

2009

A Survey of Radiology Practices' Use of After-hours Services

Adam Harris Kaye
Yale University

Follow this and additional works at: <http://elischolar.library.yale.edu/ymtdl>



Part of the [Medicine and Health Sciences Commons](#)

Recommended Citation

Kaye, Adam Harris, "A Survey of Radiology Practices' Use of After-hours Services" (2009). *Yale Medicine Thesis Digital Library*. 195.
<http://elischolar.library.yale.edu/ymtdl/195>

This Open Access Thesis is brought to you for free and open access by the School of Medicine at EliScholar – A Digital Platform for Scholarly Publishing at Yale. It has been accepted for inclusion in Yale Medicine Thesis Digital Library by an authorized administrator of EliScholar – A Digital Platform for Scholarly Publishing at Yale. For more information, please contact elischolar@yale.edu.

A Survey Of Radiology Practices' Use of After-Hours Radiology Services

**A Thesis Submitted to the
Yale University School of Medicine
in Partial Fulfillment of the Requirements for the
Degree of Doctor of Medicine**

**by
Adam Harris Kaye
2009**

Abstract

Purpose

To identify the characteristics of and the motives behind radiologists' use, or lack thereof, of after-hours services.

Methods

From August 2005 to June 2006, 300 non-specialty hospitals randomly selected from the 2005 American Hospital Association Directory of Hospitals were contacted by phone, email, and mail, with an attempt made to speak to the chief of radiology. We obtained 115 responses, a 38.3% response rate, including 64 from practices that used an external after-hours service. Responses were analyzed using descriptive statistical analyses.

Results

Practices gave convenience as the most important reason they use an after-hours services, with value for recruiting ranked second and shortage of radiologists for off-hours coverage third. Three-fourths of practices said they receive 5% or fewer of their reads from these services. Two-thirds of practices paid the service about as much as they collected or more. Approximately 40% of respondents utilized an after-hours service located internationally. Of these, 56% said that the radiologists reading internationally were either all Americans or mostly Americans

and 40% did not know the proportion of foreigners. Regardless, in-state licensure of all interpreting teleradiologists is essentially universal.

Conclusions

Most radiology groups using after-hours services do so for convenience rather than shortage of staff to provide coverage. Most practices send a very small percentage of their studies to the services. While overseas-located services are commonly used, there is little evidence of other than American radiologists or American-trained radiologists at these services.

Acknowledgments

I would first like to thank Dr. Howard Forman, my thesis advisor and, more importantly my mentor throughout my 5 years at Yale. Without your guidance and support through this project, and others, I would never have had the opportunity to study “the other side of medicine.” Thank you, as well, for being such an instrumental factor in and such a big influence on my career future career.

Thank you to Dr. Jonathan Sunshine at the American College of Radiology, with whom I worked closely on this and other projects. His help and guidance was instrumental in getting this project done. Thank you as well to his staff at the ACR who helped along the way, especially Mythreyi Bhargavan. Thank you to Dr. Roger Kapoor for helping with the data collection.

I would like to thank Dr. Kevin Johnson, with Howie the other member of my Thesis Committee. Thank you to the rest of the Department of Radiology for helping along the way.

More thanks: my father, whose passion for radiology shows in all our conversations about the topic, and whose passion for life and his family is reflected in everything he does; my mother for being such a positive influence on me and pushing me to be all I can be; my sister for teaching me that this thesis, and work in general, isn't all there is to enjoy in life; Emma, who, even when she isn't trying, constantly makes me a better person; and to my friends, in New Haven and elsewhere, who provided endless support.

Table of Contents

| | |
|--|-----------|
| ABSTRACT | II |
| ACKNOWLEDGMENTS | IV |
| INTRODUCTION | 1 |
| MATERIALS AND METHODS | 5 |
| RESULTS | 9 |
| DEMOGRAPHICS | 9 |
| PRACTICES USING AFTER-HOURS SERVICES | 11 |
| PRACTICES WITH NO AFTER-HOURS SERVICES | 18 |
| PRACTICES WITH INTERNAL AFTER-HOURS SERVICES | 20 |
| DISCUSSION | 24 |
| DEMOGRAPHICS | 24 |
| PRACTICES WITH AFTER-HOURS SERVICES | 24 |
| PRACTICES WITH NO AFTER-HOURS SERVICES | 32 |
| PRACTICES WITH AN INTERNAL AFTER-HOURS SERVICE | 33 |
| LIMITATIONS | 34 |
| CONCLUSIONS | 35 |
| APPENDIX-SURVEY ON RADIOLOGY PRACTICE'S USE OF AFTER-HOURS SERVICES | 38 |
| REFERENCES | 48 |

Disclosure

Please note: The majority of the Materials and Methods and Results sections are taken from two published papers, on which I am an author. The Introduction and Discussion portions contain some of the same material as in these papers as well. The two papers are:

Kaye AH, Forman HP, Kapoor R, and Sunshine JH. *A survey of radiology practices' use of after-hours radiology services*. J Am Coll Radiol, 2008. 5(6): 748-58.

Kennedy S, Forman HP, Kaye AH, Bhargavan M, and Sunshine JH. *The reasons that many practices don't use off-hours services*. J Am Coll Radiol, 2008. 5(8): 887-92.

Introduction

After-hours, or nighthawk, radiology companies are groups of radiologists that perform interpretation—primarily of night and weekend images—for other radiology practices and at a different site from the site of image acquisition. Anecdotally, although they are relatively new, their use has been increasing rapidly.

The absence of any surplus of diagnostic radiologists in the United States has further increased the attractiveness of such services^{1,2}. Even in the setting of a reported easing of the radiologist shortage³, stories abound among radiology circles of the increased use of these nighthawk services. Anecdotally, much of the debate over the place of nighthawks in the radiology workplace has revolved around radiology as a “lifestyle” specialty. Due to their higher salaries, and what some perceive as better hours, radiologists have been scrutinized for living easier lifestyles and working less hours for more pay than their counterparts in other fields. The debate over nighthawks, some radiologists say, adds “fuel to the fire,” so to speak, to these other physicians’ arguments.

Many issues surrounding the interpretation of images at a site other than that of image acquisition have arisen. For example, many question the safety of such practice: how can quality be measured through viable quality assurance methods when image acquisition is not tied directly to interpretation? Wong et al. explore this in a paper which argues that, with a sound quality assurance program and constant feedback, teleradiology entities can in fact provide reliable, safe

interpretation of images⁴. One study from 1995, when the use of teleradiology was just beginning to burgeon, found that off-site interpretation of emergency radiology studies was indeed efficacious⁵. Even the feasibility of international teleradiology solutions has been studied, again finding that such options are indeed viable^{6 7}.

Another major issue that arises with off-site interpretation is referring physicians' attitudes towards other radiologists—namely, not ones they are familiar with in their own hospital or health care setting—reading images. One can imagine that many physicians would be concerned about the quality of the reads and the ability to discuss findings with radiologists. Another recent study that examines referring physicians' opinions on international teleradiology found that, while referring physicians generally prefer local interpretation of images, this preference is reversed when international teleradiology produced both faster turnaround times and less cost to the patient and referring physicians are assured that an American trained physician has interpreted the study⁸. With regards to international interpretation, some have raised legal issues as well⁹.

The use of nighthawk services is of increasing importance to the practice of radiology in the near and far future. Its implications stretch beyond simple logistics (e.g. feasibility, efficacy), and many argue that the entry of nighthawks have potential to change the practice of radiology radically from its current model. What likely originally started as an idea to supplement the practice of radiology, the ability to read and interpret images has evolved in some practice settings into a full-time replacement for having radiologists on site. One website, www.telerays.com,

has been set up as an auction site for image interpretation. Basically, images are sent to the lowest bidder, and that radiologist provides final interpretation of images. Radiologists are increasingly concerned that these types of practices may eliminate the need for on-site radiologists, removing radiologists further from the center of patient care ¹⁰.

One other threat to radiologists' current practice models is other specialties with in-office image acquisition tools, such as CT and MRI scanners. This can lead to "self-referral," the act of referring patients for imaging they may not need at scanners owned by the referring physicians themselves. Clinician ownership of these scanners leads to a financial conflict-of-interest that not only takes volume away from radiologists, but is a threat to patient safety and a weight on our already strained health care system ¹¹. Teleradiology and nighthawk service also act as a tool with which self-referrers can increase their productivity. Another company, In-Office Imaging, LLC (website www.inofficeimaging.com) offers referring physicians a way to essentially "bypass" some of the barriers to imaging that make it safer.

Very little has been documented about radiologists' attitudes towards nighthawk services. Using a survey, we explored radiology practices' motivations for utilizing an after-hours service, many aspects of how they are used, and the level of satisfaction with them. We also attempted to gauge why some practices choose not to use nighthawk services. Our hypothesis is that most practices use nighthawks for "lifestyle" reasons, such as wanting to stay home at night. Do radiologists simply want to sleep in at night? Or do they value the extra productivity during the day

added by one or more additional radiologists not being on call? Similarly, do practices that do not use nighthawks look at it as too costly of an alternative, do they want to maintain total control of their image interpretation, or are other factors such as resident coverage instrumental in determining the off-hours coverage? Finally, we look at practices that, despite the widespread availability of nighthawk companies, choose to organize their own, internal nighthawk staffed and organized by their own radiologists. We also suggest ways in which the use of nighthawk services might change as it becomes more or less common, and the landscape of the economics and public policy of radiology changes. Please note that not all aspects of the survey are explored in this paper; we try to discuss the most relevant results to the topic at hand.

Materials and Methods

Subjects for the study were radiology practices at hospitals. The hospitals were chosen at random from the American Hospital Association Handbook, with specialty, rehabilitation, and psychiatric hospitals excluded. We compiled a list of 300 randomly selected hospitals and attempted to contact the physician head of radiology at these hospitals. If the second attempt to reach the chief or head of radiology was unsuccessful, we attempted to obtain an e-mail or regular mail address to which a survey could be sent and returned to us. Of the 300 hospitals contacted, 115 (38%) surveys were completed by phone, email and regular mail combined. Of these completed surveys, 63 were from practices using an external after-hours service.

The phone calls were conducted by two of the authors, AK and RK, from August 2005 to July 2006. Every effort was made to ensure that every survey was identical. Exemption from requiring consent from each participant was granted by the Human Investigation Committee at Yale University School of Medicine. The surveyors assured each participant of their anonymity. One author, AK, processed and entered the data and ensured that all identifying information was deleted from each survey by assigning each a numerical code.

In preparation for a large-scale survey, we tested various questions on a select group of radiologists, who would not be part of our sample. They were asked an open-ended question relating to their reasons for utilizing an external after-

hours service. We chose the most popular answers from this preliminary survey for the final version of the survey.

The survey (Appendix A) queried demographic information from each practice, use of an external after-hours service, and the relative importance of certain, pre-selected reasons a practice might use an external after-hours service. Other survey questions asked about motivations behind receiving preliminary (“wet”) interpretations, both radiologists’ and referring physicians’ satisfaction with the service, the volume of studies interpreted and hours covered by the service, the costs of using it and payment for it, the licensing of the physicians interpreting studies for the surveyed practice, and use of an international nighthawk.

We compared the demographic characteristics of radiology practices using the 3 types of arrangements (external, internal, and no off-hours services) and analyzed questions providing detailed information on the reasons for the use of the latter 2 categories of arrangements and on how these arrangements worked. For this analysis, we defined an external off-hours service as a group of radiologists that was a separate legal and physical entity from radiology practices with which it was contracted for off-hours (night, weekend, and holiday) image interpretation. We defined an internal off-hours service as a dedicated group of radiologists within a radiology practice who performed off-hours image interpretation (ie, a practice at which every member rotated call did not have an internal off-hours service). Finally, we defined a radiology practice with no off-hours service as one that did not contract with a separate physical and legal group of radiologists or use its own

dedicated group of radiologists to interpret off-hours imaging. This classification generally referred to practices that rotated call among most, if not all, members. It also included practices at which residents were used for off-hours interpretations.

For practices not using a nighthawk, we asked another ranked question about reasons for not using a nighthawk, as well as questions about whether a nighthawk has previously been used or considered for use, and what changes might make the practice consider an off-hours service.

We also considered practices that use an internal off-hours service, such as a teleradiology system for in-practice radiologists. These questions asked about reasons for using an internal service, what hours the service cover, number of radiologists covering the service and how it is structured (e.g. full-time night-time radiologist versus a call system, in-state versus elsewhere), volume, and whether the practice uses the service to read for other hospitals or practices.

Some questions in the survey had descriptive answers that were ranked, with four or five answer categories available (e.g. Question 12b). Each practice was given a number of factors that might explain their use/disuse of a nighthawk, for example, and asked to provide a number from one to four on how important this factor was (4=Very Important, 3=Substantial Importance, 2=Little Importance, 1=Negligible or no importance). Each respondent was given an opportunity to add their own reason if it was not listed. For other questions, a percentage was given, and we grouped these answers into categories (e.g. Question 11c).

Data were entered into an Excel spreadsheet and screened for missing values. Given that the primary aim of this study is to describe the use of nighthawk services, we generally use descriptive statistics only.

Results

Demographics

Of the 115 surveys completed, 64 (55.7%) were from radiology practices that used external off-hours services, 13 (11.3%) were from radiology practices that used internal off-hours service, and 38 (33.0%) were from radiology practices with no external or internal off-hours services. The 38 responding practices that did not use external or internal off-hours service had a median of 8 full-time radiologists, compared with a median of 4 among the 64 practices that used external off-hours services and a median of 19 among the 13 practices that used internal off-hours services (Table 1). The mean sizes of the practices were 10.7, 8.2, and 19.9 full-time radiologists, respectively. Mean practice size was significantly different between radiology practices using external off-hours services and those using internal off-hours services ($P < .01$), and was marginally significant between radiology practices using internal off-hours services and those using no off-hours services ($P < .10$). There was, however, no statistically significant difference between practices using no off-hours services and those using external off-hours services.

Sixteen percent of the practices with no off-hours services had 20 or more members, compared with 8% of the practices using external off-hours services and 46% of those using internal off-hours services. This difference was significant between practices using external off-hours services and those using internal off-hours services ($P < .01$), as well as between practices using internal off-hours

services and those using no off-hours services ($P < .05$). Again, however, there was no statistically significant difference between practices using no off-hours services and those using external off-hours services.

Table 1 - Comparison of radiology practices' demographics

| <i>Demographic</i> | <i>External Off-Hours Service</i> | <i>Internal Off-Hours Service</i> | <i>No External or Internal Off-Hours Service</i> |
|---|-----------------------------------|-----------------------------------|--|
| No. of practices | 64 | 13 | 38 |
| Mean (median) no. of full-time radiologists | 8.2 (4) | 19.9 (19) | 10.7 (8) |
| No. of solo practices | 11 (17.2%) | 1 (7.7%) | 6 (15.8%) |
| No. of practices with 2 to 9 full-time radiologists | 32 (50.0%) | 4 (30.8%) | 16 (42.1%) |
| No. of practices with 10 to 19 full-time radiologists | 16 (25.0%) | 2 (15.4%) | 10 (26.3%) |
| No. of practices with 20 or more full-time radiologists | 5 (7.8%) | 6 (46.2%) | 6 (15.8%) |
| No. of practices with part-time radiologists | 29 (45.3%) | 4 (30.8%) | 15 (39.5%) |
| Mean (median) no. of part-time radiologists (for practices with part-time radiologists) | 2.6 (2) | 5.0 (4) | 2.4 (2) |
| No. of practices with residents | 1 (1.6%) | 1 (7.7%) | 7 (18.4%) |
| Mean (median) no. of residents (for practices with residents) | 15.0 (15) | 10.0 (10) | 9.2 (4) |
| Mean (median) no. of hospitals covered | 3.0 (2) | 6.6 (6) | 3.0 (2) |
| Mean (median) no. of hospitals covered with emergency departments | 2.5 (1) | 6.5 (6) | 2.8 (2) |

Table 2 - Reasons for using an after-hours service

| Reason | Mean Score | Standard Deviation | Standard Error | 95% Confidence Interval |
|--|-------------------|---------------------------|-----------------------|--------------------------------|
| Not enough radiologists to cover nights or weekends | 2.67 | 1.25 | 0.16 | 2.36-2.98 |
| Makes practice more attractive to incoming radiologists | 3.18 | 1.07 | 0.13 | 2.92-3.45 |
| Costs less than paying a radiologist to be at the hospital | 2.43 | 1.2 | 0.15 | 2.13-2.72 |
| Convenience of being able to sleep at night | 3.76 | 0.66 | 0.08 | 3.60-3.93 |
| Not enough nighttime volume to keep own radiologists busy | 2.22 | 1.35 | 0.17 | 1.89-2.55 |

n=64

Eighteen percent of the radiology practices with no off-hours service had residents, whereas only 2% of the practices using external off-hours services and 8% of those using internal off-hours services had residents. This difference was significant between practices that used external off-hours services and those that did not use any off-hours services ($P < .05$), but other differences were not significant.

Practices Using After-Hours Services

Motivations. The most important reason for using an after-hours service was the convenience of being able to be home and sleep adequately (Table 2).

Respondents gave this reason a mean score of 3.7 on a scale of “1” for “no or negligible importance”, “2” for “little importance”, “3” for “substantial importance”, and “4” for “very important.” The second most important factor, with a mean score of 3.2 (SD 1.0), was that the use of an after-hours service made the practice more attractive to incoming radiologists.

Why preliminary interpretations? The next question asked about practices’ motives to obtain preliminary rather than final interpretations. Fifty-eight practices received preliminary interpretations, four received final ones, and one practice received either preliminary or final interpretations from the service based on how much volume the practice had at any particular time. Of the 58 practices receiving preliminary interpretations, the most important reason for doing so was that the practice wanted its own radiologists to have the responsibility of coverage (mean 3.3) Another popular reason for providing wet reads was the practice wanted to be the group that is paid for the study, rather than another entity (Table 3) .

Percentage of studies interpreted by after-hours service. Thirty-two (51%) of the 63 practices reported they received approximately 1-5% of their interpretations from the after-hours service (Table 4). Fourteen (22%) reported they received less than 1% of their interpretations from the service. Two practices reported they received greater than 50% of their interpretations from the after-hours service. One of these practices had four full-time radiologists, no part-time radiologists, and was covering for 25 hospitals. The other was one radiologist covering three hospitals.

Table 3: Reasons for obtaining preliminary interpretations

| <i>Reason</i> | <i>Mean Score</i> | <i>Standard Deviation</i> | <i>Standard Error</i> | <i>95% Confidence Interval</i> |
|---|-------------------|---------------------------|-----------------------|--------------------------------|
| Want own radiologists to have responsibility of coverage | 3.29 | 1.1 | 0.14 | 3.01-3.57 |
| Afraid hospital might wonder "Why keep us around at all?" | 2.09 | 1.09 | 0.14 | 1.81-2.36 |
| We want to be the group that is paid | 2.8 | 1.24 | 0.16 | 2.48-3.11 |
| Quality of after-hours service insufficient | 2.02 | 0.99 | 0.13 | 1.76-2.27 |
| Final interpretations not offered by after-hours | 2.2 | 1.37 | 0.19 | 1.84-2.57 |

n = 59

Table 4 - Percentage of Studies Interpreted by Nighthawk

| <i>Percentage</i> | <i>Number of Practices</i> |
|-------------------|----------------------------|
| <1% | 14 |
| 1-5% | 32 |
| 6-10% | 9 |
| 10-20% | 4 |
| 20-50% | 2 |
| >50% | 2 |

n=63

Payments. Fifty-two practices estimated what percentage of their collections per study they paid the after-hours service. Almost half (25) of these practices were paying 100% of what they collected (Table 5). Most of the rest were paying less.

Only 3 practices paid less than half of the amount they collected, and one of these practices paid less than one quarter of what they paid.

Table 5 – Percentage Paid to Nighthawk of What Practices Paid per Study

| Percentage | Number of practices |
|--------------------|----------------------------|
| 25% or less | 1 |
| 26% to 50% | 2 |
| 51%-75% | 11 |
| 76% to 99% | 4 |
| Approximately 100% | 25 |
| Greater than 100% | 9 |
| Don't know | 11 |

n=63

Thirty-eight percent of practices were receiving some form of assistance in paying for the service from their hospitals. The remainder (62%) were paying the entire cost of the external after-hours service themselves. Ten practices, or 16%, were paying nothing, and the hospital was covering the entire cost. Thirty-six practices (57%) paid none of the cost of maintaining or purchasing the equipment (Table 6). Fifteen practices (23%) paid all of these costs themselves.

Credentialing of the after-hours services' radiologists. Two practices were unaware whether the radiologists interpreting images for the after-hours service were licensed in the state where the practice was located, but the remainder of the practices reported that all the radiologists were licensed as such. Similarly, all but 5 of the practices surveyed reported that the radiologists were credentialed in their hospital. Two of the remaining 5 practices did not know, 2 practices reported that

Table 6 – Percentage of Cost of Equipment Paid by the Hospital

| <i>Percentage of equipment paid by hospital</i> | <i>Number of practices</i> |
|---|----------------------------|
| None | 15 |
| 1 to 49 | 1 |
| Half | 3 |
| 51-99 | 1 |
| All | 36 |
| Nighthawk pays | 2 |
| Don't know | 2 |
| 'Some' | 3 |

n=63

some of the radiologists were credentialed at their hospital, and one hospital did not answer. Twenty-four (40%) of the 60 practices that were able to give information on credentialing the radiologists reported that the practice had exerted little or no effort in credentialing them, but 19 (30%) reported they had exerted much effort or done everything (Table 7).

Table 7 – Effort Devoted to Credentialing

| <i>Effort</i> | <i>Number of practices</i> |
|---------------------|----------------------------|
| Little or No Effort | 24 |
| Some Effort | 16 |
| Much Effort | 12 |
| We did everything | 7 |
| Don't Know | 1 |

n=60

Malpractice coverage. Only 4 practices reported they had encountered any resistance from malpractice insurers. One practice stated it had to go through considerable trouble to have use of the service approved, and had to use an in-state

after-hours service. Another practice said it had to convince the insurance company that the use of after-hours services was becoming more commonplace before they would insure it. A third practice said that, due to separate coverage for each of the hospitals for which it interpreted studies, the practice itself had to accept all medical-legal responsibility for the after-hours service. A fourth reported not remembering what the hurdles were, as they were 3 years ago, but remembered having some trouble from malpractice insurers.

International services. Twenty-five (40%) out of the 63 practices surveyed said they used an after-hours service that was located outside the United States. Of these, 9 (36%) of them reported that all the radiologists interpreting images there were American citizens (Table 8). Ten of these practices (40%) said they were not aware of the citizenship status of the radiologists at the off-hours service. Of the 6 practices that knew of at least some foreign nationals working at the after-hours service, 1 said that the foreign citizens had some American training, 3 said that they were all American-trained, and 2 said they did not know.

Table 8 – Radiologists Interpreting Studies by International Nighthawks

| Composition | Number of practices |
|--------------------|----------------------------|
| All American | 9 |
| Mostly American | 5 |
| About equal | 1 |
| Mostly Foreign | 0 |
| All Foreign | 0 |
| Don't Know | 10 |

n=25

Communications. Fifty-five (89%) practices said that the after-hours service had capabilities for live conversation with the practice (Table 9). Of these, 41 (75%) said they rarely or never had live conversations with the service. Fifty-eight (92%) practices said their after-hours service had capabilities for live conversation with referring physicians (Table 10). There was considerably more conversation by physicians of the nighthawk service with referring physicians than with the radiology practice.

Table 9 – Live Conversation with Practice

| <i>With Practice</i> | <i>Number of practices</i> |
|----------------------|----------------------------|
| Rarely | 41 |
| Little | 4 |
| Some | 7 |
| Frequently | 3 |

n=55

Table 10 – Live Conversation with Referring Physicians

| <i>With Referring</i> | <i>Number of practices</i> |
|-----------------------|----------------------------|
| Rarely | 16 |
| Little | 13 |
| Some | 7 |
| Frequently | 13 |
| Don't know | 9 |

n=58

Satisfaction. Twenty-seven (44%) practices said the predominant reaction from the referring physicians towards use of the service was very good; 21 (43%) said it was mostly good (Table 11). One practice reported that the emergency medicine physicians' reactions were mostly good, while the remaining physicians'

reactions were mostly bad. Sixty practices claimed that referring physicians had never suggested that the after-hours service could do all interpretations for the hospital.

Table 11 – Predominant Reaction of Referring Physicians

| Reaction | Number of practices |
|-----------------|----------------------------|
| Very Good | 27 |
| Mostly Good | 21 |
| Neutral | 13 |
| Mostly Bad | 1 |
| Very bad | 0 |

n=62

Practices with no After-Hours Services

Having enough radiologists or residents to cover the night had the highest importance in driving the decision not to adopt an external off-hours service, with a mean score of 3.0 on a scale of 1 (“negligible or no importance”), 2 (“little importance”), 3 (“substantial importance”), and 4 (“very important”) (Table 12). Not rated equally important, but with the difference not significant, was an off-hours service being too costly for the benefits it offered. Rated significantly lower in importance was the off-hours service interruption of the involvement of radiologists in the practice of care ($P < .01$), the quality of an off-hours service being insufficient ($P < .01$), and having too much volume, which would mean that an off-hours service would cost too much ($P < .01$).

Table 12 - Reasons for not using an external off-hours service

| <i>Reason</i> | <i>Mean Importance</i> | <i>Standard Deviation</i> | <i>Standard Error</i> |
|---|------------------------|---------------------------|-----------------------|
| Have enough radiologists or residents to cover the night | 3 | 1.2 | 0.2 |
| Too costly for the benefits it offers us | 2.7 | 1.2 | 0.2 |
| Interrupts involvement of radiologists in the process of care | 2.2 | 1.2 | 0.2 |
| Quality is insufficient at the after-hours service | 2.1 | 1 | 0.2 |
| Have too much volume, and thus it would cost too much | 2 | 1.1 | 0.2 |

n=38

Of the 38 practices that did not use off-hours services, 82% said that the issue of using an off-hours service had been raised. In 80% of these cases, members of the practices had brought it up (Table 13).

Table 13 - Who brought up the issue of off-hours services?

| <i>Who</i> | <i>No. of Instances</i> | <i>% Total Instances</i> |
|---------------------|-------------------------|--------------------------|
| Member of practice | 28 | 80.00% |
| Referring physician | 3 | 8.60% |
| Associated hospital | 2 | 5.70% |
| Other | 2 | 5.70% |

Of the 38 practices without off-hours services, only one had previously used an external off-hours service. Sixty-eight percent of the radiology practices without off-hours services cited increases in their workloads, either through added imaging volume or staffing decreases, as a change that could cause them to adopt off-hours services (Table 14). Twenty-one percent of these practices cited cost decreases through such things as increased reimbursement, increased competition, cheaper technology, and cost sharing as a change that could cause them to adopt off-hours services. Other less often cited changes that could spur adoption included a change in the attitudes of radiologists toward off-hours services, the need to recruit new or desirable radiologists to the practice, and an improvement in the quality of off-hours services' interpretations. Finally, a few practices mentioned that they might adopt off-hours services if it gave final interpretations or if it maintained or improved the continuity of care.

Practices with Internal After-Hours Services

The consistency of the radiologists known to a practice interpreting imaging had the highest importance in driving the decision to use an internal off-hours service rather than an external one, with a mean score of 3.8 out of 4 on a scale of 1 ("negligible or no importance"), 2 ("little importance"), 3 ("substantial importance"), and 4 ("very important"). All other reasons given for using an internal off-hours service were significantly ($P < .05$) lower in importance (Table 15). There were no significant differences among them in importance, however. Seven practices mentioned other reasons as driving their decisions, including 3 practices that stated

Table 14 - The types of changes that could take place leading to the use of an off-hours service

| <i>Change</i> | <i>No. of Practices Citing This</i> | <i>% Practices Citing This</i> |
|---|-------------------------------------|--------------------------------|
| Increase in workload (more volume, decreased staffing, etc) | 26 | 68.40% |
| Cost decrease (cheaper service, cost sharing, reimbursement, etc) | 8 | 21.10% |
| Change in attitudes toward nighthawk services | 3 | 7.90% |
| Recruitment needs | 2 | 5.30% |
| If the quality improved or quality assurances were made | 2 | 5.30% |
| Adoption already underway | 1 | 2.60% |
| Other | 3 | 7.90% |

Table 15 - Reasons for using an internal off-hours service

| <i>Reason</i> | <i>Mean Importance</i> | <i>Standard Deviation</i> | <i>Standard Error</i> |
|---|------------------------|---------------------------|-----------------------|
| Consistency of people we know covering 24/7 | 3.8 | 0.4 | 0.1 |
| Too expensive to go external | 2.9 | 1.1 | 0.3 |
| Easier to manage internal off-hours service then to send to external one | 2.8 | 1.2 | 0.4 |
| Successful recruitment of someone to work only/mostly after-hours service | 2.5 | 1.4 | 0.4 |
| Quality of external after-hours service is insufficient | 2.4 | 0.9 | 0.3 |
| Radiologist(s) who was/were already in the practice willing to work after-hours service | 2.4 | 1.4 | 0.4 |

that maintaining good relationships with clinicians by interpreting their own imaging around the clock (and thus demonstrating a commitment to patient care) was very important. Two other practices cited an increase in the quality of interpretations with an internal off-hours service as very important.

With a mean practice size of 19.9 full-time radiologists and a mean of 1.4 radiologists on off-hours shifts, radiology practices with internal off-hours services staffed those services with, on average, one radiologist for every 14 radiologists in the practices.

Of the 13 radiology practices that used internal off-hours services, 7 had permanent crews of radiologists who worked off-hours, whereas 6 used rotation systems. The 7 practices that used permanent crews of radiologists were asked about incentives to work off-hours. Four of these 7 practices said that there were no incentives (ie, the individuals wanted to work off-hours), and 3 said that financial incentives were used. The 6 practices that used rotation systems were asked how long radiologists spent on the rotations on average. Four of the 6 practices said one day, one said 7 days, and one said that the time varied between one and several days.

Of the 13 practices that used internal off-hours services, 11 reported that their services covered weekends in addition to weekdays. Ten of the 13 internal off-hours services were situated locally; the remaining 3 were located within the same states.

Three of the 13 practices that used internal off-hours services also performed interpretations for other radiology practices. Of these 3 practices, 2 reported that 20% of their interpretations were for other radiology practices, while the other practice estimated 5%. Two of these 3 practices stated that they wanted to increase the number of interpretations done for other practices, while the other desired no change. Finally, 7 of the 10 practices with internal off-hours services that did not perform interpretations for other radiology practices stated that they had no desire to do this in the future, whereas 3 reported that they were starting to recruit other practices.

DISCUSSION

Demographics

There was no statistically significant difference in size between practices that did and did not use nighthawks. We would expect that larger practices would be less likely to use nighthawks, since the larger number of radiologists means a less onerous call schedule. Practices with internal arrangements did have significantly larger size, which is in line with expectations, since they would have more staff available to work the night shifts.

Practices with After-hours Services

Residents. Only one (1.5%) of the practices using an external nighthawk service had residents, while seven (19%) of the practices using no nighthawk service had residents. Our results suggest that radiology practices with residents have a relatively low likelihood of using external off-hours services, because they most likely use their residents for preliminary nighttime interpretations. However, this conclusion may be partially invalidated by the inclusion of practices with fewer than 10 members in our data. The rules of the Radiology Residency Review Committee in essence require a minimum size of 10 to cover subspecialties for a site to be a primary site for a residency. A majority of respondents in the external and no off-hours service categories had fewer than 10 radiologists. Further data on practices with residents would provide a better understanding of these hypotheses.

Motivations. Our results indicate that the most important reason for using a nighthawk service is the convenience it affords radiologists to be able to sleep at night. The second most important reason was that use of the nighthawk enhanced the practices' attractiveness to potential radiologists. "Manpower" considerations, concerning volume of studies and number of radiologists to cover nights and weekends, had lower mean scores than the more "lifestyle-based" reasons listed above. Our results suggest that the decision to use a nighthawk is more of a "lifestyle" decision than a necessity. This data has important implications for the future of radiology. Nighthawks have already drastically changed the landscape of the economics of practices across the country. In many reported cases, radiology groups have lost privileges at their hospitals, being replaced by either larger, more economically stable groups, or in a few cases, by a full-time "dayhawk" that provides coverage around the clock from a site other than image acquisition.

On the surface, these changes may make economic sense for many hospitals involved. For example, if one eliminates on-site radiologists, the hospital can collect the full share of reimbursement for the actual image acquisition, without having to share in the profits with the radiology group. However, most radiologists pride themselves on being central in patient care, and their replacement with a "lowest bidder" outside the hospital, with little to no personal contact with referring physicians, undermines this central role. In essence, it turns radiology interpretation into a commodity, which has wide implications not only on the practice of radiology, but on patient outcomes and safety.

Therefore, the “lifestyle-oriented” philosophy demonstrated by this data could spell trouble for many radiologists across the country. At its core, this is an issue of exactly what value the radiologist brings to patient care, and how best an in-house radiologist can deliver that value—to all “consumers” involved, be they referring physicians, patients, or hospital administrators. There is more work to be done in the literature on how to measure this value, as well as what methods deliver it the best, and to whom.

Why Preliminary? Most practices receive preliminary interpretations rather than final ones. Our results indicate that the main reason driving this is that radiology practices want to have ultimate responsibility for the studies that take place at their hospitals. While the other reasons did not have mean scores as high, it is possible that these others underlie the desire for responsibility. For example, one could argue that the desire to minimize loss of revenues, as well as a fear of allowing other radiologists greater access to their medical staffs, could motivate a practice to want to have the ultimate responsibility for interpreting the studies, and thus they will receive preliminary interpretations rather than final ones. The issue of causality between these factors was not explored in this paper, and is an opportunity for future study. One would assume that the restrictions by payers such as Medicare and Medicaid that restrict interpretation by non-board certified radiologists, such as those that might be trained outside the United States or American trainees, would be more instrumental in determining whether a practice receives final interpretations. We did list as a potential reason that the “nighthawk

does not offer final interpretations,” but this may not take into account these issues, and they may be reflected in other factors listed.

Percentage of Studies. Our results indicate that at the time of the survey, use of a nighthawk was limited to a small fraction of contracting practices’ total work, as indicated by the fact that almost 75% of practices used the nighthawk practice for 5% or less of their total interpretations. This likely reflects the fact that there is generally less volume overnight. The only practices with at least 50% of their studies done by the nighthawk were small practices covering multiple hospitals. Although it was not reflected in our study, this could be another reason for using a nighthawk: it makes at least one radiologist more productive. Rather than paying a radiologist to interpret a small number of studies overnight, it might be more economically reasonable to use that radiologist during the daytime, when there are is a higher volume.

Payments. At first it appears that a large percentage of practices did not financially profit from the studies interpreted by the nighthawk. Almost half of the respondents were willing to pay approximately as much as they collected, and another 17% were willing to pay more than they collected for these studies. This conclusion is somewhat weakened by the small proportion of the practices’ total revenues paid to nighthawks. However, it bears mentioning that many other issues present themselves with this.

More importantly, it neglects the previously mentioned reality that a practice’s nighttime workload is often far too little to keep a radiologist busy full

time. Thus, without a nighthawk, a practice will typically be using up an entire work shift of one of its radiologists--which could, instead, be used in the daytime to perform a full day's work--while the radiologist on-call for the night will have done only a small fraction of a full day's work. Given this reality, it may be financially advantageous for a practice to use a nighthawk service even if the service is paid considerably more than the practice collects for the studies the nighthawk interprets.

Thirty-eight percent of practices were receiving some kind of financial help from their hospitals. It will be interesting to observe trends in this data; whether hospitals will become more comfortable with the use of nighthawks and are willing to pay more for their services. There was much variability in paying for the transmission equipment. Our survey did not inquire what components of the transmission equipment were already in place prior to using the nighthawk. For example, if the hospital already had the infrastructure in place to allow the practice to interpret images from home or from another site via a PACS system, then the additional cost to "purchase or maintain" the transmission equipment would be low or negligible. Thus, the question about who pays for transmission equipment does not gauge how much effort, time, and money the practice had to spend on this aspect of initiating the use of the nighthawk. Interestingly, for two practices, the nighthawk company paid for and maintained the transmission equipment. It will be interesting to see if this is the beginning of a trend, perhaps resulting from competition for clients as the nighthawk market evolves.

Credentialing. Almost every practice claimed that the nighthawk radiologists were credentialed at their hospital and licensed in their state, regardless of whether the nighthawk was located overseas. This appears to be a prerequisite for nighthawks, as many of the respondents in the phone survey simply answered the question by stating “Of course [they are credentialed]. They have to be.” Most likely, hospitals’ medical staff credentialing guidelines require that any radiologist involved in the care of patients must be credentialed at that hospital and licensed in that state.

Forty percent of the practices surveyed claimed to have exerted little to no effort in having the nighthawk’s radiologists credentialed. The survey did not ask whether the entity putting in the effort to do credentialing in this situation was the nighthawk company, the hospital, or a combination of both. Again, it will be interesting to see if there is a trend towards practices exerting less effort in the future as nighthawks compete for their business.

Malpractice Issues. Surprisingly, our study showed there is currently little concern about nighthawk services with regard to malpractice liability issues, either on the parts of the insurers or the radiology practices. This could remain the situation; on the other hand, the relative novelty of the nighthawk business may not yet have provided sufficient experience or time for the surfacing of malpractice-related issues. As nighthawk use becomes more widespread, hospitals may send more volume to these services, and may even obtain final interpretations from

them. One could foresee more malpractice issues being transferred from in-house radiologists to after-hours services as they increase in volume.

International Services. One issue concerning nighthawks that has gained much public exposure is the use of international companies. Some fear that radiology will undergo similar changes to those seen in many service industries, where work is outsourced to another country where there may not be the same degree of oversight, thereby permitting potentially under-trained and under-qualified foreign nationals to interpret images. Of those practices surveyed, less than half of the practices used an international nighthawk. Whether this is due to a specific preference for domestic versus international providers, malpractice liability concerns, availability of the service, price, or other factors was not addressed in this survey.

Forty percent of surveyed practices using international nighthawks did not know how many of the nighthawk's radiologists were foreign nationals and how many were American radiologists. This apparent indifference suggests that practices either trusted the teleradiology provider to practice responsible credentialing, or they simply do not consider this an important factor. One would assume—or at least hope—that the former is true in the majority of cases. No practices professed knowledge of utilizing all or mostly foreign teleradiologists, indicating that, at least for now, the international nighthawk companies prefer hiring American radiologists, whether for insurability, quality assurance, or other reasons. All of the foreign radiologists known to surveyed radiologists had at least

some American training, suggesting that, at least for now, the feared practice of foreign-born, foreign-trained radiologists interpreting studies overseas is not occurring. In this context, it is worth noting that much of the international operation consists of American firms, using American radiologists, who are temporarily located overseas so they can work when it is daytime locally.

Communications. The large majority of practices had arrangements with the nighthawk for live conversation with both the practice and the referring physicians. Live conversation with the referring physicians occurred more frequently than with the practice themselves, with 75% of the practices having little or no contact with the nighthawk about cases overnight. This further supports the hypothesis that use of nighthawks is “lifestyle-oriented,” since most practices seem to use nighthawks so that they do not have to have a radiologist attending overnight—and thus be hassled with a call at home—and perform final interpretations in the morning without consultation with those doing preliminary interpretations. Again, however, this brings up a possible unwanted side effect of nighthawk use—if a practice chooses to remove itself from the care of some patients, it is inherently changing the value it adds to patient care in the context of a hospital setting, and thus could be further commoditizing its services. There are examples of this beginning to happen, but it remains to be seen what trends occur in this area.

Satisfaction. The response from referring physicians to practices’ use of nighthawks seems to be overwhelmingly positive, as only one practice said their referring physicians rated the use of nighthawks as mostly bad or worse.

Approximately 20% said referring physicians were neutral on the use of nighthawks, while the remainder of practices claimed they had a positive reaction from other physicians. Most likely, this positive reaction is due to more timely interpretation than can be provided by an under-staffed radiology department at night. For now, however, radiology practices seem not to be deterred by the prospects of these nighthawk companies taking over their duties full-time, as not a single practice claimed referring physicians or their hospitals had ever suggested the nighthawk could interpret films full-time and displace the radiology practice from the hospital. This could represent a number of things on the part of radiologists: overconfidence in the value they provide to hospitals, a strong relationship with the hospital at which they interpret, or an ignorance or indifference to a trend that may be becoming more popular across the country. One would hope that the latter is not true.

Practices with no After-Hours Services

Having enough radiologists to cover the night was the most important reasons for not using a nighthawk. Cost-benefit mismatches were also sighted as important. This differs from practices using a nighthawk: they cited lifestyle issues, rather than manpower or cost-related issues. It is possible that this represents a fundamental difference in the values of practices that do and do not use nighthawks. Radiologists in practices that do use nighthawks require a better lifestyle, and practices with such radiologists may attract their own.

The majority of the practices not using nighthawks had at least considered its use. This is in line with the idea that nighthawks have become more and more well-known in the past few years. Although we did not ask explicitly whether nighthawks have been the vehicle of suggestion for these practices, our data indicate that this is not the case. Intuition, however, would suggest that nighthawk companies—largely for-profit, executively managed companies—likely have large marketing departments that make their presence known to radiology groups around the country. One only needs to attend a radiology conference and peruse the exhibit halls to get an idea of the ubiquity of these companies.

As only one practice not using a nighthawk had previously employed one, it is likely that many of the practices using nighthawks are satisfied with it. This goes with our intuition—practices inured to not having to stay up at night to take call are unlikely to want to do so in the future. Our results also indicate that an increase in workload, or a decrease in staffing, might drive most practices to consider switching to a nighthawk. However, as off-site reading becomes more prevalent, and hospitals become more comfortable with the practice, it will be interesting to see in the future if hospital-based practices convert back to—or remain in—an overnight call system in order to add value to their relationship with the hospital.

Practices with an Internal After-Hours Service

Our data indicate that practices that have an internal nighthawk arrangement value the consistency of known radiologists the most in considering their off-hours arrangements. It also makes sense that it is the larger practices that are able to staff

these internal arrangements—and thus not have a need to trust their readings to an off-site company—since they can enjoy less call divided among more radiologists.

In contrast with external nighthawks, which often have radiologists located in other states, countries, or continents, all internal arrangements we collected data on involved a radiologists located within the state interpreting films. One wonders if this is a driving factor in their decision to use an internal nighthawk—perhaps proximity to the hospital provides some comfort to the referring physicians, or to the practices themselves.

Limitations

The primary limitation to this study was the response rate. We contacted 300 hospitals and received 115 responses, 63 of which were from hospitals with external nighthawks. The nature of the survey, which involved calling practices and attempting to speak to busy chief radiologists, meant that we had a difficult time obtaining responses. As well, a practice already using a nighthawk service or considering doing so was probably more inclined to take the time to talk to a researcher about the use of nighthawk services than were other practices to talk about why they didn't use nighthawks. Thus, although a majority of our respondents used nighthawks, we doubt that a majority—or even half—of all practices were using nighthawks at the time of our survey. However, we can note that the 63 respondents using nighthawks were 21% of the total hospitals contacted, and there were probably at least a few nighthawk-using practices that did not respond. Thus, the fraction of all practices using nighthawks must have been

at least 21%, and was probably somewhat higher. A larger sample size would also allow us to explore more differences in practices that use nighthawks based on their geographic location, size, and number of hospitals.

Another limitation of the study was that it only measured radiologists' perceptions of aspects of their use of nighthawks use. For example, of those practices using international nighthawks, we did not collect objective data on the training of the radiologists reading images there. A different study examining international nighthawks themselves would give a more accurate representation of these radiologists. Similarly, our study examined how radiologists perceive referring physicians' reactions to their use of nighthawks. Other papers, such as Lester et al.'s paper, give more accurate depictions of referring physicians' real attitudes towards nighthawks.

Conclusions

Our results show that, currently, use of nighthawks is limited to a small percentage of a practice's total interpretations. Practices are mainly using the services for lifestyle-oriented reasons. They are willing to pay as much or more than they collect for the studies interpreted by nighthawks, but this is probably financially advantageous rather than a sacrifice of income for lifestyle. Practices see it as important to maintain of ultimate responsibility for the studies performed in their hospitals by doing their own final interpretations. However, they are willing to relinquish some responsibility—in the form of allowing others to perform

preliminary interpretations of off-hour studies, some of which directly affect patients' treatment--in return for a better lifestyle.

As mentioned, in the face of commoditization and self-referral, this could be a troubling trend for radiologists. The feared commoditization has already begun, with sporadic cases of hospitals forgoing image interpretation in-house for dayhawks. Some of these companies have begun providing full interpretations for other sub-specialty practices, such as orthopedists and cardiologists, thus making it even easier for some greedy physicians to claim their piece of the "imaging pie," even in the face of overwhelming evidence that placing scanners in their own offices and providing imaging without protocol from radiologists represents a deviation from the best, safest, efficient, and most cost-effective care. More data needs to be done on how nighthawk and dayhawk companies compare to in-house radiologists in terms of many of these outcomes, and thus, how they compare in the value they provide to referring physicians, hospitals, payers, and, ultimately and most importantly, patients.

Use of fully foreign nighthawks does not seem to be widespread yet, and the radiologists interpreting studies overseas are mostly Americans. Practices are not meeting resistance from malpractice insurance companies from their employment of nighthawk companies, including international companies, and they seem to be willing to put in some effort in order to ensure they can use these services. We believe that it may be too early to assess whether insurers' ready acceptance of the current nighthawk industry is justified.

It is important to recognize that this study is cross-sectional, and only represents the state of practices' use of nighthawks at the time of the survey. The teleradiology industry, the practice of radiology, and teleradiology technology are all evolving. As more practices begin to use nighthawks, the acceptance of this practice model may increase, thereby leading to more extensive utilization by existing practices and by new customers. The future may bring more teleradiology vendors, with consequent increasing competition, thereby lowering the cost to the customers and, hopefully, increasing the quality. Of course, such potentially explosive growth could have the opposite effects. For example, unforeseen malpractice issues may arise, which would undoubtedly affect perceptions of radiology practices contracting for such services. Whatever the evolution of the industry, changes seem likely, and it is imperative that these issues be studied on an ongoing basis to gauge the changing climate of the practice of radiology in the United States.

Appendix-Survey on Radiology Practice's Use of After-Hours Services

Your Name _____

Phone Number _____

Hospital _____

Please note that the preceding information with regards to your identity will be eliminated as soon as your reply is checked for completeness and any problems are resolved.

Demographics of Radiology Practice:

A practice is defined as an entity run by a single owner (group or individual), which may encompass one or more hospitals and one or more non-hospital sites.

Number of radiologists in the practice: full-timers ___ part-timers ___

Number of residents: ___

Number of hospitals your practice covers ___

How many of the hospitals that your practice covers have an ER? ___

1. Does your practice utilize an external after-hours service or internal after-hours arrangement, or neither? An external after-hours service is a practice--not owned by your practice--that performs interpretation—primarily of night and weekend images---at a different site from the site of image acquisition. Please check or star one choice.

Yes, external after-hours

Neither

Our practice has own internal after-hours service or similar arrangement

If your practice uses an external after-hours service, please skip to number 6. If your practice uses an internal after-hours arrangement, please skip to number 17.

If your practice does not use an after-hours arrangement, please continue to number 2.

2. Has the idea of utilizing an after-hours service ever been raised to your practice? Please check or star one choice.

Yes (1)

No (0)

2a. If yes, by referring physicians, a hospital, members of the practice, or other?
(check *all* that apply)

- Referring Physicians (1)
 Hospital (2)
 Member of practice (3)
 Other (specify) _____ (4)

3. Have you previously used an external after-hours service? Please check or star one choice.

- Yes (1)
 No (0)

3a. If yes, why did you stop?

3b. Were there any specific problems? Please specify

3c. Has the idea been brought up for only nighttime ER coverage, or other uses as well? Please specify.

4. Please indicate the importance of each of the following factors in your practice's decision not to utilize an external after-hours service:

4=Very Important, 3=Substantial Importance, 2=Little Importance, 1=Negligible or no importance

- Have enough radiologists and/or residents to cover night
 Too costly for the benefits it offers us
 Quality is insufficient at after-hours service
 Interrupts involvement of radiologists in the process of care
 Have too much volume, and thus it would cost too much
 Other, Please specify _____

5. What kind of changes could take place that would cause you to use an after-hours service?

Thank you. *End of questions for practices with no after-hours arrangements.*

If your practice utilizes an external after-hours service, please continue here.

6. Please indicate the importance of each of the following factors in your practice's decision to utilize an external after-hours service:

4=Very Important, 3=Substantial Importance, 2=Little Importance, 1=Negligible or no importance

Not enough radiologists or residents to cover nights or weekends

Makes practice more attractive to incoming radiologists

Costs less than paying a radiologist to be at the hospital

Convenience of being able to sleep at night

Not enough nighttime volume to keep own radiologist busy

Other, please specify all that apply _____

7. Does your practice receive preliminary readings (sometimes called "wet readings") or final readings from the after-hours service? Please check or star one choice.

Preliminary (1)

Final (0)

7a. If preliminary, please indicate the importance of each of the following factors in your practice's decision to receive wet readings instead of final readings:

4=Very Important, 3=Substantial Importance, 2=Little Importance, 1=Negligible or no importance

- Want own radiologists to have responsibility of coverage
- Afraid hospital might wonder why keep us around at all
- We want to be group that is paid
- Quality of after-hours service is insufficient
- Final readings not offered by after-hours service
- Other (please specify)

8. What have been the main benefits or positive aspects of utilizing the after-hours service?

9. What have been the main problems or negative aspects of utilizing the after-hours service?

10. Approximately what percentage of your practice's total interpretations are done by the after-hours service? ___%

10a. What hours does the after-hours service cover on weekday nights?

___ to ___

10b. Does the after-hours service cover weekends for your practice as well?

Yes (Hours: ___ to ___)

No

11. How does the practice pay for the after-hours service? Please check or star one choice.

Hospital pays at least part (1)

Practice pays all (2)

Other, specify _____

11a. If the hospital contributes funds to pay for the after-hours service, roughly what percentage? ___%

11b. Does the hospital pay for some or all of the costs of purchasing/maintaining transmission equipment?

- None
 Some ___%
 All

11c. How does the price you pay the after-hours service compare with what you collect for the studies it reads?

We pay about ___% of what we collect. Note: if major differences by modality or otherwise, please describe:

12. Are some or all of the radiologists interpreting your practice's images for the after-hours service licensed in your state? Please check or star one choice.

- None (0)
 Some (1)
 All (2)

12a. Are some or all of the radiologists interpreting your practice's images for the after-hours service credentialed at your hospital? Please check or star one choice.

- None (0)
 Some (1)
 All (2)

12b. If all or some of the doctors are credentialed in your hospital and state, how much effort did your practice devote to making the arrangements for getting credentialed? Please check or star one choice.

- Little or no effort (0)
 Some effort (1)
 Much Effort (2)
 Did everything (3)

13. Were there any barriers to utilizing the after-hours service from malpractice liability insurers? Please check or star one choice.

- Yes (1)
 No (0)

If yes, describe _____

13a. If there were issues, what is the current arrangement for malpractice liability concerning the after-hours service?

14. Is the after-hours service located overseas? Please check or star one choice.

Yes (1)

No (0)

14a. If yes, are the radiologists there American citizens temporarily located overseas or foreign nationals? Please check or star one choice.

All American (0)

Mostly American (1)

Mostly foreign (2)

All foreign (3)

Don't Know (4)

14b. If at least some are foreign nationals, to what extent are they trained in America? Please check or star one choice.

No American Training (0)

Some American Training (1)

All American Training (2)

Don't Know (3)

14c. Are the foreign nationals credentialed in the following...? Please check or star one choice for each.

In the US: All

Some

None

Don't Know

In your state: All

Some

None

Don't Know

In any hospital: All

Some

None

Don't Know

In your hospital(s): All

Some

None

__Don't Know

15. Does the after-hours service have capabilities for live conversation with your practice? Please check or star one choice.

__Yes (1)

__No (0)

15a. If yes, how often are they used? Please check or star one choice.

__Rarely or never (0)

__Little (1)

__Some (2)

__Frequently (3)

15b. Does the after-hourse service have capabilities for live conversation with referring physicians? Please check or star one choice.

__Yes (1)

__No (0)

__Don't Know (2)

15c. If yes, how often are they used? Please check or star one choice.

__Rarely or never (0)

__Little (1)

__Some (2)

__Frequently (3)

__Don't Know (4)

16. What has been the predominant reaction of referring physicians to your practice's use of after-hours services? Please check or star one choice.

__Very Good (5)

__Mostly good (4)

__More or less neutral (3)

__Mostly Bad (2)

__Very Bad (1)

16a. If referring physicians have had any complaints, please indicate their main complaints.

16b. Have referring physicians ever suggested, to you or your hospital, that they could have the hospital use only the after-hours service, eliminating the need for your practice? Please check or star one choice.

- Yes (1)
 No (0)
 Don't know (2)

Thank you. *End of questions for practices using external after-hours service.*

If your practice uses an internal after-hours service, please continue here:

17. Please indicate the importance of each of the following factors in your practice's decision to utilize an internal after-hours service rather than an external one: 4=Very Important, 3=Substantial Importance, 2=Little Importance, 1=Negligible or no importance

- Consistency of people we know covering 24-7
 Successful recruitment of someone to work only/mostly after-hours service
 Radiologist(s) who was/were already in the practice willing to work after-hours service
 Easier to manage internal after-hours service then send to external one
 Quality of external after-hours service is insufficient
 Too expensive to go external
 Other (please specify)

18. How many radiologists work during a weekday night, on average, in your internal after-hours service?

18a. Are there certain practice members who regularly work nights, or a rotation of most practice members? Please check or star one choice.

- Permanent crew
 Rotation **(If rotation, skip to 18c)**

18b If a permanent crew, what incentive does the practice offer them to work nights? _____ **(skip to 18d)**

18c. If there is a rotation of radiologists that work nights, how long does a practice member stay on night duty?

—

18d. What hours, on a weekday night, does your internal after-hours service cover?

— to —

18e. Does your internal after-hours service cover weekends as well? Please check or star one choice.

Yes

No

18f. If yes, what hours, on the weekend, does your after-hours service cover?

— to —

19. Is the internal after-hours service physically located locally, within the state, within the country, or internationally? Please check or star one choice.

Locally

Same state

Another state

International

Please specify where, if not local _____

20. Are any of the reads done for your own practice preliminary rather than final? Please check or star one choice.

Yes

No

20a. If yes, why?

21. Approximately how many studies per night are done by your internal after-hours service for your own practice? —

21a. Approximately how many studies per year are read by your practice in total, including by the internal after-hours service? —

22. Does the internal after-hours service do readings for other practices? Please check or star one choice.

Yes

No

22a. If yes, what prompted you to choose to read for outside practices?

22b. Approximately what percentage of readings done by your after-hours service are for other practices? ___%

22c. Would you like to increase, decrease, or not change the number of interpretations done for other practices? Please check or star one choice.

Increase

Decrease

No Change

22d. If you do not read for other practices, are you seeking to do so? Please check or star one choice.

Yes

No

Thank You. End of questions for practices using internal after-hours service.

References

1. Sunshine JH, Maynard CD, Paros J, Forman HP. Update on the diagnostic radiologist shortage. *Ajr* 2004;182:301-5.
2. Meghea CI, Sunshine JH. Who's overworked and who's underworked among radiologists? An update on the radiologist shortage. *Radiology* 2005;236:932-8.
3. Sunshine JH, Meghea C. How could the radiologist shortage have eased? *Ajr* 2006;187:1160-5.
4. Wong WS, Roubal I, Jackson DB, Paik WN, Wong VK. Outsourced teleradiology imaging services: an analysis of discordant interpretation in 124,870 cases. *J Am Coll Radiol* 2005;2:478-84.
5. DeCorato DR, Kagetsu NJ, Ablow RC. Off-hours interpretation of radiologic images of patients admitted to the emergency department: efficacy of teleradiology. *Ajr* 1995;165:1293-6.
6. Kalyanpur A, Neklesa VP, Pham DT, Forman HP, Stein ST, Brink JA. Implementation of an international teleradiology staffing model. *Radiology* 2004;232:415-9.
7. Kalyanpur A, Weinberg J, Neklesa V, Brink JA, Forman HP. Emergency radiology coverage: technical and clinical feasibility of an international teleradiology model. *Emergency radiology* 2003;10:115-8.
8. Lester N, Durazzo T, Kaye A, Ahl M, Forman HP. Referring physicians' attitudes toward international interpretation of teleradiology images. *Ajr* 2007;188:W1-8.
9. Hwang NH. You've got mail. The concerns of electronically outsourcing radiological services overseas. *The Journal of legal medicine* 2004;25:469-84.
10. Larson PA, Janower ML. The nighthawk: bird of paradise or albatross? *J Am Coll Radiol* 2005;2:967-70.
11. Levin DC, Rao VM, Parker L, Frangos AJ, Sunshine JH. Ownership or leasing of CT scanners by nonradiologist physicians: a rapidly growing trend that raises concern about self-referral. *J Am Coll Radiol* 2008;5:1206-9.