

**Original Article**

***Staffing Issues at Open-Heart Centers Offering both Pediatric and Adult Perfusion Service: 1998 Survey Results***

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**ABSTRACT**

A survey directed to centers offering both pediatric and adult perfusion services was conducted to determine how pediatric cases were distributed among individual perfusionists in their departments. These centers were also asked what they believed the clinical activity level should be for a perfusionist each year to remain proficient in pediatric cardiopulmonary bypass. The questions were asked via e-mail and then followed up with telephone interviews as necessary.

Out of the 100 centers contacted, 45 responded to the survey (43 North American, 2 European). Of the forty-five centers, forty-one provided both pediatric and adult perfusion services. Thirty-two centers (78%) offering adult as well as pediatric perfusion services distributed the pediatric caseload to a select group of perfusionists. Nine centers (22%) distributed the pediatric open-heart caseload to the entire staff. From the respondents, the average minimum number of pediatric cases believed necessary to remain proficient in pediatric perfusion was 42.8 cases annually. Centers having dedicated pediatric perfusionists had a slightly higher annual caseload than did those at non-specialized centers, despite practicing at institutions averaging fewer pediatric open-heart cases annually.

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## INTRODUCTION

Though studies involving pediatric perfusion techniques and cardiopulmonary bypass (CPB) equipment exist (1, 2), there is no published literature on the subject of pediatric perfusion manpower. While it is universally agreed that adult and pediatric perfusion management techniques and circuitry are substantially different (3–5), the field of Perfusion Technology does not have any recognized guidelines addressing experience, clinical activity, nor continuing education standards for pediatric practice. Perfusionists in departments providing both pediatric and adult perfusion service must be competent in two very different perfusion techniques. In the absence of professional guidelines, these institutions must determine whether the entire staff or a subgroup within the department should perform pediatric CPB.

A survey was conducted to obtain information regarding staffing strategies at centers offering both pediatric and adult perfusion services. Occurrences of departmental pediatric specialization and the annual pediatric caseload per perfusionist deemed adequate to maintain proficiency were investigated.

## MATERIALS AND METHODS

Between April and May of 1998, surveys were sent to 100 centers via e-mail through the American Society of Extra-Corporeal Technology (AmSECT) Pediatric Committee's perfusion newsgroup database (enrollment = 258 individuals). One response was accepted from each institution to eliminate any possible redundancy.

A total of four questions was asked of the group:

1. How many pediatric CPB cases does your institution perform annually?
2. Does your institution also perform adult CPB, if so, how many annually?
3. How many perfusionists are employed at your institution and how many of those perform pediatric CPB?

4. What was believed to be the clinical activity level necessary for individuals to remain proficient in pediatric CPB.

Follow-up e-mail or telephone conversations were used as needed to clarify responses.

The responding centers were separated into two groups; Group I, centers who perform only pediatric CPB and Group II, centers performing both adult and pediatric CPB. Group II was further divided into two subgroups (Figure 1). Subgroup A consisted of centers which used a dedicated group of perfusionists to perform pediatric CPB. Subgroup B consisted of centers using the entire perfusion staff to share the pediatric CPB caseload. Once the data was obtained, comparisons between Groups and Subgroups were made regarding the average pediatric caseload per institution, the average pediatric staffing levels, the average pediatric caseload per perfusionist, and the annual recommended average pediatric caseload per perfusionist to remain a proficient practitioner. Results are expressed as means  $\pm$  the standard deviation.

## RESULTS

Out of the 100 centers contacted 45 individuals (each representing one open-heart center) responded to the survey (43 North American, 2 European). Four of the responding centers provided only pediatric services, Group I. Forty-one responding centers provided both pediatric and adult perfusion services, Group II. Within Group II, 32 centers (78%) had a dedicated group of perfusionists within the department who performed pediatric as well as adult CPB, (Subgroup A). Nine centers had no departmental pediatric specialization, (Subgroup B). The annual pediatric caseload per perfusionist in Subgroup A averaged to  $147.7 \pm 109.6$  cases. The average staffing level in Subgroup A was  $3.3 \pm 1.2$  perfusionists. The annual pediatric caseload in Subgroup B averaged to  $254.4 \pm 146.8$  cases. The average staffing level was  $7.6 \pm 3.8$  perfusionists in Subgroup B.

When asked how many annual pediatric cases per perfusion-

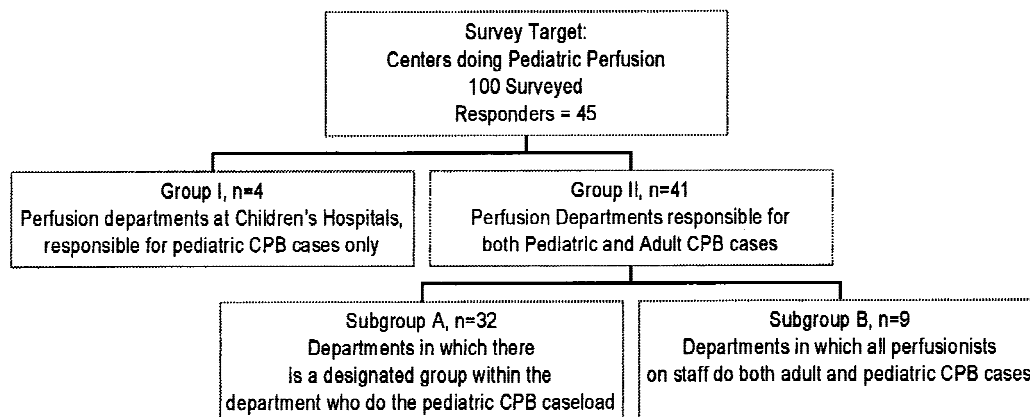


Figure 1: Survey map.

ist were recommended to maintain proficiency, Group II's responses averaged to  $42.8 \pm 16.8$  cases per year. Of the 41 centers in Group II, 25 (61%) reported that their perfusionists did not average the recommended 42.8 pediatric CPB cases per perfusionist per year. Sixteen center's (39%) perfusionists did not perform as many pediatric CPB cases annually as they recommended, from the survey, to remain proficient (Figure 2). The pediatric open-heart caseload was responsible for 12.5% of the annual caseload in Subgroup A, while in Subgroup B, 31.3% of the annual caseload was comprised of pediatric CPB cases (Table 1). An average yearly pediatric caseload equal to or greater than 30 was performed by 62% of the responding center's perfusionists. If minimum caseload thresholds are adjusted, one may determine the percentage of responding institutions that are able to attain that minimum threshold (Table 2). Subgroup A averaged 47.0 pediatric CPB cases per perfusionist per year and recommended 42.3 cases annually to remain proficient. While Subgroup B averaged 36.3 pediatric cases per year and recommended 44.4 per year to remain proficient.

Group I's response to the question of what was believed to be the clinical activity level necessary for individuals to remain proficient in pediatric CPB averaged to 60 cases per year per perfusionist. All four of Group I's perfusionists participated, as primary perfusionist, in more than 60 pediatric CPB cases per year.

## DISCUSSION

There are many centers worldwide in which perfusionists perform both adult and pediatric CPB. While this arrangement seems to work well, difficult situations may arise in institutions with a large adult caseload and a disproportionately small number of pediatric open-heart cases. These difficulties may include departmental competitiveness and a decreased comfort level of the perfusionist due to a limited individual pediatric caseload.

The majority (78%) of centers, responding to the survey, performing both pediatric and adult open-heart surgery, did

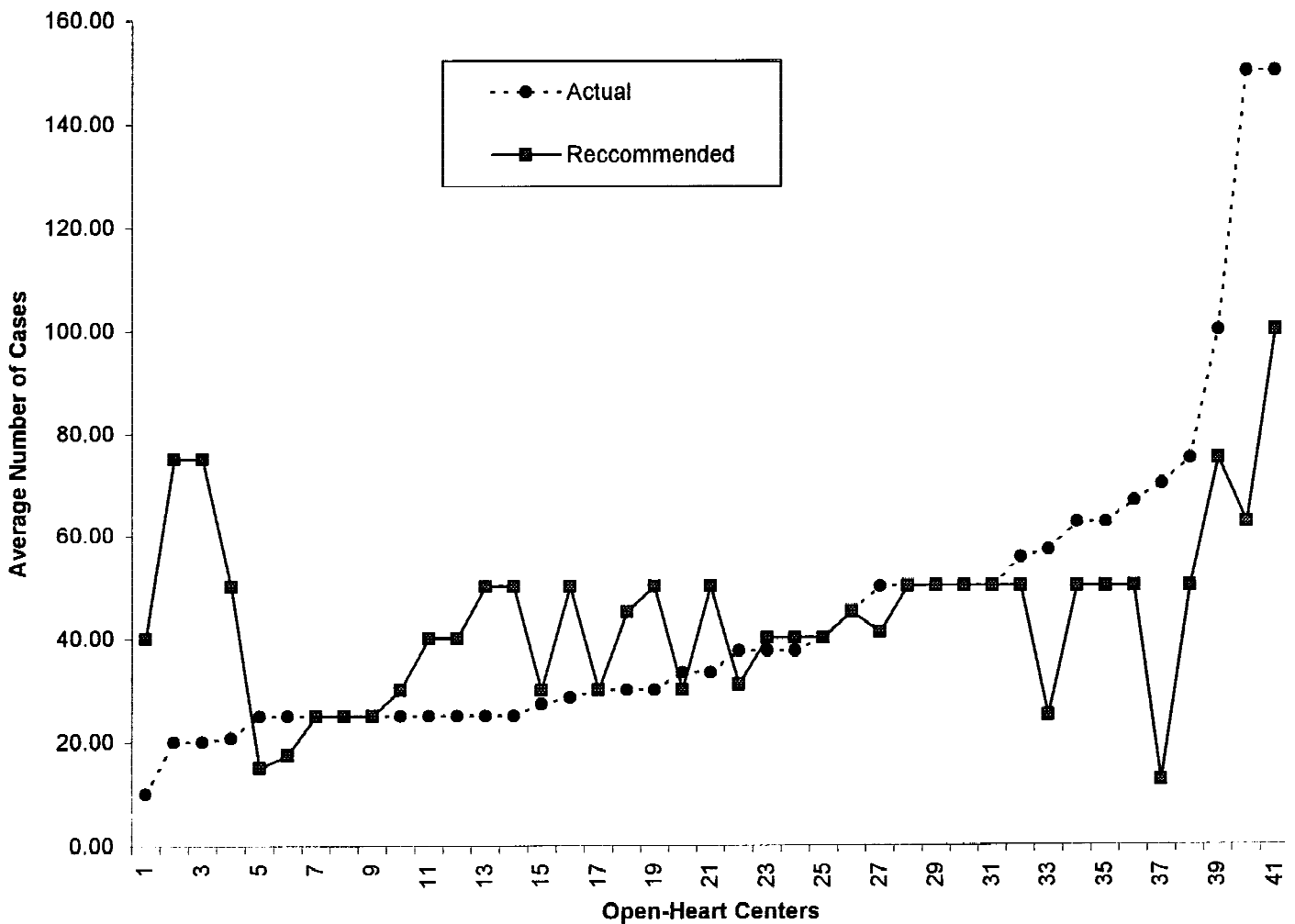


Figure 2: Actual vs. Recommended Annual Caseload per Institution

**Table 1: Open-heart centers practicing adult and pediatric CPB**

	Subgroup A N = 32	Subgroup B N = 9	Combined N = 41
Institutional Average Pediatric Caseload/yr.	147.7 ± 109.6	254.4 ± 146.8	217.1 ± 125.0
Percent of Total Caseload	12.5%	31.3%	
Range	50–500	100–500	
Average Pediatric Staffing Level	3.3 ± 1.2	7.6 ± 3.8	4.7 ± 2.7
Range	2–6	2–14	
Perfusionist Average Pediatric Caseload/yr.	47.0 ± 33.0	36.3 ± 17.0	44.6 ± 30.4
Range	10–100	20–63	
Average Recommended Pediatric Caseload/yr. Per Perfusionist	42.3 ± 18.0	44.4 ± 15.3	42.8 ± 16.8
Range	12.5–100	25–75	

All values are derived from individual institutional responses

have a designated subgroup practicing pediatric CPB. Of this group there were some unique methods of further optimizing pediatric exposure and increasing competency. One group rotated staff to the pediatric hospital they serviced, concentrating their experience into a tighter time frame, for continuity. One center has a totally separate pediatric team to perform CPB for the specified patient population. Finally, one center provided 100% secondary perfusionist backing on all pediatric CPB cases to increase exposure to this patient population. One of the European centers had recently reorganized their pediatric program by using a dedicated team of surgeons, anesthesiologists, perfusionists, and nurses and perceived an increased quality of management and patient outcome as a result. Within Subgroup B, one group reported they were trying to use a dedicated group, but found the topic to be very sensitive.

The American Board of Cardiovascular Perfusion lists 75 perfusion cases as one of its requirements to sit for the examination process. Currently, the Standards and Guidelines of the

Accreditation Committee for Perfusion Education (ACPE), recommends that graduates of perfusion education programs perform, or observe, 10 pediatric cases prior to graduation. Does performing 75 adult perfusion cases and observing 10 pediatric perfusion cases, make one competent to perform pediatric perfusion? It is quite conceivable that a graduate of an accredited perfusion program could pass the board exams, become a Certified Clinical Perfusionist, and be eligible for hire as a pediatric perfusionist, having never managed a pediatric case. Under the current system many need to be trained on the job to gain proficiency in pediatric perfusion. One option to training on the job could be a modification of the Standards and Guidelines by the ACPE requiring perfusion training programs to offer clinical pediatric case management experience to perfusion students. Another option could be the endorsement of a pediatric perfusion internship, by the ACPE, advising a level of experience gained at an appropriate institution. The exact type and amount of pediatric experience necessary to become a pediatric perfusionist needs to be addressed by the pediatric perfusion community and the ACPE.

While it appears that institutions deal with the issue of pediatric proficiency by training on the job and forming a specific sub-group within their departments, the question arises, should the perfusion community pursue formal specialization in the field of pediatric perfusion?

There are substantial differences between pediatric and adult cardiac physiology (6). Pediatric perfusion management utilizes several techniques that are not routinely used in adult practice. Modified ultrafiltration, zero balance ultrafiltration, total circulatory arrest, and mixed pH/alpha stat blood gas management are some of the different techniques used. The difference between the pediatric circuit and that of an adult is substantial. The adult is diluted 25–33%, while the neonate can be diluted 200–300% from normal (4). Pediatric open-heart

**Table 2: Recommended and adjusted minimum pediatric caseloads**

	Average No. of Cases/Yr./Perfusionist	% of Centers Achieving
Threshold Recommended		
By Respondents	42.8	39%
Adjusted Threshold	35.0	46%
	30.0	62%
	25.0	90%
	20.0	97%

By adjusting the average annual caseload per perfusionist down to lower thresholds, it is possible to determine what percentage of the responding centers could attain that minimum threshold

cases are congenital in nature; hypoxic and cyanotic patients are vastly different from the adult with acquired coronary disease (5). There has been a shift in pediatric cardiac surgery from palliative procedures towards corrective neonatal surgery (7). Neonatal circuitry has increased in complexity, at many centers, to decrease the priming volume and surface area. In addition, intrauterine fetal heart surgery can be anticipated in the near future (8, 9). These differences and changes need to be understood and appreciated by the pediatric perfusionist.

Human error has been reported to be the defining factor in 80% of all accidents (10). Experience has been cited as a highly important component of perfusion safety, especially in regards to pediatric perfusion (11). Children under one year of age represent 61% of all events entered into the Pediatric Perioperative Cardiac Arrest Registry, 37% were related to cardiovascular events (12). It has been recommended that guidelines for reasonable care in pediatric CPB needs to be established, suggesting that it is likely that perfusionists will face more litigation in the future as repair of complex congenital heart defects in younger and smaller patients becomes more commonplace (13).

The idea of specialization in allied health professions is not a new one. Medical Technologists specialize into eight different areas. These specialists obtain their certification by utilizing a wide variety of routes involving different amounts of education and work experience before being eligible to sit for a specialty certification board exam.<sup>a</sup> Diagnostic Medical Sonographers have three different registries for specialists, Registered Diagnostic Medical Sonographer,<sup>b</sup> Registered Cardiac Diagnostic Sonographer,<sup>b</sup> and Registered Vascular Technologist.<sup>b</sup> An Occupational Therapist may become board certified in Pediatric Occupational Therapy with a qualifying score on a written exam administered by the American Occupational Therapy Association (AOTA). To become eligible to sit for the board exam one must have the proper amount of pediatric experience and professional development as outlined by AOTA.

The positive effects of a pediatric specialization within perfusion technology could include increased standard of care, increased customer service, increased rapport with pediatric cardiac anesthesiologists and pediatric cardiac surgeons, increased experience level per perfusionist, and increased lab and research involvement. Adversely, negative effects may include management issues such as increased call complexity and frequency, increased daily assignment complexity, and possible departmental polarization.

To date, no guidelines are available to direct the practicing pediatric perfusionist toward a more successful pediatric practice. AmSECT has formed a pediatric committee, which coordinates continuing education seminars and facilitates commu-

nication within the pediatric perfusion community. Development of guidelines is stated as one of the pediatric committee's goals.

In the absence of professional guidelines, the authors are developing within their institution a method of assuring a high level of patient care for the pediatric patient. Providing a high level of patient care while still encouraging professional development throughout the department will be achieved by forming a core group of pediatric perfusionists. This core group of pediatric perfusionists will drive change, develop and revise protocol, attend weekly conferences, participate in lab experimentation, and provide pediatric case management on patients fifteen kilograms or less. This core group will strive to perform, as primary perfusionist, 30 pediatric CPB cases per year. It is acknowledged that difficulty arises when deriving proficiency levels from a survey. The fact that 62% of the responding centers were able to provide 30 pediatric CPB cases annually per perfusionist indicates that this number is a more realistic minimum standard for use at this institution (Table 2). The core group will be responsible for mentoring less experienced staff members conducting CPB on larger children. This core group will also concentrate on obtaining pediatric continuing education and share resources with the rest of the perfusion staff.

The issue of formal pediatric perfusion specialization is a very sensitive one. The potential benefits of such organization, however, are too great to be ignored. It is clear to the authors that some form of specialization should be seriously considered. At the very least, the perfusion community needs to further research and discuss these issues to determine meaningful standards and guidelines for pediatric CPB management.

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a American Society of Clinical Pathologist's Board of Registry.

b American Registry of Diagnostic Medical Sonographers.

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