Ken Hillman and Gillian Bishop

Clinical Intensive Care and Acute Medicine

Second Edition

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This new edition provides an accessible account of the essentials of intensive care medicine. The core of the book focuses on areas common to all critically ill patients including fluid therapy, sedation, shock, infection and other central topics. This key understanding of basic pathophysiological principles provides an excellent launch pad for the section on individual diesease entities encompassing haematology, gastroenterology, nephrology, endocrinology, the respiratory system, cardiovascular pathology, poisoning and neurology. Economic and ethical issues are also covered, and the text is supported by numerous problem-oriented guidelines to help the care provider tackle real-life practical problems as encountered in the ICU. In the same spirit, wherever possible, the authors provide precise and meaningful advice, rather than bland generalisations. This new edition reflects the excitement, challenges and uniqueness of intensive care medicine, for the benefit of all residents, trainees, nursing staff and paramedics attached to the ICU.

'While the book is specifically directed at junior medical officers, it will also be useful as an aid to the part-time intensivist and postgraduate medical and nursing education. Even for those intensive care units that already have well defined protocols, this book will fulfil an invaluable educational role. This book is an essential addition to all intensive care libraries.' *Anaesthesia and Intensive Care*

'For those of us who run intensive care units (ICU), faced with trainees of varying experience whose first question on the unit is "What book should I buy?". I can now tell them – this one. I recommend this text strongly for trainees in ICU. It will also prove useful for those preparing to take a fellowship examination. It is extremely good value.' *British Journal of Surgery*

'The clinical content of the book is sound and comprehensive and the authors are clearly masters of their topic. The volume under review is certainly a worthy addition to a burgeoning literature.' *Journal of the Royal College of Physicians of London*

'I appreciated its pragmatic approach to complex problem solving. It's size, comprehensive coverage and cost should make it an attractive competitor for other well established texts in the same area.' *Anaesthetist*

'The book conveys the information with a combination of clear descriptive paragraphs and bulleted points allowing easy reference. At the end of many chapters there are 'trouble-shooting' sections that highlight specific common problems such as oliguria – problem-oriented lists that can be quickly read by the junior doctor in time of need. I like this book for its clarity and conclusion. Very definitely a useful on-call-room companion.' *Journal of the Royal Society*

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Preface to the first edition

The book is aimed at junior medical staff who rotate through intensive care units (ICUs) and other physicians who are involved in managing patients in an ICU, but not necessarily as their primary specialty. It may also prove useful to any member of the paramedical or nursing profession who is involved in acute medicine. The book initially arose from the need to give resident medical staff rotating through our own ICU a crash course in intensive care medicine. At present this subject is not universally taught to undergraduates and too often, exposure as a postgraduate turns out to be learning by experience.

Intensive care medicine is an exciting and rapidly developing specialty. There are two major problems with writing a book about it at this point of time. Firstly, it may be out of date before it is published and secondly, it may not capture the flavour of intensive care medicine. Just as a committee of specialists representing each organ may not necessarily be the best way to approach the multiorgan problems of the critically ill, then a book which only summarises the conventional wisdom of other specialties may not be the best book on intensive care medicine. It is a new specialty, drawing on the knowledge of other specialties, but also having expertise unique to itself. The specialty has its own journals and meetings as well as nursing and medical specialists. We have tried to make this book reflect the uniqueness of intensive care medicine. We have also incorporated as much recent knowledge as possible in order to prevent premature ageing.

The core of the book concentrates on areas common to all critically ill patients rather than on specific diseases. These chapters are to be found mainly in the first part of the book. It is essential to understand the basic pathophysiological principles common to all seriously ill patients before concentrating on individual disease entities. Thus, chapters such as Routine Care of the Seriously Ill, Fluids, Nutrition, Cardiovascular Failure, Respiratory Failure, Infection, Resuscitation, Sedation, Ventilation, Monitoring and Intracranial Disasters could be relevant to all seriously ill patients, no matter what the aetiology of the disease process. These chapters represent the core knowledge of intensive care medicine. We have devoted the remaining chapters to specific problems and diseases. These

include Haematology, Gastroenterology, Nephrology, Endocrinology, the Respiratory System, Cardiovascular Pathology, Poisoning and Neurology. Discussion in these chapters is limited to the subject's relevance in the setting of the seriously ill. The reader is continually referred from these specific chapters to the core chapters. Finally, no matter how small the book about intensive care is, it cannot afford to dismiss economic and ethical issues. These are covered in the last chapter. Readers are encouraged to familiarise themselves with the core chapters and to refer to individual diseases as necessary. At the end of each chapter, we have included some articles and web sites for further reading. These are mainly of a review nature.

Many chapters also have problem-orientated guidelines to aid the reader. Many problems encountered by junior medical staff are common in different diseases but are not often specifically addressed. Examples include 'Fighting the Ventilator', 'Interpreting Non-Specific Opacities on the Chest Radiograph', 'The Confused Patient' and 'Sudden Hypoxia'. We have tried to identify specific areas which may assist the resident when confronted with these practical problems in the ICU. These guidelines are scattered throughout the book in relevant chapters and for easy access, a list is provided at the beginning of the book.

Because of the rapidly developing nature of intensive care medicine, we have drawn on recent publications and integrated these findings into 'accepted practice'. 'Accepted practice' is, of course, a variable and mobile concept. One of the dilemmas is always distinguishing between initial enthusiasm and a growing weight of opinion. For example, we feel there is a move away from invasive to non-invasive monitoring and have put what we consider an appropriate emphasis on that line. Similarly, we sense a tendency to use pressure-support ventilatory modes rather than simply employing controlled mandatory ventilation. Time and more research will demonstrate whether this is correct. In combining the latest information with accepted practice we have tempered the final guidelines with what we have found to work in the clinical situation. We make no apology for the clinical flavour of the book.

As much as one tries to avoid controversy in a textbook it could only be achieved by reverting to bland and vague suggestions such as 'support the patient', 'give fluids' and 'give oxygen'. We have tried wherever possible to give precise and meaningful 'bottom line messages'. In doing so, one runs the risk of giving messages which are not accepted by everyone. We have taken that risk rather than resort to vague and safe alternatives, in the knowledge that the individual specialists supervising junior medical staff are encouraged to modify management within their own unit's protocols.

Finally, we would like to gratefully acknowledge the inspiration and pleasure we have had from working with all our patients, junior medical colleagues and nursing staff in intensive care over the years.

Preface to the second edition

The second edition of Clinical Intensive Care maintains many of its original features. It is primarily aimed at those practising Intensive Care Medicine at the bedside with practical troubleshooting tables and chapters which distil theory into relevant guidelines for management. While the whole book has been updated to include what we believe are the most important advances in acute medicine, the size of the book has been deliberately kept the same.

Intensive Care Medicine is now a mature specialty practised in every major hospital and the principles of this specialty are now being applied in the management of patients in every part of the hospital. The walls of intensive care units are becoming more virtual as their staff are being asked to consult on the seriously ill both before and after their admission to the intensive care unit. Increasingly the principles of acute medicine are part of the knowledge base of intensive care medicine and are being captured in its journals and textbooks. It seemed appropriate therefore that the title of the book changed to 'Clinical Intensive Care and Acute Medicine'. The principles of the book can be used by intensive care staff consulting on general wards as well as by other specialists caring for potentially seriously ill patients on general wards.

Acknowledgements

Books such as this only come about as a result of inspiration and input from many sources. The list of people who fall into this category are many. First and foremost is Sue Williams, the secretary to our department who has not only typed the many drafts, but corrected them and contributed valuable advice. Other assistance in preparing the manuscript came from Jacquelene Barnes. We are indebted to Richard Barling from Cambridge University Press for his patience, inspiration and support.

Our colleagues provided a great deal of their time to review many of the chapters. Special thanks to Michael Parr, Arthas Flabouris and Antony Stewart, whose wisdom and knowledge was greatly appreciated. Thanks also to Ian Gosbell from Liverpool Hospital's microbiological department for adding a much needed dimension to the section on Infection. Stephen Deane shed clarity and perception onto our approach to the acute limb. Others to whom we owe a debt include Stephen Streat from Auckland Hospital in New Zealand for his contribution to the chapters on Trauma and Nutrition and Marcus Cremonese for his excellent illustrations.

The inspiration for this book has come from the many patients, nursing and junior medical colleagues we have been privileged to have worked with over the years. They have provided the life and meaning to the messages contained in the book and have kept us honest.

1

A systematic approach to caring for the seriously ill

- A hospital-wide system is essential for early recognition and rapid resuscitation of the seriously ill in order to limit tissue damage and optimise outcomes.
- High dependency units (HDUs) allow a more flexible approach to managing a hospital's seriously ill population.

Intensive care medicine is no longer practised wholly within the four walls of the intensive care unit (ICU). The traditional ICU patient with multiorgan failure (MOF) being supported with artificial ventilation, dialytic therapy, multiple inotropes and complex monitoring is still strongly associated with the image of an ICU. However, the skills of intensive care physicians are increasingly being utilised in a systematic way across the entire hospital. Optimal management of patients before they are admitted to ICU has a large influence, firstly on whether the admission may have been avoided with earlier intervention and secondly on the level of support required if they were admitted; and thirdly on their eventual outcome. Patients who are allowed to develop severe shock and extensive organ dysfunction require greater resources for a longer time in the ICU than if they had been treated at an earlier stage.

Intensive care medicine is increasingly being defined by care of the seriously ill across the acute hospital, rather than within the ICU. This can be illustrated by imagining a 600-bed hospital with four intensive care beds as opposed to 40. The four beds would be occupied by severely ill patients with maximum support. Because of the severity of illness and terminal state of many of the patients, the mortality of this ICU would be high and many others throughout the hospital would suffer severe complications as a result of delayed resuscitation and the effects of prolonged ischaemia and hypoxia. Some of these patients would eventually qualify for one of the few ICU beds. Staff who work in these units may even be disdainful of the role of the 40-bed unit, where many patients may not even be intubated and ventilated, i.e. not 'real' ICUs. Forty beds may, in fact, be

too many. But the real point is that if there are insufficient ICU beds, patients will eventually be admitted to the ICU when the disease state may be irreversible.

Seriously ill patients situated anywhere in a hospital need to be triaged as one does in an emergency department (ED). In fact many sick in-hospital patients may receive better treatment if they were wheeled out of the hospital and in through the ED where they would be triaged into categories according to how seriously ill they were and then receive rapid and appropriate resuscitation.

Intensive care medicine is being increasingly defined as a specialty of resuscitation and acute medicine as practised across the whole hospital. The barriers of bed limitation within the ICU should not result in inadequate resuscitation and management of the seriously ill, no matter where they are.

The problem of at-risk patients in acute hospitals is potentiated by the increasing specialisation of medicine, resulting in single organ doctors ('SODS') practising mainly ambulant medicine and not having the training, skills or experience in managing the acutely ill when organ dysfunction is rarely limited to one or even two organs. Even if medical specialists were exposed to formal training in acute hospital medicine during their training, it is difficult for 'SODS' to maintain their skills base and knowledge levels if they are mainly practising single organ medicine. Thus the acute hospital system for dealing with the seriously ill is often limited by hierarchies, ownership issues and inadequate expertise being immediately available to at-risk and seriously ill patients.

High dependency units

The skills and infrastructure required to manage a seriously ill patient with severe and established MOF are the same as those required to manage a patient at an earlier stage, who has less severe organ dysfunction. The major difference is in the number of nursing staff required for each patient. For example, a patient on artificial ventilation, dialysis and multiple inotropes may require one or even two full-time nurses at all times, whereas a monitored patient on a continuous positive airway pressure (CPAP) mask with a thoracic epidural may be able to be managed on a nurse : patient ratio of 1 : 2 or even 1 : 3. Thus, the concept of the HDU has developed. The beds may be flexible within the same unit or separate units may exist, sometimes sharing the same staff and equipment. Entirely separate units, especially for specialty based care, also exist.

High dependency units allow a flexible approach to the management of the seriously ill within a hospital. Patients too unstable to be managed in a general ward, but not sick enough to require 1 : 1 nursing care in an ICU, can be accommodated, perhaps preventing deterioration before admission to ICU. Similarly, patients may not be quite unstable enough to justify continuing management in an ICU but may be too unstable to be managed on a general ward. Management in a HDU environment may improve patient outcome, decrease complications and hospital length of stay as well as decrease the risk of readmission to the ICU from a general ward.

Table 1.1. MET criteria

Acute changes in physiology	
Airway	Threatened
Breathing	All respiratory arrests
	Respiratory rate < 5
	Respiratory rate > 36
Circulation	All cardiac arrests
	Pulse rate < 40
	Pulse rate > 140
	Systolic blood pressure < 90
Neurology	Sudden fall in level of consciousness (fall in Glasgow coma scale (GCS) of > 2 points)
	Repeated or prolonged seizures
Other	Any patient who you are seriously worried about that does not fit the above criteria

A hospital-wide approach to the seriously ill

Apart from ICUs we expect optimum care of patients, in terms of appropriate staff and monitoring, in certain areas of the hospital. These include the ED, operating rooms and coronary care units.

However, many patients are managed in undifferentiated general wards with lower staff ratios and less monitoring. A hospital-wide system may be required to detect at-risk patients early in these environments and to provide rapid resuscitation where necessary.

Early recognition of seriously ill patients

Even moderate degrees of ischaemia and hypoxia can cause cellular damage. More severe forms predispose to organ failure, long stays in intensive care and potentially avoidable death. The earlier ischaemia and hypoxia are detected and treated, the better the patient outcome. Such a system for early detection must be effective at all times. It could be as simple as the bedside nurse or clinician contacting someone with acute resuscitation skills as soon as they were concerned about a patient. However, this would depend on the attending staff having a high degree of awareness and knowledge about the early signs of a deteriorating patient and having the confidence and system support to immediately summon help.

An alternative is to formalise criteria which are associated with an at-risk patient. Such a system is based on the medical emergency team (MET) criteria (Table 1.1). These are mainly based on vital signs which define someone at risk. Added to the list is 'worried' so that staff are encouraged to seek assistance whenever they suspect a patient is at risk of deteriorating. The MET has replaced the cardiac arrest team in many hospitals.

Table 1.2. Outcome indicators for acute hospital care

Deaths	Minus all 'not for resuscitation' patients	=	Potentially unexpected deaths
Cardiorespiratory arrests	Minus all 'not for resuscitation' patients	=	Potentially unexpected cardiorespiratory arrests
Intensive care admissions	Minus all elective or expected admissions from operating rooms, recovery area, emergency department.	=	Unanticipated admissions to ICU

All events preceded by MET criteria for up to 24 h and have not been acted on are considered potentially preventable

Table 1.3. Distribution of outcome indicators for acute care hospitals

Individual patient details
Senior physician ultimately responsible for patient care
Junior medical staff caring for patients
Ward nursing staff caring for patients
Aggregated, de-identified data
Departmental audit activities
Hospital audit activities
Regional audit activities
Inter-hospital comparison audit
Possible involvement of health consumers

Rapid response to the seriously ill

Ischaemia and hypoxia are potentially dangerous for patients and once detected should be rapidly reversed. The only systematic response to the seriously ill in hospitals is usually the cardiac arrest team, by which time damage may have already occurred and the resulting outcome is often poor. The MET system involves early intervention so that ischaemia and hypoxia are rapidly reversed. The MET must have at least one person who is familiar with all aspects of advanced resuscitation and can cope with all hospital emergencies in terms of knowledge and skills. A MET system assists in changing the culture of a hospital to one of a high degree of awareness of patients who may deteriorate and become seriously ill. The MET system also emphasises the fact that care of the seriously ill is a specialised area of medicine, requiring an immediate response with appropriately trained staff.

Outcome indicators for hospital-wide care of the seriously ill

We are becoming increasingly accountable in health and that requires measuring outcomes. The performance of ICUs can be estimated using various severity of illness scoring systems. However, when assessing the care of the seriously

ill across the whole hospital, different outcome indicators are required. Suggested indicators include deaths, cardiorespiratory arrests and unanticipated admissions to ICU (Table 1.2). Potential preventability can be arbitrarily defined as the presence of a MET criteria within 24 hours of one of these three adverse patient outcomes.

These indicators and measures of preventability (Tables 1.2 and 1.3) associated with them can be provided to relevant health care deliverers, providing a basis for quality assurance and improved patient care delivery. Improved management of patients before and after admission to the ICU is essential if we are to improve overall patient outcome from hospitals and to prevent patients from requiring ICU admission.

FURTHER READING

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2

Organisation of an intensive care unit

The specialty of intensive care medicine

It is generally agreed that the specialty of intensive care medicine began in Copenhagen in the early 1950s. During the poliomyelitis epidemic at that time, patients were treated by tracheostomy and prolonged manual ventilation. As a result of those measures, the mortality rate was reduced from 87% to an impressive 40%.

Although there are now many types of intensive care units (ICUs), such as medical, paediatric, respiratory, surgical, neurosurgical, cardiothoracic surgery and trauma, they all perform the same basic function: caring for the seriously ill. Caring for a group of these patients in a single space makes economic and medical sense. Our expertise in intensive care has increased enormously since the early 1950s and there are now specialised medical and nursing staff devoted solely to intensive care medicine.

Specialists working with the seriously ill may be familiar with complicated technology, physiology and pharmacology, as well as conventional medicine. However, it is even more important to become familiar with the unique requirements of critically ill patients – to develop expertise in their individual patterns of illness. These patients often do not conform to the conventional artificial divisions of medicine: 'surgical' patients develop 'medical' diseases. 'Medical' patients may develop 'surgical' diseases. The body may be looked at as a whole rather than as a series of independent organs. This requires that we break away from the tendency toward increasing medical specialisation based on individual organs. Rather than a 'superspecialty', intensive care medicine is a very broad general specialty, based on the body as an integral system, rather than an organ-based super specialty.

Advice from each of the single organ specialists must often be sought. The intensive care specialist must balance all such expert opinions and fit them into an overall strategy. What is good for one organ may be detrimental to others, as well as to the patient's overall condition. One cannot take a committee approach

to the seriously ill. One doctor must take ultimate responsibility and make the final decision, and that doctor must have appropriate training in intensive care medicine and not be an absentee landlord. It matters little from what background intensivists come – anaesthetics, medicine or surgery – as long as they have highly developed clinical skills. Such skills can be gained only by spending time with seriously ill patients. The problem of territorial control by the various specialties (which specialty controls which patients) was an early feature of this specialty, but that attitude is gradually being replaced by a practice based on what is best for the patient.

Intensive care medicine arose from the need for physicians with skills in acute medicine. It is too much to expect a nurse from a general ward or a doctor who works only in another specialty to be able to cope with all of the problems unique to the critically ill. Both doctors and nurses in ICUs require specialised training, specialised books and journals for reference and specialised meetings to share their knowledge and experience. Above all, they need to be working regularly with the seriously ill. This does not mean that they should not seek advice from colleagues in other specialties, when needed, just as is done in all branches of medicine. However, a permanent clinical and administrative medical and nursing presence is essential for the best clinical practice.

Intensive care personnel

The permanent senior medical and nursing staff must provide the continuity of care and ensure that standards are maintained within an ICU. They are responsible for the orientation, education and training of new staff. Junior medical staff usually rotate through the ICU for varying periods and this can lead to inconsistency in the care of patients unless standardisation is ensured through protocols, supervision and educational programmes.

Maintaining a constant high standard of intensive care is the greatest challenge for an ICU. The nursing staff are the mainstay in achieving that goal. They are responsible for most of the minute-to-minute monitoring and treatment. In addition to conventional nursing responsibilities, much of the clinical decision making can be decentralised to a skilled nursing staff. This requires investment in teaching, inservice programmes and audits directed at the bedside nurse. Examples of the expanded nursing role include the following.

Weaning

The weaning process (e.g. adjusting ventilatory rates and pressures) can be carried out by the nursing staff using laboratory data and bedside monitoring.