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Effectiveness of short, personalised student assistantships

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Abstract

Objectives

Student assistantships are recommended to prepare medical graduates for clinical practice. Traditionally, assistantships have consisted of longer placements, often up to 15 weeks. However, within the constraints of the final year, medical schools need to carefully balance the time required for specialty placements, assessments and the risk of student burnout. We set out to evaluate the effectiveness of shorter, personalised student assistantships.

Design

A prospective study evaluating the changes in final year student confidence in preparedness for practice after a three-week assistantship with defined learning objectives and learning needs assessment.

Setting

Eight hospitals affiliated with Imperial College School of Medicine.

Outcomes

Student confidence in 10 learning outcomes including organising ward rounds, documentation, communication with colleagues, communication with patients and relatives, patient handover, practical procedures, patient management, acute care, prioritisation and out-of-hours clinical work.

Results

Two hundred and twenty final year medical students took part in the student assistantship, of whom 208 completed both the pre- and post-assistantship confidence rating questionnaire (95% completion rate). Post-assistantship, 169 (81%) students expressed increased confidence levels in one or more learning objectives. For each individual learning objective, there was a significant change in the proportion of students who agreed or strongly agreed post-assistantship ($P<0.0001$).

Conclusion

Overall, the focused three-week, personalised student assistantships led to significant improvement across all learning objectives related to preparedness for practice. The use of the pre-assistantship confidence rating questionnaire allowed students to identify and target areas of learning need during their assistantship.

Keywords

Assistantship, preparedness for practice, medical students, undergraduate medical education

Strengths and limitations of this study

- Short, personalised student assistantships of three-weeks duration can significantly improve student confidence in preparedness for practice.
- The use of a confidence rating questionnaire as a learning needs assessment at the start of the placement allows for a highly-focused assistantship experience.
- Without full registration with the UK General Medical Council, some clinical learning opportunities remained limited to students, such as prescribing.

Introduction

The transition from being a medical student to becoming doctor is known to be challenging [1]. In order to increase the preparedness of graduating medical students for practice in the clinical environment, the UK General Medical Council (GMC) introduced student assistantships into the medical school curriculum [2]. The purpose of the student assistantship placement is primarily to provide final year medical students with the opportunity to prepare for the reality of working in the clinical environment and to support the transition between medical student and doctor [2].

The benefits of student assistantships for preparing graduating medical students for clinical work are well documented [3-6]. Students who have undergone assistantships repeatedly report improved skills, knowledge and confidence relating to practical clinical working, communication skills and team-working [3-6]. An assistantship is able to provide students with the opportunity to practise relevant skills for the delivery of

care for real patients, creating a sense of clinical responsibility, which can be difficult to mimic elsewhere in the curriculum [7-10].

Due to the key role the student assistantship has in preparing students for clinical work, the GMC recommends that these placements take place towards the end of medical school [2]. Whilst the GMC does not stipulate the length or specialty of student assistantships, studies evaluating the benefits of the placement typically focus on longer assistantships lasting between six and 15 weeks [3-6].

Providing long assistantships near the end of final year can be particularly challenging for medical schools as they need to be balanced with the provision of sufficient clinical placement time for knowledge consolidation and assessment preparation, as well as the delivery of high-stakes, summative assessments. Furthermore, the educational benefits of prolonged assistantships need to be carefully considered, with one study noting that students experienced a learning plateau after 10 weeks [6]. Student welfare is also a factor in designing student assistantships, with medical students being at the greatest risk of burnout at the end of a year of clinical placements [11,12].

In 2020, Imperial College School of Medicine introduced a short student assistantship designed to focus solely on practising the typical duties of a newly qualified doctor. In order to maximise the learning opportunities available to students, the assistantship was combined with a learning needs assessment to personalise the placement experience. The learning needs assessment aimed to focus student learning and support them in recognising learning opportunities which can be missed on placements [10,13,14].

The emphasis of the three-week student assistantship was to provide opportunities for medical students to take on clinical responsibility in a supervised environment and manage clinical tasks such as clinical prioritisation, managing acutely unwell patients under supervision and recommending prescriptions; rather than furthering clinical or specialty knowledge [2,7,9].

The aim of this study was to evaluate the effectiveness of a short, personalised student assistantship.

Methods

The student assistantship

Final year medical students were allocated to a three-week student assistantship which was scheduled after final examinations as the last clinical placement prior to graduation. The assistantships were based in general medicine, general surgery and emergency medicine firms at an Imperial-affiliated hospital. Each medical student was paired with a Foundation Year (first two years post-graduation) doctor. They were directed to follow their work schedule, including their out-of-hours and on-call shifts, and to assist them with their daily clinical and administrative tasks. Students were to remain within the same firm throughout their assistantship under the supervision of the same firm lead.

Learning objectives and questionnaire

Ten learning objectives for the student assistantship were developed based on guidance from the GMC and existing literature (figure 1).

Figure 1: Student Assistantship Learning Objectives

A 'confidence rating' questionnaire based on the learning objectives was developed to evaluate the difference in student confidence after completing the assistantship. Prior to starting the placement, students were asked to complete the pre-assistantship questionnaire by rating their confidence on the 10 learning objectives using a five-point Likert scale which ranged from 'strongly agree' to 'strongly disagree' (Appendix 1). This questionnaire was used to identify areas of learning need for the student to focus on during the assistantship. After completing the three-week assistantship, students were asked to rate their confidence again on the same learning objectives using the same scale in the post-assistantship questionnaire (Appendix 2).

Assistantship induction and firm lead meetings

As part of the assistantship, each student received a hospital induction and an initial meeting with the firm lead upon starting the placement. The assistantship concluded with a feedback meeting with the firm lead.

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148 The hospital induction was a group session which provided students with orientation,
149 understanding of local systems and protocols, and access to resources and facilities,
150 in a similar way to a typical induction for new Foundation Year doctors.

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152 The initial meeting with the firm leads was on a one-to-one basis. These were
153 designed to guide students to use their self-ratings in the pre-assistantship
154 questionnaire to identify their personal learning needs and particular areas of focus for
155 the duration of their student assistantship.

156
157 At the end of the three-week assistantship, students attended a feedback meeting with
158 the same firm lead. This meeting was used to discuss their post-assistantship self-
159 rating, reflect on their placement experience, and receive feedback on their
160 performance. Students were able to modify their self-rating after reflecting on their
161 feedback from the firm lead if they wished.

162
163 **Analysis**

164 Data from each questionnaire was imported to Microsoft Power BI™ for quantitative
165 analysis and confirmation of normal distribution on each item. Statistical analysis was
166 performed using R (version 4.0.1). The five-point Likert items were converted to
167 dichotomous variables: of agree/strongly agree responses and neither agree nor
168 disagree/disagree/strongly disagree responses. McNemar's χ^2 test for paired data
169 was used to determine whether there was a significant change in the proportion of
170 students who agreed/strongly agreed with each statement post-assistantship.

171
172 **Patient and Public Involvement**

173 No patient involved.

174
175 **Ethical approval**

176 Ethical approval was granted by the Imperial Education Ethics Review Process
177 EERP2021-052.

178
179 **Results**

A total of 220 final year medical students took part in the three-week, personalised student assistantship across eight hospitals. The number of students that completed both the pre- and post-assistantship questionnaire was 208 (95% completion rate).

Pre-assistantship, responses approximated to normal distribution across most items, with the most common response being 'neither agree nor disagree'. For practical procedures and communication with patients and relatives, pre-assistantship results skewed towards 'agree' and 'strongly agree'.

Post-assistantship, 169 (81%) students expressed increased confidence levels in one or more learning objectives. For each learning objective, students most commonly reported that their confidence improved by one interval on the Likert scale. For communication with colleagues, the most common outcome was improvement by two intervals, and for practical procedures, the most common outcome was no change.

Figure 2: Proportion of students who agreed or strongly agreed to each statement pre- and post-assistantship

For each individual learning objective, there was a significant increase in the proportion of students who agreed or strongly agreed that they felt confident post-assistantship ($P < 0.0001$). Post-assistantship, over 90% of students 'agreed' or 'strongly agreed' that they felt confident in documentation, patient handover, practical procedures and organising ward rounds. For patient management, 60% of students 'agreed' or 'strongly agreed' that they felt confident post-apprenticeship compared to 12% pre-apprenticeship (figure 2).

Increased proportions of students who felt confident were most notable in communication with colleagues, patient handover and organising ward rounds. For communication with colleagues, the percentage of students agreeing or strongly agreeing with being confident in this learning outcome increased by 78 percentage points from 11% pre-assistantship to 89% post-assistantship. For patient handover and organising ward rounds, the proportion of students who reported confidence post-assistantship increased by 72 and 66 percentages points, respectively.

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Discussion

Overall, the three-week personalised student assistantship was associated with significant increases in student confidence across all individual learning objectives related to preparedness for practice.

The largest percentage point increases in confidence were in organising ward rounds, patient handover and communication with colleagues. These skills are all centred around the student taking clinical responsibility and using effective communication with the clinical team to support delivery of patient care. As students were embedded in the firm as a team member assisting the Foundation Year doctor, they were expected to perform these tasks regularly under supervision in an authentic clinical environment. Clinical placements prior to the assistantship were typically more focused on knowledge consolidation and practical skills in preparation for summative assessments.

This is consistent with existing literature, where students are noted to have limited ‘hands on’ experience in final year placements [15]. In contrast, the assistantship allowed students to take on supervised clinical responsibility and to practise communication and teamworking, which have been highlighted as important skills for preparedness by existing literature [7,14].

The smallest percentage point increase was regarding practical procedures. It is noted that a relatively high proportion of students identified as being confident in practical procedural skills prior to the assistantship. This correlates with final year student experience elsewhere and may be due to other opportunities in the medical school curriculum for students to practise these skills, such as in the clinical skills laboratory or in simulation sessions, leaving less room for improvement during the assistantship [15]. Despite the higher confidence levels in this area pre-assistantship, the overall improved confidence in performing practical procedures remained significant, as with all other learning objectives.

For patient management, the baseline confidence in the pre-assistantship questionnaire was one of the lowest amongst all learning objectives. This is consistent with existing literature which note that final students had relatively limited opportunity

to manage unwell patients compared to other activities, such as carrying out practical procedures [15]. Despite patient management having one of the smaller increases in confidence post-assistantship, the change remains significant. For students and Foundation Year doctors, assessing and managing patients as the first clinician called remains one of the most challenging aspects of clinical work [1]. The relatively smaller increase in confidence may be due to the challenging nature of this learning outcome and the sense of clinical responsibility and perceived risk associated with delivery of patient care as the first clinician. As the students in this study did not have GMC registration or professional responsibility for any patients, it is possible that when a clinician was required, a registered doctor was contacted in the first instance rather than the medical student. A 2011 study of UK medical school curriculum leaders demonstrated a consistently conservative approach towards students carrying out activities associated with increased patient risk, advocating that the students perform activities only with stable patients [16]. Despite this, the 48 percentage point increase as shown over the three-week assistantship from a baseline of 12% shows that even over a short period, students can gain significant confidence in this challenging task.

Timing the assistantship towards the end of the academic year allowed students to focus on preparing for practice without the stress and distraction of high-stake final examinations [17]. Scheduling it just prior to graduation further gave students the opportunity to experience working as the Foundation Year doctor in a supported and familiar environment, as close as possible to when they would formally start the role.

The use of the pre-assistantship questionnaire in the initial meeting with the firm lead allowed students to reflect and identify areas of focus for the three-week placement. This enabled the assistantship to be personalised to each individual student, allowing them to target areas of learning need and recognise learning opportunities which can otherwise be missed [10,13,14]. The highly-focused approach to the student assistantship may have been a factor in the significantly improved confidence over a relatively short period.

The meeting with the firm lead at the end of the placement provided students with feedback and the opportunity to reflect on their assistantship experience. The feedback provided may have allowed students to better benchmark their performance

282 against expected standards for a Foundation Year doctor. As self-assessment
283 enhances learning and performance, this may have further improved student
284 confidence and perceived readiness for commencing Foundation Training [18].

286 The data derived from this study has shown that short, personalised student
287 assistantships of three-weeks duration can significantly improve student confidence in
288 preparedness for practice. With substantial competing interests in the final year of
289 medical school, including high-stake summative examinations and high risk of student
290 burnout, the use of short, personalised student assistantships prior to graduation may
291 be an effective model for preparing medical students for working in the clinical
292 environment.

294 **Limitations**

295 As medical students are not registered with the GMC, there are a number of skills
296 which they may not be able to experience in full [8]. Patient safety is of utmost
297 importance when considering clinical placements and must be balanced carefully
298 against student learning needs. Managing the risk of contacting the medical student
299 as the first clinician remains challenging for clinical teams, which may limit students'
300 experience of clinical responsibility [8,16]. Medical schools and their placement
301 providers must ensure that adequate training and protocols are provided to the wider
302 clinical team to indicate when it is safe and appropriate to contact the medical student
303 as the first clinician [19]. Students attending patients as the first clinician must also
304 have adequate supervision and support to do so safely.

306 Electronic prescribing and digital investigation requests also pose a challenge to
307 medical students fully immersing themselves during assistantships. The inability to
308 submit prescriptions and investigation requests due to digital transformation and
309 clinical governance means that students are not able to fully perform all the same
310 duties their Foundation Year doctor. These limitations can impact medical students'
311 perception of clinical responsibility and their exposure to these skills during the
312 assistantship [14,16]. At Imperial, the medical school has provided alternative
313 opportunities to support these learning needs, for example through regular prescribing
314 practice and simulation sessions [20].

Due to the size of the local Foundation School, the majority of Imperial graduates will likely undertake Foundation Training outside this region. Students were therefore allocated to assistantship placements which may not be aligned to their future foundation posts. Aligned assistantships may have provided even greater improvements in confidence for starting Foundation Training [21].

Author contributions

CYF and LK contributed to the conception and design of the work, the acquisition, analysis and interpretation of the data, drafting the manuscript and final approval of the work.

EHa, NMM, OH, JJM, EHu and AS contributed to the conception and design of the work, revision of the manuscript and final approval of the work.

Competing interests

No competing interests declared.

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Data sharing statement

The datasets used in the current study are available from the corresponding author on reasonable request.

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Figure legend

Figure 1: Student Assistantship Learning Objectives

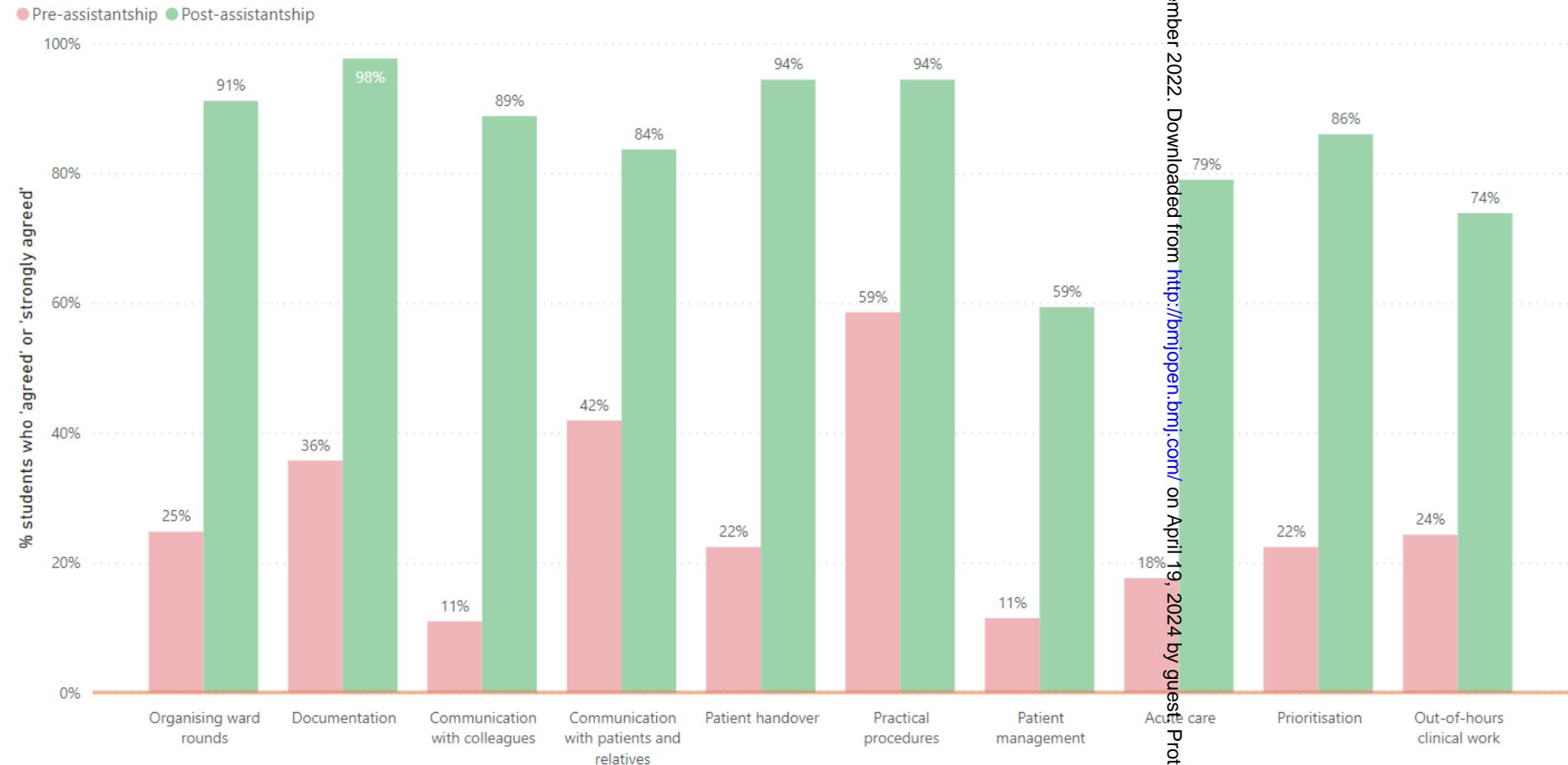
Figure 2: Proportion of students who agreed or strongly agreed to each statement pre- and post-assistantship

Figure 1: Student Assistantship Learning Objectives

1. **Organising ward rounds** (presenting patients and organising ward rounds)
2. **Documentation** (writing notes and discharge summaries)
3. **Communication with colleagues** (discussing patient care, including referrals, investigations, liaising with multidisciplinary team)
4. **Communication with patients and relatives**
5. **Patient handover** (updating the team and handing over)
6. **Practical procedures** (independently carrying out core practical procedures)
7. **Patient management** (assessing and managing patients as the first clinician called)
8. **Acute care** (actively supporting the clinical management of acutely ill patients)
9. **Prioritisation** (prioritising tasks and managing requests)
10. **Out-of-hours clinical work** (working shifts and out-of-hours, e.g. on-calls)

Figure 2: Proportion of students who agreed or strongly agreed to each statement pre- and post-assistantship

Percentage of students who 'Agreed' or 'Strongly Agreed' to each statement pre and post-assistantship. (Statistically significant improvement post-assistantship for all statements $p < 0.0001$)



Imperial College School of Medicine

Pre-PFA Placement Evaluation

To be completed at the PFA Induction Meeting

Prior to starting the PFA Placement, please rate your confidence on the following activities on a scale of 1 to 5 (1 – Strongly disagree, 2 – Disagree, 3 – Neither agree nor disagree, 4 – Agree, 5 – Strongly agree):

1. I feel confident presenting patients and organising ward rounds.				
1	2	3	4	5
2. I feel confident writing notes and discharge summaries.				
1	2	3	4	5
3. I feel confident discussing patient care and management plans with colleagues, recommending prescriptions, making referrals, arranging investigations and liaising with members of the multidisciplinary team.				
1	2	3	4	5
4. I feel confident communicating with patients and their relatives about patient care and management plans.				
1	2	3	4	5
5. I feel confident updating the team on patient care as part of the handover process.				
1	2	3	4	5
6. I feel confident independently carrying out core practical procedures (e.g. venepuncture, cannulation, ABGs etc).				
1	2	3	4	5
7. I feel confident assessing and managing patients as the first clinician called.				
1	2	3	4	5
8. I feel confident actively supporting the clinical management of acutely ill patients.				
1	2	3	4	5
9. I feel confident prioritising tasks and managing additional clinical requests during shifts (e.g. requests from bleeps).				
1	2	3	4	5
10. I feel confident working shifts and out-of-hours (e.g. on-calls).				
1	2	3	4	5

Date completed	(required)
Student signature	(required)

Imperial College School of Medicine

Post-PFA Placement Evaluation

To be completed at the PFA End of Placement Meeting

Following the PFA Placement, please rate your confidence on the following activities on a scale of 1 to 5 (1 – Strongly disagree, 2 – Disagree, 3 – Neither agree nor disagree, 4 – Agree, 5 – Strongly agree):

1. I feel confident presenting patients and organising ward rounds.				
1	2	3	4	5
2. I feel confident writing notes and discharge summaries.				
1	2	3	4	5
3. I feel confident discussing patient care and management plans with colleagues, recommending prescriptions, making referrals, arranging investigations and liaising with members of the multidisciplinary team.				
1	2	3	4	5
4. I feel confident communicating with patients and their relatives about patient care and management plans.				
1	2	3	4	5
5. I feel confident updating the team on patient care as part of the handover process.				
1	2	3	4	5
6. I feel confident independently carrying out core practical procedures (e.g. venepuncture, cannulation, ABGs etc).				
1	2	3	4	5
7. I feel confident assessing and managing patients as the first clinician called.				
1	2	3	4	5
8. I feel confident actively supporting the clinical management of acutely ill patients.				
1	2	3	4	5
9. I feel confident prioritising tasks and managing additional clinical requests during shifts (e.g. requests from bleeps).				
1	2	3	4	5
10. I feel confident working shifts and out-of-hours (e.g. on-calls).				
1	2	3	4	5

Firm Lead GMC Number	<i>(required)</i>
Firm Lead Feedback	<i>(required)</i>
Date completed	<i>(required)</i>
Firm Lead Signature	<i>(required)</i>

Date completed	(required)
Student signature	(required)

For peer review only

The RECORD statement – checklist of items, extended from the STROBE statement, that should be reported in observational studies using routinely collected health data.

	Item No.	STROBE items	Location in manuscript where items are reported	RECORD items	Location in manuscript where items are reported
Title and abstract					
	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	P2 L23-26	RECORD 1.1: The type of data used should be specified in the title or abstract. When possible, the name of the databases used should be included. RECORD 1.2: If applicable, the geographic region and time frame within which the study took place should be reported in the title or abstract. RECORD 1.3: If linkage between databases was conducted for the study, this should be clearly stated in the title or abstract.	P2 L23-26 P2 L29 NA
Introduction					
Background rationale	2	Explain the scientific background and rationale for the investigation being reported	P3 L64-112		
Objectives	3	State specific objectives, including any prespecified hypotheses	P4 L111-112		
Methods					
Study Design	4	Present key elements of study design early in the paper	P5 L114-170		
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	P5 L116-125		

Participants	6	<p>(a) <i>Cohort study</i> - Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up</p> <p><i>Case-control study</i> - Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls</p> <p><i>Cross-sectional study</i> - Give the eligibility criteria, and the sources and methods of selection of participants</p> <p>(b) <i>Cohort study</i> - For matched studies, give matching criteria and number of exposed and unexposed</p> <p><i>Case-control study</i> - For matched studies, give matching criteria and the number of controls per case</p>	P5 L117	<p>RECORD 6.1: The methods of study population selection (such as codes or algorithms used to identify subjects) should be listed in detail. If this is not possible, an explanation should be provided.</p> <p>RECORD 6.2: Any validation studies of the codes or algorithms used to select the population should be referenced. If validation was conducted for this study and not published elsewhere, detailed methods and results should be provided.</p> <p>RECORD 6.3: If the study involved linkage of databases, consider use of a flow diagram or other graphical display to demonstrate the data linkage process, including the number of individuals with linked data at each stage.</p>	P6 L163-170
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.	P6 L163-170	RECORD 7.1: A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and effect modifiers should be provided. If these cannot be reported, an explanation should be provided.	P6 L163-170
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	P6 L163-170		

Bias	9	Describe any efforts to address potential sources of bias			
Study size	10	Explain how the study size was arrived at	P5 L117		
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	P6 L163-170		
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> - If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> - If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> - If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses	P6 L163-170		
Data access and cleaning methods		..		RECORD 12.1: Authors should describe the extent to which the investigators had access to the database population used to create the study population.	P5 L127-161

				RECORD 12.2: Authors should provide information on the data cleaning methods used in the study.	
Linkage		..		RECORD 12.3: State whether the study included person-level, institutional-level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided.	NA
Results					
Participants	13	(a) Report the numbers of individuals at each stage of the study (<i>e.g.</i> , numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed) (b) Give reasons for non-participation at each stage. (c) Consider use of a flow diagram	P7 L177-179	RECORD 13.1: Describe in detail the selection of the persons included in the study (<i>i.e.</i> , study population selection) including filtering based on data quality, data availability and linkage. The selection of included persons can be described in the text and/or by means of the study flow diagram.	P5 L117
Descriptive data	14	(a) Give characteristics of study participants (<i>e.g.</i> , demographic, clinical, social) and information on exposures and potential confounders (b) Indicate the number of participants with missing data for each variable of interest (c) <i>Cohort study</i> - summarise follow-up time (<i>e.g.</i> , average and total amount)	P7 L177-179		
Outcome data	15	<i>Cohort study</i> - Report numbers of outcome events or summary measures over time <i>Case-control study</i> - Report numbers in each exposure	P7 L177-179		

		category, or summary measures of exposure <i>Cross-sectional study</i> - Report numbers of outcome events or summary measures			
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	P7 L177-211		
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	NA		
Discussion					
Key results	18	Summarise key results with reference to study objectives	P8 L213-291		
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	P11 L293-319	RECORD 19.1: Discuss the implications of using data that were not created or collected to answer the specific research question(s). Include discussion of misclassification bias, unmeasured confounding, missing data, and changing eligibility over time, as they pertain to the study being reported.	P8 L213-291
Interpretation	20	Give a cautious overall interpretation of results considering objectives,	P11 L285-291		

		limitations, multiplicity of analyses, results from similar studies, and other relevant evidence			
Generalisability	21	Discuss the generalisability (external validity) of the study results	P11 L285-291		
Other Information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	P12 L321-323		
Accessibility of protocol, raw data, and programming code		..		RECORD 22.1: Authors should provide information on how to access any supplemental information such as the study protocol, raw data, or programming code.	P6 L137 P6 L141

*Reference: Benchimol EI, Smeeth L, Guttman A, Harron K, Moher D, Petersen I, Sørensen HT, von Elm E, Langen SM, the RECORD Working Committee. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) Statement. *PLoS Medicine* 2015; in press.

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Effectiveness of short, personalised student assistantships: A prospective study across eight London hospitals

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Abstract

Objectives

Student assistantships are recommended to prepare medical graduates for clinical practice. Traditionally, assistantships have consisted of longer placements, often up to 15 weeks. However, within the constraints of the final year, medical schools need to carefully balance the time required for specialty placements, assessments and the risk of student burnout. We set out to evaluate the effectiveness of shorter, personalised student assistantships.

Design

A prospective study evaluating the changes in final year student confidence in preparedness for practice after a three-week assistantship with defined learning objectives and learning needs assessment.

Setting

Eight hospitals affiliated with Imperial College School of Medicine.

Outcomes

Student confidence in 10 learning outcomes including organising ward rounds, documentation, communication with colleagues, communication with patients and relatives, patient handover, practical procedures, patient management, acute care, prioritisation and out-of-hours clinical work.

Results

Two hundred and twenty final year medical students took part in the student assistantship, of whom 208 completed both the pre- and post-assistantship confidence rating questionnaire (95% completion rate). Post-assistantship, 169 (81%) students expressed increased confidence levels in one or more learning objectives. For each individual learning objective, there was a significant change in the proportion of students who agreed or strongly agreed post-assistantship ($P<0.0001$).

Conclusion

Overall, the focused three-week, personalised student assistantships led to significant improvement across all learning objectives related to preparedness for practice. The use of the pre-assistantship confidence rating questionnaire allowed students to identify and target areas of learning need during their assistantship.

Keywords

Assistantship, preparedness for practice, medical students, undergraduate medical education

Strengths and limitations of this study

- This study demonstrates the utility of confidence rating questionnaires as a learning needs assessment to create short, highly-focused assistantships.
- The use of confidence rating questionnaires, based on defined learning objectives, can be generalised to other undergraduate learning activities to support more focused, reflective learning, and provide rich data for learners and teachers.
- Prior to full registration with the UK General Medical Council, some learning opportunities, such as prescribing, remain restricted to students limiting their experience of clinical responsibility.
- The assistantship placements were not aligned to students' future Foundation Year 1 posts, which may have provided even greater improvements in confidence for starting Foundation Training.

Introduction

The transition from being a medical student to becoming a doctor is known to be a challenging and critically intensive learning period [1,2]. In order to increase the preparedness of graduating medical students for practice in the clinical environment, the UK General Medical Council (GMC) introduced student assistantships into the medical school curriculum [3]. The purpose of the student assistantship placement is primarily to provide final year medical students with the opportunity to prepare for the reality of working in the clinical environment and to support the transition between medical student and doctor [3].

80

The benefits of student assistantships for preparing graduating medical students for clinical work are well documented [4-7]. Students who have undergone assistantships repeatedly report improved skills, knowledge and confidence relating to practical clinical working, communication skills and team-working [4-7]. A supportive and reflective relationship between the student and clinical team empowers the student to 'act up' as an assistant. Thus, having the appropriate organisational practices in place is crucial in implementing assistantship models [8]. A successful assistantship is able to provide students with the opportunity to practise relevant skills for the delivery of care for real patients, creating a sense of clinical responsibility, which can be difficult to mimic elsewhere in the curriculum [9-12].

91

Due to the key role the student assistantship has in preparing students for clinical work, the GMC recommends that these placements take place towards the end of medical school [3]. Whilst the GMC does not stipulate the length or specialty of student assistantships, studies evaluating the benefits of the placement typically focus on longer assistantships lasting between six and 15 weeks [4-7].

97

Providing long assistantships near the end of final year can be particularly challenging for medical schools as they need to be balanced with the provision of sufficient clinical placement time for knowledge consolidation and assessment preparation, as well as the delivery of high-stakes, summative assessments. Furthermore, the educational benefits of prolonged assistantships need to be carefully considered, with one study noting that students experienced a learning plateau after 10 weeks [7]. Student welfare is also a factor in designing student assistantships, with medical students being at the greatest risk of burnout at the end of a year of clinical placements [13,14].

106

In 2020, Imperial College School of Medicine introduced a short student assistantship designed to focus solely on practising the typical duties of a newly qualified doctor. In order to maximise the learning opportunities available to students, the assistantship was combined with a learning needs assessment to personalise the placement experience. The learning needs assessment aimed to focus student learning and support them in recognising learning opportunities which can be missed on placements [12,15,16].

114

115 The emphasis of the three-week student assistantship was to provide opportunities for
116 medical students to take on clinical responsibility in a supervised environment and
117 manage clinical tasks such as clinical prioritisation, managing acutely unwell patients
118 under supervision and recommending prescriptions; rather than furthering clinical or
119 specialty knowledge [3,9,11].

120

121 The aim of this study was to evaluate the effectiveness of a short, personalised student
122 assistantship.

123

124 **Methods**

125

126 ***The student assistantship***

127 Final year medical students were allocated to a three-week student assistantship
128 which was scheduled after final examinations as the last clinical placement prior to
129 graduation. The assistantships were based in general medicine, general surgery and
130 emergency medicine firms at an Imperial-affiliated hospital. Each medical student was
131 paired with a Foundation Year (first two years post-graduation) doctor. They were
132 directed to follow their work schedule, including their out-of-hours and on-call shifts,
133 and to assist them with their daily clinical and administrative tasks. Students were to
134 remain within the same firm throughout their assistantship under the supervision of
135 the same firm lead.

136

137 The hospitals, firm leads and Foundation Year doctors involved in the student
138 assistantship were provided with detailed guidance on the nature of the placement,
139 the placement objectives and their role in its delivery. Hospitals were supported to
140 provide the relevant resources necessary for students to fully participate in the
141 assistantship, such as access passes, bleeps and rest areas. Firm leads were given
142 protected time to supervise their allocated medical students and to conduct any
143 required meetings. Foundation Year doctors were given an induction to the
144 assistantship programme and were assigned a local clinical teaching fellow as a
145 mentor for additional support.

146

147 ***Learning objectives and questionnaire***

Ten learning objectives for the student assistantship were developed based on guidance from the GMC and existing literature (figure 1).

Figure 1: Student Assistantship Learning Objectives

A ‘confidence rating’ questionnaire based on the learning objectives was developed to evaluate the difference in student confidence after completing the assistantship. Prior to starting the placement, students were asked to complete the pre-assistantship questionnaire by rating their confidence on the 10 learning objectives using a five-point Likert scale which ranged from ‘strongly agree’ to ‘strongly disagree’ (Appendix 1). This questionnaire was used to identify areas of learning need for the student to focus on during the assistantship. After completing the three-week assistantship, students were asked to rate their confidence again on the same learning objectives using the same scale in the post-assistantship questionnaire (Appendix 2).

Assistantship induction and firm lead meetings

As part of the assistantship, each student received a hospital induction and an initial meeting with the firm lead upon starting the placement. The assistantship concluded with a feedback meeting with the firm lead.

The hospital induction was a group session which provided students with orientation, understanding of local systems and protocols, and access to resources and facilities, in a similar way to a typical induction for new Foundation Year doctors.

The initial meeting with the firm leads was on a one-to-one basis. These were designed to guide students to use their self-ratings in the pre-assistantship questionnaire to identify their personal learning needs and particular areas of focus for the duration of their student assistantship.

At the end of the three-week assistantship, students attended a feedback meeting with the same firm lead. This meeting was used to discuss their post-assistantship self-rating, reflect on their placement experience, and receive feedback on their performance. Students were able to modify their self-rating after reflecting on their feedback from the firm lead if they wished.

182

183 **Analysis**

184 Data from each questionnaire was imported to Microsoft Power BI™ for quantitative
185 analysis and confirmation of normal distribution on each item. Statistical analysis was
186 performed using R (version 4.0.1). The five-point Likert items were converted to
187 dichotomous variables: of agree/strongly agree responses and neither agree nor
188 disagree/disagree/strongly disagree responses. McNemar's χ^2 test for paired data
189 was used to determine whether there was a significant change in the proportion of
190 students who agreed/strongly agreed with each statement post-assistantship.

191

192 **Patient and Public Involvement**

193 No patient involved.

194

195 **Ethical Approval**

196 Ethical approval was granted by the Imperial Education Ethics Review Process
197 EERP2021-052.

198

199 **Participant Consent**

200 In line with the ethical approval, this study used anonymised, routinely collected,
201 placement evaluation data, owned by Imperial College School of Medicine.

202

203 **Results**

204 A total of 220 final year medical students took part in the three-week, personalised
205 student assistantship. The student assistantships took place across eight hospitals
206 affiliated to Imperial College School of Medicine, and were of varying size, location
207 and demographic spread across North West London. The number of students that
208 completed both the pre- and post-assistantship questionnaire was 208 (95%
209 completion rate).

210

211 Pre-assistantship, responses approximated to normal distribution across most items,
212 with the most common response being 'neither agree nor disagree'. For practical
213 procedures and communication with patients and relatives, pre-assistantship results
214 skewed towards 'agree' and 'strongly agree'.

215

Post-assistantship, 169 (81%) students expressed increased confidence levels in one or more learning objectives. For each learning objective, students most commonly reported that their confidence improved by one interval on the Likert scale. For communication with colleagues, the most common outcome was improvement by two intervals, and for practical procedures, the most common outcome was no change.

Figure 2: Proportion of students who agreed or strongly agreed to each statement pre- and post-assistantship

For each individual learning objective, there was a significant increase in the proportion of students who agreed or strongly agreed that they felt confident post-assistantship ($P<0.0001$). Post-assistantship, over 90% of students ‘agreed’ or ‘strongly agreed’ that they felt confident in documentation, patient handover, practical procedures and organising ward rounds. For patient management, 60% of students ‘agreed’ or ‘strongly agreed’ that they felt confident post-assistantship compared to 12% pre-assistantship (figure 2).

Increased proportions of students who felt confident were most notable in communication with colleagues, patient handover and organising ward rounds. For communication with colleagues, the percentage of students agreeing or strongly agreeing with being confident in this learning outcome increased by 78 percentage points from 11% pre-assistantship to 89% post-assistantship. For patient handover and organising ward rounds, the proportion of students who reported confidence post-assistantship increased by 72 and 66 percentage points, respectively.

Discussion

Overall, the three-week personalised student assistantship was associated with significant increases in student confidence across all individual learning objectives related to preparedness for practice.

The largest percentage point increases in confidence were in organising ward rounds, patient handover and communication with colleagues. These skills are all centred around the student taking clinical responsibility and using effective communication

with the clinical team to support delivery of patient care. As students were embedded in the firm as a team member assisting the Foundation Year doctor, they were expected to perform these tasks regularly under supervision in an authentic clinical environment. Clinical placements prior to the assistantship were typically more focused on knowledge consolidation and practical skills in preparation for summative assessments. This is consistent with existing literature, where students are noted to have limited 'hands on' experience in final year placements [17]. In contrast, the assistantship allowed students to take on supervised clinical responsibility and to practise communication and teamworking, which have been highlighted as important skills for preparedness by existing literature [9,16].

The smallest percentage point increase was regarding practical procedures. It is noted that a relatively high proportion of students identified as being confident in practical procedural skills prior to the assistantship. This correlates with final year student experience elsewhere and may be due to other opportunities in the medical school curriculum for students to practise these skills, such as in the clinical skills laboratory or in simulation sessions, leaving less room for improvement during the assistantship [17]. Despite the higher confidence levels in this area pre-assistantship, the overall improved confidence in performing practical procedures remained significant, as with all other learning objectives.

For patient management, the baseline confidence in the pre-assistantship questionnaire was one of the lowest amongst all learning objectives. This is consistent with existing literature which note that final students had relatively limited opportunity to manage unwell patients compared to other activities, such as carrying out practical procedures [17]. Despite patient management having one of the smaller increases in confidence post-assistantship, the change remains significant. For students and Foundation Year doctors, assessing and managing patients as the first clinician called remains one of the most challenging aspects of clinical work [1]. The relatively smaller increase in confidence may be due to the challenging nature of this learning outcome and the sense of clinical responsibility and perceived risk associated with delivery of patient care as the first clinician. As the students in this study did not have GMC registration or professional responsibility for any patients, it is possible that when a clinician was required, a registered doctor was contacted in the first instance rather

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284 than the medical student. A 2011 study of UK medical school curriculum leaders
285 demonstrated a consistently conservative approach towards students carrying out
286 activities associated with increased patient risk, advocating that the students perform
287 activities only with stable patients [18]. Despite this, the 48 percentage point increase
288 as shown over the three-week assistantship from a baseline of 12% shows that even
289 over a short period, students can gain significant confidence in this challenging task.

290
291 Timing the assistantship towards the end of the academic year allowed students to
292 focus on preparing for practice without the stress and distraction of high-stake final
293 examinations [19]. Scheduling it just prior to graduation further gave students the
294 opportunity to experience working as the Foundation Year doctor in a supported and
295 familiar environment, as close as possible to when they would formally start the role.

296
297 The use of the pre-assistantship questionnaire in the initial meeting with the firm lead
298 allowed students to reflect and identify areas of focus for the three-week placement.
299 This enabled the assistantship to be personalised to each individual student, allowing
300 them to target areas of learning need and recognise learning opportunities which can
301 otherwise be missed [12,15,16]. The highly-focused approach to the student
302 assistantship may have been a factor in the significantly improved confidence over a
303 relatively short period.

304
305 The meeting with the firm lead at the end of the placement provided students with
306 feedback and the opportunity to reflect on their assistantship experience. The
307 feedback provided may have allowed students to better benchmark their performance
308 against expected standards for a Foundation Year doctor. As self-assessment
309 enhances learning and performance, this may have further improved student
310 confidence and perceived readiness for commencing Foundation Training [20].

311
312 This method of using confidence rating questionnaires before and after a learning
313 activity can be generalised to any clinical learning opportunities with defined learning
314 objectives. The process of self-assessment will support students to focus and reflect
315 on the key learning objectives during any learning opportunity. It highlights areas of
316 strengths and weaknesses to both the student and the teacher, providing

individualised feedback which can be further used to support the students' learning needs.

The data derived from this study has shown that short, personalised student assistantships of three-weeks duration can significantly improve student confidence in preparedness for practice. With substantial competing interests in the final year of medical school, including high-stake summative examinations and high risk of student burnout, the use of short, personalised student assistantships prior to graduation may be an effective model for preparing medical students for working in the clinical environment.

Limitations

As medical students are not registered with the GMC, there are a number of skills which they may not be able to experience in full [10]. Patient safety is of utmost importance when considering clinical placements and must be balanced carefully against student learning needs. Managing the risk of contacting the medical student as the first clinician remains challenging for clinical teams, which may limit students' experience of clinical responsibility [10,18]. Medical schools and their placement providers must ensure that adequate training and protocols are provided to the wider clinical team to indicate when it is safe and appropriate to contact the medical student as the first clinician [21]. Students attending patients as the first clinician must also have adequate supervision and support to do so safely.

Electronic prescribing and digital investigation requests also pose a challenge to medical students fully immersing themselves during assistantships. The inability to submit prescriptions and investigation requests due to digital transformation and clinical governance means that students are not able to fully perform all the same duties as their Foundation Year doctor. These limitations can impact medical students' perception of clinical responsibility and their exposure to these skills during the assistantship [16,18]. At Imperial, the medical school has provided alternative opportunities to support these learning needs, for example through regular prescribing practice and simulation sessions [22].

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3 350 Due to the size of the local Foundation School, the majority of Imperial graduates will
4
5 351 likely undertake Foundation Training outside this region. Students were therefore
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7 352 allocated to assistantship placements which may not be aligned to their future
8
9 353 foundation posts. Aligned assistantships may have provided even greater
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11 354 improvements in confidence for starting Foundation Training [23].
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14 355
15 356 The study was conducted across eight different hospitals in North West London.
16
17 357 Future work could further explore the variation in contextual factors and organisational
18
19 358 practices which could impact the delivery of assistantship placements.
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21 359
22 360 **Word count**
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25 363 **Author contributions**
26
27 364 CYF and LK contributed to the conception and design of the work, the acquisition,
28
29 365 analysis and interpretation of the data, drafting the manuscript and final approval of
30
31 366 the work.
32
33 367 EH, NMM, OH, JJM, EHu and AS contributed to the conception and design of the
34
35 368 work, revision of the manuscript and final approval of the work.
36

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43

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45 374 **Competing interests**
46
47 375 No competing interests declared.
48

49 376
50 377 **Ethical approval**
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52 378 Ethical approval was granted by the Imperial Education Ethics Review Process
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54 379 EERP2021-052.
55

56 380
57 381 **Data sharing statement**
58
59 382 The datasets used in the current study are available from the corresponding author on
60
383 reasonable request.

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Figure legend

Figure 1: Student Assistantship Learning Objectives

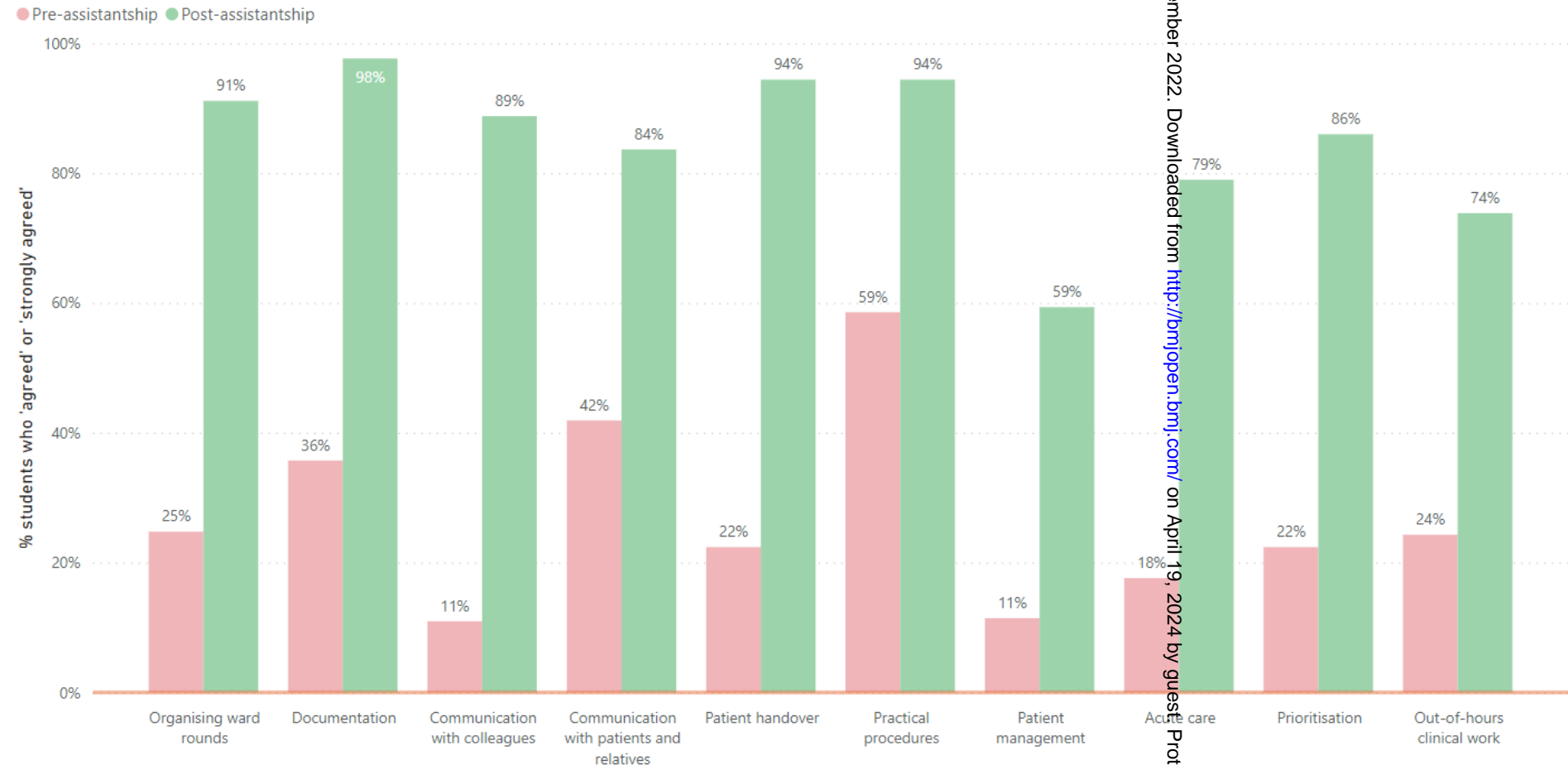
Figure 2: Proportion of students who agreed or strongly agreed to each statement pre- and post-assistantship

Figure 1: Student Assistantship Learning Objectives

1. **Organising ward rounds** (presenting patients and organising ward rounds)
 2. **Documentation** (writing notes and discharge summaries)
 3. **Communication with colleagues** (discussing patient care, including referrals, investigations, liaising with multidisciplinary team)
 4. **Communication with patients and relatives**
 5. **Patient handover** (updating the team and handing over)
 6. **Practical procedures** (independently carrying out core practical procedures)
 7. **Patient management** (assessing and managing patients as the first clinician called)
 8. **Acute care** (actively supporting the clinical management of acutely ill patients)
 9. **Prioritisation** (prioritising tasks and managing requests)
 10. **Out-of-hours clinical work** (working shifts and out-of-hours, e.g. on-calls)

Figure 2: Proportion of students who agreed or strongly agreed to each statement pre- and post-assistantship

Percentage of students who 'Agreed' or 'Strongly Agreed' to each statement pre and post-assistantship. (Statistically significant improvement post-assistantship for all statements $p < 0.0001$)



Imperial College School of Medicine

Pre-PFA Placement Evaluation

To be completed at the PFA Induction Meeting

Prior to starting the PFA Placement, please rate your confidence on the following activities on a scale of 1 to 5 (1 – Strongly disagree, 2 – Disagree, 3 – Neither agree nor disagree, 4 – Agree, 5 – Strongly agree):

1. I feel confident presenting patients and organising ward rounds.				
1	2	3	4	5
2. I feel confident writing notes and discharge summaries.				
1	2	3	4	5
3. I feel confident discussing patient care and management plans with colleagues, recommending prescriptions, making referrals, arranging investigations and liaising with members of the multidisciplinary team.				
1	2	3	4	5
4. I feel confident communicating with patients and their relatives about patient care and management plans.				
1	2	3	4	5
5. I feel confident updating the team on patient care as part of the handover process.				
1	2	3	4	5
6. I feel confident independently carrying out core practical procedures (e.g. venepuncture, cannulation, ABGs etc).				
1	2	3	4	5
7. I feel confident assessing and managing patients as the first clinician called.				
1	2	3	4	5
8. I feel confident actively supporting the clinical management of acutely ill patients.				
1	2	3	4	5
9. I feel confident prioritising tasks and managing additional clinical requests during shifts (e.g. requests from bleeps).				
1	2	3	4	5
10. I feel confident working shifts and out-of-hours (e.g. on-calls).				
1	2	3	4	5

Date completed	(required)
Student signature	(required)

Imperial College School of Medicine

Post-PFA Placement Evaluation

To be completed at the PFA End of Placement Meeting

Following the PFA Placement, please rate your confidence on the following activities on a scale of 1 to 5 (1 – Strongly disagree, 2 – Disagree, 3 – Neither agree nor disagree, 4 – Agree, 5 – Strongly agree):

1. I feel confident presenting patients and organising ward rounds.				
1	2	3	4	5
2. I feel confident writing notes and discharge summaries.				
1	2	3	4	5
3. I feel confident discussing patient care and management plans with colleagues, recommending prescriptions, making referrals, arranging investigations and liaising with members of the multidisciplinary team.				
1	2	3	4	5
4. I feel confident communicating with patients and their relatives about patient care and management plans.				
1	2	3	4	5
5. I feel confident updating the team on patient care as part of the handover process.				
1	2	3	4	5
6. I feel confident independently carrying out core practical procedures (e.g. venepuncture, cannulation, ABGs etc).				
1	2	3	4	5
7. I feel confident assessing and managing patients as the first clinician called.				
1	2	3	4	5
8. I feel confident actively supporting the clinical management of acutely ill patients.				
1	2	3	4	5
9. I feel confident prioritising tasks and managing additional clinical requests during shifts (e.g. requests from bleeps).				
1	2	3	4	5
10. I feel confident working shifts and out-of-hours (e.g. on-calls).				
1	2	3	4	5

Firm Lead GMC Number	<i>(required)</i>
Firm Lead Feedback	<i>(required)</i>
Date completed	<i>(required)</i>
Firm Lead Signature	<i>(required)</i>

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Date completed	(required)
Student signature	(required)

For peer review only

The RECORD statement – checklist of items, extended from the STROBE statement, that should be reported in observational studies using routinely collected health data.

	Item No.	STROBE items	Location in manuscript where items are reported	RECORD items	Location in manuscript where items are reported
Title and abstract					
	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	P2 L23-26	RECORD 1.1: The type of data used should be specified in the title or abstract. When possible, the name of the databases used should be included. RECORD 1.2: If applicable, the geographic region and time frame within which the study took place should be reported in the title or abstract. RECORD 1.3: If linkage between databases was conducted for the study, this should be clearly stated in the title or abstract.	P2 L23-26 P2 L29 NA
Introduction					
Background rationale	2	Explain the scientific background and rationale for the investigation being reported	P3 L64-112		
Objectives	3	State specific objectives, including any prespecified hypotheses	P4 L111-112		
Methods					
Study Design	4	Present key elements of study design early in the paper	P5 L114-170		
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	P5 L116-125		

Participants	6	<p>(a) <i>Cohort study</i> - Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up</p> <p><i>Case-control study</i> - Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls</p> <p><i>Cross-sectional study</i> - Give the eligibility criteria, and the sources and methods of selection of participants</p> <p>(b) <i>Cohort study</i> - For matched studies, give matching criteria and number of exposed and unexposed</p> <p><i>Case-control study</i> - For matched studies, give matching criteria and the number of controls per case</p>	P5 L117	<p>RECORD 6.1: The methods of study population selection (such as codes or algorithms used to identify subjects) should be listed in detail. If this is not possible, an explanation should be provided.</p> <p>RECORD 6.2: Any validation studies of the codes or algorithms used to select the population should be referenced. If validation was conducted for this study and not published elsewhere, detailed methods and results should be provided.</p> <p>RECORD 6.3: If the study involved linkage of databases, consider use of a flow diagram or other graphical display to demonstrate the data linkage process, including the number of individuals with linked data at each stage.</p>	P6 L163-170
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.	P6 L163-170	RECORD 7.1: A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and effect modifiers should be provided. If these cannot be reported, an explanation should be provided.	P6 L163-170
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	P6 L163-170		

Bias	9	Describe any efforts to address potential sources of bias			
Study size	10	Explain how the study size was arrived at	P5 L117		
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	P6 L163-170		
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> - If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> - If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> - If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses	P6 L163-170		
Data access and cleaning methods		..		RECORD 12.1: Authors should describe the extent to which the investigators had access to the database population used to create the study population.	P5 L127-161

				RECORD 12.2: Authors should provide information on the data cleaning methods used in the study.	
Linkage		..		RECORD 12.3: State whether the study included person-level, institutional-level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided.	NA
Results					
Participants	13	(a) Report the numbers of individuals at each stage of the study (<i>e.g.</i> , numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed) (b) Give reasons for non-participation at each stage. (c) Consider use of a flow diagram	P7 L177-179	RECORD 13.1: Describe in detail the selection of the persons included in the study (<i>i.e.</i> , study population selection) including filtering based on data quality, data availability and linkage. The selection of included persons can be described in the text and/or by means of the study flow diagram.	P5 L117
Descriptive data	14	(a) Give characteristics of study participants (<i>e.g.</i> , demographic, clinical, social) and information on exposures and potential confounders (b) Indicate the number of participants with missing data for each variable of interest (c) <i>Cohort study</i> - summarise follow-up time (<i>e.g.</i> , average and total amount)	P7 L177-179		
Outcome data	15	<i>Cohort study</i> - Report numbers of outcome events or summary measures over time <i>Case-control study</i> - Report numbers in each exposure	P7 L177-179		

		category, or summary measures of exposure <i>Cross-sectional study</i> - Report numbers of outcome events or summary measures			
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	P7 L177-211		
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	NA		
Discussion					
Key results	18	Summarise key results with reference to study objectives	P8 L213-291		
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	P11 L293-319	RECORD 19.1: Discuss the implications of using data that were not created or collected to answer the specific research question(s). Include discussion of misclassification bias, unmeasured confounding, missing data, and changing eligibility over time, as they pertain to the study being reported.	P8 L213-291
Interpretation	20	Give a cautious overall interpretation of results considering objectives,	P11 L285-291		

		limitations, multiplicity of analyses, results from similar studies, and other relevant evidence			
Generalisability	21	Discuss the generalisability (external validity) of the study results	P11 L285-291		
Other Information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	P12 L321-323		
Accessibility of protocol, raw data, and programming code		..		RECORD 22.1: Authors should provide information on how to access any supplemental information such as the study protocol, raw data, or programming code.	P6 L137 P6 L141

*Reference: Benchimol EI, Smeeth L, Guttman A, Harron K, Moher D, Petersen I, Sørensen HT, von Elm E, Langen SM, the RECORD Working Committee. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) Statement. *PLoS Medicine* 2015; in press.

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Effectiveness of short, personalised student assistantships: an evaluative study across eight London hospitals

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Abstract

Objectives

Student assistantships are recommended to prepare medical graduates for clinical practice. Traditionally, assistantships have consisted of longer placements, often up to 15 weeks. However, within the constraints of the final year, medical schools need to carefully balance the time required for specialty placements, assessments and the risk of student burnout. We set out to evaluate the effectiveness of shorter, personalised student assistantships.

Design

An evaluative study on the changes in final year student confidence in preparedness for practice after a three-week assistantship with defined learning objectives and learning needs assessment.

Setting

Eight hospitals affiliated with Imperial College School of Medicine.

Outcomes

Student confidence in 10 learning outcomes including organising ward rounds, documentation, communication with colleagues, communication with patients and relatives, patient handover, practical procedures, patient management, acute care, prioritisation and out-of-hours clinical work.

Results

Two hundred and twenty final year medical students took part in the student assistantship, of whom 208 completed both the pre- and post-assistantship confidence rating questionnaire (95% completion rate). Post-assistantship, 169 (81%) students expressed increased confidence levels in one or more learning objectives. For each individual learning objective, there was a significant change in the proportion of students who agreed or strongly agreed post-assistantship ($P<0.0001$).

Conclusion

Overall, the focused three-week, personalised student assistantships led to significant improvement across all learning objectives related to preparedness for practice. The use of the pre-assistantship confidence rating questionnaire allowed students to identify and target areas of learning need during their assistantship.

Keywords

Assistantship, preparedness for practice, medical students, undergraduate medical education

Strengths and limitations of this study

- This study demonstrates the utility of confidence rating questionnaires as a learning needs assessment to create short, highly-focused assistantships.
- The use of confidence rating questionnaires, based on defined learning objectives, can be generalised to other undergraduate learning activities to support more focused, reflective learning, and provide rich data for learners and teachers.
- Prior to full registration with the UK General Medical Council, some learning opportunities, such as prescribing, remain restricted to students, limiting their experience of clinical responsibility.
- The assistantship placements were not aligned to students' future Foundation Year 1 posts, which may have provided even greater improvements in confidence for starting Foundation Training.

Introduction

The transition from being a medical student to becoming a doctor is known to be a challenging and critically intensive learning period [1,2]. Existing literature demonstrates that student anxieties during the transitional period between undergraduate and postgraduate learning centre around taking responsibility for patient care, non-technical and communication skills, clinical procedures and prescribing [3-6]. This transition can be particularly challenging as medical students not only attempt to balance their clinical participation in delivering patient care with managing the risk to patient safety, but also grapple with the new physical, social, and

80 cultural aspects and activities of their new environment [7,8]. It has been repeatedly
81 highlighted in the literature that medical student confidence and competence in
82 managing this transition is best developed through an experiential and sociocultural
83 learning process situated in the context of the relevant clinical setting [8-10]. Only
84 through being embedded, gaining understanding, and learning in the new situational
85 and contextual environments, are students able to effectively and authentically build
86 confidence in the transition to Foundation Training [2,5,8,16].

88 In order to increase the preparedness of graduating medical students for practice in
89 the clinical environment, the UK General Medical Council (GMC) introduced student
90 assistantships into the medical school curriculum [11]. The purpose of the student
91 assistantship placement is primarily to provide final year medical students with the
92 opportunity to prepare for the reality of working in the clinical environment and to
93 support the transition between medical student and doctor [11].

95 The benefits of student assistantships for preparing graduating medical students for
96 clinical work are well documented [12-15]. Students who have undergone
97 assistantships repeatedly report improved skills, knowledge and confidence relating
98 to practical clinical working, communication skills and team-working [12-15]. A
99 supportive and reflective relationship between the student and clinical team empowers
100 the student to 'act up' as an assistant. Thus, having the appropriate organisational
101 practices in place is crucial in implementing assistantship models [16]. A successful
102 assistantship is able to provide students with the opportunity to practise relevant skills
103 for the delivery of care for real patients, creating a sense of clinical responsibility, which
104 can be difficult to mimic elsewhere in the curriculum [9,17-20].

106 Due to the key role the student assistantship has in preparing students for clinical work,
107 the GMC recommends that these placements take place towards the end of medical
108 school [11]. Whilst the GMC does not stipulate the length or specialty of student
109 assistantships, studies evaluating the benefits of the placement typically focus on
110 longer assistantships lasting between six and 15 weeks [12-15].

112 Providing long assistantships near the end of final year can be particularly challenging
113 for medical schools as they need to be balanced with the provision of sufficient clinical

placement time for knowledge consolidation and assessment preparation, as well as the delivery of high-stakes, summative assessments. Furthermore, the educational benefits of prolonged assistantships need to be carefully considered, with one study noting that students experienced a learning plateau after 10 weeks [15]. Student welfare is also a factor in designing student assistantships, with medical students being at the greatest risk of burnout at the end of a year of clinical placements [21,22].

In 2020, Imperial College School of Medicine introduced a short student assistantship designed to focus solely on practising the typical duties of a newly qualified doctor. In order to maximise the learning opportunities available to students, the assistantship was combined with a learning needs assessment to personalise the placement experience. The learning needs assessment aimed to focus student learning and support them in recognising learning opportunities which can be missed on placements [20,23,24].

The emphasis of the three-week student assistantship was to provide opportunities for medical students to take on clinical responsibility in a supervised environment and manage clinical tasks such as clinical prioritisation, managing acutely unwell patients under supervision and recommending prescriptions; rather than furthering clinical or specialty knowledge [11,17,19].

The aim of this study was to evaluate the effectiveness of a short, personalised student assistantship.

Methods

The student assistantship

Final year medical students were allocated to a three-week student assistantship which was scheduled after final examinations as the last clinical placement prior to graduation. The assistantships were based in general medicine, general surgery and emergency medicine firms at an Imperial-affiliated hospital. Each medical student was paired with a Foundation Year (first two years post-graduation) doctor. They were directed to follow their work schedule, including their out-of-hours and on-call shifts, and to assist them with their daily clinical and administrative tasks. Students were to

remain within the same firm throughout their assistantship under the supervision of the same firm lead.

The hospitals, firm leads and Foundation Year doctors involved in the student assistantship were provided with detailed guidance on the nature of the placement, the placement objectives and their role in its delivery. Hospitals were supported to provide the relevant resources necessary for students to fully participate in the assistantship, such as access passes, bleeps and rest areas. Firm leads were given protected time to supervise their allocated medical students and to conduct any required meetings. Foundation Year doctors were given an induction to the assistantship programme and were assigned a local clinical teaching fellow as a mentor for additional support.

Learning objectives and questionnaire

Ten learning objectives for the student assistantship were developed based on guidance from the GMC and existing literature (figure 1).

Figure 1: Student Assistantship Learning Objectives

A 'confidence rating' questionnaire based on the learning objectives was developed to evaluate the difference in student confidence after completing the assistantship. Prior to starting the placement, students were asked to complete the pre-assistantship questionnaire by rating their confidence on the 10 learning objectives using a five-point Likert scale which ranged from 'strongly agree' to 'strongly disagree' (Appendix 1). This questionnaire was used to identify areas of learning need for the student to focus on during the assistantship. After completing the three-week assistantship, students were asked to rate their confidence again on the same learning objectives using the same scale in the post-assistantship questionnaire (Appendix 2).

Assistantship induction and firm lead meetings

As part of the assistantship, each student received a hospital induction and an initial meeting with the firm lead upon starting the placement. The assistantship concluded with a feedback meeting with the firm lead.

The hospital induction was a group session which provided students with orientation, understanding of local systems and protocols, and access to resources and facilities, in a similar way to a typical induction for new Foundation Year doctors.

The initial meeting with the firm leads was on a one-to-one basis. These were designed to guide students to use their self-ratings in the pre-assistantship questionnaire to identify their personal learning needs and particular areas of focus for the duration of their student assistantship.

At the end of the three-week assistantship, students attended a feedback meeting with the same firm lead. This meeting was used to discuss their post-assistantship self-rating, reflect on their placement experience, and receive feedback on their performance. Students were able to modify their self-rating after reflecting on their feedback from the firm lead if they wished.

Analysis

Data from each questionnaire was imported to Microsoft Power BI™ for quantitative analysis and confirmation of normal distribution on each item. Statistical analysis was performed using R (version 4.0.1). The five-point Likert items were converted to dichotomous variables: of agree/strongly agree responses and neither agree nor disagree/disagree/strongly disagree responses. McNemar's χ^2 test for paired data was used to determine whether there was a significant change in the proportion of students who agreed/strongly agreed with each statement post-assistantship.

Patient and Public Involvement

No patient involved.

Ethical Approval

Ethical approval was granted by the Imperial Education Ethics Review Process EERP2021-052.

Participant Consent

In line with the ethical approval, this study used anonymised, routinely collected, placement evaluation data, owned by Imperial College School of Medicine.

Results

A total of 220 final year medical students took part in the three-week, personalised student assistantship. The student assistantships took place across eight hospitals affiliated to Imperial College School of Medicine, and were of varying size, location and demographic spread across North West London. The number of students that completed both the pre- and post-assistantship questionnaire was 208 (95% completion rate).

Pre-assistantship, responses approximated to normal distribution across most items, with the most common response being ‘neither agree nor disagree’. For practical procedures and communication with patients and relatives, pre-assistantship results skewed towards ‘agree’ and ‘strongly agree’.

Post-assistantship, 169 (81%) students expressed increased confidence levels in one or more learning objectives. For each learning objective, students most commonly reported that their confidence improved by one interval on the Likert scale. For communication with colleagues, the most common outcome was improvement by two intervals, and for practical procedures, the most common outcome was no change.

Figure 2: Proportion of students who agreed or strongly agreed to each statement pre- and post-assistantship

For each individual learning objective, there was a significant increase in the proportion of students who agreed or strongly agreed that they felt confident post-assistantship ($P<0.0001$). Post-assistantship, over 90% of students ‘agreed’ or ‘strongly agreed’ that they felt confident in documentation, patient handover, practical procedures and organising ward rounds. For patient management, 60% of students ‘agreed’ or ‘strongly agreed’ that they felt confident post-assistantship compared to 12% pre-assistantship (figure 2).

Increased proportions of students who felt confident were most notable in communication with colleagues, patient handover and organising ward rounds. For communication with colleagues, the percentage of students agreeing or strongly

agreeing with being confident in this learning outcome increased by 78 percentage points from 11% pre-assistantship to 89% post-assistantship. For patient handover and organising ward rounds, the proportion of students who reported confidence post-assistantship increased by 72 and 66 percentage points, respectively.

Discussion

Overall, the three-week personalised student assistantship was associated with significant increases in student confidence across all individual learning objectives related to preparedness for practice.

The largest percentage point increases in confidence were in organising ward rounds, patient handover and communication with colleagues. These skills are all centred around the student taking clinical responsibility and using effective communication with the clinical team to support delivery of patient care. As students were embedded in the firm as a team member assisting the Foundation Year doctor, they were expected to perform these tasks regularly under supervision in an authentic clinical environment. Clinical placements prior to the assistantship were typically more focused on knowledge consolidation and practical skills in preparation for summative assessments. This is consistent with existing literature, where students are noted to have limited 'hands on' experience in final year placements [25]. In contrast, the assistantship allowed students to take on supervised clinical responsibility and to practise communication and teamworking, which have been highlighted as important skills for preparedness by existing literature [17,24].

The smallest percentage point increase was regarding practical procedures. It is noted that a relatively high proportion of students identified as being confident in practical procedural skills prior to the assistantship. This correlates with final year student experience elsewhere and may be due to other opportunities in the medical school curriculum for students to practise these skills, such as in the clinical skills laboratory or in simulation sessions, leaving less room for improvement during the assistantship [25]. Despite the higher confidence levels in this area pre-assistantship, the overall improved confidence in performing practical procedures remained significant, as with all other learning objectives.

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285 For patient management, the baseline confidence in the pre-assistantship

286 questionnaire was one of the lowest amongst all learning objectives. This is consistent

287 with existing literature which note that final students had relatively limited opportunity

288 to manage unwell patients compared to other activities, such as carrying out practical

289 procedures [25]. Despite patient management having one of the smaller increases in

290 confidence post-assistantship, the change remains significant. For students and

291 Foundation Year doctors, assessing and managing patients as the first clinician called

292 remains one of the most challenging aspects of clinical work [1]. The relatively smaller

293 increase in confidence may be due to the challenging nature of this learning outcome

294 and the sense of clinical responsibility and perceived risk associated with delivery of

295 patient care as the first clinician. As the students in this study did not have GMC

296 registration or professional responsibility for any patients, it is possible that when a

297 clinician was required, a registered doctor was contacted in the first instance rather

298 than the medical student. A 2011 study of UK medical school curriculum leaders

299 demonstrated a consistently conservative approach towards students carrying out

300 activities associated with increased patient risk, advocating that the students perform

301 activities only with stable patients [26]. Despite this, the 48 percentage point increase

302 as shown over the three-week assistantship from a baseline of 12% shows that even

303 over a short period, students can gain significant confidence in this challenging task.

304

305 Timing the assistantship towards the end of the academic year allowed students to

306 focus on preparing for practice without the stress and distraction of high-stake final

307 examinations [16,27]. Scheduling it just prior to graduation further gave students the

308 opportunity to experience working as the Foundation Year doctor in a supported and

309 familiar environment, as close as possible to when they would formally start the role.

310

311 The use of perceived confidence or competence in the evaluation of student

312 preparedness is well-established in literature and has even been adopted by the GMC

313 in their National Training Survey [28-32]. Self-assessment is a critical aspect of

314 performance appraisal. Whilst self-rating of confidence does not equate to actual

315 performance, student perception of preparedness is founded on self-efficacy, which

316 itself is a predictor of competence [33,34].

317

The use of the pre-assistantship questionnaire in the initial meeting with the firm lead allowed students to reflect and identify areas of focus for the three-week placement. This enabled the assistantship to be personalised to each individual student, allowing them to target areas of learning need and recognise learning opportunities which can otherwise be missed [20,23,24]. The highly-focused approach to the student assistantship may have been a factor in the significantly improved confidence over a relatively short period.

The meeting with the firm lead at the end of the placement provided students with feedback and the opportunity to reflect on their assistantship experience. The feedback provided may have allowed students to better benchmark their performance against expected standards for a Foundation Year doctor. As self-assessment enhances learning and performance, this may have further improved student confidence and perceived readiness for commencing Foundation Training [35].

This method of using confidence rating questionnaires before and after a learning activity can be generalised to any clinical learning opportunities with defined learning objectives. The process of self-assessment will support students to focus and reflect on the key learning objectives during any learning opportunity. It highlights areas of strengths and weaknesses to both the student and the teacher, providing individualised feedback which can be further used to support the students' learning needs. Furthermore, the pre-assistantship evaluation data can be used to provide insights into how earlier placement experience may be improved.

The data derived from this study has shown that short, personalised student assistantships of three-weeks duration can significantly improve student confidence in preparedness for practice. With substantial competing interests in the final year of medical school, including high-stake summative examinations and high risk of student burnout, the use of short, personalised student assistantships prior to graduation may be an effective model for preparing medical students for working in the clinical environment.

Limitations

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351 As medical students are not registered with the GMC, there are a number of skills
352 which they may not be able to experience in full [18]. Patient safety is of utmost
353 importance when considering clinical placements and must be balanced carefully
354 against student learning needs. Managing the risk of contacting the medical student
355 as the first clinician remains challenging for clinical teams, which may limit students'
356 experience of clinical responsibility [18,26]. Medical schools and their placement
357 providers must ensure that adequate training and protocols are provided to the wider
358 clinical team to indicate when it is safe and appropriate to contact the medical student
359 as the first clinician [36]. Students attending patients as the first clinician must also
360 have adequate supervision and support to do so safely.

361
362 Electronic prescribing and digital investigation requests also pose a challenge to
363 medical students fully immersing themselves during assistantships. The inability to
364 submit prescriptions and investigation requests due to digital transformation and
365 clinical governance means that students are not able to fully perform all the same
366 duties as their Foundation Year doctor. These limitations can impact medical students'
367 perception of clinical responsibility and their exposure to these skills during the
368 assistantship [24,26]. At Imperial, the medical school has provided alternative
369 opportunities to support these learning needs, for example through regular prescribing
370 practice and simulation sessions [37].

371
372 Due to the size of the local Foundation School, the majority of Imperial graduates will
373 likely undertake Foundation Training outside this region. Students were therefore
374 allocated to assistantship placements which may not be aligned to their future
375 foundation posts. Aligned assistantships may have provided even greater
376 improvements in confidence for starting Foundation Training [38].

377
378 The study was conducted across eight different hospitals in North West London.
379 Future work should include further qualitative exploration into the variation in critical
380 contextual factors and organisational practices between the different hospitals, which
381 could impact the delivery of assistantship placements and thus the learning
382 experiences of the students.

383
384 **Word count**

385 2883

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387 **Author contributions**

388 CYF and LK contributed to the conception and design of the work, the acquisition,
389 analysis and interpretation of the data, drafting the manuscript and final approval of
390 the work.

391 EH, NMM, OH, JJM, EHu and AS contributed to the conception and design of the
392 work, revision of the manuscript and final approval of the work.

393

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396 commercial or not-for-profit sectors.

397

398 **Competing interests**

399 No competing interests declared.

400

401 **Ethical approval**

402 Ethical approval was granted by the Imperial Education Ethics Review Process
403 EERP2021-052.

404

405 **Data sharing statement**

406 The datasets used in the current study are available from the corresponding author on
407 reasonable request.

408

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Figure legend

Figure 1: Student Assistantship Learning Objectives

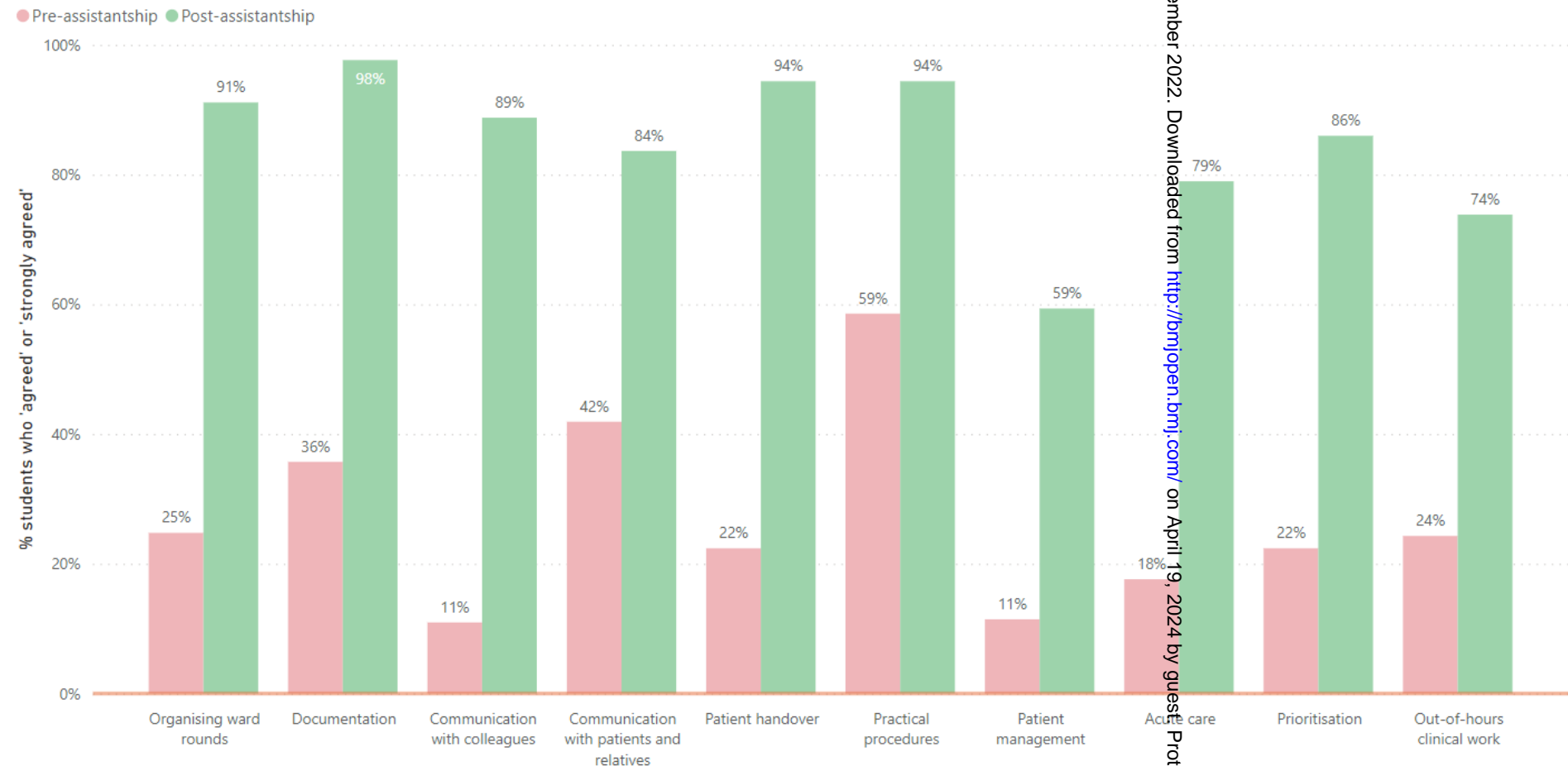
Figure 2: Proportion of students who agreed or strongly agreed to each statement pre- and post-assistantship

Figure 1: Student Assistantship Learning Objectives

1. **Organising ward rounds** (presenting patients and organising ward rounds)
 2. **Documentation** (writing notes and discharge summaries)
 3. **Communication with colleagues** (discussing patient care, including referrals, investigations, liaising with multidisciplinary team)
 4. **Communication with patients and relatives**
 5. **Patient handover** (updating the team and handing over)
 6. **Practical procedures** (independently carrying out core practical procedures)
 7. **Patient management** (assessing and managing patients as the first clinician called)
 8. **Acute care** (actively supporting the clinical management of acutely ill patients)
 9. **Prioritisation** (prioritising tasks and managing requests)
 10. **Out-of-hours clinical work** (working shifts and out-of-hours, e.g. on-calls)

Figure 2: Proportion of students who agreed or strongly agreed to each statement pre- and post-assistantship

Percentage of students who 'Agreed' or 'Strongly Agreed' to each statement pre and post-assistantship. (Statistically significant improvement post-assistantship for all statements $p < 0.0001$)



Imperial College School of Medicine

Pre-PFA Placement Evaluation

To be completed at the PFA Induction Meeting

Prior to starting the PFA Placement, please rate your confidence on the following activities on a scale of 1 to 5 (1 – Strongly disagree, 2 – Disagree, 3 – Neither agree nor disagree, 4 – Agree, 5 – Strongly agree):

1. I feel confident presenting patients and organising ward rounds.				
1	2	3	4	5
2. I feel confident writing notes and discharge summaries.				
1	2	3	4	5
3. I feel confident discussing patient care and management plans with colleagues, recommending prescriptions, making referrals, arranging investigations and liaising with members of the multidisciplinary team.				
1	2	3	4	5
4. I feel confident communicating with patients and their relatives about patient care and management plans.				
1	2	3	4	5
5. I feel confident updating the team on patient care as part of the handover process.				
1	2	3	4	5
6. I feel confident independently carrying out core practical procedures (e.g. venepuncture, cannulation, ABGs etc).				
1	2	3	4	5
7. I feel confident assessing and managing patients as the first clinician called.				
1	2	3	4	5
8. I feel confident actively supporting the clinical management of acutely ill patients.				
1	2	3	4	5
9. I feel confident prioritising tasks and managing additional clinical requests during shifts (e.g. requests from bleeps).				
1	2	3	4	5
10. I feel confident working shifts and out-of-hours (e.g. on-calls).				
1	2	3	4	5

Date completed	(required)
Student signature	(required)

Imperial College School of Medicine

Post-PFA Placement Evaluation

To be completed at the PFA End of Placement Meeting

Following the PFA Placement, please rate your confidence on the following activities on a scale of 1 to 5 (1 – Strongly disagree, 2 – Disagree, 3 – Neither agree nor disagree, 4 – Agree, 5 – Strongly agree):

1. I feel confident presenting patients and organising ward rounds.				
1	2	3	4	5
2. I feel confident writing notes and discharge summaries.				
1	2	3	4	5
3. I feel confident discussing patient care and management plans with colleagues, recommending prescriptions, making referrals, arranging investigations and liaising with members of the multidisciplinary team.				
1	2	3	4	5
4. I feel confident communicating with patients and their relatives about patient care and management plans.				
1	2	3	4	5
5. I feel confident updating the team on patient care as part of the handover process.				
1	2	3	4	5
6. I feel confident independently carrying out core practical procedures (e.g. venepuncture, cannulation, ABGs etc).				
1	2	3	4	5
7. I feel confident assessing and managing patients as the first clinician called.				
1	2	3	4	5
8. I feel confident actively supporting the clinical management of acutely ill patients.				
1	2	3	4	5
9. I feel confident prioritising tasks and managing additional clinical requests during shifts (e.g. requests from bleeps).				
1	2	3	4	5
10. I feel confident working shifts and out-of-hours (e.g. on-calls).				
1	2	3	4	5

Firm Lead GMC Number	<i>(required)</i>
Firm Lead Feedback	<i>(required)</i>
Date completed	<i>(required)</i>
Firm Lead Signature	<i>(required)</i>

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Date completed	(required)
Student signature	(required)

For peer review only

The RECORD statement – checklist of items, extended from the STROBE statement, that should be reported in observational studies using routinely collected health data.

	Item No.	STROBE items	Location in manuscript where items are reported	RECORD items	Location in manuscript where items are reported
Title and abstract					
	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	P2 L23-26	RECORD 1.1: The type of data used should be specified in the title or abstract. When possible, the name of the databases used should be included. RECORD 1.2: If applicable, the geographic region and time frame within which the study took place should be reported in the title or abstract. RECORD 1.3: If linkage between databases was conducted for the study, this should be clearly stated in the title or abstract.	P2 L23-26 P2 L29 NA
Introduction					
Background rationale	2	Explain the scientific background and rationale for the investigation being reported	P3 L64-112		
Objectives	3	State specific objectives, including any prespecified hypotheses	P4 L111-112		
Methods					
Study Design	4	Present key elements of study design early in the paper	P5 L114-170		
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	P5 L116-125		

Participants	6	<p>(a) <i>Cohort study</i> - Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up</p> <p><i>Case-control study</i> - Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls</p> <p><i>Cross-sectional study</i> - Give the eligibility criteria, and the sources and methods of selection of participants</p> <p>(b) <i>Cohort study</i> - For matched studies, give matching criteria and number of exposed and unexposed</p> <p><i>Case-control study</i> - For matched studies, give matching criteria and the number of controls per case</p>	P5 L117	<p>RECORD 6.1: The methods of study population selection (such as codes or algorithms used to identify subjects) should be listed in detail. If this is not possible, an explanation should be provided.</p> <p>RECORD 6.2: Any validation studies of the codes or algorithms used to select the population should be referenced. If validation was conducted for this study and not published elsewhere, detailed methods and results should be provided.</p> <p>RECORD 6.3: If the study involved linkage of databases, consider use of a flow diagram or other graphical display to demonstrate the data linkage process, including the number of individuals with linked data at each stage.</p>	P6 L163-170
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.	P6 L163-170	RECORD 7.1: A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and effect modifiers should be provided. If these cannot be reported, an explanation should be provided.	P6 L163-170
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	P6 L163-170		

Bias	9	Describe any efforts to address potential sources of bias			
Study size	10	Explain how the study size was arrived at	P5 L117		
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	P6 L163-170		
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> - If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> - If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> - If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses	P6 L163-170		
Data access and cleaning methods		..		RECORD 12.1: Authors should describe the extent to which the investigators had access to the database population used to create the study population.	P5 L127-161

				RECORD 12.2: Authors should provide information on the data cleaning methods used in the study.	
Linkage		..		RECORD 12.3: State whether the study included person-level, institutional-level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided.	NA
Results					
Participants	13	(a) Report the numbers of individuals at each stage of the study (<i>e.g.</i> , numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed) (b) Give reasons for non-participation at each stage. (c) Consider use of a flow diagram	P7 L177-179	RECORD 13.1: Describe in detail the selection of the persons included in the study (<i>i.e.</i> , study population selection) including filtering based on data quality, data availability and linkage. The selection of included persons can be described in the text and/or by means of the study flow diagram.	P5 L117
Descriptive data	14	(a) Give characteristics of study participants (<i>e.g.</i> , demographic, clinical, social) and information on exposures and potential confounders (b) Indicate the number of participants with missing data for each variable of interest (c) <i>Cohort study</i> - summarise follow-up time (<i>e.g.</i> , average and total amount)	P7 L177-179		
Outcome data	15	<i>Cohort study</i> - Report numbers of outcome events or summary measures over time <i>Case-control study</i> - Report numbers in each exposure	P7 L177-179		

		category, or summary measures of exposure <i>Cross-sectional study</i> - Report numbers of outcome events or summary measures			
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	P7 L177-211		
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	NA		
Discussion					
Key results	18	Summarise key results with reference to study objectives	P8 L213-291		
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	P11 L293-319	RECORD 19.1: Discuss the implications of using data that were not created or collected to answer the specific research question(s). Include discussion of misclassification bias, unmeasured confounding, missing data, and changing eligibility over time, as they pertain to the study being reported.	P8 L213-291
Interpretation	20	Give a cautious overall interpretation of results considering objectives,	P11 L285-291		

		limitations, multiplicity of analyses, results from similar studies, and other relevant evidence			
Generalisability	21	Discuss the generalisability (external validity) of the study results	P11 L285-291		
Other Information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	P12 L321-323		
Accessibility of protocol, raw data, and programming code		..		RECORD 22.1: Authors should provide information on how to access any supplemental information such as the study protocol, raw data, or programming code.	P6 L137 P6 L141

*Reference: Benchimol EI, Smeeth L, Guttman A, Harron K, Moher D, Petersen I, Sørensen HT, von Elm E, Langen SM, the RECORD Working Committee. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) Statement. *PLoS Medicine* 2015; in press.

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