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Caroline Goldfrad
Keryn Vella
Julian F. Bion
Kathy M. Rowan
Nick A. Black

Research priorities in critical care medicine in the UK

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C. Goldfrad · K. Vella · K. M. Rowan (✉)
Intensive Care National Audit and Research Centre, Tavistock House, Tavistock Square, London WC1H 9HR, UK
E-mail: J.F.Bion@bham.ac.uk
Phone: +44-121-4721311
Fax: +44-121-6272062

J. F. Bion
Intensive Care Medicine, University of Birmingham, N5 Queen Elizabeth Hospital, Birmingham B15 2TH, UK

N. A. Black
Department of Public Health & Policy, London School of Hygiene and Tropical Medicine, London WC1 E 7HT, UK

Abstract *Objectives*: To establish priorities for research in critical care medicine in the UK using survey and nominal group (NG) techniques.
Design: The senior doctor and nurse from 325 intensive care units (ICUs) in the UK were invited to contribute up to ten research questions relevant to intensive care organisation, practice or outcomes. These were then ranked twice using a Likert scale by a panel (nominal group) consisting of ten doctors (two trainees) and two nurses from university teaching and district general (community) hospitals. The first ratings were performed privately, and the second after group discussion. Thirty questions, ten each with strong, moderate or weak support, were then returned for rating by the originating ICU staff and the results compared with those of the NG.
Results: One hundred eighty-five respondents (35.6 % university teaching, 62.1 % district general, 2.3 % not stated) provided 811 questions of which 722 were research hypotheses. The most frequently identified topics were the evaluation of high dependency care, ICU characteristics, treatments for acute lung injury and acute renal failure, nurse:patient ratios, pulmonary artery catheterisation, aspects of medical and nursing practice, protocol evaluation, and interhospital transfers. These were condensed into 100 topics for consideration by the NG. Discussion and re-rating by the group resulted in strong support being offered for 37 topics, moderate support for 48, and weak support for 21. Following circulation of ten questions from each category, nine questions achieved strong support from both ICU staff and the NG. These were the effect on outcomes from critical illness of early intervention, high dependency care, nurse:patient ratios, interhospital transfers, early enteral feeding, optimisation of perioperative care, hospital type, regionalisation of paediatric intensive care and the use of pulmonary artery catheters. The absence of any questions relating to interventions targetting mediators of the immuno-inflammatory response could be a consequence of the failure of recent studies in sepsis to demonstrate benefits in outcome.
Conclusions: The intensive care community in the UK appears to prioritise research into organisational aspects of clinical practice and practical aspects of organ-system support. Health services research and the biological sciences need to develop collaborative methods for evaluating interventions and outcomes.

Key words Intensive care · Critical care · Consensus techniques · Nominal groups · Outcomes · Monitoring techniques · Health services

Introduction

Intensive care presents particular challenges for research. Heterogeneity of case mix and clinical practice, and comparatively small patient numbers, makes clinical and health services research difficult. However, intensive care has a substantial number of methods for case mix adjustment and several large observational databases. Once case mix-adjusted data are pooled from many intensive care units (ICUs), variations in clinical practice (for example, the use of a particular treatment or monitoring device) can become an asset rather than an obstacle for exploring differences in outcomes in multicentre projects.

A practical problem with multicentre research is that it requires a degree of commitment that may be difficult to sustain unless research priorities have been agreed by the participants. There might also be value in employing 'collective wisdom' to identify those research topics of greatest importance, as these are likely to motivate potential participants. Consensus development techniques offer methods for achieving these aims and for managing group decision making in the presence of uncertainty.

Formal consensus development techniques have been employed before to establish research priorities in nursing [1] and occupational medicine [2], as well as for establishing the appropriate use of interventions such as angioplasty [3] and to determine standards of practice [4, 5]. There are three methods: Delphi surveys, the use of expert panels or nominal groups (NGs) and consensus development conferences [6]. We have recently investigated one of these methods for determining research priorities for intensive care [7]. In this paper we present the clinical outcomes from that process.

Methods

Generation of research questions

Letters were sent during July 1998 to 325 ICUs in the UK, one copy to the clinical director/lead consultant and one to the senior nurse. We asked them to send us up to ten research questions that they considered important in the context of intensive care organisation, practice or outcomes, and to do this in discussion with their colleagues. An example of a research question was given in order to distinguish hypotheses from questions about numerical frequency. Respondents were not obliged to identify their hospital.

The responses were categorised into common domains by one of the authors (JFB), using the predominant theme of the question or hypothesis. Thus, had a question such as 'Does pulmonary artery catheterisation affect long-term survival in the elderly?' been posed, it would have been classified under 'monitoring' and not under interventions or post-ICU care; whereas had it been phrased 'Should techniques like pulmonary artery catheterisation be offered to elderly patients with little chance of survival', this would have been classed as an ethical issue. The process of abstraction and reduction was performed by grouping into domains, and then the most representative question within the subject area was used verbatim with minimal editing and without reference to its relative frequency.

The nominal group

A NG was convened by invitation. The group was constituted to reflect a 50:50 teaching hospital:district general (community) hospital ratio, and included two nurses and two medical trainees. To allow for discussion, the size of the group was capped at 12 participants, and the number of hypotheses for review was limited to the 100 most frequently occurring. Four weeks before the meeting the members of the NG were asked to rate all 100 hypotheses privately, and without knowledge of the relative frequency with which they had been suggested, using a Likert scale from 1 (no support) to 9 (strong support). The NG then met to discuss each topic, the discussion being facilitated by one of the authors (NAB). Sufficient time was allowed for discussion of each topic, the duration depending on the degree of controversy which was aroused. Ambiguous topics were re-phrased by agreement, and six were split into two separate topics, resulting in a final total of 106. Immediately after each topic had been discussed, each participant rated it again privately. The differences between the group's pre- and post-discussion ratings were compared subsequently, allowing calculation of the change in ratings and in degree of consensus, and estimation of both the absolute and relative importance attached to each topic.

The survey

A survey was then conducted using a single letter to the medical directors of all 325 ICUs except the 12 represented by members of the NG. Thirty questions were selected from the 106 considered by the NG: the first ten, respectively, with strong support (median rating 7–9), ten with modest support (4–6) and ten with weak support (1–3). Respondents were unaware of the ratings by the NG. They were asked to rate the importance of the questions from 1 (no support) to 9 (very strong support). Analysis of survey ratings was performed to determine the reliability of the NG.

Data and statistical analysis

Median values were calculated for the level of support for each topic and the degree of agreement or dispersion was calculated using the mean absolute deviation from the median (MADM). A reduction in MADM thus represents an increase in agreement. The level of consensus was defined by tertiles of the MADM as low (> 1.41), moderate (1.08–1.41) or high (< 1.08). Statistical significance was determined using the Wilcoxon's signed rank test for changes in rank order, and the chi-squared test for the degree of consensus. The level of association between the NG and the survey ratings was examined using Pearson's correlation coefficient and the extent of agreement using the kappa statistic.

Results

Generation of research questions

The response rate to the first questionnaire was approximately 56 % of ICUs; a precise figure for the unit-based response rate cannot be given as 42 respondents did not identify their hospital by name and some of these could, therefore, have come from medical and nursing respondents within the same ICU. Of the 185 respondents, 66 (35.6 %) identified their hospital as university or university-affiliated, 115 (62.1 %) as district general (community) hospitals and four did not provide this information.

A total of 811 questions were suggested, of which 722 were formulated, or could be reformulated, as research hypotheses. Many of these were based on common areas of interest and could be categorised within 15 domains. These are listed in Table 1 with the number of suggestions within each domain. Outcome was not used as a separate category because it was an integral part of the majority of research questions. Eighty-nine responses were excluded, either because they did not contain a hypothesis or were requests for numerical data.

The most frequently identified research domain was that of organ-system support and treatment. Of the 183 research questions in this domain, 89 (48.6 %) referred to the respiratory system, and included methods of respiratory support, the use of nitric oxide and prone positioning, weaning from ventilation, tracheostomies, nosocomial infections, suction systems and heat and moisture exchangers. The cardiovascular system attracted 33 questions, of which 20 referred to the use of intravenous fluids and blood transfusion, and only 12 to interventions affecting the inflammatory response, mainly inotropic agents and steroids. There was not a single question relating to cytokine antagonists. Hypotheses relating to pulmonary artery catheterisation were classed separately under 'Monitoring'; of the 38 questions in this domain, 30 were specifically directed at evaluating this monitoring modality. There were 32 questions about the impact of renal replacement therapy on outcome and techniques for the prevention of renal failure. Twenty-three questions were targetted at the gastrointestinal system; 18 referred to aspects of nutrition, including glutamine supplementation, route and timing. The central nervous system attracted seven questions, mostly relating to head injury management.

Aspects of nursing practice was the next most common domain. Of the 67 responses, 43 (64 %) referred to the effect on patients or staff of different nurse:patient ratios, skill mix or shift patterns. Eleven identified advanced practice roles as a suitable area for enquiry.

Within the domain for structure and resources, three main topics were identified for examination: large versus small ICUs; university hospital or specialist ICUs versus district general hospital or general ICUs; and paediatric versus adult ICUs. There was a similar level of interest in auditing various aspects of quality of practice and evaluating the utility of scoring systems for this purpose. Within the other domains, the most significant issues were evaluating high dependency care, specialist versus generalist medical practitioners, the effect of intensive care training programmes, the effect of interhospital transfers, early intervention before ICU admission, and methods for preventing cross infection.

When all 722 suggestions are taken together, the ten most frequently cited research hypotheses were as listed in Table 2. As many of the returns contained more than one question within a specific domain, these are presented as proportions both of respondents and of suggestions. To the extent that frequency of response indicates popular interest, evaluating high dependency care (including early intervention, but excluding pre-opera-

Table 1 Number (%) of responses from the questionnaire, categorised by research domain

Research domains	No. (%) of total responses
Organ-system support& treatment	183 (22.5)
Nursing practice	67 (8.2)
Structure and resources	64 (7.9)
Audit, scoring, quality, case mix, outcome measures	57 (7)
High dependency care	47 (5.8)
Infection control	45 (5.5)
Comfort care, communication	38 (4.6)
Monitoring	38 (4.6)
Pre- and post-ICU care	34 (4.2)
Admission& discharge criteria, protocols	33 (4)
Training, education, information and data handling	32 (3.9)
Medical staffing	26 (3.2)
Ethical issues	24 (2.9)
Transfers and retrievals	24 (2.9)
Care processes, clinical practice	10 (1.2)
Non-hypothesis responses	89 (10.9)
Total responses	811 (100)

Table 2 Most cited research questions/hypotheses in the questionnaire

Effect on outcomes of:	No. (%) of 185 respondents	No. (%) of 722 hypotheses
High dependency care	35 (18.9)	47 (6.5)
Size and type of ICU	33 (17.8)	34 (4.7)
Treatments for acute lung injury	28 (15.1)	39 (5.4)
Nurse:patient ratios, skill mix	24 (12.9)	39 (5.4)
Pulmonary artery catheters	24 (12.9)	30 (4.1)
Medical training, seniority	22 (11.9)	25 (3.6)
Clinical protocols and guidelines	21 (11.3)	33 (4.5)
Renal replacement therapies	21 (11.3)	25 (3.6)
Interhospital transfers, retrievals	19 (10.2)	24 (3.3)
Advanced nursing practice	16 (8.6)	20 (2.8)

tive optimisation) would appear to be the topic of greatest interest; it was suggested by 35 (18.9%) respondents. The effect of size or type (general versus specialist, DGH versus university) of ICU on outcome was the next most frequently cited, followed by various treatments for acute lung injury.

Of the 722 suggestions, 100 were selected for presentation to the NG without reference to relative frequency. During the NG meeting, six were divided into two distinct questions, resulting in a final total of 106 (Table 3).

Rating of research questions by nominal group

Of the 106 topics discussed, 15 were considered ambiguous and were re-phrased; there is, therefore, no initial rating given for these questions. All 106 questions are listed in Table 3, with the final median rating, and the initial rating for comparison. Thirty-seven of the 106 questions achieved strong support (median score 7–9) on the final rating, with 'the effect of regionalising paediatric intensive care' receiving the most support. Modest support (median 4–6) on final ratings was obtained for 48 topics, examples of which were "Is intermittent enteral feeding superior to continuous feeding?" and "Is gastric tonometry useful?" Weak support (median 1–3) was obtained for the remaining 21 topics, which included questions such as "Do physician-led ICUs have better outcomes than anaesthetic-led ICUs?" and "Do visitors affect patient outcomes?"

Effect of discussion on degree of consensus

The effect of the NG discussions on rank order and level of consensus was examined by comparing the first and second ratings. Support increased for 14 (15%) topics, reduced for 15 (17%) and was unchanged for 62 (68%). Discussion enhanced the degree of consensus between rankings, increasing for 34 (37%) topics, diminishing for 9 (10%) and remaining unchanged for 48 (53%).

Content of discussion

Discussion of the various topics was wide-ranging and good-humoured. The process of rating the questions involved discussing existing knowledge on each topic and its relevance to clinical practice. Focussed questions ('Does regionalisation of paediatric intensive care improve outcome?') were easier to assimilate than those which were less well defined ('Are the needs of children met in adult ICUs?'). Some topics were rated low priority not because they were considered unimportant but because the answer was considered self-evident: for example, 'Should ICU nurses be involved in the decision to withdraw treatment?' was regarded as a matter of basic good practice not requiring investigation. Other reasons for low ratings included evidence that the question was either currently under investigation or had already been answered, or that there was a high chance of producing erroneous results given the participants' beliefs about existing methods (e.g. measures of skill mix). A common theme was the importance and difficulty of obtaining reliable information about existing knowledge on a given topic.

Examination of the Likert scale ratings for each question demonstrated three possible patterns of response: no agreement, polarisation into two camps or consensus. Polarisation of views occurred when there were ambiguities in the question or different perspectives of the same problem. For example, on the first rating, nine members gave the question 'Does routine replacement of CVP catheters reduce infection rates?' a low priority on the basis that available evidence demonstrated this was not necessary, whereas three gave it a high priority because they considered that many ICUs were ignoring this evidence and, therefore, felt that it required reinforcement through more research. Discussion resulted in greater consensus toward a low final rating.

The survey

In order to test the extent to which the NG judgements were representative of the intensive care community, 30 of the research questions were sent to 313 ICU head consultants (which excluded the twelve ICUs represented by members of the NG). They were asked to prioritise the questions using the Likert scale, without knowledge of the NG ratings. Two hundred and forty-four replied, a 78% response rate. The comparison between the NG and the survey is shown in Table 4. Nine topics achieved strong support (7 or more) from both the survey and the NG. Survey respondents offered a higher level of support (a higher ranking) for most questions than the NG (17 same, 12 greater, 1 less), but showed less consensus among themselves. The association between the NG and the survey ratings was good (correlation coefficient 0.713), but the agreement between the absolute value of the two ratings was poor (kappa 0.15). This may have been because we erroneously gave the impression in the initial survey that only the most highly rated questions would be used in this part of the exercise.

Table 3 Nominal group *(NG)* median ratings (final and initial) and mean absolute deviation from the median *(MADM)* for 106 research questions/hypotheses (*HDU* high dependency unit, *SMR* standardised mortality ratio, SaO_2 oxygen saturation, *ALI* acute lung injury, *ARDS* acute respiratory distress syndrome, *MRSA* multiply-resistant *Staphylococcus aureus*, *CVVH/D* continuous veno-venous haemofiltration/haemodiafiltration, *COAD* chronic obstructive airway disease, *PAFC* pulmonary artery flotation catheter, *HME* heat and moisture exchanger, *NSAID* non-steroidal anti-inflammatory drug, *CVP* central venous pressure)

Research questions/hypotheses	NG median ratings (MADM)	
	Final	Initial
A. Strong support: median 7–9 (n = 37)		
Q12. Does regionalisation of paediatric intensive care improve outcome?	8.5 (1.08)	7.5 (1.50)
Q1. Does early intervention alter ICU outcome?	8.0 (0.67)	–-
Q2. Does delayed admission alter ICU outcome?	8.0 (1.08)	–-
Q3. Does perioperative optimisation of surgical patients improve outcome?	8.0 (1.25)	7.0 (1.33)
Q10. Do district general hospital ICUs perform as well as major/university centres	8.0 (1.92)	7.5 (2.17)
Q14. Is the presence of an HDU associated with improved hospital outcomes?	8.0 (1.17)	7.5 (1.17)
Q15 Do patients admitted to HDU have better outcomes than those admitted to general wards?	8.0 (1.17)	7.0 (1.14)
Q20. Does the nurse:patient ratio affect patient outcomes?	8.0 (1.08)	7.0 (1.33)
Q30. Does interhospital transfer, due to shortage of available beds, affect patient outcomes?	8.0 (1.25)	7.5 (1.00)
Q32. Do specialised transport teams have better outcomes than non-specialist?	8.0 (0.67)	7.5 (0.92)
Q56. Do pulmonary artery catheters affect patient outcomes?	8.0 (1.17)	8.0 (1.17)
Q73. Does early enteral feeding improve outcome?	8.0 (1.0)	7.5 (1.67)
Q96. What outcome measures should be used in the ICU?	8.0 (1.67)	7.0 (2.08)
Q100. Are long-term outcomes worse for the elderly (> 70, > 80)?	8.0 (1.25)	5.0 (1.45)
Q9. Do small ICUs have different outcomes than large ICUs?	7.5 (1.25)	7.0 (1.50)
Q11. Do speciality ICUs have better case-mix adjusted outcomes than general ICUs?	7.5 (1.58)	6.0 (1.92)
Q29. Does the pattern of consultant staffing affect patient outcomes?	7.5 (1.25)	–-
Q97. Can one make meaningful comparisons of the performance of ICUs using SMRs?	7.5 (1.17)	7.0 (2.00)
Q4. Can pre-ICU scoring improve patient identification in intensive care?	7.0 (0.92)	–-
Q7. Does post-ICU follow-up on the wards reduce re-admissions?	7.0 (1.42)	–-
Q17. Do HDUs alter intensive care efficacy, efficiency, workload or re-admission rates?	7.0 (0.67)	6.5 (1.00)
Q18. Do HDUs co-located with ICUs have different outcomes from geographically separate HDUs?	7.0 (0.83)	6.5 (1.75)
Q19. Does nurse skill mix affect patient outcomes?	7.0 (1.08)	6.0 (1.67)
Q28. Is there a relationship between consultant sessions per bed and outcome?	7.0 (0.67)	6.0 (1.25)
Q31. Do transferred patients have poorer outcomes than non-transferred patients?	7.0 (0.92)	7.0 (1.00)
Q33. Do ICUs with retrieval teams have better patient outcomes?	7.0 (0.92)	7.0 (1.00)
Q39. Does the presence of guidelines/protocols influence ICU outcomes?	7.0 (1.50)	7.0 (1.42)
Q42. Do patients managed via care pathways (sedation, weaning) have a shorter ICU stay?	7.0 ()1.08	6.0 (1.50)
Q60. Does monitoring intracranial pressure and/or SaO_2 improve outcome?	7.0 (0.67)	7.0 (1.00)
Q61. Does inhaled nitric oxide improve outcome from acute lung injury?	7.0 (1.50)	6.0 (1.42)
Q62. Does prone ventilation alter outcome from ALI/ARDS?	7.0 (0.75)	7.0 (0.92)
Q64. Are steroids effective in ARDS?	7.0 ()0.67	6.0 (1.25)
Q65. Is outcome from ALI improved by the early use of non-invasive ventilation?	7.0 (1.33)	6.0 (1.42)
Q72. Does the addition of glutamine to feed alter outcome?	7.0 (0.58)	6.5 (1.25)
Q79. Does anti-oxidant therapy (including acetyl cysteine) improve outcome in sepsis?	7.0 (1.0)	5.5 (1.25)
Q81. Crystalloids/synthetic colloids/albumin – any difference in outcomes?	7.0 (0.58)	6.5 (1.08)
Q98. Do Nursing Dependency Scoring systems accurately determine nursing workload?	7.0 (1.0)	5.5 (1.67)
B. Moderate support: median 4–6 (n = 48)		
Q6. Does post-ICU follow-up on the wards reduce in-hospital mortality?	6.5 (1.67)	–-
Q8. Do ICU out-patient clinics improve patient outcomes?	6.5 (1.42)	5.0 (1.27)
Q23. Does staff:patient ratio affect sickness rates amongst ICU nursing staff?	6.5 (1.08)	–-
Q25. Do children nursed in dedicated PICUs have better quality of care than those nursed in general mixed adult/paediatric ICUs?	6.5 (1.92)	4.5 (1.92)
Q46. Does MRSA affect patient outcomes on ICU?	6.5 (1.08)	5.5 (1.33)
Q74. Is jejunal or nasogastric feeding associated with better outcomes than no feeding?	6.5 (1.33)	5.0 (1.25)
Q78. Are steroids beneficial in sepsis?	6.5 (1.58)	5.5 (1.83)
Q84. Does haemoglobin level affect outcome?	6.5 (1.42)	–-
Q85. Are outcomes better with early rather than late CVVH/D	6.5 (0.83)	6.5 (1.00)
Q99. Is it justifiable to submit patients with COAD to repeat ICU admissions?	6.5 (1.58)	6.0 (1.67)
Q34. Are there common factors at ICU discharge which predict re-admission within 72 h?	6.0 (1.08)	7.0 (1.00)
Q35. Does multi-professional team working affect outcomes?	6.0 (1.75)	5.0 (1.50)
Q38. Are pressure-relieving mattresses cost-effective?	6.0 (1.42)	6.0 (1.50)
Q43. Does isolating patients in cubicles reduce the rate of infection?	6.0 (1.58)	6.0 (1.50)
Q57. Does timing of insertion of PAFCs alter outcome?	6.0 (1.17)	6.0 (1.00)

Table 3 *(Forsetzung)*

Research questions/hypotheses	NG median ratings (MADM)	
	Final	Initial
Q86. Does CVVH/D alter outcome from sepsis/septic shock in the absence of renal failure?	6.0 (1.25)	6.0 (1.08)
Q94. Is ward care better in hospitals that provide ICU rotations for medical and surgical trainees?	6.0 (1.25)	6.0 (1.42)
Q103. Are decisions to withdraw treatment influenced by availability of intensive care beds?	6.0 (1.33)	5.0 (1.42)
Q44. Do implemented infection control policies influence infection rates?	5.5 (1.25)	6.0 (1.67)
Q50. Is there a correlation between sedation regimen and patient outcomes?	5.5 (1.50)	––
Q51. Is there a correlation between sedation regimen and length of stay?	5.5 (1.25)	––
Q54. Do psychotropics enhance recovery of long-stay intensive care patients?	5.5 (0.92)	5.0 (0.83)
Q58. Can oesophageal Doppler substitute for the pulmonary artery catheter?	5.5 (1.33)	6.5 (1.42)
Q63. Does partial liquid ventilation improve outcome in ARDS?	5.5 (1.17)	4.5 (1.25)
Q68. Does early tracheostomy produce better outcomes than late?	5.5 (2.08)	6.0 (1.83)
Q69. Is percutaneous tracheostomy safer than surgical tracheostomy?	5.5 (1.33)	6.0 (1.58)
Q83. Does blood transfusion affect outcome?	5.5 (1.67)	––
Q90. Does 'low-dose' frusemide alter renal outcomes?	5.5 (1.83)	––
Q21. Does the presence of an advanced nurse practitioner affect outcomes?	5.0 (1.0)	5.0 (1.17)
Q22. Does skill mix affect sickness rates amongst ICU nursing staff?	5.0 (1.0)	––
Q24. Do units with a clinical educator in post have fewer nurse retention and recruitment difficulties?	5.0 (2.0)	5.0 (1.33)
Q27. Does the pattern of trainee medical staffing affect patient outcomes?	5.0 ()1.58	4.0 (1.17)
Q40. Do strict bed management policies affect overall outcomes and resource use?	5.0 (2.17)	6.5 (1.67)
Q47. Is there a relationship between the incidence of nosocomial infections in ICU and staffing ratios?	5.0 (1.25)	5.5 (1.42)
Q59. Is gastric tonometry useful?	5.0 (0.92)	5.0 (1.25)
Q75. Is intermittent enteral feeding superior to continuous feeding?	5.0 (1.17)	5.0 (1.33)
Q82. Is white cell depleted blood better than whole blood for critically ill patients?	5.0 (1.33)	5.0 (0.92)
Q87. Does CVVH/D improve outcome in meningococcaemia?	5.0 (1.42)	6.0 (0.92)
Q106. Do the social characteristics of patients or staff influence treatment intensity?	5.0 (1.58)	4.0 (1.83)
Q41. Does a nurse-led/operated extubation protocol result in a shorter period of ventilatory support?	4.5 (2.08)	4.5 (2.00)
Q66. Which is the best form of respiratory support for weaning patients from ventilation?	4.5 (1.33)	5.0 (1.67)
Q80. What is the best vasoactive drug regimen for septic shock?	4.5 (1.83)	5.0 (1.67)
Q91. Does post mortem examination in intensive care patients alter practice?	4.5 (1.50)	5.0 (1.92)
Q5. Can pre-ICU scoring improve patient selection in intensive care?	4.0 (1.67)	––
Q45. Does colour coding of bed areas reduce the spread of MRSA and other resistant organisms?	4.0 (0.83)	4.0 (0.83)
Q49. Are the needs of children met in adult ICUs?	4.0 (1.67)	4.0 (1.42)
Q70. Do closed suction systems produce fewer nosocomial infections than open catheters?	4.0 (1.50)	4.0 (1.42)
Q71. Do HMEs or humidified circuits affect nosocomial infections?	4.0 (0.75)	5.0 (1.08)
C. Weak support: median 1–3 (n = 21)		
Q55. Do patients recover quicker in an environment illuminated by natural light?	3.5 (1.08)	4.5 (1.00)
Q67. Is weaning time shortened by e.g.: sedative regimen, antidepressants, ACEI, Hb level?	3.5 (1.67)	5.5 (1.67)
Q88. CVVH/D or intermittent haemodialysis – does it matter?	3.5 (1.83)	4.5 (1.92)
Q92. Would access to an ICU evidence based database improve patient outcomes?	3.5 (1.67)	4.5 (1.50)
Q93. Would medical student training be improved by working with ICU nurses?	3.5 (2.42)	4.5 (2.08)
Q13. Do major vascular surgery patients have better outcomes in larger than smaller ICUs?	3.0 (1.67)	5.0 (1.50)
Q16. Do HDUs de-skill ward nurses?	3.0 (1.33)	3.5 (1.42)
Q52. Does NSAID analgesia significantly affect renal function in post-operative patients?	3.0 (1.25)	5.0 (1.25)
Q76. Do steroids affect outcome in head injury?	3.0 (1.08)	3.5 (1.50)
Q77. Does clonidine reduce the incidence of the acute withdrawal syndrome?	3.0 (1.0)	4.0 (0.75)
Q53. Do visitors affect patient outcomes?	2.5 (1.42)	3.5 (1.67)
Q89. Does 'low-dose' dopamine alter renal outcomes?	2.5 (1.50)	––
Q104. Would risk management be improved by nurses writing directly in medical notes?	2.5 (1.17)	4.0 (1.58)
Q36. Are patients more likely to die on certain days of the week, and if so, why?	2.0 (1.0)	4.0 (1.33)
Q48. Does routine replacement of CVP catheters reduce infection rates?	2.0 (1.25)	3.5 (1.92)
Q101. Should relatives be present during resuscitation attempts?	2.0 (0.83)	3.0 (0.75)
Q105. Should unconscious post-cardiac arrest patients be admitted to ICU?	2.0 (1.33)	4.0 (1.67)
Q26. Do physician-led ICUs have better outcomes than anaesthetic-led ICUs?	1.0 (0.58)	2.0 (0.92)
Q37. Does a „closed" ICU have better results than an „open" ICU?	1.0 (1.42)	5.0 (1.42)
Q95. Does severity scoring influence clinical practice in individual patient management?	1.0 (0.25)	5.5 (2.00)
Q102. Should ICU nurses be involved in the decision to withdraw treatment?	1.0 (1.25)	4.0 (1.83)

Table 4 Median ratings and mean absolute deviation from the median *(MADM)* by ICU staff (the survey), compared with nominal group *(NG)* final ratings for 30 research questions, ranked in descending order

Research question	Median ratings (MADM)	
	ICU staff	NG final rating
A. Strong support: median 7–9 (n = 13)		
Q1. Does early intervention alter ICU outcome?	8.0 (1.03)	8.0 (0.67)
Q15. Do patients admitted to HDU have better outcomes than those admitted to general wards?	8.0 (1.11)	8.0 (1.17)
Q20. Does the nurse:patient ratio affect patient outcomes?	8.0 (1.46)	8.0 (1.08)
Q30. Does inter-hospital transfer, due to shortage of available beds, affect patient outcomes?	8.0 (1.34)	8.0 (1.25)
Q73. Does early enteral feeding improve outcome?	8.0 (1.19)	8.0 (1.00)
Q3. Does optimisation of perioperative care of surgical patients improve outcome?	7.0 (1.45)	8.0 (1.25)
Q10. Do district general hospital ICUs perform as well as major/university centres?	7.0 (1.64)	8.0 (1.92)
Q12. Does regionalisation of paediatric intensive care improve outcome?	7.0 (1.76)	8.5 (1.08)
Q24. Do units with a clinical educator in post have fewer nurse retention and recruitment difficulties?	7.0 (1.95)	5.0 (2.00)
Q47. Is there a relationship between the incidence of nosocomial infections in ICU and staffing ratios?	7.0 (1.68)	5.0 (1.25)
Q56. Do pulmonary artery catheters affect patient outcomes?	7.0 (1.85)	8.0 (1.17)
Q68. Does early tracheostomy produce better outcomes than late?	7.0 (1.52)	5.5 (2.08)
Q102. Should ICU nurses be involved in the decision to withdraw treatment?	7.0 (1.98)	1.0 (1.25)
B. Moderate support: median 4–6 (n = 16)		
Q5. Can pre-ICU scoring improve patient selection in intensive care?	6.0 (1.90)	4.0 (1.67)
Q21. Does the presence of an advanced nurse practitioner affect outcomes?	6.0 (1.91)	5.0 (1.00)
Q38. Are pressure-relieving mattresses cost-effective?	6.0 (2.10)	6.0 (1.42)
Q40. Do strict bed management policies affect overall outcomes and resource use?	6.0 (1.74)	5.0 (2.17)
Q48. Does routine replacement of CVP catheters reduce infection rates?	6.0 (2.09)	2.0 (1.25)
Q54. Do psychotropics enhance recovery of long-stay intensive care patients?	6.0 (1.73)	5.5 (0.92)
Q89. Does 'low-dose' dopamine alter renal outcomes?	6.0 (2.08)	2.5 (1.50)
Q97. Can one make meaningful comparisons of the performance of ICUs using SMRs?	6.0 (1.94)	7.5 (1.17)
Q26. Do physician-led ICUs have better outcomes than anaesthetic-led ICUs?	5.0 (2.09)	1.0 (0.58)
Q53. Do visitors affect patient outcomes?	5.0 (1.95)	2.5 (1.42)
Q59. Is gastric tonometry useful?	5.0 (1.89)	5.0 (0.92)
Q95. Does severity scoring influence clinical practice in individual patient management?	5.0 (1.86)	1.0 (0.25)
Q101. Should relatives be present during resuscitation attempts?	5.0 (2.18)	2.0 (0.83)
Q104. Would risk management be improved by nurses writing directly in medical notes?	5.0 (2.25)	2.5 (1.17)
Q105. Should unconscious post-cardiac arrest patients be admitted to ICU?	5.0 (2.11)	2.0 (1.33)
Q106. Do the social characteristics of patients or staff influence treatment intensity?	5.0 (2.13)	5.0 (1.58)
C. Weak support: median 1–3 (n = 1)		
Q36. Are patients more likely to die on certain days of the week, and if so, why?	3.0 (2.00)	2.0 (1.00)

Discussion

This study demonstrates considerable motivation and interest amongst intensive care doctors and nurses for prioritising research aimed at evaluating the care they provide to critically ill patients. It was undertaken at a time of uncertainty about the organisation and future of intensive care services, and in the aftermath of the failure of many expensive multicentre projects to show a beneficial effect on outcome of treatments directed at the immuno-inflammatory cascade in sepsis [8]. Indeed, one of the most notable results was the dearth of research questions in this area, compared with the firm emphasis on examining organisational aspects of clinical practice. On the basis of frequency of response to the initial request for research questions, clinicians prioritised the following topics: high dependency care, ICU characteristics, treatments for acute lung injury and acute renal failure, nurse:patient ratios, pulmonary artery catheterisation, aspects of medical and nursing practice, protocol evaluation and interhospital transfers.

There were nine topics which achieved a median rating of 7 or more from both NG and survey respondents: questions 1, 15, 20, 30, 73, 3, 10, 12, and 56 (Table 4). The questions that achieved the greatest support were those examining current methods of organising and practising intensive care, suggesting considerable willingness on the part of the intensive care community to evaluate such activities. Within this framework, the areas for investigation included earlier intervention in patients at risk of critical illness, the effect of place of care and interhospital transfers on outcomes, the cost-effective use of nursing staff and the effect of specific technologies such as pulmonary artery catheterisation and enteral nutrition.

Early intervention (Q1, 3, 15)

This topic has attracted considerable interest in the last 3 years [9, 10, 11]. It is based on the premise that a proactive rather than a reactive approach to critical illness will result in better outcomes at lower cost. In the form of 'outreach care' it has the support of the recent Audit Commission report into intensive care in the United Kingdom [12]. 'Optimisation of perioperative care of surgical patients' (Q3) is part of this general theme, and there is already evidence that this approach improves outcomes [13, 14]. High dependency unit (HDU) care (Q15) may also be seen as a preventative technology; it is certainly one in which many hospitals are investing, but for which there is as yet little published evidence of efficacy.

Nurse:patient ratios (Q20)

The cost-effective use of nursing staff is of importance to both clinicians and managers. It has also been identified as requiring investigation by the Audit Commission [12]. The UK defines intensive care patients as requiring a 1:1 nurse:patient ratio [15]; there is evidence that other European countries operate a less generous ratio but without an adverse effect on outcomes [16]. One North American study of abdominal aortic surgery patients has shown that a nurse:patient ratio of less than 1:2 (that is, 1:3, 1:4) is associated with a prolonged ICU stay [17]. Investigation of this topic would require controlling for both case mix and medical and nursing skill mix, and assessment of qualitative aspects such as care of relatives and comfort-care of patients: mortality is unlikely to be the most appropriate outcome measure.

Place of care (Q10, 12) and interhospital transfers (Q30)

Rationalisation and regionalisation of care are important to clinicians because hospital or unit closures directly affect not only the staff but also the populations they serve. Rationing and uneven resource distribution results in large numbers of interhospital transfers each year in a country like the UK [18] and, despite evidence that standards of care during transfer affects outcome [19, 20], there has been virtually no investment in transport teams – in sharp contrast to the availability of resources for retrieval teams for organ transplantation or for paediatric intensive care.

Specific technologies

Pulmonary artery catheterisation is a well-established technique in intensive care, which is unfortunate because had it been introduced now it would have been subject to proper cost-effectiveness evaluation. It appears from observational studies that its use in patients in the ICU is associated with a higher mortality which is not easily explained by case mix or treatment bias [21]. Its benefits [13, 14] in preventing critical illness in high-risk patients awaiting major surgery may also require further scrutiny [22]. Trials are currently under way in the UK and North America to explore this finding in more detail. Early enteral nutrition is potentially beneficial in terms of gut function, microbial colonisation and the immune system; it may be difficult to evaluate using randomised controlled trials unless specific diagnostic groups are chosen (such as pancreatitis [23, 24]) in which there is sufficient individual equipoise.

Nominal group ratings were representative of all clinicians in general (high correlation). The lower consensus among respondents to the survey probably demonstrates the lack of opportunity for discussion, which is a feature of the NG. The advantages of a NG are the more timely acquisition of results and the opportunity for discussion to resolve uncertainties, encourage consensus and strengthen opinion.

Some differences between the NG and the survey are worthy of comment. Question 102 relating to involvement of ICU nurses in decisions to withdraw treatment achieved strong support from the survey, but virtually no support from the NG. One possible explanation is that the question was interpreted not as a research hypothesis but as a request for an opinion – hence expecting the answer 'yes'. Alternatively, it is possible that this is indeed a question worth exploring if nursing staff feel themselves to be excluded from decision making in a substantial number of ICUs. This divergence is itself worthy of further investigation.

The lack of research questions about the immuno-inflammatory cascade in sepsis could reflect the failure of 'anti-cytokine' trials during the last decade, lack of direct exposure to these agents in clinical practice or a view amongst the population surveyed that organisational aspects of clinical practice are of greater relevance to patient outcomes. It is curious that despite the enormous contributions which basic science research has made to knowledge of disease and pathophysiology in the last 30 years, we are uncertain how to translate this knowledge into interventions which directly improve patient outcomes from critical illness – nitric oxide, perhaps, being the best example. Conversely, research into the practice and organisation of intensive care demonstrates [17] that it is possible to obtain improvements in outcome without understanding the precise mechanisms by which these are achieved. The challenge for intensive care, and one of its potential strengths, is to resolve this paradox by acting as a clinical laboratory which links health services research to basic science.

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Appendix

Caroline Goldfrad advised on and performed data analysis; Keryn Vella administered data collection and data entry; Julian Bion initiated the study, contributed to its design, analysed the topic suggestions and wrote the paper; Kathy Rowan initiated the study, contributed to its design and commented on the paper; and Nick Black contributed to the study design, facilitated the nominal group and commented on the paper.

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