# Determinants of Pediatric Echocardiography Laboratory Productivity: Analysis from the Second Survey of the American Society of Echocardiography Committee on Echocardiography Laboratory Productivity

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*Background:* The American Society of Echocardiography Committee on Pediatric Echocardiography Laboratory Productivity aimed to study factors that could influence the clinical productivity of physicians and sonographers and assess longitudinal trends for the same. The first survey results indicated that productivity correlated with the total volume of echocardiograms.

*Methods:* Survey questions were designed to assess productivity for (1) physician full-time equivalent (FTE) allocated to echocardiography reading (echocardiograms per physician FTE per day), (2) sonographer FTE (echocardiograms per sonographer FTE per year), and (3) machine utilization (echocardiograms per machine per year). Questions were also posed to assess work flow and workforce.

*Results:* For fiscal year 2013 or academic year 2012–2013, the mean number of total echocardiograms—including outreach, transthoracic, fetal, and transesophageal echocardiograms—per physician FTE per day was 14.3 ± 5.9, the mean number of echocardiograms per sonographer FTE per year was 1,056 ± 441, and the mean number of echocardiograms per machine per year was 778 ± 303. Both physician and sonographer productivity was higher at high-volume surgical centers and with echocardiography slots scheduled concordantly with clinic visits. Having an advanced imaging fellow and outpatient sedation correlated negatively with clinical laboratory productivity. Machine utilization was greater in laboratories with higher sonographer and physician productivity and lower for machines obtained before 2009.

*Conclusion:* Measures of pediatric echocardiography laboratory staff productivity and machine utilization were shown to correlate positively with surgical volume, total echocardiography volumes, and concordant echocardiography scheduling; the same measures correlated negatively with having an advanced imaging fellow and outpatient sedation. There has been no significant change in staff productivity noted over two Committee on Pediatric Echocardiography Laboratory Productivity survey cycles, suggesting that hiring practices have matched laboratory volume increases. (J Am Soc Echocardiogr 2016;29:1009-15.)

*Keywords:* Pediatric echocardiography laboratory, Physician productivity, Sonographer productivity, Machine productivity, Work flow, Workforce

The American Society of Echocardiography (ASE) Committee on Pediatric Echocardiography Laboratory Productivity (C-PELP) was formed in 2008. The aim of this group was to study institutional factors influencing the clinical productivity of physicians and sonographers. In 2013, the first C-PELP survey results from 54 centers revealed that full-time equivalent (FTE) physicians interpreted an

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**Abbreviations**

**ASE** = American Society of Echocardiography

**C-PELP** = Committee on Pediatric Echocardiography Laboratory Productivity

**FTE** = Full-time equivalent

**TEE** = Transesophageal echocardiogram

**TTE** = Transthoracic echocardiogram

average of 15 studies per day, and sonographers performed an average of almost 1,300 studies per year.[1] These productivity numbers were independent of surgical program size but correlated directly with total laboratory volume. The survey results provided useful benchmarks for the assessment of staffing needs in an academic echocardiography laboratory.

Identifying factors that improve work flow and thereby improve efficiency and productivity is crucial in the current economic environment. We hypothesized that evaluating longitudinal survey data from a large number of pediatric cardiology programs would enhance the understanding of echocardiography laboratory productivity that resulted from the first C-PELP survey. A second survey (C-PELP II) was hence initiated to assess these longitudinal trends as well as the projected growth of echocardiography laboratories and need for additional staff members and equipment.

## METHODS

The C-PELP II survey, containing 100 questions, was electronically distributed to the directors of 99 pediatric echocardiography laboratories in the United States and Canada (Supplementary Appendix 1). All centers were identified through the ASE membership database, and the list included those with and those without pediatric cardiology fellowship programs. The survey collected information on the following:

1. Laboratory characteristics: annual total number of echocardiograms, transthoracic echocardiograms (TTEs), transesophageal echocardiograms (TEEs), fetal echocardiograms, weekend echocardiograms, and surgical procedures (surgical volume was aggregated as <150, 150 to 249, 250 to 349, and >350), as well as the number of outreach sites if any and accreditation by the Intersocietal Accreditation Commission.
2. Staffing: total number of physicians involved in covering the echocardiography laboratory, number of FTE physicians per day dedicated to the echocardiography laboratory, number of FTE physicians with advanced imaging training, budgeted versus actual number of sonographers, physician responsibilities for TTEs, TEEs, and fetal studies, physician responsibilities for performing and interpreting weekend echocardiograms, technical supervisor and director responsibilities, and sonographer responsibilities for TEEs and fetal studies.
3. System or institutional practices: open versus closed laboratory (open defined as the capability to order echocardiograms without cardiology approval), integrated laboratory performing outpatient and inpatient TTEs as well as fetal studies, integrated outpatient sedation service, patient recovery and sedation practices, percentage outpatient sedated echocardiograms, automated ordering process through an electronic medical record system, predetermined laboratory patient schedule with allocated time slots, time allocated per echocardiogram (≤60 min vs no time allocation), echocardiograms performed in preassigned rooms and/or by preassigned sonographers, sonographer responsibility for entering study data and preliminary report, and personnel (including presence of advanced imaging fellows).
4. Equipment: number of echocardiography machines; vendor diversity (one, two or three, or more than four vendors); machine age (acquired before 2005, between 2005 and 2008, or after 2009); equipment maintenance responsibilities; and data archiving, storage, and retrieval.
5. Factors that influence investment decisions (new equipment or new personnel): projected increase in number of echocardiograms per year, demonstrated increase in volume, aging machine, or new technology.

### Longitudinal Outcomes Assessment

The following three primary outcome measures were assessed for the purpose of both longitudinal assessment of clinical productivity and analysis of the second C-PELP survey:

1. Physician productivity = number of echocardiograms/FTE physician/day.
2. Sonographer productivity = number of echocardiograms/sonographer/year.
3. Equipment productivity = number of echocardiograms/machine/year.

The potential need to hire new sonographers and physicians was assessed by collecting the following data: (1) number of sonographers and physicians hired in 2013, (2) possible positions in 2014, and (3) possible imaging positions in the next 3 years (2014–2017).

The survey was not designed to evaluate quality metrics, echocardiography complexity, or physician reimbursements (work relative value units).

### Statistical Methods

Continuous variables were noted as averages and SDs and nonparametric variables as medians and ranges. A majority of the descriptive variables were dichotomous. Multiple correlations and analysis of variance were performed to assess for relationships, trends, and determinants of the three primary outcomes. Because a large number of variables was assessed, a $P$ value $< .01$ was considered to indicate statistical significance.

## RESULTS

Of the 99 echocardiography laboratory directors contacted, 64 completed the survey. Nine programs submitted fiscal year 2013 data, and 55 submitted data for the academic year ending in June 2013. Sixteen programs performed <149 surgical procedures per year, six performed 150 to 249 per year, 14 performed 250–349 per year, and 29 performed ≥350 per year. Fifty-one programs (80%) had pediatric cardiology fellowship programs, and 20 (31%) had senior imaging fellowships. Designated technical directors were present in 58 (91%), with the following average distribution of responsibilities: 53% clinical, 44% administrative, and 3% research, suggesting that the typical technical director represented only a 0.5-FTE sonographer. The total number of echocardiograms performed is listed in Table 1. The numbers of FTE physicians and sonographers allocated to coverage of all echocardiographic modalities are listed in Table 2. Physician productivity, measured as the average number of studies interpreted by an FTE physician per day, was as follows: 14.3 ± 5.9 total echocardiograms (including outreach studies) per