Resident-faculty overnight discrepancy rates as a function of number of consecutive nights during a week of night float

Abstract

Objectives: In 2018, the ACGME (Accreditation Council for Graduate Medical Education) made a change to the maximum permissible number of consecutive nights a resident trainee can be on “night float,” from six to seven nights. To our knowledge, although investigators have studied overall discrepancy rates and discrepancy rates as a function of shift length or perceived workload of a particular shift, no study has been performed to evaluate resident-faculty discrepancy rates as a quality/performance proxy, to see whether resident performance declines as a function of the number of consecutive nights. Our hypothesis is that we would observe a progressive increase in significant overnight resident–attending discrepancies over the 7 days’ time.

Methods: A total of 8,488 reports were extracted between 4/26/2019 to 8/22/2019 retrospectively. Data was obtained from the voice dictation system report server. Exported query was saved as a .csv file format and analyzed using Python packages. A “discrepancy checker” was created to search all finalized reports for the departmental standard heading of “Final Attending Report,” used to specify any significant changes from the preliminary interpretation.

Results: Model estimates varied on different days however there were no trends or patterns to indicate a deterioration in resident performance throughout the week. There were comparable probabilities throughout the week, with 2.17% on Monday, 2.35% on Thursday and 2.05% on Friday.

Conclusions: Our results reveal no convincing trend in terms of overnight report discrepancies between the preliminary report generated by the night float resident and the final report issued by a faculty the following morning. These results are in support of the ACGME’s recent change in the permissible number of consecutive nights on night float. We did not prove our hypothesis that resident performance on-call in the domain of report accuracy would diminish over seven consecutive nights while on the night float rotation. Our results found that performance remained fairly uniform over the course of the week.

Keywords: discrepancy; fatigue; night float.

Introduction

In 2018, the ACGME (Accreditation Council for Graduate Medical Education) made a change to the maximum permissible number of consecutive nights a resident trainee can be on “night float,” from six to seven nights. To our knowledge, although investigators have studied overall discrepancy rates and discrepancy rates as a function of shift length or perceived workload of a particular shift, no study has been performed to evaluate resident-faculty discrepancy rates as a quality/performance proxy, to see whether resident performance declines as a function of the number of consecutive nights [1, 2]. Such data are needed to assure that the current practice of assigning a single resident to seven consecutive nights is safe, from a patient care standpoint [3, 4]. As background, the overnight resident shifts at our institution occur between 10 PM and 7 AM and are conducted with indirect faculty supervision of resident interpretation of imaging examinations. This structure is designed to maintain resident autonomy, allows better simulation of workflow that a graduate of the program will eventually encounter, and allows the institution to maintain subspecialist over reading from faculty for all “final” interpretations. Faculty who participate in after-hours on-call work all have diagnostic PACS workstations at home and are available at all times for consultation, although the faculty, in practice, only are infrequently
asked to review an imaging study contemporaneously with the preliminary resident interpretation. Our overnight residents report conventional radiographs, CTs, MRIs, and ultrasounds of all body parts and in patients of all ages, for both Emergency Department patients and inpatients. This study specifically covered the domain of ED studies. As a quality assurance mechanism, our department carefully analyzes discrepancies between the residents’ preliminary interpretations and the final faculty reports.

To further objectively investigate the discrepancy rates as a function of number of consecutive nights during a week of night float, we wished to utilize natural language processing and subsequent logistic regression analysis to determine overall resident-faculty discrepancy rates at our institution for a period of 4 months. Logistic regression analysis of discrepancy rate for individual nights of the week independent of the identities of the individual residents, and attending radiologists involved, as well as the total number of resident reports per shift, all of which could potentially become confounding variables. Our hypothesis is that we would observe a progressive increase in significant overnight resident – attending discrepancies over the 7 days’ time.

Materials and methods

Clinical service structure

At our institution, the Penn State Milton S. Hershey Medical Center, resident radiologists perform the “night float” assignment for a duration of 9 h per shift, from 2200 to 0700 h the following day, for a period of seven contiguous nights starting on Friday evening. For the last 2 h the second shift resident overlaps with the night float resident (see chart) between 2200 and 2400 h. Between the hours of 2200 and 0800 the following day, residents work under general supervision, with subspecialty on-call faculty coverage. First year residents are excluded from the night float assignment. The following morning, resident night float cases are reviewed and corrected, and reports are final signed by subspecialty radiology faculty.

For the time included in the study and a reference to ED coverage at different times of day and night, please refer to Figure 1.

Data acquisition and preparation

Per institutional IRB, this study was determined to be exempt. The study was performed in accordance with HIPAA and all data remained within the radiology department data science team. A total of 8488 reports were extracted between 4/26/2019 to 8/22/2019 retrospectively. Data was obtained from the voice dictation system report server. Exported query was saved as a .csv file format and analyzed using Python packages. A “discrepancy checker” was created to search all finalized reports for the departmental standard heading of “Final Attending Report,” used to specify any significant changes from the preliminary interpretation.

A total of 12 radiology residents report data met study inclusion criteria requiring the standard seven consecutive days of night float. 57 radiology attendings provided final signature of these case. A total of five residents initially identified were excluded because of splitting of a weeklong shift. The other exclusion criteria included residents with less than five cases per shift such as occurs while on interventional radiology call.

Data modeling

Hierarchical Bayesian logistic regression was used to estimate the log odds of an overnight resident report having a major discrepancy for each day of the week. Hierarchical factors controlled for the following to reduce or eliminate their effects: individual radiology attendings on each day of the week, individual radiology residents on each day of the week, and cumulative reports in each resident’s shift. The model was developed in R with “rstanarm”, which uses the stan core library in C++. We used at least 10 simultaneous chains and a minimum of 4,000 iterations. Due to current data access and processing constraints, the model accepts the assumptions that the following elements do not have a significant effect on discrepancies: imaging modality, exam type, experience of individual resident (second through fourth year), demographics of patients, and details of patient stay (inpatient versus emergency). Additionally, the significance and potential clinical impact of the discrepancies were beyond the scope of this project (Figure 2).

Results

The model estimated that the median log odds of a discrepancy ranged from a low of −3.97 on Saturday to a high of −3.38 on Wednesday, which corresponds to probabilities of 1.86 and 3.28%, respectively. The highest

Figure 1: Residents’ time included in the study and a reference to ED coverage at different times of day and night.
The model estimates the logit of the probability of a discrepancy, which is the log odds of a discrepancy.

If the probability of a discrepancy for a resident report is:

$$P_D = \text{probability of a major discrepancy}$$
$$1 - P_D = \text{probability of no major discrepancy}$$

Then the odds of a discrepancy for a resident report is:

$$\text{odds}_D = \left( \frac{P_D}{1 - P_D} \right)$$

The logit of the probability can then be expressed as the log of the odds:

$$\text{logit}(P_D) = \log(\text{odds}_D) = \ln \left( \frac{P_D}{1 - P_D} \right)$$

probability was on Wednesday, with the second highest probability on Sunday (2.78%). Model estimates varied on different days however there were no trends or patterns to indicate a deterioration in resident performance throughout the week. There were comparable probabilities throughout the week, with 2.17% on Monday, 2.35% on Thursday and 2.05% on Friday. Figure 3 displays the median and 90% credible intervals for each day of the week, with the addition of a 50% credible interval added to the graph to better understand the posterior distributions.

Discussion

Our results reveal no convincing trend in terms of overnight report discrepancies between the preliminary report generated by the night float resident and the final report issued by a faculty the following morning.

Discrepancy rates varied between 2 and 3% over the course of the week. Sunday and Wednesday nights were slight outliers (approximately 3%) for reasons that are not entirely clear as they are not typically busier shifts nor is
the case mix different on these nights compared to other nights. These results are in support of the ACGME’s recent change in the permissible number of consecutive nights on night float. We did not prove our hypothesis that resident performance on-call in the domain of report accuracy would diminish over seven consecutive nights while on the night float rotation. Our results found that performance remained fairly uniform over the course of the week.

Although authors have investigated the effects of number of consecutive hours on discrepancy rates and have shown that those rates significantly increase after about 10 consecutive hours of a call shift, no studies, as far as we are aware, have investigated the role of number of consecutive nights on a call shift rotation [5]. This study is unique in that we investigated resident discrepancy rates over the course of seven nights, what our institution regards as a night float rotation, without potentially confounding factors such as length of a particular shift or perceived business of that particular time [6–11].

This result has important implications for resident training in radiology and for resident scheduling. Scheduling a resident for a full week of nights allows for a more consolidated experience and may be more practical way to schedule as opposed to scheduling multiple residents in a given week, with consistency of scheduling causing less sleep disturbances [12, 13, 14].

Limitations

The principal limitation of our study is that it involves only a single institution, with a relatively small number of subjects. Increasing the cohort size for a study such as this is especially challenging because pooling data across multiple institutions who may utilize slightly different models for resident coverage is a complicating factor in the analysis. Another limitation of our study is the use of resident-faculty discrepancy data as a proxy for resident accuracy [15, 16]. While this is a commonly used approach in the literature [17], discrepancy data are not strictly the same as a measure of resident accuracy. It is our hope that this study will prompt others to undertake similar investigations in their respective settings, to further validate the conclusions we have drawn from our own single-institutional experience [18].

Another limitation is workflow interruptions are not factored into our analysis as the data does not exist, and hence comes under one of the assumptions as being consistent throughout the week. For example, residents are required to be physically present in the trauma bay for level 1 trauma cases, and attend the CT scanner while trauma cases are being scanned, and hence such interruptions may affect train of thought and report discrepancies [19].

Lastly, a limitation of this study is that although a specific resident was on call each week, the studies were reviewed by various faculties. However, those faculty were randomly assigned to evaluate the reports generated the night before by the on-call resident and should not be a significant source of bias in this study [20].

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