# Expanding the role of perfusionists in the era of new treatment options for cardiovascular disease

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**Treatment for cardiovascular disease has dramatically changed the surgical patient population over the past 10 years. Advances in medical management and interventional cardiovascular procedures have delayed surgery in many adults, and the surgical pool has begun to decrease despite an aging population. This affects perfusionists in terms of new psychological and technical challenges, and has serious consequences and implications for the future of the profession.**

**This study will review the changing patterns of diagnosis and treatment of cardiovascular disease in the USA over the past 10 years by examining the annual surgical procedure rates and correlating them with the number of practicing perfusionists and new student graduates. The purpose of this review is to project the future employment opportunities for perfusionists.**

**The second part of the paper will look at the alternative roles perfusionists have expanded into as a result of changes in the treatment of cardiovascular disease. The results of an e-mail survey of perfusionists will be presented to identify new applications of perfusion technology.** *Perfusion* (2003) **18,** 253–256.

## Introduction

As we approach the 50th anniversary of the first successful use of cardiopulmonary bypass (CPB), it appears to most practicing clinical perfusionists that the perfusion profession is at a major crossroads. Throughout the profession's history, there have been significant technological breakthroughs that have altered the perfusion landscape and influenced the daily practice of cardiac surgery.

As early as 1974, CPB was abandoned for off-bypass cardiac massage during surgical clipping of cerebral aneurysms.[1] The off-bypass surgical approach was then abandoned for the safety of CPB as CPB techniques improved.[2] Today, CPB is being avoided during off-pump coronary artery bypass (OPCAB) procedures, and many clinical studies to determine the efficacy of the OPCAB approach are underway.

During the early 1980s, many of the 'damaging effects of cardiopulmonary bypass' were elucidated.[3] Coating tubing and anti-inflammatory agents then became available, and perfusionists began to slowly incorporate these preventative strategies into their daily routines. Today, the surface area reduction with miniaturized CPB circuits is under investigation to potentially reduce some of these deleterious effects.

In response to the growth of cardiac surgery, the number of perfusion schools in the USA increased,[4] and the profession doubled in size during the 15-year period from 1985 to 2000 (personal communication JB Riley, October 2002).

In the mid-1990s, a new procedure, percutaneous transluminal angioplasty (PTCA), became widely available and the effect on cardiac surgery was dramatic. Although this technique was successfully applied more than 25 years ago, the increase in utilization of the procedure during the 1990s was exponential. Patients formerly referred for coronary bypass surgery are now being treated in the cardiac catheterization laboratory. With the addition of thrombolytics, newly occluded coronary vessels are reopened, and the need for emergent coronary bypass surgery has decreased. Today, new technology in the form of 'coated stents' promises lower restenosis rates, and may further impact surgical rates.

As stated earlier, the use of the OPCAB has reduced the need for CPB. Many cardiac surgeons have used this technique successfully, and many thoracic surgical residents are becoming very adept

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at this procedure. Cardiologists, as well as patients, have been advised of the advantages of OPCAB surgery, and often request this technique. A recent paper reviewed the 'evidence-based medicine' analysis of the benefits of OPCAB surgical approach.[5]

Because of these technological advances, treatment for cardiovascular disease has dramatically changed the surgical patient population. Advances in medical management and interventional cardiovascular procedures have delayed surgery in many adults, and the rate of surgical procedures has been affected despite an aging population. This also affects perfusionists in terms of new psychological and technical challenges, and has serious potential consequences and implications for the future of the perfusion profession.

The purpose of this study is to analyze the future need for perfusionists by reviewing the changing patterns of diagnosis and treatment of cardiovascular disease in the USA over the past 10 years. This paper will examine the annual surgical procedure rates and compare them with the number of practicing perfusionists and new student graduates. Alternative roles that perfusionists have expanded into as a result of these technological changes will be addressed.

## Methods

In order to get baseline data, this study first examined the changing population in the USA over the past 10 years (1990–2000) and looked for significant patterns in terms of population age categories undergoing large percentage increases.

Data were retrieved from the National Center for Health Statistics regarding hospital discharge and surgical procedure rates.[6] These rates were identified through ICD-9 coding. Hospital discharge rates for various categories of cardiovascular disease were reviewed to establish the changing patterns of hospitalization of patients requiring treatment. This was recorded in terms of both the total volume change over the time period as well as the hospital discharge rate per 100 000 population. Changes in categories of cardiovascular disease indicate patterns that may identify future opportunities for surgical intervention.

Once these patterns were identified, they were used to interpret the changing volume of cardiac surgery over the same 10-year period. The cardiac surgical rates (per 100 000 population) were examined to delineate the effect of changing technology and diversion of patients away from surgical treatment.

Several perfusion training programs have reported on the state of perfusion education over this same time period.[7] This information will be evaluated as they relate to the changing patterns in surgical treatment.

Finally, a survey was conducted via the Internet on the effects of OPCAB on the perfusion profession. Although, in general, perfusionists seemed very concerned about the changes in cardiovascular treatment, they also identified opportunities for perfusionists, and gave excellent commentary about the current state of affairs in clinical practice.

## Results

From 1990 to 2000, the total population of the USA increased 11.04% (1.1%/year) from 240 million to 278 million. Because life expectancy continues to increase, the median age in the population has also increased, with a significant increase in the elderly population. During this same time period, the number of people over 45 years of age increased 21.6%. Some of this increase can be attributed to the 'baby boomer' population born between 1946 and 1965. As this group approaches retirement age of 65, beginning in 2011, a significant population shift will occur. As a reference, between 1990 and 2020, the population in the 65–74 age group is projected to grow 74%.

'Diseases of the heart' continue to be the leading cause of death in the USA, with more than 720 000 deaths in 2000. Hospital discharge rates for cardiovascular disease continue to climb. There was a 23.3% increase in volume of hospital discharges for cardiovascular disease, and a rate/100 000 population increase of 11% during the 1990s. Categories of cardiovascular disease reported from 1990 to 2000 include ischemic disease and congestive heart failure. The volume of patients discharged after treatment for ischemic disease increased 36.2% with an 11% rate/100 000 population increase. Even more dramatic, the volume of patients discharged after treatment for congestive heart failure increased 39.5% with an 11% rate/100 000 population increase during this same time period.

Cardiac catheterization volume increased 22% overall during the same 10 years, and the rate/100 000 increased 10%. In the over 65 population, cardiac catheterization volume increased 42% and the rate/100 000 increased 29%. As point of reference, the over-65 population increased 9.41% during this time period.

Percutaneous transluminal angioplasty (PTCA) increased 259% during this same time period, with

a rate/100 000 population increase of 223%. In the over 65 population, PTCA volume increased 355%.

Overall cardiac surgical volume also increased, but at a much lower rate. The volume of valve procedures increased 53% (5.3%/year) and coronary bypass surgery increased 29% (2.9%/year), although the volume and rate/100 000 of coronary artery bypass surgery reached a peak in 1997. A comparison of the percent changes on an annual basis over the 10-year period is summarized in Table 1.

Since 1990, the annualized increase in the number of certified perfusionists is 6.8%. The greatest increase occurred from 1990 to 1995. Since 1996, the number of certified perfusionists has increased only 1.6%/year. Due to annual attrition, the annual net increase in perfusionists is 1.3% (personal communication, American Board of Cardiovascular Perfusion, 2002).

Data available regarding OPCAB volume is estimated since the data available through government reports has at least a two-year lag time. Technological modification of OPCAB devices is very rapid, and there are four years of manufacturer-supplied data to report. OPCAB percentage has increased from 13.9% to 23.5% of CABG procedures during the past four years (average increase of 3.3%/year) (personal communication Medtronic Incorporated October 2002).

Based on the OPCAB e-mail survey information, 40% of perfusionists have expanded into new areas in order to increase their scope of practice. Some of these areas are listed in Table 2.

## Discussion

The rate of population growth $>65$ years of age, CABG surgery volume, valve surgery volume, and discharges for congestive heart failure are all increasing in the range of 2.6–5.3%/year. The net increase in clinical perfusionists has leveled off at 1.3% per annum. Population growth, and the looming 'baby boomer' population at the cusp of the cardiac surgical intervention period, maintains a slow but steady increase in cardiac surgical procedures. Increased hospital discharges for congestive heart failure highlight a potential avenue for perfusion and surgical expansion. Based on the hospital discharge data and new cardiology interventions, both cardiac surgeons and perfusionists should shift some of their focus from treating ischemic disease to congestive heart failure technology as the population ages. This includes participating in research to promote ventricular assist devices and other surgical methods to treat congestive heart failure.

**Table 1** Data summary 1990–2000

| | |
|---|---|
| Increase in elderly population ($>65$) | 2.6%/year |
| CABG increase | 2.9%/year |
| CABG rate increase in $>65$ | 2.8%/year |
| Valve volume increase | 5.3%/year |
| Increase in CHF hospital discharges | 3.9%/year |
| Net increase in perfusionists | 1.3%/year |

CABG, coronary artery bypass graft; CHF, congestive heart failure.

Cardiac surgeons are also facing many challenges at this time, and their success is integrally related to the future of the perfusion profession.[8] Because of the increase in interventional cardiology procedures, there has been an 11% increase in the number of hospitals performing cardiac surgery in the USA during the year 2001. This drains routine cases away

**Table 2** Perfusionists' scope of practice

| | |
|---|---|
| Activities reported added ($n=252$) | |
| No new activities | 61% |
| Adult ECMO | 1% |
| Autotransfusion (noncardiac) | 6% |
| Database management | 8% |
| Hemodynamic monitoring | 1% |
| Pediatric ECMO | 1% |
| Platelet gel | 10% |
| Point of care testing | 5% |
| Robotic surgery | 1% |
| Ventricular assist monitoring | 2% |
| **Expanded role for perfusionists** | |
| Cerebral oximetry | |
| Continuous veno-venous dialysis | |
| Apheresis | |
| Pacemaker monitoring | |
| Automatic implantable cardiac defibrillator monitoring | |
| Evaluation of lungs from 'nonbeating donors' | |
| Renal dialysis | |
| Transmyocardial laser | |
| Troubleshoot HeartMate outside hospital | |
| Doppler flow probe measurement | |
| Radio frequency ablation intraoperatively | |
| Setting up drugs for anesthesia | |
| Endoscopic vein harvesting | |
| Tissue engineering | |
| **Education changes suggested** | |
| Increase scope of practice | |
| Provide physician assistant training | |
| Decrease number of students | |
| Decrease number of schools | |
| Increase number of clinical cases | |
| More hematological training | |
| More emphasis on database management | |
| Teach how to lead in-service classes | |
| Increase point of care testing training | |
| Transesophageal echocardiography training | |
| Stress importance of dealing with government agencies | |
| Organ function, preservation and storage | |
| Liver dialysis | |
| **Continuing education changes** | |
| More hands-on in new techniques | |
| Practice questions for board exams | |
| More self-study materials for continuing education units | |
| Case scenarios presented | |

from the academic medical centers and reduces the learning opportunities for cardiothoracic residents. 'Matching' of applicants for cardiac residencies and training programs has decreased over the past several years. Cardiothoracic surgery is viewed with less opportunity for several reasons. Reimbursement has been reduced severely over the past 10 years. Many cardiac surgeons have not retired, and therefore job openings have diminished. The long residency period and work week do not appeal to many new medical school graduates. A reduction in the number of cardiac residents will reduce the number of practicing cardiac surgeons, and this may impact on the number of cardiac operations. In Canada, where the number of cardiac surgeons/100 000 population (age adjusted) is 50% of the number in the USA, the cardiac surgical rate is only 50% of the USA rate.[9] Another factor is interventional cardiology, and its impact on cardiac surgery in treating ischemic disease.

The perfusion profession needs to be flexible, adaptive, and be ready to embrace new related technologies. The future of the profession depends on the vision of today's leaders. New developments in tissue engineering and organ preservation are strongly related to our current clinical practice. As these techniques move from research into clinical practice, perfusionists need to be available to offer their expertise and participate in clinical research.

Some perfusionists, including OPCAB survey respondents, have questioned the wisdom of continuing to train new perfusionists, considering the changing patterns of cardiovascular treatment. In response to their thoughts, and based on the data presented in this paper, the continuation of perfusion education programs at their current rate of output seems justified. The perfusion profession is already very small, 3300 certified perfusionists in the USA, and the annual net increase due to education programs is just over 1%. The best way to insure the future of the profession is to expand the scope of practice, and continue to support the recognition of this scope of practice through state licensing and national certification. To reduce significantly the numbers entering the perfusion profession because we were unable to integrate ourselves into the technological innovations in cardiovascular treatment at this crossroad would be the end of our profession.

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