Coverage of Emergency After-Hours Ultrasound Cases:

Survey of Practices at U.S. Teaching Hospitals[1]

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Rationale and Objectives. Diagnostic ultrasound examinations may be performed after-hours by physicians if technologists are not available or cases are complex. Our experience suggested there is wide variability in how ultrasound coverage is provided after-hours, which motivated us to conduct a formal survey of teaching programs around the country.

Methods. Four hundred five members of the Association of Program Directors in Radiology were contacted by e-mail and sent a link to a five-part questionnaire posted on the Web. Respondents were asked whether ultrasound cases after-hours are performed in their institutions by radiology residents, technologists on the premises after-hours, technologists on-call, or some combination. Data on the type of program, number of beds in the primary hospital, number of residents in the program, and geographic location of the program were recorded. Responses were automatically written to a data file stored on a Web server and the imported into an Excel spreadsheet for data analysis. A χ^2 analysis was performed to assess associations among the variables and statistical significance.

Results. A total of 79 programs responded to the survey. Of those, 32% provided coverage with ultrasound technologists on call, 24% by ultrasound technologists on the premises, 13% provided combination coverage, and 10% provided coverage solely with residents on call. There was no association among number of residents in the program, location of the program, or type of program (university, community, or affiliated) and type of coverage provided.

Conclusion. There is wide variability in methods for providing coverage of after-hours ultrasound cases. However, on-site or on-call coverage of emergency cases by technologists did not appear to depend significantly on program location, program type, or program size.

Key Words. Staffing; call; residency; ultrasound.

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Imaging examinations have become crucial to clinical diagnosis and patient management, and radiology departments nationwide have seen their workloads grow at a rapid pace. In many institutions, demand for imaging studies after regular working hours (usually defined as 0800−1700) has increased at an even greater rate than routine studies, no doubt reflecting radiology's critical role in clinical decision-making (1). Sonographic studies are no exception, and a recent study suggests that the proportion of ultrasound studies performed after-hours is growing at a faster rate than during the routine workday (1). Meanwhile, nationwide shortages of radiologic technologists are widespread. A 2002 survey by the American Hospital Association found a 15.3% vacancy rate for radiologic technologists, the highest among the health professions, exceeding even the rate of 13% found for nurses (2).

During the 1980s and 1990s, virtually all after-hours sonograms at our institution were performed by radiology residents on-call. Residents thereby acquired technical

Acad Radiol 2006; 13:249–253

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doi:10.1016/j.acra.2005.09.091

skills that supplemented their sophistication in interpreting ultrasound images. Responsibility for scanning also proved to be a great motivation to learning. However, in recent years, our on-call residents have faced greater challenges because the volume of ultrasound requests after-hours has increased, the complexity of the cases performed on call has risen, and the number of other studies requiring interpretation during the same on-call shift (such as CT) has grown enormously.

Given staffing shortages, finding registry-certified sonographers who are willing to take calls from home or in-house calls is challenging, if not outright impossible. Nevertheless, using residents to fill the gap may fall more in the realm of clinical service than education and could negatively affect patient care if house staff training is inadequate.

Our experience suggested there is wide variability in terms of how academic radiology departments are meeting the demand for ultrasound scans after-hours. The present study was motivated by our interest in determining whether there were any trends or patterns underlying who performed after-hours sonograms. We hypothesized that on-call ultrasound staffing variability might be due to differences in number of residents available (program/hospital size), geographic variability in housing costs or general technologist staffing levels, or the hospital mission (program type).

METHODS

We designed a Web-based survey form to collect the data for this study (Fig. 1). We asked a minimum of questions so that respondents could complete the survey in 5 minutes or less. Respondents were asked to indicate whether after-hours ultrasound scans at their institutions were performed by sonographers on-call, sonographers in-house, residents on-call, or some combination of residents and sonographers. Although we requested data pertaining to all institutions staffed by each program, our analysis below is based on responses for each institution's primary hospital only because not all respondents reliably supplied information on secondary hospitals. We collected data on program size, program location, and program type using definitions common to the annual Association of Program Directors in Radiology (APDR) annual survey (Fig. 2). Because the number of residents in each program correlated with the number of hospital beds, we did not analyze number of beds explicitly.

Who performs the primary ultrasound scanning of emergency/after-hours cases (6 pm-8 am) at your program's hospitals? (Please select one)

	Primary Hospital	Hospital 2	Hospital 3	Hospital 4
Ultrasound technologists in house	○	○	○	○
Ultrasound technologists on call	○	○	○	○
Radiology residents	○	○	○	○
Ultrasound technologists for some of the shift, radiology residents for other parts of the shift	○	○	○	○
Radiology fellows	○	○	○	○
Radiology attendings	○	○	○	○
Other services (vascular, OB/GYN)	○	○	○	○

None of the above scenarios apply, but we do the following:

Figure 1. Screen shot of Part 1 of online survey.

Please characterize the institutions in your program:

	Primary Hospital	Hospital 2	Hospital 3	Hospital 4
Number of beds in each institution				

Please characterize your residency program:

Type of program:
- University
- University-affiliated
- Community
- Military

Total number of residents in program:
- Less than 13 residents
- Between 14 and 24 residents
- Between 25 and 40 residents
- More than 40 residents

Geographic location of program:
- Pacific
- Western
- Central
- Northeast
- Southeast

Send my evaluation | Clear the form

Thank you!!

Figure 2. Screen shot of Part 2 of online survey.

We contacted the APDR by e-mail, and they e-mailed a link to our online survey to each of their 455 members. Membership in the APDR includes both residency program directors and program coordinators and represents approximately 167 radiology residency programs (3). Responses to the Web form were written to a data file stored on a server in our department. The data were then imported into Microsoft Excel for analysis. We created contingency tables and performed χ^2 analysis to test for association among the variables. The data were sorted to display by geographic location, and responses for which all answers including number of beds (to three significant digits) were identical were eliminated as presumed duplicates.

Table 1
Ultrasound Survey Responding Program Characteristics Relative to the 2005 APDR Membership Survey Respondent Characteristics, in Percentages

	U.S. Survey (%) (n = 79)	APDR Member Survey (%) (n = 89)
Program type (P = 0.65)		
University	53	63
University affiliated	24	19
Community	22	17
Military	1	1
No. of residents (P = 0.36)		
≤13	23	18
14–24	42	34
25–40	28	34
>40	8	14
Geographic location (P = 0.37)		
Northeast	39	32
Central	29	30
Pacific	14	8
Southeast	11	17
West	6	12

RESULTS

There were a total of 86 responses to the survey, with 7 responses eliminated as probable duplicates. Thus, a total of 79 programs responded to the survey, which is a response rate comparable to that yielded in APDR's 2005 membership survey (Table 1). The majority of respondents (42 of 79, 53%) were in university programs. Nineteen of 79 (24%) were in university-affiliated programs, 17 were in community programs (22%), and 1 was in a military program (1%). Geographic breakdown of program location was Northeast (n = 31; 39%), Central (n = 23; 29%), Pacific (n = 11; 14%), Southeast (n = 9; 11%), and Western (n = 5; 6%). Eighteen programs (23%) had 13 or fewer residents, 33 (42%) had 14 to 24 residents, 22 programs (28%) had 25 to 40 residents, and 6 programs (8%) had more than 40 residents. Relative to the APDR membership survey, university programs, large programs, and western and southeastern programs are somewhat underrepresented in our survey results, and thus university-affiliated and community hospitals as well as small and medium-sized programs are somewhat overrepresented (Table 1). The χ^2 analysis showed that the differences were not significant between the two surveys.

Of the 79 respondents, 41% provided coverage with ultrasound technologists on-call, 30% had ultrasound technologists in-house, 16% provided coverage through a combination of radiology residents and sonographers, and 13% provided coverage with residents alone. Thus in 29% of the programs, radiology residents perform some or all of the studies on-call.

To determine whether the type of coverage depended on hospital size, geographic location, or program type, contingency tables were created (Tables 2–4). The χ^2 analysis of ultrasound staffing by number of residents (Table 2), program type (Table 3), and by geographic location (Table 4) yielded values of $P = 0.694$, $P = 0.665$, and $P = 0.707$, respectively, indicating no statistically significant association with any of these variables.

DISCUSSION

Our results suggest that there is considerable variability in how ultrasound services are provided after-hours and that this variability is not easily explained by the number of ultrasound residents in each program, by the location of the program, or by the type of hospital. In both small and large hospitals, there are examples where radiology residents perform all of the on-call scans and examples where they perform none of the scans. In almost one third of the hospitals, residents do some or all of the cases. There were no programs in the Southeast or the West in which residents do all of the scans, but in our statistical analysis, we otherwise did not find a significant association between location and staffing.

For many years, radiologic technologist staffing has been a challenge for hospitals, and with thousands of experienced technologists approaching retirement age, shortages could even worsen (2). Nationwide, 71% of hospitals report that they have technologist vacancies (4). Recent surveys, however, suggest that workplace shortages might be abating. In January 2003, an American Society of Radiologic Technologists (ASRT) survey found vacancy rates of 8.9% for CT and 12.3% for ultrasound, but by September 2004 the same vacancy rates had fallen to 5.7% and 9.5%, respectively. A recent survey by the Society of Diagnostic Medical Sonographers (SDMS) also found that sonographer shortages are abating and many larger hospitals are able to provide sonographer staffing on a 24-hour/7-days-a-week basis. Overall, their survey found that 43.7% of sonographers nationwide take some on-call time (Jean Lea Spitz, R.D.M.S., personal communication). Nevertheless, finding and retaining expert sonographers remains a challenge.

Table 2
Contingency Table of Type of Ultrasound Staffing by Program Size

	No. of Residents in Program				
	≤13	14−24	25−40	>40	Total
Sonographers on call	9	15	6	2	32
Sonographers in-house	4	9	9	2	24
Residents	1	6	2	1	10
Mixed	4	3	5	1	13
Total	18	33	22	6	79

Table 3
Contingency Table of Ultrasound Staffing by Program Type

	Military	Community	University	Affiliated	Total
Sonographers on call	1	5	16	10	32
Sonographers in-house	0	6	13	5	24
Residents	0	1	7	2	10
Mixed	0	5	6	2	13
Total	1	17	42	19	79

Table 4
Contingency Table of Ultrasound Staffing Versus Program Location

	Pacific	Southeast	Northeast	Central	West	Total
Sonographers on call	4	4	13	8	3	32
Sonographers in-house	6	3	7	7	1	24
Residents	0	0	6	4	0	10
Mixed	1	2	5	4	1	13
Total	11	9	31	23	5	79

Night call represents a crucial educational experience for radiology residents for many reasons: they are exposed to emergency clinical problems that may not be regularly encountered during regular working hours, they triage and interpret clinical studies with greater independence, and they consult with clinician colleagues on imaging interpretation and case management. Ultrasound and CT examinations represent the bulk of on-call work at our hospital and at others as well (5), and as a result our department's educational program includes an intensive "pre-call" training rotation to impart necessary scanning and interpretation skills to our residents. In recent years, the volume and complexity of cases requested from our inpatient service and emergency department have necessitated increasing sonographer coverage, and residents have less hands-on scanning responsibility so as to permit them to provide interpretations of CT, ultrasound, and other studies in a timely fashion. To date we have not seen any negative impact of this diminished scanning responsibility on our ABR examination pass rates. Residents continue to serve as sonographers at our institution after midnight or if evening or weekend sonographer coverage is not available.

Physician training in sonography is a politically charged issue because of the numerous specialties performing and billing for ultrasound studies. Training guidelines established by the ACR and AIUM for physicians who interpret ultrasound require at least 3 months of physician-supervised ultrasound training "during which the trainees will have evidence of being involved with the performance, evaluation, and interpretation of at least 300 sonograms" (6). A study by Duke University ultrasound physicians suggests that involvement in fewer than 200 cases is inadequate for training (7). Monsky et al supple-

mented their clinical sonographic training case load by using an ultrasound simulator and found that it improved resident performance in scanning and interpreting ultrasound cases (8). However, simulators may not be readily available at all institutions that train residents.

Ultrasound is the quintessential "operator-dependent" modality—study quality is only as good as the sonographer obtaining the images. When residents are required to perform sonograms on call, it is critical that they be given appropriate training and that their skills be evaluated on an ongoing basis. At our institution, the residents are assigned scanning responsibility during their first and second ultrasound rotations, and image quality of their studies is critically evaluated by our chief technologist and the attending on service each day. Other assessment tools for resident scanning skills that have been described are the "ultrasound passport" (9), a modified case log in which the number and type of each ultrasound study performed by a resident are recorded in a "passport" and the images are rated in writing by the ultrasound technologists. Alternatively, an objective structured clinical examination could be designed and administered to residents prior to taking call (10).

Our results show that in almost one third of responding programs, radiology residents perform some or all of the emergency ultrasound studies after-hours. Our survey instrument was not designed to address the rationale behind each hospital's staffing strategy, but it is likely that residents perform sonographic studies on-call at least in part because sonographers are in short supply, especially outside of regular working hours. It is therefore important to assess the tradeoff between clinical coverage and education represented by using residents in place of sonographers. Feedback and training should also be provided to residents about the quality of their images and diagnoses on a regular basis to ensure that the educational component of their scanning duties is maximized.

Our study has some significant limitations. To ensure a good response rate, we kept the survey as brief as possible. We did not capture data on the types of studies performed on call or details on resident training prior to starting sonography call duties. It is possible that there is significant variability in demand for ultrasound studies among institutions because of clinician preferences and that this difference in number of studies done accounts for differences in type of coverage.

Although we received responses from 79 programs, this represents less than half of radiology residency training programs around the country. Nevertheless, even our small study shows that there is significant variability in how ultrasound services are provided by hospitals after-hours and that institutions should be vigilant in monitoring the quality of patient care being provided, as well as the educational value of the scanning responsibility assigned to their resident physicians. With the U.S. population aging, the number of imaging procedures performed at all hours increasing, and surveys showing fewer people entering the radiologic technology profession each year, hospital administrators and radiologists will need creative long-term strategies for meeting the demand for sonographic services beyond expecting residents to fill in the gap.

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