

Analysis of Workforce Productivity After Changeover of Rotational Doctors in a UK Emergency Department: Can we Predict the “August Effect”?

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Abstract

Objective: There is limited literature examining the impact of changeover on workforce productivity and the number of patients seen per hour by doctors in UK emergency departments. Given the emphasis on key performance indicators, e.g., 4-hour and 12-hour breach targets, trusts may benefit from minimising the impact of predictable decreases in performance metrics, such as those occurring when new doctors rotate.

Materials and Methods: The mean number of patients seen per hour was calculated for 49 doctors in training in a UK emergency department over a 4–6-month period. Trends were analysed to predict the impact of changeover on productivity for each group of trainees.

Results: When averaged across all trainees, there was an increase of 0.011 patients seen per hour per week. Over the course of an 18-week rotation, this would equate to approximately 1.6 additional patients seen per doctor per shift. When analysed individually, there was a statistically significant increase in the number of patients seen per hour among FY2, GP, and ACCS trainees, although only GP trainees remained statistically significant after correction for multiple comparisons.

Conclusion: Doctors in a UK emergency department appear to increase the number of patients seen per hour during their rotation. This suggests that decreases in departmental performance at changeover may follow a predictable pattern, although conclusions should be drawn with caution due to multiple limitations, including the single-centre nature of the study.

Keywords: Emergency Department Performance Metrics, Impact of Doctors' Rotations, Workforce Productivity

Introduction

In the United Kingdom, doctors routinely move between different specialties, departments, and hospitals during their training. All Foundation Year (FY) 1 and 2 doctors (postgraduate years [PGY] 1 and 2) rotate between specialties every 3–4 months, typically in August, December, and April. Additionally, in the Emergency Department (ED), general practitioner (GP) trainees (PGY 3–5), Acute Care Common Stem (ACCS) trainees (PGY 3–5), and specialty registrars (PGY 5+) rotate every 6 months (August and February). With large proportions of the workforce moving into and out of the department simultaneously, it is assumed that there is some disruption to departmental productivity. UK studies investigating the impact of changeover on productivity are lacking, with the few studies in this field focusing on the US healthcare system.

Given that there are major emergency medicine performance targets in the UK, including the 4- and 12-hour targets, hospitals may benefit from implementing measures to mitigate the impact of changeover on performance if productivity is predictably disrupted during this period.

It is intuitive that the productivity of new doctors improves over time as they adjust to the department. Studies have shown that, in US emergency departments, resident doctors are more productive in terms of the number of patients seen toward the end of their rotation than shortly after changeover [1] and that productivity, as measured by patient complexity, increases with each stage of training [2]. The July changeover in the US may also lead to reduced patient care and longer hospital stays, with some evidence suggesting that this impact may be mitigated by higher levels of



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senior supervision [3]. Reducing the proportion of staff changing over from 40% to 20% can reduce this impact on length of stay [4]. The UK's equivalent "August effect" has not been investigated in as much detail, particularly in relation to emergency medicine. One UK study showed that the speed at which doctors performed routine tasks improved over the course of their rotation, but there were minimal differences for complex tasks [5]. Other studies have helped quantify the number of patients reviewed during a shift at various career stages, indicating that PGY 2–4 clinicians review approximately 0.8–1.2 patients per hour [6–8]. However, some of these data are not contemporary, and the demographics of emergency department attendances appear to be changing, with a higher volume of attendances involving patients with multimorbidity requiring complex care [9].

The hospital examined in this study is a UK Major Trauma Centre that employs many rotational doctors in training and locally employed doctors. There were approximately 140,000 presentations to the ED between April 2024 and March 2025, comprising both pediatric and adult patients with a full spectrum of medical, surgical, trauma, and psychiatric presentations. Doctors usually spend an entire shift in a specific area, such as Pediatrics, Resuscitation (Resus), Majors, or Ambulatory Care, but move between areas as required based on clinical acuity and patient volume. Doctors generally rotate between these areas, although some FY1 doctors and senior house officers (PGY 2–4) often spend little time in Pediatrics or Resus.

To the best of our knowledge, this is the first study to investigate the impact of doctor changeover on the productivity of a UK emergency department. This study explores trends in the number of patients seen per hour by doctors over the duration of their rotation in the emergency department of a large teaching hospital in England.

Materials and Methods

A retrospective analysis was conducted of the number of patients seen per shift by doctors in training who began working in the department between April 2024 and April 2025, inclusive. Training grades were recorded, and the rota was analyzed to identify shifts worked in patient-facing areas of the department. Shifts missed due to sickness and those assigned to receiving handovers from the previous shift were excluded.

Shifts were classified as either "day" shifts, lasting 9 hours, or "night" shifts, lasting 10.5 hours. An equal distribution of different daytime shift patterns (08:00–17:00, 10:00–19:00, 12:00–21:00, and 16:00–01:00) was assumed. Across these four shift patterns, doctors attend five handovers, each assumed to last 15 minutes. During

daytime shifts, doctors are advised to take a 30-minute break, while during night shifts, they are entitled to a total break of 1 hour and are not expected to see new patients after handover. Based on these assumptions, doctors were estimated to spend 8 hours and 11 minutes seeing new patients during a 9-hour shift and 9 hours during a night shift.

Using the Electronic Patient Record (EPR) system, clinicians assign themselves to patients when responsible for their care. This information is stored in the EPR system and can be accessed to identify the number of patients for whom a clinician was the primary care provider over a specified date range. However, if a clinician assigns themselves to a patient and is subsequently required elsewhere, the patient will still be included in the final count, even if the clinician removes their assignment. Although this occurs rarely, it is a potential source of error, and patients were included only if the clinician was recorded as the primary clinician reviewing the patient. The weekly number of patients seen by each doctor was recorded. The rota was reviewed, and the weekly numbers of day and night shifts were calculated. Using the estimates described above, the number of patients reviewed per hour was calculated for each week spent working in the Emergency Department by individual clinicians. Days of sickness were excluded from the analysis.

Clinicians were grouped according to training specialty and grade: Foundation Year (FY) 1, FY2, general practitioner (GP) trainees, Acute Care Common Stem (ACCS) trainees (postgraduate years [PGY] 3–4), Specialty Trainee (ST) 3 (PGY 5), and ST4+ (PGY 6+). In total, the activity of 49 doctors was analyzed, with the breakdown presented in Table 1. The number of patients seen per hour was calculated for each week spent working in the Emergency Department using Microsoft Excel. Mean values for each grade were calculated, and the results were reviewed to identify changes over time. It is acknowledged that the number of patients reviewed per hour is one potential indicator of resident doctor productivity but does not provide insight into the multitude of other functions that resident doctors perform in the Emergency Department, including but not limited to rapid assessment, procedures, interpretation of investigations, and supervision of more junior colleagues.

Statistical analyses were performed using linear regression, and R^2 was calculated to assess the goodness of fit of the data. There are limited data regarding learning curves specifically in emergency medicine and the patterns they follow [10]. This is a complex area distinct from the primary outcome of this retrospective study, which included doctors of various grades at different chronological stages of the learning curve. Given the range of presentations and

Table 1. Grades of doctors included in analysis

	April 2024	August 2024	December 2024	February 2025	April 2025	Total
FY1	1	2	2		1	6
FY2	6	6	5		5	22
GP trainee		2		2		4
ACCS trainee		2		2		4
ST3		4				4
ST4+		4		5		9
Total	7	20	7	9	6	49

FY1: Foundation Year 1, FY2: Foundation Year 2, GP: General Practice, ACCS: Acute Care Common Stem, ST3: Specialty Trainee 3, ST4+: Specialty Trainee 4 and above

pathways involved in managing Emergency Department patients, linear regression was assumed for simplicity during the analysis but was compared with other models to identify any significant differences.

This project was registered as a retrospective service evaluation using routinely collected Emergency Department data and therefore did not require National Health Service (NHS) Research Ethics Committee approval. No identifiable patient information was used, and individual participant data were anonymized. All data were stored and processed in compliance with local data governance requirements. The project was registered locally as a service evaluation and was deemed not to require participant consent for the reasons stated above.

Results

A total of 49 doctors were included in the analysis over a period of either 18 or 26 weeks, depending on the length of their rotation in Emergency Medicine. The weekly average number of patients seen per hour across the entire cohort ranged from 0.35 (week 1, FY1) to 1.70 (week 22, ST4+).

FY1

Figure 1 shows the results for four distinct groups of FY1 (PGY 1) doctors rotating through the department. There was a very small but statistically nonsignificant increase in the number of patients seen per hour during their time working in the ED, with an increase of 0.00383 per week (95% CI: -0.0052 to 0.0128, $p=0.38$).

FY2

Figure 2 shows the data for FY2 doctors. There was a statistically significant increase of 0.0136 patients seen per hour per week (95% CI: 0.0008 to 0.0264, $p=0.038$); however, after adjustment for multiple comparisons, this difference was no longer significant. The R^2 value suggested a moderate fit. Assuming a linear regression

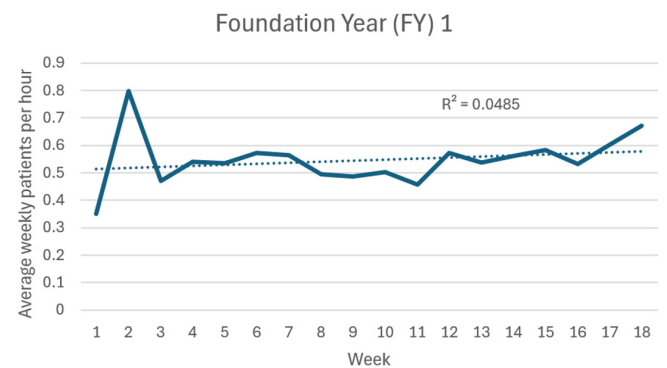


Figure 1. Average patients seen per hour by Foundation Year (FY) 1 doctors during Emergency Medicine placement

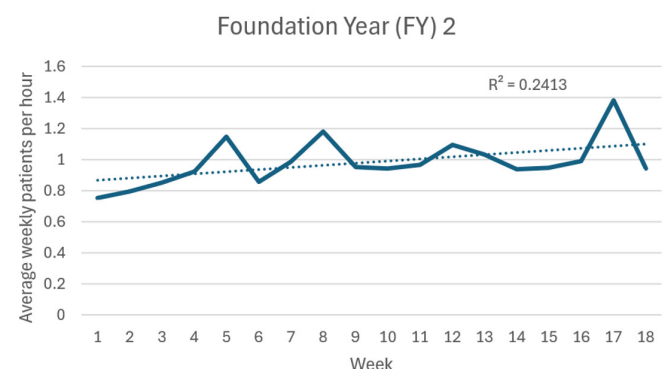


Figure 2. Average patients seen per hour by Foundation Year (FY) 2 doctors during Emergency Medicine placement

model, this would equate to each FY2 doctor seeing 2.00 more patients during day shifts and 2.20 more patients during night shifts at the end of their rotation compared with the beginning.

GP Trainee

Figure 3 shows the data for GP trainees. There was a statistically significant increase of 0.0160 patients seen per hour per week (95% CI: 0.006 to 0.026, $p=0.003$), with the model demonstrating

a moderate fit ($R^2=0.031$). Based on this model, GP trainees would see an additional 3.4 patients during a day shift and 3.7 patients during a night shift at the end of their rotation compared with the beginning. After adjustment for multiple comparisons using the Holm–Bonferroni method, this was the only group in which the difference remained statistically significant.

ACCS Trainee

Figure 4 presents the data collected for ACCS trainees. There was a statistically significant increase of 0.00715 patients seen per hour per week (95% CI: 0.0013 to 0.013, $p=0.019$). Based on the assumptions, this would equate to an additional 1.52 and 1.67 patients seen during each day and night shift, respectively, when comparing the end of the placement with the beginning. However, after correction for multiple comparisons, this difference was no longer statistically significant.

ST3

Among ST3 doctors (Fig. 5), there was a statistically nonsignificant increase of 0.00275 patients seen per hour per week (95% CI: -0.0023 to 0.0078 , $p=0.27$).

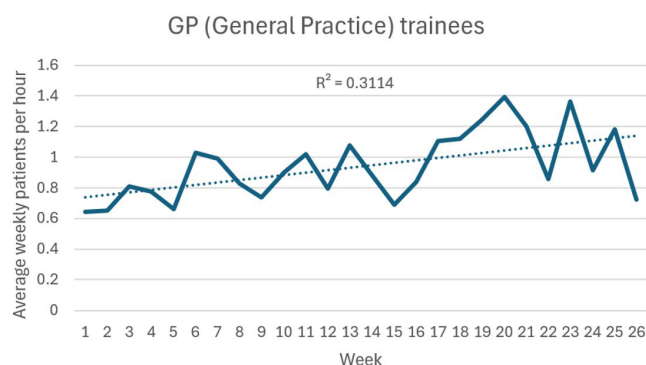


Figure 3. Average patients seen per hour by General Practice (GP) trainee doctors during Emergency Medicine placement

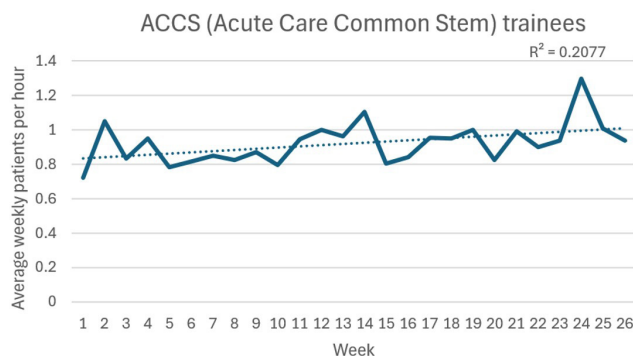


Figure 4. Average patients seen per hour by Acute Care Common Stem (ACCS) doctors during Emergency Medicine placement

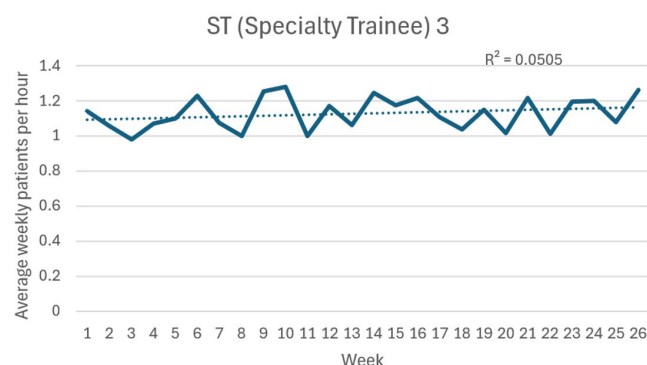


Figure 5. Average patients seen per hour by Specialty Trainee (ST) 3 doctors during Emergency Medicine placement

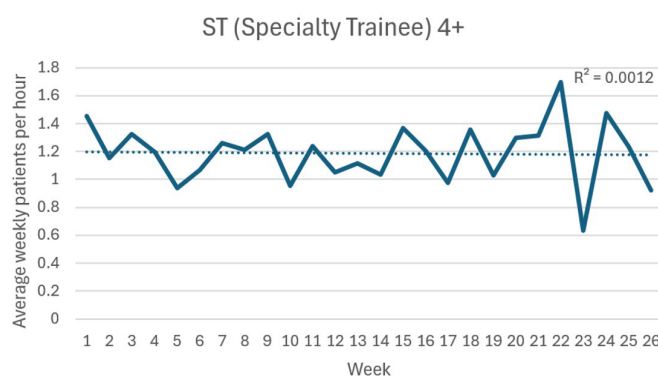


Figure 6. Average patients seen per hour by Specialty Trainee (ST) 4 doctors during Emergency Medicine placement

ST4+

There was a statistically nonsignificant decrease of 0.00097 patients seen per hour per week (Fig. 6; 95% CI: -0.0129 to 0.011 , $p=0.869$).

After applying the Holm–Bonferroni correction for multiple comparisons, only GP trainees continued to demonstrate a statistically significant difference in the number of patients seen over time (Appendix 1).

Average of All Grades Combined

When averaging the data across all grades working in the department (Fig. 7), there was a statistically significant increase of 0.011 patients seen per hour per week (95% CI: 0.0073 to 0.014, $p=8.05 \times 10^{-7}$). The R^2 value was 0.6224, demonstrating a very good fit to the complex data. This increase would equate to an additional 1.62 and 1.78 patients seen per clinician during day and night shifts, respectively, by week 19. Assuming that 20 resident doctors staff an Emergency Department over a 24-hour period, this would equate to >30 additional patients seen per day. Averages across all grades could only be calculated up to week 18 because FY1 and FY2 doctors rotated out after this period. If

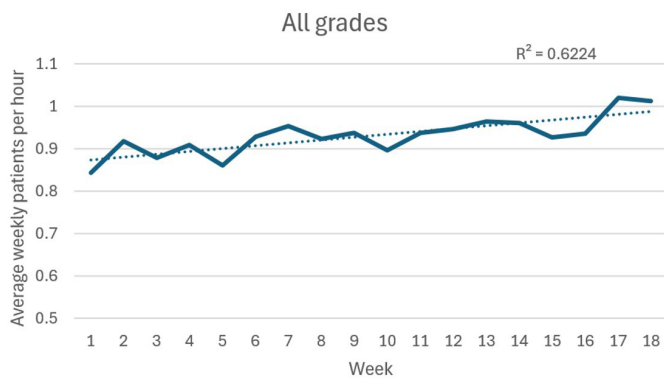


Figure 7. Average patients seen per hour across all grades of doctors during Emergency Medicine placement

extrapolated to doctors spending 6 months in the ED (PGY 3 and above), this would equate to an additional 2.34 and 2.57 patients seen per doctor per day and night shift, respectively.

Limitations

There are several limitations to this study. First, the sample size was small, particularly when considering individual grades, and the study was limited to a single center in the UK. Patient-facing time was estimated rather than directly measured. Some clinicians may have taken longer breaks, while others may not have taken their full allocated break time, as reported in previous literature [11], which could affect the number of patients seen per hour. Similarly, handover durations may vary. Although 15 minutes was assumed to represent the average handover duration, some handovers may have been longer or shorter.

Although the electronic patient record provides an accurate count of the number of patients “clicked on” by a clinician, this may not accurately represent the number of patients fully reviewed by that clinician. For example, if a clinician selected a patient for review but another patient required urgent attention, resulting in the original patient being reviewed primarily by someone else, the original patient would still be included in the clinician’s total. Fortunately, this situation is rare, and patients were included only if the clinician was recorded as the primary clinician in the EPR. Nevertheless, this may have slightly inflated the number of patients seen per hour. Likewise, some clinicians may assign themselves to patients referred directly to a specialty. These patients require significantly less workup by the Emergency Medicine clinician, and practices vary regarding the time spent with these patients. Therefore, including these patients may also artificially increase the number of patients seen per hour. Observations from the same doctors represent repeated measures; therefore, the weekly numbers of patients reviewed are not fully independent. However, multiple training cohorts were included to minimize the impact of this

limitation on the data obtained.

When comparing the number of patients seen per hour between grades, it should be noted that increasing seniority is often accompanied by numerous additional responsibilities, including but not limited to reviewing electrocardiograms (ECGs) or bloodwork, discussing or reviewing patients managed by more junior colleagues, prescribing medications, and rapidly assessing patients escalated by nursing staff. This study does not account for the supervisory and coordination roles undertaken by senior residents, particularly during night shifts. These roles were not considered in this analysis and may contribute to the differences observed between cohorts of varying seniority.

The number of patients reviewed per hour is one metric used to evaluate medical practitioner and Emergency Department productivity. However, many other system-level operational indicators of departmental performance were not included in this study. These include, but are not limited to, waiting times, average length of stay, and mortality. In the UK, key performance indicators, such as 4-hour and 12-hour breach statistics, were also not included in this study. Therefore, extrapolation of these results to broader departmental performance metrics is not recommended, although further evaluation may be warranted.

Discussion

These data suggest that there is an overall increase in the number of patients seen per hour by clinicians in the Emergency Department over time. This increase is most notable among senior house officers (SHOs; FY2, GP, and ACCS trainees), although after correction for multiple comparisons, it remains statistically significant only for GP trainees. There appears to be no change in the number of patients seen by more senior trainees (ST3 and ST4+), although these individuals have a wide range of other responsibilities during clinical shifts, as previously discussed. Overall, these findings suggest that when large numbers of resident doctors rotate, particularly SHOs, there may be a decrease in performance. This would most likely occur in August, when FY2, GP, and ACCS trainees all rotate simultaneously, along with ST3 and ST4+ doctors. The absolute number of patients reviewed per hour appears consistent with previously published literature [6–8].

Although the number of patients reviewed per hour is a pragmatic measure for evaluating resident doctor productivity in a complex setting, this measure does not account for other significant factors affecting Emergency Department performance. The measures used in this study do not account for other roles undertaken by resident doctors, such as interpreting investigations and supervising more junior colleagues. In addition, this measure is

Table 2. R squared values for each training grade with different regression analyses

	Linear	Logarithmic	Polynomial	Power
FY1	0.0485	0.0411	0.1102	0.0404
FY2	0.2381	0.3141	0.2843	0.3079
GP	0.3114	0.3341	0.3547	0.3389
ACCS	0.2114	0.1663	0.2192	0.1703
ST3	0.0463	0.0477	0.0501	0.048
ST4+	0.0011	0.0126	0.0096	0.0139
All grades	0.6445	0.5083	0.6482	0.5283

FY1: Foundation Year 1, FY2: Foundation Year 2, GP: General Practice, ACCS: Acute Care Common Stem, ST3: Specialty Trainee 3, ST4+: Specialty Trainee 4 and above

likely to be significantly influenced by local pathways and policies, patient demographics, including the proportion of patients whose first language is English, and the roles and availability of allied healthcare professionals, such as Emergency Nurse Practitioners, who manage most minor injuries in this Trust. Due to differences between hospital trusts, the absolute figures reported here should not be applied to other Emergency Departments, although the overall patterns observed may be more generalizable.

The lack of significant changes in the number of patients seen by FY1, ST3, and ST4+ doctors is likely to be multifactorial but may suggest that further education or training to enhance efficiency could be beneficial.

In many groups, there appears to be a decrease in the number of patients seen per hour during the final weeks of a rotation. This may reflect natural variation or behavioral changes among clinicians. Anecdotally, many have reported feeling “burned out” from working unsociable hours and demanding rotas in Emergency Medicine.

When calculating R^2 , a linear regression model did not always provide the best fit. Table 2 presents the R^2 values for each group according to the type of regression analysis used. These findings suggest that polynomial or logarithmic regression models often fit the data better, particularly for more junior staff members, among whom significant differences were observed. Given the complexity of Emergency Medicine and the multitude of factors that may influence the number of patients seen by a clinician, it is possible that these data do not change linearly over time. When rotating to a new specialty, doctors often need to learn new ways of working, such as referral pathways and the management of specific conditions. If these are significant factors affecting a clinician's productivity, the data would be expected to follow a pattern similar to that of their ability to learn and assimilate

these new ways of working. Further investigation is required to accurately model how clinicians' productivity changes over time. Understanding these patterns would be useful for assessing their impact on Key Performance Indicators (KPIs) and identifying potential strategies to mitigate this impact.

Conclusion

This study suggests that the number of patients seen per hour by resident doctors in UK Emergency Departments increases over time. This increase is most notable among FY2, GP, and ACCS trainees. These findings suggest a predictable decrease in productivity during changeover periods, particularly when multiple training cohorts rotate simultaneously, which may affect KPIs, such as the 4-hour target. However, conclusions should be drawn with caution due to the multiple limitations of this study. With further investigation into the exact nature of these increases, Trusts may be able to introduce measures to mitigate the effects of rotation on KPIs.

Ethics

Ethics Committee Approval: This project was registered as a retrospective service evaluation using routinely collected Emergency Department data and so did not require NHS Research Ethics Committee approval.

Informed Consent: Retrospective study.

Conflict of Interest: None declared.

Financial Disclosure: The author declared that this study has received no financial support.

Use of AI for Writing Assistance: None declared.

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Peer-review: Externally peer-reviewed.

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Group	Raw p	Holm-adjusted p
GP	0.003	0.018
ACCS	0.019	0.076
FY2	0.038	0.114
ST3	0.27	0.54
FY1	0.38	0.76
ST4	0.869	0.869

Appendix 1. Holm-Bonferroni correction for multiple comparisons