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Need for recovery amongst Emergency Physicians in the United Kingdom and Ireland: a cross-sectional survey

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ABSTRACT

Objectives: To determine the need for recovery (NFR) among Emergency Physicians and to identify demographic and occupational characteristics associated with higher NFR scores.

Design: Cross-sectional electronic survey.

Setting: Emergency Departments (n=112) in the United Kingdom and Ireland.

Participants: Emergency Physicians (n=4247) responding over a six-week period in June-July 2019.

Main outcome measure: NFR score.

Results: The median NFR score for all 4247 eligible and consented participants with a valid NFR score was 70.0 (95% CI: 65.5 to 74.5), with an IQR of 45.5 – 90.0. A linear regression model found significant associations between decreased NFR score and four non-modifiable demographic factors: clinical grade at consultant level; male gender; absence of long-term health condition or disability and working in a paediatric only ED. After adjusting for these characteristics, the NFR score increased by 3.7 (95% CI: 0.3 to 7.1) and 6.43 (95% CI: 2.0 to 10.8) for those with difficulty accessing requested study and annual leave, respectively. Increased percentage of out of hours work increased NFR score almost linearly: 26-50% out of hours work = 5.7 (95% CI: 3.1 to 8.4); 51-75% out of hours work = 10.3 (95% CI: 7.6 to 13.0); 76-100% out of hours work = 14.5 (95% CI: 11.0 to 17.9).

Conclusion: Higher NFR scores were observed among Emergency Physicians than reported in any other profession or population to date. Three modifiable occupational characteristics; poor access to study and annual leave and proportion of out of hours worked were identified to be associated

with increasing NFR score. Future strategies to reduce fatigue and improve physician wellbeing / staff retention should target these modifiable characteristics.

ARTICLE SUMMARY

Strengths and limitations of this study

- This is the first study evaluating the need for recovery (NFR) scale within a large healthcare population.

- The inclusion of responses from over half of all UK Emergency Departments indicates the results are likely to be generalisable.

- The high volume of responses, with over half of study sites exceeding 70% participant response rates, indicates that the NFR scale is an acceptable measurement tool for physicians.

- The study is limited by the single-point of time measurement therefore seasonal bias cannot be excluded and further assessment of test-retest reliability is desirable.

- The use of self-administered dichotomous questionnaires is acknowledged to limit wider insights into physician recovery and well-being.

INTRODUCTION

Recruitment and retention challenges in acute care pose a significant and ongoing threat to effective healthcare provision. The need to maintain a healthy and sustainable workforce is vital to safeguard future services.[1] Physician well-being is a key influence on retention, with low job satisfaction and high levels of stress directly leading to concern over job sustainability.[2–4] Globally, high rates of physician burnout are increasingly recognised, along with the consequent negative impact on delivery of high quality patient care.[5–10] Within unscheduled care settings such as emergency medicine, high intensity shift work is likely to further exacerbate impaired personal well-being. Where fatigue cannot be sufficiently recovered between shifts, the effect is cumulative and may lead to increased occupational stress and impaired long-term health.[11,12]

Attempts to quantify and measure well-being amongst healthcare staff have led to an increasing prevalence of burnout inventories.[13] Whilst these may provide an overview at an organisational level, they often lack the ability to define specific contributory factors or highlight opportunities for intervention.[14] Furthermore, these inventories quantify established burnout. Once this has occurred, the human and financial resource impact is already immense, with associated workforce depletion and limited mitigation strategies.[15,16]

The identification of those at risk, at an early timepoint when interventions may be effective, presents a critical challenge. The Need for Recovery (NFR) scale measures the subjective perception of the need to recuperate from physical and mental demands of a working day, and is a

suitable tool with which to assess shift workers.[17,18] Increasing NFR is associated with likelihood of progression to occupational burnout and health complaints, with negative effects cumulative over time in several validation studies.[11,17]

Staff well-being is the fourth highest Emergency Medicine Research Priority identified by the James Lind Alliance Priority Setting Partnership, involving patients, carers and physicians.[19] This priority is related to identification of initiatives to improve Emergency Department (ED) staff engagement, resilience, retention, satisfaction, individuality and responsibility. We therefore aimed to determine the NFR among Emergency Physicians in EDs in the UK and Ireland, and identify demographic and occupational characteristics associated with higher NFR scores that might allow for early targeted intervention to improve physicians' well-being and reduce burnout.

METHODS

This cross-sectional electronic survey study targeted a representative sample of Emergency Physicians working across the UK and Ireland, and was performed and reported in line with the Checklist for Reporting Results of Internet E-surveys.[20] The study was registered at ISRCTN (https://doi.org/10.1186/ISRCTN21869845). Ethical approval was obtained from the UK Health Research Authority (Reference: 19/HRA/2404) alongside equivalent approvals in Scotland, Northern Ireland and Ireland.

Settings and Participants

An initial sample of 100 EDs was deemed necessary to ensure inclusion of greater than 50% of Type 1 EDs, defined as 'a consultant led 24-hour service

with full resuscitation facilities', in England. [21] The study was coordinated via the UK Trainee Emergency Research Network (TERN) and delivered in collaboration with Paediatric Emergency Research in the UK and Ireland (PERUKI) and Ireland TERN. [22, 23] Signposting to the survey and enrolment of participants was led by site principal investigators (PI), who were provided with standardised study documentation. Local and national promotion of the study was conducted at professional meetings, through social media, national newsletters, and using the Clinical Research Network infrastructure.

Physicians of any grade who were registered with either the UK General Medical Council or Irish Medical Council, and who were employed within a participating ED, were invited to participate. The term Emergency Physician was defined as doctors specialising in Emergency Medicine (EM), or non-EM specialists undertaking rotations in the ED as part of their professional training. Physicians who did not hold a permanent contract with a participating hospital (such as those working ad-hoc locum shifts), those on leave during the study period, and those in a non-clinical role were excluded.

Survey Development

The NFR scale consists of 11 items each requiring a dichotomous 'yes' or 'no' response, originally developed as a subscale of the Dutch Questionnaire on the Experience and Evaluation of Work (QEEW).[24] The NFR has previously been demonstrated to have an overall Cronbach's alpha of 0.88, a measure of internal consistency and questionnaire reliability, with a range of 0.81 to 0.92 in subgroup analyses of the same validation study.[25] Following a minor amendment to one question to increase applicability to the study population (from 'After the evening meal, I generally feel in good shape' to 'After my breaks

I feel fresh to continue my work'), feasibility work in a single UK centre demonstrated a Cronbach's alpha of 0.79, and found that the NFR scale was acceptable and user-friendly. [26]

A patient and public involvement (PPI) consultation was conducted at the UK Emergency Medicine Trainee Association Conference (Cardiff, December 2018), using a semi-structured question guide for mixed focus groups to review a proposed participant survey. Based on this consultation, the final participant survey included the 11-item NFR scale used in the feasibility work and 44-items collecting the participants' demographic, occupational and perceived well-being characteristics (Online Supplementary Material 1).

A separate site-specific survey was developed de novo with expert input from experienced EM physicians, consisting of 39-items identified from the literature and/or consensus of the study team, which explored departmental, rota pattern and staffing characteristics likely to provide context for analysis and interpretation of individual survey results (Online Supplementary Material 2). Only one site-specific survey was required per participating centre and was completed by the site PI.

Survey Distribution, monitoring and recruitment

All participants were provided with an information sheet, and consented to participation prior to completing the survey; this was voluntary, anonymous, and no incentives were given. Respondents were able to review and change their answers prior to final submission of the survey. Branching logic was used for responses to certain questions. Data were collected during a six-week period from 3rd June 2019. The participant and site-specific surveys were open surveys accessed through a link and hosted on a research specific electronic

survey platform, Research Electronic Data Capture platform ('REDCap'; University of Bristol), which complies with European General Data Protection Regulations.[27,28]

Prior to study commencement, site PIs provided a best estimate of eligible participants which accounted for local physician absence due to sickness, leave, and factors such as sabbaticals and professional secondments. This denominator was used to give a best-estimate of the per-site survey response rate, with a stated aim of achieving a 70% response rate.

Statistical Analysis

Statistical analysis was undertaken using STATA 14. [29] Participants were only included in any of the reported analyses if they were from one of the 112 registered sites and provided a response for at least eight of the 11 items of the NFR scale as per imputation guidelines. Imputation was performed by replacing missing items with the mean of all completed items responses. [30]

As one item in the NFR scale was amended due to applicability to the study population, the internal consistency of the NFR scale for all participants with a valid NFR score was calculated by Cronbach's alpha.

To describe the study sample the frequency and percentage of participants by site, demographic and occupational characteristics is reported. As the distribution of the NFR score in this study was negatively skewed, summary statistics of the median NFR score are reported with corresponding bootstrapped 95% confidence intervals from 1000 replications (providing there are at least 8 observations to allow for sufficient number of sample combinations), and inter-quartile ranges (IQR) of all eligible participants. Box

plots were used as visual aids to identify covariates that may have a statistically significant association with the NFR score and the nature of the relationship.

To facilitate comparisons with previous published literature and given the large number of participants, we fitted Gaussian, mixed effects, linear regression models to NFR score, where site was included as a random effect to account for potentially unknown differences between different EDs. To identify statistically significant associations between the NFR score and observed covariates, the forward model selection procedure was implemented; inclusion in the model was based upon the goodness of fit test at the 5% level of significance, using only participants with complete NFR score and covariate data. The final model was estimated using participants with complete data for the included covariates and NFR score. Quantile regression was used to confirm the direction and significance of the identified associations under non-parametric assumptions.

RESULTS

Characteristics of the 112 participating sites are presented in table 1.

Table 1: Characteristics of sites registered to take part in the survey study

Site Characteristics	N (%) Total = 112
Country	
England	89 (79.5)
Wales	3 (2.7)
Northern Ireland	3 (2.7)
Scotland	12 (10.7)
Republic of Ireland	5 (4.4)
ED Annual Attendance	

≤ 50,000	11 (9.8)
50,001 to 100,000	46 (41.1)
>100,000	42 (37.5)
Missing	*13 (11.6)*
Specialist Designation	
Trauma Unit	55 (49.1)
Major Trauma Centre	25 (22.3)
Stroke Centre	42 (37.5)
PCI Centre	30 (26.8)

ED Emergency department
PCI Percutaneous Coronary Intervention

Of 5107 unique visits to the online survey, 4365 of these were registered at one of the 112 sites and provided consent, with 4247 completing at least 8 items of the NFR scale. Cronbach's alpha for all participants with a valid NFR score was 0.80. The median NFR score across all eligible participants was 70.0 (95% CI: 65.5 to 74.5), with an IQR of 45.5 – 90.0. Figure 1 and Figure 2, and tables 2 and 3 present a selection of participant's NFR score by demographic and occupational characteristics, with additional characteristics presented in the Online Supplementary Material 3.

Table 2: Summary statistics of NFR score by participant's characteristics. Frequency and percentage, median Need for Recovery (NFR) score with 95% bootstrapped confidence intervals and the inter-quartile range of participants within each category.

Participant Characteristics	N (%)	NFR Score	
		Median (95% CI)	[LQ - UQ]
All participants	4247 (100)	70.0 (62.0 to 78.0)	[45.5 - 90.0]
Length of time worked in current ED (months)			
0 to 3	740 (17.5)	72.7 (71.7 to 73.8)	[45.5 - 90.9]
> 3 to 6	848 (20.0)	72.7 (72.7 to 72.7)	[54.5 - 90.9]
> 6 to 12	729 (17.2)	72.7 (64.7 to 80.7)	[45.5 - 90.9]
> 12 to 24	370 (8.7)	63.6 (58.8 to 68.4)	[45.5 - 90.9]
> 24 to 60	583 (13.8)	63.6 (62.2 to 65.1)	[36.4 - 81.8]

> 60 to 120	497 (11.7)	63.6 (56.7 to 70.5)	[36.4 - 81.8]
> 120	473 (11.2)	54.5 (46.6 to 62.5)	[36.4 - 81.8]
Missing	*7 (0.2)*	*18.2 (NA) [1]*	*[9.1 - 54.5]*
Type of contract			
100%	3445 (83.5)	72.7 (67.1 to 78.4)	[45.5 - 90.9]
90%	72 (1.7)	63.6 (54.0 to 73.3)	[36.4 - 81.8]
80%	200 (4.8)	63.6 (61.4 to 65.8)	[45.5 - 81.8]
70%	116 (2.8)	72.7 (63.6 to 81.9)	[50.0 - 81.8]
60%	142 (3.4)	63.6 (54.4 to 72.9)	[45.5 - 90.9]
50%	85 (2.1)	63.6 (53.5 to 73.7)	[36.4 - 81.8]
< 50%	66 (1.6)	50.0 (35.7 to 64.3)	[27.3 - 81.8]
Missing	*121 (2.9)*	*72.7 (67.8 to 77.7)*	*[54.5 - 90.9]*
Significant caring responsibilities outside of work			
No	2616 (63.6)	72.7 (68.5 to 77.0)	[45.5 - 90.9]
Yes	1427 (34.7)	63.6 (62.8 to 64.5)	[36.4 - 81.8]
Prefer not to say	73 (1.8)	81.8 (71.0 to 92.7)	[54.5 - 90.9]
Missing	*131 (3.2)*	*72.7 (68.2 to 77.3)*	*[54.5 - 90.9]*

[1] *Insufficient observations for Bootstrapped 95% confidence intervals based*

ST1-ST2 *Specialist training year 1-2 (this included physicians training in Anaesthetics, Emergency Medicine, Acute Medicine and General Practice)*

SASG *Staff grade, associate specialist and speciality grade*

GP *General Practitioner working within the ED*

Table 3: Summary statistics of NFR score by occupational characteristics. Frequency and percentage, median Need for Recovery (NFR) score with 95% bootstrapped confidence intervals and the inter-quartile range of participants within each category.

Occupational Characteristics	N (%)	NFR Score	
		Median (95% CI) [1]	[LQ - UQ]
All participants	4247 (100)	70.0 (62.0 to 78.0)	[45.5 - 90.0]
scheduled weekend work frequency			
1 in 2	1479 (36.0)	72.7 (72.3 to 73.2)	[54.5 - 90.9]
1 in 3	865 (21.1)	72.7 (68.1 to 77.4)	[45.5 - 90.9]
1 in 4	542 (13.2)	63.6 (57.1 to 70.2)	[45.5 - 81.8]
1 in 5	310 (7.5)	54.5 (48.4 to 60.7)	[36.4 - 81.8]
1 in 6	485 (11.8)	54.5 (49.8 to 59.3)	[27.3 - 81.8]
< 1 in 6	307 (7.5)	63.6 (55.2 to 72.1)	[36.4 - 81.8]
None	121 (2.9)	54.5 (45.7 to 63.4)	[27.3 - 81.8]
Missing	*138 (3.4)*	*72.7 (65.9 to 79.6)*	*[45.5 - 90.9]*
Maximum number of consecutive clinical shifts scheduled to work			
1	52 (1.3)	63.6 (45.1 to 82.2)	[27.3 - 90.9]
2	190 (4.6)	54.5 (47.6 to 61.5)	[27.3 - 72.7]
3	465 (11.3)	63.6 (60.3 to 67.0)	[36.4 - 81.8]
4	783 (19)	63.6 (63.0 to 64.3)	[45.5 - 81.8]
5	827 (20.1)	72.7 (66.2 to 79.3)	[45.5 - 81.8]

6	389 (9.5)	72.7 (67.3 to 78.2)	[45.5 - 90.0]
7	855 (20.8)	72.7 (70.8 to 74.6)	[45.5 - 90.9]
8	554 (13.5)	72.7 (66.5 to 78.9)	[54.5 - 90.9]
Missing	*132 (3.2)*	*72.7 (67.9 to 77.6)*	*[54.5 - 90.9]*

[1] Bootstrapped 95% confidence intervals based on 1000 replications on a minimum of 8 observations.

Only 7.5% of the participants were aged over 50 years, and the majority were aged between 26 and 30 years (28.6%). NFR score appeared to decrease with age, such that those in age groups 20 to 35 years all had a median score of 72.7, age groups 36 to 55 had a median score of 63.6, and those over 55 years had a median score of 54.5 (figure 1a). There was a reasonable balance between males and females, with just over 1% who did not submit a response (missing), preferred not to say or other. The evidence suggested that females had a higher median NFR score of 72.7 (95% CI: 70.5 to 75.0) compared with males 63.6 (95% CI: 60.8 to 66.5) (figure 1b). Within clinical grade, consultants accounted for over a quarter of the participants who (with GPs) had the lowest median NFR score of 54.5 (consultants 95% CI: 53.6 to 55.5) compared with 72.7 in all other grades (figure 1c). The majority of participants had no long-term health conditions or disability (88.6%), with a lower NFR score of 63.6 (95% CI 60.2 to 67.1) compared with those who did report a long-term health condition or disability 72.7 (95% CI: 66.2 to 79.2) (figure 1d). Most participants worked full time (83.5%), but overall, the NFR score did not decrease as contract proportion decreased (table 2). Over half (54.6%) had been working in their current ED for 1 year or less and generally had higher NFR scores compared to those present for over 1 year. Less than 35% of participants declared significant caring responsibilities outside of work, but those who do had a lower median NFR score (63.6, 95% CI: 62.8 to 64.5) than those who did not (72.7, 95% CI: 68.5 to 77.0).

Most of the participants agreed or strongly agreed they were able to obtain study (68%) or annual (>73%) leave when requested. As the ability to obtain study and annual leave on request increased, the NFR score decreased from 81.8 (95% CI: 81.4 to 82.2) to 54.5 (95% CI: 49.4 to 59.7) for study leave and 81.8 (95% CI: 76.4 to 87.2) to 60.0 (95% CI: 51.8 to 68.2) for annual leave (figures 2a and 2b). There was evidence the NFR score increased as the proportion of time working out of hours increased, from 54.5 (95% CI: 47.8 to 61.3) to 81.8 (95% CI: 75.4 to 88.3) (figure 2c). Over 75% of participants spent the majority of their time in adult EM with a median NFR score of 72.7 for mixed or adult only, which was higher when compared with paediatrics only 63.6 (95% CI: 55.2 to 72.1) (figure 2d). Most participants worked 1 in 2 weekends (36%) with a median NFR score of 72.7, which decreased to 54.5 for those who did not work any weekend shifts (see table 3). Over 50% reported working 5 to 8 consecutive clinical shifts with a median NFR score of 72.7 compared with those who worked less than five, with a median NFR ≤ 63.6.

The summary statistics of the final regression model are presented in table 4.

Table 4: Summary of final Gaussian, mixed effects, linear regression model fitted to the Need for Recovery (NFR) score, including the adjusted coefficient estimate (Adj. Coef. Est.) with corresponding 95% confidence interval (CI) and p-value.

	Adj. Coeff. Est. (95% CI)	P-value[1]
Constant (baseline NFR score)	59.51(55.53 to 63.49)	< 0.001
Gender (baseline = Male)		
• Female	3.40(1.80 to 4.99)	< 0.001
• Other/Prefer not to say	-0.46(-9.07 to 8.15)	0.916
Any long-term health conditions or disabilities (baseline = No)		
• Yes	8.52(5.67 to 11.36)	< 0.001
• Prefer not to say	6.24(1.52 to 10.95)	0.01

ED paediatrics only? (baseline = No)		
• Yes	-7.08(-10.4 to -3.77)	< 0.001
Clinical grade (baseline = Foundation)		
• ST1-ST2	-0.08(-2.67 to 2.51)	0.953
• > ST2	1.32(-1.37 to 4.01)	0.336
• SASG	-1.13(-4.27 to 2.02)	0.482
• GP	-8.26(-15.09 to -1.44)	0.018
• Consultant	-5.30(-8.07 to -2.53)	< 0.001
I have been able to request and take study when I wanted (baseline = Neutral)		
• Strongly disagree	4.23(-0.26 to 8.71)	0.065
• Disagree	3.72(0.29 to 7.15)	0.034
• Agree	-1.32(-3.60 to 0.96)	0.257
• Strongly agree	-6.50(-9.43 to -3.56)	< 0.001
I have been able to request and take annual when I wanted (baseline = Neutral)		
• Strongly disagree	6.43(2.03 to 10.83)	0.004
• Disagree	1.13(-2.34 to 4.61)	0.523
• Agree	-2.84(-5.54 to -0.14)	0.039
• Strongly agree	-4.89(-8.06 to -1.72)	0.002
Proportion of time spent working out of hours (baseline = 0-25%)		
• 26-50%	5.74(3.13 to 8.35)	< 0.001
• 51-75%	10.32(7.60 to 13.03)	< 0.001
• 76-100%	14.45(10.97 to 17.92)	< 0.001

[1] Null hypothesis: Adjusted Coefficient Estimate = 0 (i.e. is there statistically significant evidence this category differs from the baseline category)

This model was based on 3979 participants with complete data for all the included covariates. Quantile regression confirmed the direction and significance of the associations remained the same (Online Supplementary Material 4). The results from this model indicated there were statistically significant associations between gender, health conditions, type of ED (adult or paediatric), clinical grade, access to annual and study leave, and time spent working out of hours. The model suggested that males, GPs or consultants, those working in paediatrics and those with no long-term health condition or disability had the lowest NFR score. The greatest increase in

NFR score was associated with those who reported more than a 75% proportion of out of hours work (14.45: 95% CI 10.97 to 17.92). If participants strongly agreed they were able to obtain study leave upon request this reduced their NFR score by 6.5 (95% CI: 3.56 to 9.43) and annual leave could reduce their NFR score 4.89 (95% CI 1.72 to 8.06).

DISCUSSION

Emergency Physicians in the UK and Ireland have a higher NFR score than has been reported in any previously studied population.[17,31–35] Three modifiable occupational factors were significantly associated with higher NFR scores (poor access to annual leave, and study leave, and proportion of out of hours work), and four further non-modifiable demographic factors were associated with a decreased NFR score. These were consultant grade seniority, male gender, absence of long-term health condition or disability, and working in a paediatric only ED.

The NFR score found in this study compares unfavourably with multiple other occupational groups. Whilst several confounders should be considered, useful context against which to compare our findings does exist, albeit not from UK settings. Measurement in shift workers (including hospital nurses) showed significantly lower NFR scores, [11,31] as did studies of heavy goods vehicle drivers and merchant seafarers, all with average NFR scores in the range 36-44.[34,35]

The three modifiable occupational factors represent areas of autonomy and control, correlating well with previous work establishing these as core

drivers to minimise physician workplace stress and ensure well-being. [2,36,37] Prioritising change in these domains may result in NFR score reduction, and reduce negative effects on health and well-being including occupational burnout. Whilst out of hours working is inherent and unavoidable in EM, the linear relationship we observed suggests that any reduction may result in direct improvements in NFR, and evidence-based strategies such as proportional control of 'out of hours' working, annualised rota patterns and/or provision of rest facilities should therefore be considered urgently.[38–40]

As NFR does not change with seniority prior to consultant level it is possible that the reduction in NFR seen in this cohort supports the hypothesis that broader perceptions of job autonomy and control, likely gained at this level, may be explicitly linked to well-being in healthcare.[2,37] Further areas merit exploration including the link to out of hours working and possible qualitative enquiry of personal experience and clinical performance.

The relationship observed between gender and NFR is likely to be overly simplistic requiring further evaluation. Presumed confounding variables affecting this issue (such as a primary carer role and domestic responsibilities) have been previously reported to be unrelated or protective against maladaptive fatigue and are supported with findings from this study. [41] Awareness of the four demographic factors identified could be important at a departmental planning level and increase advocacy for colleagues at greatest risk of impaired well-being.

The main strength of our study is inclusion of responses from over half of all UK EDs, enhancing generalisability of our findings.[42] The high volume of responses indicate the NFR scale is an acceptable measure for physicians, with over half of sites exceeding 70% response rates. A key weakness is the single-point-of-time measurement, as seasonal bias may have affected NFR scores. Furthermore, we acknowledge the disadvantages of self-administered dichotomous questionnaires which may limit the richness of insights.[43,44] Open-ended questions may be desirable in future survey iterations.

The median NFR observed in our study reflects current challenges facing EM, and may represent a precursor to sustained burnout in a high proportion of the current workforce. Conversely we have identified simple interventions that may reduce these high levels, and improve well-being. Iterative delivery of the NFR scale following interventions will confirm or refute the impact of such changes, and may identify further areas which will result in continual improvement. Such work should also include other ED staff groups to gain a broader picture across the multiprofessional ED team.

In conclusion, this study provides a robust estimate of the NFR for Emergency Physicians in the UK and Ireland, which is higher than any occupation reported to date. Several potentially modifiable occupational characteristics were associated with higher NFR, and future work to assess the impact of modifying these factors will inform strategies to reduce NFR. In time this may lead to improved long-term physician well-being and enhanced staff retention.

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Competing interests:

All authors have completed the ICMJE uniform disclosure form and declare: no support from any organisation for the submitted work; TR has received 50% salary funding for two years as the Trainee Emergency Research Network fellow from the Royal College of Emergency Medicine; DH reports an honorary role as the Professor of the Royal College of Emergency Medicine during the conduct of this study; no other relationships or activities that could appear to have influenced the submitted work.

Patient and Public Involvement statement:

The concept of the research was presented to over 100 members of the public at a Research & Development PPI Conference on 20th September 2018. Participants were supportive of the concept of the study, and no concerns were raised. Further public and stakeholder engagement took place through a workshop held at the UK Emergency Medicine Trainees Association Annual Conference in December 2018, this influenced the outcome measures and survey design including the removal of a formal burnout inventory due to

perceptions and experience of respondent fatigue in the target participant group.

Ethics Approval:

This study protocol was submitted through the Integrated Research Application System (IRAS), IRAS number 262048 and received proportionate ethical approval by the Health Research Authority and Health and Care Research Wales, Research Ethics Committee reference 19/HRA/2404 and equivalent approvals in Scotland, Northern Ireland and Ireland. All participants provided informed consent prior to beginning the survey

Data sharing:

De-identified participant level data by site will be made available on reasonable request through the study team (tern@rcem.ac.uk). Data will be available for researchers whose proposed use of the data has been approved by the study team.

Transparency statement:

The lead author, Dr Laura Cottey, and the co-authors affirm that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Dissemination to participants and related patient and public communities:

The authors are unable to disseminate the result of the research to study participants directly, but the results will be made publicly available through open access publication and dissemination of the results through site principal investigators and social media.

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Contributors:

LC, TR and BG contributed to the development of the study design, data collection and analysis, the first draft of the manuscript and subsequent revised versions. DH and JML contributed to the development of the study design, data analysis, the first draft of the manuscript and subsequent revised versions. MDL contributed to survey development, data collection and final version of manuscript; KS and DE provided the statistical analysis plan and contributed to

data analysis, the first draft of the manuscript and subsequent revised versions. All authors approved the final version of the manuscript for submission. LC is the guarantor. TERN and PERUKI collaborators contributed to local study promotion and participant recruitment.

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Research Checklist: The Checklist for Reporting Results of Internet E-Surveys (CHERRIES)

CHERRIES CHECKLIST ADAPTED FROM: Eysenbach, Gunther. "Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES)." *Journal of medical Internet research* vol. 6,3 e34. 29 Sep. 2004, doi:10.2196/jmir.6.3.e34			
Item Category	***Checklist Item***	***Explanation***	***Checklist Response***
Design	Describe survey design	Describe target population, sample frame. Is the sample a convenience sample? (In "open" surveys this is most likely.)	***Outlined in 'Methods'***
IRB (Institutional Review Board) approval and informed consent process	IRB approval	Mention whether the study has been approved by an IRB.	***Outlined in 'Ethics Approval'***
	Informed consent	Describe the informed consent process. Where were the participants told the length of time of the survey, which data were stored and where and for how long, who the investigator was, and the purpose of the study?	***Outlined in Survey Distribution, monitoring and recruitment***
	Data protection	If any personal information was collected or stored, describe what mechanisms were used to protect unauthorized access.	***Outlined in Survey Distribution, monitoring and recruitment***
Development and pre-testing	Development and testing	State how the survey was developed, including whether the usability and technical functionality of the electronic questionnaire had been tested before fielding the questionnaire.	***Outlined in 'Survey Development'***
Recruitment process and description of the sample having access to the questionnaire	Open survey versus closed survey	An "open survey" is a survey open for each visitor of a site, while a closed survey is only open to a sample which the investigator knows (password-protected survey).	***Outlined in Survey Distribution, monitoring and recruitment***
	Contact mode	Indicate whether or not the initial contact with the potential participants was made on the Internet. (Investigators may also send out questionnaires by mail and allow for Web-based data entry.)	***Outlined in 'Survey Distribution, monitoring and recruitment'***
	Advertising the survey	How/where was the survey announced or advertised? Some examples are offline media (newspapers), or online (mailing lists – If yes, which ones?) or banner ads (Where were these banner ads posted and what did they look like?). It is important to know the wording of the announcement as it will	***Outlined in 'Survey Distribution, monitoring and recruitment'***

		heavily influence who chooses to participate. Ideally the survey announcement should be published as an appendix.	
Survey administration	Web/E-mail	State the type of e-survey (eg, one posted on a Web site, or one sent out through e-mail). If it is an e-mail survey, were the responses entered manually into a database, or was there an automatic method for capturing responses?	***Outlined in 'Survey Distribution, monitoring and recruitment'***
	Context	Describe the Web site (for mailing list/newsgroup) in which the survey was posted. What is the Web site about, who is visiting it, what are visitors normally looking for? Discuss to what degree the content of the Web site could pre-select the sample or influence the results. For example, a survey about vaccination on a anti-immunization Web site will have different results from a Web survey conducted on a government Web site	***Outlined in 'Design'***
	Mandatory/voluntary	Was it a mandatory survey to be filled in by every visitor who wanted to enter the Web site, or was it a voluntary survey?	***Outlined in 'Survey Distribution, monitoring and recruitment'***
	Incentives	Were any incentives offered (eg, monetary, prizes, or non-monetary incentives such as an offer to provide the survey results)?	***No***
	Time/Date	In what timeframe were the data collected?	***Outlined in 'Sites and settings'***
	Randomization of items or questionnaires	To prevent biases items can be randomized or alternated.	***Not done***
	Adaptive questioning	Use adaptive questioning (certain items, or only conditionally displayed based on responses to other items) to reduce number and complexity of the questions	***Outlined in Survey Distribution, monitoring and recruitment***
	Number of Items	What was the number of questionnaire items per page? The number of items is an important factor for the completion rate.	***Outlined in 'Design'***
	Number of screens (pages)	Over how many pages was the questionnaire distributed? The number of items is an important factor for the completion rate.	***Outlined in 'Design'***
	Completeness check	It is technically possible to do consistency or completeness checks before the questionnaire is submitted. Was this done, and if "yes", how (usually JAVAScript)? An alternative is to check for completeness after the questionnaire has been submitted (and	***Not done***

		highlight mandatory items). If this has been done, it should be reported. All items should provide a non-response option such as “not applicable” or “rather not say”, and selection of one response option should be enforced.	
	Review step	State whether respondents were able to review and change their answers (eg, through a Back button or a Review step which displays a summary of the responses and asks the respondents if they are correct).	***Outlined in Survey Distribution, monitoring and recruitment***
Response rates			
	Unique site visitor	If you provide view rates or participation rates, you need to define how you determined a unique visitor. There are different techniques available, based on IP addresses or cookies or both.	***Outlined in ‘Results’***
	View rate (Ratio of unique survey visitors/unique site visitors)	Requires counting unique visitors to the first page of the survey, divided by the number of unique site visitors (not page views!). It is not unusual to have view rates of less than 0.1 % if the survey is voluntary	***Survey site contains first page of survey therefore N/A***
	Participation rate (Ratio of unique visitors who agreed to participate/unique first survey page visitors)	Count the unique number of people who filled in the first survey page (or agreed to participate, for example by checking a checkbox), divided by visitors who visit the first page of the survey (or the informed consents page, if present). This can also be called “recruitment” rate.	***Outlined in ‘Results’***
	Completion rate (Ratio of users who finished the survey/users who agreed to participate)	The number of people submitting the last questionnaire page, divided by the number of people who agreed to participate (or submitted the first survey page). This is only relevant if there is a separate “informed consent” page or if the survey goes over several pages. This is a measure for attrition. Note that “completion” can involve leaving questionnaire items blank. This is not a measure for how completely questionnaires were filled in. (If you need a measure for this, use the word “completeness rate”.)	***Outlined in ‘Results’***
Preventing multiple entries from the same individual	Cookies used	Indicate whether cookies were used to assign a unique user identifier to each client computer. If so, mention the page on which the cookie was set and read, and how long the cookie was valid. Were duplicate entries avoided by preventing users access to the survey twice; or were duplicate database entries having the same user ID eliminated before analysis? In the latter case, which entries were kept for analysis (eg, the first entry or the most recent)?	***Not used***

	IP check	Indicate whether the IP address of the client computer was used to identify potential duplicate entries from the same user. If so, mention the period of time for which no two entries from the same IP address were allowed (eg, 24 hours). Were duplicate entries avoided by preventing users with the same IP address access to the survey twice; or were duplicate database entries having the same IP address within a given period of time eliminated before analysis? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	***Not used due to survey being completed on multi-user/single log-in computers***
	Log file analysis	Indicate whether other techniques to analyze the log file for identification of multiple entries were used. If so, please describe.	***Not done***
	Registration	In "closed" (non-open) surveys, users need to login first and it is easier to prevent duplicate entries from the same user. Describe how this was done. For example, was the survey never displayed a second time once the user had filled it in, or was the username stored together with the survey results and later eliminated? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	***N/A***
Analysis	Handling of incomplete questionnaires	Were only completed questionnaires analyzed? Were questionnaires which terminated early (where, for example, users did not go through all questionnaire pages) also analyzed?	***Outlined in 'Data Analysis'***
	Questionnaires submitted with an atypical timestamp	Some investigators may measure the time people needed to fill in a questionnaire and exclude questionnaires that were submitted too soon. Specify the timeframe that was used as a cut-off point, and describe how this point was determined	***N/A***
	Statistical correction	Indicate whether any methods such as weighting of items or propensity scores have been used to adjust for the non-representative sample; if so, please describe the methods.	***Outlined in 'Data Analysis'***

Figure Legend

Figure 1

Box plots of Need for Recovery (NFR) score by participant demographic characteristics, excluding any participants who does not respond to the question (i.e. missing).

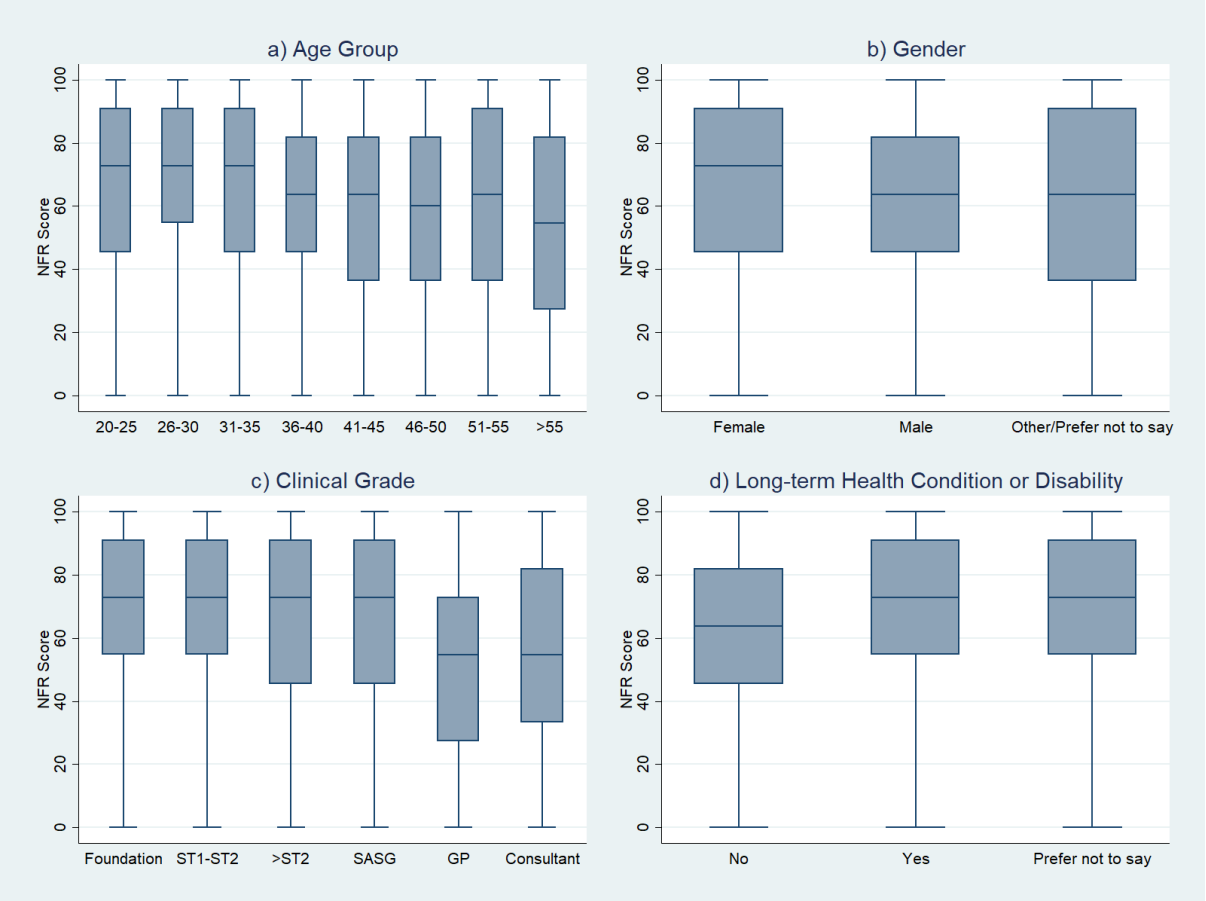
Plot a) age group in years; b) gender; c) clinical grade; d) any long-term health condition or disability.

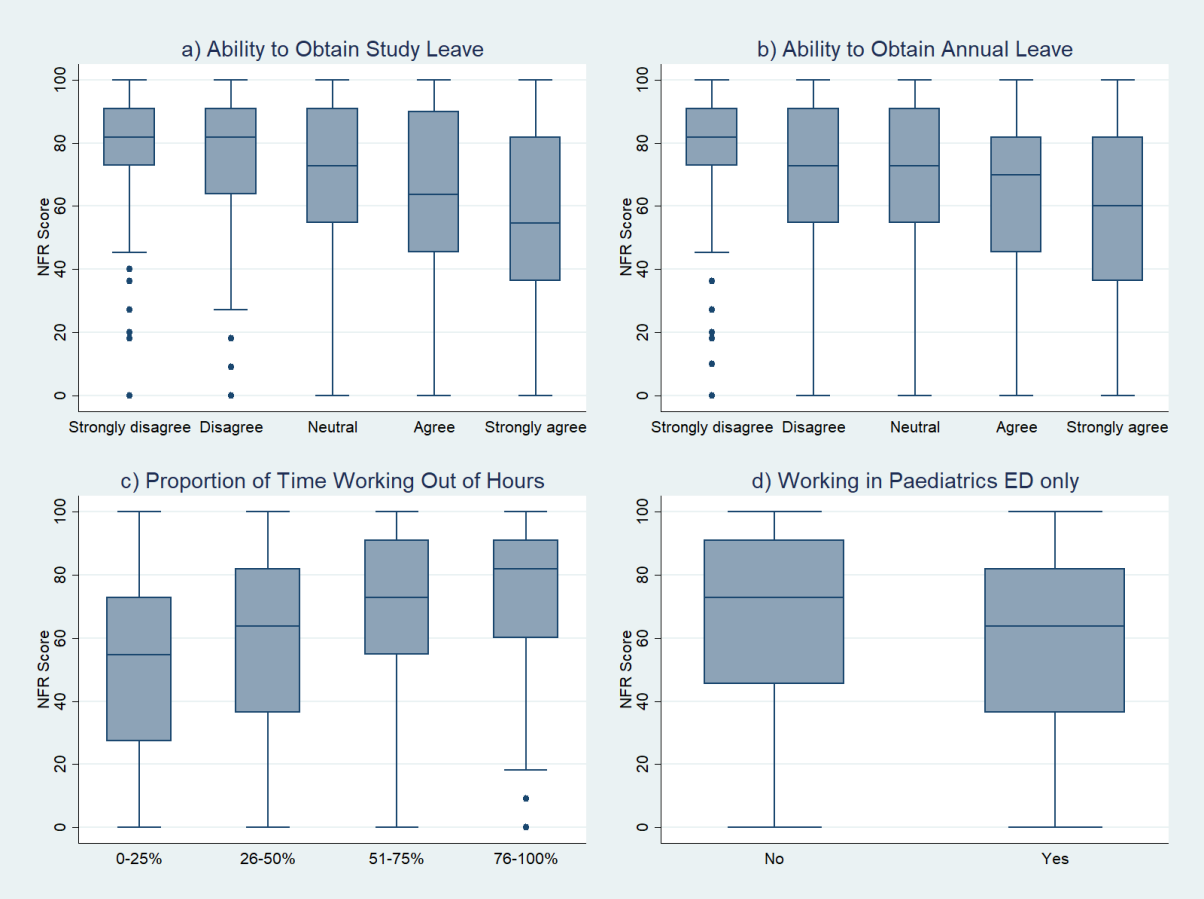
ST1-ST2=Specialist Training year 1-2 (this included physicians training in Anaesthetics, Emergency Medicine, Acute Medicine and General Practice)
SASG=Staff grade, associate specialist and speciality grade
GP=General Practitioner working within the emergency department (ED)

Figure 2

Box plot of Need for Recovery (NFR) score by participant's occupational characteristics, excluding any participants who does not respond to the question (i.e. missing).

Plot a) ability to obtain study leave when requested; b) ability to obtain annual leave when requested; c) proportion of time working out of hours; d) working in paediatrics emergency departments (ED) only.





Emergency Department Need For Recovery Survey

Do you want to read the patient participation leaflet, GDPR and consent information now?	◯ Yes ◯ No

Participant Information Sheet

Welcome to the 2019 TERN Need for Recovery Survey.

This is an electronic participant information sheet. Please take a minute or two to read this information before proceeding with the survey.

What is need for recovery?
Need for recovery is the time taken to physically and psychologically recover from work. Increased need for recovery is linked to fatigue and a range of physical and psychological health outcomes including burnout.
Why have I been asked to take part?
You are either:
• A doctor working in an emergency department which has been nominated to participate in this survey.

What is the purpose of the study?
This survey is being conducted as part of a national survey by the Trainee Emergency Research Network (TERN). The project is being led by Dr Laura Cottey (Chief Investigator) and Dr Blair Graham, with oversight from the TERN executive committee. We hope that the results from this survey will provide a baseline assessment of trainee need for recovery, and demonstrate risk factors that may indicate an increased need for recovery. It is hoped that this survey will provide insight into the phenomenon of need for recovery amongst Emergency Department doctors, show where differences exist, and how need for recovery may be reduced in the future. Ultimately it is hoped that this survey may lead to initiatives to improve the working lives of doctors in the emergency department.

What will happen if I take part?
You will asked to take part in this electronic questionnaire. You should allocate about 5 minutes to complete the questionnaire, although you can save and return to completing the questionnaire at a later time.

Do I have to take part?
In order that these results can inform future initiatives to improve working lives of emergency doctors, we do require a robust response rate. However, you are under no obligation to take part and may withdraw at any point without the need to give a reason.

Should you have uncertainties of queries about this survey, please do not hesitate to contact the study team.

What will happen to my data if I withdraw my involvement?
If you choose to withdraw your involvement in the study, any results that you have submitted will be kept for analysis. However, you will not be required to input further into the study.

If you would like to be formally withdrawn from the study at any point, please contact the study team (TERN@rcem.ac.uk). You do not have to give a reason.

Are there any potential risks or benefits of taking part?

This survey will provide valuable insight into the wellbeing of emergency department doctors nationally. We appreciate issues such as wellbeing and burnout are sensitive. We have included some information about sources that you might wish to contact for support both as part of this introduction, and at the end of the survey.

Who is involved in this project?
The project is being led by Dr Laura Cottey (Chief Investigator) and Dr Blair Graham, with oversight from the TERN executive committee which is led by Dr Tom Roberts. The study is indirectly supported by the Royal College of Emergency Medicine, but TERN is independent from the college.

What if something goes wrong?
It is very unlikely that anything will go wrong. If you feel it does, please contact the study team directly.

How will you protect my data and confidentiality?
The University Hospitals Plymouth NHS Trust is the sponsor for this study. The sponsor will be using information in order to undertake the study and will be responsible for looking after your information and using it properly. The data collected will be kept for 10 years after the study has finished.

Your rights to access, change or move your information are limited, as we need to manage your information in specific ways in order for the research to be reliable and accurate. If you withdraw from the study, we will keep the information about you that we have already obtained. To safeguard your rights, we will use the minimum personally identifiable information possible.

This study is also compliant with the General Data Protection Regulations (GDPR). For more information about GDPR click here.

How may I contact the study team in the future?
You can contact the study team by emailing Dr Laura Cottey at laura.cottey@nhs.net

What to do if you need support about wellbeing
The following organisations can help provide advice and support with regards to your wellbeing.

-Your occupational health department (contact details available via your employer)
-Your general practitioner
-BMA Counselling Service (24 Hours). Telephone 0330 123 1245. (Note that you do not have to be a member of the BMA to access this service)
-The Samaritans (24 Hours). Telephone 116 123.

You can also access further information and signposting online via the Doctors Support Network https://www.dsn.org.uk/

Feel free to leave any comments.

Consent Question 1: I have read and understood the participant information	◯ Yes ◯ No
Consent Question 2: I understand the information about confidentiality and GDPR	◯ Yes ◯ No

Demographic Characteristics

What is your current job role?

- ◯ ST1
- ◯ ST2
- ◯ ST3
- ◯ ST4
- ◯ ST5
- ◯ ST6
- ◯ ST7
- ◯ ST8
- ◯ F1
- ◯ F2
- ◯ Clinical Fellow (F2-ST3 Level)
- ◯ Clinical Fellow (>=ST4 Level)
- ◯ Consultant
- ◯ Associate Specialist
- ◯ Staff Grade
- ◯ CESR Doctor
- ◯ GP Trainee
- ◯ GP
- ◯ Other (please specify)

What is your job role?

_____

Which country do you work in?

- ◯ Scotland
- ◯ Northern Ireland
- ◯ Wales
- ◯ England
- ◯ Republic of Ireland

Which hospital do you currently work in?

- ◯ Aberdeen
- ◯ Victoria Hospital, Kirkcaldy
- ◯ Forth Valley Royal Hospital
- ◯ Monklands Hospital
- ◯ Royal Hospital for Children, Glasgow
- ◯ Royal Infirmary of Edinburgh
- ◯ St John's, Livingston
- ◯ NHS Greater Glasgow and Clyde - Queen Elizabeth
- ◯ NHS Greater Glasgow and Clyde - Glasgow Royal Infirmary
- ◯ Crosshouse, Ayrshire
- ◯ Royal Alexandria, Paisley
- ◯ Ayr
- ◯ Royal Hospital for Sick Children, Edinburgh
- ◯ Other

Which hospital do you currently work in?

- ◯ Craigavon Area Hospital, Northern Ireland
- ◯ Royal Victoria Hospital, Belfast
- ◯ Ulster Hospital, Belfast
- ◯ Other

Which hospital do you currently work in?

◯ Cardiff, University Hospital of Wales
◯ Ysbyty Gwynedd, Bangor
◯ Morriston Hospital, Swansea
◯ Wrexham, North Wales
◯ Other

Which hospital do you currently work in (the list is mostly alphabetically but if you cannot find your hospital please check the bottom)?

◯ Addenbrooke's Hospital
◯ Aintree
◯ Airedale General Hospital
◯ Basingstoke Emergency Department
◯ Bedford hospital emergency department
◯ Birmingham
◯ Bolton
◯ Bradford Royal Infirmary
◯ Brighton (Royal Sussex County Hospital)
◯ Bristol Childrens Hospital
◯ Bristol Royal Infirmary (Adults)
◯ Cambridge University Hospitals
◯ Chelsea & Westminster Hospital
◯ Croydon University Hospital
◯ Doncaster Royal Infirmary
◯ William Harvey ED
◯ East Surrey Hospital ED
◯ Epsom and St Helier NHS Trust
◯ Gloucestershire Hospitals NHS Foundation Trust
◯ Great Western Hospital Swindon
◯ Hampshire Hospitals NHS Trust (Basingstoke and Winchester)
◯ Harrogate Emergency Department
◯ Homerton Emergency Department
◯ Ipswich Hospital
◯ James Cook University Hospital Middlesbrough
◯ James Paget University Hospital
◯ Leeds teaching hospitals
◯ Leicester Royal Infirmary
◯ Leighton (Crewe)
◯ Lewisham university hospital
◯ Lister Hospital
◯ QEH, London
◯ Manchester Royal Infirmary
◯ Milton Keynes University
◯ Musgrove Park Hospital, Taunton
◯ Northern general hospital
◯ Northumbria Specialist Emergency Care Hospital
◯ Northwick Park Hospital
◯ Oxford University Hospital NHS Foundation Trust/
◯ Portsmouth - Queen Alexandra Hospital,
◯ Plymouth- Derriford
◯ Reading
◯ Royal Berkshire Hospital
◯ Royal Blackburn Hospital
◯ Royal Cornwall Hospital, Truro
◯ Royal Devon & Exeter Hospital
◯ Royal Liverpool University Hospital
◯ The Royal London Hospital (Paeds)
◯ The Royal London Hospital (Adults)
◯ Royal Manchester Children's Hospital
◯ Royal Oldham Hospital
◯ Royal Preston hospital
◯ Royal Shrewsbury Hospital
◯ Royal Stoke
◯ Royal Surrey County Hospital
◯ Royal United Hospital Bath
◯ Royal Victoria, Newcastle
◯ Salford Royal Hospital, Manchester
◯ Sheffield Childrens Hospital ED
◯ Medway Foundation NHS Trust
◯ Mid Cheshire Hospitals NHS Foundation Trust
◯ University Hospital Southampton
◯ St Helens and Knowsley
◯ Southmead Hospital
◯ Surrey and Sussex Healthcare NHS Trust
◯ St Georges Hospital Tooting

◯ St Marys Hospital, London
◯ St Richards hospital
◯ St Thomas' Hospital
◯ Torbay
◯ Tunbridge Wells Hospital
◯ Southport District General Hospital
◯ University College Hospital, London
◯ University Hospital Coventry and Warwickshire
◯ Warrington
◯ University Hospitals of Derby and Burton NHS Foundation Trust
◯ Watford General hospital
◯ West Middlesex University Hospital
◯ West Suffolk Hospital
◯ Frimley Park Hospital
◯ Wexham Park Hospital, Frimley Health NHS
◯ Whiston Hospital
◯ Wythenshawe Hospital
◯ Yeovil District Hospital
◯ York District hospital
◯ York Hospital Emergency Departments
◯ Whiston Hospital
◯ William Harvey Hospital
◯ Worthing Hospital
◯ University hospital of Hull
◯ North Middlesex
◯ Sandwell and West Birmingham
◯ Stoke Mandeville
◯ Colchester
◯ Alder Hey Children's Hospital
◯ Queen's Hospital, Romford
◯ Birmingham Children's Hospital
◯ Sunderland Royal Hospital
◯ Countess of Chester NHS foundation trust
◯ University hospital of North Durham
◯ Evelina Children's Hospital
◯ King's College, London
◯ Barnstaple
◯ Nottingham University Hospital
◯ Royal Alexandra Children's Hospital
◯ Royal Wolverhampton
◯ Salisbury NHS Trust
◯ Western Sussex NHS Trust
◯ Other
◯ Alder Hey Childrens Hospital
◯ Birmingham Women's and Childrens Hospital
◯ Countess of Chester
◯ Evelina, Guys and St Thomas's
◯ Kings College Hospital
◯ Royal Alexandra Children's Hospital, Brighton and Sussex
◯ New Cross Hospital
◯ Salisbury
◯ Barking, Havering & Redbridge - Queen's
◯ Barking, Havering & Redbridge - King George
◯ South Tyneside and Sunderland NHS Trust
◯ County Durham and Darlington
◯ North Manchester General Hospital

Which hospital do you currently work in?

◯ University Hospital Galway
◯ Mater Misericordiae University Hospital, Dublin,
◯ Sligo University Hospital
◯ Limerick regional Hospital
◯ Other
◯ Children's Health Ireland at Crumlin
◯ Children's Health Ireland at Temple Street
◯ Children's Health Ireland at Tallaght
◯ Bon Secours Hospital
◯ Cork University Hospital

Please state the name of your hospital.

_____

What type of patients do you see in your Emergency Department?

◯ Adults only
◯ Paediatrics only
◯ Mixture of Adults and Paediatrics

How old are you?

◯ 20-25
◯ 26-30
◯ 31-35
◯ 36-40
◯ 41-45
◯ 46-50
◯ 51-55
◯ 56-60
◯ 61- 65
◯ 66-70
◯ >70

What is your gender?

◯ Female
◯ Male
◯ Other
◯ Prefer not to say

Please fill out the following "Need for Recovery Score". Please base this on the LAST MONTH of work (excluding leave).

	yes	no
I find it difficult to relax at the end of the working day?	◯	◯
By the end of the working day I feel really worn-out	◯	◯
Because of my job, at the end of the working day I feel rather exhausted	◯	◯
After my breaks, I feel fresh to continue my work	◯	◯
Generally speaking, I only start to feel relaxed on my second non-working day off	◯	◯
I find it difficult to concentrate in my free time after work	◯	◯
I find it hard to show interest in other people when I have just come home from work	◯	◯
In general, it takes me over an hour to feel fully recuperated after work	◯	◯
When I get home, I need to be left in peace for a while	◯	◯
Often, after a day's work I feel so tired that I cannot get involved in other activities	◯	◯
A feeling of tiredness prevents me from doing my work as well as I normally would during the last part of the working day	◯	◯

How long have you worked in your current Emergency Department?

◯ 1 month or less
◯ 1-2 months
◯ 2-3 months
◯ 3-4 months
◯ 4-5 months
◯ 5-6 months
◯ 6 months - 1 year
◯ 1-2 years
◯ 2-3 years
◯ 3-5 years
◯ 5 -10 years
◯ 10 -15 years
◯ 15-20 years
◯ > 20 years

How long have you worked in Emergency Medicine in total in your career?

◯ 1 year or less
◯ 1 year or more

How many months have you worked in Emergency Medicine in total?

_____

How many years have you worked in Emergency Medicine in total?

_____

What is your most frequent method of transport for your commute to work?

◯ Car
◯ Motorbike
◯ Bus
◯ Train
◯ Underground
◯ Walk
◯ Run
◯ Cycle
◯ I live on-site
◯ Other

You have selected other, how do you commute?

_____

How long does your commute take in minutes (one way)?

	1-10 mins	11-20 mins	21-30 mins	31-40 mins	41-50 mins	51-60 mins	61-70 mins	71-80 mins	81-90 mins	>90 mins
On an average day	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
On a good day	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
On a bad day	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

What type of contract do you work?

◯ Full time
◯ 90%, less than full time
◯ 80%, less than full time
◯ 70%, less than full time
◯ 60%, less than full time
◯ 50%, less than full time
◯ less than 50%, less than full time

Do you have dedicated contracted time away from Adult Emergency Medicine (e.g. subspecialty or GP) or work in Paediatric Emergency Medicine?

◯ Yes
◯ No

Please select all that are applicable to your current contracted time.

☐ ICM
☐ PEM
☐ PHEM
☐ Academic
☐ Teaching
☐ Leadership/Management
☐ Paediatrics
☐ GP
☐ Other

What is your "other" contracted time?

_____

What percentage of your contract is spent in ICM rather than EM?

◯ 10%
◯ 20%
◯ 25%
◯ 30%
◯ 40%
◯ 50%
◯ 60%
◯ 70%
◯ 75%
◯ 80%
◯ 90%
◯ 100%

What percentage of your contract is spent in PEM rather than Adult EM?

- ◯ 10%
- ◯ 20%
- ◯ 25%
- ◯ 30%
- ◯ 40%
- ◯ 50%
- ◯ 60%
- ◯ 70%
- ◯ 75%
- ◯ 80%
- ◯ 90%
- ◯ 100%

What percentage of your contract is spent in PHEM rather than Adult EM?

- ◯ 10%
- ◯ 20%
- ◯ 25%
- ◯ 30%
- ◯ 40%
- ◯ 50%
- ◯ 60%
- ◯ 70%
- ◯ 75%
- ◯ 80%
- ◯ 90%
- ◯ 100%

What percentage of your contract is spent Academic rather than Adult EM?

- ◯ 10%
- ◯ 20%
- ◯ 25%
- ◯ 30%
- ◯ 40%
- ◯ 50%
- ◯ 60%
- ◯ 70%
- ◯ 75%
- ◯ 80%
- ◯ 90%
- ◯ 100%

What percentage of your contract is spent Teaching rather than Adult EM?

- ◯ 10%
- ◯ 20%
- ◯ 25%
- ◯ 30%
- ◯ 40%
- ◯ 50%
- ◯ 60%
- ◯ 70%
- ◯ 75%
- ◯ 80%
- ◯ 90%
- ◯ 100%

What percentage of your contract is spent management/leadership rather than Adult EM?

- ◯ 10%
- ◯ 20%
- ◯ 25%
- ◯ 30%
- ◯ 40%
- ◯ 50%
- ◯ 60%
- ◯ 70%
- ◯ 75%
- ◯ 80%
- ◯ 90%
- ◯ 100%

What percentage of your contract is spent doing paediatrics rather than EM?

- ◯ 10%
- ◯ 20%
- ◯ 25%
- ◯ 30%
- ◯ 40%
- ◯ 50%
- ◯ 60%
- ◯ 70%
- ◯ 75%
- ◯ 80%
- ◯ 90%
- ◯ 100%

What percentage of your contract is spent doing GP rather than Adult EM?

- ◯ 10%
- ◯ 20%
- ◯ 25%
- ◯ 30%
- ◯ 40%
- ◯ 50%
- ◯ 60%
- ◯ 70%
- ◯ 75%
- ◯ 80%
- ◯ 90%
- ◯ 100%

What percentage of your contract is spent doing "other" activities rather than Adult EM?

- ◯ 10%
- ◯ 20%
- ◯ 25%
- ◯ 30%
- ◯ 40%
- ◯ 50%
- ◯ 60%
- ◯ 70%
- ◯ 75%
- ◯ 80%
- ◯ 90%
- ◯ 100%

What is the maximum number of TOTAL clinical shifts you work in a week?

◯ 1 shift
◯ 2 shifts
◯ 3 shifts
◯ 4 shifts
◯ 5 shifts
◯ 6 shifts
◯ 7 shifts

What is the maximum number of CONSECUTIVE clinical shifts you would be scheduled to work?

◯ 1 shift
◯ 2 shifts
◯ 3 shifts
◯ 4 shifts
◯ 5 shifts
◯ 6 shifts
◯ 7 shifts
◯ > 7 shifts

What is the maximum number of consecutive NIGHT shifts you would be scheduled to work in a row?

◯ 0 shifts
◯ 1 shift
◯ 2 shifts
◯ 3 shifts
◯ 4 shifts
◯ 5 shifts
◯ 6 shifts
◯ 7 shifts

What is the maximum number of consecutive DAY shifts you would be scheduled to work in a row?

◯ 0 shifts
◯ 1 shift
◯ 2 shifts
◯ 3 shifts
◯ 4 shifts
◯ 5 shifts
◯ 6 shifts
◯ 7 shifts

What is the maximum number of consecutive TWILIGHT shifts you would be scheduled to work in a row?

◯ 0 shifts
◯ 1 shift
◯ 2 shifts
◯ 3 shifts
◯ 4 shifts
◯ 5 shifts
◯ 6 shifts
◯ 7 shifts

What is your scheduled weekend work frequency?

◯ 1 in 2
◯ 1 in 3
◯ 1 in 4
◯ 1 in 5
◯ 1 in 6
◯ Less frequent than 1 in 6
◯ I don't work weekends

Over the past month how many contracted non-clinical shifts have you had? E.g. SPA, teaching, clinical governance.

◯ 0 shifts
◯ Between 0-1 shifts
◯ 1 shift
◯ 2 shifts
◯ 3 shifts
◯ 4 shifts
◯ 5 shifts
◯ 6 shifts
◯ 7 shifts
◯ 8 shifts
◯ 9 shifts
◯ 10 shifts
◯ 11-15 shifts
◯ >15 shifts

In the past month how many locum shifts have you worked? _____

Over the past month, roughly how often have you left more than 15 minutes late following a clinical shift?

◯ Rarely
◯ A few times a month
◯ Once a week
◯ A few times a week
◯ Everyday

Over the past month, how often have you taken your full entitlement of breaks during a clinical shift?

◯ Rarely
◯ A few times a month
◯ Once a week
◯ A few times a week
◯ Everyday

What proportion would you say you spend working 'out of hours' (evenings, nights or weekends)?

◯ < 25%
◯ 26-50%
◯ 51-75%
◯ 76-100%

What proportion of your locum shifts would you say you spend working 'out of hours' (evenings, nights or weekends)?

◯ < 25%
◯ 26-50%
◯ 51-75%
◯ 76-100%

I have been able to request and take the annual leave I wanted?

◯ Strongly disagree
◯ Disagree
◯ Neutral
◯ Agree
◯ Strongly agree

I have been able to request and take the study leave I wanted?

◯ Strongly disagree
◯ Disagree
◯ Neutral
◯ Agree
◯ Strongly agree

Over the past month, roughly how often have you found yourself feeling overwhelmed with work during a clinical shift?

◯ Rarely
◯ A few times a month
◯ Once a week
◯ A few times a week
◯ Everyday

Do you consider yourself to have any long-term health conditions or disability?

◯ Yes
◯ No
◯ Prefer not to say

Do you have significant caring responsibilities outside of work?
(e.g. parent or main carer for a relative)

◯ Yes
◯ No
◯ Prefer not to say

I feel at high risk of burnout from my job in the near future?

◯ Yes
◯ No
◯ Prefer not to say

I feel I am currently suffering burnout from work?

◯ Yes
◯ No
◯ Prefer not to say

TIRED Site Survey

Department Demographics

Name of emergency department and NHS trust?	_____
Number of attendances per year?	_____
Any specialist designation?	☐ Trauma unit ☐ Adult major trauma centre ☐ Stroke centre ☐ PCI centre ☐ Paediatric major trauma centre
Number of EM Consultants?	_____
Number of EM Middle Grades (ST4 and above)?	_____
Number of EM Middle grade career clinicians equivalent to > ST4 (eg associate specialist, specialty doctors, CESR or other non-training doctors)?	_____
Number of EM trainees ST3?	_____
Number of ACCS trainees ST1-2?	_____
Number of GP trainees ST1-3?	_____
Number of ED GPs?	_____
Number of Clinical Fellows (Fy1-ST3)?	_____
Number of Clinical Fellows (>=ST4)?	_____
Number of FY2s?	_____
Number of FY1s?	_____
Total number of ED Doctors calculated from the answers above:	_____

Out of the total number of doctors above, how many will be ineligible for the study due to absence during the study period? (eg maternity, sick or annual leave)	_____
What percentage of eligible EM doctors do you estimate you will enrol in the survey? (ie if you have 50 doctors and think you will enrol 25 at your site, that would be 50%).	_____ (We are aiming for a response rate of 80% of eligible doctors as a minimum at each site but understand this not might be achievable. Therefore, this is an opportunity to document how many you think will be achievable at your site.)
Number of advanced nurse practicioners?	_____
Number of advanced clinical practitioners?	_____
Number of adult qualified EM nurses?	_____
Number of paediatric qualified EM nurses?	_____
Number of health care assistants (or equivalents)?	_____
Number of EM physician associates?	_____
Does your Consultant rota use self-rostering?	◯ Yes ◯ No
Does your Registrar rota use self-rostering?	◯ Yes ◯ No
Does your SHO rota use self-rostering?	◯ Yes ◯ No

What are the current vacancy rates for permanent staff in the following roles?

	0-10%	11-20%	21-30%	31-40%	41-50%	51-60%	61-70%	71-80%	81-90%	91-100 %
EM consultants	○	○	○	○	○	○	○	○	○	○
EM medical staff (excluding Consultants)	○	○	○	○	○	○	○	○	○	○
EM nursing staff	○	○	○	○	○	○	○	○	○	○
Non-medical staff	○	○	○	○	○	○	○	○	○	○
All staff	○	○	○	○	○	○	○	○	○	○

What percentage of patients were seen within 4 hours in April 2019? _____

What percentage of patients were seen within 4 hours in March 2019? _____

What percentage of patients were seen within 4 hours in February 2019? _____

What percentage of patients were seen within 4 hours in January 2019? _____

What percentage of patients were seen within 4 hours in December 2018 _____

What percentage of patients were seen within 4 hours in November 2018? _____

What are the current sickness rates for the following staff groups?

	0-1%	1-2%	2-3%	3-4%	4-5%	5-6%	6-7%	7-8%	8-9%	9-10%	>10%
EM Consultants	○	○	○	○	○	○	○	○	○	○	○
EM Medical Staff (excluding Consultants)	○	○	○	○	○	○	○	○	○	○	○
EM Nursing staff	○	○	○	○	○	○	○	○	○	○	○
Non-Medical Staff	○	○	○	○	○	○	○	○	○	○	○
All Staff	○	○	○	○	○	○	○	○	○	○	○

What is the Minimum Shift Length for the below groups of staff?

	6 hours	7 hours	8 hours	9 hours	10 hours	11 hours	12 hours	13 hours	N/A
EM Consultants	○	○	○	○	○	○	○	○	○
EM Trainees, ST4 and above	○	○	○	○	○	○	○	○	○
EM Non-training, ST4 and above	○	○	○	○	○	○	○	○	○
EM Trainees ST3	○	○	○	○	○	○	○	○	○
ACCS Trainees ST1-2	○	○	○	○	○	○	○	○	○
GP Trainees ST1-3	○	○	○	○	○	○	○	○	○
Clinical Fellows (FY1- ST3)	○	○	○	○	○	○	○	○	○
Clinical Fellows (>= ST4)	○	○	○	○	○	○	○	○	○
Fy2 Doctors	○	○	○	○	○	○	○	○	○
Fy1 Doctors	○	○	○	○	○	○	○	○	○

What is the maximum shift length for the following groups of staff

	6 hours	7 hours	8 hours	9 hours	10 hours	11 hours	12 hours	13 hours	>13 hours	N/A
EM Consultants	○	○	○	○	○	○	○	○	○	○
EM Trainees, ST4 and above	○	○	○	○	○	○	○	○	○	○
EM Non-trainees, ST4 and above	○	○	○	○	○	○	○	○	○	○
EM Trainees, ST3	○	○	○	○	○	○	○	○	○	○
ACCS Trainees ST1-2	○	○	○	○	○	○	○	○	○	○
GP Trainees, ST1-3	○	○	○	○	○	○	○	○	○	○
Clinical Fellows (FY1 - ST3)	○	○	○	○	○	○	○	○	○	○
Clinical Fellows (=>ST4)	○	○	○	○	○	○	○	○	○	○
Fy2 Doctors	○	○	○	○	○	○	○	○	○	○
Fy1 Doctors	○	○	○	○	○	○	○	○	○	○

How many hours are each of the shifts on your SHO rota?
(Select multiple if this changes depending on the shift)

	< 8 hours	8 hours	9 hours	10 hours	11 hours	12 hours	>12 hour
Day shift (week)	☐	☐	☐	☐	☐	☐	☐
Night shift (week)	☐	☐	☐	☐	☐	☐	☐
Twilight shift (week)	☐	☐	☐	☐	☐	☐	☐
Day shift (weekend)	☐	☐	☐	☐	☐	☐	☐
Night shift (weekend)	☐	☐	☐	☐	☐	☐	☐
Twilight shift (weekend)	☐	☐	☐	☐	☐	☐	☐

How many hours are each of the shifts on your registrar rota?
(Select multiple if this changes depending on the shift)

	< 8 hours	8 hours	9 hours	10 hours	11 hours	12 hours	>12 hour
Day shift (week)	☐	☐	☐	☐	☐	☐	☐
Night shift (week)	☐	☐	☐	☐	☐	☐	☐
Twilight shift (week)	☐	☐	☐	☐	☐	☐	☐
Day shift (weekend)	☐	☐	☐	☐	☐	☐	☐
Night shift (weekend)	☐	☐	☐	☐	☐	☐	☐
Twilight shift (weekend)	☐	☐	☐	☐	☐	☐	☐

How many hours are each of the shifts on your Consultant rota?

	< 8 hours	8 hours	9 hours	10 hours	11 hours	12 hours	>12 hour
Day shift (week)	◯	◯	◯	◯	◯	◯	◯
Night shift (week)	◯	◯	◯	◯	◯	◯	◯
Twilight shift (week)	◯	◯	◯	◯	◯	◯	◯
Day shift (weekend)	◯	◯	◯	◯	◯	◯	◯
Night shift (weekend)	◯	◯	◯	◯	◯	◯	◯
Twilight shift (weekend)	◯	◯	◯	◯	◯	◯	◯

Is there readily available rest facilities available for post night shifts?
◯ Yes
◯ No

Do people know how to access them?
◯ Yes
◯ No

Is there a break room available?
◯ Yes
◯ No

Online Supplementary Material 3
Table of Additional Participant Characteristics

Characteristic	N (%)	NFR Score	
		Median (95% CI) [1]	[LQ - UQ]
Maximum number of consecutive day shifts you would be scheduled to work			
0	30 (0.7)	63.6 (50.1 to 77.2)	[36.4 - 90.9]
1	42 (1.0)	59.1 (40.9 to 77.3)	[27.3 - 90.9]
2	217 (5.3)	63.6 (55.1 to 72.2)	[36.4 - 81.8]
3	522 (12.7)	63.6 (60.9 to 66.4)	[36.4 - 81.8]
4	788 (19.2)	63.6 (63.6 to 63.6)	[45.5 - 81.8]
5	1108 (27)	72.7 (70.0 to 75.5)	[45.5 - 81.8]
6	309 (7.5)	72.7 (66.9 to 78.6)	[54.5 - 90.9]
7	1094 (26.6)	72.7 (72.7 to 72.7)	[45.5 - 90.9]
Missing	137 (3.3)	72.7 (65.7 to 79.7)	[50.0 - 90.9]
Maximum number of consecutive Twilight shifts you would be scheduled to work			
0	339 (8.2)	54.5 (48.3 to 60.8)	[36.4 - 81.8]
1	341 (8.3)	60.0 (51.2 to 68.8)	[36.4 - 81.8]
2	496 (12.1)	54.5 (49.9 to 59.2)	[36.4 - 81.8]
3	796 (19.4)	63.6 (55.8 to 71.5)	[45.5 - 81.8]
4	1100 (26.7)	72.7 (69.9 to 75.5)	[45.5 - 90.9]
5	600 (14.6)	72.7 (72.1 to 73.4)	[54.5 - 90.9]
6	107 (2.6)	72.7 (67.6 to 77.8)	[54.5 - 90.9]
7	334 (8.1)	81.8 (74.4 to 89.3)	[54.5 - 90.9]
Missing	134 (3.3)	72.7 (67.3 to 78.1)	[54.5 - 90.9]
Maximum number of consecutive night shifts you would be scheduled to work			
0	1057 (25.6)	54.5 (52.0 to 57.1)	[27.3 – 80.0]
1	123 (3.0)	63.6 (53.2 to 74.0)	[36.4 - 90.9]
2	153 (3.7)	54.5 (44.7 to 64.4)	[45.5 - 81.8]
3	467 (11.3)	72.7 (65.6 to 79.9)	[45.5 - 90.9]
4	2188 (53.1)	72.7 (72.7 to 72.7)	[54.5 - 90.9]
5	64 (1.6)	72.7 (64.4 to 81.1)	[54.5 - 90.9]
6	6 (0.1)	54.5 (NA)	[45.5 - 81.8]
7	63 (1.5)	72.7 (64.4 to 81.1)	[54.5 - 90.9]
Missing	126 (3.1)	72.7 (67.4 to 78.0)	[54.5 - 90.9]
Maximum number of clinical shifts you work in a typical week?			
1	27 (0.7)	63.6 (45.2 to 82.0)	[45.5 - 90.9]
2	63 (1.5)	63.6 (49.2 to 78.1)	[36.4 - 81.8]

3	240 (5.9)	63.6 (58.1 to 69.2)	[36.4 - 81.8]
4	553 (13.5)	63.6 (54.9 to 72.3)	[36.4 - 81.8]
5	1074 (26.2)	63.6 (62.1 to 65.2)	[45.5 - 81.8]
6	858 (20.9)	72.7 (72.0 to 73.4)	[45.5 - 90.9]
7	1285 (31.3)	72.7 (72.7 to 72.7)	[45.5 - 90.9]
Missing	147 (3.6)	72.7 (67.1 to 78.3)	[45.5 - 90.9]
Non-clinical shifts past month			
0	1164 (28.3)	72.7 (72.7 to 72.7)	[54.5 - 90.9]
<1	394 (9.6)	72.7 (72.1 to 73.4)	[54.5 - 90.9]
1	525 (12.8)	72.7 (72.7 to 72.7)	[50.0 - 90.9]
2	527 (12.8)	63.6 (57.3 to 70.0)	[45.5 - 81.8]
3	242 (5.9)	63.6 (55.1 to 72.2)	[40.0 - 81.8]
4	525 (12.8)	60.0 (51.5 to 68.5)	[36.4 - 81.8]
5	115 (2.8)	54.5 (47.3 to 61.8)	[36.4 - 72.7]
6	124 (3.0)	54.5 (45.6 to 63.5)	[31.7 - 80.9]
7	39 (0.9)	63.6 (43.5 to 83.8)	[36.4 - 81.8]
8	157 (3.8)	54.5 (45.2 to 63.9)	[36.4 - 81.8]
9	19 (0.5)	60.0 (34.6 to 85.4)	[27.3 - 72.7]
10	102 (2.5)	54.5 (45.2 to 63.9)	[36.4 - 80.0]
11-15	86 (2.1)	54.5 (44.7 to 64.4)	[27.3 - 72.7]
>15	91 (2.2)	63.6 (47.6 to 79.7)	[27.3 - 81.8]
Missing	137 (3.3)	72.7 (66.6 to 78.9)	[54.5 - 90.9]
Average commute in minutes			
1-10	396 (9.6)	72.7 (64.2 to 81.3)	[45.5 - 81.8]
11-20	814 (19.8)	72.7 (64.6 to 80.9)	[45.5 – 90.0]
21-30	967 (23.5)	72.7 (64.6 to 80.8)	[45.5 - 90.9]
31-40	703 (17.1)	63.6 (63.6 to 63.6)	[36.4 - 81.8]
41-50	546 (13.3)	72.7 (64.5 to 81.0)	[45.5 - 90.9]
51-60	365 (8.9)	72.7 (67.6 to 77.8)	[45.5 – 90.0]
>60	325 (7.9)	72.7 (66.9 to 78.5)	[45.5 - 90.9]
Missing	131 (3.2)	72.7 (68.4 to 77.1)	[54.5 - 90.9]
Do you have a dedicated time away from adult emergency medicine?			
No	3091 (75.2)	72.7 (67.2 to 78.3)	[45.5 - 90.9]
Yes	1020 (24.8)	63.6 (62.2 to 65.1)	[36.4 - 81.8]
Missing	136 (3.3)	72.7 (67.7 to 77.8)	[45.5 - 90.9]

Frequency and percentage, median NFR score with 95% bootstrapped confidence intervals and the inter-quartile range of participants within each category.

[1] Bootstrapped 95% confidence intervals based on 1000 replications on a minimum of 8 observations.

Online Supplementary Material 4
Summary of median quantile regression model fitted to the Need for Recovery (NFR) score with fixed effects for site, including the adjusted coefficient estimate (Adj. Coef. Est.) with corresponding 95% confidence interval (CI) and p-value.

	Adj. Coeff. Est. (95% CI)	P-value[1]
Constant (baseline NFR score)	59.51 (55.53 to 63.49)	< 0.001
Gender (baseline = Male)		
• Female	3.38 (1.80 to 4.95)	< 0.001
• Other/Prefer not to say	-0.10 (-7.84 to 7.64)	0.979
Any long-term health conditions or disabilities (baseline = No)		
• Yes	8.33 (5.73 to 10.93)	< 0.001
• Prefer not to say	6.10 (1.78 to 10.43)	0.006
ED paediatrics only? (baseline = No)		
• Yes	-8.47 (-12.97 to -3.98)	< 0.001
Clinical grade (baseline = Foundation)		
• ST1-ST2	-0.20 (-2.55 to 2.16)	0.869
• > ST2	1.04 (-1.49 to 3.57)	0.421
• SASG	-1.20 (-4.32 to 1.92)	0.450
• GP	-7.33 (-15.49 to 0.83)	0.078
• Consultant	-4.94 (-7.72 to -2.17)	< 0.001
I have been able to request and take study when I wanted (baseline = Neutral)		
• Strongly disagree	3.45 (-0.19 to 7.10)	0.063
• Disagree	3.57 (0.53 to 6.61)	0.022
• Agree	-1.18 (-3.36 to 1.00)	0.290
• Strongly agree	-6.32 (-9.23 to -3.41)	< 0.001
I have been able to request and take annual when I wanted (baseline = Neutral)		
• Strongly disagree	6.42 (2.69 to 10.15)	0.001
• Disagree	1.37 (-1.73 to 4.47)	0.385
• Agree	-2.60 (-5.07 to -0.13)	0.039
• Strongly agree	-4.31 (-7.33 to -1.28)	0.005
Proportion of time spent working out of hours (baseline = 0-25%)		
• 26-50%	5.96 (3.16 to 8.76)	< 0.001
• 51-75%	10.39 (7.54 to 13.25)	< 0.001
• 76-100%	14.34 (10.92 to 17.75)	< 0.001

Need for recovery amongst Emergency Physicians in the United Kingdom and Ireland: Findings from a Trainee Emergency Research Network (TERN) survey study

Research Checklist: The Checklist for Reporting Results of Internet E-Surveys (CHERRIES)

CHERRIES CHECKLIST ADAPTED FROM: Eysenbach, Gunther. "Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES)." *Journal of medical Internet research* vol. 6,3 e34. 29 Sep. 2004, doi:10.2196/jmir.6.3.e34			
Item Category	***Checklist Item***	***Explanation***	***Checklist Response***
Design	Describe survey design	Describe target population, sample frame. Is the sample a convenience sample? (In "open" surveys this is most likely.)	***Outlined in 'Methods'***
IRB (Institutional Review Board) approval and informed consent process	IRB approval	Mention whether the study has been approved by an IRB.	***Outlined in 'Ethics Approval'***
	Informed consent	Describe the informed consent process. Where were the participants told the length of time of the survey, which data were stored and where and for how long, who the investigator was, and the purpose of the study?	***Outlined in Survey Distribution, monitoring and recruitment***
	Data protection	If any personal information was collected or stored, describe what mechanisms were used to protect unauthorized access.	***Outlined in Survey Distribution, monitoring and recruitment***
Development and pre-testing	Development and testing	State how the survey was developed, including whether the usability and technical functionality of the electronic questionnaire had been tested before fielding the questionnaire.	***Outlined in 'Survey Development'***
Recruitment process and description of the sample having access to the questionnaire	Open survey versus closed survey	An "open survey" is a survey open for each visitor of a site, while a closed survey is only open to a sample which the investigator knows (password-protected survey).	***Outlined in Survey Distribution, monitoring and recruitment***
	Contact mode	Indicate whether or not the initial contact with the potential participants was made on the Internet. (Investigators may also send out questionnaires by mail and allow for Web-based data entry.)	***Outlined in 'Survey Distribution, monitoring and recruitment'***
	Advertising the survey	How/where was the survey announced or advertised? Some examples are offline media (newspapers), or online (mailing lists – If yes, which ones?) or banner ads (Where were these banner ads posted and what did they look like?). It is important to know the wording of the announcement as it will heavily influence who chooses to participate. Ideally the survey	***Outlined in 'Survey Distribution, monitoring and recruitment'***

		announcement should be published as an appendix.	
Survey administration	Web/E-mail	State the type of e-survey (eg, one posted on a Web site, or one sent out through e-mail). If it is an e-mail survey, were the responses entered manually into a database, or was there an automatic method for capturing responses?	***Outlined in 'Survey Distribution, monitoring and recruitment'***
	Context	Describe the Web site (for mailing list/newsgroup) in which the survey was posted. What is the Web site about, who is visiting it, what are visitors normally looking for? Discuss to what degree the content of the Web site could pre-select the sample or influence the results. For example, a survey about vaccination on a anti-immunization Web site will have different results from a Web survey conducted on a government Web site	***Outlined in 'Design'***
	Mandatory/voluntary	Was it a mandatory survey to be filled in by every visitor who wanted to enter the Web site, or was it a voluntary survey?	***Outlined in 'Survey Distribution, monitoring and recruitment'***
	Incentives	Were any incentives offered (eg, monetary, prizes, or non-monetary incentives such as an offer to provide the survey results)?	***No***
	Time/Date	In what timeframe were the data collected?	***Outlined in 'Sites and settings'***
	Randomization of items or questionnaires	To prevent biases items can be randomized or alternated.	***Not done***
	Adaptive questioning	Use adaptive questioning (certain items, or only conditionally displayed based on responses to other items) to reduce number and complexity of the questions	***Outlined in Survey Distribution, monitoring and recruitment***
	Number of Items	What was the number of questionnaire items per page? The number of items is an important factor for the completion rate.	***Outlined in 'Design'***
	Number of screens (pages)	Over how many pages was the questionnaire distributed? The number of items is an important factor for the completion rate.	***Outlined in 'Design'***
	Completeness check	It is technically possible to do consistency or completeness checks before the questionnaire is submitted. Was this done, and if "yes", how (usually JAVAScript)? An alternative is to check for completeness after the questionnaire has been submitted (and highlight mandatory items). If this has been done, it should be reported. All items should provide a non-response option such as "not applicable" or	***Not done***

		"rather not say", and selection of one response option should be enforced.	
	Review step	State whether respondents were able to review and change their answers (eg, through a Back button or a Review step which displays a summary of the responses and asks the respondents if they are correct).	***Outlined in Survey Distribution, monitoring and recruitment***
Response rates			
	Unique site visitor	If you provide view rates or participation rates, you need to define how you determined a unique visitor. There are different techniques available, based on IP addresses or cookies or both.	***Outlined in 'Results'***
	View rate (Ratio of unique survey visitors/unique site visitors)	Requires counting unique visitors to the first page of the survey, divided by the number of unique site visitors (not page views!). It is not unusual to have view rates of less than 0.1 % if the survey is voluntary	***Survey site contains first page of survey therefore N/A***
	Participation rate (Ratio of unique visitors who agreed to participate/unique first survey page visitors)	Count the unique number of people who filled in the first survey page (or agreed to participate, for example by checking a checkbox), divided by visitors who visit the first page of the survey (or the informed consents page, if present). This can also be called "recruitment" rate.	***Outlined in 'Results'***
	Completion rate (Ratio of users who finished the survey/users who agreed to participate)	The number of people submitting the last questionnaire page, divided by the number of people who agreed to participate (or submitted the first survey page). This is only relevant if there is a separate "informed consent" page or if the survey goes over several pages. This is a measure for attrition. Note that "completion" can involve leaving questionnaire items blank. This is not a measure for how completely questionnaires were filled in. (If you need a measure for this, use the word "completeness rate".)	***Outlined in 'Results'***
Preventing multiple entries from the same individual	Cookies used	Indicate whether cookies were used to assign a unique user identifier to each client computer. If so, mention the page on which the cookie was set and read, and how long the cookie was valid. Were duplicate entries avoided by preventing users access to the survey twice; or were duplicate database entries having the same user ID eliminated before analysis? In the latter case, which entries were kept for analysis (eg, the first entry or the most recent)?	***Not used***
	IP check	Indicate whether the IP address of the client computer was used to identify potential duplicate entries from the same user. If so, mention the period of	***Not used due to survey being completed on multi-user/single log-in computers***

		time for which no two entries from the same IP address were allowed (eg, 24 hours). Were duplicate entries avoided by preventing users with the same IP address access to the survey twice; or were duplicate database entries having the same IP address within a given period of time eliminated before analysis? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	
	Log file analysis	Indicate whether other techniques to analyze the log file for identification of multiple entries were used. If so, please describe.	***Not done***
	Registration	In "closed" (non-open) surveys, users need to login first and it is easier to prevent duplicate entries from the same user. Describe how this was done. For example, was the survey never displayed a second time once the user had filled it in, or was the username stored together with the survey results and later eliminated? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	***N/A***
Analysis	Handling of incomplete questionnaires	Were only completed questionnaires analyzed? Were questionnaires which terminated early (where, for example, users did not go through all questionnaire pages) also analyzed?	***Outlined in 'Data Analysis'***
	Questionnaires submitted with an atypical timestamp	Some investigators may measure the time people needed to fill in a questionnaire and exclude questionnaires that were submitted too soon. Specify the timeframe that was used as a cut-off point, and describe how this point was determined	***N/A***
	Statistical correction	Indicate whether any methods such as weighting of items or propensity scores have been used to adjust for the non-representative sample; if so, please describe the methods.	***Outlined in 'Data Analysis'***

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Need for recovery amongst Emergency Physicians in the United Kingdom and Ireland: a cross-sectional survey

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Need for recovery amongst Emergency Physicians in the United Kingdom and Ireland: a cross-sectional survey

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ABSTRACT

Objectives: To determine the need for recovery (NFR) among Emergency Physicians and to identify demographic and occupational characteristics associated with higher NFR scores.

Design: Cross-sectional electronic survey.

Setting: Emergency Departments (ED) (n=112) in the United Kingdom and Ireland.

Participants: Emergency Physicians, defined as any registered physician working principally within the ED, responding between June-July 2019.

Main outcome measure: NFR scale, an 11-item self-administered questionnaire that assesses how work demands affect inter-shift recovery.

Results: The median NFR score for all 4247 eligible, consented participants with a valid NFR score was 70.0 (95% CI: 65.5 to 74.5), with an IQR of 45.5–90.0. A linear regression model indicated statistically significant associations between gender, health conditions, type of ED, clinical grade, access to annual and study leave, and time spent working out-of-hours. Groups including male physicians, consultants, General Practitioners within the ED, those working in paediatric EDs and those with no long-term health condition or disability had a lower NFR score. After adjusting for these characteristics, the NFR score increased by 3.7 (95% CI: 0.3 to 7.1) and 6.43 (95% CI: 2.0 to 10.8) for those with difficulty accessing annual and study leave, respectively. Increased percentage of out-of-hours work increased NFR score almost linearly: 26-50% out-of-hours work = 5.7 (95% CI: 3.1 to 8.4); 51-75% out-of-hours work = 10.3 (95% CI: 7.6 to 13.0); 76-100% out-of-hours work = 14.5 (95% CI: 11.0 to 17.9).

Conclusion: Higher NFR scores were observed among Emergency Physicians than reported in any other profession or population to date. Whilst out-of-hours working is unavoidable, the linear relationship observed suggests that any reduction may result in NFR improvement. Evidence-based strategies to improve well-being such as proportional out-of-hours working and improved access to annual and study leave should be carefully considered and implemented where feasible.

ARTICLE SUMMARY

Strengths and limitations of this study

- This is the first study evaluating the need for recovery (NFR) scale within a large healthcare population.

- The inclusion of responses from over half of all UK Emergency Departments indicates the results are likely to be generalisable.

- The high volume of responses, with over half of study sites exceeding 70% participant response rates, indicates that the NFR scale is an acceptable measurement tool for physicians.

- The study is limited by the single-point of time measurement therefore seasonal bias cannot be excluded and further assessment of test-retest reliability is desirable.

- The use of self-administered dichotomous questionnaires is acknowledged to limit wider insights into physician recovery and well-being.

INTRODUCTION

Recruitment and retention challenges in acute care pose a significant and ongoing threat to effective healthcare provision. The need to maintain a healthy and sustainable workforce is vital to safeguard future services.[1] Physician well-being is a key influence on retention, with low job satisfaction and high levels of stress directly leading to concern over job sustainability.[2–4] Globally, high rates of physician burnout are increasingly recognised, along with the consequent negative impact on delivery of high quality patient care.[5–10]

The Need for Recovery (NFR) scale measures the subjective perception of the need to recuperate from physical and mental demands of a working day, and is a suitable tool with which to assess the early symptoms of fatigue in shift workers.[11,12] Within unscheduled care settings such as emergency medicine, shift work is often of high intensity, and additional factors such as department crowding, pressured resources and inability to control patient volume may also influence NFR. Where fatigue does occur and cannot be sufficiently recovered between shifts, the effect is cumulative and may lead to increased occupational stress and impaired long-term health.[13,14]

Burnout inventories are increasingly utilised as an attempt to measure physician well-being.[15] Although they provide valuable insight into well-being, they are not without issue. Limitations include variability in burnout definitions, time required for completion, ease of completion, respondent survey fatigue, and difficulty translating results into intervention.[16,17,18] Additionally, these methods quantify established burnout; once this has occurred the human and financial resource impact is already immense, with

associated workforce depletion and negligible mitigation strategies.[19,20] The identification of those clinicians *at risk* of burnout, at an early timepoint when interventions may be effective, presents a critical challenge.

Increasing NFR is associated with the likelihood of progression to occupational burnout and health complaints, with negative effects cumulative over time in several validation studies [11,13]. Increased NFR may therefore precede the onset of sustained occupational burnout, and offer advantages over other burnout inventories as a simple quantifiable metric obtained through a rapid, standalone, and repeatable 11-item questionnaire. A single centre study assessing the utility of the NFR in an ED population reported a high response rate (80%) and completion time of less than 10 minutes whilst gaining insight into shift patterns, work-life balance and well-being (21). This might suggest that the method of questioning used in the NFR scale and emphasis on recovery as opposed to more emotive questioning could be beneficial in improving response rates and reducing respondent fatigue in repeat usage. As such, NFR may provide a valuable option for regular evaluating of staff well-being and identifying opportunity for early intervention in busy EDs. Staff well-being is the fourth highest Emergency Medicine (EM) Research Priority identified by the James Lind Alliance Priority Setting Partnership, involving patients, carers and physicians.[22].

We therefore aimed to determine the NFR among Emergency Physicians in EDs in the UK and Ireland, and identify demographic and occupational characteristics associated with higher NFR scores that might

allow for early targeted intervention to improve physicians' well-being and reduce burnout.

METHODS

This cross-sectional electronic survey study targeted a representative sample of Emergency Physicians working across the UK and Ireland, and was performed and reported in line with the Checklist for Reporting Results of Internet E-surveys.[23] The study was registered at ISRCTN (https://doi.org/10.1186/ISRCTN21869845). Ethical approval was obtained from the UK Health Research Authority (Reference: 19/HRA/2404) alongside equivalent approvals in Scotland, Northern Ireland and Ireland.

Settings and Participants

An initial sample of 100 EDs was deemed necessary to ensure inclusion of greater than 50% of Type 1 EDs, defined as 'an EM consultant-led 24-hour service with full resuscitation facilities', in England. [24] The study was coordinated via the UK Trainee Emergency Research Network (TERN) and delivered in collaboration with Paediatric Emergency Research in the UK and Ireland (PERUKI) and Ireland TERN. [25, 26] Signposting to the survey and enrolment of participants was led by site principal investigators (PI), who were provided with standardised study documentation. Local and national promotion of the study was conducted at professional meetings, through social media, national newsletters, and using the Clinical Research Network infrastructure.

Physicians of any grade who were registered with either the UK General Medical Council or Irish Medical Council, and who were employed within a

participating ED, were invited to participate. For the purposes of this study, the term Emergency Physician is defined as all doctors working within the ED. This included; doctors specialising in EM, comprising six years of postgraduate training for full qualification to achieve the grade of Emergency Medicine consultant, or non-EM specialists undertaking rotations in the ED as part of their professional training, including those in the first and second year of postgraduate training and physicians undertaking training in General Practice, Anaesthesia and Acute Medicine who commonly undertake a four to six month ED rotation (Online Supplementary Material 1). Physicians who did not hold a permanent contract with a participating hospital (such as those working ad-hoc locum shifts), those on leave during the study period, and those in a non-clinical role were excluded.

Survey Development

The NFR scale consists of 11 items each requiring a dichotomous 'yes' or 'no' response, originally developed as a subscale of the Dutch Questionnaire on the Experience and Evaluation of Work (QEEW) (Online Supplementary material 2, page 10).[27] Indicators of fatigue such as reduced motivation for activities and concentration at the end of a working day are assessed to measure the effect of work demands experienced. A 'yes' response to an item, with the exception of question four which is reversed, signals an unfavourable situation. The 11 items are then summated to give an overall score between 0 and 100, with a higher score denoting a greater NFR and increased short-term work-related fatigue. The NFR has previously been demonstrated to have an overall Cronbach's alpha of 0.88, a measure of internal consistency and questionnaire reliability, with a range of 0.81 to 0.92 in subgroup analyses of the same

validation study.[28] Following a minor amendment to one question to increase applicability to the study population (from 'After the evening meal, I generally feel in good shape' to 'After my breaks I feel fresh to continue my work'), feasibility work in a single UK centre demonstrated a Cronbach's alpha of 0.79, and found that the NFR scale was acceptable and user-friendly. [21]

A patient and public involvement (PPI) consultation was conducted at the UK Emergency Medicine Trainee Association Conference (Cardiff, December 2018), using a semi-structured question guide for mixed focus groups to review a proposed participant survey. A key element of this consultation explored the use of a burnout inventory within the proposed study; concerns relating to respondent fatigue, length of survey and assessment of questions using a Likert scale indicated that such an inventory was not universally acceptable to Emergency Physicians. Based on this consultation, the final participant survey included the 11-item NFR scale used in the feasibility work and 44-items collecting the participants' demographic, occupational and perceived well-being characteristics (Online Supplementary Material 2). Questions relating to 'out-of-hours' work were defined as work outside of normal working office hours (9am until 5pm, Monday to Friday).

A separate site-specific survey was developed de novo with expert input from experienced EM physicians, consisting of 39-items identified from the literature and/or consensus of the study team, which explored departmental, rota pattern and staffing characteristics likely to provide context for analysis and interpretation of individual survey results (Online Supplementary Material 3). Only one site-specific survey was required per participating centre and was completed by the site PI.

Survey Distribution, monitoring and recruitment

All participants were provided with an information sheet, and consented to participation prior to completing the survey; this was voluntary, anonymous, and no incentives were given. Respondents were able to review and change their answers prior to final submission of the survey. Branching logic was used for responses to certain questions. Data were collected during a six-week period from 3rd June 2019. During this period, advertisement of the survey and weekly reminders were sent out via site PIs. The participant and site-specific surveys were open surveys accessed through a link and hosted on a research specific electronic survey platform, Research Electronic Data Capture platform ('REDCap'; University of Bristol), which complies with European General Data Protection Regulations.[29,30]

Prior to study commencement, site PIs provided a best estimate of eligible participants which accounted for local physician absence due to sickness, leave, and factors such as sabbaticals and professional secondments. This denominator was used to give a best-estimate of the per-site survey response rate, with a stated aim of achieving a 70% response rate.

Statistical Analysis

Statistical analysis was undertaken using STATA 14. [31] Participants were only included in any of the reported analyses if they were from one of the 112 registered sites and provided a response for at least eight of the 11 items of the NFR scale as per imputation guidelines. Imputation was performed by replacing missing items with the mean of all completed item responses. [32]

As one item in the NFR scale was amended due to applicability to the study population, the internal consistency of the NFR scale for all participants with a valid NFR score was calculated by Cronbach's alpha.

To describe the study sample, the frequency and percentage of participants by site, demographic and occupational characteristics are reported. As the distribution of the NFR score in this study was negatively skewed, summary statistics of the median NFR score are reported with corresponding bootstrapped 95% confidence intervals from 1000 replications (providing there are at least 8 observations to allow for sufficient number of sample combinations), and inter-quartile ranges (IQR) of all eligible participants. Box plots were used as visual aids to identify covariates that may have a statistically significant association with the NFR score and the nature of the relationship.

To facilitate comparisons with previous published literature and given the large number of participants, we fitted Gaussian, mixed effects, linear regression models to NFR score, where site was included as a random effect to account for potentially unknown differences between EDs. To identify statistically significant associations between the NFR score and observed covariates, the forward model selection procedure was implemented; inclusion in the model was based upon the goodness of fit test at the 5% level of significance, using only participants with complete NFR score and covariate data. The final model was estimated using participants with complete data for the included covariates and NFR score, with the coefficient estimate calculated by adjusting for all covariates reported in the model. Quantile regression was used to confirm the direction and significance of the identified associations under non-parametric assumptions.

RESULTS

Characteristics of the 112 participating sites are presented in table 1.

Table 1: Characteristics of sites registered to take part in the survey study

Site Characteristics	N (%) Total = 112
Country	
England	89 (79.5)
Wales	3 (2.7)
Northern Ireland	3 (2.7)
Scotland	12 (10.7)
Republic of Ireland	5 (4.4)
ED Annual Attendance	
≤ 50,000	11 (9.8)
50,001 to 100,000	46 (41.1)
>100,000	42 (37.5)
Missing	*13 (11.6)*
Specialist Designation	
Trauma Unit (TU)	55 (49.1)
Major Trauma Centre (MTC)	25 (22.3)
Stroke Centre	42 (37.5)
PCI Centre	30 (26.8)

ED Emergency department
TU In the UK National Health Service, a hospital that provides care for all except the most severe major trauma patients. May provide initial stabilisation of severely injured patients prior to transfer to an MTC.
MTC A specialist (tertiary) centre responsible for care of the most severely injured patients.
PCI Percutaneous Coronary Intervention

Of 5107 unique visits to the online survey, 4365 of these were registered at one of the 112 sites and provided consent, with 4247 completing at least eight items of the NFR scale. Cronbach's alpha for all participants with a valid NFR score

was 0.80. The median NFR score across all eligible participants was 70.0 (95% CI: 65.5 to 74.5), with an IQR of 45.5 – 90.0. Figure 1 and Figure 2, and tables 2 and 3 present a selection of participant's NFR score by demographic and occupational characteristics, with additional characteristics presented in the Online Supplementary Material 4.

Table 2: Summary statistics of NFR score by participant's characteristics. Frequency and percentage, median Need for Recovery (NFR) score with 95% bootstrapped confidence intervals and the inter-quartile range of participants within each category.

Participant Characteristics	N (%)	NFR Score	
		Median (95% CI)	[LQ - UQ]
All participants	4247 (100)	70.0 (62.0 to 78.0)	[45.5 - 90.0]
Length of time worked in current ED (months)			
0 to 3	740 (17.5)	72.7 (71.7 to 73.8)	[45.5 - 90.9]
> 3 to 6	848 (20.0)	72.7 (72.7 to 72.7)	[54.5 - 90.9]
> 6 to 12	729 (17.2)	72.7 (64.7 to 80.7)	[45.5 - 90.9]
> 12 to 24	370 (8.7)	63.6 (58.8 to 68.4)	[45.5 - 90.9]
> 24 to 60	583 (13.8)	63.6 (62.2 to 65.1)	[36.4 - 81.8]
> 60 to 120	497 (11.7)	63.6 (56.7 to 70.5)	[36.4 - 81.8]
> 120	473 (11.2)	54.5 (46.6 to 62.5)	[36.4 - 81.8]
Missing	*7 (0.2)*	*18.2 (NA)* [1]	*[9.1 - 54.5]*
Type of contract			
100%	3445 (83.5)	72.7 (67.1 to 78.4)	[45.5 - 90.9]
90%	72 (1.7)	63.6 (54.0 to 73.3)	[36.4 - 81.8]
80%	200 (4.8)	63.6 (61.4 to 65.8)	[45.5 - 81.8]
70%	116 (2.8)	72.7 (63.6 to 81.9)	[50.0 - 81.8]
60%	142 (3.4)	63.6 (54.4 to 72.9)	[45.5 - 90.9]
50%	85 (2.1)	63.6 (53.5 to 73.7)	[36.4 - 81.8]
< 50%	66 (1.6)	50.0 (35.7 to 64.3)	[27.3 - 81.8]
Missing	*121 (2.9)*	*72.7 (67.8 to 77.7)*	*[54.5 - 90.9]*
Significant caring responsibilities outside of work			
No	2616 (63.6)	72.7 (68.5 to 77.0)	[45.5 - 90.9]
Yes	1427 (34.7)	63.6 (62.8 to 64.5)	[36.4 - 81.8]
Prefer not to say	73 (1.8)	81.8 (71.0 to 92.7)	[54.5 - 90.9]
Missing	*131 (3.2)*	*72.7 (68.2 to 77.3)*	*[54.5 - 90.9]*

[1] *Insufficient observations for Bootstrapped 95% confidence intervals based*

Table 3: Summary statistics of NFR score by occupational characteristics. Frequency and percentage, median Need for Recovery (NFR) score with 95% bootstrapped confidence intervals and the inter-quartile range of participants within each category.

Occupational	N (%)	NFR Score

Characteristics		Median (95% CI) [1]	[LQ - UQ]
All participants	4247 (100)	70.0 (62.0 to 78.0)	[45.5 - 90.0]
scheduled weekend work frequency			
1 in 2	1479 (36.0)	72.7 (72.3 to 73.2)	[54.5 - 90.9]
1 in 3	865 (21.1)	72.7 (68.1 to 77.4)	[45.5 - 90.9]
1 in 4	542 (13.2)	63.6 (57.1 to 70.2)	[45.5 - 81.8]
1 in 5	310 (7.5)	54.5 (48.4 to 60.7)	[36.4 - 81.8]
1 in 6	485 (11.8)	54.5 (49.8 to 59.3)	[27.3 - 81.8]
< 1 in 6	307 (7.5)	63.6 (55.2 to 72.1)	[36.4 - 81.8]
None	121 (2.9)	54.5 (45.7 to 63.4)	[27.3 - 81.8]
Missing	*138 (3.4)*	*72.7 (65.9 to 79.6)*	*[45.5 - 90.9]*
Maximum number of consecutive clinical shifts scheduled to work			
1	52 (1.3)	63.6 (45.1 to 82.2)	[27.3 - 90.9]
2	190 (4.6)	54.5 (47.6 to 61.5)	[27.3 - 72.7]
3	465 (11.3)	63.6 (60.3 to 67.0)	[36.4 - 81.8]
4	783 (19)	63.6 (63.0 to 64.3)	[45.5 - 81.8]
5	827 (20.1)	72.7 (66.2 to 79.3)	[45.5 - 81.8]
6	389 (9.5)	72.7 (67.3 to 78.2)	[45.5 - 90.0]
7	855 (20.8)	72.7 (70.8 to 74.6)	[45.5 - 90.9]
8	554 (13.5)	72.7 (66.5 to 78.9)	[54.5 - 90.9]
Missing	*132 (3.2)*	*72.7 (67.9 to 77.6)*	*[54.5 - 90.9]*

[1] Bootstrapped 95% confidence intervals based on 1000 replications on a minimum of 8 observations.

Only 7.5% of the participants were aged over 50 years, and the majority were aged between 26 and 30 years (28.6%). NFR score appeared to decrease with age, such that those in age groups 20 to 35 years all had a median score of 72.7, age groups 36 to 55 had a median score of 63.6, and those over 55 years had a median score of 54.5 (figure 1a). There was a reasonable balance between males and females, with just over 1% who did not submit a response (missing), preferred not to say or other. Females had a higher median NFR score of 72.7 (95% CI: 70.5 to 75.0) compared with males 63.6 (95% CI: 60.8 to 66.5) (figure 1b). Within clinical grade, consultants accounted for over a quarter of the participants who (with GPs) had the lowest median NFR score of 54.5 (consultants 95% CI: 53.6 to 55.5) compared with 72.7 in all other grades (figure 1c). The majority of participants had no long-term health conditions or

disability (88.6%), with a lower NFR score of 63.6 (95% CI 60.2 to 67.1) compared with those who did report a long-term health condition or disability 72.7 (95% CI: 66.2 to 79.2) (figure 1d). Most participants worked full time (83.5%), but overall, the NFR score did not decrease as contract proportion decreased (table 2). Over half (54.6%) had been working in their current ED for 1 year or less and generally had higher NFR scores compared to those present for over 1 year. Less than 35% of participants declared significant caring responsibilities outside of work, but those who do had a lower median NFR score (63.6, 95% CI: 62.8 to 64.5) than those who did not (72.7, 95% CI: 68.5 to 77.0).

Most of the participants agreed or strongly agreed they were able to obtain study or annual leave when requested (68% and >73%, respectively). As the ability to obtain study and annual leave on request increased, the NFR score decreased from 81.8 (95% CI: 81.4 to 82.2) to 54.5 (95% CI: 49.4 to 59.7) for study leave and 81.8 (95% CI: 76.4 to 87.2) to 60.0 (95% CI: 51.8 to 68.2) for annual leave (figures 2a and 2b). There was evidence the NFR score increased as the proportion of time working out-of-hours increased, from 54.5 (95% CI: 47.8 to 61.3) to 81.8 (95% CI: 75.4 to 88.3) (figure 2c). Over 75% of participants spent the majority of their time in adult EM with a median NFR score of 72.7 for mixed or adult only, which was higher when compared with paediatrics only 63.6 (95% CI: 55.2 to 72.1) (figure 2d). Most participants worked 1 in 2 weekends (36%) with a median NFR score of 72.7, which decreased to 54.5 for those who did not work any weekend shifts (see table 3). Over 50% reported working 5 to 8 consecutive clinical shifts and had a median

NFR score of 72.7, compared with those who worked less than five who had a median NFR ≤ 63.6.

The summary statistics of the final regression model are presented in table 4.

Table 4: Summary of final Gaussian, mixed effects, linear regression model fitted to the Need for Recovery (NFR) score, including the adjusted coefficient estimate (Adj. Coef. Est.) with corresponding 95% confidence interval (CI) and p-value.

	Adj. Coeff. Est. (95% CI)[1]	P-value[2]
Constant (baseline NFR score)	59.51(55.53 to 63.49)	< 0.001
Gender (baseline = Male)		
• Female	3.40(1.80 to 4.99)	< 0.001
• Other/Prefer not to say	-0.46(-9.07 to 8.15)	0.916
Any long-term health conditions or disabilities (baseline = No)		
• Yes	8.52(5.67 to 11.36)	< 0.001
• Prefer not to say	6.24(1.52 to 10.95)	0.01
ED paediatrics only? (baseline = No)		
• Yes	-7.08(-10.4 to -3.77)	< 0.001
Clinical grade (baseline = Foundation)		
• ST1-ST2	-0.08(-2.67 to 2.51)	0.953
• > ST2	1.32(-1.37 to 4.01)	0.336
• SASG	-1.13(-4.27 to 2.02)	0.482
• GP	-8.26(-15.09 to -1.44)	0.018
• Consultant	-5.30(-8.07 to -2.53)	< 0.001
I have been able to request and take study when I wanted (baseline = Neutral)		
• Strongly disagree	4.23(-0.26 to 8.71)	0.065
• Disagree	3.72(0.29 to 7.15)	0.034
• Agree	-1.32(-3.60 to 0.96)	0.257
• Strongly agree	-6.50(-9.43 to -3.56)	< 0.001
I have been able to request and take annual when I wanted (baseline = Neutral)		
• Strongly disagree	6.43(2.03 to 10.83)	0.004
• Disagree	1.13(-2.34 to 4.61)	0.523
• Agree	-2.84(-5.54 to -0.14)	0.039
• Strongly agree	-4.89(-8.06 to -1.72)	0.002
Proportion of time spent working out-of-hours (baseline = 0-25%)		
• 26-50%	5.74(3.13 to 8.35)	< 0.001

• 51-75%	10.32(7.60 to 13.03)	< 0.001
• 76-100%	14.45(10.97 to 17.92)	< 0.001

[1] Each coefficient estimate is adjusted for all other covariates in the model

[2] Null hypothesis: Adjusted Coefficient Estimate = 0 (i.e. is there statistically significant evidence this category differs from the baseline category)

ST1-ST2 *Specialist training year 1-2 (this included physicians training in Anaesthetics, Emergency Medicine, Acute Medicine and General Practice)*
SASG *Staff grade, associate specialist and speciality grade*
GP *General Practitioner working within the ED*

This model was based on 3979 participants with complete data for all the included covariates. Quantile regression confirmed the direction and significance of the associations remained the same (Online Supplementary Material 5). Each covariate was adjusted for all other statistically significant associations. The results from this model indicated there were statistically significant associations between gender, health conditions, type of ED (adult or paediatric), clinical grade, access to annual and study leave, and time spent working out-of-hours. The model suggested that males, GPs or consultants, those working in paediatrics and those with no long-term health condition or disability had the lowest NFR score. The greatest increase in NFR score was associated with those who reported more than a 75% proportion of out-of-hours work (14.45: 95% CI 10.97 to 17.92). If participants strongly agreed they were able to obtain study leave upon request this reduced their NFR score by 6.5 (95% CI: 3.56 to 9.43) and annual leave could reduce their NFR score 4.89 (95% CI 1.72 to 8.06).

DISCUSSION

Emergency Physicians in the UK and Ireland have a higher NFR score than has been reported in any previously studied population.[11,33–37] Three

modifiable occupational factors were significantly associated with higher NFR scores (poor access to annual leave, and study leave, and proportion of out-of-hours work), and four further non-modifiable demographic factors were associated with a decreased NFR score. These were the senior grade of EM consultant, male gender, absence of long-term health condition or disability, and working in a paediatric only ED.

The NFR median score of 70 found in this study compares unfavourably with multiple occupational groups and baseline population data from a large Dutch validation study, [37] where the highest frequency of responses were observed at the lower end of the scale. Previous measurement in shift workers (including hospital nurses) showed significantly lower NFR scores, [13,33] as did studies of heavy goods vehicle drivers and merchant seafarers, all with average NFR scores in the range 36-44.[35,36]. Our findings are however congruent with our own feasibility work completed in a single centre UK ED, reporting a median NFR of 81.8 in all staff groups. [21] The impact of rising patient numbers and overcrowding in UK and Ireland EDs is commonly reported, [39] but our findings are the first to illustrate the impact of high work demand on physician's need to recuperate from work and the modifiable factors which can mitigate this fatigue.

The three modifiable occupational factors represent areas of autonomy and control, correlating well with previous work establishing these as core drivers to minimise physician workplace stress and ensure well-being. [2,40,41] Prioritising change in these domains may result in NFR score reduction and reduce negative effects on health and well-being, including occupational

burnout. Whilst out-of-hours working is inherent and unavoidable in EM, the linear relationship we observed suggests that any reduction may result in direct improvements in NFR, and evidence-based strategies such as proportional control of out-of-hours working, annualised rota patterns and/or provision of rest facilities should therefore be considered urgently.[42–44]

As NFR does not change with seniority prior to consultant level, this indicates that factors that could be postulated to influence work stress in postgraduate training such as increased responsibility, management roles and experience, appear to have a limited influence on NFR. It is therefore possible that the reduction in NFR seen in those at consultant level supports the hypothesis that broader perceptions of job autonomy and control, may be explicitly linked to well-being in healthcare.[2,44] This correlates with our finding that poor access to study and annual leave increases NFR, likely to be more accessible at a senior level. Further areas merit exploration including the link to out-of-hours working, influence of night and day shift proportions and possible qualitative enquiry of personal experience and clinical performance.

The relationship observed between gender and NFR is likely to be overly simplistic requiring further evaluation. Presumed confounding variables affecting this issue (such as a primary carer role and domestic responsibilities) have been previously reported to be unrelated or protective against maladaptive fatigue and are supported with findings from this study. [45]

Awareness of the four demographic factors identified could be important at a departmental planning level and increase advocacy for colleagues at greatest risk of impaired well-being.

The main strength of our study is inclusion of responses from over half of all UK EDs, enhancing generalisability of our findings.[38] The high volume of responses indicate the NFR scale as an 11-item survey, is an acceptable measure for physicians, with over half of sites exceeding 70% response rates. A key weakness is the single-point-of-time measurement, as seasonal bias may have affected NFR scores. Furthermore, we acknowledge the disadvantages of self-administered dichotomous questionnaires which may limit the richness of insights.[46,47] Open-ended questions may be desirable in future survey iterations.

We have identified simple interventions that may reduce NFR. The straightforward construction and interpretation, ease of administration and completion confers advantages of the NFR scale over more complex well-being inventories allowing for quick assessment of a workforce NFR, especially in a busy clinical environment. Where identified to be high and interventions initiated such as a rota change, the NFR scale can be easily repeated to confirm or refute the impact, and may identify further areas resulting in continual improvement whilst minimising survey respondent fatigue.

Future areas of work will include analysis of the NFR findings in relationship to well-being and burnout. Any future work should also include

other ED staff groups and physician groups to gain a broader picture across the multi-professional team.

In conclusion, this study provides a robust estimate of the NFR for Emergency Physicians in the UK and Ireland, which is higher than any occupation reported to date. Several potentially modifiable occupational characteristics were associated with higher NFR, and future work to assess the impact of modifying these factors will inform strategies to reduce NFR. In time this may lead to improved long-term physician well-being and enhanced staff retention.

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This project was funded through a grant from the Royal College of Emergency Medicine (RCEM) (Reference number: G/2018/1). This study was independent of RCEM, and the sponsor had no role in the design of this study and no role during its execution, analyses, interpretation of the data, or decision to submit results.

Competing interests:

All authors have completed the ICMJE uniform disclosure form and declare: no support from any organisation for the submitted work; TR has received 50% salary funding for two years as the Trainee Emergency Research Network fellow from the Royal College of Emergency Medicine; DH reports an honorary role as the Professor of the Royal College of Emergency Medicine during the conduct of this study; no other relationships or activities that could appear to have influenced the submitted work.

Patient and Public Involvement statement:

The concept of the research was presented to over 100 members of the public at a Research & Development PPI Conference on 20th September 2018. Participants were supportive of the concept of the study, and no concerns were raised. Further public and stakeholder engagement took place through a workshop held at the UK Emergency Medicine Trainees Association Annual Conference in December 2018, this influenced the outcome measures and survey design including the removal of a formal burnout inventory due to

perceptions and experience of respondent fatigue in the target participant group.

Ethics Approval:

This study protocol was submitted through the Integrated Research Application System (IRAS), IRAS number 262048 and received proportionate ethical approval by the Health Research Authority and Health and Care Research Wales, Research Ethics Committee reference 19/HRA/2404 and equivalent approvals in Scotland, Northern Ireland and Ireland. All participants provided informed consent prior to beginning the survey

Data sharing:

De-identified participant level data by site will be made available on reasonable request through the study team (tern@rcem.ac.uk). Data will be available for researchers whose proposed use of the data has been approved by the study team.

Transparency statement:

The lead author, Dr Laura Cottey, and the co-authors affirm that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Dissemination to participants and related patient and public communities:

The authors are unable to disseminate the result of the research to study participants directly, but the results will be made publicly available through open access publication and dissemination of the results through site principal investigators and social media.

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Contributors:

LC, TR and BG contributed to the development of the study design, data collection and analysis, the first draft of the manuscript and subsequent revised versions. DH and JML contributed to the development of the study design, data analysis, the first draft of the manuscript and subsequent revised versions. MDL contributed to survey development, data collection and final version of

manuscript; KS and DE provided the statistical analysis plan and contributed to data analysis, the first draft of the manuscript and subsequent revised versions. All authors approved the final version of the manuscript for submission. LC is the guarantor. TERN and PERUKI collaborators contributed to local study promotion and participant recruitment.

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Research Checklist: The Checklist for Reporting Results of Internet E-Surveys (CHERRIES)

CHERRIES CHECKLIST ADAPTED FROM: Eysenbach, Gunther. "Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES)." *Journal of medical Internet research* vol. 6,3 e34. 29 Sep. 2004, doi:10.2196/jmir.6.3.e34			
Item Category	***Checklist Item***	***Explanation***	***Checklist Response***
Design	Describe survey design	Describe target population, sample frame. Is the sample a convenience sample? (In "open" surveys this is most likely.)	***Outlined in 'Methods'***
IRB (Institutional Review Board) approval and informed consent process	IRB approval	Mention whether the study has been approved by an IRB.	***Outlined in 'Ethics Approval'***
	Informed consent	Describe the informed consent process. Where were the participants told the length of time of the survey, which data were stored and where and for how long, who the investigator was, and the purpose of the study?	***Outlined in Survey Distribution, monitoring and recruitment***
	Data protection	If any personal information was collected or stored, describe what mechanisms were used to protect unauthorized access.	***Outlined in Survey Distribution, monitoring and recruitment***
Development and pre-testing	Development and testing	State how the survey was developed, including whether the usability and technical functionality of the electronic questionnaire had been tested before fielding the questionnaire.	***Outlined in 'Survey Development'***
Recruitment process and description of the sample having access to the questionnaire	Open survey versus closed survey	An "open survey" is a survey open for each visitor of a site, while a closed survey is only open to a sample which the investigator knows (password-protected survey).	***Outlined in Survey Distribution, monitoring and recruitment***
	Contact mode	Indicate whether or not the initial contact with the potential participants was made on the Internet. (Investigators may also send out	***Outlined in 'Survey Distribution, monitoring and recruitment'***

		questionnaires by mail and allow for Web-based data entry.)	
	Advertising the survey	How/where was the survey announced or advertised? Some examples are offline media (newspapers), or online (mailing lists – If yes, which ones?) or banner ads (Where were these banner ads posted and what did they look like?). It is important to know the wording of the announcement as it will heavily influence who chooses to participate. Ideally the survey announcement should be published as an appendix.	***Outlined in 'Survey Distribution, monitoring and recruitment'***
Survey administration	Web/E-mail	State the type of e-survey (eg, one posted on a Web site, or one sent out through e-mail). If it is an e-mail survey, were the responses entered manually into a database, or was there an automatic method for capturing responses?	***Outlined in 'Survey Distribution, monitoring and recruitment'***
	Context	Describe the Web site (for mailing list/newsgroup) in which the survey was posted. What is the Web site about, who is visiting it, what are visitors normally looking for? Discuss to what degree the content of the Web site could pre-select the sample or influence the results. For example, a survey about vaccination on a anti-immunization Web site will have different results from a Web survey conducted on a government Web site	***Outlined in 'Design'***
	Mandatory/voluntary	Was it a mandatory survey to be filled in by every visitor who wanted to enter the Web site, or was it a voluntary survey?	***Outlined in 'Survey Distribution, monitoring and recruitment'***
	Incentives	Were any incentives offered (eg, monetary, prizes, or non-monetary incentives such as an offer to provide the survey results)?	***No***
	Time/Date	In what timeframe were the data collected?	***Outlined in 'Sites and settings'***
	Randomization of items or questionnaires	To prevent biases items can be randomized or alternated.	***Not done***
	Adaptive questioning	Use adaptive questioning (certain items, or only conditionally displayed based on responses to other items) to reduce number and complexity of the questions	***Outlined in Survey Distribution, monitoring and recruitment***
	Number of Items	What was the number of questionnaire items per page? The number of items is an important factor for the completion rate.	***Outlined in 'Design'***

	Number of screens (pages)	Over how many pages was the questionnaire distributed? The number of items is an important factor for the completion rate.	***Outlined in 'Design'***
	Completeness check	It is technically possible to do consistency or completeness checks before the questionnaire is submitted. Was this done, and if "yes", how (usually JAVAScript)? An alternative is to check for completeness after the questionnaire has been submitted (and highlight mandatory items). If this has been done, it should be reported. All items should provide a non-response option such as "not applicable" or "rather not say", and selection of one response option should be enforced.	***Not done***
	Review step	State whether respondents were able to review and change their answers (eg, through a Back button or a Review step which displays a summary of the responses and asks the respondents if they are correct).	***Outlined in Survey Distribution, monitoring and recruitment***
Response rates			
	Unique site visitor	If you provide view rates or participation rates, you need to define how you determined a unique visitor. There are different techniques available, based on IP addresses or cookies or both.	***Outlined in 'Results'***
	View rate (Ratio of unique survey visitors/unique site visitors)	Requires counting unique visitors to the first page of the survey, divided by the number of unique site visitors (not page views!). It is not unusual to have view rates of less than 0.1 % if the survey is voluntary	***Survey site contains first page of survey therefore N/A***
	Participation rate (Ratio of unique visitors who agreed to participate/unique first survey page visitors)	Count the unique number of people who filled in the first survey page (or agreed to participate, for example by checking a checkbox), divided by visitors who visit the first page of the survey (or the informed consents page, if present). This can also be called "recruitment" rate.	***Outlined in 'Results'***
	Completion rate (Ratio of users who finished the survey/users who agreed to participate)	The number of people submitting the last questionnaire page, divided by the number of people who agreed to participate (or submitted the first survey page). This is only relevant if there is a separate "informed consent" page or if the survey goes over several pages. This is a measure for attrition. Note that "completion" can involve leaving questionnaire items blank. This is not a measure for how completely questionnaires were filled in. (If you need a measure for this, use the word "completeness rate".)	***Outlined in 'Results'***
Preventing multiple	Cookies used	Indicate whether cookies were used to assign a unique user identifier to each	***Not used***

entries from the same individual		client computer. If so, mention the page on which the cookie was set and read, and how long the cookie was valid. Were duplicate entries avoided by preventing users access to the survey twice; or were duplicate database entries having the same user ID eliminated before analysis? In the latter case, which entries were kept for analysis (eg, the first entry or the most recent)?	
	IP check	Indicate whether the IP address of the client computer was used to identify potential duplicate entries from the same user. If so, mention the period of time for which no two entries from the same IP address were allowed (eg, 24 hours). Were duplicate entries avoided by preventing users with the same IP address access to the survey twice; or were duplicate database entries having the same IP address within a given period of time eliminated before analysis? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	***Not used due to survey being completed on multi-user/single log-in computers***
	Log file analysis	Indicate whether other techniques to analyze the log file for identification of multiple entries were used. If so, please describe.	***Not done***
	Registration	In "closed" (non-open) surveys, users need to login first and it is easier to prevent duplicate entries from the same user. Describe how this was done. For example, was the survey never displayed a second time once the user had filled it in, or was the username stored together with the survey results and later eliminated? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	***N/A***
Analysis	Handling of incomplete questionnaires	Were only completed questionnaires analyzed? Were questionnaires which terminated early (where, for example, users did not go through all questionnaire pages) also analyzed?	***Outlined in 'Data Analysis'***
	Questionnaires submitted with an atypical timestamp	Some investigators may measure the time people needed to fill in a questionnaire and exclude questionnaires that were submitted too soon. Specify the timeframe that was used as a cut-off point, and describe how this point was determined	***N/A***
	Statistical correction	Indicate whether any methods such as weighting of items or propensity scores have been used to adjust for the non-	***Outlined in 'Data Analysis'***

		representative sample; if so, please describe the methods.	

Figure Legend

Figure 1

Box plots of Need for Recovery (NFR) score by participant demographic characteristics, excluding any participants who does not respond to the question (i.e. missing).

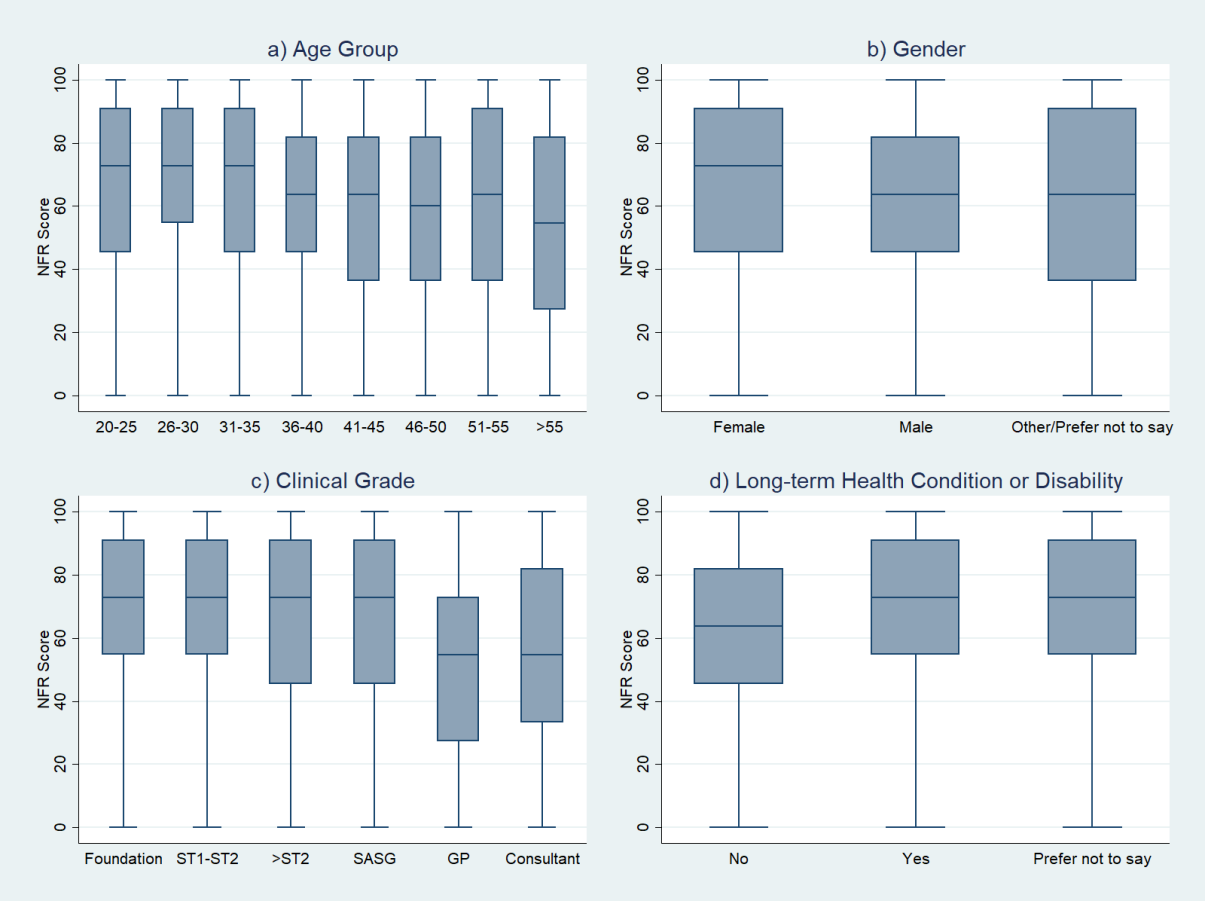
Plot a) age group in years; b) gender; c) clinical grade; d) any long-term health condition or disability.

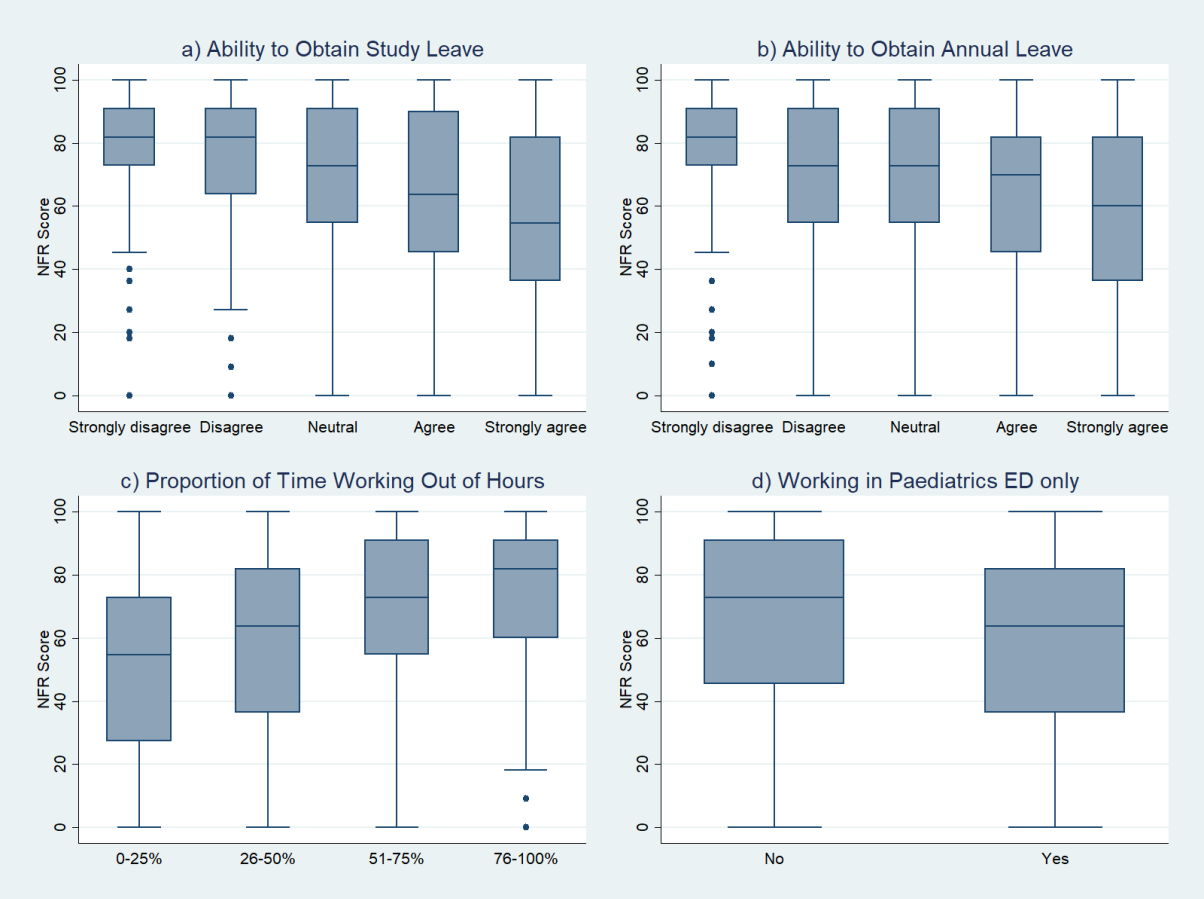
ST1-ST2=Specialist Training year 1-2 (this included physicians training in Anaesthetics, Emergency Medicine, Acute Medicine and General Practice)
SASG=Staff grade, associate specialist and speciality grade
GP=General Practitioner working within the emergency department (ED)

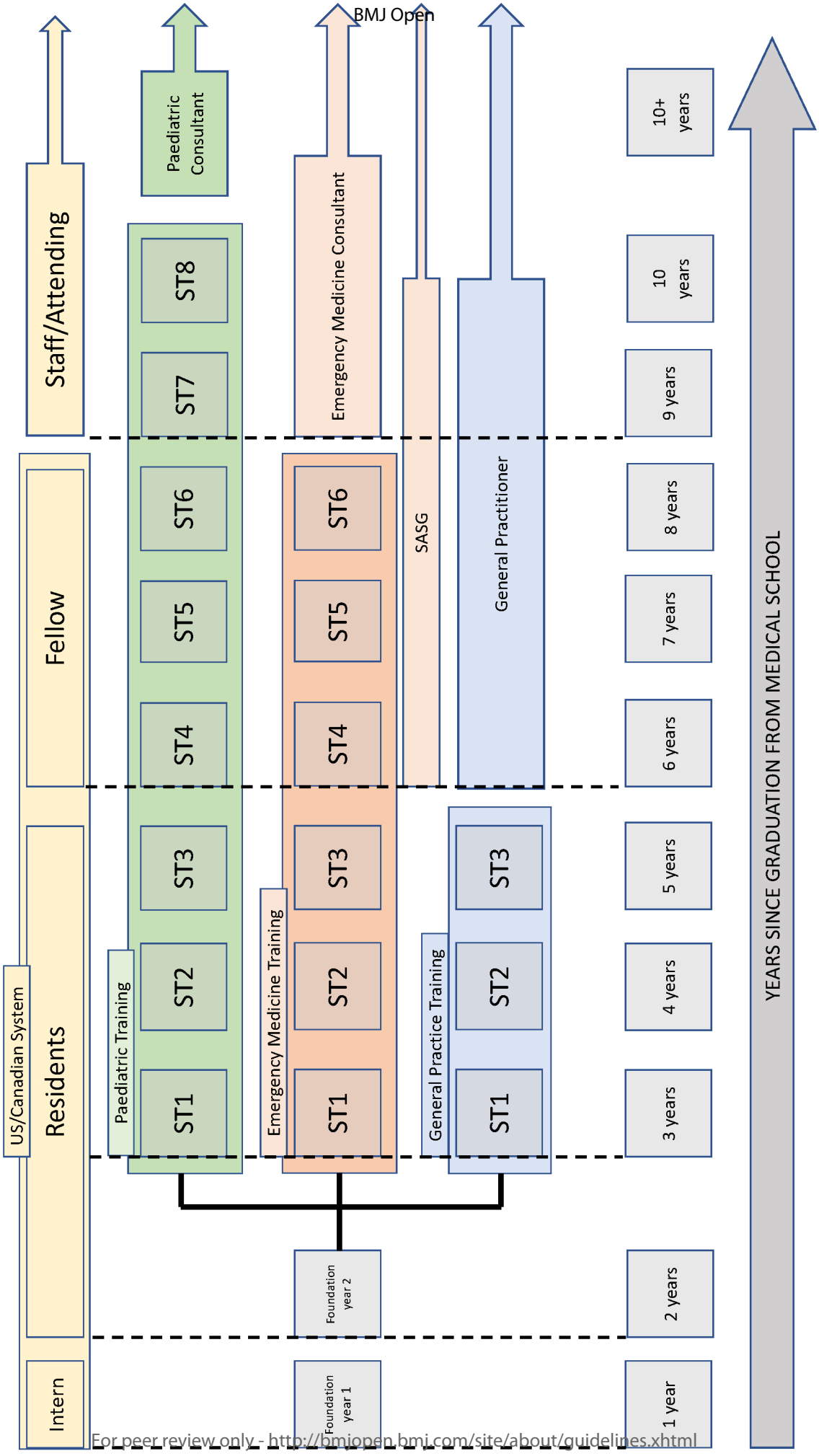
Figure 2

Box plot of Need for Recovery (NFR) score by participant's occupational characteristics, excluding any participants who does not respond to the question (i.e. missing).

Plot a) ability to obtain study leave when requested; b) ability to obtain annual leave when requested; c) proportion of time working out-of-hours; d) working in paediatrics emergency departments (ED) only.






Staff/Attending
Fellow
Residents
Intern
US/Canadian System
Paediatric Consultant
Emergency Medicine Consultant
SASG
General Practitioner
Paediatric Training
Emergency Medicine Training
General Practice Training
ST8
ST7
ST6
ST5
ST4
ST3
ST2
ST1
Foundation year 2
Foundation year 1
10+ years
10 years
9 years
8 years
7 years
6 years
5 years
4 years
3 years
2 years
1 year
YEARS SINCE GRADUATION FROM MEDICAL SCHOOL

Emergency Department Need For Recovery Survey

Do you want to read the patient participation leaflet, GDPR and consent information now?	◯ Yes ◯ No

Participant Information Sheet

Welcome to the 2019 TERN Need for Recovery Survey.

This is an electronic participant information sheet. Please take a minute or two to read this information before proceeding with the survey.

What is need for recovery?
Need for recovery is the time taken to physically and psychologically recover from work. Increased need for recovery is linked to fatigue and a range of physical and psychological health outcomes including burnout.
Why have I been asked to take part?
You are either:
• A doctor working in an emergency department which has been nominated to participate in this survey.

What is the purpose of the study?
This survey is being conducted as part of a national survey by the Trainee Emergency Research Network (TERN). The project is being led by Dr Laura Cottey (Chief Investigator) and Dr Blair Graham, with oversight from the TERN executive committee. We hope that the results from this survey will provide a baseline assessment of trainee need for recovery, and demonstrate risk factors that may indicate an increased need for recovery. It is hoped that this survey will provide insight into the phenomenon of need for recovery amongst Emergency Department doctors, show where differences exist, and how need for recovery may be reduced in the future.
Ultimately it is hoped that this survey may lead to initiatives to improve the working lives of doctors in the emergency department.

What will happen if I take part?
You will asked to take part in this electronic questionnaire. You should allocate about 5 minutes to complete the questionnaire, although you can save and return to completing the questionnaire at a later time.

Do I have to take part?
In order that these results can inform future initiatives to improve working lives of emergency doctors, we do require a robust response rate. However, you are under no obligation to take part and may withdraw at any point without the need to give a reason.

Should you have uncertainties of queries about this survey, please do not hesitate to contact the study team.

What will happen to my data if I withdraw my involvement?
If you choose to withdraw your involvement in the study, any results that you have submitted will be kept for analysis. However, you will not be required to input further into the study.

If you would like to be formally withdrawn from the study at any point, please contact the study team (TERN@rcem.ac.uk). You do not have to give a reason.

Are there any potential risks or benefits of taking part?

This survey will provide valuable insight into the wellbeing of emergency department doctors nationally. We appreciate issues such as wellbeing and burnout are sensitive. We have included some information about sources that you might wish to contact for support both as part of this introduction, and at the end of the survey.

Who is involved in this project?
The project is being led by Dr Laura Cottey (Chief Investigator) and Dr Blair Graham, with oversight from the TERN executive committee which is led by Dr Tom Roberts. The study is indirectly supported by the Royal College of Emergency Medicine, but TERN is independent from the college.

What if something goes wrong?
It is very unlikely that anything will go wrong. If you feel it does, please contact the study team directly.

How will you protect my data and confidentiality?
The University Hospitals Plymouth NHS Trust is the sponsor for this study. The sponsor will be using information in order to undertake the study and will be responsible for looking after your information and using it properly. The data collected will be kept for 10 years after the study has finished.

Your rights to access, change or move your information are limited, as we need to manage your information in specific ways in order for the research to be reliable and accurate. If you withdraw from the study, we will keep the information about you that we have already obtained. To safeguard your rights, we will use the minimum personally identifiable information possible.

This study is also compliant with the General Data Protection Regulations (GDPR). For more information about GDPR click here.

How may I contact the study team in the future?
You can contact the study team by emailing Dr Laura Cottey at laura.cottey@nhs.net

What to do if you need support about wellbeing
The following organisations can help provide advice and support with regards to your wellbeing.

-Your occupational health department (contact details available via your employer)
-Your general practitioner
-BMA Counselling Service (24 Hours). Telephone 0330 123 1245. (Note that you do not have to be a member of the BMA to access this service)
-The Samaritans (24 Hours). Telephone 116 123.

You can also access further information and signposting online via the Doctors Support Network https://www.dsn.org.uk/

Feel free to leave any comments.

Consent Question 1: I have read and understood the participant information	◯ Yes ◯ No
Consent Question 2: I understand the information about confidentiality and GDPR	◯ Yes ◯ No

Demographic Characteristics

What is your current job role?

- ◯ ST1
- ◯ ST2
- ◯ ST3
- ◯ ST4
- ◯ ST5
- ◯ ST6
- ◯ ST7
- ◯ ST8
- ◯ F1
- ◯ F2
- ◯ Clinical Fellow (F2-ST3 Level)
- ◯ Clinical Fellow (>=ST4 Level)
- ◯ Consultant
- ◯ Associate Specialist
- ◯ Staff Grade
- ◯ CESR Doctor
- ◯ GP Trainee
- ◯ GP
- ◯ Other (please specify)

What is your job role?

_____

Which country do you work in?

- ◯ Scotland
- ◯ Northern Ireland
- ◯ Wales
- ◯ England
- ◯ Republic of Ireland

Which hospital do you currently work in?

- ◯ Aberdeen
- ◯ Victoria Hospital, Kirkcaldy
- ◯ Forth Valley Royal Hospital
- ◯ Monklands Hospital
- ◯ Royal Hospital for Children, Glasgow
- ◯ Royal Infirmary of Edinburgh
- ◯ St John's, Livingston
- ◯ NHS Greater Glasgow and Clyde - Queen Elizabeth
- ◯ NHS Greater Glasgow and Clyde - Glasgow Royal Infirmary
- ◯ Crosshouse, Ayrshire
- ◯ Royal Alexandria, Paisley
- ◯ Ayr
- ◯ Royal Hospital for Sick Children, Edinburgh
- ◯ Other

Which hospital do you currently work in?

- ◯ Craigavon Area Hospital, Northern Ireland
- ◯ Royal Victoria Hospital, Belfast
- ◯ Ulster Hospital, Belfast
- ◯ Other

Which hospital do you currently work in?

◯ Cardiff, University Hospital of Wales
◯ Ysbyty Gwynedd, Bangor
◯ Morriston Hospital, Swansea
◯ Wrexham, North Wales
◯ Other

Which hospital do you currently work in (the list is mostly alphabetically but if you cannot find your hospital please check the bottom)?

◯ Addenbrooke's Hospital
◯ Aintree
◯ Airedale General Hospital
◯ Basingstoke Emergency Department
◯ Bedford hospital emergency department
◯ Birmingham
◯ Bolton
◯ Bradford Royal Infirmary
◯ Brighton (Royal Sussex County Hospital)
◯ Bristol Childrens Hospital
◯ Bristol Royal Infirmary (Adults)
◯ Cambridge University Hospitals
◯ Chelsea & Westminster Hospital
◯ Croydon University Hospital
◯ Doncaster Royal Infirmary
◯ William Harvey ED
◯ East Surrey Hospital ED
◯ Epsom and St Helier NHS Trust
◯ Gloucestershire Hospitals NHS Foundation Trust
◯ Great Western Hospital Swindon
◯ Hampshire Hospitals NHS Trust (Basingstoke and Winchester)
◯ Harrogate Emergency Department
◯ Homerton Emergency Department
◯ Ipswich Hospital
◯ James Cook University Hospital Middlesbrough
◯ James Paget University Hospital
◯ Leeds teaching hospitals
◯ Leicester Royal Infirmary
◯ Leighton (Crewe)
◯ Lewisham university hospital
◯ Lister Hospital
◯ QEH, London
◯ Manchester Royal Infirmary
◯ Milton Keynes University
◯ Musgrove Park Hospital, Taunton
◯ Northern general hospital
◯ Northumbria Specialist Emergency Care Hospital
◯ Northwick Park Hospital
◯ Oxford University Hospital NHS Foundation Trust/
◯ Portsmouth - Queen Alexandra Hospital,
◯ Plymouth- Derriford
◯ Reading
◯ Royal Berkshire Hospital
◯ Royal Blackburn Hospital
◯ Royal Cornwall Hospital, Truro
◯ Royal Devon & Exeter Hospital
◯ Royal Liverpool University Hospital
◯ The Royal London Hospital (Paeds)
◯ The Royal London Hospital (Adults)
◯ Royal Manchester Children's Hospital
◯ Royal Oldham Hospital
◯ Royal Preston hospital
◯ Royal Shrewsbury Hospital
◯ Royal Stoke
◯ Royal Surrey County Hospital
◯ Royal United Hospital Bath
◯ Royal Victoria, Newcastle
◯ Salford Royal Hospital, Manchester
◯ Sheffield Childrens Hospital ED
◯ Medway Foundation NHS Trust
◯ Mid Cheshire Hospitals NHS Foundation Trust
◯ University Hospital Southampton
◯ St Helens and Knowsley
◯ Southmead Hospital
◯ Surrey and Sussex Healthcare NHS Trust
◯ St Georges Hospital Tooting

◯ St Marys Hospital, London
◯ St Richards hospital
◯ St Thomas' Hospital
◯ Torbay
◯ Tunbridge Wells Hospital
◯ Southport District General Hospital
◯ University College Hospital, London
◯ University Hospital Coventry and Warwickshire
◯ Warrington
◯ University Hospitals of Derby and Burton NHS Foundation Trust
◯ Watford General hospital
◯ West Middlesex University Hospital
◯ West Suffolk Hospital
◯ Frimley Park Hospital
◯ Wexham Park Hospital, Frimley Health NHS
◯ Whiston Hospital
◯ Wythenshawe Hospital
◯ Yeovil District Hospital
◯ York District hospital
◯ York Hospital Emergency Departments
◯ Whiston Hospital
◯ William Harvey Hospital
◯ Worthing Hospital
◯ University hospital of Hull
◯ North Middlesex
◯ Sandwell and West Birmingham
◯ Stoke Mandeville
◯ Colchester
◯ Alder Hey Children's Hospital
◯ Queen's Hospital, Romford
◯ Birmingham Children's Hospital
◯ Sunderland Royal Hospital
◯ Countess of Chester NHS foundation trust
◯ University hospital of North Durham
◯ Evelina Children's Hospital
◯ King's College, London
◯ Barnstaple
◯ Nottingham University Hospital
◯ Royal Alexandra Children's Hospital
◯ Royal Wolverhampton
◯ Salisbury NHS Trust
◯ Western Sussex NHS Trust
◯ Other
◯ Alder Hey Childrens Hospital
◯ Birmingham Women's and Childrens Hospital
◯ Countess of Chester
◯ Evelina, Guys and St Thomas's
◯ Kings College Hospital
◯ Royal Alexandra Children's Hospital, Brighton and Sussex
◯ New Cross Hospital
◯ Salisbury
◯ Barking, Havering & Redbridge - Queen's
◯ Barking, Havering & Redbridge - King George
◯ South Tyneside and Sunderland NHS Trust
◯ County Durham and Darlington
◯ North Manchester General Hospital

Which hospital do you currently work in?

◯ University Hospital Galway
◯ Mater Misericordiae University Hospital, Dublin,
◯ Sligo University Hospital
◯ Limerick regional Hospital
◯ Other
◯ Children's Health Ireland at Crumlin
◯ Children's Health Ireland at Temple Street
◯ Children's Health Ireland at Tallaght
◯ Bon Secours Hospital
◯ Cork University Hospital

Please state the name of your hospital.

_____

What type of patients do you see in your Emergency Department?

◯ Adults only
◯ Paediatrics only
◯ Mixture of Adults and Paediatrics

How old are you?

◯ 20-25
◯ 26-30
◯ 31-35
◯ 36-40
◯ 41-45
◯ 46-50
◯ 51-55
◯ 56-60
◯ 61- 65
◯ 66-70
◯ >70

What is your gender?

◯ Female
◯ Male
◯ Other
◯ Prefer not to say

Please fill out the following "Need for Recovery Score". Please base this on the LAST MONTH of work (excluding leave).

	yes	no
I find it difficult to relax at the end of the working day?	○	○
By the end of the working day I feel really worn-out	○	○
Because of my job, at the end of the working day I feel rather exhausted	○	○
After my breaks, I feel fresh to continue my work	○	○
Generally speaking, I only start to feel relaxed on my second non-working day off	○	○
I find it difficult to concentrate in my free time after work	○	○
I find it hard to show interest in other people when I have just come home from work	○	○
In general, it takes me over an hour to feel fully recuperated after work	○	○
When I get home, I need to be left in peace for a while	○	○
Often, after a day's work I feel so tired that I cannot get involved in other activities	○	○
A feeling of tiredness prevents me from doing my work as well as I normally would during the last part of the working day	○	○

How long have you worked in your current Emergency Department?

○ 1 month or less
○ 1-2 months
○ 2-3 months
○ 3-4 months
○ 4-5 months
○ 5-6 months
○ 6 months - 1 year
○ 1-2 years
○ 2-3 years
○ 3-5 years
○ 5 -10 years
○ 10 -15 years
○ 15-20 years
○ > 20 years

How long have you worked in Emergency Medicine in total in your career?

◯ 1 year or less
◯ 1 year or more

How many months have you worked in Emergency Medicine in total?

_____

How many years have you worked in Emergency Medicine in total?

_____

What is your most frequent method of transport for your commute to work?

◯ Car
◯ Motorbike
◯ Bus
◯ Train
◯ Underground
◯ Walk
◯ Run
◯ Cycle
◯ I live on-site
◯ Other

You have selected other, how do you commute?

_____

How long does your commute take in minutes (one way)?

	1-10 mins	11-20 mins	21-30 mins	31-40 mins	41-50 mins	51-60 mins	61-70 mins	71-80 mins	81-90 mins	>90 mins
On an average day	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
On a good day	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
On a bad day	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

What type of contract do you work?

◯ Full time
◯ 90%, less than full time
◯ 80%, less than full time
◯ 70%, less than full time
◯ 60%, less than full time
◯ 50%, less than full time
◯ less than 50%, less than full time

Do you have dedicated contracted time away from Adult Emergency Medicine (e.g. subspecialty or GP) or work in Paediatric Emergency Medicine?

◯ Yes
◯ No

Please select all that are applicable to your current contracted time.

☐ ICM
☐ PEM
☐ PHEM
☐ Academic
☐ Teaching
☐ Leadership/Management
☐ Paediatrics
☐ GP
☐ Other

What is your "other" contracted time?

_____

What percentage of your contract is spent in ICM rather than EM?

◯ 10%
◯ 20%
◯ 25%
◯ 30%
◯ 40%
◯ 50%
◯ 60%
◯ 70%
◯ 75%
◯ 80%
◯ 90%
◯ 100%

What percentage of your contract is spent in PEM rather than Adult EM?

- ◯ 10%
- ◯ 20%
- ◯ 25%
- ◯ 30%
- ◯ 40%
- ◯ 50%
- ◯ 60%
- ◯ 70%
- ◯ 75%
- ◯ 80%
- ◯ 90%
- ◯ 100%

What percentage of your contract is spent in PHEM rather than Adult EM?

- ◯ 10%
- ◯ 20%
- ◯ 25%
- ◯ 30%
- ◯ 40%
- ◯ 50%
- ◯ 60%
- ◯ 70%
- ◯ 75%
- ◯ 80%
- ◯ 90%
- ◯ 100%

What percentage of your contract is spent Academic rather than Adult EM?

- ◯ 10%
- ◯ 20%
- ◯ 25%
- ◯ 30%
- ◯ 40%
- ◯ 50%
- ◯ 60%
- ◯ 70%
- ◯ 75%
- ◯ 80%
- ◯ 90%
- ◯ 100%

What percentage of your contract is spent Teaching rather than Adult EM?

- ◯ 10%
- ◯ 20%
- ◯ 25%
- ◯ 30%
- ◯ 40%
- ◯ 50%
- ◯ 60%
- ◯ 70%
- ◯ 75%
- ◯ 80%
- ◯ 90%
- ◯ 100%

What percentage of your contract is spent management/leadership rather than Adult EM?

◯ 10%
◯ 20%
◯ 25%
◯ 30%
◯ 40%
◯ 50%
◯ 60%
◯ 70%
◯ 75%
◯ 80%
◯ 90%
◯ 100%

What percentage of your contract is spent doing paediatrics rather than EM?

◯ 10%
◯ 20%
◯ 25%
◯ 30%
◯ 40%
◯ 50%
◯ 60%
◯ 70%
◯ 75%
◯ 80%
◯ 90%
◯ 100%

What percentage of your contract is spent doing GP rather than Adult EM?

◯ 10%
◯ 20%
◯ 25%
◯ 30%
◯ 40%
◯ 50%
◯ 60%
◯ 70%
◯ 75%
◯ 80%
◯ 90%
◯ 100%

What percentage of your contract is spent doing "other" activities rather than Adult EM?

◯ 10%
◯ 20%
◯ 25%
◯ 30%
◯ 40%
◯ 50%
◯ 60%
◯ 70%
◯ 75%
◯ 80%
◯ 90%
◯ 100%

What is the maximum number of TOTAL clinical shifts you work in a week?

◯ 1 shift
◯ 2 shifts
◯ 3 shifts
◯ 4 shifts
◯ 5 shifts
◯ 6 shifts
◯ 7 shifts

What is the maximum number of CONSECUTIVE clinical shifts you would be scheduled to work?

◯ 1 shift
◯ 2 shifts
◯ 3 shifts
◯ 4 shifts
◯ 5 shifts
◯ 6 shifts
◯ 7 shifts
◯ > 7 shifts

What is the maximum number of consecutive NIGHT shifts you would be scheduled to work in a row?

◯ 0 shifts
◯ 1 shift
◯ 2 shifts
◯ 3 shifts
◯ 4 shifts
◯ 5 shifts
◯ 6 shifts
◯ 7 shifts

What is the maximum number of consecutive DAY shifts you would be scheduled to work in a row?

◯ 0 shifts
◯ 1 shift
◯ 2 shifts
◯ 3 shifts
◯ 4 shifts
◯ 5 shifts
◯ 6 shifts
◯ 7 shifts

What is the maximum number of consecutive TWILIGHT shifts you would be scheduled to work in a row?

◯ 0 shifts
◯ 1 shift
◯ 2 shifts
◯ 3 shifts
◯ 4 shifts
◯ 5 shifts
◯ 6 shifts
◯ 7 shifts

What is your scheduled weekend work frequency?

◯ 1 in 2
◯ 1 in 3
◯ 1 in 4
◯ 1 in 5
◯ 1 in 6
◯ Less frequent than 1 in 6
◯ I don't work weekends

Over the past month how many contracted non-clinical shifts have you had? E.g. SPA, teaching, clinical governance.

◯ 0 shifts
◯ Between 0-1 shifts
◯ 1 shift
◯ 2 shifts
◯ 3 shifts
◯ 4 shifts
◯ 5 shifts
◯ 6 shifts
◯ 7 shifts
◯ 8 shifts
◯ 9 shifts
◯ 10 shifts
◯ 11-15 shifts
◯ >15 shifts

In the past month how many locum shifts have you worked? _____

Over the past month, roughly how often have you left more than 15 minutes late following a clinical shift?

◯ Rarely
◯ A few times a month
◯ Once a week
◯ A few times a week
◯ Everyday

Over the past month, how often have you taken your full entitlement of breaks during a clinical shift?

◯ Rarely
◯ A few times a month
◯ Once a week
◯ A few times a week
◯ Everyday

What proportion would you say you spend working 'out of hours' (evenings, nights or weekends)?

◯ < 25%
◯ 26-50%
◯ 51-75%
◯ 76-100%

What proportion of your locum shifts would you say you spend working 'out of hours' (evenings, nights or weekends)?

◯ < 25%
◯ 26-50%
◯ 51-75%
◯ 76-100%

I have been able to request and take the annual leave I wanted?

◯ Strongly disagree
◯ Disagree
◯ Neutral
◯ Agree
◯ Strongly agree

I have been able to request and take the study leave I wanted?

◯ Strongly disagree
◯ Disagree
◯ Neutral
◯ Agree
◯ Strongly agree

Over the past month, roughly how often have you found yourself feeling overwhelmed with work during a clinical shift?

◯ Rarely
◯ A few times a month
◯ Once a week
◯ A few times a week
◯ Everyday

Do you consider yourself to have any long-term health conditions or disability?

◯ Yes
◯ No
◯ Prefer not to say

Do you have significant caring responsibilities outside of work?
(e.g. parent or main carer for a relative)

◯ Yes
◯ No
◯ Prefer not to say

I feel at high risk of burnout from my job in the near future?

◯ Yes
◯ No
◯ Prefer not to say

I feel I am currently suffering burnout from work?

◯ Yes
◯ No
◯ Prefer not to say

TIRED Site Survey

Department Demographics

Name of emergency department and NHS trust?	_____
Number of attendances per year?	_____
Any specialist designation?	☐ Trauma unit ☐ Adult major trauma centre ☐ Stroke centre ☐ PCI centre ☐ Paediatric major trauma centre
Number of EM Consultants?	_____
Number of EM Middle Grades (ST4 and above)?	_____
Number of EM Middle grade career clinicians equivalent to > ST4 (eg associate specialist, specialty doctors, CESR or other non-training doctors)?	_____
Number of EM trainees ST3?	_____
Number of ACCS trainees ST1-2?	_____
Number of GP trainees ST1-3?	_____
Number of ED GPs?	_____
Number of Clinical Fellows (Fy1-ST3)?	_____
Number of Clinical Fellows (>=ST4)?	_____
Number of FY2s?	_____
Number of FY1s?	_____
Total number of ED Doctors calculated from the answers above:	_____

Out of the total number of doctors above, how many will be ineligible for the study due to absence during the study period? (eg maternity, sick or annual leave)	_____
What percentage of eligible EM doctors do you estimate you will enrol in the survey? (ie if you have 50 doctors and think you will enrol 25 at your site, that would be 50%).	_____ (We are aiming for a response rate of 80% of eligible doctors as a minimum at each site but understand this not might be achievable. Therefore, this is an opportunity to document how many you think will be achievable at your site.)
Number of advanced nurse practicioners?	_____
Number of advanced clinical practitioners?	_____
Number of adult qualified EM nurses?	_____
Number of paediatric qualified EM nurses?	_____
Number of health care assistants (or equivalents)?	_____
Number of EM physician associates?	_____
Does your Consultant rota use self-rostering?	◯ Yes ◯ No
Does your Registrar rota use self-rostering?	◯ Yes ◯ No
Does your SHO rota use self-rostering?	◯ Yes ◯ No

What are the current vacancy rates for permanent staff in the following roles?

	0-10%	11-20%	21-30%	31-40%	41-50%	51-60%	61-70%	71-80%	81-90%	91-100 %
EM consultants	○	○	○	○	○	○	○	○	○	○
EM medical staff (excluding Consultants)	○	○	○	○	○	○	○	○	○	○
EM nursing staff	○	○	○	○	○	○	○	○	○	○
Non-medical staff	○	○	○	○	○	○	○	○	○	○
All staff	○	○	○	○	○	○	○	○	○	○

What percentage of patients were seen within 4 hours in April 2019? _____

What percentage of patients were seen within 4 hours in March 2019? _____

What percentage of patients were seen within 4 hours in February 2019? _____

What percentage of patients were seen within 4 hours in January 2019? _____

What percentage of patients were seen within 4 hours in December 2018 _____

What percentage of patients were seen within 4 hours in November 2018? _____

What are the current sickness rates for the following staff groups?

	0-1%	1-2%	2-3%	3-4%	4-5%	5-6%	6-7%	7-8%	8-9%	9-10%	>10%
EM Consultants	○	○	○	○	○	○	○	○	○	○	○
EM Medical Staff (excluding Consultants)	○	○	○	○	○	○	○	○	○	○	○
EM Nursing staff	○	○	○	○	○	○	○	○	○	○	○
Non-Medical Staff	○	○	○	○	○	○	○	○	○	○	○
All Staff	○	○	○	○	○	○	○	○	○	○	○

What is the Minimum Shift Length for the below groups of staff?

	6 hours	7 hours	8 hours	9 hours	10 hours	11 hours	12 hours	13 hours	N/A
EM Consultants	○	○	○	○	○	○	○	○	○
EM Trainees, ST4 and above	○	○	○	○	○	○	○	○	○
EM Non-training, ST4 and above	○	○	○	○	○	○	○	○	○
EM Trainees ST3	○	○	○	○	○	○	○	○	○
ACCS Trainees ST1-2	○	○	○	○	○	○	○	○	○
GP Trainees ST1-3	○	○	○	○	○	○	○	○	○
Clinical Fellows (FY1- ST3)	○	○	○	○	○	○	○	○	○
Clinical Fellows (>= ST4)	○	○	○	○	○	○	○	○	○
Fy2 Doctors	○	○	○	○	○	○	○	○	○
Fy1 Doctors	○	○	○	○	○	○	○	○	○

What is the maximum shift length for the following groups of staff

	6 hours	7 hours	8 hours	9 hours	10 hours	11 hours	12 hours	13 hours	>13 hours	N/A
EM Consultants	○	○	○	○	○	○	○	○	○	○
EM Trainees, ST4 and above	○	○	○	○	○	○	○	○	○	○
EM Non-trainees, ST4 and above	○	○	○	○	○	○	○	○	○	○
EM Trainees, ST3	○	○	○	○	○	○	○	○	○	○
ACCS Trainees ST1-2	○	○	○	○	○	○	○	○	○	○
GP Trainees, ST1-3	○	○	○	○	○	○	○	○	○	○
Clinical Fellows (FY1 - ST3)	○	○	○	○	○	○	○	○	○	○
Clinical Fellows (=>ST4)	○	○	○	○	○	○	○	○	○	○
Fy2 Doctors	○	○	○	○	○	○	○	○	○	○
Fy1 Doctors	○	○	○	○	○	○	○	○	○	○

How many hours are each of the shifts on your SHO rota?
(Select multiple if this changes depending on the shift)

	< 8 hours	8 hours	9 hours	10 hours	11 hours	12 hours	>12 hour
Day shift (week)	☐	☐	☐	☐	☐	☐	☐
Night shift (week)	☐	☐	☐	☐	☐	☐	☐
Twilight shift (week)	☐	☐	☐	☐	☐	☐	☐
Day shift (weekend)	☐	☐	☐	☐	☐	☐	☐
Night shift (weekend)	☐	☐	☐	☐	☐	☐	☐
Twilight shift (weekend)	☐	☐	☐	☐	☐	☐	☐

How many hours are each of the shifts on your registrar rota?
(Select multiple if this changes depending on the shift)

	< 8 hours	8 hours	9 hours	10 hours	11 hours	12 hours	>12 hour
Day shift (week)	☐	☐	☐	☐	☐	☐	☐
Night shift (week)	☐	☐	☐	☐	☐	☐	☐
Twilight shift (week)	☐	☐	☐	☐	☐	☐	☐
Day shift (weekend)	☐	☐	☐	☐	☐	☐	☐
Night shift (weekend)	☐	☐	☐	☐	☐	☐	☐
Twilight shift (weekend)	☐	☐	☐	☐	☐	☐	☐

How many hours are each of the shifts on your Consultant rota?

	< 8 hours	8 hours	9 hours	10 hours	11 hours	12 hours	>12 hour
Day shift (week)	◯	◯	◯	◯	◯	◯	◯
Night shift (week)	◯	◯	◯	◯	◯	◯	◯
Twilight shift (week)	◯	◯	◯	◯	◯	◯	◯
Day shift (weekend)	◯	◯	◯	◯	◯	◯	◯
Night shift (weekend)	◯	◯	◯	◯	◯	◯	◯
Twilight shift (weekend)	◯	◯	◯	◯	◯	◯	◯

Is there readily available rest facilities available for post night shifts?
◯ Yes
◯ No

Do people know how to access them?
◯ Yes
◯ No

Is there a break room available?
◯ Yes
◯ No

Online Supplementary Material 4
Table of Additional Participant Characteristics

Characteristic	N (%)	NFR Score	
		Median (95% CI) [1]	[LQ - UQ]
Maximum number of consecutive day shifts you would be scheduled to work			
0	30 (0.7)	63.6 (50.1 to 77.2)	[36.4 - 90.9]
1	42 (1.0)	59.1 (40.9 to 77.3)	[27.3 - 90.9]
2	217 (5.3)	63.6 (55.1 to 72.2)	[36.4 - 81.8]
3	522 (12.7)	63.6 (60.9 to 66.4)	[36.4 - 81.8]
4	788 (19.2)	63.6 (63.6 to 63.6)	[45.5 - 81.8]
5	1108 (27)	72.7 (70.0 to 75.5)	[45.5 - 81.8]
6	309 (7.5)	72.7 (66.9 to 78.6)	[54.5 - 90.9]
7	1094 (26.6)	72.7 (72.7 to 72.7)	[45.5 - 90.9]
Missing	137 (3.3)	72.7 (65.7 to 79.7)	[50.0 - 90.9]
Maximum number of consecutive Twilight shifts you would be scheduled to work			
0	339 (8.2)	54.5 (48.3 to 60.8)	[36.4 - 81.8]
1	341 (8.3)	60.0 (51.2 to 68.8)	[36.4 - 81.8]
2	496 (12.1)	54.5 (49.9 to 59.2)	[36.4 - 81.8]
3	796 (19.4)	63.6 (55.8 to 71.5)	[45.5 - 81.8]
4	1100 (26.7)	72.7 (69.9 to 75.5)	[45.5 - 90.9]
5	600 (14.6)	72.7 (72.1 to 73.4)	[54.5 - 90.9]
6	107 (2.6)	72.7 (67.6 to 77.8)	[54.5 - 90.9]
7	334 (8.1)	81.8 (74.4 to 89.3)	[54.5 - 90.9]
Missing	134 (3.3)	72.7 (67.3 to 78.1)	[54.5 - 90.9]
Maximum number of consecutive night shifts you would be scheduled to work			
0	1057 (25.6)	54.5 (52.0 to 57.1)	[27.3 – 80.0]
1	123 (3.0)	63.6 (53.2 to 74.0)	[36.4 - 90.9]
2	153 (3.7)	54.5 (44.7 to 64.4)	[45.5 - 81.8]
3	467 (11.3)	72.7 (65.6 to 79.9)	[45.5 - 90.9]
4	2188 (53.1)	72.7 (72.7 to 72.7)	[54.5 - 90.9]
5	64 (1.6)	72.7 (64.4 to 81.1)	[54.5 - 90.9]
6	6 (0.1)	54.5 (NA)	[45.5 - 81.8]
7	63 (1.5)	72.7 (64.4 to 81.1)	[54.5 - 90.9]
Missing	126 (3.1)	72.7 (67.4 to 78.0)	[54.5 - 90.9]
Maximum number of clinical shifts you work in a typical week?			
1	27 (0.7)	63.6 (45.2 to 82.0)	[45.5 - 90.9]
2	63 (1.5)	63.6 (49.2 to 78.1)	[36.4 - 81.8]

3	240 (5.9)	63.6 (58.1 to 69.2)	[36.4 - 81.8]
4	553 (13.5)	63.6 (54.9 to 72.3)	[36.4 - 81.8]
5	1074 (26.2)	63.6 (62.1 to 65.2)	[45.5 - 81.8]
6	858 (20.9)	72.7 (72.0 to 73.4)	[45.5 - 90.9]
7	1285 (31.3)	72.7 (72.7 to 72.7)	[45.5 - 90.9]
Missing	147 (3.6)	72.7 (67.1 to 78.3)	[45.5 - 90.9]
Non-clinical shifts past month			
0	1164 (28.3)	72.7 (72.7 to 72.7)	[54.5 - 90.9]
<1	394 (9.6)	72.7 (72.1 to 73.4)	[54.5 - 90.9]
1	525 (12.8)	72.7 (72.7 to 72.7)	[50.0 - 90.9]
2	527 (12.8)	63.6 (57.3 to 70.0)	[45.5 - 81.8]
3	242 (5.9)	63.6 (55.1 to 72.2)	[40.0 - 81.8]
4	525 (12.8)	60.0 (51.5 to 68.5)	[36.4 - 81.8]
5	115 (2.8)	54.5 (47.3 to 61.8)	[36.4 - 72.7]
6	124 (3.0)	54.5 (45.6 to 63.5)	[31.7 - 80.9]
7	39 (0.9)	63.6 (43.5 to 83.8)	[36.4 - 81.8]
8	157 (3.8)	54.5 (45.2 to 63.9)	[36.4 - 81.8]
9	19 (0.5)	60.0 (34.6 to 85.4)	[27.3 - 72.7]
10	102 (2.5)	54.5 (45.2 to 63.9)	[36.4 - 80.0]
11-15	86 (2.1)	54.5 (44.7 to 64.4)	[27.3 - 72.7]
>15	91 (2.2)	63.6 (47.6 to 79.7)	[27.3 - 81.8]
Missing	137 (3.3)	72.7 (66.6 to 78.9)	[54.5 - 90.9]
Average commute in minutes			
1-10	396 (9.6)	72.7 (64.2 to 81.3)	[45.5 - 81.8]
11-20	814 (19.8)	72.7 (64.6 to 80.9)	[45.5 – 90.0]
21-30	967 (23.5)	72.7 (64.6 to 80.8)	[45.5 - 90.9]
31-40	703 (17.1)	63.6 (63.6 to 63.6)	[36.4 - 81.8]
41-50	546 (13.3)	72.7 (64.5 to 81.0)	[45.5 - 90.9]
51-60	365 (8.9)	72.7 (67.6 to 77.8)	[45.5 – 90.0]
>60	325 (7.9)	72.7 (66.9 to 78.5)	[45.5 - 90.9]
Missing	131 (3.2)	72.7 (68.4 to 77.1)	[54.5 - 90.9]
Do you have a dedicated time away from adult emergency medicine?			
No	3091 (75.2)	72.7 (67.2 to 78.3)	[45.5 - 90.9]
Yes	1020 (24.8)	63.6 (62.2 to 65.1)	[36.4 - 81.8]
Missing	136 (3.3)	72.7 (67.7 to 77.8)	[45.5 - 90.9]

Frequency and percentage, median NFR score with 95% bootstrapped confidence intervals and the inter-quartile range of participants within each category.

[1] Bootstrapped 95% confidence intervals based on 1000 replications on a minimum of 8 observations.

Online Supplementary Material 5
Summary of median quantile regression model fitted to the Need for Recovery (NFR) score with fixed effects for site, including the adjusted coefficient estimate (Adj. Coef. Est.) with corresponding 95% confidence interval (CI) and p-value.

	Adj. Coeff. Est. (95% CI)	P-value[1]
Constant (baseline NFR score)	59.51 (55.53 to 63.49)	< 0.001
Gender (baseline = Male)		
• Female	3.38 (1.80 to 4.95)	< 0.001
• Other/Prefer not to say	-0.10 (-7.84 to 7.64)	0.979
Any long-term health conditions or disabilities (baseline = No)		
• Yes	8.33 (5.73 to 10.93)	< 0.001
• Prefer not to say	6.10 (1.78 to 10.43)	0.006
ED paediatrics only? (baseline = No)		
• Yes	-8.47 (-12.97 to -3.98)	< 0.001
Clinical grade (baseline = Foundation)		
• ST1-ST2	-0.20 (-2.55 to 2.16)	0.869
• > ST2	1.04 (-1.49 to 3.57)	0.421
• SASG	-1.20 (-4.32 to 1.92)	0.450
• GP	-7.33 (-15.49 to 0.83)	0.078
• Consultant	-4.94 (-7.72 to -2.17)	< 0.001
I have been able to request and take study when I wanted (baseline = Neutral)		
• Strongly disagree	3.45 (-0.19 to 7.10)	0.063
• Disagree	3.57 (0.53 to 6.61)	0.022
• Agree	-1.18 (-3.36 to 1.00)	0.290
• Strongly agree	-6.32 (-9.23 to -3.41)	< 0.001
I have been able to request and take annual when I wanted (baseline = Neutral)		
• Strongly disagree	6.42 (2.69 to 10.15)	0.001
• Disagree	1.37 (-1.73 to 4.47)	0.385
• Agree	-2.60 (-5.07 to -0.13)	0.039
• Strongly agree	-4.31 (-7.33 to -1.28)	0.005
Proportion of time spent working out of hours (baseline = 0-25%)		
• 26-50%	5.96 (3.16 to 8.76)	< 0.001
• 51-75%	10.39 (7.54 to 13.25)	< 0.001
• 76-100%	14.34 (10.92 to 17.75)	< 0.001

Need for recovery amongst Emergency Physicians in the United Kingdom and Ireland: Findings from a Trainee Emergency Research Network (TERN) survey study

Research Checklist: The Checklist for Reporting Results of Internet E-Surveys (CHERRIES)

CHERRIES CHECKLIST ADAPTED FROM: Eysenbach, Gunther. "Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES)." *Journal of medical Internet research* vol. 6,3 e34. 29 Sep. 2004, doi:10.2196/jmir.6.3.e34			
Item Category	***Checklist Item***	***Explanation***	***Checklist Response***
Design	Describe survey design	Describe target population, sample frame. Is the sample a convenience sample? (In "open" surveys this is most likely.)	***Outlined in 'Methods'***
IRB (Institutional Review Board) approval and informed consent process	IRB approval	Mention whether the study has been approved by an IRB.	***Outlined in 'Ethics Approval'***
	Informed consent	Describe the informed consent process. Where were the participants told the length of time of the survey, which data were stored and where and for how long, who the investigator was, and the purpose of the study?	***Outlined in Survey Distribution, monitoring and recruitment***
	Data protection	If any personal information was collected or stored, describe what mechanisms were used to protect unauthorized access.	***Outlined in Survey Distribution, monitoring and recruitment***
Development and pre-testing	Development and testing	State how the survey was developed, including whether the usability and technical functionality of the electronic questionnaire had been tested before fielding the questionnaire.	***Outlined in 'Survey Development'***
Recruitment process and description of the sample having access to the questionnaire	Open survey versus closed survey	An "open survey" is a survey open for each visitor of a site, while a closed survey is only open to a sample which the investigator knows (password-protected survey).	***Outlined in Survey Distribution, monitoring and recruitment***
	Contact mode	Indicate whether or not the initial contact with the potential participants was made on the Internet. (Investigators may also send out questionnaires by mail and allow for Web-based data entry.)	***Outlined in 'Survey Distribution, monitoring and recruitment'***
	Advertising the survey	How/where was the survey announced or advertised? Some examples are offline media (newspapers), or online (mailing lists – If yes, which ones?) or banner ads (Where were these banner ads posted and what did they look like?). It is important to know the wording of the announcement as it will heavily influence who chooses to participate. Ideally the survey	***Outlined in 'Survey Distribution, monitoring and recruitment'***

		announcement should be published as an appendix.	
Survey administration	Web/E-mail	State the type of e-survey (eg, one posted on a Web site, or one sent out through e-mail). If it is an e-mail survey, were the responses entered manually into a database, or was there an automatic method for capturing responses?	***Outlined in 'Survey Distribution, monitoring and recruitment'***
	Context	Describe the Web site (for mailing list/newsgroup) in which the survey was posted. What is the Web site about, who is visiting it, what are visitors normally looking for? Discuss to what degree the content of the Web site could pre-select the sample or influence the results. For example, a survey about vaccination on a anti-immunization Web site will have different results from a Web survey conducted on a government Web site	***Outlined in 'Design'***
	Mandatory/voluntary	Was it a mandatory survey to be filled in by every visitor who wanted to enter the Web site, or was it a voluntary survey?	***Outlined in 'Survey Distribution, monitoring and recruitment'***
	Incentives	Were any incentives offered (eg, monetary, prizes, or non-monetary incentives such as an offer to provide the survey results)?	***No***
	Time/Date	In what timeframe were the data collected?	***Outlined in 'Sites and settings'***
	Randomization of items or questionnaires	To prevent biases items can be randomized or alternated.	***Not done***
	Adaptive questioning	Use adaptive questioning (certain items, or only conditionally displayed based on responses to other items) to reduce number and complexity of the questions	***Outlined in Survey Distribution, monitoring and recruitment***
	Number of Items	What was the number of questionnaire items per page? The number of items is an important factor for the completion rate.	***Outlined in 'Design'***
	Number of screens (pages)	Over how many pages was the questionnaire distributed? The number of items is an important factor for the completion rate.	***Outlined in 'Design'***
	Completeness check	It is technically possible to do consistency or completeness checks before the questionnaire is submitted. Was this done, and if "yes", how (usually JAVAScript)? An alternative is to check for completeness after the questionnaire has been submitted (and highlight mandatory items). If this has been done, it should be reported. All items should provide a non-response option such as "not applicable" or	***Not done***

		"rather not say", and selection of one response option should be enforced.	
	Review step	State whether respondents were able to review and change their answers (eg, through a Back button or a Review step which displays a summary of the responses and asks the respondents if they are correct).	***Outlined in Survey Distribution, monitoring and recruitment***
Response rates			
	Unique site visitor	If you provide view rates or participation rates, you need to define how you determined a unique visitor. There are different techniques available, based on IP addresses or cookies or both.	***Outlined in 'Results'***
	View rate (Ratio of unique survey visitors/unique site visitors)	Requires counting unique visitors to the first page of the survey, divided by the number of unique site visitors (not page views!). It is not unusual to have view rates of less than 0.1 % if the survey is voluntary	***Survey site contains first page of survey therefore N/A***
	Participation rate (Ratio of unique visitors who agreed to participate/unique first survey page visitors)	Count the unique number of people who filled in the first survey page (or agreed to participate, for example by checking a checkbox), divided by visitors who visit the first page of the survey (or the informed consents page, if present). This can also be called "recruitment" rate.	***Outlined in 'Results'***
	Completion rate (Ratio of users who finished the survey/users who agreed to participate)	The number of people submitting the last questionnaire page, divided by the number of people who agreed to participate (or submitted the first survey page). This is only relevant if there is a separate "informed consent" page or if the survey goes over several pages. This is a measure for attrition. Note that "completion" can involve leaving questionnaire items blank. This is not a measure for how completely questionnaires were filled in. (If you need a measure for this, use the word "completeness rate".)	***Outlined in 'Results'***
Preventing multiple entries from the same individual	Cookies used	Indicate whether cookies were used to assign a unique user identifier to each client computer. If so, mention the page on which the cookie was set and read, and how long the cookie was valid. Were duplicate entries avoided by preventing users access to the survey twice; or were duplicate database entries having the same user ID eliminated before analysis? In the latter case, which entries were kept for analysis (eg, the first entry or the most recent)?	***Not used***
	IP check	Indicate whether the IP address of the client computer was used to identify potential duplicate entries from the same user. If so, mention the period of	***Not used due to survey being completed on multi-user/single log-in computers***

		time for which no two entries from the same IP address were allowed (eg, 24 hours). Were duplicate entries avoided by preventing users with the same IP address access to the survey twice; or were duplicate database entries having the same IP address within a given period of time eliminated before analysis? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	
	Log file analysis	Indicate whether other techniques to analyze the log file for identification of multiple entries were used. If so, please describe.	***Not done***
	Registration	In "closed" (non-open) surveys, users need to login first and it is easier to prevent duplicate entries from the same user. Describe how this was done. For example, was the survey never displayed a second time once the user had filled it in, or was the username stored together with the survey results and later eliminated? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	***N/A***
Analysis	Handling of incomplete questionnaires	Were only completed questionnaires analyzed? Were questionnaires which terminated early (where, for example, users did not go through all questionnaire pages) also analyzed?	***Outlined in 'Data Analysis'***
	Questionnaires submitted with an atypical timestamp	Some investigators may measure the time people needed to fill in a questionnaire and exclude questionnaires that were submitted too soon. Specify the timeframe that was used as a cut-off point, and describe how this point was determined	***N/A***
	Statistical correction	Indicate whether any methods such as weighting of items or propensity scores have been used to adjust for the non-representative sample; if so, please describe the methods.	***Outlined in 'Data Analysis'***

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Need for recovery amongst Emergency Physicians in the United Kingdom and Ireland: a cross-sectional survey

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Need for recovery amongst Emergency Physicians in the United Kingdom and Ireland: a cross-sectional survey

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ABSTRACT

Objectives: To determine the need for recovery (NFR) among Emergency Physicians and to identify demographic and occupational characteristics associated with higher NFR scores.

Design: Cross-sectional electronic survey.

Setting: Emergency Departments (ED) (n=112) in the United Kingdom and Ireland.

Participants: Emergency Physicians, defined as any registered physician working principally within the ED, responding between June-July 2019.

Main outcome measure: NFR scale, an 11-item self-administered questionnaire that assesses how work demands affect inter-shift recovery.

Results: The median NFR score for all 4247 eligible, consented participants with a valid NFR score was 70.0 (95% CI: 65.5 to 74.5), with an IQR of 45.5–90.0. A linear regression model indicated statistically significant associations between gender, health conditions, type of ED, clinical grade, access to annual and study leave, and time spent working out-of-hours. Groups including male physicians, consultants, General Practitioners within the ED, those working in paediatric EDs and those with no long-term health condition or disability had a lower NFR score. After adjusting for these characteristics, the NFR score increased by 3.7 (95% CI: 0.3 to 7.1) and 6.43 (95% CI: 2.0 to 10.8) for those with difficulty accessing annual and study leave, respectively. Increased percentage of out-of-hours work increased NFR score almost linearly: 26-50% out-of-hours work = 5.7 (95% CI: 3.1 to 8.4); 51-75% out-of-hours work = 10.3 (95% CI: 7.6 to 13.0); 76-100% out-of-hours work = 14.5 (95% CI: 11.0 to 17.9).

Conclusion: Higher NFR scores were observed among Emergency Physicians than reported in any other profession or population to date. Whilst out-of-hours working is unavoidable, the linear relationship observed suggests that any reduction may result in NFR improvement. Evidence-based strategies to improve well-being such as proportional out-of-hours working and improved access to annual and study leave should be carefully considered and implemented where feasible.

ARTICLE SUMMARY

Strengths and limitations of this study

- This is the first study evaluating the need for recovery (NFR) scale within a large healthcare population.

- The inclusion of responses from over half of all UK Emergency Departments indicates the results are likely to be generalisable.

- The high volume of responses, with over half of study sites exceeding 70% participant response rates, indicates that the NFR scale is an acceptable measurement tool for physicians.

- The study is limited by the single-point of time measurement therefore seasonal bias cannot be excluded and further assessment of test-retest reliability is desirable.

- The use of self-administered dichotomous questionnaires is acknowledged to limit wider insights into physician recovery and well-being.

INTRODUCTION

Recruitment and retention challenges in acute care pose a significant and ongoing threat to effective healthcare provision. The need to maintain a healthy and sustainable workforce is vital to safeguard future services.[1] Physician well-being is a key influence on retention, with low job satisfaction and high levels of stress directly leading to concern over job sustainability.[2–4] Globally, high rates of physician burnout are increasingly recognised, along with the consequent negative impact on delivery of high quality patient care.[5–10]

The Need for Recovery (NFR) scale measures the subjective perception of the need to recuperate from physical and mental demands of a working day, and is a suitable tool with which to assess the early symptoms of fatigue in shift workers.[11,12] Within unscheduled care settings such as emergency medicine, shift work is often of high intensity, and additional factors such as department crowding, pressured resources and inability to control patient volume may also influence NFR. Where fatigue does occur and cannot be sufficiently recovered between shifts, the effect is cumulative and may lead to increased occupational stress and impaired long-term health.[13,14]

Burnout inventories are increasingly utilised as an attempt to measure physician well-being.[15] Although they provide valuable insight into well-being, they are not without issue. Limitations include variability in burnout definitions, time required for completion, ease of completion, respondent survey fatigue, and difficulty translating results into intervention.[16,17,18] Additionally, these methods quantify established burnout; once this has occurred the human and financial resource impact is already immense, with

associated workforce depletion and negligible mitigation strategies.[19,20] The identification of those clinicians *at risk* of burnout, at an early timepoint when interventions may be effective, presents a critical challenge.

Increasing NFR is associated with the likelihood of progression to occupational burnout and health complaints, with negative effects cumulative over time in several validation studies [11,13]. Increased NFR may therefore precede the onset of sustained occupational burnout, and offer advantages over other burnout inventories as a simple quantifiable metric obtained through a rapid, standalone, and repeatable 11-item questionnaire. A single centre study assessing the utility of the NFR in an ED population reported a high response rate (80%) and completion time of less than 10 minutes whilst gaining insight into shift patterns, work-life balance and well-being [21]. This might suggest that the method of questioning used in the NFR scale and emphasis on recovery as opposed to more emotive questioning could be beneficial in improving response rates and reducing respondent fatigue in repeat usage. As such, NFR may provide a valuable option for regular evaluating of staff well-being and identifying opportunity for early intervention in busy EDs. Staff well-being is the fourth highest Emergency Medicine (EM) Research Priority identified by the James Lind Alliance Priority Setting Partnership, involving patients, carers and physicians.[22].

We therefore aimed to determine the NFR among Emergency Physicians in EDs in the UK and Ireland, and identify demographic and occupational characteristics associated with higher NFR scores that might

allow for early targeted intervention to improve physicians' well-being and reduce burnout.

METHODS

This cross-sectional electronic survey study targeted a representative sample of Emergency Physicians working across the UK and Ireland, and was performed and reported in line with the Checklist for Reporting Results of Internet E-surveys.[23] The study was registered at ISRCTN (https://doi.org/10.1186/ISRCTN21869845). Ethical approval was obtained from the UK Health Research Authority (Reference: 19/HRA/2404) alongside equivalent approvals in Scotland, Northern Ireland and Ireland.

Settings and Participants

An initial sample of 100 EDs was deemed necessary to ensure inclusion of greater than 50% of Type 1 EDs, defined as 'an EM consultant-led 24-hour service with full resuscitation facilities', in England. [24] The study was coordinated via the UK Trainee Emergency Research Network (TERN) and delivered in collaboration with Paediatric Emergency Research in the UK and Ireland (PERUKI) and Ireland TERN. [25, 26] Signposting to the survey and enrolment of participants was led by site principal investigators (PI), who were provided with standardised study documentation. Local and national promotion of the study was conducted at professional meetings, through social media, national newsletters, and using the Clinical Research Network infrastructure.

Physicians of any grade who were registered with either the UK General Medical Council or Irish Medical Council, and who were employed within a

participating ED, were invited to participate. For the purposes of this study, the term Emergency Physician is defined as all doctors working within the ED. This included; doctors specialising in EM, comprising six years of postgraduate training for full qualification to achieve the grade of Emergency Medicine consultant, or non-EM specialists undertaking rotations in the ED as part of their professional training, including those in the first and second year of postgraduate training and physicians undertaking training in General Practice, Anaesthesia and Acute Medicine who commonly undertake a four to six month ED rotation (Online Supplementary Material 1). Physicians who did not hold a permanent contract with a participating hospital (such as those working ad-hoc locum shifts), those on leave during the study period, and those in a non-clinical role were excluded.

Survey Development

The NFR scale consists of 11 items each requiring a dichotomous 'yes' or 'no' response, originally developed as a subscale of the Dutch Questionnaire on the Experience and Evaluation of Work (QEEW) (Online Supplementary material 2, page 10).[27] Indicators of fatigue such as reduced motivation for activities and concentration at the end of a working day are assessed to measure the effect of work demands experienced. A 'yes' response to an item, with the exception of question four which is reversed, signals an unfavourable situation. The total sum of the unfavourable responses is multiplied by 100 and divided by the total number of scale items, 11, producing an overall score between 0 and 100, with a higher score denoting a greater NFR and increased short-term work-related fatigue. The NFR has previously been demonstrated to have an overall Cronbach's alpha of 0.88, a measure of internal consistency and

questionnaire reliability, with a range of 0.81 to 0.92 in subgroup analyses of the same validation study.[28] Following a minor amendment to one question to increase applicability to the study population (from 'After the evening meal, I generally feel in good shape' to 'After my breaks I feel fresh to continue my work'), feasibility work in a single UK centre demonstrated a Cronbach's alpha of 0.79, and found that the NFR scale was acceptable and user-friendly. [21]

A patient and public involvement (PPI) consultation was conducted at the UK Emergency Medicine Trainee Association Conference (Cardiff, December 2018), using a semi-structured question guide for mixed focus groups to review a proposed participant survey. A key element of this consultation explored the use of a burnout inventory within the proposed study; concerns relating to respondent fatigue, length of survey and assessment of questions using a Likert scale indicated that such an inventory was not universally acceptable to Emergency Physicians. Based on this consultation, the final participant survey included the 11-item NFR scale used in the feasibility work and 44-items collecting the participants' demographic, occupational and perceived well-being characteristics (Online Supplementary Material 2). Questions relating to 'out-of-hours' work were defined as work outside of normal working office hours (9am until 5pm, Monday to Friday).

A separate site-specific survey was developed de novo with expert input from experienced EM physicians, consisting of 39-items identified from the literature and/or consensus of the study team, which explored departmental, rota pattern and staffing characteristics likely to provide context for analysis and interpretation of individual survey results (Online Supplementary Material 3).

Only one site-specific survey was required per participating centre and was completed by the site PI.

Survey Distribution, monitoring and recruitment

All participants were provided with an information sheet, and consented to participation prior to completing the survey; this was voluntary, anonymous, and no incentives were given. Respondents were able to review and change their answers prior to final submission of the survey. Branching logic was used for responses to certain questions. Data were collected during a six-week period from 3rd June 2019. During this period, advertisement of the survey and weekly reminders were sent out via site PIs. The participant and site-specific surveys were open surveys accessed through a link and hosted on a research specific electronic survey platform, Research Electronic Data Capture platform ('REDCap'; University of Bristol), which complies with European General Data Protection Regulations.[29,30]

Prior to study commencement, site PIs provided a best estimate of eligible participants which accounted for local physician absence due to sickness, leave, and factors such as sabbaticals and professional secondments. This denominator was used to give a best-estimate of the per-site survey response rate, with a stated aim of achieving a 70% response rate.

Statistical Analysis

Statistical analysis was undertaken using STATA 14. [31] Participants were only included in any of the reported analyses if they were from one of the 112 registered sites and provided a response for at least eight of the 11 items of the NFR scale as per imputation guidelines. Imputation was performed by replacing missing items with the mean of all completed item responses. [32]

As one item in the NFR scale was amended due to applicability to the study population, the internal consistency of the NFR scale for all participants with a valid NFR score was calculated by Cronbach's alpha.

To describe the study sample, the frequency and percentage of participants by site, demographic and occupational characteristics are reported. As the distribution of the NFR score in this study was negatively skewed, summary statistics of the median NFR score are reported with corresponding bootstrapped 95% confidence intervals from 1000 replications (providing there are at least 8 observations to allow for sufficient number of sample combinations), and inter-quartile ranges (IQR) of all eligible participants. Box plots were used as visual aids to identify covariates that may have a statistically significant association with the NFR score and the nature of the relationship.

To facilitate comparisons with previous published literature and given the large number of participants, we fitted Gaussian, mixed effects, linear regression models to NFR score, where site was included as a random effect to account for potentially unknown differences between EDs. To identify statistically significant associations between the NFR score and observed covariates, the forward model selection procedure was implemented; inclusion in the model was based upon the goodness of fit test at the 5% level of significance, using only participants with complete NFR score and covariate data. The final model was estimated using participants with complete data for the included covariates and NFR score, with the coefficient estimate calculated by adjusting for all covariates reported in the model. Quantile regression was used to confirm the direction and significance of the identified associations under non-parametric assumptions.

RESULTS

Characteristics of the 112 participating sites are presented in table 1.

Table 1: Characteristics of sites registered to take part in the survey study

Site Characteristics	N (%) Total = 112
Country	
England	89 (79.5)
Wales	3 (2.7)
Northern Ireland	3 (2.7)
Scotland	12 (10.7)
Republic of Ireland	5 (4.4)
ED Annual Attendance	
≤ 50,000	11 (9.8)
50,001 to 100,000	46 (41.1)
>100,000	42 (37.5)
Missing	*13 (11.6)*
Specialist Designation	
Trauma Unit (TU)	55 (49.1)
Major Trauma Centre (MTC)	25 (22.3)
Stroke Centre	42 (37.5)
PCI Centre	30 (26.8)

ED Emergency department
TU In the UK National Health Service, a hospital that provides care for all except the most severe major trauma patients. May provide initial stabilisation of severely injured patients prior to transfer to an MTC.
MTC A specialist (tertiary) centre responsible for care of the most severely injured patients.
PCI Percutaneous Coronary Intervention

Of 5107 unique visits to the online survey, 4365 of these were registered at one of the 112 sites and provided consent, with 4247 completing at least eight items of the NFR scale. Cronbach's alpha for all participants with a valid NFR score

was 0.80. The median NFR score across all eligible participants was 70.0 (95% CI: 65.5 to 74.5), with an IQR of 45.5 – 90.0. Figure 1 and Figure 2, and tables 2 and 3 present a selection of participant's NFR score by demographic and occupational characteristics, with additional characteristics presented in the Online Supplementary Material 4.

Table 2: Summary statistics of NFR score by participant's characteristics. Frequency and percentage, median Need for Recovery (NFR) score with 95% bootstrapped confidence intervals and the inter-quartile range of participants within each category.

Participant Characteristics	N (%)	NFR Score	
		Median (95% CI)	[LQ - UQ]
All participants	4247 (100)	70.0 (62.0 to 78.0)	[45.5 - 90.0]
Length of time worked in current ED (months)			
0 to 3	740 (17.5)	72.7 (71.7 to 73.8)	[45.5 - 90.9]
> 3 to 6	848 (20.0)	72.7 (72.7 to 72.7)	[54.5 - 90.9]
> 6 to 12	729 (17.2)	72.7 (64.7 to 80.7)	[45.5 - 90.9]
> 12 to 24	370 (8.7)	63.6 (58.8 to 68.4)	[45.5 - 90.9]
> 24 to 60	583 (13.8)	63.6 (62.2 to 65.1)	[36.4 - 81.8]
> 60 to 120	497 (11.7)	63.6 (56.7 to 70.5)	[36.4 - 81.8]
> 120	473 (11.2)	54.5 (46.6 to 62.5)	[36.4 - 81.8]
Missing	*7 (0.2)*	*18.2 (NA)* [1]	*[9.1 - 54.5]*
Type of contract			
100%	3445 (83.5)	72.7 (67.1 to 78.4)	[45.5 - 90.9]
90%	72 (1.7)	63.6 (54.0 to 73.3)	[36.4 - 81.8]
80%	200 (4.8)	63.6 (61.4 to 65.8)	[45.5 - 81.8]
70%	116 (2.8)	72.7 (63.6 to 81.9)	[50.0 - 81.8]
60%	142 (3.4)	63.6 (54.4 to 72.9)	[45.5 - 90.9]
50%	85 (2.1)	63.6 (53.5 to 73.7)	[36.4 - 81.8]
< 50%	66 (1.6)	50.0 (35.7 to 64.3)	[27.3 - 81.8]
Missing	*121 (2.9)*	*72.7 (67.8 to 77.7)*	*[54.5 - 90.9]*
Significant caring responsibilities outside of work			
No	2616 (63.6)	72.7 (68.5 to 77.0)	[45.5 - 90.9]
Yes	1427 (34.7)	63.6 (62.8 to 64.5)	[36.4 - 81.8]
Prefer not to say	73 (1.8)	81.8 (71.0 to 92.7)	[54.5 - 90.9]
Missing	*131 (3.2)*	*72.7 (68.2 to 77.3)*	*[54.5 - 90.9]*

[1] *Insufficient observations for Bootstrapped 95% confidence intervals based*

Table 3: Summary statistics of NFR score by occupational characteristics. Frequency and percentage, median Need for Recovery (NFR) score with 95% bootstrapped confidence intervals and the inter-quartile range of participants within each category.

Occupational	N (%)	NFR Score

Characteristics		Median (95% CI) [1]	[LQ - UQ]
All participants	4247 (100)	70.0 (62.0 to 78.0)	[45.5 - 90.0]
scheduled weekend work frequency			
1 in 2	1479 (36.0)	72.7 (72.3 to 73.2)	[54.5 - 90.9]
1 in 3	865 (21.1)	72.7 (68.1 to 77.4)	[45.5 - 90.9]
1 in 4	542 (13.2)	63.6 (57.1 to 70.2)	[45.5 - 81.8]
1 in 5	310 (7.5)	54.5 (48.4 to 60.7)	[36.4 - 81.8]
1 in 6	485 (11.8)	54.5 (49.8 to 59.3)	[27.3 - 81.8]
< 1 in 6	307 (7.5)	63.6 (55.2 to 72.1)	[36.4 - 81.8]
None	121 (2.9)	54.5 (45.7 to 63.4)	[27.3 - 81.8]
Missing	*138 (3.4)*	*72.7 (65.9 to 79.6)*	*[45.5 - 90.9]*
Maximum number of consecutive clinical shifts scheduled to work			
1	52 (1.3)	63.6 (45.1 to 82.2)	[27.3 - 90.9]
2	190 (4.6)	54.5 (47.6 to 61.5)	[27.3 - 72.7]
3	465 (11.3)	63.6 (60.3 to 67.0)	[36.4 - 81.8]
4	783 (19)	63.6 (63.0 to 64.3)	[45.5 - 81.8]
5	827 (20.1)	72.7 (66.2 to 79.3)	[45.5 - 81.8]
6	389 (9.5)	72.7 (67.3 to 78.2)	[45.5 - 90.0]
7	855 (20.8)	72.7 (70.8 to 74.6)	[45.5 - 90.9]
8	554 (13.5)	72.7 (66.5 to 78.9)	[54.5 - 90.9]
Missing	*132 (3.2)*	*72.7 (67.9 to 77.6)*	*[54.5 - 90.9]*

[1] Bootstrapped 95% confidence intervals based on 1000 replications on a minimum of 8 observations.

Only 7.5% of the participants were aged over 50 years, and the majority were aged between 26 and 30 years (28.6%). NFR score appeared to decrease with age, such that those in age groups 20 to 35 years all had a median score of 72.7, age groups 36 to 55 had a median score of 63.6, and those over 55 years had a median score of 54.5 (figure 1a). There was a reasonable balance between males and females, with just over 1% who did not submit a response (missing), preferred not to say or other. Females had a higher median NFR score of 72.7 (95% CI: 70.5 to 75.0) compared with males 63.6 (95% CI: 60.8 to 66.5) (figure 1b). Within clinical grade, consultants accounted for over a quarter of the participants who (with GPs) had the lowest median NFR score of 54.5 (consultants 95% CI: 53.6 to 55.5) compared with 72.7 in all other grades (figure 1c). The majority of participants had no long-term health conditions or

disability (88.6%), with a lower NFR score of 63.6 (95% CI 60.2 to 67.1) compared with those who did report a long-term health condition or disability 72.7 (95% CI: 66.2 to 79.2) (figure 1d). Most participants worked full time (83.5%), but overall, the NFR score did not decrease as contract proportion decreased (table 2). Over half (54.6%) had been working in their current ED for 1 year or less and generally had higher NFR scores compared to those present for over 1 year. Less than 35% of participants declared significant caring responsibilities outside of work, but those who do had a lower median NFR score (63.6, 95% CI: 62.8 to 64.5) than those who did not (72.7, 95% CI: 68.5 to 77.0).

Most of the participants agreed or strongly agreed they were able to obtain study or annual leave when requested (68% and >73%, respectively). As the ability to obtain study and annual leave on request increased, the NFR score decreased from 81.8 (95% CI: 81.4 to 82.2) to 54.5 (95% CI: 49.4 to 59.7) for study leave and 81.8 (95% CI: 76.4 to 87.2) to 60.0 (95% CI: 51.8 to 68.2) for annual leave (figures 2a and 2b). There was evidence the NFR score increased as the proportion of time working out-of-hours increased, from 54.5 (95% CI: 47.8 to 61.3) to 81.8 (95% CI: 75.4 to 88.3) (figure 2c). Over 75% of participants spent the majority of their time in adult EM with a median NFR score of 72.7 for mixed or adult only, which was higher when compared with paediatrics only 63.6 (95% CI: 55.2 to 72.1) (figure 2d). Most participants worked 1 in 2 weekends (36%) with a median NFR score of 72.7, which decreased to 54.5 for those who did not work any weekend shifts (see table 3). Over 50% reported working 5 to 8 consecutive clinical shifts and had a median

NFR score of 72.7, compared with those who worked less than five who had a median NFR ≤ 63.6.

The summary statistics of the final regression model are presented in table 4.

Table 4: Summary of final Gaussian, mixed effects, linear regression model fitted to the Need for Recovery (NFR) score, including the adjusted coefficient estimate (Adj. Coef. Est.) with corresponding 95% confidence interval (CI) and p-value.

	Adj. Coeff. Est. (95% CI)[1]	P-value[2]
Constant (baseline NFR score)	59.51(55.53 to 63.49)	< 0.001
Gender (baseline = Male)		
• Female	3.40(1.80 to 4.99)	< 0.001
• Other/Prefer not to say	-0.46(-9.07 to 8.15)	0.916
Any long-term health conditions or disabilities (baseline = No)		
• Yes	8.52(5.67 to 11.36)	< 0.001
• Prefer not to say	6.24(1.52 to 10.95)	0.01
ED paediatrics only? (baseline = No)		
• Yes	-7.08(-10.4 to -3.77)	< 0.001
Clinical grade (baseline = Foundation)		
• ST1-ST2	-0.08(-2.67 to 2.51)	0.953
• > ST2	1.32(-1.37 to 4.01)	0.336
• SASG	-1.13(-4.27 to 2.02)	0.482
• GP	-8.26(-15.09 to -1.44)	0.018
• Consultant	-5.30(-8.07 to -2.53)	< 0.001
I have been able to request and take study when I wanted (baseline = Neutral)		
• Strongly disagree	4.23(-0.26 to 8.71)	0.065
• Disagree	3.72(0.29 to 7.15)	0.034
• Agree	-1.32(-3.60 to 0.96)	0.257
• Strongly agree	-6.50(-9.43 to -3.56)	< 0.001
I have been able to request and take annual when I wanted (baseline = Neutral)		
• Strongly disagree	6.43(2.03 to 10.83)	0.004
• Disagree	1.13(-2.34 to 4.61)	0.523
• Agree	-2.84(-5.54 to -0.14)	0.039
• Strongly agree	-4.89(-8.06 to -1.72)	0.002
Proportion of time spent working out-of-hours (baseline = 0-25%)		
• 26-50%	5.74(3.13 to 8.35)	< 0.001

• 51-75%	10.32(7.60 to 13.03)	< 0.001
• 76-100%	14.45(10.97 to 17.92)	< 0.001

[1] Each coefficient estimate is adjusted for all other covariates in the model

[2] Null hypothesis: Adjusted Coefficient Estimate = 0 (i.e. is there statistically significant evidence this category differs from the baseline category)

ST1-ST2 *Specialist training year 1-2 (this included physicians training in Anaesthetics, Emergency Medicine, Acute Medicine and General Practice)*
SASG *Staff grade, associate specialist and speciality grade*
GP *General Practitioner working within the ED*

This model was based on 3979 participants with complete data for all the included covariates. Quantile regression confirmed the direction and significance of the associations remained the same (Online Supplementary Material 5). Each covariate was adjusted for all other statistically significant associations. The results from this model indicated there were statistically significant associations between gender, health conditions, type of ED (adult or paediatric), clinical grade, access to annual and study leave, and time spent working out-of-hours. The model suggested that males, GPs or consultants, those working in paediatrics and those with no long-term health condition or disability had the lowest NFR score. The greatest increase in NFR score was associated with those who reported more than a 75% proportion of out-of-hours work (14.45: 95% CI 10.97 to 17.92). If participants strongly agreed they were able to obtain study leave upon request this reduced their NFR score by 6.5 (95% CI: 3.56 to 9.43) and annual leave could reduce their NFR score 4.89 (95% CI 1.72 to 8.06).

DISCUSSION

Emergency Physicians in the UK and Ireland have a higher NFR score than has been reported in any previously studied population.[11,33–37] Three

modifiable occupational factors were significantly associated with higher NFR scores (poor access to annual leave, and study leave, and proportion of out-of-hours work), and four further non-modifiable demographic factors were associated with a decreased NFR score. These were the senior grade of EM consultant, male gender, absence of long-term health condition or disability, and working in a paediatric only ED.

The NFR median score of 70 found in this study compares unfavourably with multiple occupational groups and baseline population data from a large Dutch validation study, [37] where the highest frequency of responses were observed at the lower end of the scale. Previous measurement in shift workers (including hospital nurses) showed significantly lower NFR scores, [13,33] as did studies of heavy goods vehicle drivers and merchant seafarers, all with average NFR scores in the range 36-44. [35,36] Our findings are however congruent with our own feasibility work completed in a single centre UK ED, reporting a median NFR of 81.8 in all staff groups. [21] The impact of rising patient numbers and overcrowding in UK and Ireland EDs is commonly reported, [38,39] but our findings are the first to illustrate the impact of high work demand on physician's need to recuperate from work and the modifiable factors which can mitigate this fatigue.

The three modifiable occupational factors represent areas of autonomy and control, correlating well with previous work establishing these as core drivers to minimise physician workplace stress and ensure well-being. [2,40,41] Prioritising change in these domains may result in NFR score reduction and

reduce negative effects on health and well-being, including occupational burnout. Whilst out-of-hours working is inherent and unavoidable in EM, the linear relationship we observed suggests that any reduction may result in direct improvements in NFR, and evidence-based strategies such as proportional control of out-of-hours working, annualised rota patterns and/or provision of rest facilities should therefore be considered urgently.[42–44]

As NFR does not change with seniority prior to consultant level, this indicates that factors that could be postulated to influence work stress in postgraduate training such as increased responsibility, management roles and experience, appear to have a limited influence on NFR. It is therefore possible that the reduction in NFR seen in those at consultant level supports the hypothesis that broader perceptions of job autonomy and control, may be explicitly linked to well-being in healthcare.[2,44] This correlates with our finding that poor access to study and annual leave increases NFR, likely to be more accessible at a senior level. Further areas merit exploration including the link to out-of-hours working, influence of night and day shift proportions and possible qualitative enquiry of personal experience and clinical performance.

The relationship observed between gender and NFR is likely to be overly simplistic requiring further evaluation. Presumed confounding variables affecting this issue (such as a primary carer role and domestic responsibilities) have been previously reported to be unrelated or protective against maladaptive fatigue and are supported with findings from this study. [45]

Awareness of the four demographic factors identified could be important at a departmental planning level and increase advocacy for colleagues at greatest risk of impaired well-being.

The main strength of our study is inclusion of responses from over half of all UK EDs, enhancing generalisability of our findings. [24] The high volume of responses indicate the NFR scale as an 11-item survey, is an acceptable measure for physicians, with over half of sites exceeding 70% response rates. A key weakness is the single-point-of-time measurement, as seasonal bias may have affected NFR scores. Furthermore, we acknowledge the disadvantages of self-administered dichotomous questionnaires which may limit the richness of insights.[46,47] Open-ended questions may be desirable in future survey iterations.

The straightforward construction and interpretation, ease of administration and completion confers advantages of the NFR scale over more complex well-being inventories allowing for quick assessment of a workforce NFR, especially in a busy clinical environment. Where identified to be high and interventions initiated such as a rota change, the NFR scale can be easily repeated to confirm or refute the impact, and may identify further areas resulting in continual improvement whilst minimising survey respondent fatigue.

Future areas of work will include analysis of the NFR findings in relationship to well-being and burnout. Any future work should also include

other ED staff groups and physician groups to gain a broader picture across the multi-professional team.

In conclusion, this study provides a robust estimate of the NFR for Emergency Physicians in the UK and Ireland, which is higher than any occupation reported to date. Several potentially modifiable occupational characteristics were associated with higher NFR, and future work to assess the impact of modifying these factors will inform strategies to reduce NFR. In time this may lead to improved long-term physician well-being and enhanced staff retention.

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This project was funded through a grant from the Royal College of Emergency Medicine (RCEM) (Reference number: G/2018/1). This study was independent of RCEM, and the sponsor had no role in the design of this study and no role during its execution, analyses, interpretation of the data, or decision to submit results.

Competing interests:

All authors have completed the ICMJE uniform disclosure form and declare: no support from any organisation for the submitted work; TR has received 50% salary funding for two years as the Trainee Emergency Research Network fellow from the Royal College of Emergency Medicine; DH reports an honorary role as the Professor of the Royal College of Emergency Medicine during the conduct of this study; no other relationships or activities that could appear to have influenced the submitted work.

Patient and Public Involvement statement:

The concept of the research was presented to over 100 members of the public at a Research & Development PPI Conference on 20th September 2018. Participants were supportive of the concept of the study, and no concerns were raised. Further public and stakeholder engagement took place through a workshop held at the UK Emergency Medicine Trainees Association Annual Conference in December 2018, this influenced the outcome measures and survey design including the removal of a formal burnout inventory due to

perceptions and experience of respondent fatigue in the target participant group.

Ethics Approval:

This study protocol was submitted through the Integrated Research Application System (IRAS), IRAS number 262048 and received proportionate ethical approval by the Health Research Authority and Health and Care Research Wales, Research Ethics Committee reference 19/HRA/2404 and equivalent approvals in Scotland, Northern Ireland and Ireland. All participants provided informed consent prior to beginning the survey

Data sharing:

De-identified participant level data by site will be made available on reasonable request through the study team (tern@rcem.ac.uk). Data will be available for researchers whose proposed use of the data has been approved by the study team.

Transparency statement:

The lead author, Dr Laura Cottey, and the co-authors affirm that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Dissemination to participants and related patient and public communities:

The authors are unable to disseminate the result of the research to study participants directly, but the results will be made publicly available through open access publication and dissemination of the results through site principal investigators and social media.

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Contributors:

LC, TR and BG contributed to the development of the study design, data collection and analysis, the first draft of the manuscript and subsequent revised versions. DH and JML contributed to the development of the study design, data analysis, the first draft of the manuscript and subsequent revised versions. MDL contributed to survey development, data collection and final version of

manuscript; KS and DE provided the statistical analysis plan and contributed to data analysis, the first draft of the manuscript and subsequent revised versions. All authors approved the final version of the manuscript for submission. LC is the guarantor. TERN and PERUKI collaborators contributed to local study promotion and participant recruitment.

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Research Checklist: The Checklist for Reporting Results of Internet E-Surveys (CHERRIES)

CHERRIES CHECKLIST ADAPTED FROM: Eysenbach, Gunther. "Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES)." *Journal of medical Internet research* vol. 6,3 e34. 29 Sep. 2004, doi:10.2196/jmir.6.3.e34			
Item Category	***Checklist Item***	***Explanation***	***Checklist Response***
Design	Describe survey design	Describe target population, sample frame. Is the sample a convenience sample? (In "open" surveys this is most likely.)	***Outlined in 'Methods'***
IRB (Institutional Review Board) approval and informed consent process	IRB approval	Mention whether the study has been approved by an IRB.	***Outlined in 'Ethics Approval'***
	Informed consent	Describe the informed consent process. Where were the participants told the length of time of the survey, which data were stored and where and for how long, who the investigator was, and the purpose of the study?	***Outlined in Survey Distribution, monitoring and recruitment***
	Data protection	If any personal information was collected or stored, describe what mechanisms were used to protect unauthorized access.	***Outlined in Survey Distribution, monitoring and recruitment***
Development and pre-testing	Development and testing	State how the survey was developed, including whether the usability and technical functionality of the electronic questionnaire had been tested before fielding the questionnaire.	***Outlined in 'Survey Development'***
Recruitment process and description of the sample having access to the questionnaire	Open survey versus closed survey	An "open survey" is a survey open for each visitor of a site, while a closed survey is only open to a sample which the investigator knows (password-protected survey).	***Outlined in Survey Distribution, monitoring and recruitment***
	Contact mode	Indicate whether or not the initial contact with the potential participants was made on the Internet. (Investigators may also send out	***Outlined in 'Survey Distribution, monitoring and recruitment'***

		questionnaires by mail and allow for Web-based data entry.)	
	Advertising the survey	How/where was the survey announced or advertised? Some examples are offline media (newspapers), or online (mailing lists – If yes, which ones?) or banner ads (Where were these banner ads posted and what did they look like?). It is important to know the wording of the announcement as it will heavily influence who chooses to participate. Ideally the survey announcement should be published as an appendix.	***Outlined in 'Survey Distribution, monitoring and recruitment'***
Survey administration	Web/E-mail	State the type of e-survey (eg, one posted on a Web site, or one sent out through e-mail). If it is an e-mail survey, were the responses entered manually into a database, or was there an automatic method for capturing responses?	***Outlined in 'Survey Distribution, monitoring and recruitment'***
	Context	Describe the Web site (for mailing list/newsgroup) in which the survey was posted. What is the Web site about, who is visiting it, what are visitors normally looking for? Discuss to what degree the content of the Web site could pre-select the sample or influence the results. For example, a survey about vaccination on a anti-immunization Web site will have different results from a Web survey conducted on a government Web site	***Outlined in 'Design'***
	Mandatory/voluntary	Was it a mandatory survey to be filled in by every visitor who wanted to enter the Web site, or was it a voluntary survey?	***Outlined in 'Survey Distribution, monitoring and recruitment'***
	Incentives	Were any incentives offered (eg, monetary, prizes, or non-monetary incentives such as an offer to provide the survey results)?	***No***
	Time/Date	In what timeframe were the data collected?	***Outlined in 'Sites and settings'***
	Randomization of items or questionnaires	To prevent biases items can be randomized or alternated.	***Not done***
	Adaptive questioning	Use adaptive questioning (certain items, or only conditionally displayed based on responses to other items) to reduce number and complexity of the questions	***Outlined in Survey Distribution, monitoring and recruitment***
	Number of Items	What was the number of questionnaire items per page? The number of items is an important factor for the completion rate.	***Outlined in 'Design'***

	Number of screens (pages)	Over how many pages was the questionnaire distributed? The number of items is an important factor for the completion rate.	***Outlined in 'Design'***
	Completeness check	It is technically possible to do consistency or completeness checks before the questionnaire is submitted. Was this done, and if "yes", how (usually JAVAScript)? An alternative is to check for completeness after the questionnaire has been submitted (and highlight mandatory items). If this has been done, it should be reported. All items should provide a non-response option such as "not applicable" or "rather not say", and selection of one response option should be enforced.	***Not done***
	Review step	State whether respondents were able to review and change their answers (eg, through a Back button or a Review step which displays a summary of the responses and asks the respondents if they are correct).	***Outlined in Survey Distribution, monitoring and recruitment***
Response rates			
	Unique site visitor	If you provide view rates or participation rates, you need to define how you determined a unique visitor. There are different techniques available, based on IP addresses or cookies or both.	***Outlined in 'Results'***
	View rate (Ratio of unique survey visitors/unique site visitors)	Requires counting unique visitors to the first page of the survey, divided by the number of unique site visitors (not page views!). It is not unusual to have view rates of less than 0.1 % if the survey is voluntary	***Survey site contains first page of survey therefore N/A***
	Participation rate (Ratio of unique visitors who agreed to participate/unique first survey page visitors)	Count the unique number of people who filled in the first survey page (or agreed to participate, for example by checking a checkbox), divided by visitors who visit the first page of the survey (or the informed consents page, if present). This can also be called "recruitment" rate.	***Outlined in 'Results'***
	Completion rate (Ratio of users who finished the survey/users who agreed to participate)	The number of people submitting the last questionnaire page, divided by the number of people who agreed to participate (or submitted the first survey page). This is only relevant if there is a separate "informed consent" page or if the survey goes over several pages. This is a measure for attrition. Note that "completion" can involve leaving questionnaire items blank. This is not a measure for how completely questionnaires were filled in. (If you need a measure for this, use the word "completeness rate".)	***Outlined in 'Results'***
Preventing multiple	Cookies used	Indicate whether cookies were used to assign a unique user identifier to each	***Not used***

entries from the same individual		client computer. If so, mention the page on which the cookie was set and read, and how long the cookie was valid. Were duplicate entries avoided by preventing users access to the survey twice; or were duplicate database entries having the same user ID eliminated before analysis? In the latter case, which entries were kept for analysis (eg, the first entry or the most recent)?	
	IP check	Indicate whether the IP address of the client computer was used to identify potential duplicate entries from the same user. If so, mention the period of time for which no two entries from the same IP address were allowed (eg, 24 hours). Were duplicate entries avoided by preventing users with the same IP address access to the survey twice; or were duplicate database entries having the same IP address within a given period of time eliminated before analysis? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	***Not used due to survey being completed on multi-user/single log-in computers***
	Log file analysis	Indicate whether other techniques to analyze the log file for identification of multiple entries were used. If so, please describe.	***Not done***
	Registration	In "closed" (non-open) surveys, users need to login first and it is easier to prevent duplicate entries from the same user. Describe how this was done. For example, was the survey never displayed a second time once the user had filled it in, or was the username stored together with the survey results and later eliminated? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	***N/A***
Analysis	Handling of incomplete questionnaires	Were only completed questionnaires analyzed? Were questionnaires which terminated early (where, for example, users did not go through all questionnaire pages) also analyzed?	***Outlined in 'Data Analysis'***
	Questionnaires submitted with an atypical timestamp	Some investigators may measure the time people needed to fill in a questionnaire and exclude questionnaires that were submitted too soon. Specify the timeframe that was used as a cut-off point, and describe how this point was determined	***N/A***
	Statistical correction	Indicate whether any methods such as weighting of items or propensity scores have been used to adjust for the non-	***Outlined in 'Data Analysis'***

		representative sample; if so, please describe the methods.	

Figure Legend

Figure 1

Box plots of Need for Recovery (NFR) score by participant demographic characteristics, excluding any participants who does not respond to the question (i.e. missing).

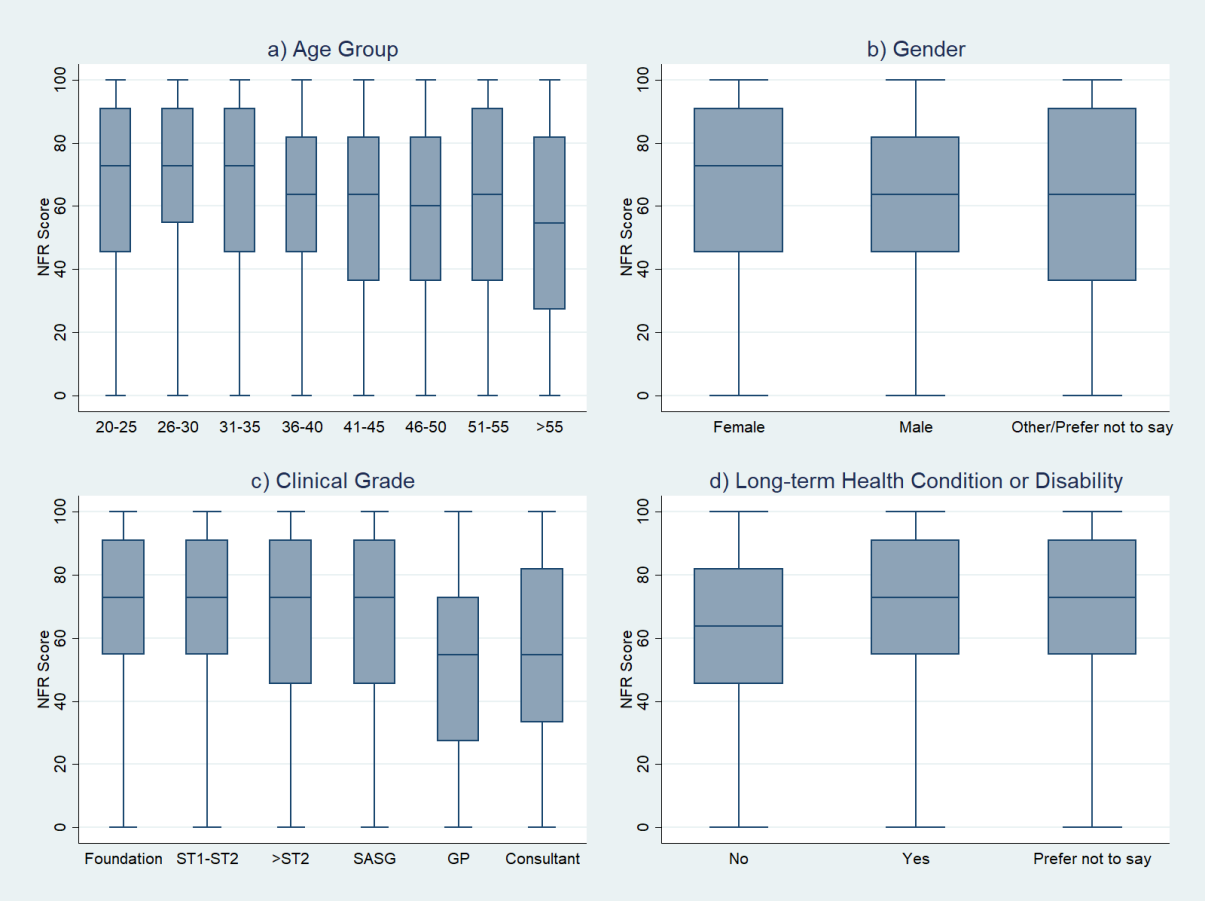
Plot a) age group in years; b) gender; c) clinical grade; d) any long-term health condition or disability.

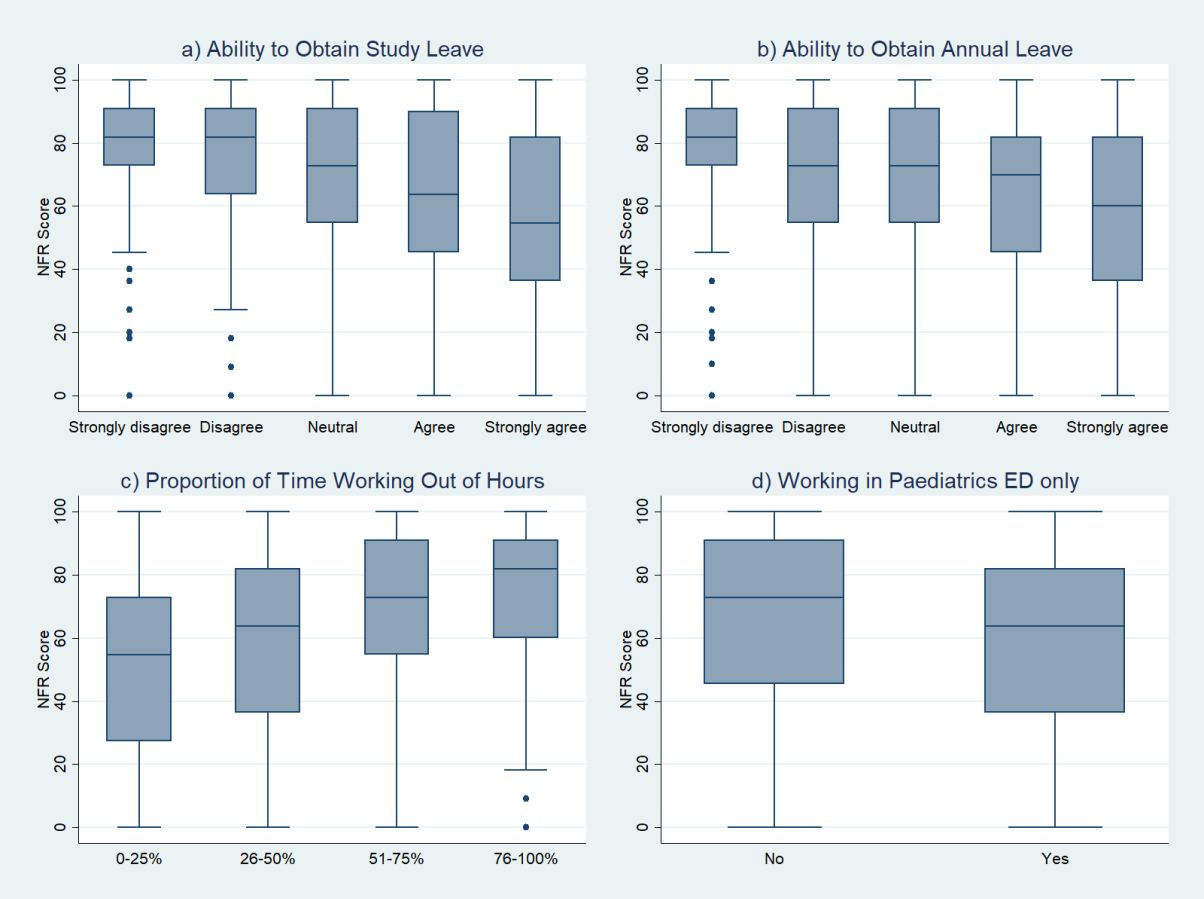
ST1-ST2=Specialist Training year 1-2 (this included physicians training in Anaesthetics, Emergency Medicine, Acute Medicine and General Practice)
SASG=Staff grade, associate specialist and speciality grade
GP=General Practitioner working within the emergency department (ED)

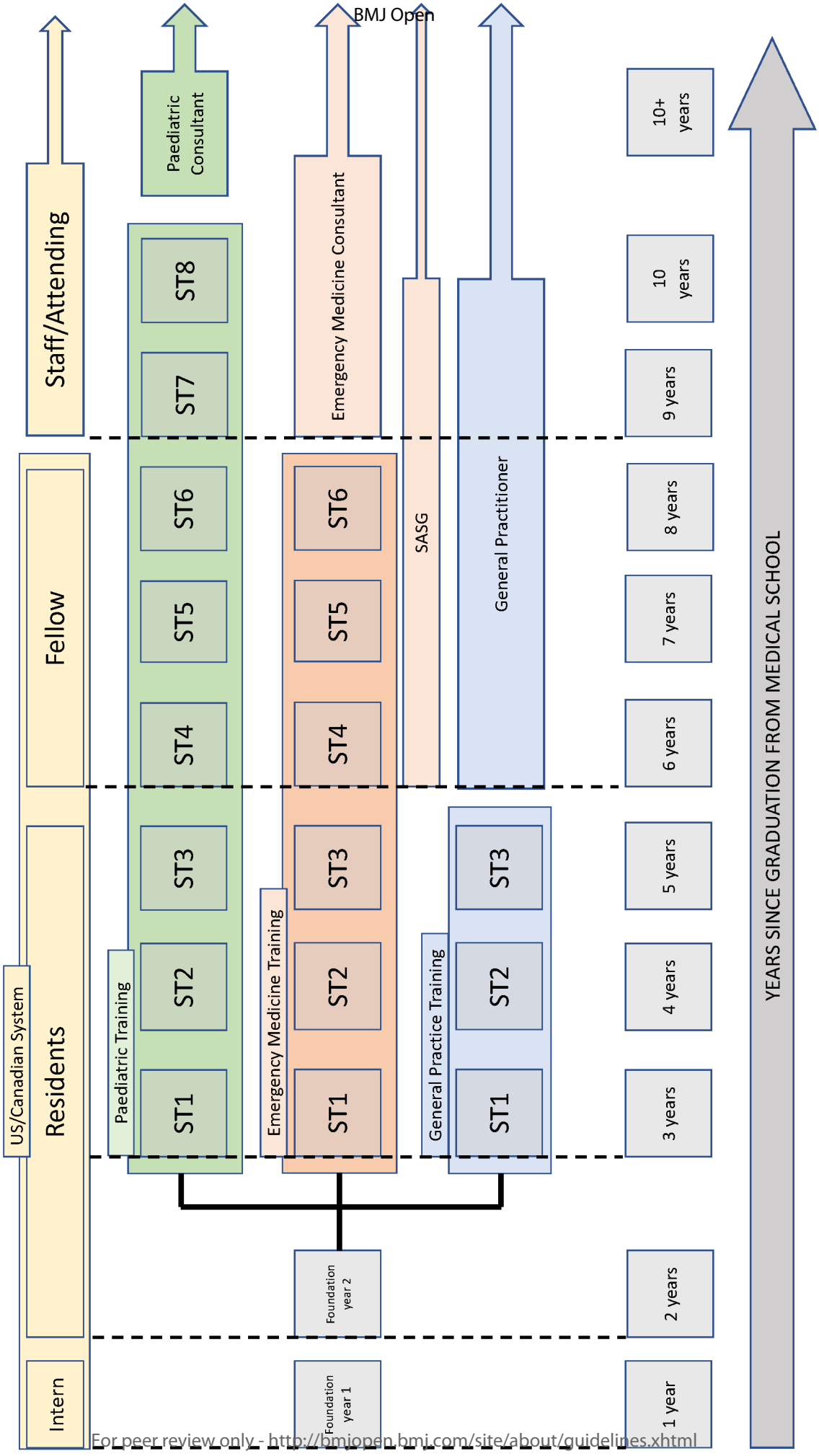
Figure 2

Box plot of Need for Recovery (NFR) score by participant's occupational characteristics, excluding any participants who does not respond to the question (i.e. missing).

Plot a) ability to obtain study leave when requested; b) ability to obtain annual leave when requested; c) proportion of time working out-of-hours; d) working in paediatrics emergency departments (ED) only.






Staff/Attending
Fellow
Residents
Intern
US/Canadian System
Paediatric Consultant
Emergency Medicine Consultant
SASG
General Practitioner
Paediatric Training
Emergency Medicine Training
General Practice Training
ST8
ST7
ST6
ST5
ST4
ST3
ST2
ST1
Foundation year 2
Foundation year 1
10+ years
10 years
9 years
8 years
7 years
6 years
5 years
4 years
3 years
2 years
1 year
YEARS SINCE GRADUATION FROM MEDICAL SCHOOL

Emergency Department Need For Recovery Survey

Do you want to read the patient participation leaflet, GDPR and consent information now?	◯ Yes ◯ No

Participant Information Sheet

Welcome to the 2019 TERN Need for Recovery Survey.

This is an electronic participant information sheet. Please take a minute or two to read this information before proceeding with the survey.

What is need for recovery?
Need for recovery is the time taken to physically and psychologically recover from work. Increased need for recovery is linked to fatigue and a range of physical and psychological health outcomes including burnout.
Why have I been asked to take part?
You are either:
• A doctor working in an emergency department which has been nominated to participate in this survey.

What is the purpose of the study?
This survey is being conducted as part of a national survey by the Trainee Emergency Research Network (TERN). The project is being led by Dr Laura Cottey (Chief Investigator) and Dr Blair Graham, with oversight from the TERN executive committee. We hope that the results from this survey will provide a baseline assessment of trainee need for recovery, and demonstrate risk factors that may indicate an increased need for recovery. It is hoped that this survey will provide insight into the phenomenon of need for recovery amongst Emergency Department doctors, show where differences exist, and how need for recovery may be reduced in the future.
Ultimately it is hoped that this survey may lead to initiatives to improve the working lives of doctors in the emergency department.

What will happen if I take part?
You will asked to take part in this electronic questionnaire. You should allocate about 5 minutes to complete the questionnaire, although you can save and return to completing the questionnaire at a later time.

Do I have to take part?
In order that these results can inform future initiatives to improve working lives of emergency doctors, we do require a robust response rate. However, you are under no obligation to take part and may withdraw at any point without the need to give a reason.

Should you have uncertainties of queries about this survey, please do not hesitate to contact the study team.

What will happen to my data if I withdraw my involvement?
If you choose to withdraw your involvement in the study, any results that you have submitted will be kept for analysis. However, you will not be required to input further into the study.

If you would like to be formally withdrawn from the study at any point, please contact the study team (TERN@rcem.ac.uk). You do not have to give a reason.

Are there any potential risks or benefits of taking part?

This survey will provide valuable insight into the wellbeing of emergency department doctors nationally. We appreciate issues such as wellbeing and burnout are sensitive. We have included some information about sources that you might wish to contact for support both as part of this introduction, and at the end of the survey.

Who is involved in this project?
The project is being led by Dr Laura Cottey (Chief Investigator) and Dr Blair Graham, with oversight from the TERN executive committee which is led by Dr Tom Roberts. The study is indirectly supported by the Royal College of Emergency Medicine, but TERN is independent from the college.

What if something goes wrong?
It is very unlikely that anything will go wrong. If you feel it does, please contact the study team directly.

How will you protect my data and confidentiality?
The University Hospitals Plymouth NHS Trust is the sponsor for this study. The sponsor will be using information in order to undertake the study and will be responsible for looking after your information and using it properly. The data collected will be kept for 10 years after the study has finished.

Your rights to access, change or move your information are limited, as we need to manage your information in specific ways in order for the research to be reliable and accurate. If you withdraw from the study, we will keep the information about you that we have already obtained. To safeguard your rights, we will use the minimum personally identifiable information possible.

This study is also compliant with the General Data Protection Regulations (GDPR). For more information about GDPR click here.

How may I contact the study team in the future?
You can contact the study team by emailing Dr Laura Cottey at laura.cottey@nhs.net

What to do if you need support about wellbeing
The following organisations can help provide advice and support with regards to your wellbeing.

-Your occupational health department (contact details available via your employer)
-Your general practitioner
-BMA Counselling Service (24 Hours). Telephone 0330 123 1245. (Note that you do not have to be a member of the BMA to access this service)
-The Samaritans (24 Hours). Telephone 116 123.

You can also access further information and signposting online via the Doctors Support Network https://www.dsn.org.uk/

Feel free to leave any comments.

Consent Question 1: I have read and understood the participant information	◯ Yes ◯ No
Consent Question 2: I understand the information about confidentiality and GDPR	◯ Yes ◯ No

Demographic Characteristics

What is your current job role?

- ◯ ST1
- ◯ ST2
- ◯ ST3
- ◯ ST4
- ◯ ST5
- ◯ ST6
- ◯ ST7
- ◯ ST8
- ◯ F1
- ◯ F2
- ◯ Clinical Fellow (F2-ST3 Level)
- ◯ Clinical Fellow (>=ST4 Level)
- ◯ Consultant
- ◯ Associate Specialist
- ◯ Staff Grade
- ◯ CESR Doctor
- ◯ GP Trainee
- ◯ GP
- ◯ Other (please specify)

What is your job role?

_____

Which country do you work in?

- ◯ Scotland
- ◯ Northern Ireland
- ◯ Wales
- ◯ England
- ◯ Republic of Ireland

Which hospital do you currently work in?

- ◯ Aberdeen
- ◯ Victoria Hospital, Kirkcaldy
- ◯ Forth Valley Royal Hospital
- ◯ Monklands Hospital
- ◯ Royal Hospital for Children, Glasgow
- ◯ Royal Infirmary of Edinburgh
- ◯ St John's, Livingston
- ◯ NHS Greater Glasgow and Clyde - Queen Elizabeth
- ◯ NHS Greater Glasgow and Clyde - Glasgow Royal Infirmary
- ◯ Crosshouse, Ayrshire
- ◯ Royal Alexandria, Paisley
- ◯ Ayr
- ◯ Royal Hospital for Sick Children, Edinburgh
- ◯ Other

Which hospital do you currently work in?

- ◯ Craigavon Area Hospital, Northern Ireland
- ◯ Royal Victoria Hospital, Belfast
- ◯ Ulster Hospital, Belfast
- ◯ Other

Which hospital do you currently work in?

◯ Cardiff, University Hospital of Wales
◯ Ysbyty Gwynedd, Bangor
◯ Morriston Hospital, Swansea
◯ Wrexham, North Wales
◯ Other

Which hospital do you currently work in (the list is mostly alphabetically but if you cannot find your hospital please check the bottom)?

◯ Addenbrooke's Hospital
◯ Aintree
◯ Airedale General Hospital
◯ Basingstoke Emergency Department
◯ Bedford hospital emergency department
◯ Birmingham
◯ Bolton
◯ Bradford Royal Infirmary
◯ Brighton (Royal Sussex County Hospital)
◯ Bristol Childrens Hospital
◯ Bristol Royal Infirmary (Adults)
◯ Cambridge University Hospitals
◯ Chelsea & Westminster Hospital
◯ Croydon University Hospital
◯ Doncaster Royal Infirmary
◯ William Harvey ED
◯ East Surrey Hospital ED
◯ Epsom and St Helier NHS Trust
◯ Gloucestershire Hospitals NHS Foundation Trust
◯ Great Western Hospital Swindon
◯ Hampshire Hospitals NHS Trust (Basingstoke and Winchester)
◯ Harrogate Emergency Department
◯ Homerton Emergency Department
◯ Ipswich Hospital
◯ James Cook University Hospital Middlesbrough
◯ James Paget University Hospital
◯ Leeds teaching hospitals
◯ Leicester Royal Infirmary
◯ Leighton (Crewe)
◯ Lewisham university hospital
◯ Lister Hospital
◯ QEH, London
◯ Manchester Royal Infirmary
◯ Milton Keynes University
◯ Musgrove Park Hospital, Taunton
◯ Northern general hospital
◯ Northumbria Specialist Emergency Care Hospital
◯ Northwick Park Hospital
◯ Oxford University Hospital NHS Foundation Trust/
◯ Portsmouth - Queen Alexandra Hospital,
◯ Plymouth- Derriford
◯ Reading
◯ Royal Berkshire Hospital
◯ Royal Blackburn Hospital
◯ Royal Cornwall Hospital, Truro
◯ Royal Devon & Exeter Hospital
◯ Royal Liverpool University Hospital
◯ The Royal London Hospital (Paeds)
◯ The Royal London Hospital (Adults)
◯ Royal Manchester Children's Hospital
◯ Royal Oldham Hospital
◯ Royal Preston hospital
◯ Royal Shrewsbury Hospital
◯ Royal Stoke
◯ Royal Surrey County Hospital
◯ Royal United Hospital Bath
◯ Royal Victoria, Newcastle
◯ Salford Royal Hospital, Manchester
◯ Sheffield Childrens Hospital ED
◯ Medway Foundation NHS Trust
◯ Mid Cheshire Hospitals NHS Foundation Trust
◯ University Hospital Southampton
◯ St Helens and Knowsley
◯ Southmead Hospital
◯ Surrey and Sussex Healthcare NHS Trust
◯ St Georges Hospital Tooting

◯ St Marys Hospital, London
◯ St Richards hospital
◯ St Thomas' Hospital
◯ Torbay
◯ Tunbridge Wells Hospital
◯ Southport District General Hospital
◯ University College Hospital, London
◯ University Hospital Coventry and Warwickshire
◯ Warrington
◯ University Hospitals of Derby and Burton NHS Foundation Trust
◯ Watford General hospital
◯ West Middlesex University Hospital
◯ West Suffolk Hospital
◯ Frimley Park Hospital
◯ Wexham Park Hospital, Frimley Health NHS
◯ Whiston Hospital
◯ Wythenshawe Hospital
◯ Yeovil District Hospital
◯ York District hospital
◯ York Hospital Emergency Departments
◯ Whiston Hospital
◯ William Harvey Hospital
◯ Worthing Hospital
◯ University hospital of Hull
◯ North Middlesex
◯ Sandwell and West Birmingham
◯ Stoke Mandeville
◯ Colchester
◯ Alder Hey Children's Hospital
◯ Queen's Hospital, Romford
◯ Birmingham Children's Hospital
◯ Sunderland Royal Hospital
◯ Countess of Chester NHS foundation trust
◯ University hospital of North Durham
◯ Evelina Children's Hospital
◯ King's College, London
◯ Barnstaple
◯ Nottingham University Hospital
◯ Royal Alexandra Children's Hospital
◯ Royal Wolverhampton
◯ Salisbury NHS Trust
◯ Western Sussex NHS Trust
◯ Other
◯ Alder Hey Childrens Hospital
◯ Birmingham Women's and Childrens Hospital
◯ Countess of Chester
◯ Evelina, Guys and St Thomas's
◯ Kings College Hospital
◯ Royal Alexandra Children's Hospital, Brighton and Sussex
◯ New Cross Hospital
◯ Salisbury
◯ Barking, Havering & Redbridge - Queen's
◯ Barking, Havering & Redbridge - King George
◯ South Tyneside and Sunderland NHS Trust
◯ County Durham and Darlington
◯ North Manchester General Hospital

Which hospital do you currently work in?

◯ University Hospital Galway
◯ Mater Misericordiae University Hospital, Dublin,
◯ Sligo University Hospital
◯ Limerick regional Hospital
◯ Other
◯ Children's Health Ireland at Crumlin
◯ Children's Health Ireland at Temple Street
◯ Children's Health Ireland at Tallaght
◯ Bon Secours Hospital
◯ Cork University Hospital

Please state the name of your hospital.

_____

What type of patients do you see in your Emergency Department?

◯ Adults only
◯ Paediatrics only
◯ Mixture of Adults and Paediatrics

How old are you?

◯ 20-25
◯ 26-30
◯ 31-35
◯ 36-40
◯ 41-45
◯ 46-50
◯ 51-55
◯ 56-60
◯ 61- 65
◯ 66-70
◯ >70

What is your gender?

◯ Female
◯ Male
◯ Other
◯ Prefer not to say

Please fill out the following "Need for Recovery Score". Please base this on the LAST MONTH of work (excluding leave).

	yes	no
I find it difficult to relax at the end of the working day?	○	○
By the end of the working day I feel really worn-out	○	○
Because of my job, at the end of the working day I feel rather exhausted	○	○
After my breaks, I feel fresh to continue my work	○	○
Generally speaking, I only start to feel relaxed on my second non-working day off	○	○
I find it difficult to concentrate in my free time after work	○	○
I find it hard to show interest in other people when I have just come home from work	○	○
In general, it takes me over an hour to feel fully recuperated after work	○	○
When I get home, I need to be left in peace for a while	○	○
Often, after a day's work I feel so tired that I cannot get involved in other activities	○	○
A feeling of tiredness prevents me from doing my work as well as I normally would during the last part of the working day	○	○

How long have you worked in your current Emergency Department?

○ 1 month or less
○ 1-2 months
○ 2-3 months
○ 3-4 months
○ 4-5 months
○ 5-6 months
○ 6 months - 1 year
○ 1-2 years
○ 2-3 years
○ 3-5 years
○ 5 -10 years
○ 10 -15 years
○ 15-20 years
○ > 20 years

How long have you worked in Emergency Medicine in total in your career?

◯ 1 year or less
◯ 1 year or more

How many months have you worked in Emergency Medicine in total?

_____

How many years have you worked in Emergency Medicine in total?

_____

What is your most frequent method of transport for your commute to work?

◯ Car
◯ Motorbike
◯ Bus
◯ Train
◯ Underground
◯ Walk
◯ Run
◯ Cycle
◯ I live on-site
◯ Other

You have selected other, how do you commute?

_____

How long does your commute take in minutes (one way)?

	1-10 mins	11-20 mins	21-30 mins	31-40 mins	41-50 mins	51-60 mins	61-70 mins	71-80 mins	81-90 mins	>90 mins
On an average day	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
On a good day	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
On a bad day	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

What type of contract do you work?

◯ Full time
◯ 90%, less than full time
◯ 80%, less than full time
◯ 70%, less than full time
◯ 60%, less than full time
◯ 50%, less than full time
◯ less than 50%, less than full time

Do you have dedicated contracted time away from Adult Emergency Medicine (e.g. subspecialty or GP) or work in Paediatric Emergency Medicine?

◯ Yes
◯ No

Please select all that are applicable to your current contracted time.

☐ ICM
☐ PEM
☐ PHEM
☐ Academic
☐ Teaching
☐ Leadership/Management
☐ Paediatrics
☐ GP
☐ Other

What is your "other" contracted time?

_____

What percentage of your contract is spent in ICM rather than EM?

◯ 10%
◯ 20%
◯ 25%
◯ 30%
◯ 40%
◯ 50%
◯ 60%
◯ 70%
◯ 75%
◯ 80%
◯ 90%
◯ 100%

What percentage of your contract is spent in PEM rather than Adult EM?

- ◯ 10%
- ◯ 20%
- ◯ 25%
- ◯ 30%
- ◯ 40%
- ◯ 50%
- ◯ 60%
- ◯ 70%
- ◯ 75%
- ◯ 80%
- ◯ 90%
- ◯ 100%

What percentage of your contract is spent in PHEM rather than Adult EM?

- ◯ 10%
- ◯ 20%
- ◯ 25%
- ◯ 30%
- ◯ 40%
- ◯ 50%
- ◯ 60%
- ◯ 70%
- ◯ 75%
- ◯ 80%
- ◯ 90%
- ◯ 100%

What percentage of your contract is spent Academic rather than Adult EM?

- ◯ 10%
- ◯ 20%
- ◯ 25%
- ◯ 30%
- ◯ 40%
- ◯ 50%
- ◯ 60%
- ◯ 70%
- ◯ 75%
- ◯ 80%
- ◯ 90%
- ◯ 100%

What percentage of your contract is spent Teaching rather than Adult EM?

- ◯ 10%
- ◯ 20%
- ◯ 25%
- ◯ 30%
- ◯ 40%
- ◯ 50%
- ◯ 60%
- ◯ 70%
- ◯ 75%
- ◯ 80%
- ◯ 90%
- ◯ 100%

What percentage of your contract is spent management/leadership rather than Adult EM?

◯ 10%
◯ 20%
◯ 25%
◯ 30%
◯ 40%
◯ 50%
◯ 60%
◯ 70%
◯ 75%
◯ 80%
◯ 90%
◯ 100%

What percentage of your contract is spent doing paediatrics rather than EM?

◯ 10%
◯ 20%
◯ 25%
◯ 30%
◯ 40%
◯ 50%
◯ 60%
◯ 70%
◯ 75%
◯ 80%
◯ 90%
◯ 100%

What percentage of your contract is spent doing GP rather than Adult EM?

◯ 10%
◯ 20%
◯ 25%
◯ 30%
◯ 40%
◯ 50%
◯ 60%
◯ 70%
◯ 75%
◯ 80%
◯ 90%
◯ 100%

What percentage of your contract is spent doing "other" activities rather than Adult EM?

◯ 10%
◯ 20%
◯ 25%
◯ 30%
◯ 40%
◯ 50%
◯ 60%
◯ 70%
◯ 75%
◯ 80%
◯ 90%
◯ 100%

What is the maximum number of TOTAL clinical shifts you work in a week?

◯ 1 shift
◯ 2 shifts
◯ 3 shifts
◯ 4 shifts
◯ 5 shifts
◯ 6 shifts
◯ 7 shifts

What is the maximum number of CONSECUTIVE clinical shifts you would be scheduled to work?

◯ 1 shift
◯ 2 shifts
◯ 3 shifts
◯ 4 shifts
◯ 5 shifts
◯ 6 shifts
◯ 7 shifts
◯ > 7 shifts

What is the maximum number of consecutive NIGHT shifts you would be scheduled to work in a row?

◯ 0 shifts
◯ 1 shift
◯ 2 shifts
◯ 3 shifts
◯ 4 shifts
◯ 5 shifts
◯ 6 shifts
◯ 7 shifts

What is the maximum number of consecutive DAY shifts you would be scheduled to work in a row?

◯ 0 shifts
◯ 1 shift
◯ 2 shifts
◯ 3 shifts
◯ 4 shifts
◯ 5 shifts
◯ 6 shifts
◯ 7 shifts

What is the maximum number of consecutive TWILIGHT shifts you would be scheduled to work in a row?

◯ 0 shifts
◯ 1 shift
◯ 2 shifts
◯ 3 shifts
◯ 4 shifts
◯ 5 shifts
◯ 6 shifts
◯ 7 shifts

What is your scheduled weekend work frequency?

◯ 1 in 2
◯ 1 in 3
◯ 1 in 4
◯ 1 in 5
◯ 1 in 6
◯ Less frequent than 1 in 6
◯ I don't work weekends

Over the past month how many contracted non-clinical shifts have you had? E.g. SPA, teaching, clinical governance.

◯ 0 shifts
◯ Between 0-1 shifts
◯ 1 shift
◯ 2 shifts
◯ 3 shifts
◯ 4 shifts
◯ 5 shifts
◯ 6 shifts
◯ 7 shifts
◯ 8 shifts
◯ 9 shifts
◯ 10 shifts
◯ 11-15 shifts
◯ >15 shifts

In the past month how many locum shifts have you worked? _____

Over the past month, roughly how often have you left more than 15 minutes late following a clinical shift?

◯ Rarely
◯ A few times a month
◯ Once a week
◯ A few times a week
◯ Everyday

Over the past month, how often have you taken your full entitlement of breaks during a clinical shift?

◯ Rarely
◯ A few times a month
◯ Once a week
◯ A few times a week
◯ Everyday

What proportion would you say you spend working 'out of hours' (evenings, nights or weekends)?

◯ < 25%
◯ 26-50%
◯ 51-75%
◯ 76-100%

What proportion of your locum shifts would you say you spend working 'out of hours' (evenings, nights or weekends)?

◯ < 25%
◯ 26-50%
◯ 51-75%
◯ 76-100%

I have been able to request and take the annual leave I wanted?

◯ Strongly disagree
◯ Disagree
◯ Neutral
◯ Agree
◯ Strongly agree

I have been able to request and take the study leave I wanted?

◯ Strongly disagree
◯ Disagree
◯ Neutral
◯ Agree
◯ Strongly agree

Over the past month, roughly how often have you found yourself feeling overwhelmed with work during a clinical shift?

◯ Rarely
◯ A few times a month
◯ Once a week
◯ A few times a week
◯ Everyday

Do you consider yourself to have any long-term health conditions or disability?

◯ Yes
◯ No
◯ Prefer not to say

Do you have significant caring responsibilities outside of work?
(e.g. parent or main carer for a relative)

◯ Yes
◯ No
◯ Prefer not to say

I feel at high risk of burnout from my job in the near future?

◯ Yes
◯ No
◯ Prefer not to say

I feel I am currently suffering burnout from work?

◯ Yes
◯ No
◯ Prefer not to say

TIRED Site Survey

Department Demographics

Name of emergency department and NHS trust?	_____
Number of attendances per year?	_____
Any specialist designation?	☐ Trauma unit ☐ Adult major trauma centre ☐ Stroke centre ☐ PCI centre ☐ Paediatric major trauma centre
Number of EM Consultants?	_____
Number of EM Middle Grades (ST4 and above)?	_____
Number of EM Middle grade career clinicians equivalent to > ST4 (eg associate specialist, specialty doctors, CESR or other non-training doctors)?	_____
Number of EM trainees ST3?	_____
Number of ACCS trainees ST1-2?	_____
Number of GP trainees ST1-3?	_____
Number of ED GPs?	_____
Number of Clinical Fellows (Fy1-ST3)?	_____
Number of Clinical Fellows (>=ST4)?	_____
Number of FY2s?	_____
Number of FY1s?	_____
Total number of ED Doctors calculated from the answers above:	_____

Out of the total number of doctors above, how many will be ineligible for the study due to absence during the study period? (eg maternity, sick or annual leave)	_____
What percentage of eligible EM doctors do you estimate you will enrol in the survey? (ie if you have 50 doctors and think you will enrol 25 at your site, that would be 50%).	_____ (We are aiming for a response rate of 80% of eligible doctors as a minimum at each site but understand this not might be achievable. Therefore, this is an opportunity to document how many you think will be achievable at your site.)
Number of advanced nurse practicioners?	_____
Number of advanced clinical practitioners?	_____
Number of adult qualified EM nurses?	_____
Number of paediatric qualified EM nurses?	_____
Number of health care assistants (or equivalents)?	_____
Number of EM physician associates?	_____
Does your Consultant rota use self-rostering?	◯ Yes ◯ No
Does your Registrar rota use self-rostering?	◯ Yes ◯ No
Does your SHO rota use self-rostering?	◯ Yes ◯ No

What are the current vacancy rates for permanent staff in the following roles?

	0-10%	11-20%	21-30%	31-40%	41-50%	51-60%	61-70%	71-80%	81-90%	91-100 %
EM consultants	○	○	○	○	○	○	○	○	○	○
EM medical staff (excluding Consultants)	○	○	○	○	○	○	○	○	○	○
EM nursing staff	○	○	○	○	○	○	○	○	○	○
Non-medical staff	○	○	○	○	○	○	○	○	○	○
All staff	○	○	○	○	○	○	○	○	○	○

What percentage of patients were seen within 4 hours in April 2019? _____

What percentage of patients were seen within 4 hours in March 2019? _____

What percentage of patients were seen within 4 hours in February 2019? _____

What percentage of patients were seen within 4 hours in January 2019? _____

What percentage of patients were seen within 4 hours in December 2018 _____

What percentage of patients were seen within 4 hours in November 2018? _____

What are the current sickness rates for the following staff groups?

	0-1%	1-2%	2-3%	3-4%	4-5%	5-6%	6-7%	7-8%	8-9%	9-10%	>10%
EM Consultants	○	○	○	○	○	○	○	○	○	○	○
EM Medical Staff (excluding Consultants)	○	○	○	○	○	○	○	○	○	○	○
EM Nursing staff	○	○	○	○	○	○	○	○	○	○	○
Non-Medical Staff	○	○	○	○	○	○	○	○	○	○	○
All Staff	○	○	○	○	○	○	○	○	○	○	○

What is the Minimum Shift Length for the below groups of staff?

	6 hours	7 hours	8 hours	9 hours	10 hours	11 hours	12 hours	13 hours	N/A
EM Consultants	○	○	○	○	○	○	○	○	○
EM Trainees, ST4 and above	○	○	○	○	○	○	○	○	○
EM Non-training, ST4 and above	○	○	○	○	○	○	○	○	○
EM Trainees ST3	○	○	○	○	○	○	○	○	○
ACCS Trainees ST1-2	○	○	○	○	○	○	○	○	○
GP Trainees ST1-3	○	○	○	○	○	○	○	○	○
Clinical Fellows (FY1- ST3)	○	○	○	○	○	○	○	○	○
Clinical Fellows (>= ST4)	○	○	○	○	○	○	○	○	○
Fy2 Doctors	○	○	○	○	○	○	○	○	○
Fy1 Doctors	○	○	○	○	○	○	○	○	○

What is the maximum shift length for the following groups of staff

	6 hours	7 hours	8 hours	9 hours	10 hours	11 hours	12 hours	13 hours	>13 hours	N/A
EM Consultants	○	○	○	○	○	○	○	○	○	○
EM Trainees, ST4 and above	○	○	○	○	○	○	○	○	○	○
EM Non-trainees, ST4 and above	○	○	○	○	○	○	○	○	○	○
EM Trainees, ST3	○	○	○	○	○	○	○	○	○	○
ACCS Trainees ST1-2	○	○	○	○	○	○	○	○	○	○
GP Trainees, ST1-3	○	○	○	○	○	○	○	○	○	○
Clinical Fellows (FY1 - ST3)	○	○	○	○	○	○	○	○	○	○
Clinical Fellows (=>ST4)	○	○	○	○	○	○	○	○	○	○
Fy2 Doctors	○	○	○	○	○	○	○	○	○	○
Fy1 Doctors	○	○	○	○	○	○	○	○	○	○

How many hours are each of the shifts on your SHO rota?
(Select multiple if this changes depending on the shift)

	< 8 hours	8 hours	9 hours	10 hours	11 hours	12 hours	>12 hour
Day shift (week)	☐	☐	☐	☐	☐	☐	☐
Night shift (week)	☐	☐	☐	☐	☐	☐	☐
Twilight shift (week)	☐	☐	☐	☐	☐	☐	☐
Day shift (weekend)	☐	☐	☐	☐	☐	☐	☐
Night shift (weekend)	☐	☐	☐	☐	☐	☐	☐
Twilight shift (weekend)	☐	☐	☐	☐	☐	☐	☐

How many hours are each of the shifts on your registrar rota?
(Select multiple if this changes depending on the shift)

	< 8 hours	8 hours	9 hours	10 hours	11 hours	12 hours	>12 hour
Day shift (week)	☐	☐	☐	☐	☐	☐	☐
Night shift (week)	☐	☐	☐	☐	☐	☐	☐
Twilight shift (week)	☐	☐	☐	☐	☐	☐	☐
Day shift (weekend)	☐	☐	☐	☐	☐	☐	☐
Night shift (weekend)	☐	☐	☐	☐	☐	☐	☐
Twilight shift (weekend)	☐	☐	☐	☐	☐	☐	☐

How many hours are each of the shifts on your Consultant rota?

	< 8 hours	8 hours	9 hours	10 hours	11 hours	12 hours	>12 hour
Day shift (week)	◯	◯	◯	◯	◯	◯	◯
Night shift (week)	◯	◯	◯	◯	◯	◯	◯
Twilight shift (week)	◯	◯	◯	◯	◯	◯	◯
Day shift (weekend)	◯	◯	◯	◯	◯	◯	◯
Night shift (weekend)	◯	◯	◯	◯	◯	◯	◯
Twilight shift (weekend)	◯	◯	◯	◯	◯	◯	◯

Is there readily available rest facilities available for post night shifts?
◯ Yes
◯ No

Do people know how to access them?
◯ Yes
◯ No

Is there a break room available?
◯ Yes
◯ No

Online Supplementary Material 4
Table of Additional Participant Characteristics

Characteristic	N (%)	NFR Score	
		Median (95% CI) [1]	[LQ - UQ]
Maximum number of consecutive day shifts you would be scheduled to work			
0	30 (0.7)	63.6 (50.1 to 77.2)	[36.4 - 90.9]
1	42 (1.0)	59.1 (40.9 to 77.3)	[27.3 - 90.9]
2	217 (5.3)	63.6 (55.1 to 72.2)	[36.4 - 81.8]
3	522 (12.7)	63.6 (60.9 to 66.4)	[36.4 - 81.8]
4	788 (19.2)	63.6 (63.6 to 63.6)	[45.5 - 81.8]
5	1108 (27)	72.7 (70.0 to 75.5)	[45.5 - 81.8]
6	309 (7.5)	72.7 (66.9 to 78.6)	[54.5 - 90.9]
7	1094 (26.6)	72.7 (72.7 to 72.7)	[45.5 - 90.9]
Missing	137 (3.3)	72.7 (65.7 to 79.7)	[50.0 - 90.9]
Maximum number of consecutive Twilight shifts you would be scheduled to work			
0	339 (8.2)	54.5 (48.3 to 60.8)	[36.4 - 81.8]
1	341 (8.3)	60.0 (51.2 to 68.8)	[36.4 - 81.8]
2	496 (12.1)	54.5 (49.9 to 59.2)	[36.4 - 81.8]
3	796 (19.4)	63.6 (55.8 to 71.5)	[45.5 - 81.8]
4	1100 (26.7)	72.7 (69.9 to 75.5)	[45.5 - 90.9]
5	600 (14.6)	72.7 (72.1 to 73.4)	[54.5 - 90.9]
6	107 (2.6)	72.7 (67.6 to 77.8)	[54.5 - 90.9]
7	334 (8.1)	81.8 (74.4 to 89.3)	[54.5 - 90.9]
Missing	134 (3.3)	72.7 (67.3 to 78.1)	[54.5 - 90.9]
Maximum number of consecutive night shifts you would be scheduled to work			
0	1057 (25.6)	54.5 (52.0 to 57.1)	[27.3 – 80.0]
1	123 (3.0)	63.6 (53.2 to 74.0)	[36.4 - 90.9]
2	153 (3.7)	54.5 (44.7 to 64.4)	[45.5 - 81.8]
3	467 (11.3)	72.7 (65.6 to 79.9)	[45.5 - 90.9]
4	2188 (53.1)	72.7 (72.7 to 72.7)	[54.5 - 90.9]
5	64 (1.6)	72.7 (64.4 to 81.1)	[54.5 - 90.9]
6	6 (0.1)	54.5 (NA)	[45.5 - 81.8]
7	63 (1.5)	72.7 (64.4 to 81.1)	[54.5 - 90.9]
Missing	126 (3.1)	72.7 (67.4 to 78.0)	[54.5 - 90.9]
Maximum number of clinical shifts you work in a typical week?			
1	27 (0.7)	63.6 (45.2 to 82.0)	[45.5 - 90.9]
2	63 (1.5)	63.6 (49.2 to 78.1)	[36.4 - 81.8]

3	240 (5.9)	63.6 (58.1 to 69.2)	[36.4 - 81.8]
4	553 (13.5)	63.6 (54.9 to 72.3)	[36.4 - 81.8]
5	1074 (26.2)	63.6 (62.1 to 65.2)	[45.5 - 81.8]
6	858 (20.9)	72.7 (72.0 to 73.4)	[45.5 - 90.9]
7	1285 (31.3)	72.7 (72.7 to 72.7)	[45.5 - 90.9]
Missing	147 (3.6)	72.7 (67.1 to 78.3)	[45.5 - 90.9]
Non-clinical shifts past month			
0	1164 (28.3)	72.7 (72.7 to 72.7)	[54.5 - 90.9]
<1	394 (9.6)	72.7 (72.1 to 73.4)	[54.5 - 90.9]
1	525 (12.8)	72.7 (72.7 to 72.7)	[50.0 - 90.9]
2	527 (12.8)	63.6 (57.3 to 70.0)	[45.5 - 81.8]
3	242 (5.9)	63.6 (55.1 to 72.2)	[40.0 - 81.8]
4	525 (12.8)	60.0 (51.5 to 68.5)	[36.4 - 81.8]
5	115 (2.8)	54.5 (47.3 to 61.8)	[36.4 - 72.7]
6	124 (3.0)	54.5 (45.6 to 63.5)	[31.7 - 80.9]
7	39 (0.9)	63.6 (43.5 to 83.8)	[36.4 - 81.8]
8	157 (3.8)	54.5 (45.2 to 63.9)	[36.4 - 81.8]
9	19 (0.5)	60.0 (34.6 to 85.4)	[27.3 - 72.7]
10	102 (2.5)	54.5 (45.2 to 63.9)	[36.4 - 80.0]
11-15	86 (2.1)	54.5 (44.7 to 64.4)	[27.3 - 72.7]
>15	91 (2.2)	63.6 (47.6 to 79.7)	[27.3 - 81.8]
Missing	137 (3.3)	72.7 (66.6 to 78.9)	[54.5 - 90.9]
Average commute in minutes			
1-10	396 (9.6)	72.7 (64.2 to 81.3)	[45.5 - 81.8]
11-20	814 (19.8)	72.7 (64.6 to 80.9)	[45.5 – 90.0]
21-30	967 (23.5)	72.7 (64.6 to 80.8)	[45.5 - 90.9]
31-40	703 (17.1)	63.6 (63.6 to 63.6)	[36.4 - 81.8]
41-50	546 (13.3)	72.7 (64.5 to 81.0)	[45.5 - 90.9]
51-60	365 (8.9)	72.7 (67.6 to 77.8)	[45.5 – 90.0]
>60	325 (7.9)	72.7 (66.9 to 78.5)	[45.5 - 90.9]
Missing	131 (3.2)	72.7 (68.4 to 77.1)	[54.5 - 90.9]
Do you have a dedicated time away from adult emergency medicine?			
No	3091 (75.2)	72.7 (67.2 to 78.3)	[45.5 - 90.9]
Yes	1020 (24.8)	63.6 (62.2 to 65.1)	[36.4 - 81.8]
Missing	136 (3.3)	72.7 (67.7 to 77.8)	[45.5 - 90.9]

Frequency and percentage, median NFR score with 95% bootstrapped confidence intervals and the inter-quartile range of participants within each category.

[1] Bootstrapped 95% confidence intervals based on 1000 replications on a minimum of 8 observations.

Online Supplementary Material 5
Summary of median quantile regression model fitted to the Need for Recovery (NFR) score with fixed effects for site, including the adjusted coefficient estimate (Adj. Coef. Est.) with corresponding 95% confidence interval (CI) and p-value.

	Adj. Coeff. Est. (95% CI)	P-value[1]
Constant (baseline NFR score)	59.51 (55.53 to 63.49)	< 0.001
Gender (baseline = Male)		
• Female	3.38 (1.80 to 4.95)	< 0.001
• Other/Prefer not to say	-0.10 (-7.84 to 7.64)	0.979
Any long-term health conditions or disabilities (baseline = No)		
• Yes	8.33 (5.73 to 10.93)	< 0.001
• Prefer not to say	6.10 (1.78 to 10.43)	0.006
ED paediatrics only? (baseline = No)		
• Yes	-8.47 (-12.97 to -3.98)	< 0.001
Clinical grade (baseline = Foundation)		
• ST1-ST2	-0.20 (-2.55 to 2.16)	0.869
• > ST2	1.04 (-1.49 to 3.57)	0.421
• SASG	-1.20 (-4.32 to 1.92)	0.450
• GP	-7.33 (-15.49 to 0.83)	0.078
• Consultant	-4.94 (-7.72 to -2.17)	< 0.001
I have been able to request and take study when I wanted (baseline = Neutral)		
• Strongly disagree	3.45 (-0.19 to 7.10)	0.063
• Disagree	3.57 (0.53 to 6.61)	0.022
• Agree	-1.18 (-3.36 to 1.00)	0.290
• Strongly agree	-6.32 (-9.23 to -3.41)	< 0.001
I have been able to request and take annual when I wanted (baseline = Neutral)		
• Strongly disagree	6.42 (2.69 to 10.15)	0.001
• Disagree	1.37 (-1.73 to 4.47)	0.385
• Agree	-2.60 (-5.07 to -0.13)	0.039
• Strongly agree	-4.31 (-7.33 to -1.28)	0.005
Proportion of time spent working out of hours (baseline = 0-25%)		
• 26-50%	5.96 (3.16 to 8.76)	< 0.001
• 51-75%	10.39 (7.54 to 13.25)	< 0.001
• 76-100%	14.34 (10.92 to 17.75)	< 0.001

Need for recovery amongst Emergency Physicians in the United Kingdom and Ireland: Findings from a Trainee Emergency Research Network (TERN) survey study

Research Checklist: The Checklist for Reporting Results of Internet E-Surveys (CHERRIES)

CHERRIES CHECKLIST ADAPTED FROM: Eysenbach, Gunther. "Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES)." *Journal of medical Internet research* vol. 6,3 e34. 29 Sep. 2004, doi:10.2196/jmir.6.3.e34			
Item Category	***Checklist Item***	***Explanation***	***Checklist Response***
Design	Describe survey design	Describe target population, sample frame. Is the sample a convenience sample? (In "open" surveys this is most likely.)	***Outlined in 'Methods'***
IRB (Institutional Review Board) approval and informed consent process	IRB approval	Mention whether the study has been approved by an IRB.	***Outlined in 'Ethics Approval'***
	Informed consent	Describe the informed consent process. Where were the participants told the length of time of the survey, which data were stored and where and for how long, who the investigator was, and the purpose of the study?	***Outlined in Survey Distribution, monitoring and recruitment***
	Data protection	If any personal information was collected or stored, describe what mechanisms were used to protect unauthorized access.	***Outlined in Survey Distribution, monitoring and recruitment***
Development and pre-testing	Development and testing	State how the survey was developed, including whether the usability and technical functionality of the electronic questionnaire had been tested before fielding the questionnaire.	***Outlined in 'Survey Development'***
Recruitment process and description of the sample having access to the questionnaire	Open survey versus closed survey	An "open survey" is a survey open for each visitor of a site, while a closed survey is only open to a sample which the investigator knows (password-protected survey).	***Outlined in Survey Distribution, monitoring and recruitment***
	Contact mode	Indicate whether or not the initial contact with the potential participants was made on the Internet. (Investigators may also send out questionnaires by mail and allow for Web-based data entry.)	***Outlined in 'Survey Distribution, monitoring and recruitment'***
	Advertising the survey	How/where was the survey announced or advertised? Some examples are offline media (newspapers), or online (mailing lists – If yes, which ones?) or banner ads (Where were these banner ads posted and what did they look like?). It is important to know the wording of the announcement as it will heavily influence who chooses to participate. Ideally the survey	***Outlined in 'Survey Distribution, monitoring and recruitment'***

		announcement should be published as an appendix.	
Survey administration	Web/E-mail	State the type of e-survey (eg, one posted on a Web site, or one sent out through e-mail). If it is an e-mail survey, were the responses entered manually into a database, or was there an automatic method for capturing responses?	***Outlined in 'Survey Distribution, monitoring and recruitment'***
	Context	Describe the Web site (for mailing list/newsgroup) in which the survey was posted. What is the Web site about, who is visiting it, what are visitors normally looking for? Discuss to what degree the content of the Web site could pre-select the sample or influence the results. For example, a survey about vaccination on a anti-immunization Web site will have different results from a Web survey conducted on a government Web site	***Outlined in 'Design'***
	Mandatory/voluntary	Was it a mandatory survey to be filled in by every visitor who wanted to enter the Web site, or was it a voluntary survey?	***Outlined in 'Survey Distribution, monitoring and recruitment'***
	Incentives	Were any incentives offered (eg, monetary, prizes, or non-monetary incentives such as an offer to provide the survey results)?	***No***
	Time/Date	In what timeframe were the data collected?	***Outlined in 'Sites and settings'***
	Randomization of items or questionnaires	To prevent biases items can be randomized or alternated.	***Not done***
	Adaptive questioning	Use adaptive questioning (certain items, or only conditionally displayed based on responses to other items) to reduce number and complexity of the questions	***Outlined in Survey Distribution, monitoring and recruitment***
	Number of Items	What was the number of questionnaire items per page? The number of items is an important factor for the completion rate.	***Outlined in 'Design'***
	Number of screens (pages)	Over how many pages was the questionnaire distributed? The number of items is an important factor for the completion rate.	***Outlined in 'Design'***
	Completeness check	It is technically possible to do consistency or completeness checks before the questionnaire is submitted. Was this done, and if "yes", how (usually JAVAScript)? An alternative is to check for completeness after the questionnaire has been submitted (and highlight mandatory items). If this has been done, it should be reported. All items should provide a non-response option such as "not applicable" or	***Not done***

		"rather not say", and selection of one response option should be enforced.	
	Review step	State whether respondents were able to review and change their answers (eg, through a Back button or a Review step which displays a summary of the responses and asks the respondents if they are correct).	***Outlined in Survey Distribution, monitoring and recruitment***
Response rates			
	Unique site visitor	If you provide view rates or participation rates, you need to define how you determined a unique visitor. There are different techniques available, based on IP addresses or cookies or both.	***Outlined in 'Results'***
	View rate (Ratio of unique survey visitors/unique site visitors)	Requires counting unique visitors to the first page of the survey, divided by the number of unique site visitors (not page views!). It is not unusual to have view rates of less than 0.1 % if the survey is voluntary	***Survey site contains first page of survey therefore N/A***
	Participation rate (Ratio of unique visitors who agreed to participate/unique first survey page visitors)	Count the unique number of people who filled in the first survey page (or agreed to participate, for example by checking a checkbox), divided by visitors who visit the first page of the survey (or the informed consents page, if present). This can also be called "recruitment" rate.	***Outlined in 'Results'***
	Completion rate (Ratio of users who finished the survey/users who agreed to participate)	The number of people submitting the last questionnaire page, divided by the number of people who agreed to participate (or submitted the first survey page). This is only relevant if there is a separate "informed consent" page or if the survey goes over several pages. This is a measure for attrition. Note that "completion" can involve leaving questionnaire items blank. This is not a measure for how completely questionnaires were filled in. (If you need a measure for this, use the word "completeness rate".)	***Outlined in 'Results'***
Preventing multiple entries from the same individual	Cookies used	Indicate whether cookies were used to assign a unique user identifier to each client computer. If so, mention the page on which the cookie was set and read, and how long the cookie was valid. Were duplicate entries avoided by preventing users access to the survey twice; or were duplicate database entries having the same user ID eliminated before analysis? In the latter case, which entries were kept for analysis (eg, the first entry or the most recent)?	***Not used***
	IP check	Indicate whether the IP address of the client computer was used to identify potential duplicate entries from the same user. If so, mention the period of	***Not used due to survey being completed on multi-user/single log-in computers***

		time for which no two entries from the same IP address were allowed (eg, 24 hours). Were duplicate entries avoided by preventing users with the same IP address access to the survey twice; or were duplicate database entries having the same IP address within a given period of time eliminated before analysis? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	
	Log file analysis	Indicate whether other techniques to analyze the log file for identification of multiple entries were used. If so, please describe.	***Not done***
	Registration	In "closed" (non-open) surveys, users need to login first and it is easier to prevent duplicate entries from the same user. Describe how this was done. For example, was the survey never displayed a second time once the user had filled it in, or was the username stored together with the survey results and later eliminated? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	***N/A***
Analysis	Handling of incomplete questionnaires	Were only completed questionnaires analyzed? Were questionnaires which terminated early (where, for example, users did not go through all questionnaire pages) also analyzed?	***Outlined in 'Data Analysis'***
	Questionnaires submitted with an atypical timestamp	Some investigators may measure the time people needed to fill in a questionnaire and exclude questionnaires that were submitted too soon. Specify the timeframe that was used as a cut-off point, and describe how this point was determined	***N/A***
	Statistical correction	Indicate whether any methods such as weighting of items or propensity scores have been used to adjust for the non-representative sample; if so, please describe the methods.	***Outlined in 'Data Analysis'***