PEER REVIEW HISTORY

ARTICLE DETAILS

TITLE (PROVISIONAL)	Current issues and future considerations for the wider implementation of robotic-assisted surgery: a qualitative study
AUTHORS	Lawrie, Louisa; Gillies, Katie; Davies, Loretta; Torkington, Jared; McGrath, John; Kerr, Richard; Immanuel, Arul; Campbell, Marion; Beard, David

VERSION 1 – REVIEW

REVIEWER	Adamson, Joy University of York, Health Sciences
REVIEW RETURNED	31-Aug-2022

GENERAL COMMENTS	I found this to be a well written paper, based on sound methods, with a clear message that will be of interest to the readership. This is clearly part of a suite of papers which will be published from a larger piece of work, this particular manuscript makes a valuable contribution relating to pragmatic considerations relating to robotic assisted surgery now and moving forward. I have no major flows to highlight however, I would request the authors give some consideration to the following points: - in both the strengths and limitation box and this section of the discussion the authors state "The sample for interview comprised mostly of surgeons and was small (although in line with other qualitative studies)" - I really would discourage the size of the sample being described as a limitation in this context. As the authors themselves state, this sample size is typical of qualitative studies in the field and by mentioning this as a potential limitation per se perpetuates the incorrect notion that the number is the most important consideration for appropriate qualitative sampling. In this case the 'variation' in the sample does seem more important as the authors do discuss e.g. dominated by surgeons, and those with a positive opinion of robotic assisted surgery. I'd be tempted to remove 'small' as this is relative and implicitly suggests small is somehow inappropriate. - Data collection: It is stated that LL8 (typo LL?) conducted the interviews with 'observation and assistance' from other co-authors. This is a bit odd, if this is the case then perhaps requires some further elaboration relating to the kind of assistance and why there was a need for this/the potential impact observation may have had on interviews etc. However, this may relate to the focus groups, where assistance would make more sense? Can this be clarified? - description of participants, ethnicity is provided - was this self-identified ethnicity? the category Caucasian feels a bit odd given the other categories in the table are broadly in line with ONS descriptions? - 'Patient/public' the term is used a little inconsistently, sometimes just public - may wish to homogenise this. It seems that this focus

	group was with an existing PPI contributor group associated with one of the researcher departments. Perhaps some more detail would be helpful here - it was not clear if this was just a more 'general public' view or whether patients had undergone surgery or were waiting for types of surgery where robots are common place etc. A sentence or 2 about this group would be helpful. - purposive sampling for interviews - it is not clear on the basis of what criteria and how this was achieved?

REVIEWER	Zhao, Beiqun University of California San Diego
REVIEW RETURNED	06-Sep-2022

GENERAL COMMENTS	In this study by Lawrie et al, the authors perform a well-designed qualitative study looking at the implementation of robotic surgery in the UK. The authors should be commended on their efforts, as I am sure it was a substantial undertaking. But this is a very important topic and is best discussed using qualitative techniques. Please find my comments below: Major Comments: 1. The authors performed semi-structured interviews of the subjects with interview guides. How were these guides developed? The authors mentioned "piloting" (pg 7, line 6). Was this piloting used to iteratively refine the guides? Typically, these guides are constructed in an iterative process, especially when interviews are semi-structured. More detail would be appreciated in the methods section. 2. Were any of the interviewees responsible for "running the ORs"? While a variety of roles are included in the interview pool, one of the roles most affected by robotic surgery are the people responsible for making sure the ORs are on time. In the US, that job usually falls to the anesthesiologist "board runner", who moves cases to and fro to make sure the ORs are running efficiently. In my experience, they often have a lot of opinions regarding robotic surgery (as it tends to increase the turnover and operative time for procedures). 3. The two focus groups are very interesting to me. The effect of RAS on surgical training is a very important topic, one that deserves more expanding in this paper. "workforce training needs" was a topic in the results, but there were no quotes. This needs to be expanded. In a quick pubmed search, there are several papers examining the effects of RAS on surgical training (Zhao et al, Chen et al, etc), though I didn't see any in the UK. Perhaps this is a knowledge gap that can be filled. 4. The patient focus group is also very interesting. I think this is a very unique viewpoint that is often not considered in the literature. I think expansion of instances in which patient/public viewpoints were at odds with user viewpoints (e.g. the possibility of remote surgery) would be very interesting. Were there other instances where this happened? In addition, while the authors make a point to state the potential for sample bias given that most users were likely proponents of RAS, the opinions of the public are not necessarily so. Therefore, their opinions may provide a balance in terms of bias towards/away from RAS. 5. Are the different sites homogenous or heterogenous in terms of their application of RAS. The authors recruited from 16 centers across three countries. I would imagine that there would be some heterogeneity in how surgeons use RAS in England versus Wales, but I might be wrong. Please comment.

	6. In identifying themes, did any other author go through the transcripts other than LL? Typically, a second or third author will identify themes within the transcript in order to prevent bias from a single author. 7. The topic of cost deserves more attention in the discussion, especially in the UK. This is a big topic in the US. Minor Comments: 8. Please include demographics data on the patient/public focus group. How many of these patients had surgeries in the past? 9. What is LL8- (pg 7, line 6)? 10. How were the interviews transcribed? Manually or by program? Were there any quality assurance measures employed? Were the interviews recorded? How long was the time between transcription and analysis for themes (does not need to be exact, but would be nice to get a sense of how "fresh" the interviews were)? 11. Was institution review board or ethics approval obtained? In addition, under "patient and public involvement" heading (pg 7, line 39), this should be marked as YES. 12. Why were there 2 surgical trainees in the interview group? Were these two trainees also in the focus group? 13. A brief description of the types of surgeries that are performed robotically would be nice. For example, it is surprising to me that there were orthopedic surgeons (robotic spine procedures?). 14. A summary of the overall themes would be very helpful. Perhaps a figure of some kind?

VERSION 1 – AUTHOR RESPONSE

Reviewer #1 comments	**Authors' responses**
I found this to be a well written paper, based on sound methods, with a clear message that will be of interest to the readership. This is clearly part of a suite of papers which will be published from a larger piece of work, this particular manuscript makes a valuable contribution relating to pragmatic considerations relating to robotic assisted surgery now and moving forward.	Thank you very much for your positive feedback.
In both the strengths and limitation box and this section of the discussion the authors state "The sample for interview comprised mostly of surgeons and was small (although in line with other qualitative studies)" - I really would discourage the size of the sample being described as a limitation in this context. As the authors themselves state, this sample size is typical of qualitative studies in the field and by mentioning this as a potential limitation per se	Thank you for pointing this out. We agree, and have now removed the reference to the size of the sample within the strengths and limitations box (and in the discussion section), instead highlighting the lack of variation in roles (for interviews) as a limitation.

perpetuates the incorrect notion that the number is the most important consideration for appropriate qualitative sampling. In this case the 'variation' in the sample does seem more important as the authors do discuss e.g. dominated by surgeons, and those with a positive opinion of robotic assisted surgery. I'd be tempted to remove 'small' as this is relative and implicitly suggests small is somehow inappropriate.	
Data collection: It is stated that LL8 (typo LL?) conducted the interviews with 'observation and assistance' from other co-authors. This is a bit odd, if this is the case then perhaps requires some further elaboration relating to the kind of assistance and why there was a need for this/the potential impact observation may have had on interviews etc. However, this may relate to the focus groups, where assistance would make more sense? Can this be clarified?	LL8 was a typo which has now been corrected. The interviews were led by LL, accompanied by some interjections by co-authors to ensure that all relevant/technical aspects of issues related to RAS were covered. Co-authors sometimes probed participants on specific aspects. We acknowledge that this use of 'two-to-one' interview format is uncommon, but note too that it is starting to be used within other studies [1]. We would also like to highlight that this interview format was advantageous in that it: 1. Ensured maximum coverage of current debates in the field of RAS and 2. Allowed clarification of some issues for both interviewer and interviewee utilising the expertise of the authors. It was more useful and common for the focus groups as stated by the reviewer. However, we also recognise that the presence of additional personnel and questions may have impacted interviewee responses in various ways: for example, it may have been more difficult to establish an individual rapport with participants compared to one-to-one interview scenarios but may have elicited a broader in-depth response. We have now clarified the type of assistance provided by the co-authors during the interviews within the methods section. [1]. Monforte J, Úbeda-Colomer J. Tinkering with the two-to-one interview: Reflections on the use of two interviewers in qualitative constructionist

	inquiry. Methods in Psychology. 2021 Dec 1;5:100082.
Description of participants, ethnicity is provided - was this self-identified ethnicity? the category Caucasian feels a bit odd given the other categories in the table are broadly in line with ONS descriptions?	The ethnicities outlined in the paper refer to the ethnicities that participants used to describe themselves. We have now clarified within the paper that the ethnicities were self-identified (Table 1).
'Patient/public' the term is used a little inconsistently, sometimes just public - may wish to homogenise this. It seems that this focus group was with an existing PPI contributor group associated with one of the researcher departments. Perhaps some more detail would be helpful here - it was not clear if this was just a more 'general public' view or whether patients had undergone surgery or were waiting for types of surgery where robots are common place etc. A sentence or 2 about this group would be helpful.	Thank you for pointing out this inconsistency. We have now opted to use the term public, as opposed to patient/public, to describe this group of participants – the paper has been amended to reflect this. None of the participants in the public focus group reported having had a robotic assisted procedure, although some indicated their patient experience of other types of keyhole surgery. This is highlighted in the Results section (prior to Table 1).
Purposive sampling for interviews - it is not clear on the basis of what criteria and how this was achieved?	The sample was purposively selected to include a range of views (e.g. proponents and opponents) and experiences of RAS (i.e. variations in specialty and duration of RAS experience). We have clarified this in the paper within the methods section, and also indicated that a pre-specified sample of 35 was included to ensure full representation of stakeholders and saturation of themes. We have also included a reference in the paper which includes details of the principles we used to judge the sufficiency of our sample size.

Reviewer #2	**Authors' response**
In this study by Lawrie et al, the authors perform a well-designed qualitative study looking at the implementation of robotic surgery in the UK. The authors should be commended on their efforts, as I am sure it was a substantial undertaking. But this is a very important topic and is best discussed using qualitative techniques.	Thank you very much for your positive feedback.

1. The authors performed semi-structured interviews of the subjects with interview guides. How were these guides developed? The authors mentioned "piloting" (pg 7, line 6). Was this piloting used to iteratively refine the guides? Typically, these guides are constructed in an iterative process, especially when interviews are semi-structured. More detail would be appreciated in the methods section.	More information is now included in the Methods section under the 'Design' sub-heading. Pilot interviews were used to test the suitability of our interview topic guide (in terms of relevance and comprehensibility) – these interviews were conducted with key informants who had expertise in RAS. The topic guides were also iteratively updated throughout data collection.
2. Were any of the interviewees responsible for "running the ORs"? While a variety of roles are included in the interview pool, one of the roles most affected by robotic surgery are the people responsible for making sure the ORs are on time. In the US, that job usually falls to the anesthesiologist "board runner", who moves cases to and fro to make sure the ORs are running efficiently. In my experience, they often have a lot of opinions regarding robotic surgery (as it tends to increase the turnover and operative time for procedures).	Yes, we had some interviewees that were OR managers or senior nursing staff responsible for running the OR. We agree they were important to sample. We also interviewed anaesthetists (although perhaps not as many as we would have wished).
3. The two focus groups are very interesting to me. The effect of RAS on surgical training is a very important topic, one that deserves more expanding in this paper. "workforce training needs" was a topic in the results, but there were no quotes. This needs to be expanded. In a quick pubmed search, there are several papers examining the effects of RAS on surgical training (Zhao et al, Chen et al, etc), though I didn't see any in the UK. Perhaps this is a knowledge gap that can be filled.	We agree that this area (workforce training needs) is worthy of further expansion. We had previously omitted a quote from this section to reduce the overall word count of the paper. However, we have now included a quote to illustrate the content of this theme. The training aspect is indeed critical to RAS (hence the sub-group of trainees chosen) and further separate publications on this issue may ensue.
4. The patient focus group is also very interesting. I think this is a very unique viewpoint that is often not considered in the literature. I think expansion of instances in which patient/public viewpoints were at odds with user viewpoints (e.g. the possibility of remote surgery) would be very interesting. Were there other instances where this happened? In addition, while the authors make a point to state the potential for sample bias given that most users were likely proponents of RAS, the opinions of the public are not necessarily so. Therefore, their opinions may provide a balance in terms of bias towards/away from RAS.	Thank you for this suggestion. We have now included an additional quote (from a public focus group participant) which emphasises the view that RAS is more beneficial than other types of surgery. This is highlighted in the 'Public Understanding' section of the findings. We have also included another quote to highlight the public focus group participants' concerns about remote surgery – this is under the 'Future direction of RAS' sub-heading in the findings. We had no direct evidence of conflict between patients and users and therefore respectfully felt

	that any greater expansion of the sentiments here would be out of remit. There were no other instances where the public and user viewpoints were at odds.
5. Are the different sites homogenous or heterogenous in terms of their application of RAS. The authors recruited from 16 centers across three countries. I would imagine that there would be some heterogeneity in how surgeons use RAS in England versus Wales, but I might be wrong. Please comment.	There is no evidence that the RAS services in Wales or Scotland are utilised any differently to those in England. However, the cost mechanisms and pathways may be slightly different and this is an area we intend to explore in a larger, currently ongoing, project known as REINFORCE.
6. In identifying themes, did any other author go through the transcripts other than LL? Typically, a second or third author will identify themes within the transcript in order to prevent bias from a single author.	Thank you for pointing this out. We have now included more detail in the 'Data Analysis' section of the Methods. A double coder checked the themes accurately described the content of participants' responses in five transcripts.
7. The topic of cost deserves more attention in the discussion, especially in the UK. This is a big topic in the US.	We did not explore costs to any great extent in this piece of work as it would have been anecdotal and perhaps misleading. Again, we have a whole Work Package dedicated to costs and cost differences in the subsequent work (REINFORCE), which is funded by a major UK health funder - the NIHR HS&DR.
8. Please include demographics data on the patient/public focus group. How many of these patients had surgeries in the past?	Information pertaining to participants' age, ethnicity and gender were not collected for the public focus group. We did not ask participants if they had surgery in the past. But there were two in the group who volunteered this information and indicated that they have had keyhole surgery. This is highlighted in the Results section under 'Demographics'.
9. What is LL8- (pg 7, line 6)?	Thank you for pointing this out. This was a typo which has now been corrected.
10. How were the interviews transcribed? Manually or by program? Were there any quality assurance measures employed? Were the interviews recorded? How long was the time between transcription and analysis for themes (does not need to be exact, but would be nice to get a sense of how "fresh" the interviews were)?	The interviews were audio-recorded and transcribed verbatim by an external transcription company. LL anonymised and reviewed the transcripts for accuracy, (re)checking against the audio recordings where necessary (e.g. where extracts of the transcripts were highlighted as 'inaudible'). We have now included this information within the methods section.

	The approximate time between receiving the final transcript (transcribed in full) to the development of themes was around four months.
11. Was institution review board or ethics approval obtained? In addition, under "patient and public involvement" heading (pg 7, line 39), this should be marked as YES.	This study was approved by the Life Sciences and Medicine Ethics Review Board (CERB) at the University of Aberdeen (CERB/2020/7/1984). This information is included towards the end of the manuscript (before the References), as per BMJ Open formatting requirements. Under “patient and public involvement” we have now clarified that patients and/or public were not involved in the design or analysis of the study, but their views were an integral part of the study findings.
12. Why were there 2 surgical trainees in the interview group? Were these two trainees also in the focus group?	The trainees in the interview sample were not in the trainee focus group. We have now clarified this within the Results section (Table 1).
13. A brief description of the types of surgeries that are performed robotically would be nice. For example, it is surprising to me that there were orthopedic surgeons (robotic spine procedures?).	The operations that are carried out are quite varied and include body cavity-based work (most often cancer) in colorectal, upper GI, thoracic, head and neck, urology, gynaecology, and orthopaedics. Orthopaedics is slightly different (knee, hip, and spine) as it is mainly related to accuracy of cutting bone rather than manipulation of instruments inside a body cavity. We have now listed the surgery types in the text (under Results).
14. A summary of the overall themes would be very helpful. Perhaps a figure of some kind?	We agree that this would be a useful addition to the paper. We have now included a figure (Figure 1) in the findings section to summarise the themes arising from the interviews and focus groups.

VERSION 2 – REVIEW

REVIEWER	Adamson, Joy University of York, Health Sciences
REVIEW RETURNED	20-Oct-2022

GENERAL COMMENTS	This is a high quality manuscript that makes a useful contribution to the field. I would not expect the current manuscript to include these references, but for future research the authors may wish to consider the following papers (if they haven't already seen them)

	which describe an update to the thematic analysis used for the current paper and further debate on qualitative saturation, which has fallen out of fashion a little: Virginia Braun & Victoria Clarke (2019) Reflecting on reflexive thematic analysis, Qualitative Research in Sport, Exercise and Health, 11:4, 589-597, DOI: 10.1080/2159676X.2019.1628806 Virginia Braun & Victoria Clarke (2021) To saturate or not to saturate? Questioning data saturation as a useful concept for thematic analysis and sample-size rationales, Qualitative Research in Sport, Exercise and Health, 13:2, 201-216, DOI: 10.1080/2159676X.2019.1704846

REVIEWER	Zhao, Beiqun University of California San Diego
REVIEW RETURNED	14-Oct-2022

GENERAL COMMENTS	The authors have adequately addressed all comments.