



Dexterity assessment of hospital workers: prospective comparative study

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Additional material is published online only. To view please visit the journal online.

Cite this as: *BMJ* 2024;387:e081814
<http://dx.doi.org/10.1136/bmj-2024-081814>

Accepted: 30 October 2024

ABSTRACT

OBJECTIVES

To compare the manual dexterity and composure under pressure of people in different hospital staff roles using a buzz wire game.

DESIGN

Prospective, observational, comparative study (Tremor study).

SETTING

Leeds Teaching Hospitals NHS Trust, Leeds, UK, during a three week period in 2024.

PARTICIPANTS

254 hospital staff members comprising of 60 physicians, 64 surgeons, 69 nurses, and 61 non-clinical staff.

MAIN OUTCOME MEASURES

Successful completion of the buzz wire game within five minutes and occurrence of swearing and audible noises of frustration.

RESULTS

Of the 254 hospital staff that participated, surgeons had significantly higher success rates in completing the buzz wire game within five minutes (84%, n=54) compared with physicians (57%, n=34), nurses (54%, n=37), and non-clinical staff (51%, n=31) (P<0.001). Time-to-event analysis showed that surgeons were quicker to successfully complete the game, independent of age and gender. Surgeons exhibited the highest rate of swearing during the game (50%, n=32), followed by nurses (30%, n=21), physicians (25%, n=60), and non-clinical staff (23%, n=14) (P=0.004). Non-clinical staff showed the highest use of frustration noises (75%), followed by nurses (68%), surgeons (58%), and physicians (52%) (P=0.03).

CONCLUSIONS

Surgeons showed greater dexterity, but higher levels of swearing compared with other hospital staff roles, while nurses and non-clinical staff showed the highest

rates of audible noises of frustration. The study highlights the diverse skill sets across hospital staff roles. Implementation of a surgical swear jar initiative should be considered for future fundraising events.

Introduction

In the complex ecosystem of a hospital, from the operating theatre to clinic rooms, manual dexterity has a crucial, yet varied, role. Surgeons, physicians, nurses, and non-clinical staff each face unique dexterity challenges in their daily tasks. Surgeons require fine motor precision and composure under pressure to perform procedures safely. The same principles are replicated by many other staff members daily, from physicians performing interventional procedures to administrative staff rapidly typing without error. This diversity led us to consider whether people wielding scalpels truly possess greater dexterity than people in other hospital staff roles. Furthermore, in settings of fine motor challenges, whether some colleagues maintain better composure under pressure.

Published data to address this important clinical question is scarce, and prior studies have reached divergent results.^{1 2} One study noted no significant difference in dexterity between medical and surgical residents,¹ challenging the narrative that surgical training enhances fine motor skills. Another study that examined six surgical subspecialties showed no substantial variations in dexterity,² questioning the long-held belief that some specialties develop superior fine motor skills. These findings suggest that dexterity may be more evenly distributed across healthcare roles than commonly believed, contradicting the presumed principle of so-called surgical precision. However, the comparative assessment of dexterity of different hospital staff roles remains unexplored.

To address this gap in evidence, we conducted the dexterity assessment of hospital workers (Tremor) comparative study, which aimed to compare the manual dexterity and composure under pressure of different hospital staff roles.

Methods

We reported this study using the checklist for strengthening the reporting of observational studies in epidemiology (STROBE).³

Study design and participants

Tremor was a prospective, observational study comparing the manual dexterity and composure of different hospital staff roles, conducted at one site in the UK. Participants took part in a single observed assessment of manual dexterity with no subsequent

WHAT IS ALREADY KNOWN ON THIS TOPIC

Previous studies have shown conflicting results regarding differences in manual dexterity between surgeons and physicians

The comparative assessment of dexterity across different hospital staff roles has not been previously explored

WHAT THIS STUDY ADDS

Surgeons showed significantly greater manual dexterity compared with physicians, nurses, and non-clinical staff when assessed using a buzz wire game
Surgeons had the highest rates of swearing during the dexterity task, while nurses and non-clinical staff showed the highest rates of audible noises of frustration

follow up. Participants were recruited from a single NHS trust in England (Leeds Teaching Hospitals NHS Trust), specifically from its two largest tertiary care hospitals. Eligible participants were employed within one of four hospital staff roles: physicians, surgeons, nurses, and non-clinical staff. Physicians and surgeons were eligible if they were consultants or specialty doctors in training (registrars) registered with the General Medical Council. Nurses were eligible if they were registered with the Nursing and Midwifery Council. Non-clinical staff were required to be current employees who were not in direct patient care roles, including, but not limited to, ward clerks, secretaries, domestic staff, and porters. To ensure a generalisable and representative sample, exclusion criteria were kept minimal and limited to unwillingness to participate and self-reported physical limitations precluding task completion.

Recruitment

Recruitment to the study was undertaken during a three week period between 25th June and 16th July 2024. Eligible staff present at work during the three week study period were approached to take part. Potential participants were initially identified and approached using a stratified convenience sample, accounting for individuals within each eligible staff group at various locations throughout the NHS trust premises. Recruiters actively visited clinical areas, ward staff rooms, coffee rooms, offices, and other communal areas across the hospital sites to invite participants. Additional recruitment occurred through snowballing sampling, which was used to identify and approach individuals from colleagues' wider networks and work acquaintances. Potential participants were provided with a participant information sheet about the study.

Dexterity assessment

Manual dexterity was assessed using a buzz wire game (Buzzwire, John Lewis, UK), consisting of a twisted metal wire path fixed on a non-conductive base. Participants were instructed to guide a wand

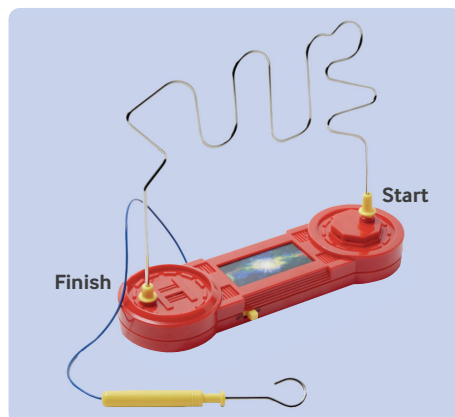


Fig 1 | Image of the buzz wire game. Image reproduced with permission from John Lewis

with a metal loop from one end of the path to the other without touching the wire. If the loop touched the wire at any point, a buzzer sounded, and the participant was required to return to the start. The goal was to complete the entire path without triggering the buzzer. Instructions provided to participants were standardised and no practice attempts were permitted. This CE-marked device is approved for use in the UK for individuals aged 4 years or older (fig 1). Two short video demonstrations are available in the online supplementary materials.

Outcomes and measures

The primary outcome was successful completion of the game within five minutes. A timer began on each participant's first hand movement and continued until a run free of errors was completed. Any error required participants to restart from the beginning while the timer continued to run (fig 1). A time frame of five minutes was chosen based on pilot attempts completed by the Tremor steering committee and agreed by consensus as providing a reasonable period for the successful completion of the buzz wire game.

Secondary outcomes comprised the use of swearing and audible expressions of frustration. Additionally, we conducted sensitivity analyses in which we compared study completion between hospital staff roles at two minutes, assessed study completion in a time-to-event analysis, as well as analyses adjusting for age and gender as covariates. Although participants were aware they would be observed during the task, the specific outcomes being measured were not specified in the statement of agreement.

All outcome assessments were completed by a single, unmasked assessor. Blinding of participant groups was not considered to be feasible due to recognisable participant uniforms. The risk of detection bias was mitigated by a standardised and pre-agreed approach to identifying buzzer sounds, swear words, and expressions of exasperations. Before recruitment, investigators took part in a familiarisation exercise using the buzz wire game to ensure consistency in facilitating the test and identifying outcomes. Any audible noise from the speaker of the buzz wire game was identified as a buzzer sound, requiring participants to restart their attempt. Audible noises of frustration were defined as any vocal expressions of exasperation, such as sighs, groans, or mutters. Swearing was defined as any swear word not suitable for broadcast before the 9pm watershed on UK television according to a publicly available list of offensive language published by Ofcom.⁴

Data collection

Participants provided basic demographic information including age (years), gender, and hospital staff group (ie, nurse, physicians, surgeons, or non-clinical staff). For physician and surgical groups, seniority (registrar, consultant) was also collected. All data were collected anonymously.

Sample size calculation

We decided a priori that a between group difference of 25% in the five minutes completion rate would be sufficient to regard one group as having superior manual dexterity compared with other hospital staff roles. To meet 80% power in detecting differences between these groups, with a significance level of 5%, a sample size of 58 participants per group was required.

Statistical analysis

Continuous data are presented as medians with 25th-75th centiles and categorical data as rates with percentages. The buzz wire game completion within five or two minutes for each hospital staff role group were compared using χ^2 test. This outcome was also presented as a time-to-event analysis using Kaplan-Meier plots. Binary logistic modelling with time to completion or failure as a covariate within two or five minutes was used to assess if differences in completion rates between groups were independent of age and gender, using surgeons as the reference group. The secondary outcome was determined by frequencies of swearing and noises of frustration with hospital staff roles compared by χ^2 test. All statistical tests were two sided, and statistical significance was defined as $P < 0.05$. All analyses were done using Stata/MP (version 18).

Governance and ethics

The NHS Research and Innovation Service at the participating NHS trust confirmed that NHS Research Ethics Committee approval was not required for staff to participate in the study. Each participant was provided with a participant information sheet and gave verbal consent to participate. All data were collected and stored anonymously.

Patient and public involvement

We discussed the Tremor protocol with key stakeholders, including patients and staff at our hospital trust who guided the selection of the buzz wire game. The selected assessment modality was considered to be amusing and accessible while also providing objective data describing between group differences in manual dexterity. No further public involvement was used during the study.

Results

Study participants

A total of 254 hospital staff members participated in the study, comprising 60 physicians, 64 surgeons, 69 nurses, and 61 non-clinical members of staff (table 1). Less than 5% of invited staff did not provide consent to participate. Median age across hospital staff roles varied; nurses were younger with a median age of 32 years (interquartile range 26-46) compared with physicians at 38 years (34-43), surgeons at 38 years (33-45), and non-clinical staff at 38 years (31-52). Gender distribution also differed, with men comprising 10% (n=7) of nurses, 65% (n=39) of physicians, 80% (n=51) of surgeons, and 20% (n=12) of non-clinical staff. A diverse group of hospital staff roles for non-clinical staff and specialties for nursing, physician, and surgical staff were included (supplementary table 1A-D).

Dexterity assessment

Surgeons had a significantly higher success rate in completing the buzz wire game within five minutes. A total of 84% (n=54/64) of surgeons successfully completed the game within five minutes compared with physicians (57%, n=34/60), nurses (54%, n=37/69), and non-clinical staff (51%, n=31/61) ($P < 0.001$) (fig 2, top). When assessed in a time-to-event analysis, we again observed that surgeons completed the task significantly quicker than other groups (logrank $P < 0.001$, fig 2, bottom). These observations remained evident in analyses adjusting for age and gender (table 2), as well as where successful completion was defined as occurring within two minutes, with surgeons completing the task more frequently compared with other hospital staff roles ($P < 0.001$, table 2 and supplementary figure 1). Surgeons had the fastest median time to game completion or failure at 89 seconds (interquartile range 52-169), compared with physicians at 120 seconds (65-277), nurses at 135 seconds (92-210), and non-clinical staff at 161 seconds (104-264). Neither the time of day the test was performed, nor the grade of physician or surgeon was associated with successful completion of the game (supplementary tables 2 and 3).

Use of swearing and noises of frustration

Significant differences were observed in the use of swearing and noises of frustration across the groups. The 64 surgeons exhibited the highest rate of swearing

Table 1 | Participants' demographics and dexterity

Characteristics	Physicians (n=60)	Surgeons (n=64)	Nurses (n=69)	Non-clinical staff (n=61)
Age (interquartile range)	38 (34-43)	38 (33-45)	32 (26-46)	38 (31-52)
Male, no. (%)	39 (65)	51 (80)	7 (10)	12 (20)
Grade—consultant: specialist registrar	34:26	22:42	—	—
Time of test, no. (%):				
Morning (06:00 to 12:00)	3 (5)	4 (6)	10 (14)	6 (10)
Afternoon (12:00 to 18:00)	38 (63)	29 (45)	43 (62)	33 (54)
Evening (18:00 to 02:00)	19 (32)	31 (48)	16 (23)	22 (36)

Continuous data presented as median with 25th and 75th centile while categorical data are presented as no. (%).

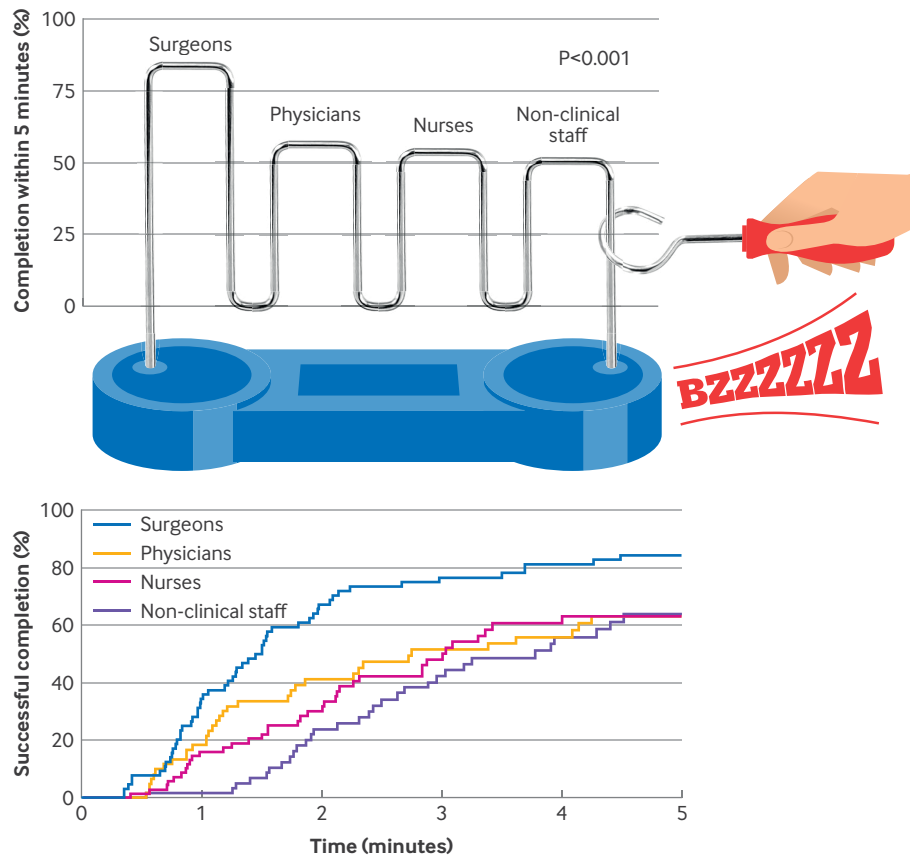


Fig 2 | Top graph, percentage of participants successfully completing the buzz wire game within five minutes, stratified by hospital staff role; $P < 0.001$ by χ^2 test. Bottom graph, Kaplan-Meier curve of successfully completing the buzz wire game within five minutes, stratified by hospital staff role

during the game (50%, $n=32$), which was significantly higher than that of the other groups ($P=0.004$, fig 3, top). The 69 nurses had the second highest rate at 30% ($n=21$), followed by physicians at 25% ($n=15/60$), and non-clinical staff at 23% ($n=14/61$). Non-clinical staff showed the highest use of frustration noises (75%, $n=46$) followed by nurses (68%, $n=47$), surgeons (58%, $n=37$), and physicians (52%, $n=31$) ($P=0.03$, fig 3, bottom).

Discussion

Key findings

The Tremor study found that surgeons on average were quicker and more successful at completing the buzz wire game within five minutes compared with other hospital staff roles; although, they were more likely to swear while completing the task. This difference remained evident even after accounting for baseline differences in age and gender between groups and when analysed over two minutes.

Findings in relation to the available evidence

The buzz wire game might be a reasonable tool for assessing manual dexterity because the tool evaluates fine motor skills, hand and eye coordination, steadiness, handling stress, and provides objective data within an inexpensive and simple solution. Although not formally validated as a measure of manual dexterity, previous studies have found the buzz wire game performs comparably to other validated tools of dexterity.⁵ Moreover, it counts any haptic feedback as an error, preventing participants feeling their way through the task and provides a true assessment of manual dexterity.⁵ Similar style wire loop games have

Table 2 | Unadjusted and adjusted odds ratios for completion within five minutes of the buzz wire dexterity game by hospital staff group

Outcome	Unadjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Completion within five minutes		
Surgeons	1.00 (reference)	1.00 (reference)
Physicians	0.21 (0.07 to 0.62), $P < 0.01$	0.25 (0.11 to 0.58), $P < 0.01$
Nurses	0.18 (0.06 to 0.49), $P < 0.01$	0.23 (0.09 to 0.58), $P < 0.01$
Non-clinical staff	0.21 (0.08 to 0.59), $P < 0.01$	0.22 (0.08 to 0.56), $P < 0.01$
Completion within five minutes		
Surgeons	1.00 (reference)	1.00 (reference)
Physicians	0.23 (0.08 to 0.71), $P=0.01$	0.23 (0.07 to 0.72), $P=0.01$
Nurses	0.20 (0.07 to 0.59), $P < 0.01$	0.23 (0.06 to 0.86), $P=0.03$
Non-clinical staff	0.21 (0.07 to 0.62), $P < 0.01$	0.23 (0.07 to 0.79), $P=0.02$

Adjusted model is adjusted for participant age, gender, and time to completion or failure. CI=confidence interval.

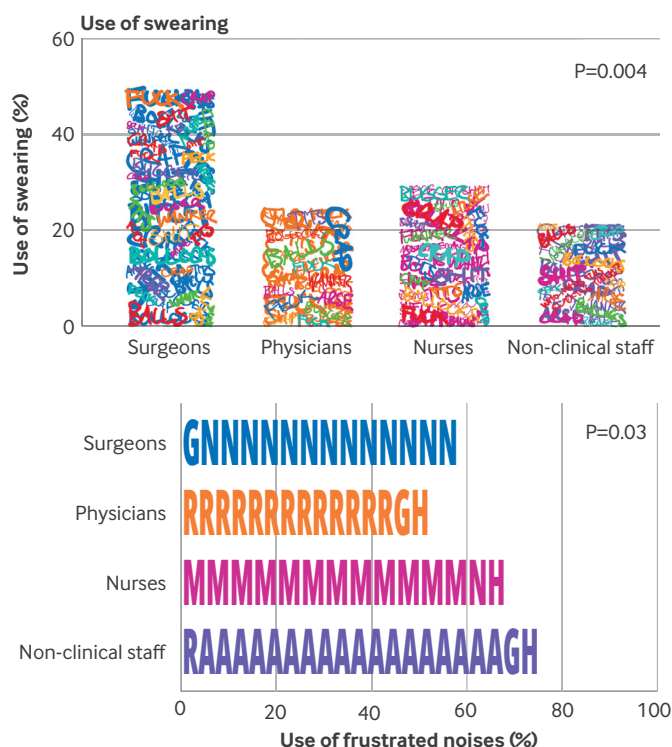


Fig 3 | Top graph, Percentage of participants swearing during the buzz wire game, stratified by hospital staff role; $P=0.004$ by χ^2 test. Bottom graph, Percentage of participants that made frustration noises during the buzz wire game, stratified by hospital staff role; $P=0.03$ by χ^2 test.

been used in earlier studies assessing dexterity, fine motor skills, and hand-eye coordination.⁶

Previous research has suggested that surgeons' propensity for swearing might be a coping mechanism for high pressure situations to help them maintain skill despite stress.⁷⁻⁸ Nurses and non-clinical staff showed relatively good game completion rates and were most likely to express noises of frustration. Physicians swore less and had the lowest level use of noises of frustration. Our findings both align with and diverge from previous studies. Squire and colleagues found no dexterity differences between medical and surgical residents, contrasting our results.¹ Constansia and colleagues reported no correlation between surgical subspecialisation and dexterity, with dexterity negatively correlating with age.² Our study, however, showed surgeons outperforming other groups of healthcare workers, maintaining superior dexterity across age groups. These contrasts highlight the complexity of assessing manual dexterity in healthcare settings. Our use of the buzz wire game and broader participant range might offer new insights into dexterity distribution across hospital roles.

Nature versus nurture

Although tremor was observational in nature, and hence not designed to determine reasons for the observed differences, a possible explanation for the better performance of surgeons compared with other

hospital staff roles might be due to either a training effect or innate ability. Surgeons undergo extensive training and continue to use their hands daily while operating. Over time, frequent operating might enhance hand and eye coordination and their ability to complete tasks such as the buzz wire game. Conversely, surgeons might be a self-selected group for whom tasks requiring hand and eye coordination is appealing, or individuals with poor manual dexterity might not progress through surgical training. Doctors who find manual tasks challenging might also be attracted to other specialties; although, this explanation might in part be refuted by the observation that some medical specialties include interventional procedures. Additionally, these hypotheses do not explain the observed difference between surgeons and nursing staff, suggesting some degree of a training effect. To definitively answer this question, twin studies comparing surgeons and non-medical siblings are required, although feasibility might be challenging.

Implications

These data provide surgeons at Leeds Teaching Hospitals with boasting rights regarding their dexterity skills, in both the operating theatre and the coffee room. In the future, assessments such as the buzz wire game could be included in the training programme for surgical trainees to develop fine motor skills. Another potential use of the buzz wire game might be as a tool to streamline cumbersome interviews for specialty training programmes. Future studies should examine the clinical and cost effectiveness of such approaches for the wider NHS and how these may seamlessly integrate into practice. Staff members in specialties with lower performance might consider adding the buzz wire game to their Christmas wish lists for use as a training tool.

Although surgeons performed better than other groups, their use of swearing was higher. Surgeons, and those working with surgeons, might wish to consider investing in a swear jar or similar intervention aimed at reducing swearing and optimising composure during challenging tasks; although, such interventions must be tested in prospective studies to ensure their effectiveness.

Limitations

Our study has important limitations that should be noted. Firstly, the use of a family game as an assessment tool may have introduced bias by potentially favouring people with young children or with other previous experience. People considering themselves to be more dexterous may also have been more likely to take part and the reasons for non-participation were not recorded. Secondly, confounding factors, such as prevailing stress, fatigue, and caffeine consumption at the time of the assessment might have affected performance because none of these factors was controlled. We attempted to mitigate this risk by recruiting participants away from direct patient contact, but the pattern of secondary

care work is difficult to predict. Thirdly, although we recruited a diverse cohort of hospital staff from various roles, our study was conducted at a single NHS trust, which limits the generalisability. On one hand, some generalisability is met through the standardisation of healthcare training in the UK, meaning that healthcare staff have similar opportunities to develop their skills of dexterity. On the other hand, the study does not account for regional, national, or international differences in working patterns, activities, or resources, which might lead some professionals to develop their skills more than others. Fourthly, the Tremor study was observational in nature, and hence not designed to determine the reason for the observed differences between hospital staff groups. Fifthly, being observed might have resulted in a lower frequency of swearing (Hawthorne effect), or conversely that surgeons curtailed their foul language less than other hospital staff groups. Finally, our findings are not applicable to children younger than 4 years for whom the buzz wire game's small parts may represent a choking hazard, although these individuals are unlikely to be currently employed in secondary care.

Conclusions

This study shows that surgeons at Leeds Teaching Hospitals have greater dexterity but higher levels of swearing when assessed using a buzz wire game compared with other hospital staff roles. Nurses and non-clinical staff showed commendable dexterity and expressed noises of frustration more openly, showing the diverse skill sets across hospital staff roles. Future training might benefit from incorporating family games to enhance both dexterity and stress management across all specialties. Implementation of a surgical swear jar initiative should be considered for future fundraising events.

We thank Richard Cubbon and Mark Kearney, University of Leeds, for their invaluable support.

Contributors: TJ and OIB have joint first authorship. MD conceived the idea for the study and all authors made substantial contribution to the design. All authors were involved in data collection. OIB analysed the data. MD, TJ, and OIB drafted the manuscript. SK, MG, RCS, EBH, SJC, TAS, and SS critically revised the manuscript. MD is the guarantor (the contributor who accepts full responsibility for the finished article, had access to any data, and controlled the decision to submit for publication). The corresponding author (MD) attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Transparency: MD affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; there are no discrepancies from the study as originally planned.

Funding: No funding was received for this work. TJ, RCS, SJC, SS, and MD are supported by the National Institute of Health and Care Research.

Conflicts of interest: All authors have completed the ICMJE uniform disclosure form at www.icmje.org/disclosure-of-interest/ and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Ethical approval: The NHS Research and Innovation Service at the participating NHS Trust confirmed that NHS Research Ethics Committee approval was not required for staff to participate in the study.

Data sharing: The study data are available on reasonable request.

Dissemination to participants: The study results will be disseminated to participants via the Leeds Teaching Hospitals NHS Trust weekly newsletter and the Trust intranet.

Provenance and peer review: Not commissioned; externally peer reviewed.

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Web appendix: Extra material supplied by authors

Video 1: Demonstration of the process of using the buzz wire and restarting when the buzzer noise sounded

[bmj-2024-081814-vid1](#)The BMJ Video Player

Video 2: Demonstration of the process of using the buzz wire correctly without triggering the buzzer

[bmj-2024-081814-vid2](#)The BMJ Video Player