate selection process, establishing and coordinating the individual rotations, auditing the resident case log book, coordinates the core curriculum and morbidity/mortality conferences, and collecting the clinical rotation evaluations from both staff and residents. The director also arranges and coordinates the written and oral examinations. Salary, benefits, vacation, and personal resident issues are also his/her charge.

Selection/Acceptance requirements

Following successful completion of an approved 6 year medical university program, the candidate can apply for the 6 year CT surgery program. If selected, the program begins in October following graduation from the medical university in June or July prior.

Program Outline

The program overview is summarized in Table 3. Other elements include:

5 year program: 2 years basic surgery/3 years CT surgery

Operative caseloads and log: Observe, 2nd assist, 1st assist, Primary with Attending 1st assistant or Attending observing with junior as 1st assistant. (Appendix 1)

Rotations: Basic, CT surgery (Appendix 2)

Wet laboratory; Simulation (University medical school campus). Also Cho Ray hospital wet lab.

Core Bibliography (Appendix 3)

Written exam after basic surgery, then written/oral exam after final CT surgery program

Certificate from Dept. CT Surgery HCM University as well as Cho Ray hospital, and Master's Degree from HCM University

Faculty issues

The senior surgeons, especially those trained abroad, must be responsive, enthusiastic, and dedicated to the education/training of the younger residents. They need to be a model for the future CT surgeon, and willing to transfer their experience to the next generation, as well as the development of their respective cardiac department.

Academic appointment at University and clinical appointment at teaching hospital is required.

Clinical Publications: Case report, How to do it, Reviews, Retrospective study, Prospective study.

A proposal was discussed with Dean/Director of HCM medical university regarding visiting foreign senior faculty for 3 month periods over a 2 year period (Providing financial airfare/ hotel/ 1 week vacation).

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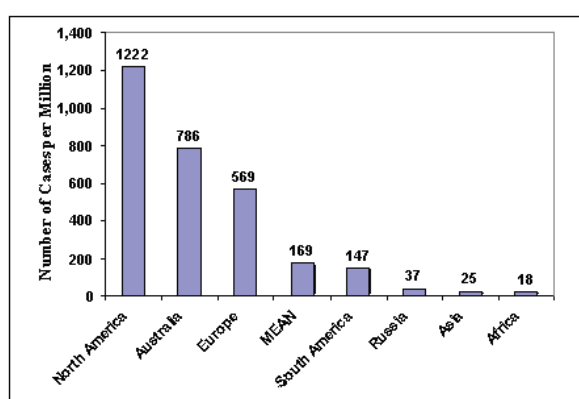


Figure 1 : Cardiac surgery worldwide



Figure 2: CT surgery residents 2012, Cho Ray General Hospital, HCM City, Vietnam

Table 1 : Demographic and Health Care characteristics in vietnam

Total population (2012)	90,796,000
Gross national income per capita (PPP international \$, 2012)	3,620
Life expectancy at birth m/f (years, 2011)	73/77
Probability of dying under five (per 1 000 live births, 2012)	23
Probability of dying between 15 and 60 years m/f (per 1, 000 population, 2011)	128/87
Total expenditure on health per capita (Intl \$, 2011)	231
Total expenditure on health as % of GDP (2011)	6.8

Table 2:

Accreditation Council for Graduate Medical Education (ACGME) Core Competencies

- Patient Care
- Medical Knowledge
- Practice-Based Learning and Improvement
- Interpersonal/Communication Skills
- Professionalism
- Systems-Based Practice

*Source: <http://aats.org/multimedia/files/ACGME-Competencies-In-Srgical-Rresidencies-ACS.pdf>. Accessed 9/21/13

Table 3: Overview of Program Requirements for Certification

- Program Director/Coordinator
- Basic 2 year surgery rotations and procedures
- Cardiothoracic Rotations
- Core Curriculum
- Caseload; Operative Log
- Core lectures- 3 year academic cycle with lectures prepared/given by resident
- Weekly preoperative case discussions to include indications, contraindications, timing of procedure, knowledge of operative technique, and early/late complications of operation
- Simulation training---- wet lab, "boot camp"- Cho Ray, University (20)
- Bibliography of basic texts, journals, websites (c.f. appendix 3; www.ctsnet.org)
- Call schedules/Vacations/ Individual resident needs
- Evaluations – Resident/Rotations/Faculty
- Specific certification requirements
- Clinical competency-approval of program director
- Operative minimum requirements
- Successful completion of 2 part examination process (written and oral)

Appendix 1 : Operative case loads and log

Cardiothoracic Pathway		Requirements	General Thoracic Pathway	
USA--Vietnam			USA-----	Vietnam
20	20	Congenital Heart Disease	10*	10*
10	10	Primary		
10	10	First Assistant	*All cases can be as First Assistant	
150	65	Adult Cardiac	75	65
50	45	Acquired Valvular Heart	20	45
80	10	Myocardial Revascularization	40	10
15	5	Re-Operations	5	5
5		Aorta	0	0
15	10	Other	15	0
50	50	Lung, Pleura, Chest Wall	100	100
30	30	Pneumonectomy, lobectomy, Segmentectomy	50	50
20	20	Other	50	50
5		Mediastinum (resection)	10	10
15	8	Esophagus	30	30
10	4	Esophagectomy/Resection	20	20
0	0	Benign Esophageal Disease	5	0
5	4	Other	5	5

Appendix 2**CT Surgery Residency Rotations**

Basic Surgery- 24 weeks

General Surgery- 6 months

- Core competencies, Preoperative care and Risk assessment, Database, Fluid/Electrolytes, Metabolic stress, Nutrition, Hematological issues, Wound healing, Surgical infection, Shock, Oncology, Transplantation, Trauma, Burns, Critical Care
- General Surgery: Acute abdomen, Hepatobiliary, Hernias, GI, Liver/portal system, Colorectal, Spleen, Head/Neck, Abdominal wall, Endocrine (Thyroid, Parathyroid, Adrenal), Skin/Soft tissue, Breast, Obesity

-Support rotations

Trauma/ Burns-2 month
 Critical care-----1 month
 Anesthesia-----1 month

Surgical specialties

Cardiac surgery-2 months
 Thoracic surgery-1 month
 Vascular surgery-1 month
 Orthopedics-----1 month
 Neurosurgery-----1 month
 Plastic surgery----1 month
 Pediatric surgery-2 months
 Urology-----1 month
 ENT, Endoscopy---1 month

Elective, Radiology, Pathology, Wet lab. 1 month

Elective-----1month

CT Surgery rotations- 36 weeks**Year one:**

Cardiac Surgery – 3 months
 Thoracic Surgery—2 months
 Vascular Surgery- 1 month
 Clinical Cardiology- 1 month
 Interventional Cardiology- 1 month
 Pulmonary/Oncology- 1 month
 Anesthesia Cardiac/ Thoracic - 2 months
 Perfusion- 1 month

Year two: (varies with concentration)

Adult Cardiac- 3-6 months
 Pediatric Cardiac- 3-6 months
 General Thoracic- 3-6 months

Year three: (varies with concentration)

Adult Cardiac- 12 months
 Pediatric Cardiac- 12 months
 General Thoracic- 12 months

Core Procedures on Surgical Subspecialties

Neuro-surgery

Traumas, Head bolt- Increased ICP
 Craniotomy
 Thoracic spine-Posterior mediastinum vertebral body access

Orthopedics

Amputation lower extremities (AKA, BKA)
 Thoracic vertebral body exposure

Urology

Supra-pubic bladder tube placement
 Peritoneal dialysis catheter placement
 Repair ureter
 Nephrectomy

Plastic Surgery

Burns (Adult/Pediatric)
 Hand injury
 Rotation Muscle Flaps (pectoralis, trapezius)

ENT

Epistaxis
 Cervical Esophagus
 Thyroidectomy
 Tracheostomy
 Laryngoscopy
 Endoscopy

Colorectal

Colon interposition
 Roux en Y

General Surgery

Damage control for trauma
 Exploratory celiotomy

Gastric resection
 Pyloroplasty
 Splenectomy
 Liver injury control and resection
 Laparoscopy
 Gastrostomy
 Jejunostomy
 Mastectomy
 Thyroidectomy
 Cholecystectomy

Vascular Surgery
 Embolectomy
 Carotid endarterectomy
 Abdominal Aortic Aneurysm (AAA)
 Aorto femoral bypass
 Femoral poploterial bypass
 Renal fistula

Critical Care Procedures
 Monitor preparation, zeroing, CO
 determination
 ET intubation
 Tracheostomy
 Vascular access (arterial, venous)
 Swan Ganz placement
 Pericardiocentesis
 IAB Insertion, removal
 Peritoneal dialysis catheter insertion
 (Tenckhoff)
 Supra-pubic bladder catheter insertion
 Chest tube placement
 Bronchoscopy
 Cut down access (neck, arm, leg)

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Appendix 3

Core Program Bibliography

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