

Supervision, scheduling, satisfaction and shared working: how experiences of junior doctors relate to excess mortality within the NHS

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ABSTRACT

Background

We sought to explore associations between trainee doctor perception and excess patient mortality.

Methods

Data from two publicly available databases reflecting mortality and components of trainee satisfaction within 81 NHS healthcare institutions between the years 2012 and 2019 were analysed. Pearson's correlation coefficients were calculated.

Results

All domains of trainee perception were correlated with excess mortality. Clinical supervision out of hours ($R=-0.44$; $p<0.0001$), teamwork ($R=-0.36$; $p<0.0001$) and clinical supervision at any time ($R=-0.35$; $p<0.0001$) were most strongly correlated. Most associations remained consistent year on year.

Conclusion

Trainee doctor perceptions of clinical supervision, rota design and teamwork within the NHS are consistently correlated with excess patient mortality. Further exploration of these associations could identify opportunities for interventions to reduce excess patient mortality. Given the clinical significance of our findings, organisations should consider rapid implementation of evidence-based interventions where they exist.

KEYWORDS: patient safety, mortality, organisation, administration

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Introduction

Throughout this article we use the terms 'excess patient harm' and 'excess patient mortality' when referring to the analysed data and preceding literature. We use 'excess patient mortality' to refer to harm above that which would be expected in an average NHS hospital adjusted for the patient demographics of the hospital in question. Some of this mortality is likely to arise from demographic and lifestyle factors, which are not fully adjusted for by existing models. However, some excess mortality is likely to result from modifiable factors within the processes of a trust, and this we describe as 'excess patient mortality'. We would like to emphasise that any harm caused by medical intervention is and should be considered excessive; however, for the purposes of this analysis, we are referring solely to relative incidence of this harm.

In 2021, there were 586,344 deaths across the UK,¹ with 250,000 occurring in hospital.² These inpatient deaths are disproportionately distributed and remain so even after adjustment for variables such as clinical activity and patient demographics.² The Summary Hospital Mortality Indicator (SHMI) is a marker of relative mortality between hospitals. It uses patient-level data to derive an expected mortality for each trust. The actual numbers of deaths can be then compared with this, to give a relative mortality indicator for each hospital. In 2021, 12 NHS organisations had death rates outside statistical controls.² Any statistical variation away from baseline suggests either that the SHMI calculation does not fully account for adverse patient characteristics or that there are differences in care provision.

The NHS is currently experiencing unprecedented pressure.³ Such pressure can contribute to a reduction in quality of patient care⁴ and a subsequent increase in excess patient mortality.⁵ 'Junior' doctors (ie those in NHS postgraduate training who have not received a certificate of completion of training) form over half of the medical workforce delivering patient care.⁶ They undertake a large proportion of acute clinical work and provide the majority of out-of-hours (OOH) care. Given that they frequently rotate between hospitals, they are well positioned to observe and comment on the quality of patient care delivered within, and between, their respective organisations. The General Medical Council (GMC) National Training Survey (NTS) represents the largest and most consistent method of capturing the perceptions

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of this group of staff on a yearly basis.⁷ Annual survey uptake averages 80–90%.⁸

Our group recently examined the relationship between the NTS results and SHMI for a single year.⁹ We demonstrated that trainee-perceived clinical supervision and clinical supervision OOH correlated well with excess patient mortality on a trust-by-trust basis. We also demonstrated a weaker correlation between teamwork, rota design and overall satisfaction with SHMI. Importantly, we showed that there is no identifiable correlation between excess patient mortality and commonly suspected sources of medical error, such as subjective workload. This work represented the first exploration of these associations on such a large scale. However, because this was an initial exploratory analysis of data from a single year (2018), there was an urgent need to establish whether these relationships remained consistent over time. Through this, we could identify opportunities for further investigation or targeted interventions, with an aim to reduce excess patient mortality within the UK.

Here, we tested the hypothesis that trainee satisfaction, perceived clinical supervision both in and out of hours, perceived teamwork, rota design and overall satisfaction were correlated with excess patient mortality in the period 2012–2019, and whether these relationships are consistent over time.

Methods

This paper describes a retrospective cohort study of 81 healthcare institutions, utilising data from two publicly available databases. Where appropriate, the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines were followed (see supplementary material S1).¹⁰ We build upon a previous exploratory analysis evaluating associations between data from the NTS and SHMI for the year 2018,⁹ which found a significant correlation between SHMI perceived clinical supervision, clinical supervision out of hours (OOH), rota design, teamwork and overall satisfaction. We explored whether these correlations exist for the preceding years and following year (2012–2019), with the exception of rota design, given that the domain was only introduced in 2018. Data from all NTS domains were analysed for 2019.

NHS Digital defines the SHMI as a ratio of 'the actual number of patients who die following hospitalisation at the trust and the number that would be expected to die on the basis of average England figures, given the characteristics of the patients treated there'.² SHMI data are collected and published on a monthly rolling basis. It is considered a robust, transparent and reproducible measure of excess deaths and has been validated within NHS England.¹¹

The NTS data comprise up to 18 different 'domains', which the GMC and other related bodies have identified as relevant to trainee experience, and which are internally tested and validated via factor analysis, outlier analysis and indicator distribution analysis. Questions and domains are typically piloted for 1 year before formal publication and analysis. Data for each domain are generated from several Likert-scale questions. Responses are collated to represent domains, and a scale (0–100) is generated for each domain. High scores indicate positive trainee responses, except for 'workload', where an ideal score would be 50.

Data collection and processing

Methods of data collection and cleaning were as described previously.⁹ In brief, publicly available data from NHS Digital² and

the GMC Database⁸ were downloaded from the years 2012–2019. Healthcare institutions with a score in every NTS domain were then matched to those with complete SHMI data from 2012 to 2019, resulting in 81 healthcare institutions with complete NTS and SHMI data for analysis. Given changes to the NTS over time, data pertaining to trainee perception of clinical supervision OOH were only available from 2015; teamwork data were only available from 2017; and rota design data were only available from 2018. The joint NTS/SHMI dataset was then further cleaned and analysed as described in our previous paper.⁹ The 2018 data from that initial exploratory analysis are presented within this complete 2012–2019 analysis, and are highlighted because they represent the same initial dataset reported.⁹

Data were reorganised from their original downloadable form (individual year summaries) to tables for each NTS variable (eg 'Clinical supervision'). These contained years in the columns and individual specialties within trusts in rows. Rows with missing data for the domains were excluded from further analysis. NTS data are not reported if there are fewer than three respondents for a category. A mean score across all specialties for the NTS domains of interest was then calculated for each year, for each healthcare institution.

Data processing was performed with Excel (Microsoft, version 16.48); the final dataset was then transferred to Prism (Graphpad, version 9.1.2) and R (CRAN, version 4.2.2) for data visualisation and analysis.

Statistical analysis

Descriptive statistics of SHMI and each NTS domains were performed. Normality was assessed with QQ-plots and Shapiro-Wilk testing. Linearity was assessed with scatterplots and regression analysis. Most variables were not normally distributed and had non-linear relationships.

Spearman's Rank correlation coefficients were calculated between the SHMI of matched healthcare institutions and the corresponding NTS scores for each domain across that healthcare institution. Bonferroni correction for multiple comparisons was applied with an adjusted alpha level of 0.01.¹²

Ethics

No ethical approval was sought as the data were derived from publicly available sources.

Results

The final dataset comprised 109,828 departmental responses across all NTS domains and years, collected from 81 NHS trusts. The SHMI for each NHS trust is presented in Fig 1. Mean combined SHMI was 1.01 (standard deviation (SD)=0.09, range 0.88–1.14).

Mean NTS domain scores across all years were highest for clinical supervision (mean=88.2; SD=3.18) and clinical supervision OOH (mean=85.7; SD=3.33). Rota design had the lowest mean NTS domain score (mean=54.75; SD=5.75). Mean NTS domain scores for each year are presented in Fig 2.

Spearman's Rank correlation coefficients are presented in Table 1. Fig 3 represents the individual NHS trust scores for SHMI by NTS domain score. When combining NTS and SHMI data for all years, all NTS domains were significantly correlated with SHMI.

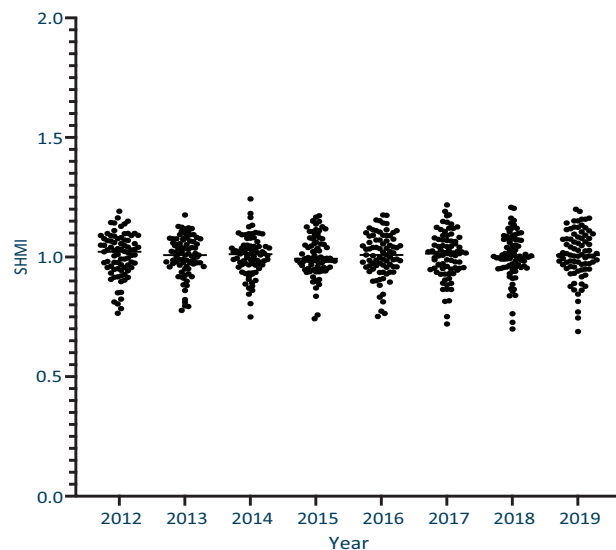


Fig 1. Summary Hospital Mortality Indicator by year. Points represent individual NHS trusts.

Clinical supervision OOH demonstrated the strongest correlation ($R=-0.44$; $p<0.001$). For individual years, all GMC domains were negatively correlated with SHMI except overall satisfaction in years 2013 ($R=-0.18$; $p=0.11$), 2014 ($R=-0.2$; $p=0.08$), 2015 ($R=-0.15$; $p=0.18$), 2016 ($R=-0.19$; $p=0.82$), and 2018 ($R=-0.15$; $p=0.03$), and clinical supervision in 2018 ($R=-0.18$; $p=0.1$).

Discussion

Junior doctors comprise over half of the medical workforce⁶ and undertake the majority of inpatient clinical work, particularly OOH. Given frequent rotations between hospitals and trusts, they are well placed to make important comparisons around patient care, but are less likely to be affected by institutional biases compared with permanent staff. One of the most comprehensive methods by which data are routinely collected on junior doctor experiences is

via the NTS, which receives an 80–90% response rate.⁸ Previously our group reported that five NTS domains were correlated with excess patient mortality as reported by SHMI using 2018 data.⁹ In particular, lower levels of perceived clinical supervision, especially OOH, was associated with a higher rate of excess mortality. Analysis of the four domains for which pre-2018 data were available (clinical supervision, clinical supervision OOH, teamwork, and overall satisfaction) demonstrated that almost all of these associations remain consistent year on year.

Clinical supervision and clinical supervision OOH were moderately and consistently correlated with SHMI ($R=-0.35$ and -0.44 , respectively). Although clinical supervision is relatively poorly defined and inherently subjective, the literature supporting an association between author-defined clinical supervision and consequent reductions in patient morbidity is relatively comprehensive.¹³ However, there is limited evidence to support an association between clinical supervision and patient mortality.¹³ The clinical supervision score in the NTS is based on four questions, with three further almost identical questions referencing the 'out of hours' context.¹⁴ The questions ask whether the trainee is always aware of who their clinical supervisor is, how much they had to work alone beyond their abilities, whether they thought the supervisor was competent, and the 'overall quality of supervision'. This is in essence a subjective method of measuring senior presence and competence in the eyes of the trainees. Trusts with consultant vacancies using temporary locum consultants might score poorly in this metric, alongside those without a strong training culture. Seen this way, 'clinical supervision' acts as a surrogate for departmental staffing and organisation, or even knowledge of, and adherence to, local clinical processes. All of these factors have been associated with excess mortality in a range of clinical settings.^{9,15,16} A junior doctor's perception of clinical supervision is also strongly associated with their psychological response to challenging working conditions or to adverse events while at work.¹⁷ Therefore, our data might represent a degree of reverse causality: if a doctor is involved in a serious adverse event, they might ascribe blame to themselves, other professionals or the organisation. Poor supervision could be blamed for the adverse events. Scaled up, a trust with a high SHMI might report a low score in clinical supervision. Following this logic,

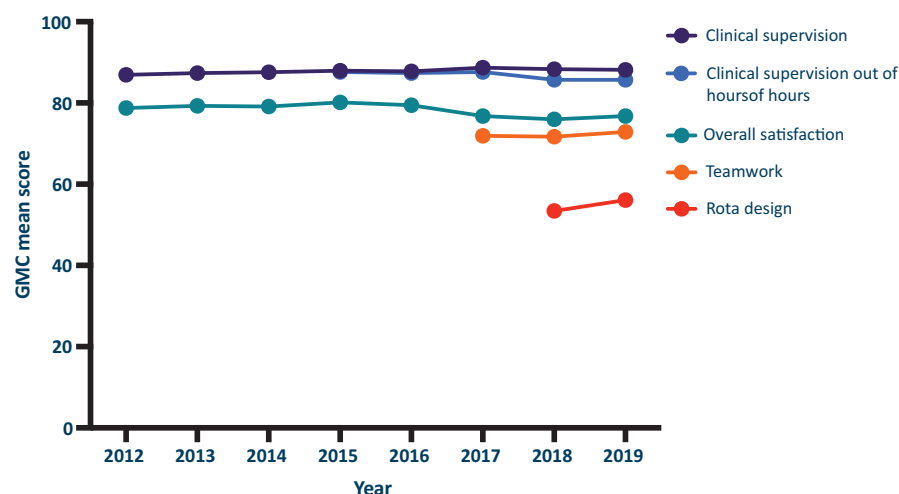


Fig 2. Mean General Medical Council National Training Survey domain scores by year.

Table 1. Spearman's rank correlation of Summary Hospital Level Mortality Indicator with General Medical Council National Training Survey domains^a

	Combined	2012	2013	2014	2015	2016	2017	2018 ^b	2019
Clinical supervision	-0.35***	-0.27*	-0.3**	-0.28*	-0.33**	-0.41**	-0.36**	-0.18	-0.46***
Clinical supervision out of hours	-0.44***	–	–	–	-0.35**	-0.45***	-0.43***	-0.33**	-0.51***
Rota design	-0.26**	–	–	–	–	–	–	-0.22*	-0.35**
Teamwork	-0.36***	–	–	–	–	–	-0.38**	-0.24*	-0.39**
Overall satisfaction	-0.22***	-0.26*	-0.18	-0.2	-0.15	-0.19	-0.35**	-0.15	-0.28*

^a*p<0.05, **p<0.01, ***p<0.0001.

^bPreviously published data within initial exploratory analysis.⁹

one would expect that most or even all domains of the NTS would show an association with SHMI, but this was not the case.⁹

The association between teamwork and SHMI was consistent across all years except 2018. This association is well recognised within the international literature.^{9,18} Interventions attempting to improve teamwork, such as mandatory simulation, have consistently resulted in improved patient outcomes.^{18–20} Given the extensive evidence base supporting interventions that improve teamwork, failure to adopt these interventions into policy or training both locally and nationally is harmful to the public. Research priorities in this area should no longer focus on mechanism, but rather on the external validity and replicability of evidence-based interventions.

We previously reported a weak correlation between overall satisfaction on SHMI when examining 2018 NTS data.⁹ We have now demonstrated that not only is the correlation weak when combining years, but that it is also not consistent between years. A multiple regression analysis of the NTS dataset in 2019 reported that the domains most closely related to overall satisfaction were 'feedback' and 'workload'.²¹ These variables as reported by the NTS have demonstrated no association with SHMI.⁹ This

is perhaps surprising, given the reported association between variables, such as staff burnout and patient outcomes.²² However, given our findings, we would not recommend overall satisfaction score use as a reliable indicator of processes associated with patient mortality.

The weak correlation observed between poor rota design and SHMI must also be interpreted with caution. The first year that rota design was incorporated within the NTS was 2018; thus, a consistent relationship has not yet been established, unlike other domains. Nevertheless, an association between rota design and patient safety within the UK has already been reported, and our data reported an association in 2019. After implementation of the European Working Time Directive, a large qualitative analysis reported patient safety concerns, increased intensity of night shifts, reduced opportunities for rest and associated implications as affecting decision making.²³ The association between inadequate rest and medical error is well reported.^{24–26} There is also information supporting interventions that improve junior doctor satisfaction with rota design,^{26–28} but there is no current literature providing objective evidence of such interventions improving patient outcomes. Literature exploring the complex

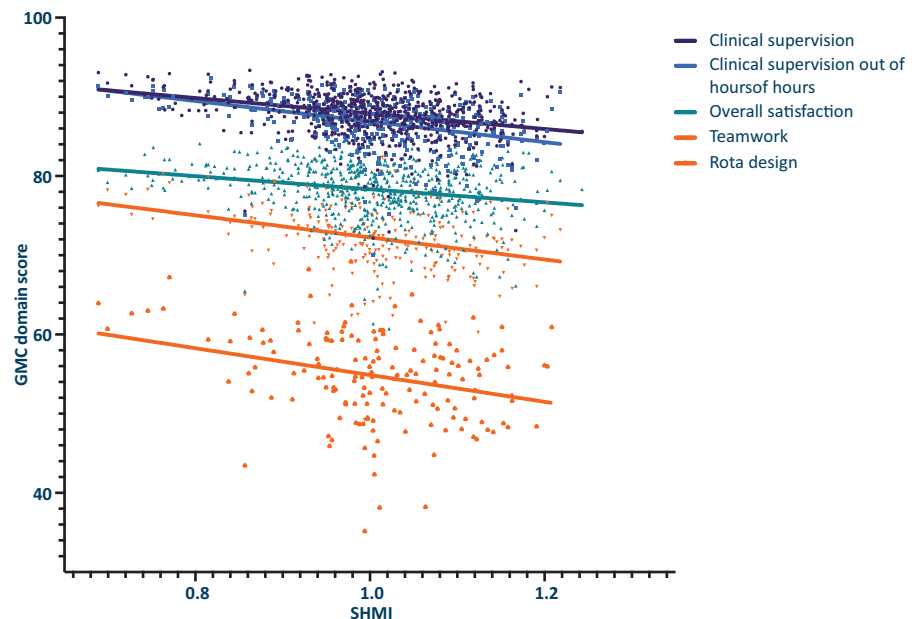


Fig 3. General Medical Council National Training Survey domain score versus Summary Hospital Mortality Indicator by NHS Trust.

mechanisms between such associations is non-existent. Further research is needed in this area before we can confidently support an association between rota design and excess patient mortality.

Considering the strength and consistency of the associations observed, we believe that the relationship between clinical supervision, clinical supervision OOH and teamwork with excess mortality is undeniable. Taken literally, our findings would suggest that important interventions to address excess mortality within the UK would be to implement validated teamwork interventions while increasing senior supervision. The latter could be achieved by increasing the number and availability of those providing clinical supervision. In doing so, NHS trusts must address competing factors preventing the supervision being delivered (eg a consultant clinic while the consultant is overseeing acute admissions). Yet, to interpret our findings without nuance risks numerous unintended and potentially harmful consequences.⁹ Rather, they must prompt urgent exploration of the drivers of the observed association between clinical supervision and excess mortality. One means by which to achieve this might lie in understanding how trust clinical supervision scores relate to the Royal College of Physicians' minimum safe staffing, including Tier 1 cover (ie consultant level) reported by NHS trusts. Publicly available vacancy rates could provide further context surrounding the drivers of the association, and how it might relate to NTS reporting. While high-quality clinical supervision is always welcome, it might not be important in managing excess deaths in all specialties; however, we can explore this further by interrogating speciality specific data within the NTS. Ultimately, there is a need for primary data collection with the aim of understanding what defines good, or bad, clinical supervision and how this relates to excess mortality. In doing so, we hope to identify areas for targeted interventions that will improve trainee experiences and reduce patient mortality.

Strengths

This is the first time that the results from the NTS and SHMI datasets have been compared over an extended period. Both are large, well-validated datasets. The high response rates of both limit the risk of sampling bias and, although statistical misinterpretation and ecological fallacy are possible, the strength and consistency of the associations observed over a 6-year period suggest that they represent a genuine relationship. Our findings also replicate the observations of smaller studies that have previously identified associations between teamwork,^{9,18} clinical supervision and patient outcomes.¹³

Limitations

The NTS–SHMI dataset has several important limitations. Most prominent is the inherent subjectivity of the NTS data, making domain scores prone to bias. There is also a substantial degree of missing data. Many specialties within trusts do not have the minimum three trainees required for a departmental domain score (~34% of possible data are missing or censored). It cannot be said whether this would favour or reduce domain scores. However, despite this data loss, over 50% of trainees are represented in the findings (ie over 25,000 individual voices each year). Given that the NTS data were averaged and compiled by trust to match SHMI returns, scores from individual departments might have been lost

or inappropriately weighted. The effect of this is that individual trainee voices from smaller departments are louder in the data than those from larger departments.

Using excess mortality as a surrogate for poor quality care is itself controversial.²⁹ SHMI is also a statistical construct and, thus, must be interpreted with caution and should not be used to directly rank trusts in terms of quality-of-care delivery.² Analysing large datasets in this way poses analytical challenges, and the reported association between them might be a result of confounders, colliders, or even a statistical phenomenon, such as Simpson's paradox.³⁰ Without primary data, we cannot form any hypotheses relating to direction or causality of the associations observed. However, we have proposed potential mechanisms of the relationship founded in the wider literature and have observed a consistent relationship across 7 years of data and hundreds of thousands of data points. Thus, we believe that, given the evidence base and strength of our observations, the relationship we have reported reflects a true and clinically important one. Further research is necessary to understand the relationship between subgroups of the NTS and their relationship of SHMI, including evaluating NTS data by departments and specialties. Ultimately, primary data collection and analysis are necessary at this stage.

Conclusion

Trainee doctor perceptions of clinical supervision, rota design and teamwork within the NHS are consistently correlated with excess patient mortality. Causality and confounding factors affecting these relationships are yet to be fully elucidated. Further exploration of these data could identify opportunity for interventions to reduce, or avoid, excess mortality within the NHS. Given the clinical significance of our findings, organisations should consider rapid implementation of evidence-based interventions, where they exist. ■

Summary

What is known?

Excess, or relative, inpatient mortality varies between NHS organisations. Trainee perception of quality of care, workplace satisfaction and training also vary between NHS organisations. Pilot evidence suggests that trainee satisfaction and excess mortality are associated.

What is the question?

Do components of the GMC National Training Survey, a validated measure of trainee satisfaction, correlate with Summary Hospital Mortality Indicator, a validated measure of excess mortality?

What was found?

When examining data from 81 NHS healthcare institutions, across an 8-year period, trainee-perceived clinical supervision, teamwork and rota design were consistently correlated with excess mortality.

What is the implication for practice now?

There is an urgent need for further research into the association between trainee perception and excess mortality. Doing so could provide opportunities for targeted interventions aimed at preventing avoidable deaths. Given the available evidence, validated teamwork interventions must be implemented across NHS organisations as a matter of urgency.

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Supplementary material

Additional supplementary material may be found in the online version of this article at <https://www.sciencedirect.com/journal/clinical-medicine:S1:STROBE-guidelines>

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