PEER REVIEW HISTORY

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ARTICLE DETAILS

TITLE (PROVISIONAL)	How surgical Trainee Research Collaboratives achieve success: a mixed methods study to develop trainee engagement strategies
AUTHORS	Clement, Clare; Coulman, Karen; Heywood, Nick; Pinkney, Tom; Blazeby, Jane; Blencowe, Natalie; Cook, Jonathan; Bulbulia, Richard; Alejandro Arenas-Pinto, Alejandro Arenas-Pinto; Snowdon, Claire; Hilton, Zoe; Magill, Laura; MacLennan, Graeme; Glasbey, James; Nepogodiev, Dmitri; Hardy, Victoria; Lane, Athene

VERSION 1 – REVIEW

REVIEWER	Shebrain, Saad Western Michigan University
REVIEW RETURNED	19-Apr-2023

GENERAL COMMENTS	Well designed and well writtent manuscript.

REVIEWER	Nally, Deirdre Royal College of Surgeons in Ireland, Department of Surgical Affairs
REVIEW RETURNED	26-Apr-2023

GENERAL COMMENTS	Thank you for the opportunity to review this article addressing engagement of trainees in TRC / CTU activity. I commend you on the triangulation of data from observations, surveys and interviews and your novel means of dissemination of the findings to increase and widen participation. Some comments / questions and suggestions are provided below Introduction Royal College of Surgeons England could be abbreviated to RCS Eng Methods: Who are the co-applicants mentioned? “Observations were non-participant (i.e., researcher not involved)” Meaning of this? Does it mean that the observers were not the researchers for this study or the researchers of this study did not act as observers TRC of which they were members? What research paradigm was adopted for this study. How did researcher positionality influence the interpretation and reporting of findings? Was reflexivity used to acknowledge this - could a reflective diary be provided?

	Was ethical approval provided for the recruitment of interview participants? If not this is a major limitation and would change my decision on publication. What reporting guidelines were used for the preparation of this manuscript. SRQR or other? Is there an audit trail available via NVIVO for each stage of coding? RESULTS: Gastroenterology is included but as by medics this is for surgical specialities only? What does the superscript above clinical regions relate to? Interesting themes and subthemes which do seem relevant to the data and the inductive and deductive coding strategies used. DISCUSSION: The presumed low survey response rate is a clear limitation to the paper. To what extent do the authors believe that responder bias influences the findings? I think interviews with those who do not engage / participate with TRC would very much contrast and complement the interviews with those who do. I appreciate that the surveys were anonymous so participants cannot be identified via that route but purposeful / convenience sampling could have been used to recruit such participants. Including stakeholders especially the research nurses was a valuable and insightful addition to this paper. Did the nurses raise any concerns / issues with TRC (consisency / continuity) Did the research group consider including a PPI representative in this piece of work. I think a patients insights into the process would add extra value. Some personal questions after reading this manuscript are the following (although it may not have emerged from the data) 1. The illustrative quote "we really rely on the registrars [trainees]... You'd have quite substantial, well double the amount of staff that we do now." (P11 consultant, interview)" could reflect a potentially exploitative relationship- TRC participants take on huge amounts of unpaid work for seniors. Was this mentioned 2. To follow on from this, Was the motivation for trainer / consultant involvement or participation in TRC examined? In addition to a desire to produce high quality research to advance patient care and provide mentorship to the next generation, there can be individual gains including reputational advancement. Was this discussed at any point. 3. Did any survey respondents / interviewees discuss TRC activity as an alternative to individualized academic / bench research and the pros and cons of this.

REVIEWER	Hopkins, Luke

	NHS Wales Health Education and Improvement Wales I have previously taken part in Trainee Research Collaborative based studies.
REVIEW RETURNED	04-Jun-2023

GENERAL COMMENTS	The manuscript provides a comprehensive investigation into the motivations, challenges, and strategies for enhancing clinician engagement in surgical trainee research collaboratives (TRCs). The study utilizes a mixed-methods approach, including non-participant observation, semi-structured interviews, surveys, and a stakeholder workshop. The findings are presented clearly and organized into three main themes: motivations for engagement, challenges to engagement, and facilitating and optimizing trainee collaborative research. Overall, the study provides valuable insights into the factors influencing clinician engagement in TRCs and offers practical strategies for enhancing participation. Specific comments: Methods: Sample and setting: It would be beneficial to provide more information on the selection criteria for interviewees. How were they purposively sampled? Were there any inclusion or exclusion criteria? Additionally, the reasons for the non-response of some participants should be acknowledged and discussed to address any potential bias in the sample. Discussion The authors briefly touch upon the motivations, challenges, and strategies identified in the study, but they could further elaborate on the implications of these findings for future research and practice. How do these findings contribute to the existing knowledge on clinician engagement in trials, and what are the potential avenues for further research or intervention?

REVIEWER	Hussein, Nabil Castle Hill Hospital, Cardiothoracic surgery
REVIEW RETURNED	10-Jun-2023

GENERAL COMMENTS	The authors present a well written paper exploring the role of surgical trainee research collaboratives using a mixed methods study. They review motivators, barriers and suggest a 5 step strategy to enhance such collaboratives. The authors should be congratulated on conducting a nice piece of qualitative research. I have a few comments outlined below: 1) As a surgical trainee with a research background I found it particularly challenging to undertake high quality research whilst coping with the demands of the clinical job. Personally I elected to take time out of training to do academic research which significantly boosted my research credentials and has made participating in research much easier during my return to training. The authors should comment on the challenges of undertaking high quality research and potentially suggest methods of how trainees should undertake research training prior to participating in such projects. For example, in countries such as the US, residents

	in some programmes are required to take one-year out to participate in research. This alleviates the clinical pressures and allows trainees to focus on developing their scientific background/skills which facilitates performing quality research once they return to training. Usually this happens after a couple of years of surgical training prior to the demands of later training. 2) Ideally research skill development should occur early in surgical training (ST1-ST3) prior to increased clinical responsibility, surgical independence, FRCS preparation, fellowship applications and preparation for CCT/consultancy jobs. The authors should make comment of the ideal time to get trainees involved in research collaboratives. 3) It is important to note the very few surgical trainees have formal scientific/research training prior and during training programmes (it is not mandatory). The authors such suggest methods of achieving this. For example in our training programme, there is a requirement to attend a train the trainer course and management course prior to CCT. Should there be a requirement for trainees to participate in a research methods course and evidence participation of research collaboratives at least once during training? 4) There are pathways to being an academic surgeon (clinical lecturer, NIHR funding academic roles). The authors such comment on these roles and how they can be mobilised to help such research initiatives. 5) The challenges of the academic surgeon – Unlike other medical specialities, surgical training has a strong focus on the development of technical surgical skills, which require hours of training/rehearsal in the operating room. Very few surgical training jobs come with academic/admin time which is common in other medical specialities. Therefore a surgical trainees time to commit to such research collaboratives is even more limited and therefore there is a stronger emphasis/ need to have an active core in the research project to lead and delegate tasks in an efficient way. This should be mentioned as a challenge/potential solution. 6) Another barrier that should be discussed is movement of trainees across hospitals within a deanery during training (i.e. trainees usually spend 1 year in a hospital and then are required to rotate). This is a significant barrier to participating in research collaboratives, therefore there is a requirement for objective setting and data collection to be completed within a short period of time. The authors describe a good methodology of pilot studies etc however they should also comment on the time constraints for surgeons and how this could potentially be overcome (i.e. base unit/team which has the key stakeholders – main PI, associate PI, research nurse, data centre, statisticians etc). In the US for example, trainees usually stay in a single hospital for the duration of their residency so it is much easier to develop as an academic surgeon. It is not uncommon that by the end of their residency surgeons can have their own lab with research team. Such a possibility within the UK system is extremely rare for surgeons. 7) Data was collected in 2017-18 yet is being submitted in 2023. Can the authors comment on this delay? 8) I find the 5 step strategy and very good tool, which nicely supplemented by the youtube video (excellent!). Could the authors provide an example of a study that has utilised this strategy and been successful? What was the feedback from this?

VERSION 1 – AUTHOR RESPONSE

R2: Royal College of Surgeons England could be abbreviated to RCS Eng.	The abbreviation has been adopted throughout the manuscript.
R2: Who are the co-applicants mentioned?	"Co-applicants" has been amended to name the co-authors involved in this activity (page 6).
R2: "Observations were non-participant (i.e., researcher not involved)" Meaning of this? Does it mean that the observers were not the researchers for this study or the researchers of this study did not act as observers TRC of which they were members?	Clarification has been added to 'researcher not involved' (page 6) as the observers were the study researchers. *"Observations were non-participant (i.e., observing study researchers were not TRC members and did not."*
R2: What research paradigm was adopted for this study.	The use of pragmatism as the research paradigm underpinning the study has been added (page 6).
R2: How did researcher positionality influence the interpretation and reporting of findings? Was reflexivity used to acknowledge this - could a reflective diary be provided?	A reflexivity section has been added to the Methods that recognises the influences of the multidisciplinary team (page 8). A reflective diary was not used, rather emerging findings and interpretations were discussed at study management group meetings throughout data collection and analysis.
R2: Was ethical approval provided for the recruitment of interview participants? If not this is a major limitation and would change my decision on publication.	Yes, ethical approval was granted. An ethical approval statement is at the end of the manuscript (page 26).
R2: What reporting guidelines were used for the preparation of this manuscript. SRQR or other?	The SRQR reporting checklist has been completed (provided with resubmission) and a sentence describing the use of the guidelines has been added to the manuscript (page 6).
R2: Is there an audit trail available via NVIVO for each stage of coding?	Yes, the researchers do have a clear trail of NVivo database versions as the coding progressed throughout data collection. We have now included our coding framework as supplementary materials.
R2: Gastroenterology is included but as by medics this is for surgical specialities only?	Thank you for spotting this error, the data has been updated to reflect this participant should have been in the colorectal category (page 9).
R2: What does the superscript above clinical regions relate to?	The superscript has now been removed as it was not needed (page 9).
R2: The presumed low survey response rate is a clear limitation to the paper. To what extent do the authors believe that responder bias influences the findings?	Reflection on the potential impact of a presumed low response rate has been added to the discussion as it is possible that more motivated trainees replied, although 41% had never been involved in TRCs and 49% had received no formal research training (page 24).
R2: I think interviews with those who do not engage/participate with TRC would very much contrast and complement the interviews with those who do. I appreciate that the surveys were anonymous so participants cannot be identified via that route but purposeful / convenience sampling could have been used to recruit such participants.	The sentence has been reframed and acknowledgement of the potential impact of interviewing those who were not engaged with TRCs has been added (page 24). Unfortunately, we could not access lists held by the Deaneries due to GDPR, so were unable to approach trainees directly to identify those who did not participate in TRCs. Our only direct contact with trainees was at TRC events.

R2: Including stakeholders especially the research nurses was a valuable and insightful addition to this paper. Did the nurses raise any concerns/issues with TRC (consistency / continuity).	We have looked at the data and the nurses did not raise concerns with TRC consistency/continuity although research nurses highlighted that this was a new way of working *"a whole new strategy we had to come up with" (*page 18).
R2: Did the research group consider including a PPI representative in this piece of work. I think a patients insights into the process would add extra value.	As the primary focus of engagement in trials was on trainees as the key stakeholders who would be affected by the research we did not include a PPI representative. However, we acknowledge patient's views may have added value and have included this as a limitation in the Discussion (page 24). We have added explanation for not including PPI representatives (page 8).
R2: Some personal questions after reading this manuscript are the following (although it may not have emerged from the data). 1. The illustrative quote "we really rely on the registrars [trainees]... You'd have quite substantial, well double the amount of staff that we do now." (P11 consultant, interview)" could reflect a potentially exploitative relationship- TRC participants take on huge amounts of unpaid work for seniors. Was this mentioned? 2. To follow on from this, Was the motivation for trainer/consultant involvement or participation in TRC examined? In addition to a desire to produce high-quality research to advance patient care and provide mentorship to the next generation, there can be individual gains including reputational advancement. Was this discussed at any point? 3. Did any survey respondents/interviewees discuss TRC activity as an alternative to individualized academic / bench research and the pros and cons of this?	The reviewer highlights some interesting queries. We have revisited the data and considered these points carefully. Where we could find evidence, we have included this in the manuscript, sometime this resulted in expanding/clarifying the existing text. 1. A potentially exploitative relationship was not indicated by our participants. Interviewees viewed the relationship as mutually beneficial due to knowledge gained, research conducted, contributions to the CV and publications. They acknowledged that it was an extra commitment and time to their existing role. A sentence and a new quote has been added to reflect this mutual relationship (pages 10 and 11). 2. No additional trainer/consultant motivations were discussed or implied than those presented, including individual gains or reputational advancement. 3. We have expanded sections of the findings to reflect interviewees' views of collaborative versus individualised research. There was perceived to be more impact through larger collaborative research studies (page 10), but individual research was easier and quicker (page 15).
R3: It would be beneficial to provide more information on the selection criteria for interviewees. How were they purposively sampled? Were there any inclusion or exclusion criteria? Additionally, the reasons for the non-response of some participants should be acknowledged and discussed to address any potential bias in the sample.	More information has been added regarding the selection criteria (page 6). Reasons for non-response are unknown with only two people actively declining interviews. We have amended the methods as there was a single invitation without reminders or incentives. We have added to the Discussion

	limitations a view that interviewees may have held a greater interest and stronger beliefs about TRCs (page 24).
R3: The authors briefly touch upon the motivations, challenges, and strategies identified in the study, but they could further elaborate on the implications of these findings for future research and practice. How do these findings contribute to the existing knowledge on clinician engagement in trials, and what are the potential avenues for further research or intervention?	We have added discussion about how our research contributes to the existing knowledge of clinician engagement in trials (page 21) and the uptake of the strategies by digital animation (page 24). We have also added a suggestion for future research in the era of the NIHR Associate PI scheme and how that might complement or compete with the TRCs in training, mentoring, and acquiring research skills (page 24).
R4: 1) As a surgical trainee with a research background I found it particularly challenging to undertake high quality research whilst coping with the demands of the clinical job. Personally I elected to take time out of training to do academic research which significantly boosted my research credentials and has made participating in research much easier during my return to training. The authors should comment on the challenges of undertaking high quality research and potentially suggest methods of how trainees should undertake research training prior to participating in such projects. For example, in countries such as the US, residents in some programmes are required to take one-year out to participate in research. This alleviates the clinical pressures and allows trainees to focus on developing their scientific background/skills which facilitates performing quality research once they return to training. Usually this happens after a couple of years of surgical training prior to the demands of later training.	We have highlighted the challenges for trainees undertaking research on top of busy clinical and training schedules (pages 12 and 15). One of the main advantages of the TRCs was seen as the opportunity for trainees to lead and conduct high-quality research in multi-centre studies, including randomised trials. The TRCs also provide a mentoring and training environment in research skills from more senior trainees and external mentors (consultant surgeons and trials unit staff) as shown in several quotes. Participants also highlighted the benefits of informal 'on the job' training and by participating in large-scale studies. This has been added to the manuscript with a supporting quote (pages 17 and 19). Participants also suggested that trainees would benefit from dedicated research time, including potentially undertaking PhD/MDs although they did not discuss the optimal timing for a research "time out". We have added this to the strategies theme with a supporting quote (pages 17 and 19).
R4: 2) Ideally research skill development should occur early in surgical training (ST1-ST3) prior to increased clinical responsibility, surgical independence, FRCS preparation, fellowship applications and preparation for CCT/consultancy jobs. The authors should make comment of the ideal time to get trainees involved in research collaboratives.	The optimal timing of training was not discussed by participants. At observed TRC meetings, which often included research skills training or "Dragons Den" (sand-pit style) research ideas presentations, a mix of more and less senior grades was perceived to work well (although not in all cases) and quotes support this view of early engagement with TRCs (page 17 Mentorship).
R4: 3) It is important to note the very few surgical trainees have formal scientific/research training prior and during training programmes (it is not mandatory). The authors such suggest methods of achieving this. For example in our training programme, there is a requirement to attend a train the trainer course and management course prior to CCT. Should there be a requirement for trainees to participate in a research methods course and evidence participation of research collaboratives at least once during training?	As presented on page 17, participants in this study believed there should be greater emphasis on research training in the curriculum. However, they felt that any research training should not be made mandatory. We have added all the recommended strategies that the stakeholders considered in their workshop in the supplementary materials which includes types of training courses trainees could undergo. Noting the word

	count, we have refrained from presenting more information as it was not the main focus of the research.
R4: 4) There are pathways to being an academic surgeon (clinical lecturer, NIHR funding academic roles). The authors such comment on these roles and how they can be mobilised to help such research initiatives.	As previously, we did not collect data on this as the focus was on TRCs. Some cited references link to this broader perspective of training clinicians e.g., the NIHR Associate PI scheme, reference 7.
R4: 5) The challenges of the academic surgeon – Unlike other medical specialities, surgical training has a strong focus on the development of technical surgical skills, which require hours of training/rehearsal in the operating room. Very few surgical training jobs come with academic/admin time which is common in other medical specialities. Therefore a surgical trainees time to commit to such research collaboratives is even more limited and therefore there is a stronger emphasis/ need to have an active core in the research project to lead and delegate tasks in an efficient way. This should be mentioned as a challenge/potential solution.	It is an interesting point that the TRCs started in surgery which may have been to address the lack of research training and time due to technical skill development, although that was not discussed explicitly by interviewees. We highlight the challenges for trainees undertaking research on top of busy clinical and training schedules (pages 12 and 15). Participants suggested that trainees might benefit from dedicated time away from their busy clinical schedules. We have added this to the strategies theme with a supporting quote (pages 17 and 19). An active core in a research project was not discussed by participants, possibly because the TRCs allocate trainees to key roles like Steering Committee, Data validation, Regional and Local Leads, and Writing Group for studies to provide a core. In addition, it was acknowledged that consultants and CTUs also facilitated TRC research as key players (page 17).
R4: 6) Another barrier that should be discussed is movement of trainees across hospitals within a deanery during training (i.e. trainees usually spend 1 year in a hospital and then are required to rotate). This is a significant barrier to participating in research collaboratives, therefore there is a requirement for objective setting and data collection to be completed within a short period of time. The authors describe a good methodology of pilot studies etc however they should also comment on the time constraints for surgeons and how this could potentially be overcome (i.e. base unit/team which has the key stakeholders – main PI, associate PI, research nurse, data centre, statisticians etc). In the US for example, trainees usually stay in a single hospital for the duration of their residency so it is much easier to develop as an academic surgeon. It is not uncommon that by the end of their residency surgeons can have their own lab with research team. Such a possibility within the UK system is extremely rare for surgeons.	Reflecting on our data, the movement of trainees has been added as a challenge although it was also felt to open up opportunities for trainees to get involved in different studies. A nuanced discussion and quotes of how this can also be beneficial for trainees and trials are provided on pages 12, 12 and 15.
R4: 7) Data was collected in 2017-18 yet is being submitted in 2023. Can the authors comment on this delay?	We have added an explanation in the Discussion (page 24) and timing of the YouTube digital animation video to the text (page 21 and Impact funding in Acknowledgement). In 2019 the digital animation was completed having secured

	external funding for the professional production through an Impact award which was presented at the national trainee meeting. During the COVID-19 pandemic, other research took priority and the clinical co-applicants would have been unlikely to be able to contribute fully to the manuscript. We submitted this paper to a surgical journal in 2022 which was rejected in 2023 before submission to the BMJ Open. We have added a sentence to the limitations section in the Discussion regarding the timescale (page 21).
R4: 8) I find the 5 step strategy and very good tool, which nicely supplemented by the youtube video (excellent!). Could the authors provide an example of a study that has utilised this strategy and been successful? What was the feedback from this?	A sentence has been added to the discussion citing positive evaluation of this approach in science communication more generally (page 24)

VERSION 2 – REVIEW

REVIEWER	Hussein, Nabil Castle Hill Hospital, Cardiothoracic surgery
REVIEW RETURNED	27-Sep-2023

GENERAL COMMENTS	I am satisfied with the responses and changes the authors have made to the script.

VERSION 2 – AUTHOR RESPONSE