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Patient need at the heart of workforce planning: the use of supply and demand analysis in a large teaching hospital's acute medical unit

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ABSTRACT – Timely medical assessment is integral to the safety and quality of healthcare delivery in acute medicine. Medical staff are an expensive resource. This study aimed to develop a modelling system that facilitated efficient workforce planning according to patient need on the acute medical unit. A realistic 24-hour 'supply' of junior doctors was calculated by adjusting the theoretical numbers on the rota for leave allowances, natural breaks and other ward duties by a combination of direct observation of working practice and junior doctor interviews. 'Demand' was analysed using detailed admission data. Supply and demand were then integrated with data from a survey of the time spent on the process of clerking and assessment of medical admissions. A robust modelling system that predicted the number of unclerked patients was developed. The utility of the model was assessed by demonstrating the impact of a regulation-compliant redesign of the rota using existing staff and by predicting the most efficient use of an additional shift. This simple modelling system has the potential to enhance quality of care and efficiency by linking workforce planning to patient need.

KEY WORDS: workforce planning, supply/demand analysis, acute medicine

Introduction

The NHS spends approximately £60 billion per year on staff, of which over 50% are doctors or nurses.[1] This reflects the fact that the interaction between patient and clinician is the most fundamental process in the provision of healthcare. While evidence-based medicine is now a guiding principle in clinical decision making, the same standards have not been applied to human resource allocation. In an era of financial constraint and an NHS focused on quality and safety, it is vital that our most expensive and valuable resources are utilised efficiently and that patients' needs are placed at the heart of workforce planning.

There is a growing evidence base for improved outcome as a result of timely medical assessment in many areas integral to acute medicine: severe sepsis,[2] myocardial infarction,[3] acute kidney injury[4] and stroke,[5] among many others. It therefore follows that a system which has a human resource allocation that is insufficient to allow staff to rapidly assess, recognise and treat acutely unwell patients is jeopardising the quality and safety of care provision. Equally, research shows that, alongside the attitudes and interpersonal skills of staff and the information given to patients, waiting time was one of three 'service factors' that influenced patient satisfaction.[6] In the emergency department, those who see a doctor relatively quickly are more likely to rate the care they received as excellent or very good.[7]

In an ideal system, the supply of clinicians meets the demand of patient flow and should be able to maintain a consistent service without jeopardising quality and safety at times of high demand, or wasting resource where it is not needed. In the longer term, a system in which patients are seen rapidly throughout the 24-hour period might reduce length of stay, allowing both a reduction in bed stock and the use of smaller, more efficient units.

In most acute medical units (AMUs), medical staffing has evolved rather than been designed. Over the past decade, this evolution has been subject to the selective pressures of the European Working Time Directive (EWTD), banding of rotas and a number of influences that affect the recruitment and retention of junior doctors.[8] In the face of these pressures and against a background of rising numbers of unselected medical admissions,[9] it is essential that human resource allocation is planned on the basis of robust data.

The Queen's Medical Centre campus of Nottingham University Hospitals (NUH) is a large (1000-bed) teaching hospital whose AMU comprises two wards (B3 and D57), which admit 80–90 medical patients each day. B3 is designed to see and treat patients whose length of stay is estimated to be less than 48 hours. Patients who are predicted to need longer periods as inpatients under specialties outside of acute medicine are directed to D57. The senior doctors who staff the AMU are predominantly acute medicine consultants, with a 39% weekday contribution from consultants in other medical specialties. There is a dedicated junior doctor team from 9am to 5pm, with a few later shifts on D57. Outside these hours, and at weekends, cover is provided by an 'on-call' team of junior and senior staff derived from the major medical specialities.

This study describes the development of a simple and useful model for workforce planning in a complex system, which aligns our medical staffing resources with patient need.

Methods

To define 'demand', the admission times for patients presenting to the AMU on weekdays were derived from our Emergency Department Information System (EDIS), which is used to track patient progress through the AMU. To allow for seasonal variation, two separate two-month periods were analysed (January–February 2011 and May–June 2011).

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'Supply' was assessed by careful analysis of rota patterns and AMU policy on annual and study leave for on-call junior doctors (FY1/FY2/ST1/ST2) and those working in attachments on AMU. A combination of junior doctor interviews and direct observation on the wards was employed to adjust the theoretical supply of doctors to a realistic number available at any one time for clerking new admissions.

Excel 2007 was used to compare this realistic supply of doctors available for clerking with the hourly demand of patient admissions. The index of 'patients per doctor-hour' was then calculated individually for each of the 24 single-hour blocks in the day.

In order to assess the time spent in clerking and assessing a new medical admission, a survey of junior doctors working in the AMU was undertaken. To encourage realistic and honest reporting, the anonymised self-reporting of 41 patient assessments was coordinated by a junior doctor colleague. This information was used to create an 'optimal ratio' of patients per doctor-hour.

By comparing optimal patient per doctor-hour ratios to actual patient per doctor-hour ratios, and then applying this ratio to the absolute numbers of patients arriving per hour, a cumulative prediction of the number of unclerked patients was derived over the 24-hour period. As NUH has a working policy of clerking the majority of patients not seen overnight on the consultant-led morning ward rounds, a fixed number of patients left unclerked was set at the time these rounds finished. The cumulative number of unclerked patients was then calculated from this time point, with positive values adding to the number and negative values reducing it. The tally was never allowed to go below zero.

To assess the theoretical impacts of shift-time adjustments, redistribution of staff within the AMU system and addition of new staff, an automated spreadsheet was developed to enable continuous update of these calculations. Using these methods, the most efficient use of staffing resource, as determined by patient and service needs, was planned.

Results

During the two periods of data collection (comprising 80 mid-week days and 6,720 patients) a mean of 84 patients per day were admitted through the two AMU wards. The number of patients arriving on a weekday varies considerably by hour of the day (Fig 1). This pattern is consistent and predictable, regardless of the month or day and constitutes the 'demand'.

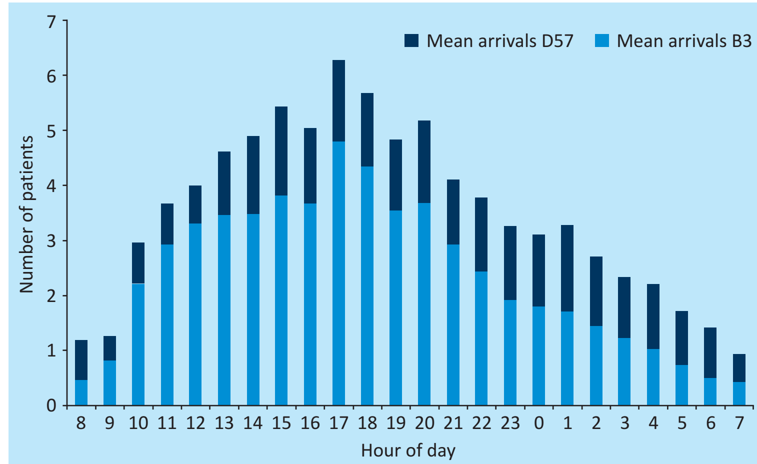

Fig 1. Mean number of patients arriving each hour in the two wards under investigation, D57 and B3.

Table 1 shows the 'supply' of doctors. The total number of doctors available by hour is listed, with a separation of on-call staff and those attached to the AMU. Annual and study leave correction is applied according to the maximal annual and study leave allowed according to AMU policy. The time required for ward tasks that routinely prevented clerking (including ward rounds, board rounds, inpatient reviews and on-going management of existing inpatients), food breaks and handovers were assessed by the combination of junior doctor interviews and direct observation on the wards. These data were incorporated into calculation of an hourly number of doctors realistically available for clerking.

The ratio of newly arriving patients that needed to be clerked each hour to the number of available doctors (patients per doctor-hour) is displayed in Fig 2 for three different rotas. In addition to the original 'old' rota, Fig 2 shows a new, cost-neutral, EWTD-compliant rota designed using the model described which could be achieved purely by the reallocation of staff between the two wards and the redistribution of doctors into the evening. In addition, Fig 2 shows a hypothetical rota that

Table 1. The activities of junior doctors assigned to acute medicine and calculated numbers of those 'available for clerking'.

Hour	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
From on-call rota	3	3	0	0	0	1	1	1	1.5	4.5	5	5	5	5.5	5	3.5	3	3	3	3	3	3	3	3
Acute medicine staff	4	15	17	17	16	16	16	16	16	6	5	5	5	3	1	0	0	0	0	0	0	0	0	0
Total	7	18	17	17	16	17	17	17	18	11	10	10	10	8.5	6	3.5	3	3	3	3	3	3	3	3
Holiday (max)	0	−4	−4	−4	−4	−4	−4	−4	−4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ward round and jobs	−2	−9	−9	−9	−4	−4	−4	−4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food breaks	0	0	0	0	−3	−4	0	0	0	0	−3	−4	0	0	0	0	0	0	0	0	0	0	0	0
Handover	0	−3	0	0	0	0	0	0	−2	−2.5	0	0	0	−2	−1	0	0	0	0	0	0	0	0	0
Available for clerking	5	2	4	4	5	5	9	9	12	8	7	6	10	6.5	5	3.5	3	3	3	3	3	3	3	3

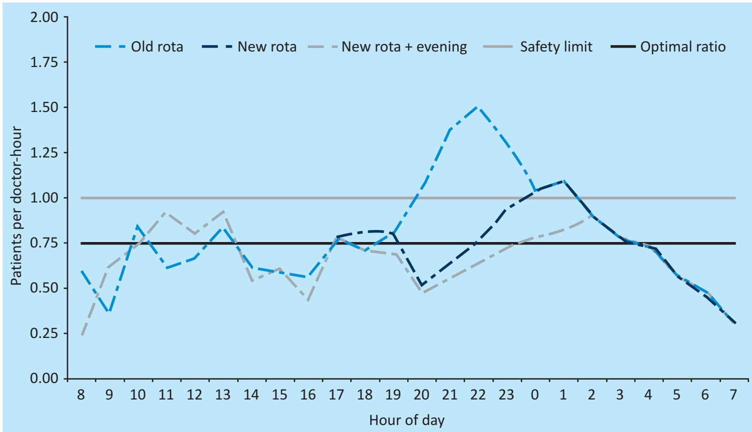

Fig 2. Overall patient per doctor-hour ratios over the 24-hour period across the acute medical system.

demonstrates the potential impact of the addition of a single additional junior doctor to this new rota between 6pm and 2am.

The junior doctor survey of time spent on clerking demonstrated a mean clerking time of 76.7 minutes. Taking mean values for each aspect of the assessment, this comprised 7.5 minutes reading the information from primary care or the emergency department, 28.5 minutes with the patient, 7.3 minutes obtaining collateral history where necessary, 3.1 minutes obtaining supplementary drug history from primary care, 17.3 minutes writing up the clerking, 4.8 minutes completing the drug chart, 9.2 minutes on the hospital results and ordering system (NoTIS), 5.2 minutes on the radiology imaging retrieval system (PACS) and 0.7 minutes on the EDIS ward management system. This total was rounded up to 80 minutes and then converted to a patient per doctor-hour ratio of 0.75, labelled the 'optimal ratio' in Fig 2. At this ratio, patients admitted should be able to be promptly assessed and safely managed without the inefficiency associated with over-staffing.

In a previous study,[10] direct observation of systems in four local AMUs demonstrated that subjectively busy, over-stretched periods corresponded to times of day when the patients per doctor-hour ratio was either very high or greater than 1 for three or more consecutive hours. Using these observations, we have labelled a ratio of 1.0 as the 'Safety limit' in Fig 2.

In order to give a more easily visualised, objective marker of unit performance, these ratios were translated into a predicted cumulative number of unclerked patients (Fig 3) for the same three rota variations referred to in Fig 2.

Discussion

These results demonstrate that information that is available to all AMUs can be used to calculate the staffing levels required on an AMU over the 24-hour period so as to manage the medical take efficiently and yet ensure that there are enough junior doctors to allow the early clerking and assessment of new patients.

The major strength of this work is that the methodology is logical and simple. Hence, it could be widely applied to other trusts or organisations, and indeed to other staff groups working in acute medical admissions areas. The principle components include:

1 Accurate analysis of the rate of arrival of new patients which, despite being 'unscheduled' care, tends to follow a predictable, repetitive pattern over the 24-hour period.
2 Realistic calculation of the number of doctors available at any time. This relies not only on analysis of the rota but careful observation of ward working and junior doctor input into the process.
3 A junior doctor-led detailed assessment of the time required for the process of clerking and assessing a new patient.

With this information, the methodology described could be used to calculate an index of supply and demand and to set an 'optimal ratio', both of which would be unique to the organisation in which they had been created. Generating the cumulative number of unclerked patients from this information gives a visual and easily understood marker of unmet need, and therefore of the potential for compromised patient care, that accounts for the absolute numbers of patients arriving each hour.

It is essential that the observation work is done within the system to which the model is to be applied because all AMUs have different standard operating procedures, interactions with specialties and contributions from allied health professionals to assessment and discharge arrangements. Creation of a universal 'optimal ratio' or standard proportions of rota time lost to other ward duties are less useful than situation-specific assessment. Mathematically, these adjustments are simple to integrate into this modelling system. We would encourage teams to determine their own optimal ratio through a process that engages their staff in order to plan their workforce requirement accurately. This optimal ratio could become a useful benchmarking tool, enabling comparisons between different AMU systems.

There is a commonly expressed feeling that clerking by junior doctors takes an excessive amount of time and is inefficient. Performance management of junior doctors on AMUs is, however, difficult when there are inherent inefficiencies in the system in which they work resulting from understaffing at key times in the day. Addressing the supply and demand equation should help provide a stable platform from which to look at performance management logically and productively. If system changes do improve performance, then the unit's optimal ratio will increase and this can be reflected in the modelling.

In the example cited here, the model projections suggest that significant improvements in the number of unclerked patients could be achieved by moving shift times without staff additions. Using the existing junior doctor pool, we adjusted the contributions from 'on-call' and AMU-attached staff, moved some shift times away from the standard 9–5 day (when there was a relative excess of staff) and corrected the balance of staff between the two wards that comprised the AMU (data not shown). These changes were cost-neutral and made no difference to banding or EWTD compliance. Where rota inadequacies persisted despite this reorganisation, the model could be used to test the impact of additional staff and to maximise the efficiency of their input. As an example, Fig 2 shows two distinct times during which the patients per doctor-hour ratio achieved by the 'new' rota is above the optimum (10am–1pm and 10pm–3am). Having adjusted for the absolute numbers of patients arriving and the impact of the hours before and after these periods (Fig 3), it became clear that the earlier of these two time periods did not lead to a significant increase in the projected number of unclerked patients. Hence, the deployment of an additional junior doctor at this time would have been less efficient than their deployment in the evening.

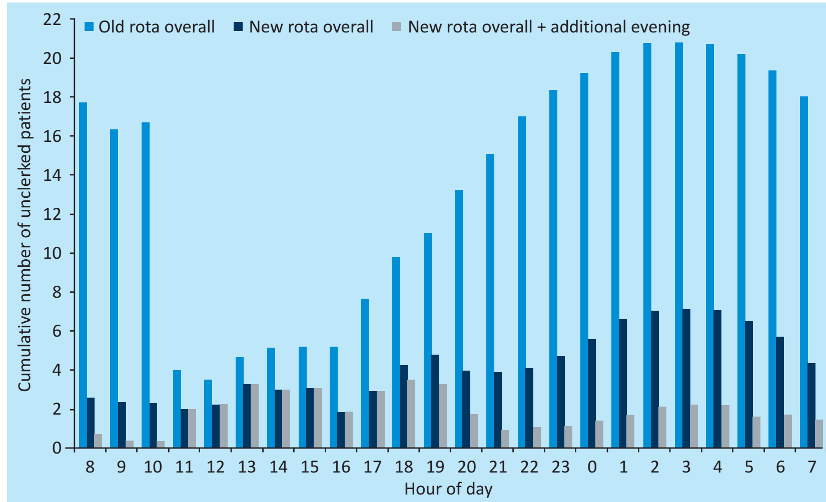

Fig 3. Cumulative impact of rota changes on patients waiting to be seen across the acute medicine system.

There are a few potential criticisms of this work. First, the information on time spent in clerking and completing admission-related tasks is based on a small survey of junior doctors. Case-by-case variation between time spent on the components of this initial assessment (requirement for collateral history, contacting the GP to corroborate medication history and so on), and case complexity (increased time spent ordering investigations, request for senior opinion, referral to specialists and so on) generates a wide range of clerking times, for which we have calculated a mean value from 41 cases. There is potential for under-reporting resulting from a desire to appear efficient. We attempted to minimise this bias, and therefore generate the best chance of obtaining a realistic estimate of the time taken to clerk and assess a new patient, by collecting this information through anonymous self-reporting to a fellow junior. A larger, exhaustive survey would be difficult and time-consuming to replicate and we wanted this model to be practical.

Secondly, the time spent on duties other than clerking again varies between units. We have included adjustments for routine tasks such as ward rounds, handovers, breaks for meals and educational meetings. We encouraged the junior doctors to engage in determining these adjustments in order to get a realistic estimate of time lost. When accounting for annual leave, we used the maximum number of junior doctors allowed time off from the AMU at any one time. This only applied to those junior doctors working attachments to AMU; on-call doctors had prospective cover arrangements. This method tends to underestimate the numbers of available doctors between 9am and 5pm as there are relatively few weeks in the year when maximum numbers actually take leave. We hope that a relative excess of junior doctors in other weeks should enable focus on non-clinical work aimed at service improvement and training.

This system of modelling needs to be used in conjunction with expertise and software that can support the design of rotas according to the rules set by EWTD and the financial constraints imposed by banding.[8] The future development of this model might incorporate these external influences so that rota design can be performed in a single step once the data representative of the AMU have been collected. In addition, we feel that this methodology could be applied equally usefully to other professions working on the AMU, and indeed, with different definitions of the baseline workload, to other specialties.

Quality healthcare is defined as a safe, effective and positive experience for patients.[11] The principle of this simple approach is to put patient need and, as a consequence, the quality, safety and value of the care we offer, at the heart of workforce planning. The important message is that this process should be done jointly with the staff on the rota and should accurately reflect practice on each AMU.

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