Intensive Care Nursing

A framework for practice
Second edition

Philip Woodrow

Clinical Scenarios by Jane Roe

Routledge
Taylor & Francis Group

Intensive Care Nursing

This completely updated and revised edition is specially written for qualified nurses working in intensive care nursing units. Fully comprehensive and developed to be as user-friendly as possible it contains four new chapters and valuable, updated and new clinical scenarios to aid learning.

Intensive Care Nursing is structured in user-friendly sections. Each chapter contains 'fundamental knowledge' needed to understand the chapter, an introduction, 'implications for practice', a chapter summary, completely updated further reading, 'time out' sections for revision and a clinical scenario with questions included. This second edition has been fully developed and reviewed by practitioners and teachers, as well as a senior pharmacist and covers:

- patient-focused issues of bedside nursing
- the technical knowledge necessary to safely care for ICU patients
- the more common and specialised disease processes and treatments encountered
- how nurses can use their knowledge and skills to develop their own and others' practice.

Written by a practice development nurse with a strong clinical background in intensive care nursing and experience of nursing teaching, *Intensive Care Nursing* is essential reading for nurses and health professionals working with high-dependency patients.

A support website at www.routledge.com/textbooks/0415373239 links to other important sites, gives answers to the clinical scenario questions and provides a forum for discussion of important clinical issues.

Philip Woodrow is an experienced university lecturer and now works as a Practice Development Nurse for the East Kent Hospitals NHS Trust, one of the largest acute trusts in the UK. He is also the co-author of *High Dependency Nursing Care* (Routledge, 2000).

Contributor: **Jane Roe** is a Lecturer Practitioner in Intensive Care at St George's Hospital, Kingston University and St George's University of London. She is also current chair of the Southern Region British Association of Critical Care Nurses (BACCN).

What reviewers said of the first edition of *Intensive Care Nursing*

'Incredibly comprehensive . . . this text should meet Woodrow's goal of contributing to the "further growth of intensive care nursing". It should find a place on the shelves of intensive care nursing units, as well as in Higher Education institutions providing critical care courses. It will also be a welcome resource of reference for nurses caring for critically ill patients outside of the intensive care unit. Woodrow provides a balance between pathophysiology oriented aspects of nursing practice and the relationship between patient/ family and nurses that is the very essence of intensive care nursing. The text is helpfully punctuated with activities for the reader, whilst the extensive references also enable the reader to pursue specific aspects in greater depth.'

Ruth Endacott, *Advisor and Researcher in Critical Care*

'An excellent book which will be useful to nurses working in ICUs in many countries. It integrates theory with practice to produce an easy-to-read practical text which will be useful to both beginning and experienced ICU nurses.'

Kathy Daffurn, *Associate Professor and Co-Director Division of Critical Care, Liverpool Health Service, Liverpool, Australia*

'A book geared for practical use, it will be helpful to many intensive care nurses, especially those new to the discipline.'

Pat Ashworth, Editor, *Intensive and Critical Care Nursing*

'An informed, well written and clinically focussed text that has ably drawn together the central themes of intensive care course curricula and will therefore be around for many years. . . . Revision activities and clinical scenarios should encourage students to learn as they engage in analysing and reflecting on their everyday practice experiences. More experienced nurses will also find it a valuable reference source as a means of refreshing their ideas or in developing practice.'

John Albarran, *Faculty of Health and Social Care, University of the West of England*

Intensive Care Nursing

A framework for practice

Second edition

Philip Woodrow

Clinical Scenarios by Jane Roe

LONDON AND NEW YORK

To the States or any one of them, or any city of the States,
Resist much, obey little,
Once unquestioning obedience, once fully enslaved,
Once fully enslaved, no nation, state, city, of this earth, ever afterwards resumes its liberty.

Walt Whitman

Fashion, even in medicine.

Voltaire

First published 2000
by Routledge
Second edition published in 2006
by Routledge
2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

Simultaneously published in the USA and Canada
by Routledge
270 Madison Ave, New York, NY 10016

Reprinted 2000, 2001, 2003 (twice) and 2004

Routledge is an imprint of the Taylor & Francis Group

Main text © 2006 Philip Woodrow
Clinical scenarios © 2006 Jane Roe

This edition published in the Taylor & Francis e-Library, 2006.

"To purchase your own copy of this or any of Taylor & Francis or Routledge's collection of thousands of eBooks please go to www.eBookstore.tandf.co.uk."

All rights reserved. No part of this book may be reprinted or reproduced or utilised in any form or by any electronic, mechanical or other means, now known or hereafter invented, including photocopying and recording, or in any information storage or retrieval system, without permission in writing from the publishers.

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Cataloging in Publication Data
A catalog record for this book has been requested

ISBN10: 0–415–37322–0 (hbk)
ISBN10: 0–415–37323–9 (pbk)

ISBN13: 9–78–0–415–37322–7 (hbk)
ISBN13: 9–78–0–415–37323–4 (pbk)

Contents

List of illustrations ix
Preface xiii
Acknowledgements xiv
List of abbreviations xvii

Part I

Contexts of care 1

1 Nursing perspectives 3
2 Humanism 11
3 Psychological care 17

Part II

Fundamental aspects 29

4 Artificial ventilation 31
5 Airway management 47
6 Sedation 59
7 Pain management 70
8 Pyrexia and temperature control 81
9 Nutrition and bowel care 87
10 Mouthcare 98
11 Eyecare 108
12 Skincare 114
13 Children in adult ICUs 122
14 Older patients in ICU 131
15 Infection control 138
16 Ethics 148

Part III

Monitoring 157

17 Respiratory monitoring 159
18 Gas carriage 170

19 Acid–base balance and arterial blood gas analysis 182
20 Haemodynamic monitoring 195
21 Blood results 209
22 ECGs and dysrhythmias 223
23 Neurological monitoring 247

Part IV

Micropathologies **259**

24 Cellular pathology 261
25 Immunity and immunodeficiency 269
26 Disseminated intravascular coagulation (DIC) 277

Part V

Respiratory **285**

27 Acute respiratory distress syndrome (ARDS) 287
28 Severe acute respiratory syndrome (SARS) and Legionella 297
29 Alternative ventilatory modes 304

Part VI

Cardiovascular **313**

30 Acute coronary syndromes 315
31 Cardiac surgery 327
32 Shock 343
33 Sepsis, SIRS and MODS 354
34 Fluid management 362
35 Inotropes and vasopressors 372
36 Vascular surgery 382

Part VII

Neurological **389**

37 Central nervous system injury 391
38 Peripheral neurological pathologies 406

Part VIII

Abdominal **411**

39 Acute renal failure 413
40 Haemofiltration 422
41 Gastrointestinal bleeds 432
42 Hepatic failure 441
43 Obstetric emergencies in ICU 450
44 Transplants 458

Part IX

Metabolic 471

45 Pancreatitis 473
46 Diabetic crises 480
47 Overdoses 488

Part X

Professional 499

48 Professionalism 501
49 Managing the ICU 508
50 Cost of intensive care 517

Glossary 523
References 531
Index 571

Illustrations

Figures

5.1	ETT just above carina	49
5.2	High and low pressure ETT cuffs	51
5.3	Nasal cavity	52
7.1	Referred pain	73
7.2	Dermatomes	77
9.1	Krebs (citric acid) cycle	89
9.2	Bristol stool form chart (after Heaton, 2000)	93
10.1	Oral (buccal cavity)	100
11.1	External structure of the eye	112
12.1	Pressure sore grading	117
17.1	Auscultation sites for breath sounds (anterior chest wall)	162
17.2	Normal (self-ventilating) breath waveform	163
17.3	Pressure:volume (hysteresis) graph	164
18.1	Oxygen dissociation curve	174
18.2	Carbon dioxide dissociation curve	176
19.1	Origin of acid–base imbalance	185
20.1	Arterial trace	198
20.2	Main central venous cannulation sites	199
20.3	CVP waveform	200
22.1	Normal sinus rhythm	226
22.2	Chest lead placement	227
22.3	Action potential	229
22.4	Sinus arrhythmia	232
22.5	Atrial (supraventricular) tachycardia	233
22.6	Premature atrial ectopic	235
22.7	Atrial fibrillation	235
22.8	Atrial flutter	236
22.9	Wolff–Parkinson–White syndrome	237
22.10	Nodal/junctional rhythm	237

22.11 First degree block 238
22.12 Second degree block (Type 1) 239
22.13 Second degree block (Type 2) 239
22.14 Third degree block 240
22.15 Bundle branch block 240
22.16 Multifocal ventricular ectopics 241
22.17 Bigeminy and trigeminy 242
22.18 Ventricular tachycardia 243
22.19 Torsades de pointes 243
22.20 Ventricular fibrillation 244
23.1 Pressure/volume curve 249
23.2 Intracranial hypertension and tissue injury: a vicious circle 250
23.3 Cross-section of the cranium showing Foramen of Monro 255
23.4 Normal ICP waveform 255
24.1 Cell structure 262
30.1 Coronary arteries, with inferior myocardial infarction 317
31.1 Intra-aortic balloon pump – inflated (a) and deflated (b) 331
31.2 Arterial pressure trace showing augmented pressure from use of an intra-aortic balloon pump 332
31.3 Ventricular assist devices (left and right) 333
34.1 Perfusion gradients 366
41.1 Sengstaken tube 434

Tables

1.1 Levels of care 4
4.1 Commonly used abbreviations and terms 33
4.2 Recommended PEEP to FiO_2 settings 39
6.1 Ramsay 63
6.2 Addenbrookes 63
6.3 Newcastle scale 64
6.4 New Sheffield 64
9.1 Normal anthropometric chart 92
10.1 Normal contents of saliva 100
10.2 The Jenkins oral assessment tool 102
10.3 Jiggins & Talbot's (1999) oral assessment 103
17.1 Sputum colour – possible causes 161
18.1 Partial pressures of gases at sea level 171
18.2 Some factors affecting oxygen dissociation 173
19.1 Some symbols commonly found on blood gas samples 189
19.2 Main electrolyte + metabolite results measured by most blood gas analysers 189
20.1 Normal flow monitoring parameters 203
21.1 Erythrocyte results 211
21.2 Some types of anaemia 212
21.3 Normal white cell counts 213

22.1	Framework for ECG interpretation	228
22.2	Antidysrhythmic drug classification	231
27.1	Complications of prone positioning	291
30.1	TIMI risk score (Antman *et al.*, 2000)	318
34.1	Summary of fluids	364
35.1	Main target receptors for drugs	375
36.1	Common complications of open surgery to the aorta (after Prinssen *et al.*, 2004)	386
37.1	Possible main aspects of medical management of moderate/ severe head injury	396
37.2	Priorities of care during fitting	399
39.1	Functions of the kidney	414
40.1	Renal replacement therapies – commonly used terms	424
42.1	Main liver function tests	444
44.1	Code of practice: preconditions (DOH, 1998)	460
44.2	Brainstem death tests	460
45.1	Priorities of nursing care	475

Preface

This book is for ICU nurses. Intensive care is a diverse speciality with many sub-specialities. Even within a single ICU, the range of pathologies and treatments seen may vary widely. No text can hope to cover every possible condition readers may see and general texts cannot cover topics comprehensively. My aim for this book, as in the first edition, is to offer nurses working in general ICUs an overview of the more commonly encountered pathologies and treatments. This text will probably be most useful about 6–12 months into ICU nursing careers and therefore assumes that readers are already qualified nurses with experience of caring for ventilated patients but who want to develop their knowledge and practice further. Because some knowledge is assumed, 'fundamental knowledge' is listed at the start of many chapters for readers to pursue any assumed aspects of which they are unsure. 'Further reading' at the end of each chapter identifies some useful, and usually relatively easily accessible, resources for readers to pursue. This book is also supported by the website www.routledge.com/textbooks/0415373239, which provides further resources and information. Definitions of some technical terms can be found in the glossary – where these terms appear in the text they are italicised, although italics are sometimes used for other reasons – for example standard practices of italicising names of publications and micro-organisms is followed.

This new edition has given me the opportunity to update and develop contents. I could have doubled the size of this book, but doubling size would make it less affordable, more unwieldy and less used. My priority in revising this book has therefore been to identify core issues within a similar-length text. Six years is a long time in the ICU. Some topics covered in the first edition have passed into history; others have faded from fashion. Obsolete topics have been removed, but some material which is neither obsolete nor a priority has also been discarded to make room for new chapters and topics. Some links made to incorporate topics into chapters are tenuous, but I hope that their presence justifies this approach.

Some chapters include details of support groups. Contact details or groups themselves may subsequently change. I have included groups of which I am aware and which I think may be helpful to readers, but the lists are not exhaustive and inclusion (or absence) of any group is not intended to imply relative merit. Other support groups can often be identified through internet searches.

Knowledge develops and changes; controversy can, and should, surround most issues. Some controversies are identified, others are not. But every aspect of knowledge and practice should be actively questioned and constantly reassessed. I have tried to minimise errors, but some are almost inevitable in a text this size; like any other source, this text should be read critically. If this book encourages further debate among practising nurses it will have achieved its main purpose. References to statute and civil law are usually English and Welsh law, so readers in Scotland, Northern Ireland and outside the United Kingdom should check applicability to local legal systems. My hope remains that this book benefits readers and so contributes to delivering quality patient care.

Acknowledgements

Any book is a team effort, and I have been very fortunate to have an excellent and supportive team behind this book. Sheila Quinn (Senior Lecturer, Middlesex University) first suggested I should write a textbook. I am especially grateful to the two main reviewers – Jane Roe and John Albarran who as always have provided a wealth of ideas and resources. I am also grateful to the many other people who have commented on parts of this book: Scott Mercer, Dr James Nash, Sue Roberts and Kathy Dalley.

Teaching ICU nursing helped me gather and organise much information, and sabbatical leave from Middlesex University enabled the first edition to be completed. Since then I have moved to employment by East Kent Hospitals NHS Trust, which has both supported my continuing development and provided me with invaluable experience of clinical practice on its three ICUs at Kent & Canterbury (Canterbury), Queen Elizabeth the Queen Mother (Margate) and Williams Harvey (Ashford) hospitals. I am especially grateful to Moira Taylor and the team at Taylor & Francis Informa for commissioning this second edition and supporting it throughout its development.

Table 6.1 has been reproduced with permission from the British Medical Journal Publishing Group (1974), Ramsay, M.A., Savege, T.M., Simpson, B.R. and Goodwin, R., 'Controlled sedation with alphaxolone-alphadolone', ii(920): 656–659.

Table 6.2 has been reproduced from *Clinical Intensive Care*, 1(3), O'Sullivan, G.F. and Park, G.R., 'The assessement of sedation in critically ill patients', 116–22, Copyright (1990), with permission from Elsevier.

Table 6.3 has been reproduced from *Journal of Drug Development*, 2(Supplement 2), Cook, S. and Palma, O., 'Diprivan as the sole sedative agent for prolonged infusion in intensive care', 65–7, Copyright (1989), with permission from Elsevier.

Table 6.4 has been reproduced from *Intensive and Critical Care Nursing*, 8(3), Laing, A.S.M., 'The applicability of a new sedation scale for intensive care', 149–52, Copyright (1992), with permission from Elsevier.

Figure 9.2 has been reproduced from *Understanding Your Bowels*, Heaton, K., Copyright (2000), with permission from BMA Family Doctor Books.

Table 10.2 has been reproduced with permission from *Nursing Standard*, 4(7), Jenkins, D.A., 'Oral care in the ICU: an important nursing role', 24–8, Copyright (1989).

Table 10.3 has been reproduced with permission from *Paediatric Nursing*, 11(10), Jiggins, M. and Talbot, J., 'Mouth care in PICU', 23–6, Copyright (1999).

Table 30.1 has been reproduced from *Journal of the American Medical Association (JAMA)*, 284(7), Antman, E.M., Cohen, M., Bernink, P.J.L.M. *et al*., 'The TIMI risk score for unstable angina/non-ST elevation MI', 835–42, Copyright (2000), with permission from the American Medical Association.

Table 44.1 has been reproduced with permission from DOH (1998), *Code of practice: preconditions*, Licence number: C02W0007187, Start date: 04/08/2005, End date: 03/08/2010.

Philip Woodrow, *July 2004*

Abbreviations

ACT	Activated clotting times (normal 120–150 seconds)
AF	Atrial fibrillation
AIDP	Acute inflammatory demyelinating polyneuropathy
AMAN	Acute motor axonal neuropathy
ANF	Atrial natriuretic factor (also called ANP)
ANP	Atrial natriuretic peptide (also called ANF)
APACHE	Acute physiology and chronic health evaluation
ARDS	Acute respiratory distress syndrome (see Chapter 25)
ATP	Adenosine triphosphate
AV	Atrioventricular
BE	Base excess
CAPD	Chronic ambulatory peritoneal dialysis
CAVH	Continuous arteriovenous haemofiltration (= ultrafiltration; rarely now used in ICU)
CAVHD	Continuous arteriovenous haemodialysis
CAVHDF	Continuous arteriovenous haemodiafiltration
CCP	Cerebral perfusion pressure
CD4, CD8	CD = cluster designation, a type of surface antigen; the numbers refer to different types
CMV	Controlled mechanical ventilation *or* cytomegalovirus (depending on context)
COP	Colloid osmotic pressure
CPP	Cerebral perfusion pressure
CRP	C reactive protein 9
CRRT	Continuous renal replacement therapy, blanket term used to describe any mode
CSF	Cerebrospinal fluid
CT	Computerised tomography
cTnI	(cardiac) Troponin I
cTnT	(cardiac) Troponin T

CVA	Cerebrovascular accident (stroke)
CVVH	Continuous venovenous haemofiltration
CVVHD	Continuous venovenous haemodialysis
CVVHDF	Continuous venovenous haemodiafiltration
Da	Daltons (molecular weight)
DIC	Disseminated intravascular coagulation
DKA	Diabetic ketoacidosis
DSA	Digital subtraction angiography
DVT	Deep vein thrombosis
E. coli	*Escherichia coli*, a species of gram negative bacteria, one of the major gut commensals; presence of *E. coli* in the blood (or wounds) is an infection
EEG	Electroencephelogram
ETT	Endotracheal tube
FDP	Fibrin degradation product
FEV	Forced expiratory volume (so FEV_1 = forced expiratory volume at 1 second)
FFP	Fresh frozen platelets
FiO_2	Fraction of inspired oxygen (expressed as a decimal fraction, so FiO_2 1.0 = 100% or pure oxygen)
FVC	Functional ventilatory capacity
GBS	Guillain–Barré syndrome
HAI	Hospital acquired infection
HAS	Human albumin solution (i.e. albumin for infusion)
HbA	Adult haemoglobin
HbF	Foetal haemoglobin (abnormal after 3 months of age)
HbS	Sickle cell haemoglobin
HBV	Hepatitis B virus
Hct	Haematocrit (also called 'packed cell volume')
HCV	Hepatitis C virus
HDL	High density lipoprotein
HELLP	Haemolysis elevated liver enzymes and low platelets
HHS	Hyperosmolar hyperglycaemic syndrome (= HONKS)
HITTS	Heparin-induced thrombocytopaenia and thrombosis syndrome
HIV	Human immunosuppressive virus
HONKS	Hyperosmolar non-ketotic state (= HHS)
ICP	Intracranial pressure
Ig	Immunoglobulin (e.g. IgA = immunoglobulin A)
IL	Interleukin
INR	International normalised ratio (measures clotting time – see Chapter 21)
iu	international units
IVI	Intravenous infusion
kDa	kiloDaltons (molecular weight), =1000 daltons (Da)
kJ	kilojoule

LBBB	Left bundle branch block
LDL	Low density lipoprotein
MDMA	3–4 methylenedioxymethamphetamine (Ecstasy)
MetHb	Methaemoglobin
mmol	millimole
MODS	Multiorgan dysfunction syndrome
MRI	Magnetic resonance imaging
MRSA	Methicillin-resistant *Staphylococcus aureus*, also called multi-resistant *Staphylococcus aureus*
NSTEMI	Non-ST elevation myocardial infarction
O_2Hb	Fraction of total haemoglobin combined with oxygen
PAF	Platelet activating factor, a pro-inflammatory lipid mediator, released as part of system immune response
PaO_2	Partial pressure of arterial oxygen
PCP	*Pneumocystis jiroveci* (formerly called *Pneumocystis carinii* pneumonia)
PCV	Packed cell volume (also called 'haematocrit')
PDIs	Phosphodiesterase inhibitors
PE	Pulmonary embolus
PEA	Pulseless electrical activity
PEEP	Positive end expiratory pressure
PFC	Perfluorocarbon
PGI_2	Prostaglandin I_2 (also called 'prostacylin')
pHi	Intramucosal pH
PSV	Pressure support ventilation
PTT	Prothrombin time
PUFAs	Polyunsaturated fatty acids
QALYs	Quality adjusted life years
RBBB	Right bundle branch block
RHb	Reduced or deoxygenated haemoglobin
RNA	Ribonucleic acid (part of cells)
RR	Respiratory rate
SA	Sinoatrial (node)
SCUF	Slow continuous ultrafiltration removal of ultrafiltrate, usually using a small-pore filter, so minimising solute removal; used only for removing/reducing fluid overload
SDD	Selective digestive decontamination
SD plasma	Solvent detergent plasma
SIADH	Syndrome of inappropriate anti-diuretic hormone
SIMV	Synchronised intermittent minute volume
SIRS	Septic inflammatory response syndrome
STEMI	ST elevation myocardial infarction
SV	Stroke volume (in context of ventilation, SV = self ventilating)
SVT	Supraventricular tachycardia
TBI	Traumatic brain injury
TNFα	Tumour necrosis factor alpha

t-PA, rt-PA	(recombinant) tissue plasminogen activator
TV	Tidal volume (also written at V_t)
TXA_2	Thromboxane A_2
VALI	Ventilator-associated lung injury (see VILI)
VILI	Ventilator-induced lung injury (see VALI)
V/Q	Ventilation:perfusion ratio, minute volume compared with cardiac output (normally 0.8)
VRE	Vancomycin resistant *Enterococci*
V_t	Tidal volume (also written at TV)
WCC	White cell count

Part I

Contexts of care

Chapter 1

Nursing perspectives

Contents

Introduction	4
Technology	4
The patient . . .	5
. . . their relatives . . .	5
. . . and the nurse	6
Stress	7
Breaking bad news	8
Duty of care	8
Implications for practice	9
Summary	9
Further reading	10
Clinical questions	10

Introduction

What is the purpose of nurses in an ICU? What does critical illness and admission to intensive care cost patients and their families? In the busyness of everyday practice, these fundamental questions can be too easily forgotten. Yet an ICU is expensive: staffing accounts for half of the ICU budgets, and nursing accounts for most staffing costs (Edbrooke *et al.*, 1999). So ICU nurses need to clarify their value and 'articulate the importance of their role in caring for patients and their relatives' (Wilkinson, 1992: 196). This book explores issues for ICU nursing practice; this section establishes core fundamental aspects of ICU nursing. To help readers articulate the importance of their role, this chapter explores what nursing means in the context of intensive care, while Chapter 2 outlines two schools of psychology (Behaviourism and Humanism) that have influenced healthcare and society.

Acknowledging and continuously re-evaluating our beliefs is part of human growth. Examining nursing's values and beliefs, within the context of our own area of practice, is part of our professional growth (Sarvimaki & Sanderlin Benko, 2001).

In the UK, Comprehensive Critical Care (DOH, 2000a) identified four levels of care (see Table 1.1), used throughout the National Health Service (NHS). This text is about level three (critically ill) patients; a companion book (Moore & Woodrow, 2004) focuses on level 2 patients.

Technology

Intensive care is a young speciality. The first purpose-built intensive care unit (ICU) in the UK opened in 1964 (Ashworth, personal communication). ICUs offer potentially life-saving intervention during acute physiological crises, with emphasis on medical need and availability of technology.

Technology provides valuable means of monitoring and treatment. Continuous observation of critically ill patients is important (RCN, 2003a), but should not become a substitute for care. To achieve a patient-centred focus,

***Table 1.1* Levels of care**

Level	Description
Level 0	Patients whose needs can be met through normal ward care in an acute hospital
Level 1	Patients at risk of their condition deteriorating, or those recently relocated from higher levels of care, whose needs can be met on an acute ward with additional advice and support from the critical care team
Level 2	Patients requiring more detailed observation or intervention including support for a single failing organ system or post-operative care and those 'stepping down' from higher levels of care
Level 3	Patients requiring advanced respiratory support alone or basic respiratory support together with support of at least two organ systems. This level includes all complex patients requiring support for multi-organ failure

***Source*: DOH, 2000a**