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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Benjamin W. Eidem, MD, FASE, served as guest editor for this report.

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0894-7317/$36.00

http://dx.doi.org/10.1016/j.echo.2016.06.007

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

Table 1 Total number of echocardiograms across all 64 institutions

	Mean	SD	Median	Minimum	Maximum
Total without outreach	8,238	4,759	7,505	5,620	26,043
TTEs	7,543	4,777	6,590	5,271	24,550
Fetal	702	574	532	0.0	2,675
TEEs	326	244	294	0.0	1,400
Total including outreach	9,707	5,495	8,830	5,620	26,339

Table 2 Physician FTE dedicated to the echocardiography laboratory

	Mean	SD	Median	Minimum	Maximum
Physician (total) FTE/day	2.7	1.1	2.5	1.0	6.0
Physician TTE FTE/day	1.8	1.0	1.5	0.5	8.0
Physician fetal FTE/day	0.6	0.3	0.5	0.1	1.6
Physician TEE FTE/day	0.5	0.3	0.5	0.0	1.0
Sonographer FTE/day	8.3	5.1	7.0	1.4	27.0

Table 3 Echocardiograms per physician FTE per day for all echocardiographic imaging modalities

Echocardiograms per physician FTE per day	Mean	SD	Median	Minimum	Maximum
Total	12.5	4.7	12.4	1.4	23.5
TTEs	17.7	6.5	17.1	1.6	33.0
Fetal	5.2	4.3	4.2	0.0	12.4
TEEs	0.8	0.6	0.7	0.5	3.3
Total with outreach	14.3	5.9	14.3	3.4	29.0

day, 12.5 ± 4.7 total echocardiograms (not including outreach studies) per day, and 17.7 ± 6.5 TTEs per day when the physician does not have TEE or fetal echocardiogram responsibilities (Table 3). Physicians time spent on image acquisition averaged <10% and did not achieve statistical significance for the analysis. An average of 4.35 ± 4% of the TTEs were obtained under sedation. Sonographer productivity, measured as the average number of echocardiograms per FTE sonographer per year, was 1,056 ± 441 (Table 4), and equipment productivity, measured as the average number of echocardiograms per machine per year, was 778 ± 303.

Physician and Sonographer Productivity

Physician productivity was positively associated with surgical volume, total TTEs ($r = 0.50$, $P < .001$), total TEEs ($r = 0.40$, $P < .001$), total fetal studies ($r = 0.30$, $P < .01$), number of FTE sonographers, number of machines, and echocardiograms per machine. In contrast, physician productivity was negatively associated with weekend echocardiograms, sedations, outreach, and having a senior imaging fellow (Table 5). Physicians with other responsibilities while assigned to read echocardiograms also had a negative association with productivity ($P = .01$).

Sonographer productivity was positively associated with outreach, weeknight and weekend echocardiography responsibility, and machine productivity. Outpatient sedated echocardiograms integrated into outpatient laboratory work flow had a negative impact (Table 5).

Sonographer responsibilities of performing numeric data entry, (72%), calculations (94%), and preliminary echocardiography reports (32%) did not affect sonographer productivity significantly, but creating preliminary reports trended toward a negative association ($P = .04$).

Equipment Productivity

Equipment productivity was affected mainly by sonographer and physician productivity (Table 5). Using a machine acquired before 2009 had a negative impact ($r = -0.30$) on equipment productivity, but vendor diversity did not. Thirty-seven laboratories (59%) used only a single vendor, 24 (38%) used two or three vendors, and only two laboratories used five vendors. Machine age was analyzed on the basis of whether a machine was acquired before or in 2009 and thereafter. All machines were purchased after 2008 for 10 laboratories, 75% to 92% were purchased after 2008 for 14 laboratories, and 50% to 75% were purchased after 2008 for 18 laboratories; all machines were purchased before 2009 for four laboratories, and >50% were purchased before 2009 for 16 laboratories. Neither vendor diversity nor machine age influenced physician and sonographer productivity. Additionally, neither vendor diversity nor machine age correlated with surgical volume.

Institutional and Laboratory Characteristics

Sixty laboratories (92%) had outpatient sedation services, and 46 (60%) had integrated inpatient services (one laboratory was responsible for both inpatient and outpatient studies). Integrated fetal services were present in 39 laboratories (62%). Physicians reviewed images before patient discharge in 37 laboratories (58%). Scheduled outpatient echocardiography slots were synchronized with clinic appointments in 21 (32%), a hybrid model involving both coordinated echocardiography and clinic scheduling and add-ons was present in 41 (63%), and three laboratories (5%) had no predefined schedules. Intersocietal Accreditation Commission accreditation was obtained for TTEs in 94%, for TEEs in 72%, and for fetal studies in 83%. Several laboratory characteristics correlated with surgical size.

As expected, larger surgical programs were more likely to perform large numbers of TTEs, TEEs, and outreach studies (Table 6). Surgical centers with <149 surgical procedures per year had smaller fetal echocardiography volumes compared with the larger centers (Table 6). Centers with surgical volume ≤349 per year were more likely to have integrated services (no separate fetal or sedation service) as well as physicians with combined service responsibilities. Physician productivity and equipment productivity were significantly lower at centers with surgical volume <149 per year (Table 6). Centers with >250 surgical procedures per year were also more likely to have physicians with advanced imaging training compared with centers with <249 procedures per year (75% vs 54% of reading physicians, respectively).

Work Flow

Patient flow was organized by the first available examination room in 29 laboratories (36%), by a preallocated sonographer in 18 (22%), by

Table 4 Sonographer and machine productivity*

	Mean	SD	Median	Minimum	Maximum
Sonographer FTE/Day	8.3	5.0	7.0	1.4	27.0
Echocardiograms/FTE/year	1,056	441	982	360	3,427
Echocardiograms/FTE/Year with outreach	1,221	500	1,244	318	3,642
Echocardiograms/FTE/day	5.0	2.2	5.0	1.7	16.0
Echocardiograms/FTE/day with outreach	5.8	2.4	6.0	2.0	17.0
Echocardiograms/machine/year	778	303	812	803	1,838

*Sonographer allocation and productivity measured by number of echocardiograms per FTE per year and per day. The echocardiograms performed per FTE per day are calculated assuming 210 working days per sonographer FTE.

Table 5 Multiple correlations of continuous and categorical variables with the primary outcomes

Primary outcome	Echocardiograms/sonographer FTE/year		Echocardiograms/physician FTE/day		Echocardiograms/machine/year	
Variable	Pearson's correlation	*P*	Pearson's correlation	*P*	Pearson's correlation	*P*
Echocardiograms/physician FTE/day	0.14	.27			0.42	.00001*
Echocardiograms/sonographer FTE/year	1		0.14	.26	0.62	.00001*
Echocardiograms/machine/year	0.62	.00001*	0.50	.00001*	1	
Weekend echocardiograms	0.90	.0008*	0.30	.00006†	0.18	.16
Surgical program size	0.40	.70	0.60	.00001*	0.36	.03
Total sonographer FTE	−0.30	.05	0.40	.002*	−0.02	.90
Total echocardiography machines	−0.16	.20	0.40	.001*	−0.26	.05
Advanced imaging fellowship	.80		.02		.60	
Weekend and weeknight sonographer coverage	.0005*		.35		.60	
Scheduled time slots for studies	.07		.008*		.80	
Outpatient sedation	.003†		.04†		.50	
Echocardiography schedule coordinated with outpatient clinic schedule	.30		.30		.03	
Preliminary data and reports entered by sonographer	.10		.60		.86	
Physicians with additional responsibilities	.02†		.01†		.05†	

*Statistically significant ($P < .01$).
†Negative association.

a preallocated machine in six (7%), and a by combination of approaches in 28 (38%). Having echocardiography slots synchronized with clinic slots had a positive impact on physician, sonographer, and equipment productivity. Having an integrated outpatient sedation service and advanced imaging fellows had a negative impact on the number of echocardiograms read by a physician FTE per day (Table 5).

Longitudinal Trends

Longitudinal comparison was done for physician, sonographer, and equipment productivity between the first and second C-PELP surveys for 42 centers that participated in both surveys. The only difference noted between the two periods was an increase in the total number of machines and a decrease in the number of echocardiograms per machine. No significant changes were noted in physician and sonographer productivity when looking at total echocardiography volume inclusive of fetal echocardiograms and TEEs (Table 7). Factors that influenced hiring and increase in equipment complement were also evaluated. There was a notable increase in the number of echocardiography systems per laboratory across the 42 laboratories that participated in both surveys. The criteria for investing in new equipment and hiring sonographers are noted in Table 8: the main reason given was for an existing or projected increase in volume. The number of echocardiograms used by institutions to justify investment in new equipment ranged from 500 to 1,500 studies per year in a majority of the laboratories (Table 9).

Workforce Assessment

In calendar year 2013, 26 programs hired 42 imaging physicians, On January 1, 2014, there were 16 echocardiography laboratories that had physician job openings, and 48 programs planned to hire over the period of 2014 through 2017. In 2013, 49 programs hired 90 sonographers for replacement or expansion, and there were 27 projected sonographer job openings in 2014.

Table 6 Surgical center size for total volume versus physician and sonographer FTE, physician and sonographer productivity, and machine productivity

Surgical program size	Total echocardiograms	Outreach (programs with outreach)	Fetal	Physician FTE/day	Sonographer FTE/day	Echocardiograms/ physician FTE/day	Echocardiograms/ sonographer FTE/year	Echocardiograms/ machine/ year
<149 (*n* = 16)	3,561 ± 1,710	755 ± 869 (*n* = 14)	351 ± 219	2.2 ± 1.3	4.7 ± 2.0	8.0 ± 3.5	966 ± 711	616 ± 314
150–249 (*n* = 6)	6,208 ± 2,202	758 ± 828 (*n* = 3)	859 ± 624	2.6 ± 1.1	6.3 ± 2.7	11.6 ± 1.6	1,222 ± 424	804 ± 380
250–349 (*n* = 14)	6,178 ± 1,613	1,022 ± 1,152 (*n* = 10)	613 ± 387	2.43 ± 0.8	6.6 ± 2.7	13.3 ± 4.7	1,116 ± 350	885 ± 318
>350 (*n* = 24)	10,788 ± 5,271	1,628 ± 1,810 (*n* = 18)	914 ± 685	3.1 ± 1.7	11.5 ± 5.8	14.8 ± 3.8	1,042 ± 259	811 ± 246

Data are expressed as mean ± SD.

Table 7 Physician and sonographer FTE and productivity for 42 centers who participated in both 2011 and 2013 surveys

	Total echocardiograms	Physician FTE/day	Sonographer FTE/day	Echocardiograms/ physician FTE/day	Echocardiograms/ sonographer FTE/year	Echocardiograms/ machine/year
2011	10,502 ± 4,749	2.8 ± 1.0	8.0 ± 3.8	15.0 ± 4.4	1,290 ± 235	1,213 ± 425
2013	11,502 ± 5,708	2.9 ± 1.0	9.7 ± 5.5	15.0 ± 5.6	1,202 ± 394	798 ± 222*

Data are expressed as mean ± SD.
*$P < .001$.

DISCUSSION

In the current era of medical reimbursement and payments, productivity requirements have been an issue for most echocardiography laboratory programs. Physicians responsible for providing imaging services are often challenged by additional clinical and academic responsibilities. There has been a focus on optimal staffing, equipment, and work flow to allow maximal utilization of all. The C-PELP committee, composed of a core group of echocardiography laboratory directors,[1] was formed by the ASE Council on Pediatric and Congenital Heart Disease in 2008 to assess factors that influence physician, sonographer, and equipment productivity. This initiative is unique, as it surveys most of the pediatric cardiovascular imaging programs in the country to assess these productivity metrics. The current report details the findings from the more comprehensive second survey performed in 2014 aimed at assessing work flow, laboratory organization, and workforce besides obtaining clinical productivity data.

Physician productivity was measured as the number of echocardiograms read per FTE physician per day. The data regarding FTE physicians allocated to reading echocardiograms were submitted by all programs on the basis of calculator (Supplementary Appendix 2) provided with the survey. The variables that positively influenced physician productivity were surgical center size, sonographer productivity, and equipment productivity. Having fourth-year fellows had a mildly negative correlation with physician productivity. Lower volume centers were more likely to have physicians with responsibilities in addition to reading TTEs and an integrated laboratory environment.

Physician productivity did not change over the course of the two surveys (for the 42 centers that participated in both the surveys) (Table 7). The total echocardiography volume did trend up between 2010 and 2013, but the number of echocardiograms per FTE physician remained the same, suggesting that echocardiography physician hiring practices appropriately matched echocardiogram volume increases. The workforce survey revealed that 26 imaging physicians were hired in 2013 across 26 programs. It is unclear why outreach echocardiograms had a negative impact on productivity. The survey did not specifically address the time assigned to perform outreach echocardiograms for either physicians or sonographers, and this may have affected this specific analysis. It is possible that outreach services also require additional physician time for clinical evaluation and other responsibilities and hence may influence equipment and physician productivity.

A recent study by Banka *et al.*[2] evaluating determinants of resource utilization in a large pediatric and congenital echocardiography laboratory focused on the lengths of studies in pediatric echocardiography laboratories and noted that the median time to perform a TTE was 65 min, with 25% of examinations taking >85 min; 47% of this time was for scanning and the remainder for pre- and postscanning activities. The investigators also noted that hospital charges based on Current Procedural Terminology codes for the technical component of TTEs correlated poorly with the time it took to obtain TTEs. The C-PELP II survey did not look at relative value units but did query laboratory directors on work flow inclusive of time slots allocated for scheduling and sonographer responsibilities in entering data and preliminary reports. We did not, however, ask for the time to complete the studies, the type of protocol (complete vs limited), or the complexity of the studies.

Unlike physician productivity, sonographer productivity was independent of surgical center size and other sonographer responsibilities. As would be expected, weeknight, weekend, and outreach coverage increased sonographer productivity, whereas outpatient sedation decreased productivity. The survey was not designed to evaluate whether off-hour sonographer requirement was considered as a factor that would influence the hiring of more sonographers. Somewhat surprisingly, sonographer participation in fetal echocardiograms or

Table 8 Criteria for adding additional machines and sonographers

	Machines: total responses (multiple per laboratory) (*n* = 182)	Sonographers: total responses (*n* = 54)
Quantitative increase in study volume (echocardiograms per year)	55 (30%)	12 (22%)
Projected future growth (i.e., new clinical activity or new physician hire)	37 (20%)	18 (33%)
Aging machine	48 (26%)	
New technology	41 (23%)	
Other (no reason given)	1 (1%)	24 (44%)

Table 9 Number of echocardiograms used to justify addition of machine or staff sonographer

	Addition of a machine (responses *n* = 60)	Addition of a sonographer (responses *n* = 58)
0–499 echocardiograms/year	3 (5%)	3 (5%)
500–999 echocardiograms/year	16 (27%)	11 (19%)
1,000–1,499 echocardiograms/year	14 (23%)	11 (19%)
1,500–1,999 echocardiograms/year	0	2 (3%)
>2,000 echocardiograms/year	1 (2%)	2 (3%)
Qualitative assessment (no specific number) + projected future growth and new hires	26 (43%)	29 (50%)

TEEs, additional sonographer responsibilities to enter data and/or preliminary reports, and study time allocation did not have a statistically significant impact on productivity, though having sonographers create preliminary reports trended toward decreased productivity. Sonographer productivity had a very strong correlation with the number of machines and the number of echocardiograms per machine but was independent of total echocardiography and surgical volume and physician staffing variables.

Overall, the implication was that sonographer productivity was better if they worked with a predetermined schedule and no additional responsibilities related to sedation or inpatient studies or if they worked on weekends or at outreach sites.

The total number of echocardiography systems increased per program over time, but the number of echocardiograms per machine decreased. This change may reflect purchase of new-generation equipment and retention of older, underutilized machines in the fleet. Equipment productivity had a weakly positive association with program size (as denoted by the number of machines, TTEs, and surgical cases) and a weakly negative association with outreach echocardiograms.

The impact of work flow on the three productivity outcomes was also assessed in this survey. The use of scheduled echocardiography slots did have a positive impact on physician productivity, whereas covering outreach and sedation services had a negative impact. If physicians were responsible for sedation, outreach sites, or other services when they were scheduled to read echocardiograms, the number of echocardiograms read by the physician decreased. Centers with separate physician coverage for sedation, inpatient studies, or fetal studies had better physician productivity. Most of the laboratories allocated 60 min for an echocardiogram, though some allocated <60 min, and a few others used no specific time allocation. The impact of time allocation per echocardiogram could not be determined, because there were very few in the latter two categories (<60 min or no time allocation).

Workforce assessment related to hiring physicians and sonographers over the next 3 years suggested a decrease in the number of new job openings for imaging physicians but not for sonographers. Although not assessed in the present survey, one may infer that in the current cost containment environment, programs are guarded in their hiring practices, at least on the physician side.

Studies looking at cost-effectiveness and quality benchmarks have defined the interplay of many factors in academic centers.[3-7] Garson[3] evaluated cost-effectiveness in academic pediatric cardiology by describing direct and indirect medical costs, lost wages, and intangibles.

Effectiveness can be measured in terms of health and utility. Given the evolving economic environment at academic institutions, physicians are often asked to maximize productivity and efficiency. Results from surveys like ours help provide realistic benchmarks and allow echocardiography laboratory directors to assess their own laboratory structure in terms of personnel and equipment needs. Data related to quality initiatives, teaching responsibilities, and academic productivity were not obtained in this survey. These activities are standard practice of care in many centers, and the necessary time and effort for these activities can have a significant impact on clinical productivity, unless the responsibilities are allocated to a separate physician and/or sonographer not providing the clinical service. Evaluating these issues may be a worthwhile objective for future surveys by this committee and others.

Limitations

This study had significant limitations that are inherent in a survey-based assessment. Responses and response rates were heterogeneous across institutions. To reduce the survey length and increase response rates, not all variables were assessed. Undoubtedly, this heterogeneity also applies to the factors that influence physician and sonographer productivity. This survey did not ask questions specific to dedicated FTE staff members for outreach sites, time allocation to physicians and fellows performing TTEs, TEEs, and complex positive fetal examinations, and so on, and this may have influenced the results we obtained.

As with the initial C-PELP survey, the present survey median data should be interpreted with caution and should not be used as benchmarks for individual physicians or sonographers, because the survey cannot completely adjust for competing job responsibilities, levels of patient complexity, and other factors affecting productivity. Importantly, the survey has made no attempt to factor in quality, a critical component of laboratory performance. The finding of fewer echocardiograms per machine may also be affected by how the questions were asked, which differed slightly between the two surveys. Future surveys will be performed to validate these trends.

CONCLUSIONS

In a large survey of pediatric echocardiography laboratories, physician productivity correlated positively with surgical volume, TTE, TEE, and fetal volumes, and higher sonographer productivity, and equipment utilization. Scheduled echocardiography slots correlated positively with improved laboratory work flow and physician productivity, whereas an advanced imaging fellowship and an outpatient sedation service correlated negatively. There has been no significant change in physician and sonographer productivity over the two survey cycles (2010–2011 and 2012–2013). Longitudinal collection of these data will help provide pediatric echocardiography laboratory directors and hospital administrators with aggregate staff and work flow benchmarks to optimize productivity in accordance to the needs and sizes of their own institutions.

ACKNOWLEDGMENTS

We thank Howard Andrews, PhD, associate professor of neuroscience (in biostatistics) at the Columbia University Medical Center, for his help with statistical analysis and Meryl Cohen, MD, FASE, for critical review of this report as chair of the Pediatric Council of Congenital Heart Disease of the ASE.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.echo.2016.06.007.

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