PEER REVIEW HISTORY

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ARTICLE DETAILS

TITLE (PROVISIONAL)	Life or limb. An international qualitative study on decision making in sarcoma surgery during the COVID-19 pandemic.
AUTHORS	Bunzli, Samantha; O'Brien, Penny; Aston, Will; Ayerza, Miguel; Chan, Lester; Cherix, Stephane; de las Heras, Jorge; Donati, Davide; Eyesan, Uwale; Fabbri, Nicola; Ghert, Michelle; Hilton, Thomas; Idowu, Oluwaseyi; Imanishi, Jungo; Puri, Ajay; Rose, Peter; Sabah, Dundar; Turcotte, Robert; Weber, Kristy; Dowsey, Michelle; Choong, Peter

VERSION 1 – REVIEW

REVIEWER	Hobusch, Gerhard Medical University of Vienna, Department of Orthopaedics
REVIEW RETURNED	25-Dec-2020

GENERAL COMMENTS	Thank you for the opportunity to review this interesting qualitative paper. Authors as well as participants from 18 different countries are describing their decision-making in sarcoma surgery during the pandemic crisis when “traditional” decision making could not be applied. They used cognitive task analysis to analyze the mental process behind the decision making. Authors claim that results could have relevance not only in health crisis but also to decision-making in patient care more broadly. Mostly, the manuscript is good to follow and, concerning the qualitative method, it is scientifically sound. The way how “normal” decision-making is meant to be needs to be explained somehow and I would suggest more consistency of the 4 themes throughout the whole manuscript. Here are my remarks: Introduction: Type in the running title should be Covid-19 not Covid-1, Page 4 line 3. Not sure how these findings could apply more broadly in other situations but crisis? Methods: Page 5 line 53 Authors/Participants are more pseudonymised than anonymized due to Snowball sampling. Demographics are easy to identify, do authors really want that- this fact indeed is the most critical limitation for the bias of social desirability. Results: Why not using the same wording of themes in the paragraph page 7 lines 8-15 and in the headlines? This would be easier to follow. The limited resources might differ most between countries on ascending part of COVID-crisis or reaching the plateau. Did the authors see differences in the way the participants answered? Limited resources might also depend on health care systems and

	their different supply capacities. Although these are not the main issues in this study (and might be a topic for a different study) could these differences be discussed by participants´ quotations? And also be mentioned in the limitations? Furthermore, countries may have learned a lot from countries who came first in the history of the pandemic. Could you see a chronologic development of perspectives? In the description of “4. Least-decision making” (page 12 line 12-50) I would suggest to shorten the described quotation and add a further one from another author, maybe an example with changed chemotherapy-protocol, for this seemed to be a frequent issue according to table 3 (Examples of unique decisions). I would prefer using “Covid-19” with consistency throughout the manuscript check for different spellings. As table 4 (suggested strategies) is mentioned in the results as well as in the discussion several times in my feeling should be explained also in the text. Furthermore, why not keeping the same 4 themes in this table for consistency? Discussion: What Is the framework applied under normal circumstances? Can you supply also a graphical summary for normal and new framework? Please ad or just state that this is the framework under special circumstances. (page 13, line 26) As table 4 is only mentioned here, please explain also in the text. Table 2 (participants’ characteristics): Why not adding the health expenditure according to the gross domestic product of each participant´s state? There are differences between 8 or 12%. Lower expenditure exerts more pressure to physicians in terms of lack of resources. Table 4 (suggested strategies): I would recommend consistency with the 4 themes all over the manuscript. To the last point: The suggested strategy for least-worse decisions is maintaining multidisciplinary consultations. I am wondering how multidisciplinary tumorboard meetings changed over the time in the institutions of the participants? Weren´t these meetings scheduled (maybe as video-meetings) for the time of COVID-crisis? Also least-worst procedures could have been discussed in these meetings? I would suggest to put table 2 of supplemental material in the main manuscript, for these statements are very important and interesting facts for the reader of this qualitative work. However, again I recommend to stay consistent with the 4 themes and re-arrange accordingly.

REVIEWER	Taylor, Rachel University College London Hospitals NHS Foundation Trust, CNMAR
REVIEW RETURNED	20-Jan-2021

GENERAL COMMENTS	Thank you for asking me to review this qualitative study reporting the decision-making processes for conducting sarcoma surgery during the pandemic. While this is an interesting and important study, in its current format I do not think it is suitable for publication in BMJ Open. I think a major change that is needed is the reporting of information at individual level and the amount of detail that accompanies this. With not a lot of effort, I was able to determine that participant 2 delayed amputation and risked the patient developing lung tumours and this decision was probably

	made by Dr Weber from Pennsylvania operating on a patient in April. This is an open access journal so I wonder how her patient would feel about this if they read this paper (using Dr Weber as an example but it is also possible to make the links to all the other surgeons who joined the paper as a co-author). Participants should be described collectively and quote according to theme rather than the individual. I offer the additional suggestions that I think will strengthen the reporting of this study. 1. Cognitive Task Analysis needs more explanation of what this is and there needs to be more evidence throughout the paper of how this was applied and underpinned the findings. 2. The authors specify that this was a snowball sample but they then specify that an email invitation was sent from the lead investigator so it sounds more like a convenience sample. It needs to be clear what sampling method was used and if this was a convenience or purposive sample, details need to be presented on the criteria the lead investigator used to select the surgeons to invite. As there was a process of selection, some reference to bias is needed as a limitation in the discussion. 3. Eligibility criteria for the surgeons – how was 'senior surgeon' defined? 4. Participants are presented in Figure 1 and Table 1. I do not think it is necessary to present both and as specified above participants should not be presented at individual level because the authors then specify the inclusion of participants as co-authors (although I note there is no UK co-author so clarifying text should be included about this), so anonymity is no longer assured. 5. It refers to saturation in the abstract, which sounds like it is related to data, i.e., data saturation, but in the main text the authors refer to 'sufficient patterns in the sample'. I am unclear what this latter term means so this should be clarified. As the interviews were conducted in rapid succession, I am sure they are not referring to data saturation as it would not be possible to analyse qualitative data sufficiently to ascertain data saturation in this short time period. This description needs to be clearer and amended in the abstract for accuracy. 6. The number of deaths has been used as a determinant of decision-making but this is not necessarily the driving force. I do not think these data or all the graphs in the supplemental file are relevant to this qualitative study. What I was most interested in was the policy in each country with regards to business as usual and how this was translated at hospital level, i.e., most surgery in the UK was suspended for a period of time with only most urgent cases continuing so the decision-making ability was driven by policy. This did not emerge from the findings, which I felt was surprising. 7. Tables 1 and 2 are at individual level and should be collapsed to provide a summary of participants collectively. 8. Participant 6 was not really eligible to participate and was excluded in the analysis so the text should be altered to reflect 17 participants not 18. 9. Figure 2 does not reflect the themes specified in the text at the beginning of the findings. 10. It is unclear in the description of the methods of analysis how this was guided by the cognitive task analysis framework. It reads as standard thematic analysis but I would have thought the starting framework if using CTA would be focused on information about the knowledge, thought processes, and goal structures that

	were needed to carry out a task. The absence of this link to CTA is therefore evident in the findings which do not reflect this form of analysis. 11. As noted above, the findings are quite descriptive, do not explain the decision-making processes and the quotes do not illuminate the text merely repeat what has been specified in the text. There needs a deeper level of analysis to lift the findings from the individual level to deliver an understanding of how surgeons as a whole made these decisions. The interview schedule indicates that there are some valuable and rich data that could provide a more developed understanding but the policy and system-level data that would definitely have influenced decision-making do not emerge in these findings. 12. There is repetition of quotes in the supplemental table and in the text, as noted earlier – it would be better to present quotes according to theme to illuminate the findings rather than at individual level because of the risk to confidentiality. 13. The theme 'Duty of care', how was this influenced by hospital governance and national policy? Not going in to work just because you are older was not an option in the NHS: all who could work and were not on the government shielding list were required to work. 14. I find it interesting that there was nothing about the patient involvement in the decision-making process. Do surgeons make decisions about treatment arbitrarily without consulting the patient? 15. Table 4 needs to identify which parts of this are specific to a pandemic and which are part of the normal decision-making process. 16. Much of the supplemental data is not relevant – the authors have not showed any link either in their data or from elsewhere between epidemiology and decision-making. It is also unclear why the USA was split into city and the other countries are not; the UK was London, which had a different rate of infection than other parts of the country at the time of the study.

VERSION 1 – AUTHOR RESPONSE

Reviewer: 1

1. Mostly, the manuscript is good to follow and, concerning the qualitative method, it is scientifically sound. The way how "normal" decision-making is meant to be needs to be explained somehow and I would suggest more consistency of the 4 themes throughout the whole manuscript.

We have added a definition of 'normal':

Line 424-432: *"Under 'normal' circumstances (i.e. pre-pandemic), decision-making is driven by rational and recognition-primed choices[10]. Having determined 'what is going on', decision makers consider multiple courses of action, and select the action that offers a 'superior' outcome[11]. In the abundance of resources, triage is based on the principle of need, with the sickest being the first to receive care[12]. The ethical standard respects the autonomy of the patient and provider, taking into account their preferences through shared decision-making[12]. In the narrative accounts of decision-making documented in this study, a paradigm shift was observed, most notably in the hospitals hardest-hit by COVID-19."*

We have also edited the manuscript for better consistency of the 4 themes throughout see for example we have inserted subtitles linking the themes to paragraphs in the discussion:

Line 438: *Least-worst decision making and the context of uncertainty*

Line 449: *Least-worst decision making and the context of limited resources*

Line 472: *Least-worst decision making and the duty of care*

Introduction:

2. Type in the running title should be Covid-19 not Covid-1

The authors have amended this editing mistake. Running head now reads COVID-19.

3. Page 4 line 3. Not sure how these findings could apply more broadly in other situations but crisis?

The authors agree that the reference to patient care more broadly was not substantiated sufficiently in the introductory paragraph. We have removed this reference to patient care and amended the sentence to now focuses on crisis only:

Line 113-115: *"This knowledge has particular relevance during a major national or international crisis that significantly impairs the supply, delivery and use of resources that impacts patient care, such as international war, pandemic or natural disaster"*

Methods:

4. Page 5 line 53 Authors/Participants are more pseudonymised than anonymized due to Snowball sampling. Demographics are easy to identify, do authors really want that- this fact indeed is the most critical limitation for the bias of social desirability.

The authors agree that the anonymity of the participants can be strengthened. We have stripped detail from the abstract and results section which now reads:

Line 62-63: *From 22 invited sarcoma surgeons, 18 surgeons participated who had an average of 19 years experience.*

Line 208: *Eighteen sarcoma surgeons from 14 countries…*

We have also removed participant numbers from the epidemiology data table (Table 1) and now collapsed the participant demographic table (Table 2) to only show aggregated data.

Results:

5. Why not using the same wording of themes in the paragraph page 7 lines 8-15 and in the headlines? This would be easier to follow.

We thank the reviewer for the opportunity to clarify the titles of the themes. We have amended the titles in the abstract and the results:

Line: 66-72: *Common to 'unique' decisions about patient care was the context of uncertainty (Theme 1), limited resources (Theme 2), duty of care (Theme 3) and least-worst decision-making (Theme 4).*

Line 227-229: *"Common to 'unique' decisions about patient care was the context of uncertainty (Theme 1), limited resources (Theme 2), duty of care (Theme 3) and least-worst decision-making (Theme 4)."*

6.The limited resources might differ most between countries on ascending part of COVID-crisis or reaching the plateau. Did the authors see differences in the way the participants answered? Limited resources might also depend on health care systems and their different supply capacities. Although these are not the main issues in this study (and might be a topic for a different study) could these differences be discussed by participants´ quotations? And also be mentioned in the limitations?

Thank you for highlighting this. Despite being in different phases of the pandemic, while there were differences in the answers the participants gave, we observed common themes among the experiences of the surgeons who participated in our study. We have included a statement to this effect at the start of the results:

Line 223-225: "*Despite being in different phases of the pandemic (see Supplementary Material), the key themes identified were common to the experiences of all 17 participants. Instances where diverse experiences occurred are reported within the description of each theme below".*

We have also added some detail on how resources differed between settings:

Line 325-329: *This participant practicing in a 'rich country' where resources remained available despite the high prevalence of COVID-19, also saw the pandemic as an opportunity to rethink resource stewardship: "We are a rich country, so we have adapted activity to our means - maybe we follow up our patients a bit too long. So we were able to postpone some without too much thought" (*Participant 18).

Line 454-460*: "While many participants in our study described situations in which limited resources impacted their clinical decision-making, it is important to note that significant differences existed between health systems and supply capacities and how impacted these were by the pandemic. However, even in settings where resources were not overwhelmed during the ascending phase of the COVID-19 curve, restrictions were put in place in anticipation of the 'impending wave' and thus participants in settings minimally impacted (e.g. Australia) experienced reduced access to resources.*
"

7. Furthermore, countries may have learned a lot from countries who came first in the history of the pandemic. Could you see a chronologic development of perspectives?

As discussed in (6) above, we indeed observed a chronological development of perspectives. Countries which experienced COVID later, observed how resources in other countries became overwhelmed by the 'COVID wave'. We have added this observation into the discussion:

Line 454-460*: "While many participants in our study described situations in which limited resources impacted their clinical decision-making, it is important to note that significant differences existed between health systems and supply capacities and how impacted these were by the pandemic. However, even in settings where resources were not overwhelmed during the ascending phase of the COVID-19 curve, restrictions were put in place in anticipation of the 'impending wave' and thus participants in settings minimally impacted (e.g. Australia) experienced reduced access to resources.*
"

8. In the description of “4. Least-decision making” (page 12 line 12-50) I would suggest to shorten the described quotation and add a further one from another author, maybe an example with changed chemotherapy-protocol, for this seemed to be a frequent issue according to table 3 (Examples of unique decisions).

We have shorted this quote as suggested and included an additional example of deviating from the planned chemotherapy protocol:

Line 391-405: *In addition to changes to radiotherapy protocols, many participants described changes. to chemotherapy protocols. For example, this participant recounts the risk balance of least-worst*

decision making when their patient tests positive to COVID-19 within 48 hours of surgery. Even though the patient is severely immunocompromised, the 'courageous' decision is made to postpone surgery and administer an additional round of chemotherapy whilst they wait for the patient to test negative: "One patient with a high grade osteosarcoma of the femur and is undergoing preoperative chemotherapy…by the time that we were getting ready for surgery, the policy of testing the patient within 48 hours from the day of surgery was implemented and unfortunately, he tested COVID positive. So this is a challenge on multiple level. Obviously it's a deviation from ideal treatment. Number two, it challenges at a cognitive level because this patient is severely immunocompromised. Which means that we take the courage essentially to give another round to chemotherapy to a patient possibly COVID positive. This is a risk balance without precedent to make reference to. It's a combination of – gut feeling or courage or experience in trying to beat the cancer up as much as we can while at the same time caring about the pandemic" (Participant 4).

9. I would prefer using "Covid-19" with consistency throughout the manuscript check for different spellings.

We have amended all references to COVID-19 (in body and supplementary material) to reflect consistent spelling, except instances of a direct participant quote, where references reflect the language used by the participants.

10. As table 4 (suggested strategies) is mentioned in the results as well as in the discussion several times in my feeling should be explained also in the text. Furthermore, why not keeping the same 4 themes in this table for consistency?

Thank you for this suggestion to better link the strategies and recommendations in Table 4 to the text. Please see additions below:

Line 446-447: "*We recommend maintaining multidisciplinary consultations to ensure consensus decision making and support in the context of uncertainty (see Table 4)"*

Line 469-470: "*Recommendations to support decision making in the context of limited resources include early establishment of prioritisation systems (see Table 4)."*

Line 482-484: "*Recommendations to support surgeons in their 'duty of care' include implementing institutional processes to assess and support the mental health needs of individuals and teams (see Table 4)."*

The authors agree that consistent titles of themes throughout the document and tables improves flow and readability. We have amended Table 4 to reflect the titles of each themes in the document as below:

Table 4. Suggested strategies to support surgical decision-making

Themes	**Suggested strategies**
The context of uncertainty	• Establish strategy of clear and regular communication from institutional and clinical leaders • Establish evidence-based practice guidelines for treatment rationalisation • Maintain multidisciplinary consultations and discussion to ensure consensus decision-making and support
Limited resources	• Establish prioritisation system for personnel, consumable and treatment resources • Establish split treatment teams to reduce vulnerability of cross infection amongst clinicians and support staff • Establish "designated survivor" status • Ensure early communication and agreement between stakeholders within treatment teams of treatment and diagnostic strategies

Duty of care	• Establish clear guidelines with regard to personal protective equipment • Establish clear guidelines for institutional and personal guidelines for direct patient contact • Establish prioritisation for shared (centre versus community) services e.g. investigations, biopsy • Minimise travel to and from treatment centres • Broaden network of treatment facilities e.g. radiotherapy, chemotherapy. • Maintain multidisciplinary consultations to ensure optimal care • Ensure patient support system exists • Develop mechanisms to assess mental health of staff • Provide clear institutional support for mental health needs of individuals and teams
Least-worst decision-making	• Maintain multidisciplinary consultations to ensure decision support

Discussion:

11. What Is the framework applied under normal circumstances? Can you supply also a graphical summary for normal and new framework? Please ad or just state that this is the framework under special circumstances. (page 13, line 26)

Thank you for the opportunity to clarify. We have removed the word 'framework' in this section as we believe it is misleading. The authors are drawing on the factors that influence normal clinical decision-making rather than a specified framework and as such this section now reads:

Line 434-434: *The factors which guided clinical decision-making under 'normal' circumstances no longer applied and a new decision-making framework was revealed (see Figure 2).*

12. As table 4 is only mentioned here, please explain also in the text.

We have addressed this in comment #10.

13. Table 2 (participants' characteristics): Why not adding the health expenditure according to the gross domestic product of each participant´s state? There are differences between 8 or 12%. Lower expenditure exerts more pressure to physicians in terms of lack of resources.

We added information about health system into supplementary table 2 and into the text (see comments reviewer 2, comment 12)

14. Table 4 (suggested strategies): I would recommend consistency with the 4 themes all over the manuscript. To the last point: The suggested strategy for least-worse decisions is maintaining multidisciplinary consultations. I am wondering how multidisciplinary tumorboard meetings changed over the time in the institutions of the participants? Weren´t these meetings scheduled (maybe as video-meetings) for the time of COVID-crisis? Also least-worst procedures could have been discussed in these meetings?

We have addressed the consistency of the 4 themes throughout the manuscript.

Please see the addition of commentary related to the multidisciplinary tumorboard meetings in the findings:

Lines 407-419: Disruption to multidisciplinary tumorboard meetings added to the experience of uncertainty for some participants. Institutions 'overrun' by the virus at the peak of the curve, cancelled multidisciplinary tumorboard meetings as all care focussed on managing the flood of COVID-19 patients. For other institutions in the earlier phases of COVID-19, meetings were also cancelled with the rapid introduction of social distancing measures preventing in-person gatherings. Those with access to necessary infrastructure were able to continue with meetings over video conferencing platforms, however these were often described as a 'shadow of their former selves'. "*Definitely missed the support of the team and that decision-making process. It definitely gives you an added layer of comfort or reassurance that you are making the right thing. Even if they just agree with you, it's nice that people agree with you and I definitely do miss those ones where it was less obvious. It's definitely been more difficult*" (Participant 014).

15. I would suggest to put table 2 of supplemental material in the main manuscript, for these statements are very important and interesting facts for the reader of this qualitative work. However, again I recommend to stay consistent with the 4 themes and re-arrange accordingly.

We have changed the column headings for supplementary Table 2 to be consistent with the themes in the main text. The authors also agree that the statements within the table are important to our work, however due to the size of the table we would like to defer to the editor to decide on this aspect of the manuscript.

Reviewer: 2

1. Thank you for asking me to review this qualitative study reporting the decision-making processes for conducting sarcoma surgery during the pandemic. While this is an interesting and important study, in its current format I do not think it is suitable for publication in BMJ Open. I think a major change that is needed is the reporting of information at individual level and the amount of detail that accompanies this. With not a lot of effort, I was able to determine that participant 2 delayed amputation and risked the patient developing lung tumours and this decision was probably made by Dr Weber from Pennsylvania operating on a patient in April. This is an open access journal so I wonder how her patient would feel about this if they read this paper (using Dr Weber as an example but it is also possible to make the links to all the other surgeons who joined the paper as a co-author). Participants should be described collectively and quote according to theme rather than the individual.

The authors agree that due to the complexity of including participants in the authorship team there were a number of issues with protecting the identity of each of the surgeons. To address this, we have removed participant numbers from the epidemiology data table (Table 1) and now collapsed the participant demographic table (Table 2) to only show aggregated data. The use of participant numbers (e.g in the supplementary Table 2) now cannot be identified.

2. Cognitive Task Analysis needs more explanation of what this is and there needs to be more evidence throughout the paper of how this was applied and underpinned the findings.

In the interest of simplification, we have removed reference to Cognitive Task Analysis. As the reviewer points out in the comment #11, while we structured our interview schedule on cognitive task analysis the results presented in this paper are the result of the thematic analysis of the interview data. Please see adjusted methods section:

Line 136-142: "*The qualitative approach underpinning the study was reflexive thematic analysis[5]. This approach enabled the research team to co-construct meaning from the participants responses*

through their 'lens' as clinicians and researchers with backgrounds in social science, physiotherapy, orthopaedic nursing and sarcoma surgery and generate themes that could inform patient care in future crises. Data were collected through semi-structured interviews to facilitate rich understanding of surgical decision making in each participants' unique context."

3. The authors specify that this was a snowball sample but they then specify that an email invitation was sent from the lead investigator so it sounds more like a convenience sample. It needs to be clear what sampling method was used and if this was a convenience or purposive sample, details need to be presented on the criteria the lead investigator used to select the surgeons to invite. As there was a process of selection, some reference to bias is needed as a limitation in the discussion.

We used a combination of convenience and snowball sampling to achieve our target for diversity. Please see clarification:

Line 153-156: "*We started with a convenience sample of drawing on links between the lead investigator and an international network of limb salvage surgeons. We then used snowball sampling to identify and recruit additional surgeons practicing in diverse settings that were in different phases of the first wave the COVID-19 pandemic".*

4. Eligibility criteria for the surgeons – how was 'senior surgeon' defined?

We have removed reference to 'senior surgeon' and specified our inclusion of surgeons more broadly:

Line 157: *To be eligible for the study, surgeons had to be i) specialist sarcoma surgeons*

Please note that all sarcoma surgeons are considered specialists in their field. We have provided additional information about the surgeons' level of experience and clinical context in the participant characteristics table (Table 2).

5. Participants are presented in Figure 1 and Table 1. I do not think it is necessary to present both and as specified above participants should not be presented at individual level because the authors then specify the inclusion of participants as co-authors (although I note there is no UK co-author so clarifying text should be included about this), so anonymity is no longer assured.

We have deleted Figure 1. Please also see the changes we have made to the manuscript to ensure anonymity (see responses to reviewers 1 comment #4 and reviewer 2 comment #13). Please note that there is a UK surgeon on the authorship team (William Aston).

6. It refers to saturation in the abstract, which sounds like it is related to data, i.e., data saturation, but in the main text the authors refer to 'sufficient patterns in the sample'. I am unclear what this latter term means so this should be clarified. As the interviews were conducted in rapid succession, I am sure they are not referring to data saturation as it would not be possible to analyse qualitative data sufficiently to ascertain data saturation in this short time period. This description needs to be clearer and amended in the abstract for accuracy.

We have clarified our definition of saturation:

Line 164-167: "*Recruitment and data analysis were conducted in parallel and recruitment ceased when data saturation was reached (when no new concepts were emerging in subsequent interviews) and we reached out target for diversity."*

Please note that while the interviews were conducted in rapid succession, preliminary analysis commenced on the completion of each interview through debriefing between the two interviewers and memo writing. Interviews were transcribed within two days and analysis commenced through reading and re-reading and preliminary open coding.

7.The number of deaths has been used as a determinant of decision-making but this is not necessarily the driving force. I do not think these data or all the graphs in the supplemental file are relevant to this qualitative study. What I was most interested in was the policy in each country with regards to business as usual and how this was translated at hospital level, i.e., most surgery in the UK was suspended for a period of time with only most urgent cases continuing so the decision-making ability was driven by policy. This did not emerge from the findings, which I felt was surprising.

Indeed, the translation of policy at a hospital level was something we explored in our interviews and analysis. We thank the reviewer for the opportunity to add further detail on this into the main text:

Line 275-292: "*Most participants reported an early establishment of patient triage guidelines that came from government health departments, recommending that all elective, non-emergency surgeries should be postponed to conserve resources. However, the participants explained that some sarcoma cases were more like emergency than elective cases. Being a rare cancer, sarcoma was usually not explicitly mentioned in the guidelines, leaving the decision to 'fall on the surgeon's shoulder':* "*There've been some guidelines issued by the [government health department] regarding wait time for the different cancers. Sarcoma was not part of these guidelines. And this is the frustration - they always rely on your judgment for a final decision. So, the health department don't say don't do cancer surgery or do. They're just saying well, maybe things should be delayed, but it's for the surgeon to judge. So, basically, it always falls on your shoulder" (Participant 03).*

Except for those in settings most impacted by the pandemic, who reported being unable to operate at the peak of the COVID-19 wave, the majority of participants were able to continue operating, with theatre access restricted to the most urgent surgical cases: "We went from four theatres to one that was dedicated to orthopaedic oncology on our operating day as it were. And what that did was it made us be really clear about what would be on those lists, and we had to sit and discuss amongst ourselves what would the priorities be?" (Participant 01).

In addition, we have added extra detail into the Supplementary Table 2 under the columns titled 'Health system context' and 'Hospital/clinical context'. We have also reflected these changes in our Figure.

8. Tables 1 and 2 are at individual level and should be collapsed to provide a summary of participants collectively.

We have removed the participant numbers from Table 1 to enhance anonymity. We have also collapsed Table 2 (below) to present aggregate data only (ranges and percentages).

Table 2: Participant characteristics

Characteristic	Percentage participants (%)
Experience (years)	
<10	22.2
11-20	33.3
21-30	38.9
>30	5.6
Time at institution (years)	
<10	38.9
11-20	33.3
21-30	11.1
>30	16.7
Department surgeries*	
<250	50.0
250-500	33.3
501-1000	11.1
>1000	5.6
Public/private/mixed patient load	
Public	44.4
Private	0.0
Mixed	55.6

* Number of orthopaedic oncology surgeries team performs per year (pre-COVID-19)

9. Participant 6 was not really eligible to participate and was excluded in the analysis so the text should be altered to reflect 17 participants not 18.

Indeed, while Participant 6 met our inclusion criteria at the time of recruitment and was interviewed, they did not report a unique decision related to sarcoma surgery during the pandemic due to their redeployment. We have included the following detail in the text:

Line 219-223: *The single participant who did not describe a unique decision (Participant 06), had been redeployed to non-oncology clinical areas since the start of the pandemic. Therefore, the qualitative themes presented below relate to the 17 participants who reported unique decisions related to sarcoma surgery during the pandemic.*

10. Figure 2 does not reflect the themes specified in the text at the beginning of the findings.

We have adjusted Figure 2 so that the blue boxes are consistent with the thematic headings, and deleted Figure 1 which the authors agree did not add to the paper. We have also added health system factors to the figure to reflect changes made throughout the manuscript and supplementary data.

11. It is unclear in the description of the methods of analysis how this was guided by the cognitive task analysis framework. It reads as standard thematic analysis but I would have thought the starting framework if using CTA would be focused on information about the knowledge, thought processes, and goal structures that were needed to carry out a task. The absence of this link to CTA is therefore evident in the findings which do not reflect this form of analysis.

Please see our response to reviewer 2, comment #2.

12. As noted above, the findings are quite descriptive, do not explain the decision-making processes and the quotes do not illuminate the text merely repeat what has been specified in the text. There

needs a deeper level of analysis to lift the findings from the individual level to deliver an understanding of how surgeons as a whole made these decisions. The interview schedule indicates that there are some valuable and rich data that could provide a more developed understanding but the policy and system-level data that would definitely have influenced decision-making do not emerge in these findings.

Our interviews with each surgeon lasted on average 60 minutes yielding a very rich data set. Unfortunately, it is not possible for us to capture this richness in a single manuscript. In response to this valuable review, we have focused the aim of this paper to describe the decisions surgeons are faced with and the factors influencing these decisions.

We agree that it would be useful to include some detail about the policy and system level data influencing decisions. Further details outlining health system and policy impact on decision may be the focus of future analysis. However, please find the inclusion of an additional column addressing health system and policy context in supplementary Table 2 and additional detail in the main text:

Line 275-292: *Most participants reported an early establishment of patient triage guidelines that came from government health departments, recommending that all elective, non-emergency surgeries should be postponed to conserve resources. However, the participants explained that some sarcoma cases were more like emergency than elective cases. Being a rare cancer, sarcoma was usually not explicitly mentioned in the guidelines, leaving the decision to 'fall on the surgeon's shoulder': "There've been some guidelines issued by the [government health department] regarding wait time for the different cancers. Sarcoma was not part of these guidelines. And this is the frustration - they always rely on your judgment for a final decision. So, the health department don't say don't do cancer surgery or do. They're just saying well, maybe things should be delayed, but it's for the surgeon to judge. So, basically, it always falls on your shoulder" (Participant 03). Except for those in settings most impacted by the pandemic, who reported being unable to operate at the peak of the COVID-19 wave, the majority of participants were able to continue operating, with theatre access restricted to the most urgent surgical cases: "We went from four theatres to one that was dedicated to orthopaedic oncology on our operating day as it were. And what that did was it made us be really clear about what would be on those lists, and we had to sit and discuss amongst ourselves what would the priorities be?" (Participant 01).*

We have also added the health system domain to Figure 1.

13. There is repetition of quotes in the supplemental table and in the text, as noted earlier – it would be better to present quotes according to theme to illuminate the findings rather than at individual level because of the risk to confidentiality.

The authors agree that in its submitted form, there were issues with protecting identity and confidentiality in our paper. We have removed participant numbers from the epidemiology data table (Table 1) and now collapsed the participant demographic table (Table 2) to only show aggregated data. The use of participant numbers (e.g in the supplementary Table 2) are now not identifiable. The authors believe that providing example quotes from all anonymous participants adds value to our study.

Supplementary Table 2 now also presents quotes according to the themes specified in the main text and we have removed any instances of repetition of quotes in the main text.

14. The theme ‘Duty of care’, how was this influenced by hospital governance and national policy? Not going in to work just because you are older was not an option in the NHS: all who could work and were not on the government shielding list were required to work.

As also suggested by reviewer 1, we have provided added contextual information about the health system, hospital governance and national policy into supplementary Table 2 and into the text. Please see response to comment #12.

15. I find it interesting that there was nothing about the patient involvement in the decision-making process. Do surgeons make decisions about treatment arbitrarily without consulting the patient?

Evidence from the field of crisis medicine suggests that in times of crises, decision making in medicine shifts from a model of shared decision making to a more unilateral doctor-driven model of decision making. In our study, the participants arrived at the least-worst decision in consultation with their patients. Please see additional comments to emphasise this shift:

Line 300-302: "*Deviating from previous best practice, particularly in order to benefit the 'collective good', could pose a threat to the therapeutic relationship between surgeons and their patients which had been built on a foundation of shared decision-making"*

Line 360-363-381: "*Participants faced with a lack of certainty about 'what was going on', limited resources, and a potential threat to self, engaged in least-worst decision-making where none of the options were perceived as 'ideal', and the participants settled on the least-worst option at that point in time for each specific patient."*

Line 382-384*: "While neither option is 'ideal', the surgical oncology team* and the patient *decided that the worst option would be to 'not reach the finish line' and so the second option was selected as the 'least-worst'"*

16. Table 4 needs to identify which parts of this are specific to a pandemic and which are part of the normal decision-making process.

As suggested by reviewer 1, we have linked strategies identified in Table 4 to each theme identified in our data and therefore are specific to the pandemic. We have amended the title of the Table to more accurately reflect this, which now reads:

Table 4. "Suggested strategies to support surgical decision-making during COVID-18 and future crises"

17. Much of the supplemental data is not relevant – the authors have not showed any link either in their data or from elsewhere between epidemiology and decision-making. It is also unclear why the USA was split into city and the other countries are not; the UK was London, which had a different rate of infection than other parts of the country at the time of the study.

We did not set out to demonstrate a link between the epidemiological data and decision making. Rather, the data was included as a point of interest to show the point along the pandemic trajectory that the interviews were conducted. Our data demonstrate that around the world, both COVID numbers and deaths varied greatly from country to country. Despite this variation we observed common themes among the experiences of the surgeons who participated in our study. We are happy to be guided by the editor as to whether or not to include the epidemiological data as a supplement. We have also included the following detail:

Line 223-225: "*Despite being in different phases of the pandemic (see Supplementary Material), the key themes identified were common to the experiences of all 17 participants. Instances where diverse experiences occurred are reported within the description of each theme below".*

We understand that different locations within the USA and UK experienced different rates of infection, however national data was not available from our data source (Johns Hopkins University Coronavirus Resource Centre), we were therefore only able to collect state/city level data for participants based in the UK and the USA.

VERSION 2 – REVIEW

REVIEWER	Hobusch, Gerhard Medical University of Vienna, Department of Orthopaedics
REVIEW RETURNED	14-May-2021

GENERAL COMMENTS	Authors have answered the reviewers´ queries thoroughly and adapted the text and tables accordingly. The manuscript is good to read, especially since the themes gained consistency over the whole text. This study increases the awareness of problems that may be faced in sarcoma treatment when a huge crisis ends up in limited medical resources. Although the study conceptualizes similar global experiences, the study opens the eyes for individual topics that may differ around the world. Interesting could be a follow-up study when things have normalized again about lessons learned from crisis in a re-calmed mindset. Apart from topics that may not to be changed in any crisis other topics like interconnecting with other oncologic disciplines or even with foreign colleagues to share thoughts and decisions in time when needed may be worthy of improvement.

REVIEWER	Taylor, Rachel University College London Hospitals NHS Foundation Trust, CNMAR
REVIEW RETURNED	16-May-2021

GENERAL COMMENTS	Thank you for asking me to re-review this manuscript reporting the impact of the pandemic on sarcoma surgeon's decision making. I thank the authors for making corrections based on my comments, which have mostly been addressed, although there are a couple of points requiring further clarification and the authors have raised a comment of particular concern that should be addressed in the discussion. The point of concern relates to the response to my point 15 about shared decision making or lack of, based on this being a 'field of crisis medicine'. I agree that we were delivering care in a challenging time but outside of COVID-care, the delivery of services that were allowed to progress in the UK were not based on a crisis model, more a modified version of care. The authors may want to look at the case of Montgomery versus Lanarkshire, which has resulted in updated guidance from the GMC about shared decision and the fact this is "fundamental to good medical practice". This guidance was published as we left one wave and entered another so some reflection on this in the discussion is warranted, i.e., how can surgeons adopt a model of shared decision making in a challenging circumstance. Minor comments: Table 4 needs correcting to refer to COVID-19 not 18, and I will leave for the editor to make a judgement about the epidemiology information in the supplement because it really does not add anything to this paper in my viewpoint and in fact, the information I would find particularly helpful, which has not been addressed sufficiently is the Government response to existing services in each country. I appreciate they included quotes in the table from surgeons but rather than the perspective of the surgeon, it would be more helpful to know what each

	Government's guidance was with regards to maintaining surgical services.

VERSION 2 – AUTHOR RESPONSE

Minor Revision

Life or limb. An international qualitative study on decision making in sarcoma surgery during the COVID-19 pandemic

Reviewer 1

Authors have answered the reviewers´ queries thoroughly and adapted the text and tables accordingly. The manuscript is good to read, especially since the themes gained consistency over the whole text. This study increases the awareness of problems that may be faced in sarcoma treatment when a huge crisis ends up in limited medical resources. Although the study conceptualizes similar global experiences, the study opens the eyes for individual topics that may differ around the world. Interesting could be a follow-up study when things have normalized again about lessons learned from crisis in a re-calmed mindset. Apart from topics that may not to be changed in any crisis other topics like interconnecting with other oncologic disciplines or even with foreign colleagues to share thoughts and decisions in time when needed may be worthy of improvement.

Authors' Response:
We thank reviewer 1 for their time in providing insightful feedback on this manuscript.

Reviewer: 2
Thank you for asking me to re-review this manuscript reporting the impact of the pandemic on sarcoma surgeon's decision making. I thank the authors for making corrections based on my comments, which have mostly been addressed, although there are a couple of points requiring further clarification and the authors have raised a comment of particular concern that should be addressed in the discussion.

1. The point of concern relates to the response to my point 15 about shared decision making or lack of, based on this being a 'field of crisis medicine'. I agree that we were delivering care in a challenging time but outside of COVID-care, the delivery of services that were allowed to progress in the UK were not based on a crisis model, more a modified version of care. The authors may want to look at the case of Montgomery versus Lanarkshire, which has resulted in updated guidance from the GMC about shared decision and the fact this is "fundamental to good medical practice". This guidance was published as we left one wave and entered another so some reflection on this in the discussion is warranted, i.e., how can surgeons adopt a model of shared decision making in a challenging circumstance.

2. Minor comments: Table 4 needs correcting to refer to COVID-19 not 18, and I will leave for the editor to make a judgement about the epidemiology information in the supplement because it really does not add anything to this paper in my viewpoint and in fact, the information I would find particularly helpful, which has not been addressed sufficiently is the Government response to existing services in each country. I appreciate they included quotes in the table from surgeons but rather than the perspective of the surgeon, it would be more helpful to know what each Government's guidance was with regards to maintaining surgical services.

Authors' Response:

1. We thank reviewer 2 for providing us with these important resources. We have considered these and incorporated commentary to discuss shared decision making under the discussion heading: 'Least-worst decision-making and the context of limited resources.

Line 451-457: *"In the place of shared decision-making, a utilitarian model may emerge where decisions are made to be equitable for the greater 'collective' good. In this model, the patients most in need, who require the most resources, are the least likely to receive treatment. Guidelines have been published by the General Medical Council (GMC) stating that shared decision-making is a fundamental component of good clinical practice. Therefore, surgeons should be supported to continue to adopt a model of shared-decision making even in the most challenging of circumstances."*

Line 463-474: *"While not on the front-line of the pandemic, surgeons have a responsibility to 'steward' limited resources to benefit the greatest number of patients. Medical associations have recognised that decision-making under these conditions can be 'ethically challenging' and may conflict with doctor's 'moral intuitions'[14]. Since data were collected for this study during the first phase of the pandemic, the GMC have published recommendations for doctors who face making challenging decisions about how to prioritise access to care within resources constraints. These recommendations include; taking account of local and national policies that set out criteria for accessing treatment; basing decisions on clinical need and likely effectiveness; taking account of patients wishes and expectations whilst also being transparent about decision-making processes and keeping a record of decisions made and reasons for them[15]. Most importantly, and also reflected in our data, is that decision-making in challenging situations should not rest with individual clinicians, rather, support from colleagues and multidisciplinary teams should be sought[13, 15]."*

2. We have corrected the typing error in Table 4 and amended COVID-18 to COVID-19. Our study was conducted from the perspective of surgeons and our inclusion of quotes in the table related to Government responses is consistent with our approach. We are happy to defer to the editor's decision regarding the publishing of the epidemiological data.