Thoughts and Musings from a Pediatric Echocardiographer Involved in a Pediatric Echocardiography Lab Productivity Project

Picture the start of a typical day in your echocardiography laboratory. It’s morning. You walk into work, identification badge in hand. You set down your personal items and prepare your desk space for the day ahead. You look at the staffing board and the patient schedule and probably make a quick, mental assessment of your work load. What thoughts go through your head? “Oh, it’s going to be busy.” Or, “hmm, light day today.” Or maybe you hear a sonographer utter: “How many called in sick??” As the cardiologist, your mind kicks into gear: “I wonder which fellow is with us today...will I have time to finish the lecture I need to give? When do I have time to submit that manuscript?” Just like the Goldilocks and the Three Bears tale, you are determining if your load for the day is going to be too much, too little, or just right.

With the myriad possible starts to the day, there are just as many challenges with appropriately staffing, organizing, and coordinating a busy academic pediatric echocardiography laboratory. In 2011, a group of pediatric cardiologists recognized the benefit of creating a more formal, comprehensive assessment of echocardiography laboratory practices. They formed a Committee on Pediatric Echocardiography Laboratory Productivity (C-PELP). Starting in 2011, C-PELP, with support from the American Society of Echocardiography (ASE) and spearheaded by cardiologists Drs. Wyman Lai and Vivek Allada, devised and created a set of surveys that revolved around helping answer seemingly simple questions: What is echocardiography lab productivity and what are the ways to define it? How are pediatric echocardiography laboratories organized? What facets within an echocardiography laboratory influence productivity? Currently, a total of three surveys have been released and published. I had the privilege of serving on the group for the second and third surveys. Some highlights are covered in this article, and I highly recommend that readers refer to the publications (linked at the end) for complete information.

Laboratory Identification

North American academic pediatric echocardiography laboratories were initially identified through fellowship programs, known contacts among echocardiography laboratory directors, and registry data from ASE. The number of laboratories identified for the survey expanded from 74 in 2011, to 99 in 2013. Seven of the centers were determined to be purely clinical—not associated with a university, or self-assigned as non-academic. Since the intent was to focus on academic centers, the database of laboratories was updated accordingly.

Physician Productivity and Roles

In 2011, physicians covered a combination of the three modalities: transthoracic echocardiography (TTE), transesophageal echocardiography (TEE), and fetal echocardiography in 69%, or 37 of 54 laboratories. In 2014, a similar pattern emerged. Based on the phrasing of the survey, we also determined that 51 of 64 laboratories, or 80%, had a separate physician whose assignment was primarily dedicated to cover fetal echocardiograms. Laboratories whose physician responsibilities included “echocardiography coverage in addition to other clinical responsibilities” were similar in 2011 (19 of 54 [35%]) and 2014 (26 of 85 [31%]).
Not adjusting for multiple factors, including range of physician responsibilities, case complexity, and level of staff experience, the average number of studies performed per physician and per sonographer remained stable between the 2011 and 2013 surveys. Physicians read 15.0 (± 4.4 and 5.6 in 2011 and 2013) studies in a typical day. Sonographers performed 8.0 (± 3.8 and 9.7 ± 5.5 studies in 2011 and 2013), which did not reach statistical significance (Table 7). Lower volume centers were more likely to have physicians with additional responsibilities above reading echocardiograms.

<table>
<thead>
<tr>
<th>Total echocardiograms</th>
<th>Physician FTE/day</th>
<th>Sonographer FTE/day</th>
<th>Echocardiograms/physician FTE/day</th>
<th>Echocardiograms/sonographer FTE/year</th>
<th>Echocardiograms/machine/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>16,502 ± 4,749</td>
<td>2.8 ± 1.0</td>
<td>8.0 ± 3.8</td>
<td>15.0 ± 4.4</td>
<td>1,209 ± 235</td>
</tr>
<tr>
<td>2013</td>
<td>11,502 ± 5,708</td>
<td>2.9 ± 1.0</td>
<td>9.7 ± 5.5</td>
<td>15.0 ± 5.6</td>
<td>1,202 ± 204</td>
</tr>
</tbody>
</table>

Data are expressed as mean ± SD.

In most North American pediatric cardiology practices, clinical echocardiography is comprised of the collaborative “two-party” system—cardiologists and sonographers. Traditionally, the sonographers scan patients; and the cardiologists render their interpretation and place their report in the clinical record. In many centers that answered the surveys, that demarcation line is more porous. Sonographers provide an important “extra set of eyes”—helping and contributing to interpretation of the echocardiogram images. In 2013, 32% of centers stated that sonographers created detailed, pre-finalized reports. Cardiologists render final interpretation and reports, which in fee-for-service healthcare model also generates a bill. However, in certain cases, physicians feel obligated to scan some patients themselves, in order to glean a better understanding of a patient’s anatomy and physiology, and to better convey a clinically meaningful report. In the 2013 survey, physicians were estimated to perform hands-on imaging in a median of 10% +/- 12 of TTE patients and 60% +/- 33 of fetal patients.

**Additional Productivity Measures**

The median number of echocardiograms performed per machine was 812+/−303 (Table 2) and was not adjusted for location or purpose. Rationales used to acquire new echocardiography equipment were qualitative in 43% of the laboratories.

**Table 4 Sonographer and machine productivity**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Median</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sonographer FTE/Day</td>
<td>8.3</td>
<td>5.0</td>
<td>7.0</td>
<td>1.4</td>
<td>27.0</td>
</tr>
<tr>
<td>Echocardiograms/FTE/year</td>
<td>1,095</td>
<td>441</td>
<td>982</td>
<td>350</td>
<td>3,427</td>
</tr>
<tr>
<td>Echocardiograms/FTE/year with outreach</td>
<td>1,221</td>
<td>500</td>
<td>1,244</td>
<td>318</td>
<td>3,642</td>
</tr>
<tr>
<td>Echocardiograms/FTE/day</td>
<td>5.0</td>
<td>2.2</td>
<td>5.0</td>
<td>1.7</td>
<td>16.0</td>
</tr>
<tr>
<td>Echocardiograms/FTE/day with outreach</td>
<td>5.8</td>
<td>2.4</td>
<td>6.0</td>
<td>2.0</td>
<td>17.0</td>
</tr>
<tr>
<td>Echocardiograms/machine/year</td>
<td>778</td>
<td>303</td>
<td>812</td>
<td>803</td>
<td>1,638</td>
</tr>
</tbody>
</table>

*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.*

The surveys were also intended to trend procedural and staffing data across time, and it is worthwhile to include a direct quotation from the 2013 survey: "Longitudinal comparison was done for physician, sonographer, and equipment productivity between the first [2011] 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... There was a notable increase in the number of echocardiography systems per laboratory..., 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." Since in a two-year timeframe there was little change in the per-physician and per-sonographer procedural volumes, additional collection of procedural data was tabled in lieu of obtaining information surrounding laboratory organization.
Laboratory Composition

The third survey, published this year, sought to collect additional factors that were associated with physician and sonographer clinical activity. We examined other features that are considered vital to academic centers such as research and training; and we evaluated the extent of participation among fellows and sonographers. We also sought to quantify and describe leadership roles. While the survey was sent to 92 centers, there were fewer replies – 38 responses or 41%.

Directors were asked to determine whether their categorical fellows would “be able to independently perform and interpret” three different echocardiographic modalities. Among the 31 laboratories that answered, 90% replied “yes” for TTE, 29% said “yes” for TEE, and 0% of centers replied “yes” for fetal echocardiography. These values reflect a general sentiment that most categorical pediatric cardiology fellowship programs are geared to enable most graduates to perform TTE, but less so for the TEE, and fetal. In response to a follow-up question, over 90% answered that if trainees were interested, they would spend additional time during their categorical fellowship, in order to independently perform TEE and fetal echocardiography. For other modalities such as cardiac MRI, 35% of centers stated that fellows could receive advanced training during categorical fellowship years to become independent.

Balancing clinical responsibilities with research is always an ongoing challenge. When centers were asked, “What are the greatest barriers to successfully completing a research project?” the barriers cited, in order from the most frequent to the least frequent were (1) sonographer full time equivalent (FTE)/time, (2) cardiologist FTE/time, (3) funding, (4) statistical/database support, and (5) laboratory “culture.” Physical infrastructure, such as echocardiography machine, postprocessing software, and examination room availability, were the least likely to be barriers to research.

Quality improvement initiatives are becoming more prevalent in clinical care. With one exception, all respondents were accredited by the Intersocietal Accreditation Commission. This would translate to a similar proportion of laboratories performing quality improvement. A majority (71%) also reported that sonographers actively participated in novel QI projects. Fortunately, despite the perceptions associated with additional work, there was no statistically significant association between degree of QI efforts, and either academic or research productivity.

Productivity Assessments, Survey Limitations and Challenges

How are productivity and a noninvasive physician FTE defined? These may be answered differently, depending on the perspective. In the United States, the Centers for Medicare and Medicaid Services created a measure called relative value units, or RVUs. Stated simplistically, the goal was to devise a scale that would allow administrators to “slice the pie” of healthcare dollars into the right number of appropriately-sized slices. Perhaps as an unintended consequence, these measures have been adapted into the credo that “how many RVUs have you billed lately” is a direct marker for “are you contributing appropriately to our practice?” Weighted toward reimbursements and revenues, one person’s perspective may require the highest amount of patient turnover as possible. In other words, the more studies read in a given day, the more revenue or work generated. Another person would answer that a combination of scholarship activity, clinical care, and teaching effectiveness are important in productivity—tenets that define some, but not all, the roles of an academic faculty member.

Every laboratory is unique, and the heterogeneity of practices between centers makes it challenging to collect standardized data. Sonographer work expectations will vary between centers. For cardiologists, one center may require that they participate in clinic proctoring or seeing patients. While “assigned” to echocardiogram reading, they may be so pressed for time and have other obligations such that a significant portion of their efforts may be focused away from reading studies. In other centers, there may be a number of cardiologists whose sole focus is a single echocardiographic modality. These practice variabilities in turn
transform what appears to be a straightforward metric: number of studies/(staffing unit of measurement)/(unit of time), into something that is most meaningful only when considering all contexts as described in the surveys. However, “...the rationale for measuring clinical productivity as daily studies per physician was to allow a direct comparison between laboratories despite the great variability among institutions in the definition of a physician FTE.”

Given the heterogeneity of physician and sonographer roles, and using the words from the first publication, it is this writer’s opinion that the numbers generated in these surveys may guide, but are “...not intended to generate recommendations for clinical staffing requirements.” As demonstrated in the surveys, it is nearly impossible to standardize or uniformly define a noninvasive physician FTE, yet the notion that the standard definition exists “...cannot be understated, as RVU targets are generated with such a definition in mind. It should be noted that the information captured with [these surveys] was laboratory-centered, and not directly applicable to the productivity of any one person.... Moreover, the issues of study quality and accuracy were not addressed.”

**Looking Back, Moving Forward**

Survey writing is its own science—creating questions that are free of intrinsic biases and providing answers that are meaningful and analyzable. Questions are carefully crafted to ensure they are uniformly interpreted by the people answering. At the same time, we continue to work on where to set the needle for the overall length of a survey: striking a balance between obtaining detailed, granular information, and remaining mindful of the proportional amount of time and work required to complete it.

Over the series of three surveys, of which I was a co-author in the latter two, the pediatric echo laboratory community was able to glean workflow and productivity data on a more widely documented scale. Our community can continue to reap the benefits of collecting and serializing pediatric echocardiography laboratory organizational metrics. In separate experiences, co-authors have been notified that laboratories have been able to use our data to shape staffing and echocardiography laboratory organization. Several labs were able to use the data to their benefit, with the main goal of being able to provide quantitative data to administrators and to provide a broader perspective of what it means to be imaging cardiologists and sonographers, and how RVUs will not always match an individual’s workload. The survey data also provided a guide for how many machines are needed, as well how one may balance between studies, sonographers, and readers. Additionally, it also gives some data that allows labs to support needs for equipment upgrade, resource allocation for research and quality and education.

We are at a point in time to consider collecting a new set of serial data. This year, under the auspices of the Society of Pediatric Echocardiography, a group of echocardiography laboratory directors met to discuss the past and the future of the productivity surveys. There was universal agreement that a follow-up survey to assess procedural and staffing volumes would be beneficial. With support from ASE’s Pediatric and Congenital Heart Disease Council, the ASE Board has considered this need. This survey will once again be supported by the ASE with its funding, volunteers, and staff resources. We hope to publish this survey, as we did the prior studies, in the *Journal of the American Society of Echocardiography* (JASE).

**Author Disclosure**

The thoughts in this article represent my own opinions and would not necessarily reflect those who co-authored all of the publications to date. I would also like to thank Shubhi Srivastava, MD, FASE, who provides continued guidance and mentorship.

First survey summary published October 2013:  

Second survey summary published October 2016:  

Third survey summary published September 2018:  