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

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ABSTRACT

Objectives The COVID-19 pandemic is unprecedented as a global crisis over the last century. How do specialist surgeons make decisions about patient care in these unprecedent times?

Design Between April and May 2020, we conducted an international qualitative study. Sarcoma surgeons from diverse global settings participated in 60 min interviews exploring surgical decision making during COVID-19. Interview data were analysed using an inductive thematic analysis approach.

Setting Participants represented public and private hospitals in 14 countries, in different phases of the first wave of the pandemic: Australia, Argentina, Canada, India, Italy, Japan, Nigeria, Singapore, Spain, South Africa, Switzerland, Turkey, UK and USA.

Participants From 22 invited sarcoma surgeons, 18 surgeons participated. Participants had an average of 19 years experience as a sarcoma surgeon.

Results 17/18 participants described a decision they had made about patient care since the start of the pandemic that was unique to them, that is, without precedence. Common to 'unique' decisions about patient care was uncertainty about what was going on and what would happen in the future (*theme 1: the context of uncertainty*), the impact of the pandemic on resources or threat of the pandemic to overwhelm resources (*theme 2: limited resources*), perceived increased risk to self (*theme 3: duty of care*) and least-worst decision making, in which none of the options were perceived as ideal and participants settled on the least-worst option at that point in time (*theme 4: least-worst decision making*).

Conclusions In the context of rapidly changing standards of justice and beneficence in patient care, traditional decision-making frameworks may no longer apply. Based on the experiences of surgeons in this study, we describe a framework of least-worst decision making. This framework gives rise to actionable strategies that can support decision making in sarcoma and other specialised fields of surgery, both during the current crisis and beyond.

Strengths and limitations of this study

- ► While task forces have mobilised to establish recommendations for patient prioritisation during COVID-19, and survey studies have explored the impact of COVID-19 on patient care, our study is the first to describe *how* clinical leaders make decisions at this unprecedented time.
- ► We applied a robust qualitative research methodology to uncover themes that pervaded the thinking of sarcoma surgeons in their decision making during COVID-19 and the impact of their decision making on centre-based multidisciplinary care.
- ► We included teams from 18 diverse international sites, at various points in the first wave of the pandemic, to understand if there was commonality in response and how this information would help to inform future strategies for the inevitable second and subsequent waves.
- ► The use of 'snowball sampling' to recruit the participants who were also invited to join the authorship team raises the potential that social desirability forces influenced interview responses.

INTRODUCTION

In the last century, natural disasters have typically been regional (eg, Ebola, Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS)). The global nature of the current COVID-19 crisis makes it unprecedented as a pandemic in our lifetimes. How can we make the best decisions for our patients in these unprecedented times is a question at the forefront of clinicians minds the world over.

In naturalistic decision-making environments, pattern recognition helps to select optimal courses of action and predict outcomes.[1] Failure to recognise a pattern from previous experience or training,[2] in unfamiliar circumstances such as during a

once-in-a-life time pandemic, can dramatically accentuate the complexity of healthcare delivery for frontline clinicians. By identifying the variety of decisions that experts have to make during a crisis, we can gain insight into the skills needed and strategies employed to successfully work through critical problems. 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, natural disaster or pandemic.

The aim of this study was to investigate how expert sarcoma surgeons make decisions about the care of their patients during the COVID-19 pandemic. Sarcoma care is highly time dependent, resource intensive and combines the multidisciplinary approaches of diagnostics, surgery, chemotherapy and radiotherapy.[3] Left untreated, limbs are lost at best, and the disease is fatal at worst.[4] Encompassing the three priority areas of timing of treatment, integrating adjuvant therapies and selecting the appropriate surgical procedure, sarcoma surgery is an ideal context to study decision making as the findings will be applicable to other areas where surgery is the pivotal option.

Adopting a qualitative approach, we explored two specific research questions: what decisions do sarcoma surgeons have to make along the patient journey during COVID-19 and what cues (ie, relevant items of information) and rules are associated with each decision? We aimed to develop a framework that specialist teams in other fields could learn from and apply in practice, both during this pandemic and in future crises.

MATERIALS AND METHODS

Study design

In this study, we used a qualitative approach to study the processes that occur beneath the visible surface when expert sarcoma surgeons make decisions about patient care, not only *what* difficult decisions expert surgeons were faced with, but more importantly, *how* they made these decisions. The qualitative approach underpinning the study was reflexive thematic analysis.[5] This approach enabled the research team to coconstruct 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 semistructured interviews to facilitate rich understanding of surgical decision making in each participants' unique context. Information on the study timeline is presented in online supplemental figures 1 and 2.

Patient and public involvement

No patient involvement.

Study setting

This was an international study involving 18 centres, representing each continent (see table 1).

Participants

We sought to include surgeons from each continent, practising in a range of locations at different points in the pandemic. This is consistent with best practice in qualitative research that seeks to capture a range of diverse voices, rather than an average or single 'representative' voice. We started with a convenience sample, drawing on links between the lead investigator and an international network of limb salvage surgeons. We then used snowball sampling[6] to identify and recruit additional surgeons practising in diverse settings that were in different phases of the first wave the COVID-19 pandemic. To be eligible for the study, surgeons had to be: (1) specialist sarcoma surgeons and (2) willing to participate in a 1-hour interview over a video conferencing platform. Participating surgeons were invited to join the authorship team and contribute to the interpretation of data and writing of this manuscript. Twenty-two surgeons were invited to participate via an email invitation from the lead investigator. Email invitations also included a study protocol that identified the occupation and role of each of the interviewers (SB and PO). Of these, 18 consented to participate, two did not respond, one passed the study details on to a colleague working in the same country without providing a reason for declining and one surgeon declined to participate. 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.

Data collection

Data from the Johns Hopkins University Coronavirus Resource Centre, which included total confirmed COVID-19 positive cases and deaths in each country, were tracked in each participant's region and country from the inception of the study (4 April 2020) until the conclusion of the study (7 August 2020).Timing of participants' interviews were recorded on each of the corresponding COVID-19 graphs (see online supplemental material 1 and figures 3–18) to provide context to their responses in relation to the severity of the pandemic at the time of interview. Further context was provided by general information about the impact of COVID-19 on each surgeon's specific health service (number of COVID-19 cases in their institution), the participant's sex, years of experience as an orthopaedic oncology surgeon and number of oncology patients treated in the past year.

Individual interviews were conducted by teleconference between 24 April and 19 May 2020. Interviews lasted 60 min and were audio-recorded for transcription purposes. These were anonymised and kept confidential from other participants. The interviews and data analysis were conducted by SB, a female qualitative researcher and musculoskeletal clinician (physiotherapist), supported by PO'B, a female social scientist. Interviewers engaged in a researcher reflection at the conclusion of each interview and also recorded field notes. In the interviews, participants were asked to think of a patient that they

Table 1 Snapshot of COVID-19 context at time of interviews

	Worldwide*		Country			Region		
Interview date	Cases	Deaths	Place	Cases	Deaths	Place	Cases	Deaths
24 April 2020	2 719 522	191 228	Australia*	6657	76	Victoria‡	1342	16
24 April 2020			USA*	869 172	49 963	Pennsylvania*	38 379	1724
24 April 2020			Canada*	43 286	2241	Quebec (Montreal)*	21 838	1243
25 April 2020	2 812 557	197 506	USA*	905 333	51 949	New York*	271 590	21 411
25 April 2020			India*	24 530	780	Maharashtra¶	6430	283
27 April 2020	2 981 592	206 803	Singapore*	14 423	12	Singapore*	14 423	12
28 April 2020	3 052 245	211 350	UK*†	145 993	25 302	London**	27 112	5416
29 April 2020	3 126 806	217 555	Japan*	13 736	394	Saitama¶	851	30
29 April 2020			Nigeria*	1532	44	Lagos¶	844	19
30 April 2020	3 206 333	227 847	Turkey*	117 589	3081	Anatolia††	–	–
1 May 2020	3 267 867	233 560	Nigeria*	1932	58	Oyo¶	23	2
6 May 2020	3 677 165	257 454	Argentina*	5020	264	Buenos Aires Provence¶	1811	103
6 May 2020			Italy*	213 013	29 315	Emili-Romagna¶	26 275	3705
6 May 2020			South Africa*	7572	148	Western Cape§	3609	71
7 May 2020	3 768 535	264 109	Canada*	64 694	4336	Ontario (Hamilton)*	19 910	1560
7 May 2020			USA*	1 228 609	73 431	Minnesota*	9365	508
8 May 2020	3 861 697	269 867	Spain†	256 855	26 070	Madrid¶	64 333	8552
19 May 2020	4 819 959	318 833	Switzerland*	30 597	1886	Vaud¶	5503	389

*https://coronavirus.jhu.edu/map.html
†https://www.worldometers.info/coronavirus/#countries
‡https://www.covid19data.com.au/
§https://sacoronavirus.co.za
¶https://en.wikipedia.org/wiki/Template:COVID-19_pandemic_data
**https://coronavirus.data.gov.uk/details/deaths
††No data publicly available.

had treated during the pandemic and were prompted to think about the decisions they had to make throughout the patient's care (see online supplemental table 1).

Data analysis

Transcribed interview data were analysed using an inductive (data derived) thematic analysis.[5] This began with 'open coding' in which concepts were identified in the interview data related to: (1) the decisions about patient care and (2) the cues and rules associated with these decisions. Two researchers (SB and PO'B) conducted open coding in duplicate, and a preliminary list of codes (coding framework) was compiled through consensus discussion. This coding framework continued to be refined through application to subsequent transcripts until it captured all relevant raw data. The refined framework was then applied to all 18 transcripts using the software NVivo (QSR international). Codes were grouped thematically, and preliminary themes were described following group discussion among the core research team in which alternative interpretations of the data were explored and debated. The core research team comprised of the two interviewer/analysts (SB and PO'B), the project lead and academic surgeon (PFMC), and an epidemiologist with content expertise in surgical decision making (MMD). Themes were then shared with the participating surgeons to check that they were an accurate interpretation of their experiences. Final themes were presented in narrative form and depicted in a figure (figure 1).

RESULTS

Eighteen sarcoma surgeons from 14 countries (table 1) were interviewed between April 2020 and May 2020. Participants had on average 19 years experience as a sarcoma surgeon. Ten participants had a mixed public and private caseload (n=10), with eight operating only in public institutions (table 2).

At the time of the interviews, centres in Argentina, Canada, India, Japan, Nigeria, South Africa, Singapore, Turkey, the UK and the USA were on the ascending part of the first wave of the pandemic. Centres in Australia, Italy, Spain and Switzerland were reaching or on the plateau of the first wave (see table 1).

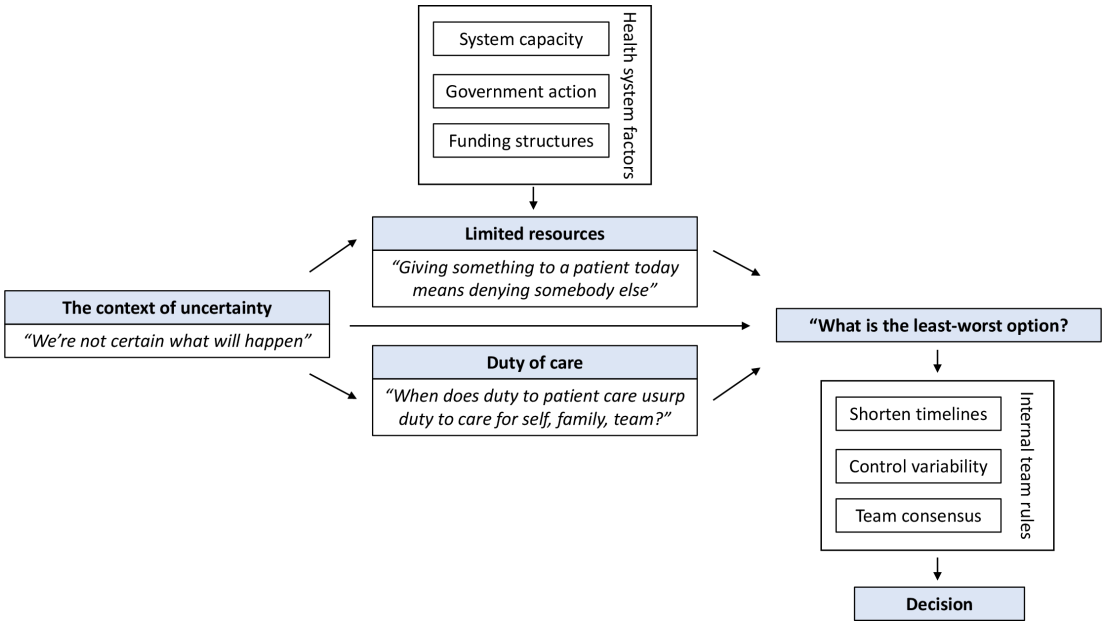

Figure 1 Framework of least-worst decision making in orthopaedic oncology care during COVID-19.

In total, 17 of the 18 participants described a decision they had had to make about patient care during the pandemic, which was unique to them; that is, they perceived there was no evidence or previous experience to draw on in making the decision (see box 1). 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 further relate to the 17 participants who reported unique decisions related to sarcoma surgery during the pandemic. Despite being in different phases of the pandemic, 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.

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).

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*). These themes are described further, supported by quotes indexed by the participant number. Further contextual information for each participant is presented as additional quotes (see online supplemental table 2).

The context of uncertainty

The dynamic nature of the pandemic made it challenging for the participants to determine 'what is going on' and 'what will happen if…'. Without these key 'puzzle pieces', decision making was characterised by sentiments of uncertainty.

Participants emphasised the almost daily changes. Many, particularly those on the ascending part of the first wave, went to work each day not 'knowing what to expect': '*What has changed now is that on a daily basis I don't know what to expect*' (participant 09). For those in leadership, the 'constantly changing' situation made it difficult to implement protocols and processes for their teams: '*You set in a protocol, you set in a system, that needs to be changed a week later just because the situation has changed*' (participant 05).

Ambiguity about 'what was going on' made it challenging for participants to model outcomes of any course

Box 1 Examples of 'unique' decisions

Participant 01: a decision is made to condense the course of radiotherapy into a shorter timeframe, accepting a reduction in the total dose and potential for greater side effects so that a patient can get to surgery sooner without becoming infected or the surgical team becoming infected.
Participant 02: a decision is taken to delay major surgery for a patient requiring an amputation that would take a lot of time and hospital resources and instead give additional chemotherapy to 'get further out of the pandemic' despite the risk that the tumour does not respond and potentially spread to the patient's lungs.
Participant 03: a decision is made to condense the course of radiotherapy as the radiation oncology staff have been told to reduce their case load, but this means that the surgeon has to find a spot for surgery a month earlier than anticipated, and it is possible the hospital will not have capacity by then.
Participant 04: a decision is made to give another round of chemotherapy to a patient who tests positive to COVID-19 just before surgery even though the patient is severely immunocompromised because a positive patient may struggle postoperatively and the theatre team would be at risk of exposure during surgery.
Participant 05: a decision is taken to defer surgery for large tumours that involve resource-intensive plastic surgery for a period of 8–10 weeks in the hope that the pandemic situation improves.
Participant 07: a decision is made to perform local flap procedures instead of large free flap procedures that require specialist services from a COVID-19 'hot-spot' hospital, as patients will be able to undergo chemotherapy for a couple of months until there is more capacity, even though local flaps may break down and need salvaging later.
Participant 08: a surgeon who is also a medical oncologist decides to act conservatively when treating patients with chemotherapy to reduce patients' vulnerability to infection.
Participant 09: a decision is made to operate on a patient with sarcoma, but the anaesthesiologists and scrub nurses are scared of doing anything that is not an emergency. So the hospital authorities intervene to help convince staff that this was an emergency case and without surgery the patient had a poor chance of survival.
Participant 10: a decision is made not to give preoperative radiotherapy, but instead to operate first and then give postoperative radiotherapy to reduce the risk of contamination by having to come regularly into a 'pandemic hospital'.
Participant 11: a surgeon who trained as a medical oncologist but stopped administering chemotherapy many years ago because of poor patient outcomes decides to administer chemotherapy to a patient who cannot access alternative chemotherapy services because of travel restrictions.
Participant 12: a surgeon in the 'at risk' category for COVID-19 who receives pressure from their own family to stop operating decides to operate on a young child whose COVID-19 status is unknown because the patient's family would not consent to a junior surgeon performing the surgery.
Participant 13: a decision is made to delay surgery and continue chemotherapy for patients with sarcoma.
Participant 14: a decision is made to put a patient with a large fracture requiring amputation in balanced traction and treat with chemotherapy when their surgery is cancelled because theatre staff went home to isolate. However, the oncology ward will not have a patient in traction, and chemotherapy cannot be given on the orthopaedic ward.
Participant 15: a decision is made to bring surgery forward rather than wait for skin to heal after radiation because the hospital was starting to be closed down and the surgeon worried the patient would be 'shut out'.
Participant 16: a decision is made to give radiation to a young child following a disfiguring amputation with a poor prognosis because 'we have gone this far, we don't want to stop'. However, the hospital will not allow both the child's parents to be present at the same time so the parents resort to lying to get past the 'guardians at the door'. The surgeon, charged with protecting others in the hospital, must tell the parents to stop this.
Participant 17: a decision is made that surgeries cannot go ahead because there are no more places available in the intensive care unit.
Participant 18: a decision is taken to operate first rather than give radiotherapy for a painful, growing tumour because of difficulties organising referral to radiotherapy in the early phases of the pandemic.

of action. The majority recounted the difficulty of planning a timeline for adjunct therapy and surgery when it was unclear what impact COVID-19 would have on hospital capacity and resources over time. In the following extract, a participant recounts how their hospital began to shut down in the early phases of the pandemic in preparation for the 'COVID-19 flood'. The participant refers to the 'radiation window' as the ideal time to schedule a strategy of preoperative radiotherapy and surgery but expresses concern that by the time this window is reached, hospital resources may no longer be available for non-COVID-19 patients: '*They were starting to close down the hospital and I was worried they were going to shut him out and delay his surgery beyond the radiation window, which would be really tragic*' (participant 015). Several participants also recounted unforeseen disruptions that occurred during the surgical window that prompted life-saving surgery to be cancelled. These included travel restrictions, self-isolation of theatre staff and patients contracting COVID-19 just prior to surgery. The inability to predict when life-saving surgery would be able to go ahead made it difficult for participants to decide if and how to adjust the treatment plan. In the case of contracting COVID-19 just prior to surgery, a lack of evidence and clinical precedence meant participants were uncertain about how the virus would affect patients and impact on the surgical timeline, as recounted by this participant: '*She's currently asymptomatic, but we're uncertain if she'll never be symptomatic from the disease, or if she's about to blossom a very significant respiratory illness*' (participant 016).

Limited resources

Making decisions was further challenged by the shift in the institutional model of care as the pandemic overwhelmed, or threatened to overwhelm, available resources. Shifting away from a model of shared decision making, institutions adopted a more utilitarian model of care in which resources had to be shared equitably with the greater 'collective good' in mind. Consequently,

many participants were required to act as 'stewards of resources'.

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, and 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 judgement 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 among ourselves what would the priorities be?*' (participant 01). In the following extract, a participant recounts how the need for resource stewardship meant that surgical procedures requiring 'disproportionate' hospital resources were automatically deferred to conserve resources for the impending influx of COVID-19 patients: '*So we haven't done major pelvic surgery because we don't want to have patients who are likely to require intensive care for a longer period of time. We also don't want to have patients who may require blood products beyond a certain known limit*' (participant 05).

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 that had been built on a foundation of shared decision making. In the following extract, a participant in the peak of the first COVID-19 wave recounts their experience of 'informing' the parents of a young child that surgery cannot proceed due to limited resources: '*It's not because I don't want to operate or don't want to take good care of your child. But we are in the middle of a situation that's scary and we don't know enough. At the moment this is the best that we can do. This is genuinely what we think is best for your son, for our hospital, for the other patients. We have resources that are limited. We have to share those resources with other patients. And so if your son cannot be operated on now, we may devote this opportunity to somebody else*' (participant 04). This extract captures the tension between acting in the best interests of the patient, while sharing resources justly with all patients requiring care. Participant 04 coped with this tension by rationalising the decision as 'beyond their control': '*It makes me feel bad, but I think at personal level it sort of relieves me, because it's beyond my reach. It's not because I don't want to. It's not because I have done a bad operation and my margins should have been wider. It's not something that I'm in control of. I'm not in control of this. It's above me*' (participant 04).

Other participants reframed the experience of 'resource stewardship' as 'balancing a more holistic picture', perceiving it as an opportunity to reconsider what is really necessary in patient care: '*In a pre-COVID era, there was no restraint. You could throw what you wanted at the patient. Today, giving something to the patient means denying somebody else something else, or you are adding further to the patient having to travel… And so you are balancing it in a more holistic picture - how much quality am I actually adding to the patient? Hopefully it will make some of us think about what is really important and how we should be looking at things*' (participant 05). This participant practising 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).

Duty of care

While committed to the ethical principle of beneficence (acting in the interests of others in need), fulfilling duties to patient care increased the participants' personal risk of being exposed to the virus and transmitting the virus to family members. Many older participants, who were themselves more vulnerable to the virus, experienced pressure from family members to stay away from active duty at the hospital. For these participants, deciding whether or not to operate on a patient involved a difficult trade-off between one's ethical duty to care for patients and one's ethical duty to care for oneself and one's family. This is captured in the following extract where a participant recounts their experience of caring for child in the early phases of the first COVID-19 wave when availability of virus testing was low: '*I received a lot of pressure from my family saying, "don't go to that surgery, you are going to be contaminated by the virus," and another pressure from the father's patient, saying to me, "No, doctor. I need you to be the surgeon." So it was a big deal*' (participant 012). Several participants drew on war-time metaphors to describe this 'ethical trade-off', finding meaning and purpose in being able to contribute to the 'war effort': '*So we are really waiting for the big wave and god knows if it's going to kill us or we're going to be swamped with COVID-19 patients. There is a mutual sentiment of, you know, we've got to be strong all together and go through all together…I think it has to do with the type of cancer that we treat… we swear to Hippocrates and this is just in line with that*' (participant 04).

While the participants in this study all continued to provide patient care, several recounted stories of colleagues who had taken time away from patient care to look after their own mental health: '*Everyone handles the*

pressure differently. One of my junior staff members comes from a different city and was really struggling with their mental health. They needed to be with their family at this time, so they asked for a break' (participant 09)

Least-worst decision making

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.

To decide on a least-worst option, participants in all phases of the COVID-19 wave applied common strategies, including: (1) shortening the timeline, that is, preferring short-term over longer-term treatment planning and goals; (2) controlling sources of variability which caused unpredictability, for example, choosing to give a COVID-19-positive patient another round of chemotherapy rather than waiting to see when they would recover from virus to proceed with surgery; and (3) seeking consensus so that 'responsibility' for decision making was shared among members of the surgical oncology team.

In the following example, a participant considers two courses of action: either continue with a standard course of radiotherapy delivered over a 5-week period or collapse the course of radiotherapy into a 2-week period. The participant explains that the first option would optimise the tumour for surgery but would involve more visits to hospital, thus increasing the risk of the patient being exposed to COVID-19. There was also a chance that the pandemic could overwhelm hospital capacity within the 5-week treatment period, resulting in the cancellation of surgery. In the second option, the 'finish line' (ie, surgery) would be reached sooner. However, a reduction in the total dose of radiotherapy could mean that the tumour is less optimised for surgery and the condensed dose of radiotherapy increased the chance that the patient would experience uncomfortable side effects. 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': '*It's a bigger intensity, sometimes greater side effects but not as much of the (radiotherapy) dose is given over a shorter period of time. It means if they're lucky, they get through radiotherapy without becoming infected with COVID-19 or without the surgical team falling out from under them if they became infected. So it's really a balance of providing the best possible care, hoping to reach the finish line sooner than normal*' (participant 01).

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 while 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-19 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-19 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 04).

Participants emphasised the importance of sharing least-worst decisions with the surgical oncology team and disruption to multidisciplinary tumour board meetings added to the experience of uncertainty in decision making for some participants. Institutions 'overrun' by the virus at the peak of the curve, cancelled multidisciplinary tumorboard meetings as all care focused 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'. '*I definitely missed the support of the team and that decision-making process. It gives you an added layer of comfort or reassurance that you are making the right decision. Even if they just agree with you, it's nice that people agree with you and I do miss those ones where it was less obvious. It's definitely been more difficult*' (participant 014).

DISCUSSION

To our knowledge, this is the first qualitative study of surgical decision making during COVID-19. Under 'normal' circumstances (ie, prepandemic), decision making is driven by rational and recognition-primed choices.[7] Having determined 'what is going on', decision makers consider multiple courses of action and select the action that offers a 'superior' outcome.[8] In the abundance of resources, triage is based on the principle of need, with the sickest being the first to receive care.[9] The ethical standard respects the autonomy of the patient and provider, taking into account their preferences through shared decision making.[9] 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. The factors that guided clinical decision making under 'normal' circumstances no longer applied, and a new decision making framework was revealed (see figure 1). Specific, actionable recommendations arising from this framework that may inform patient care in

Table 3 Suggested strategies to support surgical decision making during COVID-19 and future crises

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 among 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 vs community) services, for example, investigations and biopsy. ► Minimise travel to and from treatment centres. ► Broaden network of treatment facilities, for example, radiotherapy and 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.

both sarcoma and other areas of life-saving surgery are presented in table 3 and discussed further.

Least-worst decision making and the context of uncertainty

Combat studies have revealed that decision makers lacking certainty about the outcome of a high-stakes decision identify 'workable' courses of action that match the situation and, committing to an unknown outcome, select the least-worst option at that point in time.[10] Unlike military personnel, surgeons (particularly oncology surgeons) are rarely trained in 'disaster management'.[11] Despite this, the participants in our study applied recognised strategies in least-worst decision making, including shortening timelines, controlling sources of variability and seeking team consensus,[12] within the constraints of changing ethical standards of justice and beneficence principles in patient care. We recommend maintaining multidisciplinary consultations to ensure consensus decision making and support in the context of uncertainty (see table 3).

Least-worst decision making and the context of limited resources

In crisis medicine where resources are limited, the model of care shifts to benefit as many people as possible with available resources.[9] 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. 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 (eg, Australia) experienced reduced access to resources. While not on the frontline 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'.[13] Since data were collected for this study during the first phase of the pandemic, the GMC has 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; and taking account of patients' wishes and expectations while also being transparent about decision-making processes and keeping a record of decisions made and reasons for them.[14] 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.[14 15] Standardising and documenting these ethical principles underlying triage during crisis is likely to help decision makers to manage distress.[9 16] As the participants in our study shifted to a model of 'collective justice', many sought to reduce distress by drawing on the strength of the patient–surgeon relationship, the consensus of a multidisciplinary team approach, applying strategies such as reframing (ie, 'balancing a more holistic picture') and avoiding rumination about decisions beyond their control. Based on the findings of our study, further recommendations to support decision making in the context of limited resources include early establishment of prioritisation systems (see table 3).

Least-worst decision making and the duty of care

While the 'duty of care' was a strong theme in our study, the crisis medicine literature reveals shifting boundaries around the principles of beneficence during a highly contagious pandemic.[17 18] Clinicians have both an ethical obligation to care for their patients *and* themselves, raising the question: when does the duty to care for one's patients usurp the duty to care for oneself, and by extension, one's family?[19] Such ethical obligations can be viewed as 'protected values', that is, values that are held 'sacred', more important than others and are not easily traded-off.[20] Being forced to make decisions that violate protected values have the potential to cause 'moral injury'.[21] While many of the participants in our study found meaning and purpose in contributing to 'the war effort', recognising the impact of any moral injury and distress, and how to support this, may play an important role in the 'return to normal' post-COVID-19.[21] 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 3).

Design considerations

That the study participants were able to employ strategies to minimise distress may reflect our sampling strategy. It is possible that surgeons experiencing higher levels of distress were more likely to decline participation. Many participants described a range of reactions from members of their surgical teams, including elevated distress and disengagement from clinical work. It is possible that we only interviewed surgeons who were on the other end of this scale. The use of 'snowball sampling'[6] to recruit the participants who were also invited to join the authorship team raises the potential that social desirability forces influenced interview responses. We attempted to minimise this by ensuring that the interviewers were unknown to the participants, by ensuring that interview responses were not shared with any other surgeon on the authorship team and the deidentified reporting of findings. With these assurances in place, participants shared their experiences honestly and openly, as reflected in the interview data (see online supplemental table 2).

Our findings resonate with other papers discussing triage decisions and resource allocation in oncology care and surgery during COVID-19.[22–25] This suggests that our findings have applicability for surgeons practising in settings beyond those captured in our study. A key strength of our study is that we captured a global perspective of decision making in surgical oncology using a rigorous qualitative approach and found commonality in the responses despite surgical teams being at different stages of the first wave of COVID-19. Unlike survey studies exploring the impact of COVID-19 on surgical care (see, eg, refs 25–27), our qualitative approach enabled in-depth, novel insights into *how* surgeons make decisions during COVID-19 in 'real-time'. Participants had the opportunity to challenge/confirm these themes, and there was consensus agreement that the themes presented an accurate interpretation of their experiences. Finally, several guidelines have been published on patient prioritisation during COVID-19 since our interviews (see, eg, refs 22 23 28), and this may have influenced surgical decision making. Subsequent qualitative studies would be useful to capture how surgical decision-making changes over time.

Based on the findings of this unique, international qualitative study, we have identified strategies that may support decision making in sarcoma care both during the current crisis and beyond (see table 3). We suggest that while surgeons have evolved to be resilient, optimistic, self-sacrificing and just, profound anxieties can exist behind this face of professionalism. Establishing a robust, reliable and responsive network that can be used in any moment of peak or unexpected clinical demand would assist surgeons in times of need to leverage the support of their peers around the world.

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Supplementary material

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Table 1. Interview guide

Construct	Example question
Context	Can you please tell me about the current state of COVID-19 where you are? *Can you tell me about the first actions your health service made in response to COVID?
Type of decisions and how they are made	I am going to now ask you to think of a patient you have treated since the start of this crisis. Can you please talk me through their care journey and the decisions you have had to make along the way? Prompts: -Tell me more about the decision you made at time x. -What thoughts were running through your head at the time? -What was your intuition telling you? -How did you feel making that decision?
Factors influencing decision making:	Now we would like to explore in more depth the factors which influence the decisions you are having to make about patient care, starting with the 'bigger picture factors' such as the political climate and health system changes then moving onto factors closer to home
Political factors	Can you give me an example of how the political climate in the context of COVID-19 has impacted on decisions you have made about patient care?
Health system factors	Can you give me an example of how health system responses to COVID-19 have impacted on decisions you have made about patient care?
Health service factors	Can you give me an example of how the response of your health service to COVID-19 has impacted on decisions you have made about patient care?
Team factors	How has the functioning of your team (e.g. the MDT conference) been affected by COVID-19? Can you give me an example of how these changes have impacted on decisions you have made about patient care? As head of the sarcoma service, what unique decisions have you had to make for your team?
Patient factors	Can you give me an example of how your patients are feeling about the COVID-19 crisis? How might this be impacting on shared decision making?
Emotional factors	How are you are feeling about COVID-19? What have your emotional responses been? How might this impact on the decisions you make?
Wrap up	If you could go back in time and give advice to yourself a few weeks ago, what would that advice be? If there is one thing you will take away from this crisis what would it be?

Table 2. Contextual information and additional quotes

Participant number	Health system and institutional context	Impact on case load	THEME 1: The context of uncertainty	THEME 2: Limited resources	THEME 3: Duty of care
01	"There's a lot of politics; governmental politics which we absolutely have to engage with because that's regulated. So I want to treat my patients even if it's - it may not be a malignancy but it may be a really aggressive but benign condition, but I'm told I can't, it's not a category one. And I might feel really fussed about that. You know, there can't be a state of anarchy. For the system to work you just have to play by the rules."	"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?"	"Although we might say 'Oh, maybe it's not too bad', because it's not what we would normally do, you just walk that line of 'Well, let's hope that it will work'. Intellectually it probably will to some degree, but if you're trying to work hard against something that does not have a very good response rate in the first instance, then normally what we want to do is throw everything at it. You don't want to throw just a little bit of things at it, you know? So we're kind of caught. As I said before, we're giving something but we're all shifting nervously because we don't think it's adequate."	"Suddenly we got a call that she found a lump elsewhere. And that required a number of things including investigating these through imaging and then ultimately a biopsy of that lump. Which sounds very straightforward but in a system where both the imaging and biopsy services were also significantly restricted because they also have waiting rooms and they also have people who need to be touched and placed upon imaging tables and all the rest of it, they also have their version of crowd control and all the things that go with COVID. So there was a reduced service availability."	"Just go with it. This is one time it's like swimming, you hate getting wet but you're going to get wet. Just jump in. You know, don't care whether it's going to be cold or hot, just jump in because there is no choice. The circumstances mean there's no choice. And the way you get around your trust issues is you keep talking to me. Keep feeding back. Keep telling me about it. You know, let's work it through together so you're not on your own when you're trying to go on this journey."
02	"Our health system has been extremely proactive. We've been very on top of it. A lot of communication. Everybody's really informed every day. We have PPE. We didn't have enough for everybody initially, but they've been judicious and creative about it. And so I feel like I'm really lucky to work here because our leadership is taking it seriously and the patients' safety is a priority."	"I have operated on sarcoma patients and I've operated on fracture patients - people who have a fracture femur from a metastatic disease. I felt like you can't make that wait. I would say in general I haven't modified my caseload because I maybe haven't had the type of cases that we were talking about the call where you have a big, massive surgery that's going to require a lot of blood or a lot of time and a lot of exposure that may be needed to be put off.. Luckily we haven't had such a crisis with PPE that we can not take care of people. So, we've still been able to give people chemotherapy, give the urgent surgeries, give the radiation."	"You hope that we're not making bad decisions and having people at home where we're not getting to see them or missing something because we're on a telephone or a video and the patient says, 'I'm not coming down there'. If we find out later that we missed something because we didn't get to it soon enough, well, at least we've written that down. I hope I'm doing the right thing."	"People are developing all sorts of re-entry plans...Even though the surgeons are all rearing to go because they've been cleaning their closets, what does that mean about the nurses and the resources? They're spent. Do we have enough PPE for a massive surge? What if we all want to operate eighteen hours a day and Saturdays? Who's going to help us? You can't do that by yourself. Do we have the resources for that? What if the nurses say, 'Look, I'm done. I've been at the end of my ropes. So it's not just about us. It's about can the system manage the re-entry as a whole. Do we have enough equipment that if there's another surge, do we have enough masks?"	"I've not been redeployed so I'm not on that frontline. And I think you also will hear people talk about sort of that guilt of, 'I'm cleaning my closet' and there are other people in the emergency room and in the intensive care units. I'm a leader and I'm a good doctor and I could be helping. They don't need my help right now. But it's sort of like those people are risking their lives a lot more than orthopedic surgeons are. I mean as a field we're not frontline."
03	Every day, every hospital in the area has to send the [government health department] their operating lists. We need to justify the	"Initially they cancelled all surgeries except emergencies and they asked that we select the patient for surgery and even the trauma cases. The effect was that it created a backlog of cancer patients. I do about a case a week at the moment. So	"We were cutting on the radiation therapy regiment, we're doing, you know, five days of treatment instead of twenty-five, that means we do surgery, like, a month earlier instead of when you do. But in six weeks	"What we realise right now is that we've done too much in the hospital system for something that was apprehended, something that was foreseen that did not happen. So we shut down the hospital, we	"There's a level of stress in the operating room, things are not as efficient, as it used to be. You work other people you're not used to work with. People are more stressed. We're trained but when it's

	patients we're doing and they want to monitor. At some point my superior told me that the government thinks we're doing too many surgeries. And there's all the issues of the supplies. Most of the country were not supplied enough in masks, gowns and whatever, Propofol and anaesthetic agents, for the crisis. So everyone was short on the gowns, short on masks and that led to also the justification to cut activities, because if you do surgery you need mask, you need gown. Even we had instruction to cut on the number of team members in the operating theatre. Not having, let's say, two resident, having only one resident, to save a gown and a pair of gloves and thing like that. So this is where we were at some point."	urgent cancer cases that need absolutely do be done within the next couple of weeks or one month. But we've seen a bit less cases than usual, I would say. So maybe patient don't go see their doctors or the tests are not done, so thing have been a bit slow down. But I didn't have to live through catastrophe, so it was not really a big struggle."	they won't be back to normal. So the patient will be coming back to the system earlier than they would. So, we spare the system for a few weeks, you know, the burden of having too many radiation treatment, but the same time we need to find a spot now for surgery a bit earlier."	closed the operating rooms, we closed beds, we sent a lot of people home, secretaries, all research assistants. We do a lot of research. Now we're essentially paralysed... but we didn't want to live to selecting who will live and who will die, so they cut a lot of surgery."	for you, like an anaesthesiologist, they're really at risk at the time of the intubation."
04	And by the time that we were getting ready for surgery, the policy of testing the patient within 48 hours from the day of surgery that has been an important practise. Clearly reflecting the fact that at some point the fear of COVID certainly has overcome the priority of cancer, at least in the broader sense strategically . So the policy was made in place in order to minimise the admission of patients positive for COVID, no matter what the underlying diagnosis was. We have received emails that were saying we're going to restrict	"There is one operating theatre for a moment, and imagine one recovery – and the recovery area, if you imagine a patient that is going through this path from pre-op to operating theatre to recovery area, there are three ventilators available, one in the pre-op area, the patients for some reason cannot breathe. One in the operating theatre where the patient is intubated, and one in the recovery area. And so in order to maximise the availability of ventilators, this has been shut down, all the surgery have been rescheduled in the smaller rooms, and the larger has been kept available for about three to four weeks I would say, for potential use for COVID patients. So that	"There's no precedent to make reference to. And it's a combination of – I don't know if that's more 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."	"An additional caveat is that personal protective equipment, you know, the issue of the year. Do we have enough masks? Do we have enough shields? Do we have enough personal protective equipment? You know, we are solid now. But a month ago, not so much. The hospital leadership reassured us we had supplies for about one to two weeks but – you know, we didn't have routine shields. So that's why anaesthesiology were probably even more exposed back then than now. But what I wanted to know was - if it is life saving surgery do I	"The primary resource is the healthcare workers. So this is important when you mention, you know, protecting your anaesthesiologists. Don't expose them to an unnecessary risk. This is like, you know, the guy next to you. It's like being brother in arms... too many of us got sick, how are we going to run the – how are we going to take care of the patients?"

	immensely the elective surgery, even that this is cancer. Consider additional chemotherapy. Consider any potential strategy to maximise and to bridge this time."	really the difficult issue was to sort of fitting in a much smaller room, with sometimes sizeable cases. I am operating at 50%."		still go and make the plea to the operating committee?"	
05	We are a government hospital, not a private hospital, so that does help. We've not had restrictions in supply of equipment that maybe others have had. So it's a question of whether it's PPE or even routine equipment necessary to run the hospital, for example sanitisers, gloves, ordinary masks, we've been quite fortunate in getting equipment at a fairly – I mean, we have not been as hard hit as what I read in the news, or I get feedback from other colleagues at other institutions. I think that's been an advantage, because we had government authorised suppliers in place, so we've not had issues also about the quality of the equipment that is coming in. Some institutes who have had to ramp up their supply and approach different suppliers have had an issue in the quality of equipment coming."	"We are doing exactly the same now, but it's an issue of one, there is a limited number of patients available to us because of the travel restrictions that I mentioned earlier, so our pool is also shorter. But among that pool we are taking it further, these are the patients that we need to prioritise, these are the patients that can be deferred, or these are the sort of surgeries that possibly may not be there at this time."	"In some of the large tumours where we feel we may require a plastic surgery flap et cetera, these are the patients we have sent for pre-op radiotherapy because then we can safely defer surgery for a period of about eight to 10 weeks and hopefully the situation improves. I mean we're hoping it improves, it may actually worsen and we may be in a worse place than now. But as of today that seems to be the best decision."	"Being a cancer centre, the patients, the leukemias and the lymphomas, et cetera, that require blood much more than in elective surgeries, we've had to decide how we use the blood products that are available to us. Major surgeries that require plastic surgery cover for example flaps that are likely to extend for a long period of time, we've tried to defer because of the staffing issues."	"One of the patients who was operated on turned out to be positive subsequently, and the theatre staff just refused to walk into the theatre the next day, because they felt that they were not given the adequate PPE that should have been given to them."
06	"The government had prepared for this years in advance. Our hospital is a designated Infectious Disease Cente. So referral patterns have changed and the sarcoma cases are being diverted elsewhere."	" So, within the hospital there's medical and surgical divisions, and the medical divisions are still very busy because COVID's a medical condition. Surgical divisions are not so busy, so they've redeployed our manpower towards the emergency, sort of the frontline, screening patients, taking histories, doing swabs."	"Last week there was a thing, because whenever you've got a big lot of COVID cases, you know that 10 days down the road you're going to have a proportion of those who are going to need ICU...So, watch this space, I don't know. Maybe in two weeks' time we'll be manning the new makeshift ICUs or something, I don't know."	"I'm sort of living day by day now. I mean I think there's a lot of things that you realise that you can live without, and I think maybe COVID helps you to work out what is essential to your service and what really isn't."	"Because as the essence of a surgeon, you want sometimes when you've got this whole crisis thing happening, it's harder to do nothing. When you feel like you've got something to do and it's purposeful and it's meaningful I mean, there's a bit of nervousness.. because you don't want to be playing the numbers game. If you get it, I'm young, I'm healthy, I get it, I'm probably not going to get that sick, but you never know. You

					could be that 5% of my age group that still needs ICU care.”
07	"The health system has been split into hot hospitals which are now just COVID hospitals and cold hospitals which try to continue operating, prioritising the patients that need surgery the most. But the whole health system is creaking. Ambulance services and paramedical services are at a massive strain."	"So we’re a totally orthopaedic hospital, so non-medical hospital at all, but we now have a respiratory ward where any COVID positive patients go or are suspected. But we’re able to operate. We’ve all changed our job hands round, but we’re able to operate at pretty much normal sarcoma service in regard to volume and theatre time, access to theatre time, et cetera, going forward."	"Well, when you get to the day of operating, you think, 'All right. What was said in that meeting? Can’t quite remember.' I mean everything is really well documented, so that helps a lot. But it does put just another element of slight doubt or stress in your mind because often, you’re not actually there when the decision is made because you are either doing a list which wouldn’t normally be on or whatever because you’re trying to service that work. So that makes it a bit more difficult."	"We have a plastic surgeon who comes to our site maybe one and a half days a week, but if he was to do a free flap, he wants to do that at his base hospital because they have the expertise, which we don’t necessarily have on our site or enough plastic surgical cover on our site to do that. Currently, on his site, they’ve gone down to one operating list for the whole hospital, emergency operating list for the whole hospital each day, because they just don’t have the capacity or the staff. So that means that if you want to take eight hours of time out to do this complex free flap, that’s not going to happen."	"Sometimes there’s family, 'Oh, don’t come near me. You’ve got COVID,' or whatever because you’ve been in a hospital where you’ve been in contact with them. Kids are like that or whatever and you’re like – and it’s a joke, but it just grates a little bit because then you start worrying again."
08	“[The government] announced some sort of guidelines, and probably most of the hospitals are following the guidelines. And in reality, almost all hospital are doing almost the same things as hospitals in other countries. The national orthopaedic association at the beginning of April, they announced triage of the patients, and tumour cases, malignant tumour cases in the top most category."	"Actually, for the last three weeks, no big difference in terms of my practice number-wise. For the last three weeks, probably I treated three surgical cases, big cases, and I have treated those patients in a similar way... But the number, the number of patients referred to us is now decreasing. But I think lipoma cases almost no. So, for the last one month, I've never seen small cases. Just only big cases referred to us."	"So far, supply has been enough. And probably for the next month, no problem. But I don't know in two months or three months’ time whether we have enough supply for such equipment or not. Just, I don't know."	"One thing is rehabilitation after a big surgery. Patients don't return to home directly, but hospitalisation is much longer than other countries. I have to transfer some of the patient to another hospital for rehabilitation. But some hospitals don't like the idea of receiving the patient from another setting. And now one of the hospitals announced PCR tests is necessary before transfer. But our hospital doesn't want to perform PCR test for patients without symptoms. So, transfer of the patient is becoming a big issue."	"Last month, March, for one patient I had to move between two big hospitals, and I mean, last month I had to go to another hospital to assist surgery and at that time I was really stressful. I felt really stressful because I have to be very careful the situation around me, and that's really stressful."
09	“The health service have adopted universal precautions, so the Patients only have the opportunity of coming in through the emergency department. And the emergency department has a protocol of treating everybody as	"The outpatient clinics, have been phased out in the last four weeks so we don’t see any patients in the clinics at all. All the patients who have post-operative complications, or who have new emergencies, end up in the emergency department... the patient load has reduced significantly. But what has changed is the	"What has changed now is that on a daily basis I just don’t know what to expect. You can just get called to solve different kind of problems in the emergency department."	"So at the moment we’ve had to limit the number of professionals who are in the operating theatre itself, and then everybody, their PPE is changed from the pre-COVID period."	"I do worry, I have a colleague that has passed on in the last two or three weeks as well. So it’s quite worrying. And I think my family worries more than myself. So I get calls on a regular basis, or a daily basis, from family members trying to check up and make sure that

	suspected – well, as probably COVID."	fact that we now need to be more available. The governing – the management actually encourages senior doctors or the consultants to stay longer in the hospital, make sure you see most patients and determine the urgency of a situation."			you're just being safe. But having said that, I think we just have to do our jobs, try and stay safe, and pray."
10	"I think one of the things that they did not do it right is that, in my opinion first they had to choose a hospital as a pandemic hospital and after it is full then the second hospital could be declared as a pandemic second hospital. We also needed clean hospitals because there are patients who need to receive chemotherapy or delivery and everything so because they wanted every hospitals to see also COVID-19 patients so it's not logical, I think. It's a waste of material because probably you will use the same material to take care of just 10 COVID-19 positive patients or 20 or 30 but if you just distribute to 30 patients to six hospitals so it means that six times more you have to consume all the equipment and everything."	"No, there was a period but for example we cancelled the outpatient clinic so we are trying to communicate with the patients and trying to understand who needs immediate care. Actually, we did not stop, we always operated, but before we were operating five to six cases a day and during this period we were operating only two or three cases a week, so the number was decreased."	" In the first weeks I was really very confused because I didn't have an idea what the course would be. We don't know how many patients are we going to have, our intensive care units beds will be sufficient or not. In those days we are not sure that because we were seeing in [other countries] people were just laying on the ground in very bad conditions and the doctors had to make choices who was going to live and who was going to die so because of these conditions we were really very confused."	"We needed clean hospitals because there are patients who need to receive chemotherapy or delivery and everything so because they wanted every hospitals to see also corona virus patients so it's not logical, I think. It's a waste of material because probably you will use the same material to take care of just 10 coronavirus positive patients or 20 or 30 but if you just distribute to 30 patients to six hospitals so it means that six times more you have to consume all the equipment and everything."	"Three of our residents had COVID positive tests, I was operating with them but with the masks and everything so that's why I was considered as risky. Because I was dealing with sarcoma patients I chose to stay at home for five days and then do my test and after seeing that it's negative, I know that it's 30% false negative results but I was feeling very well so I did not have any symptoms so the test was negative and I started to operate."
11	"In government hospitals, whether the doctors work or not, the hospitals are closed or not, their salaries are paid. In private hospitals like this, if. we close the clinics and theatre then we will not be able to raise funds and salaries will not get paid. So we still do our elective surgeries, but we have processes in place."	"I would not see outpatients in the clinic. I will let them give very spaced follow-ups. I will space the follow-ups. I will do follow-up for the tumours, I may also space them, but I will see the primary cases, if I need to do biopsies, I will do them, and I will plan their surgeries, and the ones that require surgery urgently, benign tumours, I will give them longer follow-ups. But the malignant, primary malignant bone tumours, once I made a diagnosis, I will go ahead and plan the operation."	"Transportation is actually preventing them from reaching the hospital, even for other orthopaedic cases during lockdown... we don't know if they can get to us, but if they come, we operate."	"Nobody stocks chemotherapy here [in this rural setting]. So, if the pharmacy cannot have it on the shelf, it will expire, so we have to give them the prescription, they have to go and buy the drugs from the city. So, now how does he go to the city to buy the drugs, and then come back here when there are travel restrictions and everything costs so much? That's going to be a challenge and these things will discourage patients and we just lose to follow up."	"If a staff picks it up from a patient, the attitude of the staff may change. Then of course you can't deliver care the way you want to do it anymore because the nursing union will say no, they can't continue, they make more demands on the institution and all that."

12	“Well everybody’s very worried because we aren’t having any reimbursement. We are reimbursed according to our operations, our consults that we do. We don’t have salaries. So it depends of our work. If we don’t see patients, we don’t have compensation. So that’s a big deal. And because of the COVID-19. we stopped seeing regular patients and we start operating only those cases who need the surgery. For example, trauma patients with cancer or tumours and patients with infections.”	“The hospital is operating at 10% now. We are doing 25% of our surgery in oncology is what we are doing now in comparison to last year. So we start opening now after seven weeks of doing nothing."	"Well in this particular case, they have 1,600 kilometres by car, nowadays we don’t have any plane. If she had a problem, I don’t know what can we do, you know?"	"In relation to the operating rooms, I was telling you that we have eight, and those eight were reserved only for COVID-positive patients. But nowadays we’re not having – because of the quarantine, we are not seeing any COVID-positive patients with an orthopaedic condition that need an operation. We are waiting the wave. And the wave of COVID never comes. Never came. We are alone. We have everybody at home. The hospital is empty. There are no patients. Everybody is scared. Everybody has fear."	"In families you have grandfathers and nobody wants to kill their own grandfathers with the virus, because if you are young then you transport the virus to your house and your grandparents die because of that. It’s a terrible situation."
13	“Most hospitals in the country have been transformed into COVID-19 hospitals. But we are an orthopaedic hospital and most of the hospital has been available for the orthopaedic patients. Admission was restricted to only to the A patients or the urgent patient. So, most of the hospital was doing not much, and everybody was available for us, basically. So, we had a lot of availability in terms of imaging department, pathology department, whatever.”	"We are a tertiary referral centre. Basically, in this period we have been fully operated. I would say that somebody could have a quicker service than it was before. The hospital, all together, it was working not more than 25% in terms of admittance. But all the services were open, basically opened and so, we still have been working at least 80/90 per cent of our usual activity. But, I'm expecting a number of patient has not been treated."	"We started to test the patient regularly not more than one month ago, so I don’t know if somebody contaminated with COVID."	"We were not provided by the mask. After 15 days, there were no masks also in the hospital. We had to ask for any procedure directly to one nurse that was taking all the supply to get the mask for any surgery. if you don't have the mask for the theatre, it's better that you don't proceed."	"We basically faced the first part of the virus without any protection. Even though I'm not so young. My job is a risky job, so as probably any other surgeon, we feel ourselves like supermen. But usually the doctor, even though they are deep in the problem, they don't think the problem can affect you. It's a sort of mind-rescue strategy."
14	“The [public] patients were affected more. I get a lot of referrals from other parts of [the country] because sarcoma surgery is not widely available here. I get referrals from places which are hours away and we had grounding of transports, so normally we fly them in an air ambulance but planes were grounded which meant that there were delays in transfer of those patients to us so the timing of surgery was delayed.”	"We normally run three full lists a day. When lockdown happened, we went down to two lists so then - you’ve got to cut a third of your work so you’re competing with two other surgical teams for those two listing spaces. Now they’ve relaxed the restrictions and allowing time-sensitive patients to be processed but again, we’re nowhere near full capacity in terms of theatre because patients aren’t coming."	"In the last six weeks, we haven’t met as a team so I’ve basically made the decision on my own with the oncologist and I hope I’ve made the right decision but I may not have, I’m not sure."	"We have a few nurses test positive for COVID and then there’s a mass panic and everyone goes and gets tested and self isolates for two weeks. Yesterday, we had a complete shutdown of theatre because we had no theatre staff around so we’re sitting there with patients in the ward who we’ve brought in for these operations."	"I’m relatively young and healthy. I suspect I maybe even had it already and very mild symptoms. Luckily, I wasn’t at work at that time so I stayed at home but it’s very alarming looking at some of those images from the epicentres, but if I had to go and help out in COVID ICUs, I would do that."

15	When the pandemic was declared our hospital system was preparing for a surge so there was a lot of changes made in the way we can deliver care, basically eliminated all elective surgery, and this wave did not materialise. So, we have a lot of empty space in the hospitals."	"We have continued to operate, we even had a little bit extra because we had some paediatric cases that were done at the other hospital, so sometimes we had two hour days a week instead of just one. So, that's the operating time."	"I feel okay not having a physical exam [in telehealth], but it does make me feel a little uncomfortable that I haven't actually laid eyes on them because, as doctors, it's ingrained in us that the physical exam is critical and we're not doing a physical exam. I'm relying on my patients to do their own physical exams. Most of them I think that's totally fine, but there are a few that I'm not quite sure what they're saying, and I get off the phone and I think, 'Oh, I hope that was okay.'"	" The cancer centre was very clear about what should be cancelled or deferred as far as follow ups. On average there's 700 visits a day to the cancer centre, 300 of them are chemo and radiation, and when we were able to cut down our follow ups it went down to 400 a day. So, 300 of the 400 follow up visits of all the doctors in the cancer centre not just orthopaedic oncology; we're down by 75%, but they kept 100% of the chemo radiation."	"There was a sense of foreboding and fear. Not so much for me, I'm not scared of getting sick, I'm scared for my family and their lives."
16	The state put through a prohibition on any elective surgery to conserve resources, both physical resources and also bed availability for patients who would have COVID. For approximately a week's period of time, locked down any surgery which was not a true emergency. And so unless a patient had an absolute acute trauma or had a life threatening event right then and there, there was no surgery which was going on. After that, we began to look at how we could treat patients who had urgent problems. Committees were set up to define what was an appropriate urgent problem from an oncologic perspective. And then it became clear that the impact was much less than had been feared. What is a challenge now is for patients outside of our system and once they go home to access physiotherapy because that's been very, very limited."	"Since we realised the impact was less than we anticipated, we have essentially expanded our oncology practise to a nearly unlimited practise as of about June 1st. I realize we have a luxury, that we're not looking at the tremendous and direct toll from COVID, which has happened to many unfortunate people there. But it's having a tremendous impact on us and our way of doing things and in our way of caring for patients."	"We're making the best decisions we can based on information which is incomplete. And I'm thankful that we have some very smart and dedicated people guiding us in this, but we're still – we're sort of fumbling in the dark right now with things."	"If a patient was anticipated to have a high need for a blood transfusion, those patients would be deferred because of resource utilisation. Patients who were anticipated to have greater than a one-night stay in the ICU were deferred because of concern about ICU utilisation. Skilled nursing facility placement is virtually unavailable at this time. And so patients who would be anticipated to need to dismiss a skilled nursing facility were also essentially deferred from surgery."	"I understand the desire to have both the parents with the young child who's gone through this horrific thing. At the same time, I'm the attending surgeon and I'm charged with the responsibility of protecting her and protecting other individuals in the hospital. And I'm trying to do it politely with a smile and cajoling, but I'm effectively ejecting her mother from the hospital, saying, "It's either you or dad, but not both at once."
17	"It's not only every one of the hospitals but the entire system, because this new hospital they	"At some point, middle of March, all the consults were cancelled, and all the surgeries were also cancelled because we	"Now when you look back it was very difficult weeks because things were changing every day and things	"The real problem was there were not places in the intensive care unit for non-coronavirus patients	"At the beginning, it was a little difficult too because the increase was so fast there was limited

	[built] in a meeting area, it helped a lot, but it was a decision of the state. They also opened hotels for patients that are more or less doing okay. They leave the hospital and go that medical hotels to finish their treatment to leave more room for new patients in the hospital. But, the co-ordination is above the hospital, it's not from inside the hospital because we couldn't deal with all these patients by ourselves – the planning has to be coordinated with the rest of the system and the state."	needed the rooms and the people to work for the coronavirus. So, at that point, everything, all the activity of the service was at the minimum rate. Only the fractures were treated and only patients with sarcomas that needed to be treated."	were a little worse every day. This thing has been so fast. Again, I mean in February we were completely normal, normal activity, everything was normal. March and April has been a nightmare ... I mean, it's like, what happened here?"	because all the intensive care units was also treating coronavirus. So you have to talk to the anaesthesiologist and to the intensive care and see if they have a place for this patient, if so, you can go ahead. But most of the time there is no place available."	dressings or masks and everything. It looks like in all the world wars at the same time."
18	"There is such a discrepancy between the countries, and we have so many means here, so we don't have that pressure. Even though we talk about money, we don't have the same pressure as they do [elsewhere]."	"It was really comfortable because if you have less outpatient clinics and less staff meetings and so, you have more time to – you have more time actually, so you keep on doing the surgeries. I kept on taking care of my patients as I wanted to because I can say – I could say to the head of the operating programme, "This guy, I need to operate on him," and it was done."	"It was a strange feeling because we had never seen that before, of course. In the beginning, it was a kind of stress because we didn't know if it was the black pest or just a small cold."	"We have many, many ICU beds as regard to the population as compared to the other countries. So we have 10 or 20 or 100 times more ICU capacities for the same population in [other European countries]. So it means that more patients would survive here. The resources are so much different, you cannot imagine."	"We did not know if we would be there two months later, personally. Before the shutdown there was a big meeting where all the senior consultants of the hospital were together and the general director said, "Maybe in two or three months some of you will not be there anymore." It was this kind of ambience like before the beginning of a war."

Epidemiological data

Figure 1: Global COVID Data

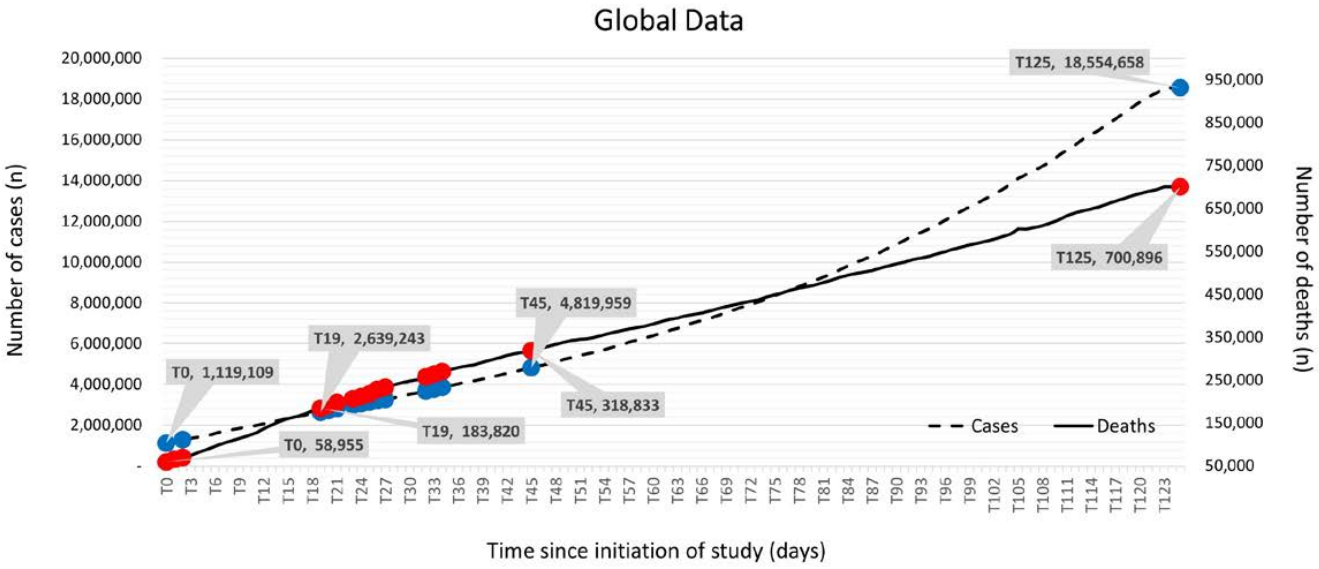


Figure 2: Global numbers by study timelines and Milestones

Timepoint	Date	Event	Confirmed Cases	Confirmed Deaths
T^{o}	4th April 2020	Investigator meeting; protocol development	1,119,109	58,955
T^{2}	6th April 2020	Study protocol submitted for ethics approval	1,280,046	69,789
T^{19}	23rd April 2020	Ethics approval granted	2,639,243	183,820
T^{20}	24th April 2020	Participant interview (x3)	2,719,522	191,228
T^{21}	25th April 2020	Participant interview (x2)	2,812,557	197,506
T^{23}	27th April 2020	Participant interview (x1)	2,981,592	206,803
T^{24}	28th April 2020	Participant interview (x1)	3,052,245	211,350
T^{25}	29th April 2020	Participant interview (x2)	3,126,806	217,555
T^{26}	30th April 2020	Participant interview (x1)	3,206,333	227,847
T^{27}	1st May 2020	Participant interview (x1)	3,267,867	233,560
T^{32}	6th May 2020	Participant interview (x3)	3,677,165	257,454
T^{33}	7th May 2020	Participant interview (x2)	3,768,535	264,109
T^{34}	8th May 2020	Participant interview (x1)	3,861,697	269,867
T^{45}	19th May 2020	Participant interview (x1)	4,819,959	318,833
T^{125}	7th August 2020	Final manuscript draft review by investigators	191,111,123	715,163

Figure 3

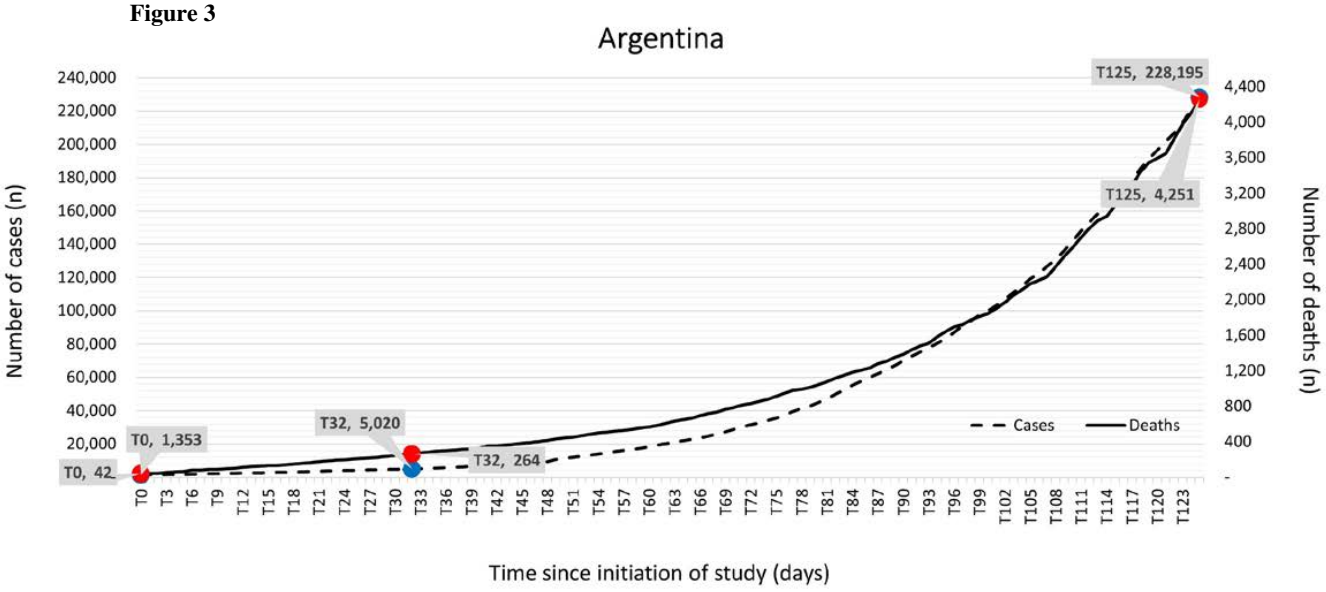


Figure 4

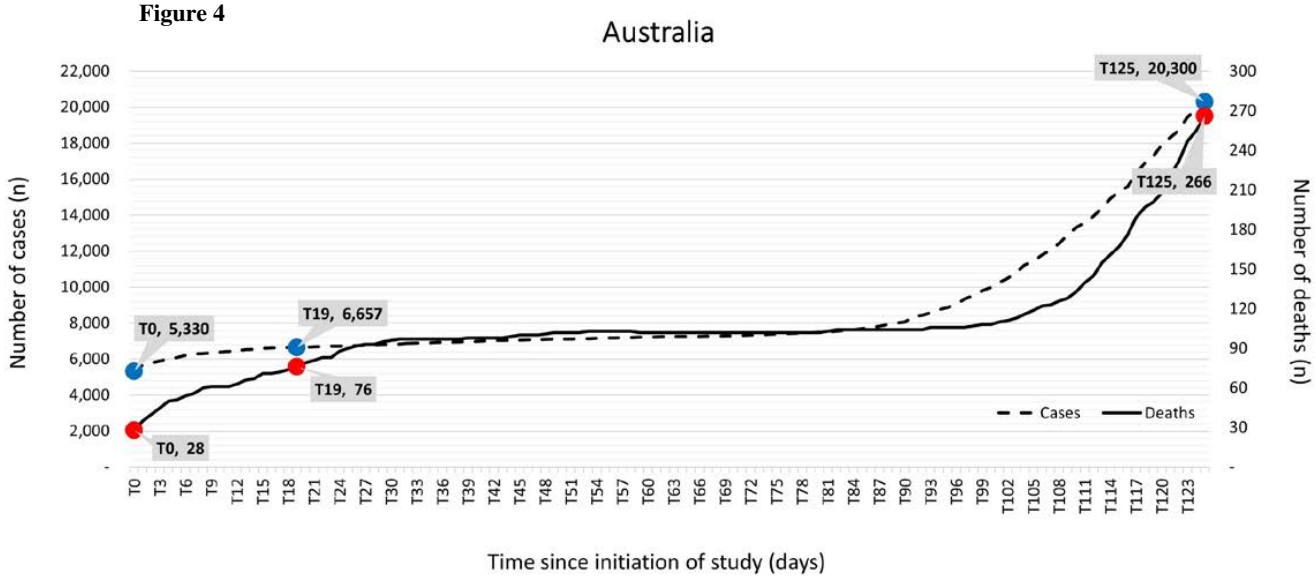
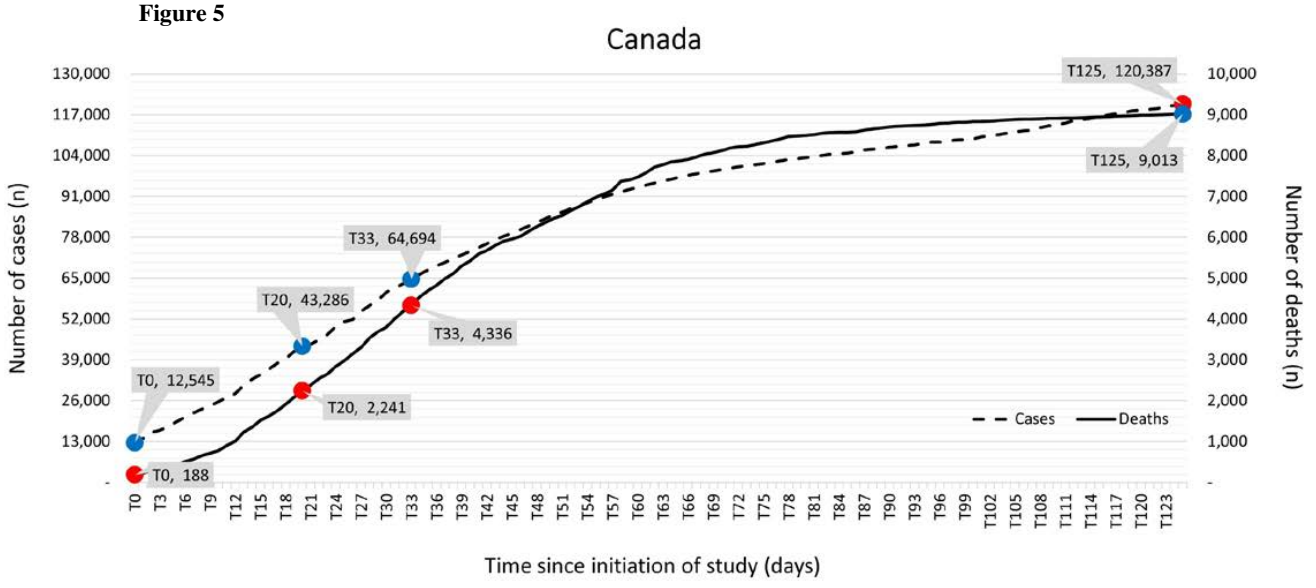


Figure 5



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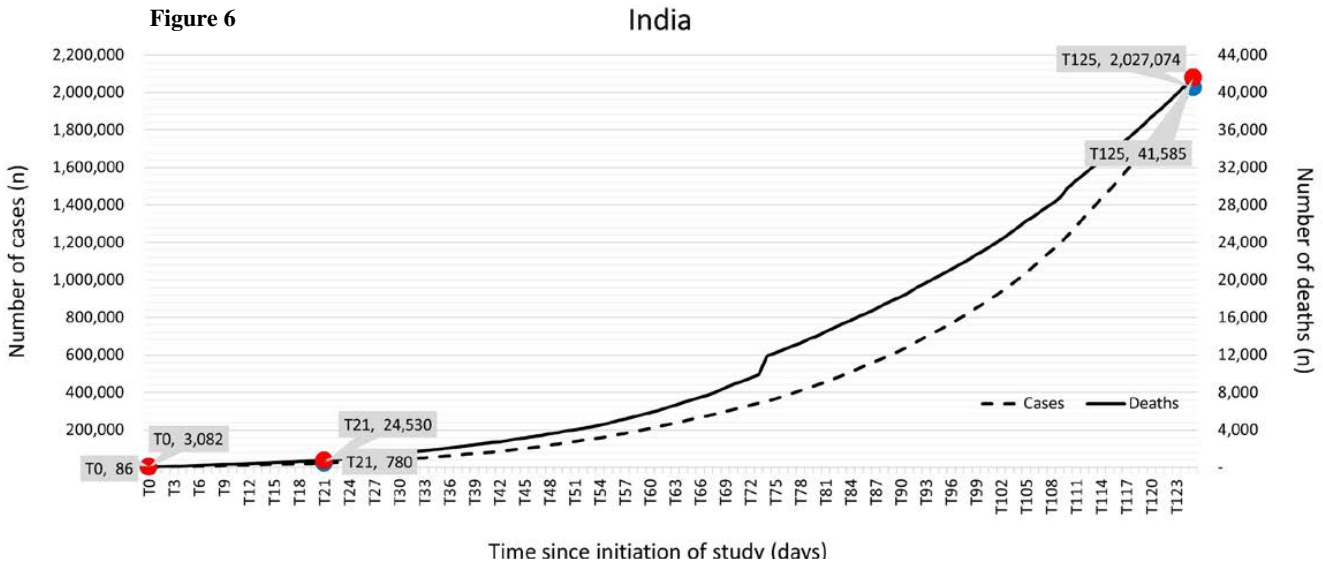

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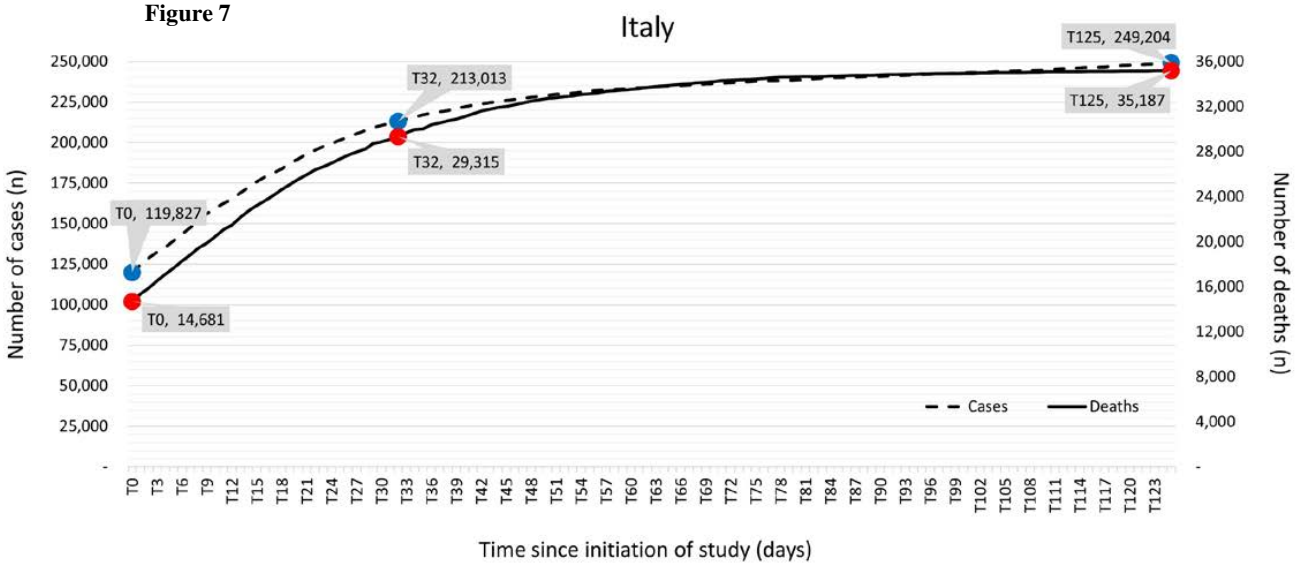


Figure 8

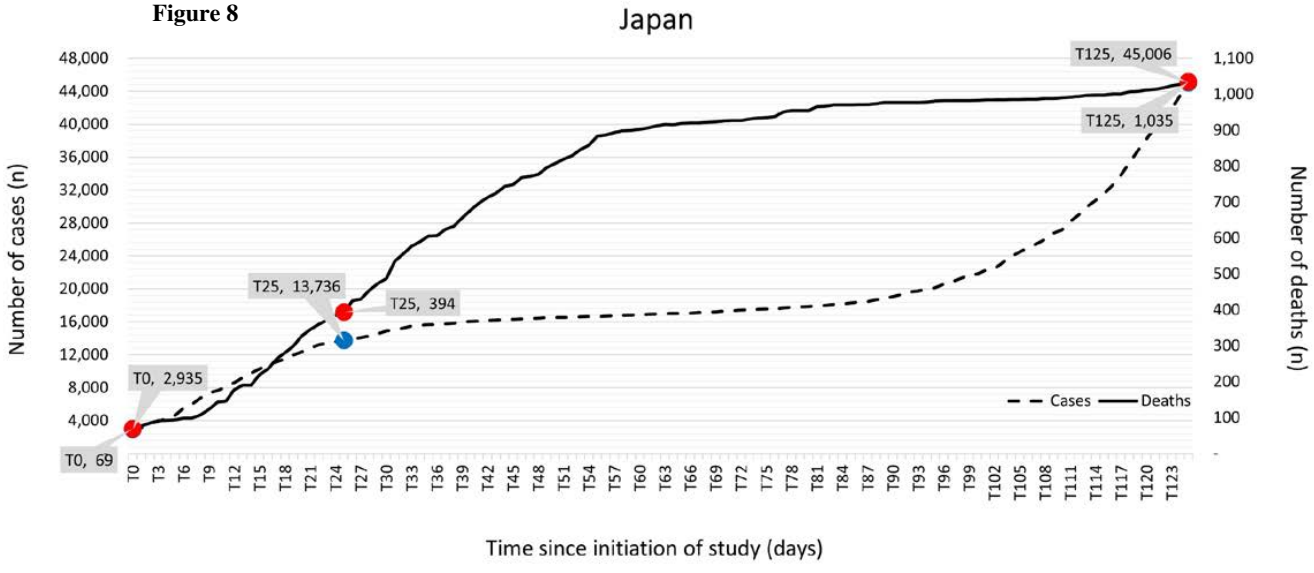
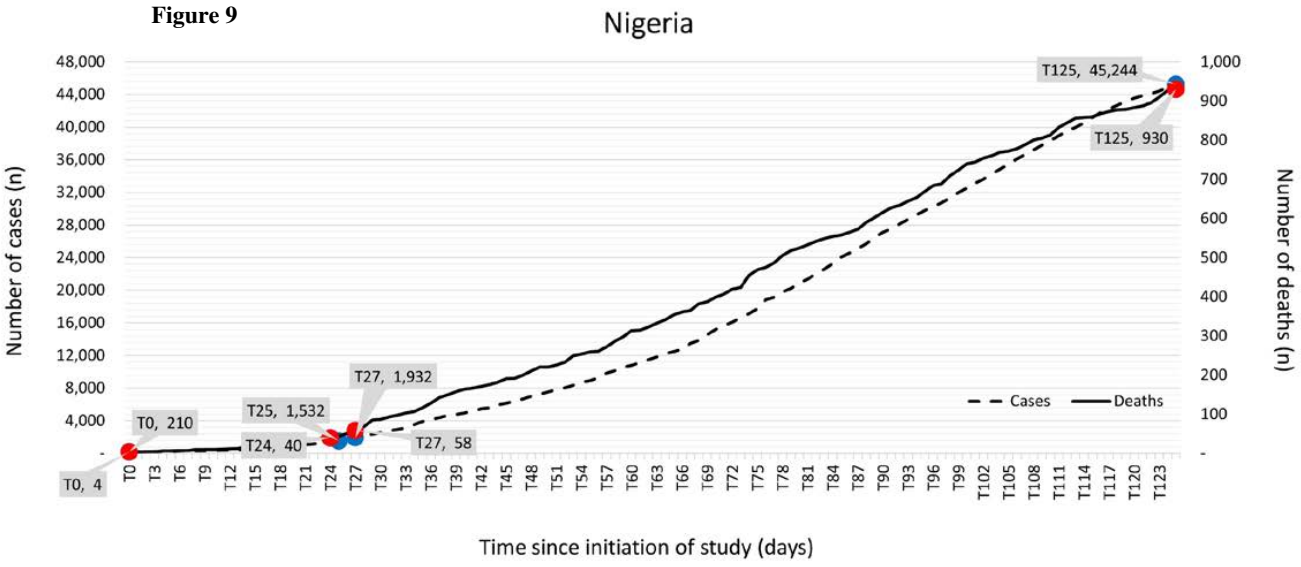


Figure 9



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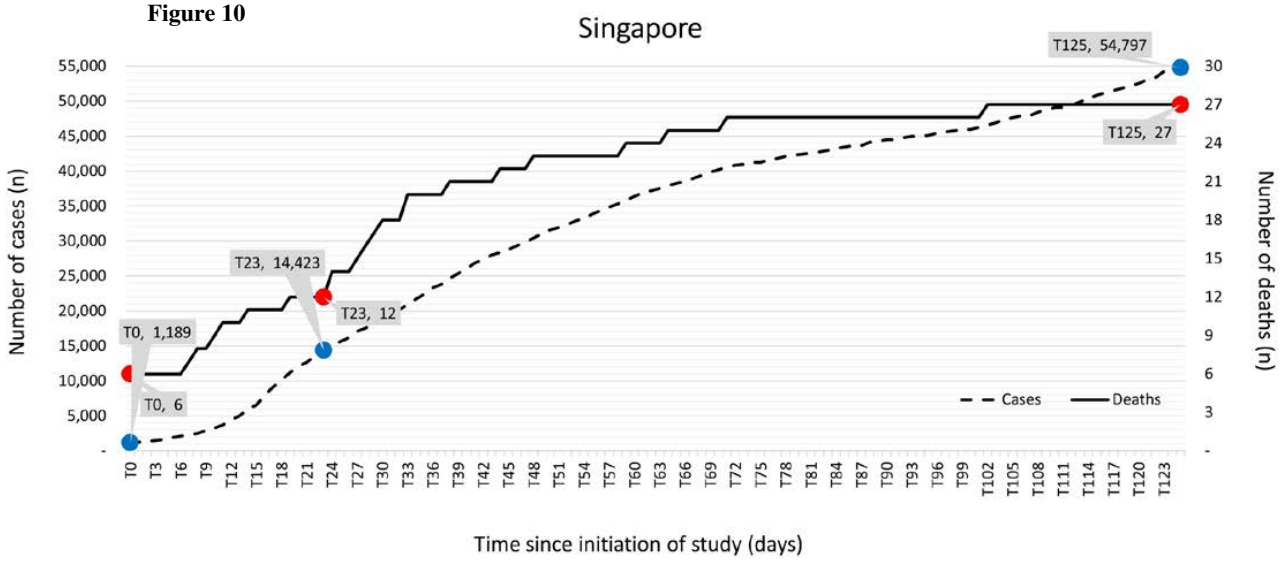

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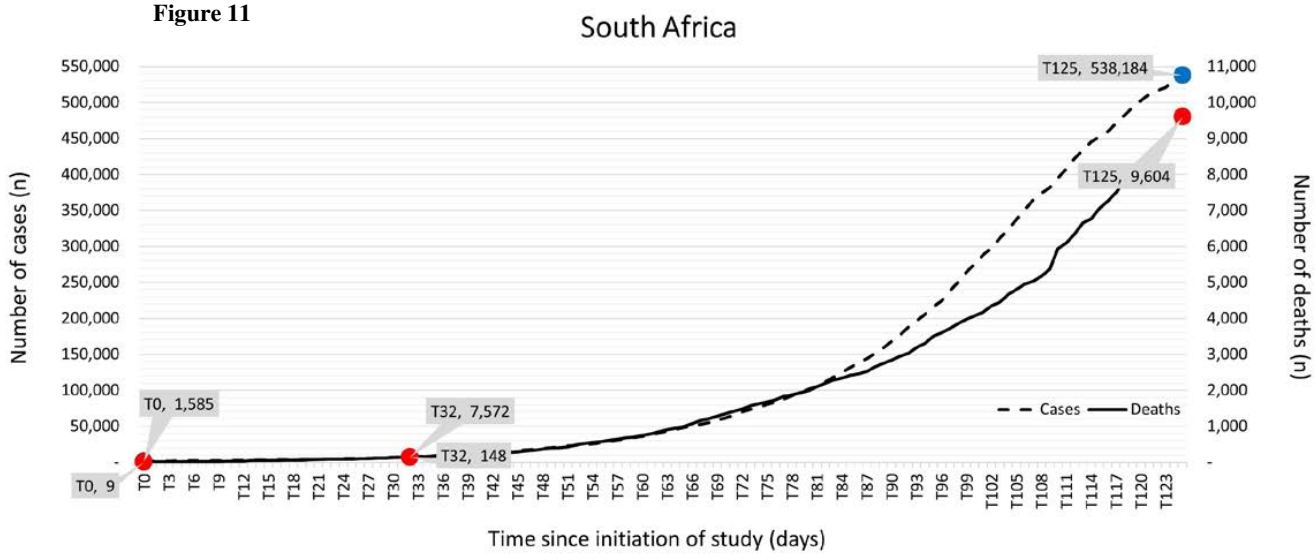

Figure 12

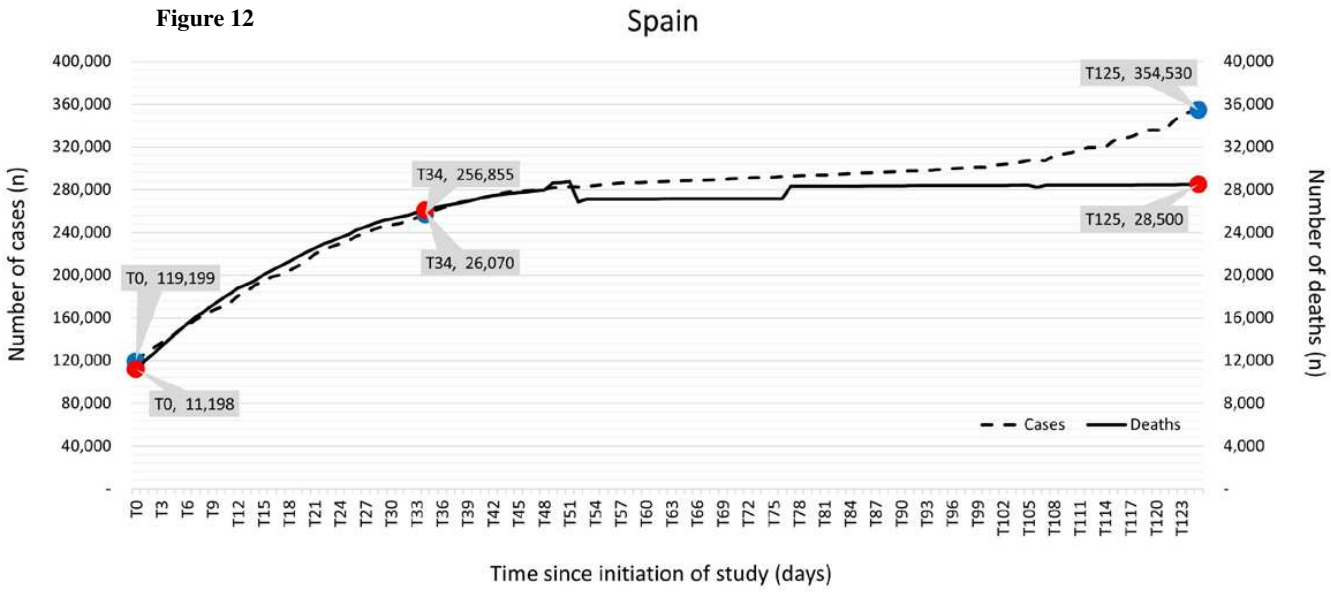

Figure 13

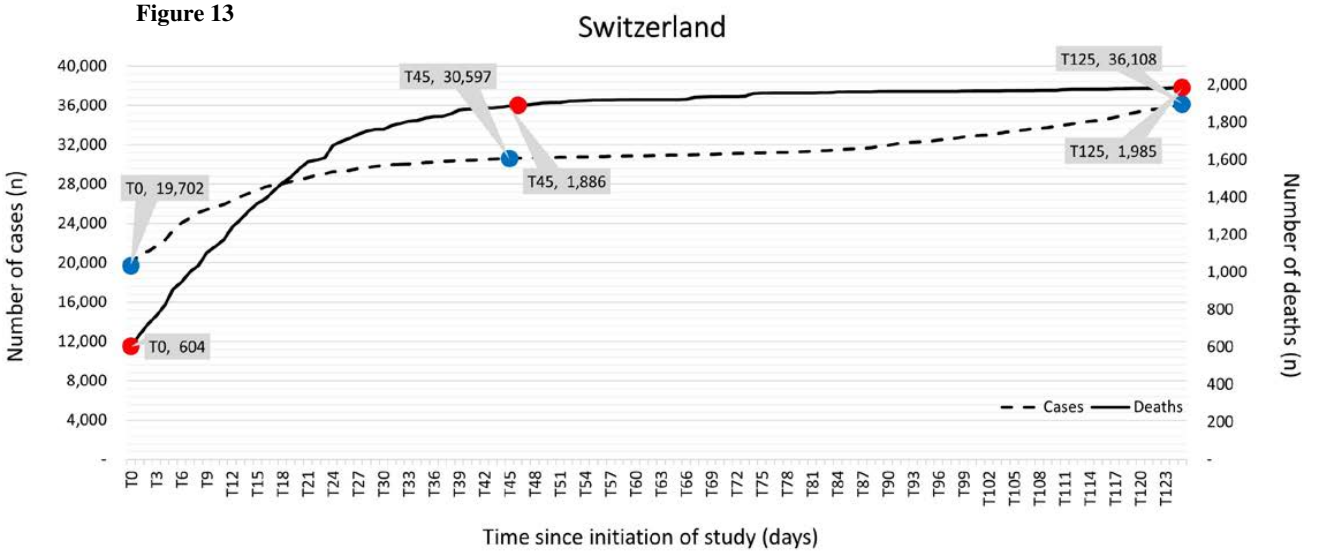

Figure 14

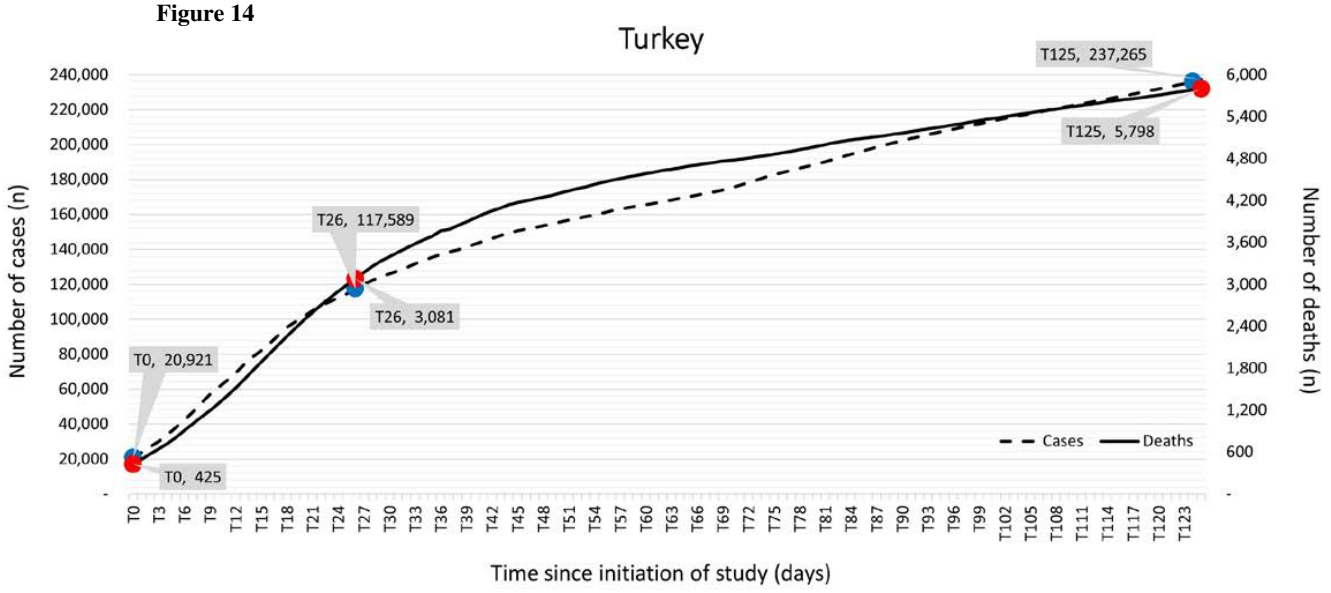

Figure 15

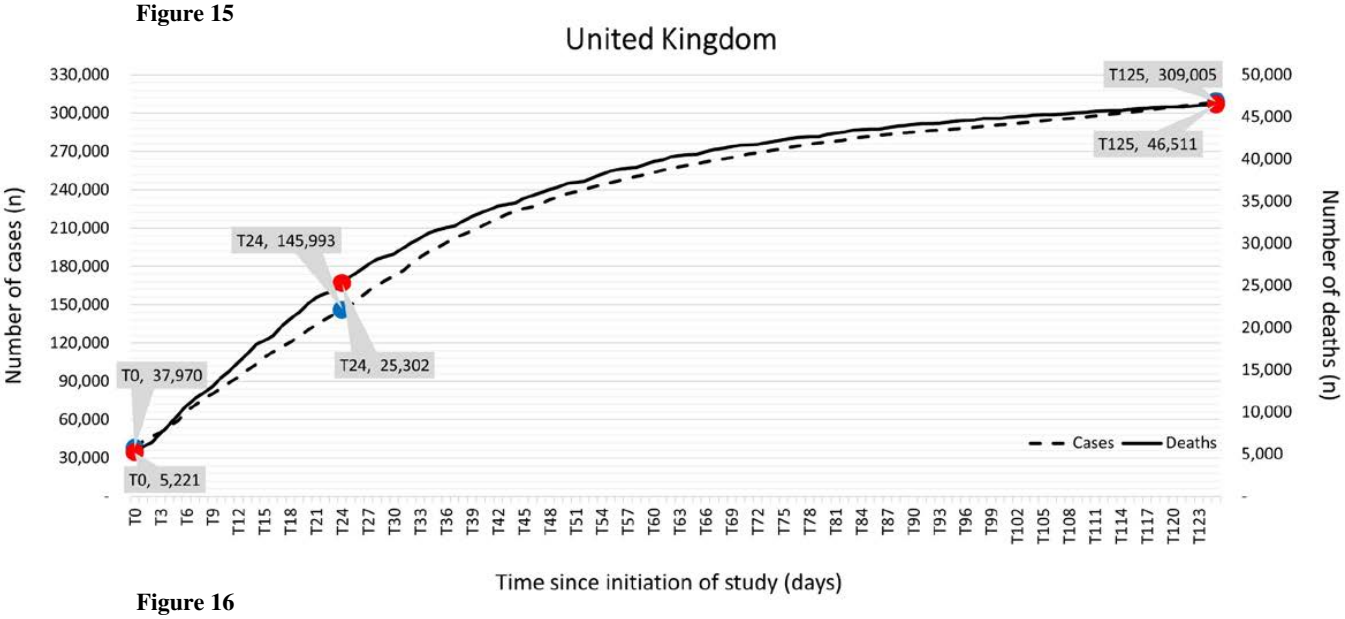

Figure 16

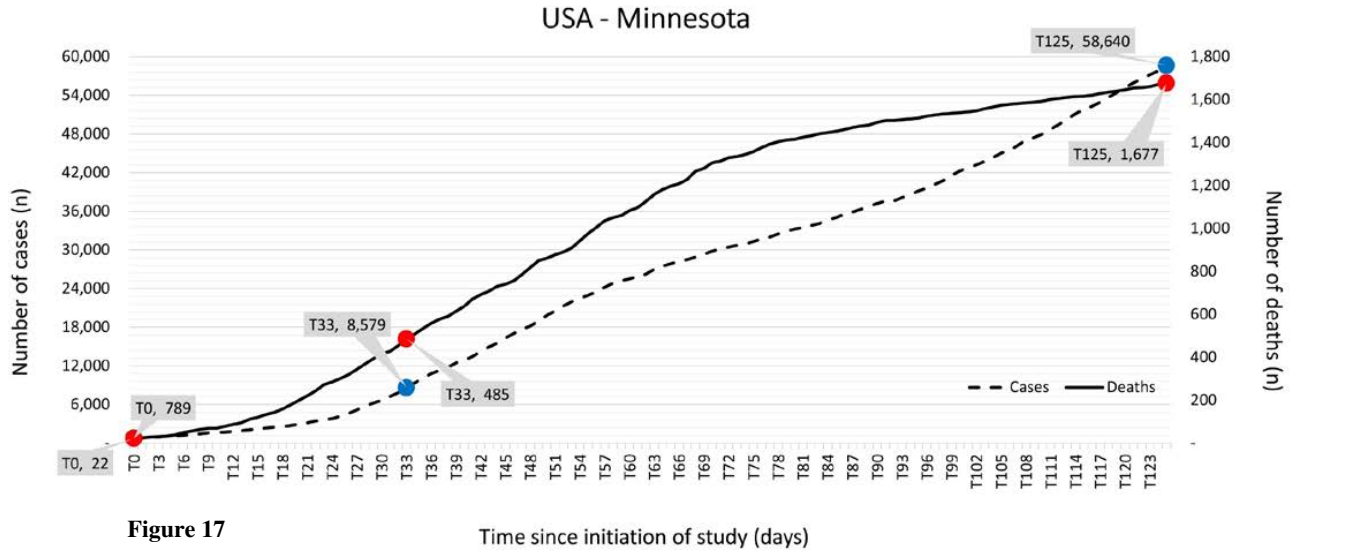

Figure 17

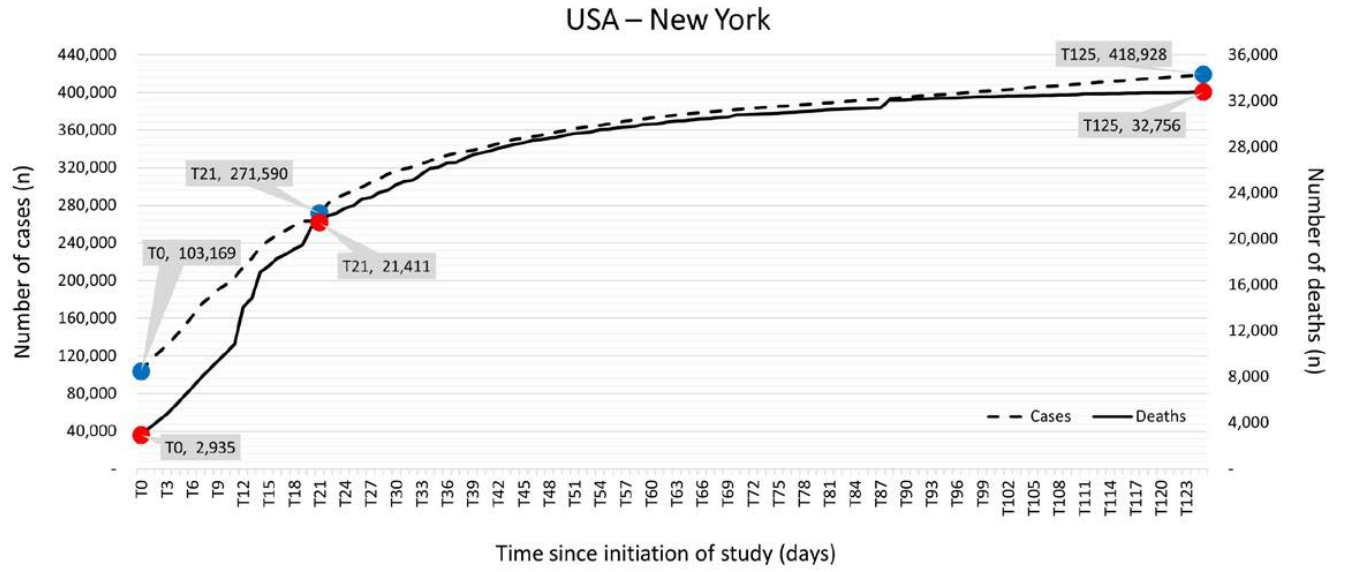

Figure 18

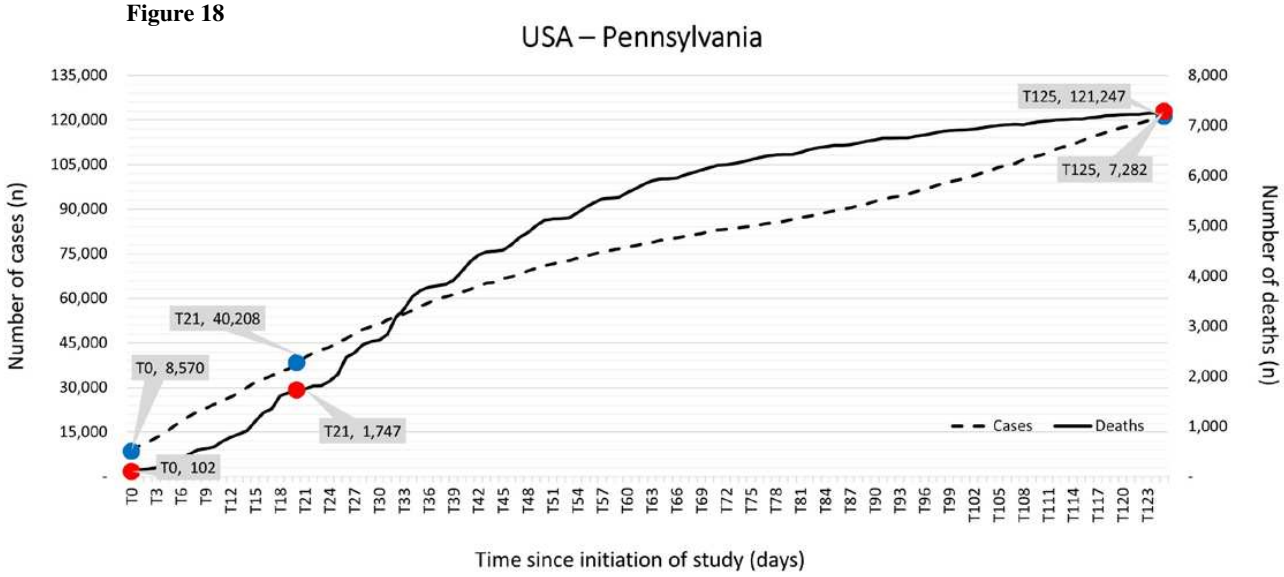
USA – Pennsylvania
Number of cases (n)
Number of deaths (n)
Time since initiation of study (days)
T0, 8,570
T0, 102
T21, 40,208
T21, 1,747
T125, 121,247
T125, 7,282
Cases
Deaths

Figure Legend

Figure 1: Global COVID data presenting cases (dashed line) and deaths (solid line) from initiation to conclusion of study. Blue dots represent study milestones or timepoints in relation to cases. Red dots represent study milestones in relation to deaths. Timepoints plotted represent days since initiation of study such that T0 = study initiation, T19 = ethics approval granted, T45 final participant interview conducted and T125 = study conclusion.

Figure 2: Global numbers by study timelines and Milestones.

Figure 3: COVID cases (dashed line) and deaths (solid line) in Argentina from initiation to conclusion of study. Blue dots represent study milestones or timepoints in relation to cases. Red dots represent study milestones in relation to deaths. Timepoints plotted represent days since initiation of study such that T0 = study initiation, T32 = time of participant interview and T125 = study conclusion.

Figure 4: COVID cases (dashed line) and deaths (solid line) in Australia from initiation to conclusion of study. Blue dots represent study milestones or timepoints in relation to cases. Red dots represent study milestones in relation to deaths. Timepoints plotted represent days since initiation of study such that T0 = study initiation, T19 = time of participant interview and T125 = study conclusion.

Figure 5: COVID cases (dashed line) and deaths (solid line) in Canada from initiation to conclusion of study. Blue dots represent study milestones or timepoints in relation to cases. Red dots represent study milestones in relation to deaths. Timepoints plotted represent days since initiation of study such that T0 = study initiation, T20 = time of first participant interview, T33= time of second participant interview and T125 = study conclusion.

Figure 6: COVID cases (dashed line) and deaths (solid line) in India from initiation to conclusion of study. Blue dots represent study milestones or timepoints in relation to cases. Red dots represent study milestones in relation to deaths. Timepoints plotted represent days since initiation of study such that T0 = study initiation, T21 = time of participant interview and T125 = study conclusion.

Figure 7: COVID cases (dashed line) and deaths (solid line) in Italy from initiation to conclusion of study. Blue dots represent study milestones or timepoints in relation to cases. Red dots represent study milestones in relation to deaths. Timepoints plotted represent days since initiation of study such that T0 = study initiation, T32 = time of participant interview and T125 = study conclusion.

Figure 8: COVID cases (dashed line) and deaths (solid line) in Japan from initiation to conclusion of study. Blue dots represent study milestones or timepoints in relation to cases. Red dots represent study milestones in relation to deaths. Timepoints plotted represent days since initiation of study such that T0 = study initiation, T25 = time of participant interview and T125 = study conclusion.

Figure 9: COVID cases (dashed line) and deaths (solid line) in Nigeria from initiation to conclusion of study. Blue dots represent study milestones or timepoints in relation to cases. Red dots represent study milestones in relation to deaths. Timepoints plotted represent days since initiation of study such that T0 = study initiation, T25 = time of first participant interview, T27= time of second participant interview and T125 = study conclusion.

Figure 10: COVID cases (dashed line) and deaths (solid line) in Singapore from initiation to conclusion of study. Blue dots represent study milestones or timepoints in relation to cases. Red dots represent study milestones in relation to deaths. Timepoints plotted represent days since initiation of study such that T0 = study initiation, T23 = time of participant interview and T125 = study conclusion.

Figure 11: COVID cases (dashed line) and deaths (solid line) in South Africa from initiation to conclusion of study. Blue dots represent study milestones or timepoints in relation to cases. Red dots represent study milestones in relation to deaths. Timepoints plotted represent days since initiation of study such that T0 = study initiation, T32 = time of participant interview and T125 = study conclusion.

Figure 12: COVID cases (dashed line) and deaths (solid line) in Spain from initiation to conclusion of study. Blue dots represent study milestones or timepoints in relation to cases. Red dots represent study milestones in relation to deaths. Timepoints plotted represent days since initiation of study such that T0 = study initiation, T34 = time of participant interview and T125 = study conclusion.

Figure 13: COVID cases (dashed line) and deaths (solid line) in Switzerland from initiation to conclusion of study. Blue dots represent study milestones or timepoints in relation to cases. Red dots represent study milestones in relation to deaths. Timepoints plotted represent days since initiation of study such that T0 = study initiation, T45 = time of participant interview and T125 = study conclusion.

Figure 14: COVID cases (dashed line) and deaths (solid line) in Turkey from initiation to conclusion of study. Blue dots represent study milestones or timepoints in relation to cases. Red dots represent study milestones in relation to deaths. Timepoints plotted represent days since initiation of study such that T0 = study initiation, T26 = time of participant interview and T125 = study conclusion.

Figure 15: COVID cases (dashed line) and deaths (solid line) in United Kingdom from initiation to conclusion of study. Blue dots represent study milestones or timepoints in relation to cases. Red dots represent study milestones in relation to deaths. Timepoints plotted represent days since initiation of study such that T0 = study initiation, T24 = time of participant interview and T125 = study conclusion.

Figure 16: COVID cases (dashed line) and deaths (solid line) in Minnesota, United States of America from initiation to conclusion of study. Blue dots represent study milestones or timepoints in relation to cases. Red dots represent study milestones in relation to deaths. Timepoints plotted represent days since initiation of study such that T0 = study initiation, T33 = time of participant interview and T125 = study conclusion.

Figure 17: COVID cases (dashed line) and deaths (solid line) in New York, United States of America from initiation to conclusion of study. Blue dots represent study milestones or timepoints in relation to cases. Red dots represent study milestones in relation to deaths. Timepoints plotted represent days since initiation of study such that T0 = study initiation, T21 = time of participant interview and T125 = study conclusion.

Figure 18: COVID cases (dashed line) and deaths (solid line) in Pennsylvania, United States of America from initiation to conclusion of study. Blue dots represent study milestones or timepoints in relation to cases. Red dots represent study milestones in relation to deaths. Timepoints plotted represent days since initiation of study such that T0 = study initiation, T21 = time of participant interview and T125 = study conclusion.