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Comparisons of unscheduled absences among categories of anesthesia practitioners, including anesthesiologists, nurse anesthetists, and anesthesia residents

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ABSTRACT

Background: An "unscheduled absence" refers to an occurrence when an employee does not appear for work and the absence was without advance approval by an authorized supervisor. Recently we estimated the prevalence of unscheduled absences in a cohort of certified registered nurse anesthetists at the University of Miami. We performed a historical cohort study for all types of anesthesia practitioners at the University of Iowa.
Methods: Two-years of person-assignment days were studied. The total population was 62,951 regular operating room days among 293 people. There were 56,437 days among 203 practitioners with multiple workdays over multiple quarters.
Results: In the total population, the 91 nurse anesthetists had 1.48% person-days with an unscheduled absence, comparable to the 1.74% from University of Miami. Most unscheduled absences (99% lower confidence limit 80.1%) resulted in the person being absent from an operating room clinical assignment for just 1 day. Compared with nurse anesthetists, residents and fellows had proportionately fewer unscheduled absences (odds ratio 0.24 [0.13-0.45], $P<.0001$), as did anesthesiologists (0.49 [0.30-0.79], $P=.0002$). Among all practitioners, Mondays, Fridays, and days adjacent to holidays had significantly more unscheduled absences than Tuesdays, Wednesdays, and Thursdays (1.45 [1.19-1.76], $P<.0001$).
Conclusions: To have an adequate daily workforce, anesthesia clinical directors need to estimate the daily expected percentage of assigned anesthesia practitioners who will be absent. Potential inter-group differences should be considered. We provide a worked example showing how to use the results to decide numbers of practitioners to plan daily.

1. Introduction

An "unscheduled absence" refers to an occurrence when an employee does not appear for work and the absence was not approved in advance by an authorized supervisor.[1] From the perspective of making operating room assignments, if authorization was not given by the time when the final assignments for the next workday were posted, such absences are counted as unscheduled. If, subsequent to such posting, a certified registered nurse anesthetist, student registered nurse anesthetist, resident physician, fellow physician, or anesthesiologist ("practitioner") calls in to report they are unable to work because of illness or another reason, this can cause disruption to the operating room schedule, impact timely patient care, and potentially result in additional departmental expenses to cover for the absent anesthesia practitioner.

Recently we estimated the prevalence of unscheduled absences in a cohort of certified registered nurse anesthetists at a teaching hospital over a 3-year period.[1] The primary focus was to study how to analyze statistically potential patterns of absences (e.g., individuals with a higher than expected number of unscheduled absences on Fridays or Mondays). Our study was novel.[1,2] There has been only 1 other previous

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[1] As done before our prior study from the University of Miami,[1] we performed PubMed search on August 25, 2020, using the following search string: ("sick leave" OR (unplanned AND (absence)) OR (unscheduled AND (absence))) AND (nurse OR nursing OR anaesthetist OR anesthetist OR anesthesiologist OR anaesthesiologist) AND (anesthesia OR anaesthesia OR anesthesiology OR anaesthesiology). There were 18 articles returned, only 2 relevant to the topic of the study, the one published in 2003 and our prior study published in 2019.

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study related to absences among anesthesia practitioners,[a] but that focused on total work hours, not incidences of unscheduled absences.[2]

Our previous results were that at least a year of data would be required to detect outliers for unscheduled absences exceeding the 95% upper confidence limit among all nurse anesthetists.[1] No individual nurse anesthetist among the 99 studied was responsible for more than 5% of the total unscheduled absences over the studied three years.[1] Attempting to identify patterns of absences being on specific days of the week or as related to holidays and vacations would require multiple years of data.[1] Finally, as part of that study, the overall prevalence of unscheduled absences among all regular workdays with clinical assignments was 1.7%, with minor differences among days of the week or on the day before or after a vacation or holiday.[1]

We listed multiple limitations in our prior study.[1] There were no prior published studies reporting the prevalence of unscheduled absences among anesthesia practitioners,[a] highlighting the uniqueness of that study but reflecting weakness in having data from only one teaching hospital.[1] Also, although the same statistical approach would apply to anesthesiologists, residents, and fellows, there were not data available from the hospital previously studied to compare prevalence among those groups.[1]

We had previously tried to use data not only from the University of Miami, but also the University of Iowa. However, the University of Iowa's documentation of absences had been inconsistent. Contemporaneous with the previous study,[1] the University of Iowa implemented a revised program to record unscheduled absences accurately. The current paper reports a historical cohort study for all types of anesthesia practitioners at this department.

2. Methods

The University of Iowa Institutional Review Board declared August 12, 2020 that this project #202008135 does not meet the regulatory definition of human subjects research, because the activity is limited to retrospective analyses of deidentified data and is a process improvement project at one institution.

Since Monday August 6, 2018, the University of Iowa Department of Anesthesia has used a dedicated phone number with an automated voice message recording system for anesthesia practitioners to report unplanned absences on regular workdays. The practitioner was instructed to provide his or her name, role, assigned location, reason for absence, and alternate coverage, if already arranged. The recorded audio file was stored and linked to a discrete record in a database for each processed call. At 6:00 AM, the audio files were sent automatically via text messaging and email to the clinical director of the day. Any new message left after 6:00 AM generated an immediate text message and email with the recorded message to the clinical director of the day. The clinical director listened to each recording, documented the name of the practitioner from a drop-down list in a software application, confirmed the assigned location, then initiated an email and page back to the practitioner who called. These data stored in the department's staff assignment database were used for this analysis. We studied the 2-year period from the first whole week after the system was started, August 12, 2018; the final date was then August 8, 2020. The period of 2 years was known to be suitable from the previous study at the University of Miami.[1]

During the studied 2-year period, there were 106,239 person-assignment days in the department's scheduling software program (QGenda, Atlanta, GA). This count included days that people were scheduled not to be working, including holidays and weekends. For example, if a nurse anesthetist worked 2 twelve-hour shifts per week for 50 weeks per year, over the 2 studied years the person contributed 730 person-assignment days (365 × 2), of which 200 (2 × 50 × 2) were clinical assignments. Among the 106,239 person-assignment days, there were 1157 planned sick time absences (e.g., parental leave or post-operative recuperation), 298 excused illness days, and 709 unscheduled absences. If on sequential workdays following an unexcused absence for illness, the practitioner remained unable to work, such absences were counted as excused illness days. The sum of 1157 and 298 was 1455 scheduled absences. Unscheduled absences were inferred as days on which the practitioner had a clinical assignment but called to report that they were unable to work that day.

Exclusion of the 43,267 days people were not scheduled to be working (e.g., vacations, meeting, post-call), weekends, holidays, and assignments without potential operating room cases (e.g., pain medicine), there were left 62,972 person-assignment combinations for anesthetic care of patients on regular workdays (Fig. 1). At the University of Iowa, there were three surgical suites in connected buildings, each within a 5-minute walk of one another.[3] Therefore, these locations were pooled, matching the University of Miami study.[1] We excluded 21 post-call days with the unscheduled absence call being due to working late the night before. The resulting 62,951 combinations were clinical assignment days of 293 people. This population is referred to in Section 3, below, as the "total population." This includes only regular workdays.

There were 90 people who failed to have at least 5 of 8 quarters each with at least 5 scheduled workdays. These people would potentially be identifiable from the department's daily assignment tables, posted on the hospital intranet. They and their 6514 person-assignment workdays (10.3%) were therefore excluded from the mixed effects modeling (Fig. 1). The resulting population studied for that analysis was 56,437 person-assignment workdays of 203 anesthesia practitioners: 72 anesthesiologists, 73 nurse anesthetists, 52 resident and fellow physicians, and 19 student nurse anesthetists (Table 1). As done previously, weekdays were divided into two categories: (1) Tuesdays, Wednesdays, and Thursdays not adjacent to holidays (N = 32,659) and (2) Mondays, Fridays, or days adjacent to holidays (N = 23,778) (Table 1).[1] For example, the Wednesdays before Thanksgiving (i.e., holiday Thursdays) were in the 2nd group.

Inferential tests were two-sided, treating $P < 0.01$ as statistically significant, and equivalently reported with 99% confidence intervals. The confidence intervals for binomial proportions were calculated using the Clopper-Pearson conservative, exact method (StatXact 12.0, Cytel, Cambridge, MA). Comparisons of raw percentages with published historical data from the University of Miami[1] was performed using the exact chi-square test (StatXact). The effects on unscheduled absences of practitioner type and weekday were analyzed while adjusting for the 203 clusters of person using mixed effects logistic regression with robust variance estimation (STATA 16.1, College Station, TX). The baseline comparator used was nurse anesthetists on Tuesdays through Thursdays not adjacent to holidays, thereby matching results from the University of Miami.[1] There were no significant interactions among practitioner types and category of workday.

3. Results

The total population of 62,951 operating room clinical assignment days of 293 people had 746 unplanned sick days (1.19%), of which 631 were unexcused absences (0.99%) and 115 were excused illness days (0.18%). The 91 nurse anesthetists had 22,227 person-days of which 328 were unscheduled absences (1.48%) and 42 were excused illness days (0.19%). In comparison, the observed percentage unscheduled absences among nurse anesthetists at the University of Miami was 1.74%, 489 of 28,689.[1] The observed percentages of 1.48% and 1.74% were comparable, and not significantly different, $P = 0.043$.

The 56,437 person-assignment days with blinded counts by person had 536 unscheduled absences (0.95%) plus 83 subsequent operating room sequential excused illness workdays (0.15%). The 73 nurse anesthetists had 20,546 person-days of which 293 were unscheduled absences (1.43%) and 41 were excused illness days (0.20%) (Table 1). These percentages also were comparable with the University of Miami, $P = 0.016$.

The ratio of 536 unscheduled absences to 83 subsequent excused illness days shows that most unscheduled absences resulted in the

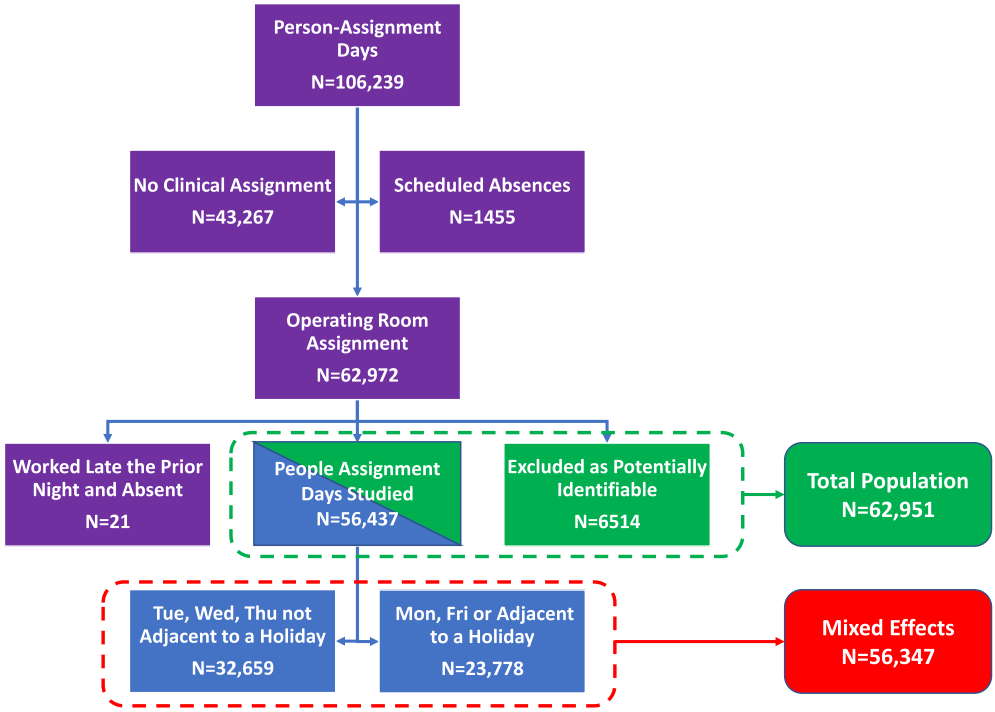

Fig. 1. Flow diagram of operating room person-assignments studied, as described in detail in the successive paragraphs of the Methods. The Mixed Effects analysis excludes person-assignment days for which the practitioner might be identifiable, due to few working days. The Total Population analysis includes all person-assignment days.

Table 1
Unadjusted percentages of unscheduled absences.

Anesthesia practitioners	Percentages of unscheduled absences	
	Tue, Wed, Thu, not adjacent to holiday (N=32,659)	Mon, Fri, or day adjacent to holiday (N=23,778)
Residents and fellows (N=52 people, N=14,080 days)	0.28% (23/ 8208)	0.54% (32/ 5872)
Anesthesiologists (N=72 people, N=18,250 days)	0.80% (84/ 10523)	0.83% (64/ 7727)
Student nurse anesthetists, SRNAs (N=19 people, N=3561 days)	1.00% (21/ 2097)	1.15% (19/ 1464)
Nurse anesthetists, CRNAs (N=73 people, N=20,546 days)	1.14% (135/ 11831)	1.81% (158/ 8715)

person being absent from an operating room clinical assignment for just 1 day. The 83 excused absences were total days, not the number of unscheduled absences with at least 1 subsequent excused day. Thus, the maximum possible percentage of unscheduled absences with at least 1 excused day was 15.5% (83/536), 99% confidence limit 11.7% to 19.9% (see Section 5, below).

Compared with nurse anesthetists, residents and fellows had proportionately fewer unscheduled absences (odds ratio 0.24 [0.13 to 0.45], $P < 0.0001$), as did anesthesiologists (0.49 [0.30 to 0.79], $P = 0.0002$). The student nurse anesthetists did not differ significantly from the nurse anesthetists (0.98 [0.41 to 2.39], $P = 0.96$), but the sample size was small resulting in wide confidence intervals for that group comparison.

Unlike at the University of Miami, the proportional incidences of unscheduled absences differed among weekdays. Mondays, Fridays, and days adjacent to holidays had significantly more unscheduled absences than Tuesdays, Wednesdays, and Thursdays (1.45 [1.19 to 1.76], $P < 0.0001$).

4. Worked Example Applying the Results

To interpret these results in terms of staff scheduling, suppose that a date needs to have 65 anesthesia practitioners in operating rooms, and this will include 40 nurse anesthetists and 25 residents and fellows. If the nurse anesthetists' prevalence of unscheduled absences were comparable to that of the residents and fellows on Tuesdays, both would have an unscheduled absence rate of approximately 0.28% (Table 1). To have at

Table 2
Example of Section 4 treating the unscheduled absence rate as a binomial probability.

Probabilities	Unscheduled absence rate 0.28%	Unscheduled absence rate 1.81%
0 unscheduled absences among 65 scheduled	83.3%	30.4%
1 or more unscheduled absences among 65 scheduled	16.7%	69.6%
2 or more unscheduled absences among 66 scheduled	1.5%	33.7%
3 or more unscheduled absences among 67 scheduled		12.2%
4 or more unscheduled absences among 68 scheduled		3.5%

The probability of identifying > x events in a n independent trials where the probability of the event occurring in an individual trial = p can be calculated in Excel using the formula 1 - BINOM.DIST(x, n, p, TRUE), or in Google Sheets using 1 - BINOMDIST(x, n, p, TRUE).

least a 90% probability of having 65 working, there would need to be 66 scheduled (Table 2). In contrast, if the residents' and fellows' prevalence of absences were comparable to that of the nurse anesthetists on Mondays, both would have an unscheduled absence rate of approximately 1.81%. To have at least a 90% probability of having 65 working, there would need to be 68 scheduled (Table 2).

5. Discussion

We start with the critical disclaimer that the greater prevalence of unscheduled absences among nurse anesthetists compared to residents and fellows in no way should be interpreted as a criticism or commendation of any group. Potentially, the lower prevalence of unscheduled absences among residents and fellows is a consequence of their working when they are sick (referred to scientifically as "presenteeism"). Unfortunately, there is little known about the prevalence of "presenteeism" in anesthesia practitioners, so this is a theoretical issue. A validated instrument to study presenteeism among nurses was only published within the past year.[4] We found no previous studies of presenteeism in anesthesia.[2] Further study of presenteeism among anesthesia practitioners would be useful, especially because of the current Coronavirus 2019 (COVID-19) pandemic.

Our worked example (Section 4, Table 2) shows a stepwise process that operating room and anesthesia group managers can apply to estimate their hospital's expected prevalence of unscheduled absences. This method allows them to calculate the number of extra unassigned practitioners needed to be able to supply full coverage for all rooms with first case starts. Unscheduled absences have substantial operational and clinical impact. We recommend first evaluating whether all days of the week can be considered as equivalent, because if true the calculations will be simplified.[1] That requires that the anesthesia department tracks absences accurately.[5]

Our finding that the overall percentage of unscheduled absences for nurse anesthetists was similar at the two University practices is encouraging with respect to generalizability. However, there were differences in the results by weekday. The nurse anesthetists at the University of Iowa and the University of Miami accumulate vacation time and sick time similarly. However, more useful is that the proportional effect of weekday was a main effect, applicable to all groups (e.g., evident for the resident physicians and fellows in the first row of Table 1). Without knowing whether presenteeism is a relevant factor, we do not currently have an explanation for the difference among groups in the prevalence of unscheduled absences. The implication, however, is that each department should check using its own data if there are different prevalence of unscheduled absences among weekdays and practitioner groups.

We had hoped to provide some insight on excused illness days, the days after unscheduled absences. However, we have reason to doubt the generalizability of the results. From the Methods, among all clinicians' person-days including days when people were not scheduled to work in the operating room, plus administration, education, critical care, etc., the ratio of excused illness days (N=298) to the sum of unscheduled absences (N=709) and excused illness days (N=298) was 29.6%, confidence interval 25.9% to 33.4%. In contrast, once limiting to the data for the mixed effects modeling, the estimated percentages were 15.5%, 11.7% to 19.9%. The reasons were that many clinicians in our department work >10 hour shifts for fewer than 5 days per week, provide clinical services at non-operating room locations, and/or have educational and managerial roles.[6] Therefore, illnesses extending more than 1 day would often not result in greater than 1 day absent from providing operating room care, although other assignments would be affected. What the confidence intervals do show reliably is that at least 2/3rd of unscheduled absences result in only one clinical day unavailable. Other anesthesia departments – especially those that are non-academic – can expect their estimated percentage to be substantially greater than our observed 84.5%. As Dzoljic et al. observed, the longer the workday and the fewer days per week thus worked, the consequence would be that each unscheduled absence results in a greater number of hours lost.[2] On the other hand, our results highlight that it reduces the probability of the absence extending for more than one day.

Our paper is limited in being from only one teaching hospital, but that too is its novelty. There are few previous reports on unscheduled absences among anesthesiologists, anesthesia residents and fellows, and student registered nurse anesthetists.[a,1] Studies to evaluate generalizability and learn what other departments can treat as reliable are important. We necessarily excluded some practitioners from the mixed effects modeling because of confidentiality concerns. However, because their overall contribution to the studied person-assignment days was small (approximately 10%), it is unlikely that this affected model estimates and conclusions. The ability of other departments to apply our methodology to estimate the number of additional practitioners needed to cover for unscheduled absences is dependent on a robust system in place to record such absences. That was a previous limitation at the University of Iowa overcome using a dedicated phone number and transcribed audio recording.

Another limitation is that a few months of our study period coincided with the ongoing COVID-19 pandemic. Increases in absenteeism among certain occupations including healthcare support has been observed during the early phases of this pandemic.[7] However, Johnson County, where University of Iowa is located, was minimally impacted during the periods of overlap between the COVID-19 pandemic and the study.

In conclusion, anesthesia clinical directors need to judge what percentage of anesthesia residents can be expected in operating rooms daily.[8] They need to judge what percentage of the residents and fellows will likely have an unscheduled absence. They need to do the same for nurse anesthetists, anesthesiologists, and student nurse anesthetists. We modeled each group (Table 1), detected significant differences, and showed that the differences are sufficiently large as to affect numbers of practitioners to plan daily.

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CRediT authorship contribution statement

Franklin Dexter: Conceptualization, Methodology, Formal analysis, Data curation, Writing - original draft, Writing - review & editing. **Richard H Epstein:** Validation, Writing - original draft, Writing - review & editing. **Anil A. Marian:** Conceptualization, Writing - review & editing.

Declaration of Competing Interest

The Division of Management Consulting of the University of Iowa's Department of Anesthesia provides consultations to hospitals. Dr. Dexter receives no funds personally other than his salary and allowable expense reimbursements from the University of Iowa and has tenure with no incentive program. His family and he have no financial holdings in any company related to his work, other than indirectly through mutual funds for retirement. Income from the Division's consulting work is used to fund Division research. A list of all the Division's consults is available at FranklinDexter.net/Contact_Info.htm. Dr. Dexter is a member of the Editorial Board of Perioperative Care and Operating Room Management. Drs. Epstein and Marian have nothing to disclose.

[2] We performed PubMed search August 25, 2020: presenteeism AND (nurse OR nurses OR nursing OR anaesthetist OR anesthetist OR anesthesiologist OR anaesthesiologist OR anaesthetists OR anesthetists OR anesthesiologists OR anaesthesiologists) AND (anesthesia OR anaesthesia OR anesthesiology OR anaesthesiology). There was 1 article retrieved, not related.

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