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# Impossible decision? An investigation of risk trade-offs in the intensive care unit

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**ABSTRACT**

In the intensive care unit (ICU), clinicians must often make risk trade-offs on patient care. For example, on deciding whether to discharge a patient before they have fully recovered in order to create a bed for another, sicker, patient. When misjudged, these decisions can negatively influence patient outcomes: yet it can be difficult, if not impossible, for clinicians to evaluate with certainty the safest course of action. Using a vignette-based interview methodology, a naturalistic decision-making approach was utilised to study this phenomena. The decision preferences of ICU clinicians ($n$ = 24) for two common risk trade-off scenarios were investigated. Qualitative analysis revealed the sample of clinicians to reach different, and sometimes oppositional, decision preferences. These practice variations emerged from differing analyses of risk, how decisions were 'framed' (e.g. philosophies on care), past experiences, and perceptions of group and organisational norms. Implications for patient safety and clinical decision-making are discussed.

**Practitioner Summary:** Physicians managing ICUs have to make rapid decisions with incomplete information and suboptimal resources. A qualitative vignette-based interview study examined how such decisions are made. We found physicians used a heterogeneous mixture of risk assessments, factual knowledge and prior experience to make judgements, which leads to potential for inconsistent decision-making.

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## 1. Introduction

Clinical decision-making relates to judgements on the presence, type, severity and treatment of patient illnesses (McNeil, Keeler, and Adelstein 1975). Research has explored how decision-making errors compromise patient safety, with various human factors-related issues influencing clinical judgements (Croskerry, Singhal, and Mamede 2013; Lamb et al. 2011; Mishra et al. 2008). However, minimal research has focused on decisions that necessitate 'risk trade-offs'. This is where clinicians must potentially compromise on an aspect of patient safety: for example discharging a patient from a full hospital unit before they are fully recovered in order to admit another who needs care (Cook 2006). In settings such as the intensive care unit (ICU), these predicaments have serious implications for patients. Yet it can be difficult, if not impossible, for clinicians to evaluate with certainty an entirely safe course of action. Furthermore, the nature, and potential consequences for patient safety, of how risk trade-offs are managed is relatively unexplored (Mohan and Angus 2010).

To address this, we utilise a vignette-based interview methodology to examine the decision-making of ICU doctors for two common risk trade-offs: 'admissions' and 'bumping'. We consider clinician variations in decision-making, the causes of these, and potential consequences for patient safety.

## 2. Risk trade-offs

The notion of 'risk trade-offs', where decision-makers must weigh up the risks associated with different courses of action in order to reach a decision, is central to decision-making theory (Slovic et al. 2004).

Relatively little human factors work has conceptualised or examined risk trade-offs in safety-critical workplaces. We define these as where uncertainty, risk, situational dynamics, and resource constraints mean decision-makers must attempt to trade-off the risks associated with various options in order to ascertain a decision preference for the safest, most efficient, and satisfactory course of action. Previous research on this is minimal, and shows the difficulty of making risk trade-offs in strategic management

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and investing (Glac 2009; Smith 2014), the importance (e.g. in deep-sea fishing) of risk exposure to making effective judgements (Morel, Amalberti, and Chauvin 2008), and the 'decision inertia' that occurs when making difficult risk trade-offs (Alison et al. 2015).

The concept of risk trade-offs appear especially pertinent to health care, where such decisions are commonplace due to the complexity, uncertainty, time pressure, and resource constraints associated with treating acutely ill patients (Amalberti 2013; Reader and Cuthbertson 2011). For example, in prescribing treatments (Tinetti and Kumar 2010), or allocating resources (Beach et al. 2005). Yet, risk trade-offs in health care remain poorly understood, and we adopt a Naturalistic Decision-Making (NDM) approach to examine them (Klein 2008).

### 2.1. NDM in health care

NDM explains and theorises decision-making in environments with (i) ill-defined, shifting, and competing goals, (ii) uncertainty and missing data, (iii) dynamic conditions, time pressure, and stress, (iv) experienced decision-makers who work in teams and (v) wider organisational goals and norms. NDM is used to examine the skills required for effective decision-making in such contexts.

A substantial body of NDM work has emerged in health care, much of which examines whether expert clinicians make 'recognition primed decisions' (Klein, Calderwood, and Clinton-Cirocco 2010). This is where decision-makers recognise a situation, and apply a workable prototypical strategy (i.e. previously utilised or witnessed) for managing it instead of selecting and comparing options. Research shows doctors and nurses utilise past experiences and 'pattern matching' to make emergency decisions in anaesthesia (Bond and Cooper 2006); to rapidly generate option strategies for critically ill patients (Cesna et al. 2005); to recognise patient deterioration (Endacott et al. 2010); and to apply decision strategies for managing surgery (Pauley et al. 2011).

NDM research has also focused on the factors that influence how clinicians evaluate risk. For example, in terms of their preferences for using informal rather than formal decision-making processes (Halter et al. 2010; Jacklin et al. 2008), their reliance on experience (Farnan et al. 2008), and the types of information they utilise (Reyna and Lloyd 2006). Various contextual variables are shown to influence decision-making. For instance, the complexity of patient haemodynamic presentations (Currey and Botti 2006); whether clinicians are managing multiple or single ICU patients (Fackler et al. 2009); and whether planning or emergency decisions are being made (Reader, Flin, and Cuthbertson 2011).

In summary, NDM research in health care has examined how patient safety is influenced by risk-related judgements, with 'practice variations' (where decision-makers treat an identical situation differently, and thus reach different decision preferences: Reyna and Lloyd 2006) being a product of clinician' characteristics (e.g. experience) and situational factors (e.g. uncertainty). Thus, NDM provides a suitable approach for studying risk trade-offs in health care. We explore these in the context of the ICU, where risk-trade off situations are common.

### 2.2. Risk trade-offs in the ICU

Intensive care is a domain of health care where complex and critically ill patients suffering multiple organ dysfunction are treated by multidisciplinary teams. Resources are limited in terms of beds (10–18), and this means that trade-offs in ICU frequently relate to deciding which patients can receive care. We focus on two common risk trade-offs.

The first is for 'admissions', whereby patients should only be admitted to ICU if they have a reasonable chance of sustained recovery (i.e. to eventually leave hospital) (Ridley 2002). If a patient is inappropriately refused admission in to ICU, this will reduce their chances of recovery and survival. For example, in terms of receiving a lower level of nursing and medical support, which increases the chances of poor recovery and death (Metcalfe, Sloggett, and McPherson 1997). However, if patients are admitted to ICU when they are too sick to recover, this also creates risk. Specifically, due to bed and staffing constraints, if a patient is inappropriately admitted when a unit is at capacity, this can prevent a subsequent appropriate patient from receiving ICU care – increasing their chances of mortality (Vanhecke et al. 2008). Trading-off the costs of inappropriately admitting a patient against refusing one who might survive is a difficult judgement, as it is highly complex to evaluate *post hoc* (e.g. by considering the potential success of an alternative treatment strategy), and admissions criteria vary from institution to institution (Nasraway et al. 1998). This has contributed to variations between hospitals. For example, institutions vary in the number of appropriate (for ICU) elderly patients they admit, with higher refusal rates being associated with poorer patient outcomes (Garrouste-Orgeas et al. 2009).

The second risk trade-off we examine is 'bumping'. This is where all beds in an ICU are occupied with critically ill patients, and the unit is asked to admit a suitable new patient. This means that a current patient has to be discharged before they are ready (Robert et al. 2012), or out of daytime hours when ward areas are not optimally set up to accept a precarious discharge. Discharging a patient 48 h before they are ready increases the chance of post-discharge mortality by up to 39%, with discharges at night

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being particularly dangerous (Daly, Beale, and Chang 2001; Goldfrad and Rowan 2000). This is because true patient vulnerability is often exposed only after the challenge of a step-down in care, and care continuity is disturbed during the hand-over. Bumping decisions have implications for patient safety, because if an ICU refuses to admit a critically-ill patient, that patient has a lower chance of survival (as they will be admitted to a hospital area that lacks intensive nursing or medical input for technical organ support) (Chalfin et al. 2007). However, if the admission is permitted, the patient who is 'bumped' will be put at risk if clinicians have misjudged their recovery. Research shows that when ICUs are full, bumping decisions increase, with negative consequences for patients inappropriately bumped (Sinuff et al. 2004).

Both admissions and bumping are common risk trade-offs within ICU. Yet, they are not managed consistently in different institutions, which potentially creates risks for patient safety as patient outcomes (e.g. mortality) are highly influenced by these decisions. Yet, to date relatively minimal research has examined how clinicians make these decisions, or why variations exist.

### 2.3. Current study

Within the human factors literature there has been relatively little investigation of risk trade-offs. Such situations are commonplace in health care, with clinicians often being required to make decisions on whether to withhold or withdraw care for one patient in order to support another. ICU research shows that institutions vary in how they make such decisions, with consequences for patient outcomes. Yet, practice variations amongst clinicians for such risk trade-offs remain un-examined. Utilising a vignette methodology, we begin the exploration of this. The current study examines (i) whether there are practice variations in ICU clinician' decision preferences for bumping and admissions scenarios, and (ii) the psychological and contextual factors that might underlie these.

## 3. Methods

The study received appropriate institutional approval from local university and hospital research compliance offices.

### 3.1. Participants

Participants ($n$ = 24) were eight junior trainee doctors (JT), eight senior trainee doctors (ST) and eight senior doctors (SD: consultants or attending physicians) working in three university hospitals in London. STs and SDs lead on patient admission decisions, whilst JTs advise and support. Participants were recruited via local promotion of the study throughout the critical care service by one of the investigators (SJB). All doctors were fully qualified. JTs had spent an average of 4 months in their ICU (but with experience elsewhere), STs an average of 3 years, and SDs an average of 12 years. This sample was selected in order to examine the role of experience in decision preferences.

### 3.2. Design

Two decision-making vignettes were explored through a semi-structured interview method. Vignettes are short descriptions of a scenario for which participants are required to make a decision. Through analysing the information within a scenario from the perspective of one's knowledge and experience, they aim to simulate the mental processes of participants for making real and complex decisions. Vignettes examine complex decisions where *in situ* methods (e.g. think-aloud protocols) are less practical, and are used extensively in NDM research (Jacklin et al. 2008; Patel, Kaufman, and Arocha 2002; Reyna and Lloyd 2006).

#### 3.2.1. Vignette scenarios

The vignette scenarios were drafted by one of the investigators (SJB), and piloted and refined with three ICU senior doctors. This was to ensure there was sufficient information to form a decision preference, and that they were clinically realistic. The scenarios are included in Table 1. The first related to an 'emergency admission' of a critically ill patient. Participants could admit or refuse the patient entry to ICU, and were asked to indicate their preference. The second related to a 'bumping' situation, where participants could discharge a current patient at night in order to admit an incoming patient, or take an alternative course of action. Participants had four options (see Table 1) to choose from, and ranked them in terms of preference.

#### 3.2.2. Interview protocol

For both scenarios, participant decisions were explored through a short semi-structured interview protocol (average 20 min per scenario) based on the cognitive task analysis technique (Stanton et al. 2010). Interviews focused on the factors influencing decision-making (e.g. clinical, experience, social), and participants were systematically asked to:

- Indicate and justify their preferred decision;
- Consider the risks and threats to patient safety;
- Discuss the
  - Key factors (e.g. information, scenario detail) leading to this decision;
  - Influence of organisational factors (e.g. protocols, norms) underlying decision-making;

**Table 1.** Study vignettes.

*Scenario 1 (Admissions).* You have been asked to review and consider admitting Mr. GS who is currently in the acute medical unit. He is a 72-year-old man with type-II diabetes, significant overweight issues, and chronic obstructive pulmonary disease for which he receives full medical treatment and home oxygen. He was admitted to the hospital some 8 h previously with a history of progressively worsening breathlessness. Please indicate whether you would admit the patient. The key current issues appear to be:

- His admission blood gas assessment showed a severe respiratory acidosis with a pH of 7.0 and a $PC0_2$ of 10 kPa
- In spite of non-invasive ventilatory support, he remains drowsy and appears to be failing
- The consultant in acute medicine, who also happens to be the Trust lead for non-invasive ventilatory support, has asked for an assessment of the patient for suitability for endotracheal intubation and full mechanical ventilatory support
- The current situation in the intensive care unit is that it is full. Accepting Mr. GS would thus be an organisational challenge
- Intensive care unit has one possibility of a discharge if Mr. GS were to be swapped with a medical patient who could conceivably be managed in the acute medicine unit

*Scenario 2 (Bumping).* Mrs. S is a 32-year-old patient who needs to be admitted to intensive care because of a major obstetric haemorrhage. She has required a twelve litre transfusion and is now probably stable with a pulse of 110 and a blood pressure of 110/70 with a haemoglobin of 850 $gl^{-1}$ and a mild coagulopathy. She is mechanically ventilated. The intensive care unit is full there are a number of possible options for creating a bed, and you have been asked to make a decision for implementing the following;

(1) Transfer the new patient to a different hospital
(2) Provide ventilatory support in the operating theatre department overnight
(3) Transfer Mr. J a 75-year-old man breathing via a tracheostomy who has been in the intensive care unit for six weeks recovering from hepatic encephalopathy due to chronic liver disease
(4) Discharge Miss C, a 19-year-old patient with type-I diabetes who is recovering from a severe episode of diabetic ketoacidosis. She had required 24 h of ventilatory support to help her through her period of pulmonary oedema. She was extubated this morning and is receiving face mask oxygen, she is currently on a sliding scale insulin infusion, and receiving intravenous potassium supplementation

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- Previous experience of similar situations;
- Strategy for managing similar situations;
- Further information required.

### 3.3. Analysis

Two phases of analysis were conducted.

First, for each participant, the decision-making preferences for each scenario was ascertained and tabulated, alongside the principle factors underlying this (TR, GR). For the admissions scenario, this was whether to admit the incoming patient. For the bumping scenario, this was the best and worst options (out of four possible alternatives) for managing the situation.

Second, the psychological and contextual factors influencing decision-making were explored. First, an inductive approach was taken (Braun and Clarke 2006), whereby transcripts were analysed by capturing themes that appeared to represent a level of patterned response across the data. Coding was performed using NVIVO (version 10). The data were independently coded by a single coder and themes were identified in terms of factors influencing decision-making (GR). This was an iterative process, with a second coder (TR) independently evaluating the data extraction and the generation of themes.

To ground the inductive analysis theoretically, a deductive approach was then taken, whereby the themes generated were interpreted using theoretical approaches to decision-making in the patient safety literature (and social sciences) that appeared relevant to the case. Specifically, we drew on research relating to cost–benefit analyses (Bertsimas, Farias, and Trichakis 2012; Pauker and Kassirer 1975), framing effects upon decision-making (Croskerry 2002; Fackler et al. 2009; Kahneman, Slovic, and Tversky 1982), experience and expertise (Flin, Youngson, and Yule 2007; Klein 1993; Patel, Kaufman, and Arocha 2002), and organisational and group norms for decision-making (Eisenberg 1979; Gore et al. 2006).

Finally, the themes and data from the qualitative analysis were summarised and synthesised into a single table, which aimed to provide an initial conceptual set (illustrated by examples) of factors influencing how clinicians make risk trade-offs in ICU.

## 4. Results

### 4.1. Decision-making preferences for the trade-off scenario

#### 4.1.1. Scenario 1: Admissions

Decision preferences for individual clinicians are reported in Table 2. For the first scenario, fifteen (62%) clinicians supported patient admission. Primary reasons were that although the patient's condition was judged as deteriorating and possibly irreversible, ICU-level ventilation provided some prospect of survival and was needed to provide time and space for the family and clinical team to make assessments on chances of recovery, and potential quality-of-life. Nine participants (38%) indicated that they would not admit the patient due to the irreversibility of Mr. GS' condition, the discomfort of ICU care for a dying patient (e.g. receiving invasive care), and the poor long-term prospects of the patient.

**Table 2.** Decision-making for scenario 1 (admissions).

| Participant (role, hospital) | Admit patient to ICU? | Key reason(s) |
|---|---|---|
| 1 (JT, H1) | Yes | Patient is deteriorating on maximum medical treatment that is available on the ward, and will continue to deteriorate unless he is intubated |
| 2(JT, H1) | Yes | Patient is quite acidotic, is not to responsive to non-ITU treatment, and situation is not stabilising and appears to be getting worse |
| 3 (JT, H1) | No | Patient unlikely to be weaned off ventilatory support if ventilated, and has a number of medical co-morbidities as well as poor COPD |
| 4 (JT, H1) | Yes | Patient requires intubation to survive and co-morbidities are not a sufficient reason to not admit the patient |
| 5 (JT, H2) | Yes | Patient needs mechanical ventilation to survive because non-invasive ventilation is not working |
| 6 (JT, H2) | No | Patient has multiple co-morbidities and is severely ill, and could not be admitted without more information on potential quality-of-life after ICU |
| 7 (JT, H1) | Yes | If a patient fails on non-invasive ventilation, then the next stage is to intubate them and mechanically ventilate them |
| 8 (JT, H1) | Yes | Patient is severely acidotic, has reached maximum treatment short of intubation, and requires ventilation |
| 9 (ST, H1) | No | Patient appears to be at end stage COPD, and would need to establish likely quality of future-life and family wishes |
| 10 (ST, H2) | No | Patient fully treated for COPD and has had ventilation for some time, yet has not improved and thus is unlikely to benefit from a stay in ICU |
| 11 (ST, H1) | Yes | Patient requires intubation, and provided quality-of-life is not extremely poor would benefit from ICU |
| 12 (ST, H2) | No | More information would need to be known about potential quality-of-life after ICU treatment before patient could be admitted |
| 13 (ST, H2) | Yes | Although the patient will require a long ventilatory wean, he has the potential to survive, even with a lower quality-of-life |
| 14 (ST, H3) | Yes | Patient should be intubated and put on invasive ventilation, and then decisions for recovery or end-of-life care will proceed this |
| 15 (ST, H3) | No | Patient may be inappropriate for intubation, as he has sever COPD and if this is part of the disease process (co-morbidities) it will not be reversible |
| 16 (ST, H3) | Yes | Despite pessimistic scenario, patient requires ICU-level non-invasive-ventilation to have a chance of survival |
| 17 (SD, H1) | No | Patient requires intubation and Co2 management due to respiratory failure. This can be done outside ICU, where underlying illness will not be solved |
| 18 (SD, H2) | No | Patient likely to experience a protracted length of stay in ICU, with little chance of recovery |
| 19 (SD, H2) | Yes | Patient requires invasive ventilation to survive, and should come prior to discussions with the family on continuation of care or end-of-life treatment |
| 20 (SD, H3) | Yes | Patient has a chance of survival, but will not do so without ICU care |
| 21 (SD, H1) | Yes | Whilst there may be no reversibility in the overall illness, the deterioration may be caused by an infection, meaning there is a chance to improve condition |
| 22 (SD, H2) | Yes | Patient requires ventilation to survive, and issues around quality-of-life must be decided with the family and patient |
| 23 (SD, H3) | No | Patient has multiple co-morbidities, and underlying pulmonary disease, and is unlikely to survive ICU |
| 24 (SD, H3) | Yes | Patient requires ICU-level non-invasive ventilation prior to any decisions being made on mechanical ventilation, recovery, or end-of-life |

Notes: SD = Senior ICU doctor; ST = Senior ICU trainee doctor; JT = Junior ICU trainee doctor.
H1 = Hospital 1; H2 = Hospital 2; H3 = Hospital 3.

#### *4.1.2. Scenario 2: Bumping*

Decision preferences are reported in Table 3. The most preferred option was to provide ventilatory support and monitor Mrs. S in an operating theatre (option 2) until a bed became available elsewhere (13 participants, 54%). Despite the high-resource cost of this option (occupying a nurse and anaesthetist overnight), this was preferred as Mrs. S would receive near-ICU level support without disrupting other patients. However, three participants (12%) considered option 2 the most risky option, due to it significantly reducing the night-time medical workforce available (e.g. for managing emergencies).

The second most preferred option was to discharge Mr. J out of the ICU (option 3) to admit Mrs. S (seven participants, 30%). Participants judged Mr. J to be safe to move due to his condition being chronic and having stabilised. However, four participants (17%), all SDs, considered the most risky, as it would disrupt the care of a recently stabilised patient being treated for encephalopathy.

The third most preferred option was to discharge Miss C out of the ICU (option 4) so to admit Mr. S (two participants, 8%). This was due to her being extubated and thus no longer requiring strictly defined ICU-care. Five participants judged this to be highly risky (21%) due to the ongoing risk that Miss C could deteriorate rapidly, and require re-admittance to the (now full) ICU. Finally, two participants (8%) decided to transfer Mrs. S to another hospital (option 1), as her condition had stabilised, and resources were available elsewhere in the system. Half of participants ($n$ = 12) considered this to be highly unsafe, due to the risks associated with hospital transfers (e.g. patient deterioration in an ambulance).

#### *4.1.3. Summary*

The analysis showed clinicians to report substantial practice variations in their decision preferences for ICU risk trade-off scenarios. We explore the factors underlying this below.

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**Table 3.** Decision-making for scenario 2 (bumping).

| Participant (role, hospital) | Option selection? | Key reason(s) |
|---|---|---|
| 1 (JT, H1) | Best: 1 (transfer to another hospital) | Easier and more stable option to transfer patient to another hospital |
| | Worst: 4 (transfer Miss C to create bed) | Miss C may become unstable again, and another patient will have to be moved to re-admit her to ICU |
| 2 (JT, H1) | Best: 3 (transfer Mr. J to create bed) | Mr. J seems stable, and only requires a low form of ventilation that can be provided elsewhere |
| | Worst: 4 (transfer Miss C to create bed) | Miss C may become unstable again, and it is important to provide her with continuous care |
| 3 (JT, H1) | Best: 2. (treat in operating theatre) | Patient may well need to go back to theatre at some point if she starts bleeding, and therefore would be in the right place |
| | Worst: 1 (transfer to another hospital) | Patient transfers always have a high level of risk |
| 4 (JT, H2) | Best: 3 (transfer Mr. J to create bed) | Mr. J is the 'least' risky patient to move as he has a chronic condition that should be treated on the ward |
| | Worst: 1 (transfer to another hospital) | Patient has lost a lot of blood and needed a lot of products, and if she bled during transfer she is likely to die. |
| 5 (JT, H2) | Best: 3 (transfer Mr. J to create bed) | Patient is breathing on a tracheotomy and thus could likely be managed on a ward |
| | Worst: 1 (transfer to another hospital) | Patient may suffer a complication during transfer, and not receive necessary support |
| 6 (JT, H2) | Best: 4 (transfer Miss C to create bed) | Miss C is extubated and does not require ICU any longer, and could be monitored easily in a acute medical ward |
| | Worst: 1 (transfer to another hospital | Patient has had a major obstetric haemorrhage and a transfer would be high risk |
| 7 (JT, H1) | Best: 2 (treat in operating theatre) | Ventilatory support can be provided in the operating theatre, and this avoids putting other patients at risk |
| | Worst: 1 (transfer to another hospital | Patient is not stable to transfer as her heart rate is still high and her haemoglobin is low |
| 8 (JT, H1) | Best: 2 (treat in operating theatre) | Patient requires management of tracheostomy, but can be cared for adequately in operating theatre |
| | Worst: 4 (transfer Miss C to create bed | Patient only just extubated, and has recently had a pulmonary oedema, and thus would be dangerous to move |
| 9 (ST, H1) | Best: 3 (transfer Mr. J to create bed) | Mr. J is stable, has been in ICU for a long-time, and should be transferred out |
| | Worst: 4 (transfer Miss C to create bed) | Miss C is not stable, and primary care of duty is to current patients |
| 10 (ST, H2) | Best: 2. (treat in operating theatre) | Patient can receive ventilatory support in operating theatre, and this is safer than discharging current patients |
| | Worst: 1 (transfer to another hospital) | Risky to move an unstable patient |
| 11 (ST, H1) | Best: 3 (transfer Mr. J to create bed) | Patient will have a tracheotomy mask which a respiratory ward or high dependency ward should be able to cope with |
| | Worst: 2 (treat in operating theatre) | Monitoring the patient in an operating theatre would be a drain on resources as it would require an anaesthetist and a nurse |
| 12 (ST, H2) | Best: 3 (transfer Mr. J to create bed) | Mr. JS is on oxygen and is recovering from a tracheotomy so he would be safe to move in order to create a bed for Mrs. S |
| | Worst: 1 (transfer to another hospital | Creates logistical demands and puts patient at risk |
| 13 (ST, H2) | Best: 2. (treat in operating theatre) | Patient may require further treatment in operating theatre, so it makes sense to continue closely monitoring her there |
| | Worst: 1 (transfer to another hospital | Creates logistical demands and puts patient at risk |
| 14 (ST, H3) | Best: 3 (transfer Mr. J to create bed) | Mr. JS has been on the unit for some time, and appears ready to move onto an acute unit |
| | Worst: 2: (treat in operating theatre) | Patient requires 24 h cover care, and fully-trained ICU nurses to manage her recovery |
| 15 (ST, H3) | Best: 4 (transfer Miss C to create bed | Miss C is extubated and can be observed in an acute ward |
| | Worst: 2: (treat in operating theatre) | Patient requires ICU ventilators, and requires monitoring by fully-trained ICU nurses |
| 16 (ST, H3) | Best: 2 (treat in operating theatre) | Patient has stabilised, and can be monitored effectively in the operating theatre |
| | Worst: 3 (transfer Mr. J to create bed) | Dangerous to transfer patients with unclear airways in the evening, especially if they are settled in ICU |
| 17 (SD, H1) | Best: 1 (transfer to another hospital) | Patient can be stabilised and safely moved elsewhere where they will receive continuous care |
| | Worst: 3 (transfer Mr. J to create bed) | Not in the best interest of the current patients to move them out of the unit. |
| 18 (SD, H2) | Best: 2. (treat in operating theatre) | Operating theatre can provides ICU-level support, and this is better than creating new risks through transferring other patients |
| | Worst: 1 (transfer to another hospital) | Patient could have a secondary bleed during transfer |
| 19 (SD, H2) | Best: 2. (treat in operating theatre) | Patient can receive ventilatory and ICU-level support in operating theatre, although this does tie up resources |
| | Worst: 1 (transfer to another hospital) | Obstetric patients should never be transferred after a bleed |
| 20 (SD, H3) | Best: 2. (treat in operating theatre) | Patient can be ventilated and monitored safely in the operating theatre |
| | Worst: 4 (transfer Miss C to create bed) | If patient can be cared for in the operating theatre, it would not be appropriate to create risks for other patients |
| 21 (SD, H2) | Best: 2 (treat in operating theatre) | Patient can be monitored effectively in the operating theatre, and a bed is likely to become free in ICU the next day |
| | Worst: 3 (transfer Mr. J to create bed) | Although Mr. J is recovering, the ICU has a duty of care, and it is not right to put him at risk in order to benefit another patient |
| 22 (SD, H1) | Best: 2 (treat in operating theatre) | Although in operating theatre, patient would receive intensive care in terms of nursing and medical input |
| | Worst: 1 (transfer to another hospital | Places patient at risk, as they may deteriorate during transfer |
| 23 (SD, H3) | Best: 2 (treat in operating theatre) | Provided sufficient nursing staff are available, the patient could be appropriately monitored overnight until a bed is found |
| | Worst: 3 (transfer Mr. J to create bed) | Patient has encephalopathy and a tracheostomy, and would not be safe or possible to move |
| 24 (SD, H3) | Best: 2 (treat in operating theatre) | Patient can be monitored safely, and this option is least disruptive to other patients |
| | Worst: 1 (transfer to another hospital | Patient is not stable and would be put at risk by a transfer |

Notes: SD = Senior ICU doctor; ST = Senior ICU trainee doctor; JT = Junior ICU trainee doctor.
H1 = Hospital 1; H2 = Hospital 2; H3 = Hospital 3.
[a]See Table 3 for full options.

### 4.2. Factors influencing risk trade-off decisions in the ICU

The inductive analysis revealed a range of factors to influence clinician decision preferences. To facilitate and structure the interpretation and reporting of these, we utilised the aforementioned theory on cost–benefit analyses, framing effects upon decision-making, experience and expertise, and organisational and group norms for decision-making.

#### 4.2.1. Cost–benefit analyses

Cost–benefit analyses relate to evaluations on whether the benefits of taking one decision option exceed those of an alternative (Bertsimas, Farias, and Trichakis 2012; Pauker and Kassirer 1975). For both scenarios, clinicians considered at length the benefits and costs of engaging in comparative courses of action.

For example, in terms of the potential costs of inappropriately admitting Mr. GS to ICU against not admitting him when he might benefit from intensive care (admissions scenario). In this case, most clinicians ($n$ = 21) indicated that Mr. GS was probably not suitable for ICU (due to the irreversibility of his condition), and four participants immediately argued that 'good palliative care in this type of patient' would be technically more appropriate than ICU. However, despite the conclusions of their cost–benefit analyses, twelve participants were not willing to refuse ICU care to Mr. GS due to the concern that they would effectively be deciding to end his life.

For the 'bumping scenario', decision preferences also emerged from cost–benefit evaluations, with most participants ($n$ = 21) ruling out the riskiest options immediately. However, there were substantial variations in what was evaluated as risky (Table 3). For example, five participants judged moving Mr. J to another unit (to create a bed) a low-risk option as 'he seems stable… and has a form of ventilation that can be provided elsewhere' and is on an upwards trajectory and so can be 'transferred relatively safely'. Conversely, for other clinicians transferring Mr. J was a high-risk option as 'he's still got a tracheostomy, he's still clearly unwell', and moving someone who is 'potentially agitated, confused, disorientated and with an airways situation overnight would be risky'. In considering bumping a patient in order to admit Mrs. S, all participants explored the notion that 'in some ways your loyalties lie with the sickest patient who needs your help', and whether the risks created by bumping a patient were justifiable even if it improved the chances of recovery for Mrs. S. To explore this, sixteen clinicians anticipated the likely trajectory of the bump-able patients. For example, in terms of this risks facing Mr. J: 'he is not terribly stable he could deteriorate, and then what do you do if he deteriorates on the ward because now you have no bed to re-admit him?', and the risks facing Miss C where the danger is 'she crashes and continues to bleed and you've lost her life'.

Thus, cost–benefit decisions appear central to risk trade-offs in intensive care. Yet the uncertainty within each decision scenario meant that clinicians reached different – and sometimes oppositional conclusions – on how risk should be managed.

#### 4.2.2. Framing effects

Framing effects describe how personal and contextual factors can influence decision preferences. For example, research shows how judgements can be inconsistent with 'rational' assessments of a scenario due to tendencies for avoiding losses (Croskerry 2003; Kahneman, Slovic, and Tversky 1982), and in ICU, that perspectives on care (e.g. on one's responsibilities) can determine how a problem is approached (Fackler et al. 2009). In the current study, framing effects appeared relevant.

For example, decisions on admissions were often based on assessments of Mr. GS' potential post-ICU quality of life, and a concern on hurrying his death, despite the potential consequences for other patients. Most participants ($n$ = 21) agreed that even if Mr. GS could be stabilised, he would likely require permanent oxygen or ventilator support (with a poor long-term prognosis). Yet, the implications of this were framed differently. Some ($n$ = 7) argued that the 'the remainder of life attached to any oxygen tank would be no life', and were concerned over causing discomfort to a seriously ill man: 'there's a cost to the patient … (they) describe it (receiving a tracheotomy) like people coming towards them with iron, red hot irons poking into their tracheas'. For those supporting admission, ICU care presented a chance for life, and that being 'hooked up to an oxygen tank' would be acceptable for some patients as their 'grandchildren can come round' and they can have 'their fags and day time TV'. Thus, decision-making became focused on more subjective notions of quality of life, patient comfort and distress, and the role of clinicians in allowing death.

In terms of evaluating decision-options, framing effects were also found to shape decision-preferences. For example, in scenario 2 (bumping), participants attempted to compare patients in order to assess which would benefit most from ICU care: 'Miss C is on a recovering trajectory and Mrs. S is an unknown trajectory … therefore to me she is more at risk because she is an unknown quantity whereas there's already some information coming from Miss C'. In some cases this was challenging, as the benefits of ICU care were not simply considered in terms of immediate clinical benefit to patients, but also wider considerations relating to the value of life: 'you have to ask the question … do you want to risk the life of a 19 year old or a 75 year old with

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chronic disease? That's the decision between those two and it's obviously not an easy one'.

Finally, the frame of decision-making varied according to experience and role. Specifically, for scenario 2 (bumping), no SD advocated bumping a patient. All advocated holding Mrs. S in an operating theatre overnight, with the trade-off being that an anaesthetist and nurse would be unable to treat other patients. To explain this, SDs discussed the notion of '*distributive justice*', which relates to maintaining equity in health care delivery through considering how decisions for a patient influences others in a multi-patient system (Beach et al. 2005). They argued that 'there's a finite resource and a finite number of beds', and it is necessary to maintain fairness through ensuring 'everybody has equal access' and recognising 'you have a primary responsibility to the people who are your patients in the first place'. Thus, SDs (unlike most STs and all JTs) preferred to avoid the proximal and fairly certain risks of bumping a patient, and instead preferred to move the cost of caring for Mrs. S into the wider system.

#### 4.2.3. Experience

NDM research has long-focused on the role of experience and expertise in decision-making (Flin, Youngson, and Yule 2007; Klein 2008). Experts are generally shown to be more efficient and effective at identifying solutions for previously experienced situations.

In the current study, STs and SDs ($n$ = 16) frequently referred to previous patients. In particular, for the admissions scenario, they discussed how previous patients similar to Mr. GS influenced decision-making. Whilst acknowledging 'there are no crystal balls in medicine', all SDs and STs stated that from their experience such patients generally have a protracted ICU stay, followed by death.

Yet, SDs often adopted a counterfactual position, whereby they reflected on 'exceptional' cases where patients they had deemed unsuitable for ICU were admitted (by another doctor) and had survived: 'I think the trouble is as time goes on you are surprised that some people make it … people surprise you and the people you think have no chance actually sometimes do okay'. Along these lines, SDs reflected on their previous experiences ($n$ = 8), and how their approach to patients such as Mr. GS had changed: 'as a junior you're on the wards and you very much think "for Christ sake why are they doing this"… but as you get older you've been proved wrong maybe once or twice and you become a bit more cautious'. Whilst judgements were also influenced by previously successful cases, the memory of exceptional patients that had caused SDs to doubt or question their decision-making capabilities were especially salient in considering the scenarios. This deviates from the RPD model, with experience introducing uncertainty into decisions that might appear intuitive (Klein, Calderwood, and Clinton-Cirocco 2010).

Senior trainee doctors also tended to draw on previous (but primarily successful) cases to reflect on decision-making, whilst JTs – who often had limited experiences for admissions and bumping scenarios – tended to focus on the clinical parameters of each scenario.

#### 4.2.4. Organisational and group norms

Organisational and social psychology research shows that decision-making on risk is often influenced by social norms for how risk is understood and responded to (Bettenhausen and Murnighan 1985; Gore et al. 2006; Trevino 1986). This appeared relevant for both scenarios.

For example, fourteen participants discussed the impact of local norms on decision-making, with JTs all having worked recently in other hospitals. For example, in terms of organisational norms 'the threshold is different…I have worked in XXXX with patients who are very sick and a lot of people with COPD, Mr. GS would never get in to ICU but here you really would (admit)'. In addition, nineteen participants discussed the importance of meeting team and group expectations: 'there has to be a degree of conformity…with your surrounding colleagues … even if you are making a decision on your own you work in conjunction with other specialties and other healthcare professionals'.

This indicates that clinicians consider judgements on trade-off decisions in the context of what is 'normal' to colleagues and the hospital, with implications for patients treated in different ICUs.

#### 4.2.5. Summary

ICU clinicians report a range of factors relating to cost–benefit analyses, framing, experience, and organisational and group norms as underlying their decision preferences for risk trade-off scenarios. Table 4 synthesises the qualitative analysis, and provides an initial set of theoretically-derived contextual factors influencing risk trade-offs in ICU.

## 5. Discussion

Though utilising a vignette methodology, this study examined risk trade-offs in ICU. Practice variations were found for the decision preferences of clinicians for admissions and bumping scenarios. These are uncertain situations with potentially life and death implications for patients. It is highly difficult – if not impossible – for clinicians to be certain that one path of action is safer than another. To navigate risk, clinicians drew on criteria and knowledge from cost–benefit analyses, 'frames' for understanding and contextualising decisions, past experiences, and organisational and group norms. Whilst this facilitated evaluations

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**Table 4.** Factors influencing risk trade-offs in ICU.

| Factor | Description | Examples from ICU admissions and bumping scenarios |
|---|---|---|
| Cost/benefit analysis | Evaluations on whether the costs/benefits of taking one decision option exceed those of an alternative | • Costs of inappropriately admitting a patient to ICU is compared against the cost of not admitting a patient who is suitable<br>• Different courses of action are compared against each other in terms of their riskiness |
| Framing | Perspectives on a decision scenario that shape how risk is understood and managed | • Beliefs about possibility and acceptability of quality-of-life post-ICU care<br>• Reluctance to hurry the death of an already dying patient, despite the impact upon resources<br>• Comparisons of candidates for ICU care according to clinical factors and broader considerations on the value of a 'young' or 'old' life<br>• Perspectives on care, for example in terms of preferences for creating distal risks (e.g. in the wider hospital system) rather than proximal risks (e.g. to current patients)<br>• Philosophies on equity and fairness in health care delivery, and that current patients must always take priority over those being admitted |
| Experience | Previous experiences of the risk-trade-off scenarios that influence decision-making | • Where appropriate, past trade-off situations in ICU are recalled and used to anticipate likely future outcomes<br>• For the most experienced, instances of unsuccessful decision-making are also recalled, and ensure caution in decision-making<br>• Where past experiences are not available, decisions are primarily based on observed clinical and patient factors |
| Organisational and group norms | Organisational and group norms on decisions for risk trade-off | • Decisions are expected to be consistent with clinical team expectations.<br>• Clinicians consider judgements on trade-off decisions in the context of what is 'normal' to colleagues and the hospital |

of the risk trade-offs, the highly individualised nature of decision-making introduced practice variations. We consider the implications below.

### 5.1. Theoretical implications

Clinical decision-making is often examined from a rational/utilitarian perspective, whereby decision errors emerge from misjudgements or bias (Croskerry 2003; Sox and Higgins, and Owens 2013). The current study indicates that whilst decisions for risk trade-offs do utilise rational assessments, in environments such as ICU, the uncertain nature of decision-making means that the outcomes of cost/benefit evaluations vary from to clinician-to-clinician, and decision preferences are often formed using quite subjective criteria. For example, perspectives about quality-of-life, memories of previous experiences, and normative belief structures. Practice variations do not necessarily emerge from error (Croskerry, Singhal, and Mamede 2013), but instead reflect an interaction between risk assessment and individual knowledge belief structures (Dekker 2011). Nonetheless, there are potential implications for patient safety.

For example, research on admissions and bumping shows practices vary considerably at an institutional level, with direct impact upon patients (e.g. ICUs that refuse high numbers of appropriate patients have poorer clinical outcomes) (Garrouste-Orgeas et al. 2009; Sinuff et al. 2004). Whilst these variations may occur for a myriad of reasons (e.g. economic), the current study indicates practice variations amongst clinicians for risk trade-offs may also be a factor. Although these are not necessarily a product of human error, questions emerge over whether patient safety might be improved through more standardised forms of decision-making that enhance the likelihood of optimal decision-making in these highly complex scenarios (e.g. though comparing ICUs with differential outcomes in order to establish best-practice). Yet, questions emerge over the extent to which decision-making for risk trade-offs such as admissions and bumping can be standardised. In particular, for decisions with end-of-life implications, clinicians argue the importance of being able to act ethically and with discretion, alongside making clinically defensible decisions (Stevens et al. 2002).

In terms of the risk trade-off literature, the study has implications. Risk trade-offs have traditionally been examined for more classical probabilistic scenarios (e.g. economic decisions) (Phillips and e Costa 2007), and we applied the concept to safety-critical workplaces. Here, we propose risk trade-offs refer to comparing options to determine the safest – or least risky – course of action. Whilst cost–benefit analyses (traditionally the focus of risk trade-off studies) were important for evaluating options,

the criticality and uncertainty of the scenarios meant decision-makers utilised more subjective and personalised criteria to make decisions. The current study outlines those criteria, and future research may investigate whether they apply to other safety-related risk trade-off scenarios, or whether alternative factors (not identified here) are also important.

Finally, the study also provided useful insight for NDM theory. In particular, compared to JTs, SDs often described the difficulties of knowing what a 'correct' decision was due to their own perceived past misjudgements for decision-making on admissions and bumping. This suggests expertise acted as a 'brake' on intuitive decision-making, and indicates an alternative avenue of research for investigations on the recognition primed decision-making model (Klein 1993).

### 5.2. Practical implications

Whilst ICU-level variations for admissions and bumping decisions have been show to influence patient outcomes (Sinuff et al. 2004), it is questionable whether easy solutions are available. These risk trade-offs emerge due to resource constraints in ICU, and guidelines are deliberately vague in order to provide clinicians flexibility in decision-making. This is because the environment in which decisions are made is highly dynamic (e.g. staff levels, patient numbers, severity of illnesses), and decisions have to fit operational constraints. The introduction of procedures and protocols to structure such decisions would limit the ability of clinicians to do this, whilst also indicating there is a 'right' solution for highly complex scenarios. Furthermore, relying on population data to support decision-making can be of modest value, as it often fails to predict individual outcome, and is not always valued by families and other surrogates.

Yet, if practice variations are occurring for highly similar risk trade-off scenarios, it implies some patients may be experiencing sub-optimal decision-making. Balancing uncertainties is a permanent feature of clinical decision-making, and patient safety could be improved through ensuring consistency and equity in clinical trade-off decisions. This might involve supporting the restriction of 'gate-keeping' decisions to a small number of people, with more decisions being made collectively in smaller expert groups. This has been indicated as effective in domains such as cancer care (Lamb et al. 2013), although groups can also show practice variations in terms making risk-related decisions (Isenberg 1986). In addition, formalising training for specific risk trade-offs into educational programmes would help to bring consistency in decision-making, for example through providing insight on the how such complex decisions might be made, and through supporting clinician' understanding of how judgements are influenced by psychological and contextual factors.

### 5.3. Limitations

Study limitations were the following. First, the methodology utilised vignettes, and we cannot ascertain whether responses to the scenarios correspond to clinical behaviours (we did not validate the results against clinician behaviours for actual admissions/bumping situations). Second, whilst our pilot group and participants reported that the decision scenarios were clinically realistic, and provided ample information, their ecological validity is low. For example, whilst the scenarios were based around common dilemmas in ICU, the time-pressure, affect, social dynamics and possibility to investigate further was absent. The study prioritised control of the scenarios and deeper reflections on decision-making over situational fidelity. Future simulator-based studies would be able to explore risk trade-offs with higher realism (e.g. in a team), and to validate the data collected through the vignettes. Third, the sample for different sub-groups was relatively small, and this reflects the difficulties of accessing ICU clinicians. Fourth, because the qualitative analysis relied on inductive and then deductive analyses, reliability statistics were not applied. Furthermore, a limited set of theoretical constructs were used to analyse the qualitative data, and these were chosen according to the knowledge and backgrounds of the study investigators. Finally, the generalisability of the findings requires further testing.

## 6. Conclusions

Risk trade-offs are core to health care delivery. However, because they can involve allocating resources to one patient at the expense of another, they have serious implications for patients. Utilising a vignette methodology, we found clinicians to use cost–benefit analyses, 'frames' for understanding and contextualising decisions, past experiences, and organisational and group norms to help them navigate the uncertainties and complexities of ICU 'admissions' and 'bumping' scenarios. Whilst these allowed clinicians to navigate the risk trade-off scenarios, they also introduced practice variations in decision preferences, with potential consequences for patient safety.

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