UK Intensivists' preferences for patient admission to ICU: Evidence from a Choice Experiment
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Abstract

Objective: Deciding whether to admit a patient to the intensive care unit (ICU) requires considering several clinical and non-clinical factors. Studies have investigated factors associated with the decision but have not explored the relative importance of different factors, nor the interaction between factors on decision-making. We examined how ICU consultants prioritise specific factors when deciding whether to admit a patient to ICU.

Design: Informed by a literature review and data from observation and interviews with ICU clinicians we designed a choice experiment (CE). Senior intensive care doctors (consultants) were presented with pairs of patient profiles and asked to prioritise one of the patients in each task for admission to ICU. A multinomial logit and a latent class logit model was used for the data analyses.

Setting: On-line survey across UK intensive care.

Participants: Intensive care consultants working in NHS hospitals.

Results: Of the factors investigated, patient's age had the largest impact on admission followed by the views of their family, and severity of their main co-morbidity. Physiological measures indicating severity of illness had less impact than the gestalt assessment by the ICU registrar. We identified four distinct decision-making patterns, defined by the relative importance given to different factors.

Conclusion: ICU consultants vary in the importance they give to different factors in deciding who to prioritise for ICU admission. Transparency regarding which factors have been considered in the decision-making process could reduce variability and potential inequity for patients.

Introduction

The decision whether to admit a patient to the intensive care unit (ICU) can be complex and difficult. ICU provides potentially lifesaving treatments unavailable elsewhere in the hospital. For patients unlikely to survive this can mean enduring invasive and distressing therapies rather than benefiting from supportive ward-based or palliative care. Often doctors make such decisions in situations of clinical uncertainty, with limited time, and unable to discuss treatment with the patient due to the severity of their illness. There are few relevant prognostic indicator tools and limited professional guidance to support doctors making these decisions. It is therefore unsurprising that there is substantial variability in how such decisions are made (1).

Studies have explored a range of factors that may influence whether a patient is admitted to ICU including: severity of acute illness (2-9); severity of co-morbidities (5, 10-13); functional status of patient (3,5, 14-20); clinical trajectory of patient's condition (13,16,21,22); patient's age (3,5,6,11,13,14, 23,24); patient's gender (11,24,25,26,); insurance status of patient (in USA) (12,) and availability of ICU resources (2-5, 7,12,13,15,17). These studies are of variable quality, and heterogeneity of results make it difficult to draw generalizable conclusions. Further, methods used do not allow for comparison of the relative importance of these factors, or exploration of interactions between factors.

We examined how senior intensive care doctors (consultants) prioritise factors when making decisions about whether to admit a patient to ICU. We also investigated how they differ in their preferences.

Methods

Design: The study used an economics approach, choice experiment (CE), widely used in health-care to understand preferences in decision-making (27,28). We determined how consultants used patient-related information to make ICU admission decisions, specifically whether a factor played a significant role in their decision-making; the type of influence it had (i.e., increase/decrease the probability of admission); and which factors exert the greatest influence on decisions.

Development of the CE: This study was part of the project: "Understanding and improving the decision-making process surrounding admission to the intensive care unit" which included a systematic review of factors influencing ICU admission and an ethnographic study of the decision-making process at six UK hospitals (29).

A planned interim analysis of data from the systematic review and the ethnographic study was used to identify factors to be included in the CE. The systematic review identified 88 studies investigating factors associated with decisions around admission to ICU. We analysed data from observations of 15 ICU referrals and interviews with 20 ICU doctors from two NHS hospitals in our ethnographic study, at which point no additional new information with regard to factors influencing admission decisions (the specific objective of this analysis) was emerging from the data.

We coded observation field notes and interview transcripts for influences on the decision-making process and categorised codes into factors that were mapped to factors identified in the systematic review to check for congruence and any additional factors. For example, the gestalt assessment of the patient (the "look" of the patient) did not feature as a factor in the literature but emerged from the qualitative data. Table S1 in the supplementary material provides more detail of how the systematic review and qualitative data informed the development of the CE.

The final list of factors included in the CE (Table 1) were all patient-related. Factors were allocated levels corresponding to clinical situations observed during the ethnographic study. Severity of acute illness of the patient was included as both physiological parameters and the UK National Early Warning Score (NEWS). Levels of co-morbidities were selected to reflect comparable stages of disease: peri-diagnosis, established disease, advanced disease with limited survival

Patient profiles were generated using experimental design methods (30), resulting in 24 choice tasks. To reduce cognitive burden each respondent faced 12 choice tasks. A warm-up choice task and two data quality check tasks were added. In each choice task, two hypothetical patient profiles were presented, and participants were asked three related questions: (i) would you admit patient A? (Yes/No); (ii) would you admit patient B? (Yes/No); (iii) which patient should be given priority for admission? (Patient A/B) (Figure 1). Information was collected on participants' socio-demographic characteristics and response times. The CE tool was delivered on-line by ClinVivo Limited http://www.clinvivo.com/.

Participant recruitment: We recruited NHS hospitals through regional clinical research networks (that support recruitment to research across the NHS). In participating hospitals an invitation to participate and link to the CE was distributed to senior ICU doctors (consultants). An invitation was also emailed to all consultant members of the UK intensive care society. Participants could indicate which hospital they worked at, but this was not required. No financial incentive was received. Completion of the survey was interpreted as implied consent. Ethical approval for the project was obtained from the Coventry and Warwickshire Research Ethics Committee (15/WM/0025).

Sample size: Using standard sample size calculations for CEs, a minimum of 146 ICU consultants were required (31). We doubled this to explore how preferences differed among ICU consultants. See supplementary material for information on sample size calculations.

Analysis: We assessed the quality of the choice data using standard criteria (desirability; stability; logical consistency; response time; see supplementary material). We specified a multinomial logit (MNL) model to estimate the effects of changes in patient-related factors (e.g., increasing patient's age from 66 to 79 years) on the probability of admitting the patient to ICU. We report odds ratios (ORs), indicating changes in the likelihood of a patient's admission to ICU when one factor changes. Using the MNL parameter estimates we calculate the relative importance (RI) each attribute makes to the referral decision; this is calculated as the difference in the range of attribute's parameter values. We calculate percentages from these relative ranges, obtaining a set of attribute importance values that add to 100% (32).

Differences among ICU consultants in their preference patterns for patient admission were estimated using a latent class logit (LCL) model (33). We again estimate RI scores for attributes, as described above. Given that eight factors were used to describe patients' profiles, a perfectly balanced decision-making would result in a 12.5% score of relative importance (RI) for each factor (100/8). This was used as a benchmark to determine whether the consultants' decision-making is biased towards any factor. We analysed effects of consultants' personal characteristics on their membership of a preference pattern group.

We further explored preferences by investigating the relationship between type and severity of co-morbidity i.e. does the importance of type of co-morbidity in the referral decision depend on severity

of co-morbidity? To do this we re-estimated the MNL model with additional interaction effects between preferences for type and severity of main co-morbidity.

Results

The CE opened in April and remained open until we had achieved the necessary sample size, closing in June 2016 with 303 consultants from at least 48 different UK hospitals, completing the questionnaire. (The Faculty of Intensive Care Medicine (FICM) database includes 2377 consultants). Our sample reflects the gender and age mix of ICU consultants in the UK; 79.5% of respondents were male (compared to 78.2% of FICM registered consultants), 21.1% were aged under 40 and 28.1% over 50 years. The 2017 FICM unpublished workforce survey (39% response rate) reported that 19% of consultant responders were under 40 and 37% over 50 years (34). 76.9% of our respondents had worked in ICU for more than ten years and 33.6% worked in a university hospital. All respondents will have completed ICU specialty training.

The quality of responses was high, with 73.6% of participants meeting all four quality criteria. No participants failed more than two tests. There was no systematic relationship between consultants' personal characteristics and the quality of their choices. See supplementary material, including Tables S2 and S3). All responses were included in the final analyses.

Impact of patient related factors on referral decisions

All eight factors had a significant effect on the decision to admit (Table 2). All three age-related parameters were significant and positive, with younger patients more likely to be admitted. Patients with good functional status, more severe acute illness, subjectively reported as struggling by the registrar, on a ward with reduced nursing capacity, or whose family insist on admissions were more likely to be admitted.

Patients' age had the largest influence on consultants' decisions (Relative importance (RI)= 23.9%) with 39-year-old patients 12 times and 66-year-old patients 5 times more likely to be admitted than 89-year-old patients. This is followed by family views (RI= 19.9%). When the family is against admission, the patient is 6 times less likely to be admitted. The third most important effect is severity of co-morbidity (RI= 17.9%). Patients with mild co-morbidity are 6.4 times more likely to be admitted than those with severe co-morbidity. Least important are type of main co-morbidity (RI= 3.8%), patient's safety in non-ICU ward (RI= 2.5%), and the severity of acute condition (RI= 7.5%). Patients with COPD, heart failure, or dementia are 1.04, 1.34 and 1.48 times less likely to be admitted than patients with prostate cancer.

Differences among ICU consultants in their preferences for patient admission

Four preference patterns were identified (see Figure 2 and Table S4 in supplementary material for detailed results). Preference pattern 1 is described as "age-oriented" (giving relatively more weight to age); 2 as "age-dominant" (decisions based mainly on age); 3 as "holistic" (similar importance to all factors); and 4 "family-dominant" (decisions mainly driven by family's views). These four patterns represent 31% (pattern 1), 33.2% (pattern 2), 17.4% (pattern 3) and 18.4% (pattern 4) of participants.

Effects of consultants' personal characteristics on their preference patterns

Six effects reach significance at the 5% level (see supplementary information, Table S5): consultants older than 40 years are more likely to belong to preference pattern 1 and 3 than 4 compared to younger consultants. This is especially true for consultants older than 50 years. Consultants working in a medium-size ICU (11-19 beds) and in a University hospital are less likely to belong to preference patterns 1 and 3 respectively.

Interaction between type and severity of co-morbidity

Increasing severity of all co-morbidities was associated with a decreased likelihood of admission to ICU, however differences were observed across co-morbidities (Figure 3; see Table S6 in supplementary material for corresponding data). For a mild level of severity, patients in all four co-morbidity groups were more likely to be admitted than patients with severe prostate cancer. However, for moderate severity, the probability of ICU admission fell only in patients with COPD. At the most severe level, dementia was the co-morbidity most likely to result in the patient not being admitted to ICU, followed by heart failure, then COPD.

Discussion

This study investigated the relative importance ICU consultants give to patient-related factors when deciding whether to admit to ICU. Of the factors examined, the most impactful are patient's age, views of their family, and severity of main co-morbidity. The acute physiological parameters of the patient had less impact than the subjective assessment of the registrar about how ill the patient looked. Both these acute illness assessments had less impact than age, co-morbidity and functional status. Four preference patterns emerged: "age oriented", "age dominant", "holistic", and "family dominant". Notably, the importance given to physiological parameters as an indicator of severity and to views of the patient's family significantly differs across preference patterns. We also found that the relative effect of the type of co-morbidity depends on the severity of that co-morbidity.

Numerous studies have shown that increasing age is associated with refusal of admission to ICU (3,5,6,11,13,14,23,24). Older patients often have several co-morbidities and reduced physiological reserve compared to younger patients. Our study suggests that age has an influence independent of this association. It may be that ICU consultants are consciously or subconsciously discriminating

against older patients, or that there is an implicit linking of age with reduced capacity to benefit over and above other objective considerations. Alternatively, consultants may use age as a proxy for capacity to recover when other information such as functional reserve or co-morbidity is unavailable, and this heuristic is maintained even when specific information is known. It is important that implicit assumptions are made explicit and justified to avoid unfair discrimination, particularly in the context of an ageing population and equality legislation.

Existing literature supports our finding that severity of the patient's acute illness is not the primary factor influencing admission decisions. Studies including multivariate analysis of severity of acute illness assessed by a variety of measures have shown no clear effect on decision-making (2-9) despite an association with patient outcomes (35). In our ethnographic study, ICU consultants expressed a reluctance to rely on physiological parameters, placing more weight on their gestalt assessment of the patient. This is consistent with our respondents who were influenced more by the registrar's subjective report.

Few studies have explored the effect of patient or family preferences on admission to ICU; those which have report mixed findings (13,16,18). Our results suggest family views, when known, would have an influence on these decisions, particularly if this view is that the patient would not want to be admitted. This may reflect the legal framework in the UK which requires clinicians to consult those close to the patient if the patient lacks capacity, and take their views on the patient's wishes into consideration. However, there are practical difficulties in engaging with patients and families at the time these decisions need to be made so often their views are unknown. The use of advance directives and emergency care treatment plans can provide valuable information for clinicians (36), but more work is needed to explore how patient preferences can have a meaningful influence on these decisions.

Our finding that patients with mild severity of co-morbidity are more likely to be admitted suggests participants assess these patients as more likely to benefit from ICU. Evidence from a recent UK study on patient outcomes following ICU admission supports this assessment (37). This prioritisation reflects the gatekeeping role of ICU consultants in the UK i.e. responsible for minimising burden of ICU treatment while maximising potential benefit from a limited resource. The finding that for a given level of severity of co-morbidity patients with COPD, heart failure and dementia are less likely to be admitted than those with prostate cancer may also be linked to clinicians' perception of the patient's ability to benefit from ICU. There is evidence that ICU clinicians are overly pessimistic in estimating outcomes for patients with COPD and heart failure (38,39). In a resource-limited situation this undue prognostic pessimism may influence a clinician to prioritise admission for a patient who does not have these co-morbidities.

We find, unsurprisingly, variability in consultants' preference patterns. Clinical judgments are often made in complex and uncertain situations, where clinicians may rely on heuristics and be influenced by "availability bias" (where own experience with a condition has more importance than objective weighing of the evidence, (40,41). Transparency regarding which factors have been considered in the decision-making process could reduce variability and potential inequity for patients. Understanding by clinicians of their own cognitive biases (42,) and what influences them is a necessary part of improving practice. With this in mind, and looking forward, we have developed decision-making simulators which consultants can use to observe how their probability of admitting a given patient would be influenced by changes in the patient's profile. Consultants can also see to which preference pattern group they are more likely to belong (available at https://warwick.ac.uk/fac/med/research/hscience/sssh/research/intensive/). Similar studies in different health care systems and further qualitative exploration of the decision-making process

will help to explicate and make more transparent the wider contextual influences on these difficult and complex decisions.

This is the first study to use a CE to look at relative importance of patient-related factors for decisions to admit to intensive care and explore the interaction between different factors on decision-making. A strength of our study is the use of observational data to inform the CE. We identified factors not seen in the literature but which our observations indicated were important in clinical practice e.g. "look of the patient" and capacity of the ward to deliver care safely. Data quality was high, providing confidence in responses. Our results support previous findings of the importance of age but also confirmed our qualitative findings on the influence of gestalt assessment on these decisions. However, the study is limited by its design in that the cases do not take account of non-patient related factors and thus may not reflect the complex reality of these decisions. While our sample reflected the UK ICU consultant population with regard to demographic characteristics there may be other characteristics that affect its representativeness, for example responders are more likely to think this is an important issue. This study focussed on practice in the UK NHS. Future research could replicate our study in different countries to investigate the effects of social, professional, and regulatory differences on consultants' admission decisions.

Conclusion

ICU consultants place more priority on the age of a patient, the views of their family, and the severity of their co-morbidity than physiological prognostic scores when making admission decisions. However, consultants vary in their decision-making and how they prioritise these factors. Transparency regarding how factors are considered in the decision-making process could reduce variability and potential inequity for patients.

Ethical approval

The project was approved by the Coventry and Warwickshire research ethics committee (REC reference 15/WM/0025)

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Figure Legends

Figure 1. Illustration of the choice task format

Figure 2. Comparison of relative importance scores across the four preference patterns identified among respondents

Note: the dashed line indicates all attributes have equal importance i.e. relative importance = 12.5% (100/8).

Figure 3. ~~Influence of interaction of type and severity of co-morbidity~~

Associations between severity of co-morbidities and likelihood of admission to ICU

Note: The dashed line indicates a null effect on consultants' admission decisions (i.e. odds ratio = 1) with PCa_Severe is the reference category. All other effects estimated relative to this reference category. Corresponding model estimates are in supplementary material.

Table 1 Factors and levels in the choice experiment

Factors	Descriptor of level	Expected effect on ICU referral
Age	89 years	Reference
	79 years	Positive
	65 years	Positive
	39 years	Positive
Type of main co-morbidity	Prostate cancer	Reference
	Ischaemic heart disease	Unknown
	Chronic Obstructive Pulmonary Disease	Unknown
	Dementia	Unknown
Severity of main co-morbidity	For Ischaemic heart disease: Echo shows severe LV impairment; Numerous long hospital admissions; Biventricular pacemaker and on spironolactone and b.d. furosemide. For Chronic Obstructive Pulmonary Disease: FEV1 28% predicted; 2 hospital admissions for exacerbations in the last year. For prostate cancer: A recent CT scan revealed bone metastases. For dementia: Forget many recent conversations and needs some help washing and dressing; family say they remain contented.	Reference
	For Ischaemic heart disease: Moderate heart failure on echo; on regular furosemide and ramipril. For Chronic Obstructive Pulmonary Disease: FEV1 45% predicted; 3 courses of steroids and antibiotics over the last 12 months. For prostate cancer: Local spread on recent staging CT; on hormonal therapy with planned radiotherapy. For dementia: Started on Aricept in the last month.	Positive
	For Ischaemic heart disease: Previous MI; Recent echo shows LVH and a mildly decreased ejection fraction; on ramipril. For Chronic Obstructive Pulmonary Disease: FEV1 65% predicted; 1 course of steroids and antibiotics in the last year. For prostate cancer: On hormonal therapy. For dementia: Recently referred by GP to memory clinic for suspected diagnosis of dementia; otherwise well.	Positive

Functional status	Mobilises around the ground-floor of their home; cannot manage stairs. Has carers twice a day.	Reference
	Mobile to shops with family; has to rest climbing stairs.	Positive
	Mobilises independently; walks dog daily.	Positive
Severity of acute illness	NEWS 11	Positive
	NEWS 8	Positive
	NEWS 5	Reference
'Look of patient' as reported by registrar	Registrar saw the patient earlier and says that they look dreadful now.	Positive
	Registrar saw the patient earlier and tells you that they look like they are tiring.	Positive
	Registrar has seen the patient and tells you that they are stable, and "holding their own".	Reference
Safety (capacity) on referring ward	Patient is on a busy acute ward with 1 trained nurse per 8 patients; The ward sister is worried the ward cannot cope with looking after the patient.	Positive
	Patient is on a busy acute ward with 1 trained nurse per 4 patients; critical care outreach nurses are available to provide further support.	Reference
Family's views	The patient's family say that they think the patient would not want to be admitted to ICU.	Negative
	The patient's family say they have never discussed ICU admission or end-of life care: they will leave all the decisions to the medical team.	Reference
	The patient's family have already approached the ward doctors and said that they insist on the patient being admitted to ICU.	Positive

Table 2 Impact of patient related factors on ICU intensivists admission decisions

Investigated factor		Relative importance	Odds Ratio
Age (Reference: 89 years old)	*39 years*	23.9%	12.04[a]
	66 years		5[a]
	79 years		2.55[a]
Co-morbidity type (Reference: Prostate cancer)	*COPD*	3.8%	0.96[a]
	Dementia		0.68[a]
	Heart failure		0.75[a]
Co-morbidity severity (Reference: Severe)	*Mild*	17.9%	6.42[a]
	Moderate		4.08[a]
Functional status (Reference: Bad)	*Good*	14.3%	4.43[a]
	Intermediate		2.66[a]
NEWS (Reference: score = 5)	*11*	7.5%	2.19[a]
	8		1.13[a]
Look (Reference: Good)	*Bad*	10.2%	2.87[a]
	Intermediate		2.12[a]
Safety (Reference: Good)	*Bad*	2.5%	1.3[a]
Family views (Reference: Unsure)	*No*	19.9%	0.17[a]
	Yes		1.32[a]

Model statistics: 303 respondents; 7,272 observations; 19 model parameters; Log-likelihood = -5,663.4;
[a] significant at 1% level

Note: Relative importance (RI) is calculated as the difference in the range of attribute's parameter values; percentages are estimated from these relative ranges. The reference level for each attribute has a value of zero. As an example, the relative importance of Age is calculated as:

2.488 – 0 /(2.488-0) + (0 - - 0.391) + (1.859 – 0) + (1.489 – 0) + (0.784 – 0) + (1.055 – 0) + (0.26 – 0) + (0.277 - - 1.791) = 23.9%