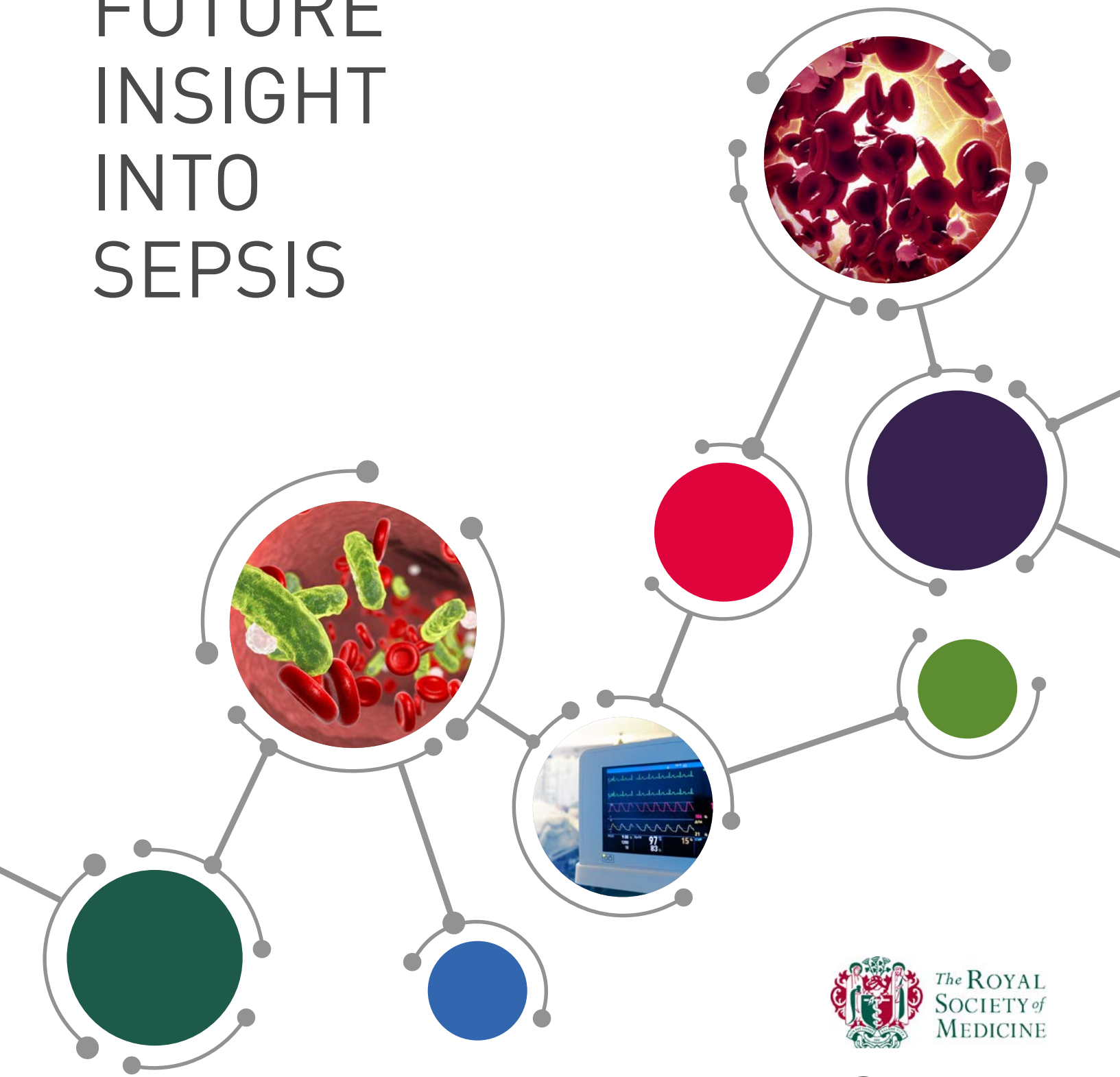
A **CRC Press** FreeBook

FUTURE INSIGHT INTO SEPSIS



The Royal Society of Medicine

CRC Press
Taylor & Francis Group

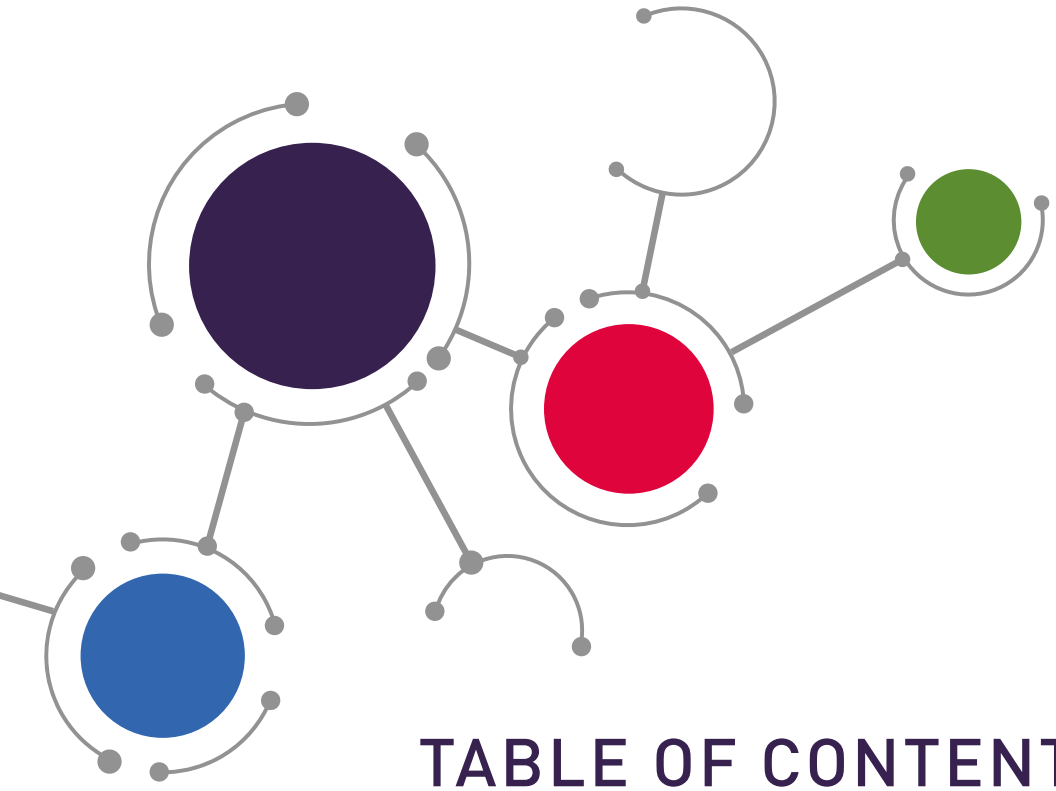


TABLE OF CONTENTS

FUTURE INSIGHT INTO SEPSIS
INTRODUCTION

Throughout the ages, infectious diseases have been a major cause of death in humans. Vaccination programmes; improved sanitation and public health measures; infection prevention and the advent of antimicrobials have all led to a significant decline in death rates in the Western world.

Sepsis, as defined as the body's response to overwhelming infection, remains a global healthcare problem. Despite advances in medical care, mortality in intensive care patients with multi-organ failure secondary to infection remains around 35%. Worldwide, infection related deaths are estimated to still be around 8 million people p.a.

Simple interventions remain our mainstay of treatment: early recognition, timely interventions with antimicrobials and fluids and good source control. However, we are entering an era that will question some of our fundamental paradigms.

Antibiotic resistance is a global time bomb and soon some of our basic armamentarium may be lost forever. Our future treatments must rely on a better understanding of the pathophysiology of sepsis, genetics and identifying novel targets for modulating this process.

CRC Press-Taylor & Francis Group publishes a wide breadth of medical literature. Sepsis is a condition that crosses all boundaries. All clinicians and healthcare providers will encounter this during their practice. A selection of chapters is presented covering the fundamental basics of sepsis identification and management.

We hope you enjoy reading these taster chapters and encourage you to consider sepsis in your day-to-day practice.

Gareth Scholey
Consultant Intensive Care Medicine
Clinical Director Intensive Care
University Hospital of Wales.

Matt Thomas
Consultant Intensive Care
University Hospitals Bristol
Critical Care Lead, Great Western Air Ambulance.

FUTURE INSIGHT INTO SEPSIS INTRODUCTION

SUMMARY

Why are certain infection prevention practices upheld and are all practices informed by evidence? Chapter 1 "Just infection prevention and control" from *Infection Prevention and Control* examines the consequences of myths and provides actions on infection prevention that are based on halting transmission and departing from practices which may lead to inequity or psychological harm.

Antibiotic resistance is a major threat to global public health. Chapter 2 "Antibiotics: help or hindrance?" from *Infection Prevention and Control* discusses how bacteria are evading antibiotic treatment, the extent of the problem and potential measures to combat the rise of antibiotic-resistant infections from patient education to antimicrobial stewardship.

Chapter 3 "International health regulations: Policy" taken from *Disease Surveillance: Technological Contributions to Global Health Security* summarises the 66 articles and 9 annexes of the IHR and outlines case studies of the IHR in use during recent public health emergencies of international concern.

Foreign travel emergencies concerning infectious diseases can be devastating for international travellers. Chapter 4 "Infectious Diseases and Foreign Travel Emergencies" is taken from *Emergency Medicine: Diagnosis and Management*, a book that incorporates the latest rationale and evidence underpinning best practice emergency medical care. This chapter covers the major infectious diseases that may be encountered and provides guidelines on the treatment of patients.

Infection and organ failure are often seen as preventable causes of mortality for the trauma patient in the Intensive Care Unit. Chapter 5 "Critical Care of the Trauma Patient" from the *Manual of Definitive Surgical Trauma Care* examines the importance of ICU care and the treatment and management of these most vulnerable patients, with particular reference to antibiotics and surviving sepsis.

FUTURE INSIGHT INTO SEPSIS INTRODUCTION

AUTHORS

CHAPTER 1 | JUST INFECTION PREVENTION AND CONTROL

Julie Storr, BN (Hons), RGN, MBA Director, S3 Global, Consultant, World Health Organization, Past President, Infection Prevention Society S3 Global, London

CHAPTER 2 | ANTIBIOTICS: HELP OR HINDRANCE?

Sarah Pye, RGN, DN, BSc (Hons), MA, PGCLT(HE), MRCN Senior Lecturer Practice Learning, School of Nursing, Canterbury Christ Church University, Kent

Clare Hancock, MPharm, MRPS Clinical Pharmacist, The Royal Surrey, County Hospital NHS Foundation Trust

CHAPTER 3 | INTERNATIONAL HEALTH REGULATIONS: POLICY

Rebecca Katz, Milken Institute School of Public Health, George Washington University, Washington, DC

Sarah Kornblet, Milken Institute School of Public Health, George Washington University, Washington, DC

Erin M. Sorrell, Milken Institute School of Public Health, George Washington University, Washington, DC

Claire Standley, Milken Institute School of Public Health, George Washington University, Washington, DC

Julie Fischer, Milken Institute School of Public Health, George Washington University, Washington, DC

CHAPTER 4 | INFECTIOUS DISEASE AND FOREIGN TRAVEL EMERGENCIES

Anthony F. T. Brown, MB ChB, FRCP, FRCS(Ed), FRCEM, FACEM, Professor Discipline of Anaesthesiology and Critical Care, School of Medicine MD Program, University of Queensland, Brisbane

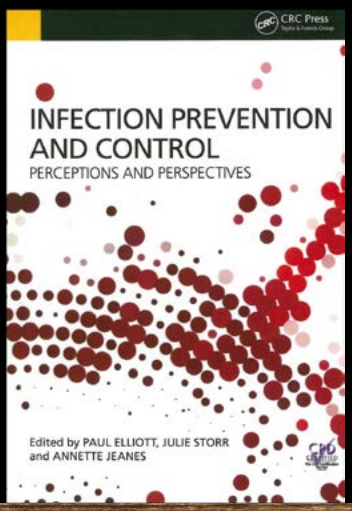
Senior Staff Specialist (Pre-eminent), Department of Emergency Medicine, Royal Brisbane and Women's Hospital, Brisbane

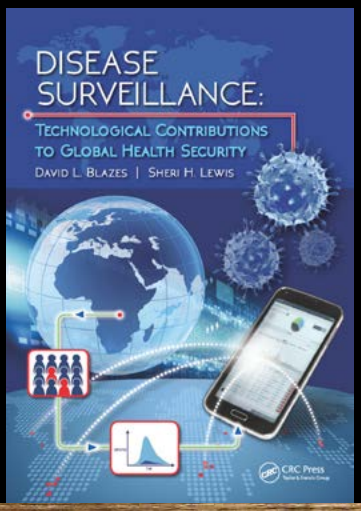
Mike D. Cadogan, MA(Oxon), MB ChB (Ed), FACEM, Staff Specialist in Emergency Medicine, Department of Emergency Medicine, Sir Charles Gairdner Hospital, Perth

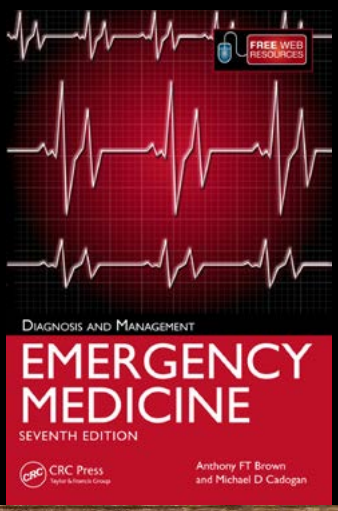
CHAPTER 5 | CRITICAL CARE OF THE TRAUMA PATIENT

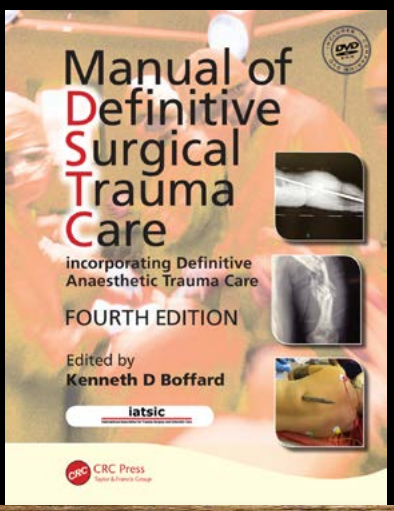
Kenneth D Boffard, BSc(Hons) FRCS FRCPS FCS(SA) FACS, Professsor Emeritus, Department of Surgery, Milpark Hospital and University of the Witwatersrand, South Africa

READ THE LATEST CHAPTERS ON SEPSIS & INFECTION WITH THESE KEY TITLES









VISIT **CRCPRESS.COM** TO BROWSE OUR FULL RANGE OF BOOKS AND SAVE 20% WITH THE DISCOUNT CODE **RSM03**

CRCPRESS.COM

CRC Press, Taylor & Francis Group is a global publisher of world-class references, handbooks, and textbooks for the medical, scientific and technical communities including academics, professionals, and students. For a complete catalog of our sepsis & infection books including bestselling and forthcoming titles, or to sign up for our email list to receive exclusive offers, visit www.crcpress.com today.

» CLICK HERE

JUST INFECTION PREVENTION AND CONTROL

1 :: JUST INFECTION PREVENTION AND CONTROL

JULIE STORR

The following is excerpted from *Infection Prevention and Control: Perceptions and Perspectives*, by Paul Elliott, Julie Storr, Annette Jeanes

Information giving and anxiety reduction should be fundamental parts of nursing

INTRODUCTION

Over 20 years ago, a conversation was stimulated on the challenges of moving away from outdated nursing procedures that are based on myths and consist of ritualistic behaviour and which are carried out by healthcare practitioners (nurses) without thinking and insight. This chapter resumes the conversation in the present day, through an infection prevention and control lens. It explores what, if any, are the present-day myths and rituals in modern healthcare that are carried out in the name of infection prevention and control, alongside practices that have become accepted as the norm. Most important, it considers the unintended consequences that such myths and misconceptions can have, particularly in terms of injustice, inequity, ethics and psychological harm. It calls for action now where warranted to stop injustice, to refocus on activities that are safe, evidence informed, patient focused and, ultimately, sensible. It subsequently highlights the need to build capacity and capability across healthcare such that insight into the consequences of what is carried out in the name of infection control is readdressed, posing the question: 'What can we do better to ensure justice for infection prevention in the name of patient safety?' This chapter culminates in a number of proposed actions, including a healthcare worker training revolution, research on the impact of redundant or unnecessary practices on the psychological health of patients, a 'consumer or future patient' awareness-raising campaign – driven by policy and supported by informed media – and infection prevention and control strategies that are focused on halting microbial transmission and subsequent harm from a holistic, rights-based perspective that takes account of dignity, ethics, humanity and justice.

Hospital workers exercise care through a network of practices and fundamental beliefs that are largely taken for granted. This author emphasises the 'embodied know-how that goes into a surgeon's operations, or into the touch of the doctor or nurse when examining a patient' – care described as grounded in skillful micro-practices that healthcare workers have absorbed and carry out without freshly thinking them through on each occasion. It is only when aspects of practice become problematic that they are raised for debate and can be changed.

For a long time infection prevention and control has been focused on the impact of microbes on the health and well-being of patients, and on how practices control the spread of these microbes. Is it now perhaps the moment to consider the patient related impact of some of the micro- and macro-practices that are in place in the

1 :: JUST INFECTION PREVENTION AND CONTROL

JULIE STORR

name of halting transmission; some of the 'problems' associated with these; and to call time on those that at least might be unnecessary and at worst might actually be harmful.

BOX 1.1 • A personal reflection

My first recollection of infection control, as it was then described, was during the last century – the 1980s to be precise, and my first ward placement as a student nurse. I recall being told in no uncertain terms and most seriously by a healthcare assistant that on no account must I use talcum powder when assisting a patient with activities of daily living, because of the infection hazard it presented. Whether this was rooted in scientific evidence I never got to know, because I accepted it on its face value as a fact.

The account described in **Box 1.1** is reflective of a pattern that has permeated the rest of my career, initially in nursing and more recently healthcare.

Similar 'advice' continues to be heard to this day, ranging from a dentist who explained that the regulators instructed him to take a poster off the ceiling (it was intended to be a distraction to the anxious dental patient) because it presented an infection risk, to a nurse who explained medicine carts were no longer used for the same reason. Ties, watches, sleeves, flowers, Christmas decorations, bed-sitters – all frowned on in the name of infection prevention. Some of the frowning might well be justifiable, and while talcum powder and Christmas decorations might not have a significant effect on recovery or the psychological status of a patient, some of the practices we do (some for no sound reason) in the name of infection prevention and control can and do have consequences, which range from low-level annoyance through to heightened anxiety levels of patients and their families. The negative consequences, not of microbes but of the prevention and control mechanisms we employ, have surprisingly generated little debate in the academic literature. This chapter is intended to stimulate a new debate.

While much of infection prevention is evidence informed (or is increasingly so), this chapter is predicated on the acceptance that some of the things we do under the guise of preventing infection are based in mythology, some ritualistic and some plain nonsense. Everything addressed in the next few pages can be challenged, disputed and argued against, and, as a progressive infection preventionist, I welcome such discourse. This chapter is intended to push the healthcare community to revisit

1 :: JUST INFECTION PREVENTION AND CONTROL

JULIE STORR

what we do in the name of stopping infection from occurring and/or spreading. Exploring the extent of this problem, if it exists, and its impact on patients will form an important contribution to a patient-focused approach to infection prevention and the pursuit of care and treatment that is patient-centered as well as concerned with the important matter of risk reduction. Healthcare teams that interact with patients 24 hours a day must be empowered to critique, understand and apply good science as well as to know when to consign myths and injustices to Room 101.

This chapter will explore:

- unintended consequences of (unnecessary) patient isolation – actions that ignore cognitive well-being and contribute to both under- and over-compliance of necessary infection control practices such as the right times for hand hygiene
- implementation of policies and practices that have no grounding in infection prevention evidence or logic (i.e. related to uniforms, buckles, beds, ties, patient chairs, toys, visitors, and so on)
- the impact of misunderstanding the dynamics of microbial spread at the patient bedside and therefore foregoing some important patient interactions, such as a comforting touch
- losing sight of the human being, the person beneath the patient, including risk communication and its impact on anxiety levels.

Martin Luther King Jr has been credited with the statement: 'Of all the forms of inequality, injustice in health care is the most shocking and inhumane.' A number of infection prevention and control practices grounded in myth have the potential to result in and perpetuate injustice in modern healthcare, an issue that must be addressed for patient well-being. Examples are not too hard to find. In the English National Health Service at the time of writing there continue to exist hospitals that ban visitors during outbreaks of norovirus, using the infection prevention and control argument in its defence; this is, in fact, counter to national guidance that, while discouraging social visitors, cites 'operational expedience' rather than infection control as its rationale. Yet other National Health Service organisations are considering the use of Skype and FaceTime as a means of communication between patients and visitors when visiting is restricted because of infection risks.

1 :: JUST INFECTION PREVENTION AND CONTROL

JULIE STORR

BOX 1.2 • Some questions

Before reading further, consider the following: How much investment, time and lobbying has gone into strengthening surveillance – really high-quality surveillance that has been proven to contribute to reduction in healthcare-associated infection? How much investment is put into building high-quality, competent practitioners who are skilled in epidemiology? How much pressure is there for hospitals to undertake surveillance across the range of common healthcare- associated infections? How much surveillance is mandatory? Contrast this with the amount of effort and zeal that many in healthcare, including at the policy level, put into 'bare below the elbows', auditing of commodes, and deep cleaning? What drove the latter focus on politically motivated edicts and what prevents the former investment on interventions that are evidence-informed? Is this, in the end, an injustice?

SETTING THE SCENE

There seems to be something very strange going on. Is it all in the interests of being seen to be doing something very noticeable about the worrying levels of hospital based infections, however ineffective and otherwise disruptive.

You don't have to look too hard in the published and grey literature to find a plethora of examples of the zealous application of practices in the name of infection prevention and control. What emerges from many of these examples is a trade-off between the need to prevent harm (usually, but not always, to patients or other patients in the vicinity) and the need to maximise the health and well-being of individual patients, including physical and psychosocial well-being.

A number of these issues are described perfectly in a blog post exploring whether well-minded infection control procedures are in fact subverted. Within the blog it is suggested that many infection control procedures, with their origins in the maintenance of patient safety, have become routinised into our mindset and detached from their original purpose. The banning of flowers, which thankfully no longer seems all-pervasive from an infection control perspective, is used to illustrate the point. There is no evidence that flowers pose a risk of infection; however, as the author states, the maintenance, arrangement and emptying of vases may be seen

1 :: JUST INFECTION PREVENTION AND CONTROL

JULIE STORR

as a burden to already busy staff, and the risk of spillage of water an unwanted side issue. Rather than using these justifications, the infection control agenda added a sense of legitimacy and a kickback to justify the exclusion of flowers from general wards. Similar illustrations are used that include toys and magazines in communal areas and restrictions on the number of visitors. In some instances infection control has taken on a social role and become a means of control, or even a pointless exercise, rather than an evidence-based practice.

Iona Heath, quoted at the start of this section, summarised some of the issues in an article. She described the prohibition in modern healthcare of sitting on a patient's bed, in the name of infection control. The article presents a compelling account of the benefits, as she perceives it, to patients when doctors are permitted to sit on a bed during an encounter. Heath describes such interactions as precious and, alarmingly, suggests that this ban on bedsitters seems to be imposed even when patients are dying. She suggests that infection control specialists enforcing such approaches lack humanity and common sense, and she cites the national evidence-based guidelines on infection prevention and control as being devoid of any mention of bed-sitting (or flowers – an issue previously addressed by Heath in the BMJ). Her default assumption is that there is no evidence for such a rule. Heath concludes by returning us to the issue of humanity and calls for bed-sitting (and flowers) to be freely permitted unless there is robust evidence to deter these 'elements of home' from penetrating hospitals and improving patient well-being.

> *Patients consistently estimate that they have been given more time when the doctor sits down rather than stands.*

It seems that considering infection through the narrow chink of a microscope lens could contribute to some of the challenges described here. These brief examples suggest a problem illustrative of misguided thinking on what's right and wrong, influenced by a lack of insight, misapplication of knowledge or, indeed, absence of sound knowledge, and a silent infection prevention and control community that needs to shout much louder if it is to be part of the solution and not a contributor to the problem. The media undoubtedly play a role, as evidenced in a review of the drivers and influencers of the media coverage of meticillin-resistant *Staphylococcus aureus* (MRSA) in the early to mid-2000s. The authors concluded that the media played a powerful role in driving policy away from scientific evidence and toward popular, 'common-sense' solutions, and in addition the authors touched on the weaknesses in the scientific community, including professional bodies, in their inability to penetrate the media machine with counterarguments.

1 :: JUST INFECTION PREVENTION AND CONTROL

JULIE STORR

So far, this chapter has provided two anecdotal examples to illustrate that there may be a problem. Does the scientific literature shed any more light on the subject?

HUMANITY, ETHICS, RIGHTS AND CONSEQUENCES

This section focuses on a snapshot of the literature that highlights the potential injustices; it does not aim to present a full literature review balancing these points with the benefits of infection prevention and control measures, as these are freely available in many other documents. The key point being posed is that these measures are being applied separately from other patient care needs.

Considering justice in infection control from an ethical standpoint draws out the important point that most infection prevention professionals enter the specialty from a clinical medicine background – one where the welfare of individual patients trumps broader social concerns – and this can result in infection control measures infringing on individual rights and liberties. Examples cited include surveillance, isolation precautions and antimicrobial prudence. In terms of the impact of infection prevention practices, patient isolation has received the greatest attention. Isolation undoubtedly serves a purpose in helping to control the spread of some microorganisms. However, there is some documented work that reports the isolation of patients and subsequent 'barrier' precautions can lead to fewer bedside visits by doctors and nurses and thereby resultant negative psychological impact on the patient, as well as poorer perceived satisfaction with treatment.

A recent systematic review aimed to determine whether contact isolation leads to psychological or physical problems for patients. The authors looked at 16 studies on the impact of isolation on the mental well-being of patients, patient satisfaction, patient safety or time spent by healthcare workers in direct patient care using validated tools scoring for levels of anxiety and depression. Their findings conclude that isolation has a negative impact on the mental well-being and behaviour of patients, including higher scores for depression, anxiety and anger among isolated patients. The literature revealed that healthcare workers spent less time with patients in isolation and that patient satisfaction was adversely affected, particularly influenced by the extent to which patients were kept informed of their healthcare. Patient safety was also negatively affected, although this has been contended in other studies, and the review found an eightfold increase in adverse events. The authors suggest that patient education may be an important step to mitigate the adverse psychological effects of isolation. However, the review did not consider patient information within the context of an empowered, well-educated and well-informed health workforce.

1 :: JUST INFECTION PREVENTION AND CONTROL

JULIE STORR

More recently, as part of a doctoral thesis, Parker synthesised eight qualitative research studies focused on patients' experiences of healthcare-associated infections. The findings follow a similar pattern to that already outlined – experience was largely negative, psychological needs were often overlooked and fear, worry, stress and guilt were common features of the patient's experience. The patient experience was exacerbated by poor information-giving by staff, based on preconceptions and assumptions. Parker describes the negative experience as resulting in a 'double iatrogenic effect' on the patient. The issue of poor information-giving predicated on limitations in staff knowledge and competence in the field is not explored in any detail.

It seems logical from this brief review of the literature that isolation is applied only when absolutely necessary for patient safety and that healthcare workers are aware of its potentially negative side effects.

What emerges from much of the literature is the need for a philosophical and ethical debate focused on the complexity that is infection prevention and control, and its practices that are ubiquitous and often never challenged. Many of the academic papers cited here focus on issues of justice, individual human rights, freedom of movement, the greater good of society and citizenship. Bryan and colleagues, in particular, suggest that national guidelines and regulations sometimes fail to offer tidy solutions to infection prevention and control problems. Therefore, what is needed is a decision-making process that includes a careful review of the facts, values and external factors (such as guidelines) and an awareness of relevant ethical frameworks.

Healthcare-associated infection has also been considered from a patient rights perspective, addressing respect for human dignity, and this adds an interesting dimension to the debate. Millar describes the universality of human rights, particularly for citizens unable to advocate for themselves, and considers the isolation of patients as a potential breach of the right to dignity and respect. Millar further discusses control strategies for MRSA and suggests that such measures operate at the interface between public health and the promotion of public good, and the care of individual patients – something that creates a tension within healthcare. Millar proposes that historically there has been an acceptance by patients of the many actions that are taken to prevent and control healthcare- associated infection; however, by considering issues of patient rights, it becomes a matter of importance to be able to justify the measures taken.

1 :: JUST INFECTION PREVENTION AND CONTROL

JULIE STORR

If patient rights are to be over-ridden, patients and the public might reasonably expect there to be transparent and explicit reasons, preferably supported not only by professional and expert opinion of the evidence but also consensus agreement with patients and the public.

More recently, a World Health Organization Europe document considered the important aspect of patient rights in relation to patient safety. Its chief focus is on the right to safe healthcare and it explores patient empowerment as one component of this, in relation to a number of safety- related areas including hand hygiene improvement. It does not concern itself with rights in relation to the unintended consequences of patient safety interventions.

In terms of a possible resolution of the conflicts identified in this chapter, Stelfox and colleagues call for multicomponent interventions that are implemented in the name of patient safety, and this applies to many of the infection prevention practices described so far – particularly isolation – to have their individual parts examined to determine whether all elements are essential. They suggest that it might be possible to 'disentangle' which isolation policy components are most important for infection control and which may be most harmful to the isolated patient. They further call for individualisation, citing that patients who experience the most negative effects of isolation may not be those who present the greatest risk of microbial transmission. These authors discuss the interdependence of individual patient characteristics, clinician factors, environmental constraints and organisational culture as key influencers of patient safety.

MRSA was described in a recent paper as 'the infectious stigma of our time', the paper challenging the reader to consider some of the things undertaken in the name of infection prevention guidelines. Here are some examples of practices uncovered during a reflective analysis of MRSA guideline application in Norway:

- older patients with dementia isolated for long periods
- patients denied access to a GP practice and had their consultation in a car park
- new employees made to stand naked and be examined for skin lesions.

The authors understandably ask the question, 'Oh God, what are we doing?' They consider the dichotomy of guideline implementation and an appreciation of the ethical dilemmas this can raise.

1 :: JUST INFECTION PREVENTION AND CONTROL

JULIE STORR

> *We isolate people as if they have highly contagious TB [tuberculosis], but they may be as 'healthy' as persons with HIV [human immunodeficiency virus].*

These authors go on to suggest that MRSA, in particular, is unique in that it can result in the isolation of carriers who do not have clinical disease. This isolation can result in feelings of anxiety and powerlessness, and this is further compounded because often the time period for isolation is not well defined. The use of personal protective equipment, in some instances, by visitors can result in fewer visits by loved ones and in social deprivation. The authors conclude by calling for more emphasis on ethics within guidelines such as those designed to limit transmission of MRSA; at the very least they should contain an explicit ethical argument. The authors further suggest that we have failed to learn the lessons from the era of HIV, when in an attempt to prevent stigmatisation, universal precautions were introduced. The authors call for healthcare workers not to rely on passive conveyance of the measures suggested in guidelines, but rather to reflect on possible actions, particularly the ethical considerations and implications of the guidelines on patients and relatives.

It seems that, increasingly, the research community is beginning to challenge some of the historic approaches to infection prevention and control. Spence and colleagues describe how they have ceased to apply contact precautions within their 285-bed hospital in the United States for patients asymptomatically colonised with MRSA, with no noticeable impact on transmission. However, as with many hospitals in the United States, all patients in this 285-bed hospital have their own room; this is not the case at present in the United Kingdom.

Recently, there have also been some fresh voices and opinions heard on this topic, highlighted through the power that is social media, with eminent infectious disease physicians and epidemiologists in the United States using their blog post to share thoughts on topics such as 'Why I Hate Contact Precautions' and 'Let Me Hate on Contact Precautions Some More'. These challenging discussions must be welcomed and the role of social media explored further as a catalyst for change. The reflective exercises in Box 1.3 invite the reader to consider his or her own controversies and present a number of probing questions.

1 :: JUST INFECTION PREVENTION AND CONTROL

JULIE STORR

BOX 1.3 • Reflective exercise – the case for or against

Consider the following scenarios.

- Visitors of a patient isolated because of a resistant organism are instructed to wear gloves and a plastic apron on entry to the room and for the duration of their visit
- A postpartum woman being treated for a breast abscess due to MRSA is told she is not allowed to visit her infant in the busy neonatal intensive care unit in which MRSA has not yet emerged as a significant problem
- A sign outside the entrance to a ward instructing visitors not to take flowers onto the ward
- A recommendation is made in a report of 'failing hospitals' for the health service to consider introducing Skype and FaceTime for patients in isolation, to minimise visitors
- A nurse in a nursing uniform, with a coat, the uniform looks clean and smart, enters a supermarket; the manager of the shop emails the manager of the local hospital to complain, citing risk of infection as a concern
- A report from a regulatory body that has undertaken a review of what are considered 'failing hospitals' criticises the infection prevention and control team because of a number of noticeable breaches of best practice, including one example of nurses wearing buckles
- An elevator in a large teaching hospital instructs all visitors to clean their hands as they enter a ward

For each scenario, try to answer the following three questions:

1. What is the key risk and who is it a risk to?
2. How strong, if at all, do you think the evidence behind the infection prevention and control measures is?
3. What might be the unintended consequences of the measures, and to whom?

If the measures are justified, in your opinion, how might the unintended consequences be lessened?

1 :: JUST INFECTION PREVENTION AND CONTROL

JULIE STORR

WHAT WE CAN DO MOVING FORWARD

This chapter has focused on aspects of infection prevention and control that may have unintended consequences and which could be described as perpetuating injustice for patients. A key focus has been on the impact of isolation on a patient's cognitive well-being, but there are other examples of practices implemented in the name of infection prevention, practices where the consequences have so far evaded academic scrutiny and have largely bypassed any sort of challenge or healthy debate. These are summarised in the following list – this list is certainly not exhaustive, but it aims to prompt action now where warranted to help stop injustice, and to refocus on activities that are safe, evidence informed, patient focused and, ultimately, sensible.

- Patient isolation only when absolutely necessary for patient safety, taking heed of the existing research (i.e. what we already know) about the psychological impact of isolation and contact precautions
- Compassion-informed risk communication when addressing infection/colonisation in patients, making the best use of all available skills and resources
- The development of a competent infection prevention-informed workforce and a gigantic leap forward in capacity building at the undergraduate and postgraduate level, driven by competent specialist practitioners
- Informed leadership, policymakers and regulators across every level of health-care who promote the right culture for infection prevention
- An informed media ready to listen to a strong, credible and convincing scientific community
- The use of digital social media to promote the right messages
- Revisiting of the learning from HIV and universal precautions and consideration of the ethical argument for all infection prevention interventions
- Refocusing on evidence base and surveillance, and the impact of recommendations and data on behaviour
- Empowering patients and consumers – patient education and information on the rationale for everything undertaken in the name of infection prevention and control

And there are other aspects that should at least be considered now:

- research that looks beyond the impact of the germs, exploring the impact of redundant or unnecessary practices on the psychological health of patients
- a revolution in healthcare worker training, and bold moves to change how we approach this, with the goal of true capacity building and true behaviour change

1 :: JUST INFECTION PREVENTION AND CONTROL

JULIE STORR

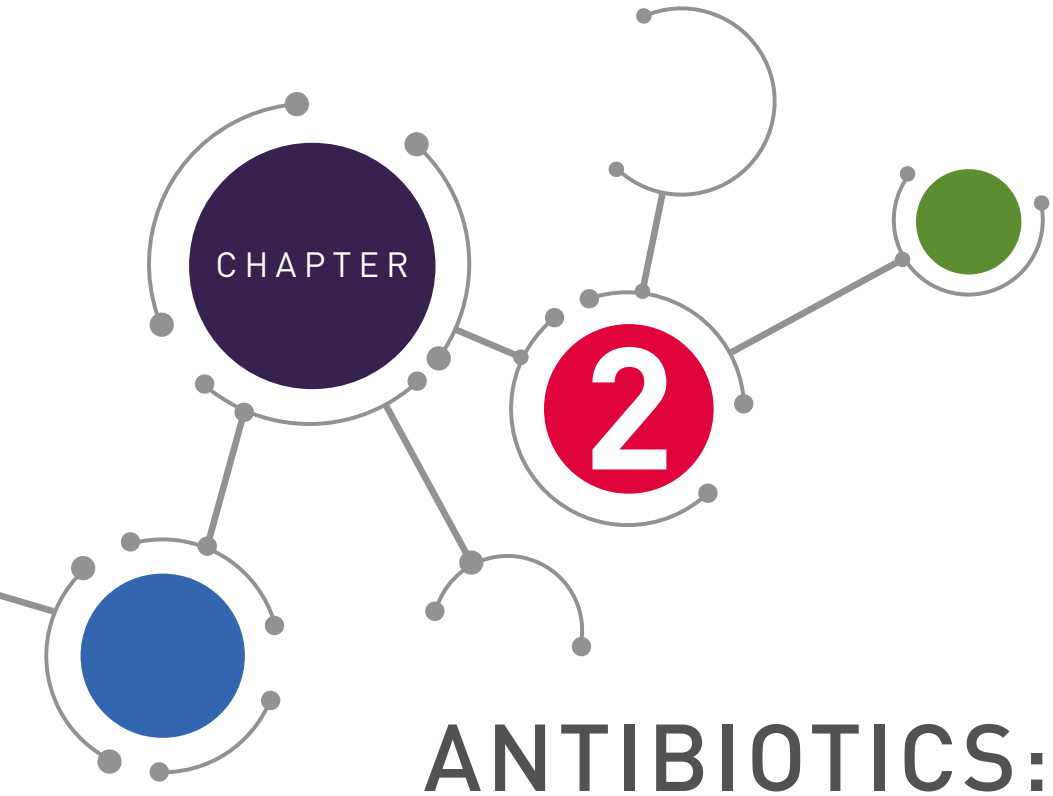
- revised infection prevention and control strategies that are focused on halting microbial transmission and subsequent harm from a holistic, rights-based perspective that takes account of dignity, ethics, humanity and justice.

CONCLUSION

The topics that have been touched on in this chapter show that a number of practices appear to have lost sight of the person beneath the patient, and some of them have undoubtedly lost sight of the dynamics of spread of microbes at the bedside that can lead to patient harm. Based on what we now know in the twenty-first century, this chapter calls for all those working in healthcare to refocus on what infection prevention and control stands for, perhaps to redefine the specialty, and certainly to ensure that the practices carried out in its name never lose sight of the patient and his or her family. This requires strong, informed leadership to generate the right cultural milieu and a cadre of bold, progressive and pragmatic healthcare personnel to drive a new agenda.

Bryan and colleagues introduce the notion of practical wisdom and love as key virtues for competence and caring, and that all healthcare workers, including infection preventionists and hospital epidemiologists, need *practical wisdom* to guide them in decision making in the face of uncertainty, to seek a balance between individual rights and the common good; *temperance* to seek restraint in the use of healthcare resources; and *courage* to engage busy and politically powerful physicians and administrators in dialogue. In conclusion, this chapter calls for an immediate cessation of the perpetuation of any injustice that is introduced or promoted in the name of infection prevention and control.

Additionally, infection prevention practitioners need to lead by standing up and denouncing anything that contributes minimally to patient safety and emerge as the credible, respected champions of logic, patient-centred care and safety. In the achievement of an exemplar culture of infection prevention and control, there is a need to win the hearts and minds of clinicians and managers. Much progress has been made but the need remains to strive for the right balance between risk, human rights and human wrongs. This is a challenge to all involved in healthcare and will involve a multifaceted approach. Infection preventionists should be blazing the trail, but it is the doctor, the nurse, the student, the porter, the domestic assistant and all those who exercise care through what Farrands described as the network of practices and fundamental beliefs that are largely taken for granted. These are the workers who touch the lives of patients every day. Each interaction should be safe and sound, just and sensible, and not influenced in any way by myths and rituals that have the potential to cause harm.



ANTIBIOTICS: HELP OR HINDRANCE?

2 :: ANTIBIOTICS: HELP OR HINDRANCE?

SARAH PYE AND CLARE HANCOCK

The following is excerpted from *Infection Prevention and Control: Perceptions and Perspectives*, by Paul Elliott, Julie Storr, Annette Jeanes

Purchase a copy HERE.

INTRODUCTION

Regardless of the numerous guidelines, extensive research, worldwide media campaigns and public awareness–raising initiatives, antibiotic resistance remains a threat to global public health. This chapter will consider the extent to which bacteria are evading the antibiotic. How bacteria become resistant will be discussed, along with the strategies that are being implemented to combat the rising number of antibiotic-resistant infections.

REFLECTION EXERCISE

Consider why antibiotic resistance occurs. Reflect upon the consequences of antibiotic resistance in healthcare and consider what actions can be taken to reduce the problem. Compare your thoughts with what follows throughout the chapter.

THE EXTENT OF THE PROBLEM

In 2011, over 40 million prescriptions for antibacterial drugs were dispensed in the United Kingdom (UK). Alarming stories about antibiotics are a regular feature of the mass media and recent newspaper headlines have highlighted the antimicrobial resistance (AMR) crisis in healthcare. It has been estimated by the European Commission that in the European Union:

- approximately 25,000 patients per year die from drug-resistant bacterial infections
- approximately 4 million patients per year acquire a healthcare-associated infection
- the costs associated with AMR exceed 1.5 billion Euros.

There have been repeated public health campaigns to increase awareness of the risks associated with inappropriate antibiotic prescribing. For example, the annual European Antibiotic Awareness Day coordinated by the European Centre for Disease Prevention and Control aims to raise awareness about the threat to public health of antibiotic resistance, and prudent antibiotic use.

Despite these efforts, recent research by the Health Protection Agency has shown that over half of those visiting their doctor for a respiratory tract infection expected a prescription for an antibiotic. A quarter of people surveyed thought that antibiotics were effective treatment for most coughs and colds.

2 :: ANTIBIOTICS: HELP OR HINDRANCE?

SARAH PYE AND CLARE HANCOCK

With rising rates of AMR, the rational and prudent prescribing of antibiotics presents a major challenge for healthcare providers. Consequently, the World Health Organization (WHO) has called this 'a developing global crisis in health care' requiring urgent action to address the problem.

HOW AND WHY DOES ANTIMICROBIAL RESISTANCE DEVELOP?

AMR is not a new phenomenon – resistance was observed within years of anti- biotics being available for widespread use. For example, in 1963 ampicillin was introduced as the first broad-spectrum penicillin. At launch it was active against *Escherichia coli* but by l965 ampicillin-resistant *E. coli* had been discovered.

AMR develops due to the occurrence of genetic mutations, which allow bacteria to resist the action of an antimicrobial agent. Exposure to antibiotics creates an evolutionary pressure that selects for bacteria with resistant traits: an example of Charles Darwin's 'survival of the fittest' evolutionary theory. Inappropriate prescribing and poor adherence to treatment by patients both contribute to the development of AMR.

The use of certain antibacterial treatments can predispose patients to future antimicrobial-resistant infections. For example, *Clostridium difficile* infection often occurs after a patient has received antibiotic treatment. The risk of developing *C. difficile* infection is greatest with ampicillin, amoxicillin, co-amoxiclav, second- and third-generation cephalosporins, clindamycin, and quinolones, but most antibiotics have been associated with this side effect. Patients who have recently received antibiotic treatment, particularly quinolone or macrolide antibiotics, are thought to be at greater risk of developing a meticillin-resistant *Staphylococcus aureus* (MRSA) infection compared to those who have received no antibiotic treatment.

TREATMENT OF ANTIMICROBIAL-RESISTANT INFECTIONS

The management of antimicrobial-resistant infections is a continually changing landscape, with new challenges appearing on a regular basis. The management of MRSA and *C. difficile* infections are well described, but healthcare professionals need to be aware of changing resistance patterns. The emergence of new multi-resistant infections, such extended-spectrum beta-lactamases (ESBLs) and carbapenemase-producing Enterobacteriaceae, to antibiotics is cause for considerable concern, as difficult-to-treat infections have the potential to put significant strain on the healthcare system.

2 :: ANTIBIOTICS: HELP OR HINDRANCE?

SARAH PYE AND CLARE HANCOCK

Infections caused by bacteria-producing ESBLs are one example of a difficult-to-treat infection that is on the increase. ESBLs are enzymes that enable the bacteria to resist the action of commonly prescribed antibiotics, such as cephalosporins and penicillins. ESBL infections were discovered in the 1980s and, until relatively recently, were rarely encountered. Risk factors for developing an ESBL infection include serious underlying disease, prolonged hospital stay, presence of invasive medical devices and previous antibiotic usage. Treatment options are limited but include nitrofurantoin, fosfomycin and carbapenems.

Carbapenem antibiotics, such as imipenem and meropenem, have a broad spectrum of activity and are used for the treatment of severe hospital-associated infections and polymicrobial infections. As such they are often used as last-line treatments for resistant infections. Worryingly, carbapenem resistance has begun to develop, resulting in bacteria that are resistant to all but a handful of antibiotics. A growing number of bacteria from the Enterobacteriaceae species, such as *E. coli* and Klebsiella, have been noted to produce carbapenemase enzymes. These enzymes destroy carbapenem antibiotics, and therefore bacteria producing them can cause multidrug-resistant infections. Resulting infections present a therapeutic challenge, as there are limited treatment options, such as colistin and tigecycline. This has been a growing problem in recent years. The United States, India and parts of Europe are all reported to have high prevalence of healthcare-associated carbapenemase-producing Enterobacteriaceae.

FUTURE DEVELOPMENTS AND NEW ANTIMICROBIAL TREATMENTS

As bacteria have developed resistance to treatment with traditional antibiotics, hope has turned to the development of new drugs to overcome the problem. The complex process of taking new chemical entities from the laboratory bench to the patient, and the significant associated development costs, mean that the supply of new treatments by the pharmaceutical industry has not met the demand in recent years.

Both WHO and the European Commission have called for innovation in anti-biotic drug development to help tackle this crisis. WHO has recommended that government incentives should be used to encourage the pharmaceutical industry to invest in research and development for new antimicrobials. It has also suggested that fast-track systems could be developed for medicines regulators to bring new agents to the market.

2 :: ANTIBIOTICS: HELP OR HINDRANCE?

SARAH PYE AND CLARE HANCOCK

New antibacterial drugs have reached the market in recent years, but speed of drug development has not matched the demand for new treatments. Some new treatments have failed to live up to expectations. For example, tigecycline was released in 2006 as a treatment for complicated skin and soft tissue, and intraabdominal infections. In 2011, the Medicines and Healthcare Products Regulatory Agency issued a warning that tigecycline should only be used when other antibiotics are unsuitable, because of increased mortality rates observed in clinical trials. As such, the treatment has a limited value and is not routinely used. The usefulness of newly launched antimicrobial drugs, such as ceftaroline and fidaxomicin, remain to be seen.

The development of AMR is inevitable and we can only act to slow its progress, not eradicate it completely. Due to the rapid replication of bacteria and the associated genetic mutations that lead to AMR, scientific research will always struggle to keep pace. Drug development is unlikely to provide timely solutions, in sufficient volume, to tackle the growing problem of antimicrobial-resistant infections. Therefore, it is essential that existing antimicrobials are used prudently, following local guidance and sensitivity results where these are available, to slow progress of AMR. The many factors that influence the prescribing of antibiotics and can lead to antibiotic misuse shall now be considered.

WHAT DO WE MEAN BY ANTIBIOTIC MISUSE?

REFLECTION EXERCISE

Reflect on what is meant by antibiotic misuse. Compare your thoughts with the discussion outlined in this section.

If prudent prescribing is required, are antibiotics currently prescribed irresponsibly or misused? The link between antibiotic use and resistance is noted, and misuse of antibiotics is indeed considered to be a causative factor in the rise of AMR. If bacteria continue to evade the antibiotic this is a problem that could in fact get worse. WHO recognises this as a global threat and calls for 'stronger action worldwide to avert a situation that entails an ever increasing health and economic burden'. Interventions have been aimed at reducing the risks associated with AMR, including targeted education for the public, health workers and prescriber, and awareness-raising campaigns. These activities span almost 2 decades of intervention, but they have done little, it seems, to reverse the tide. As the most commonly prescribed drug,

2 :: ANTIBIOTICS: HELP OR HINDRANCE?

SARAH PYE AND CLARE HANCOCK

the way in which antibiotics are used is vital in the fight against antibiotic resistant bacteria. A recent report, *Antibiotic Resistance Threats in the United States, 2013*, from the Centers for Disease Control and Prevention (CDC), states that 'up to 50% of all the antibiotics prescribed for people are not needed or are not optimally effective as prescribed'. From the vast array of published literature, antibiotic misuse could be described as:

- unnecessary prescribing of antibiotics, overuse (e.g. for viral infections)
- use of broad-spectrum antibiotics, or narrow-spectrum antibiotics used incorrectly
- misuse and inappropriate dosing, route of administration and/or treatment duration
- prescribing in the absence of microbiological culture results.

There is evidence to support the view that there is a clear link between antibiotic resistance and the use of antibiotics by patients and prescribers. This evidence is global and spans over a decade. It is important that the role of prescribers and the public in tackling this problem is considered. The reported issue of misuse of antibiotics perhaps assumes there is a general belief that there is a problem. However, this may not be the case. There is evidence to suggest that not all clinicians or patients see antibiotic resistance as a reason for antibiotics not to be prescribed; some clinicians even view the risk as 'theoretical or minimal' and some state 'the issue has been exaggerated'. It seems interventions are required in the education of both prescribers and the general public. Perhaps a starting point would be to consider why prescriptions are issued in the first place. It could be argued that a prescription is issued to achieve a therapeutic objective, either to:

- relieve a symptom
- reach curative outcome
- or prevent a condition occurring.

In the case of a prescription for an antibiotic, it is apparent that the prescriber should be aiming to reach a curative outcome. This would assume an accurate diagnosis is made, the bacterium causing the infection is known and there is evidence to suggest an antibiotic will cure the infection.

However, there is evidence to suggest that prescribers are not influenced by clinical factors alone when prescribing. While an abundance of evidence exists, a systematic review by Lopez-Vazquez warns that some evidence has limited significance due to

limitations in methodology, although this review did recognise complacency (patient expectation) and fear (complications) as related to inappropriate prescribing.

WHAT INFLUENCES ANTIBIOTIC PRESCRIBING?

> REFLECTION EXERCISE
>
> Reflect upon what you feel may influence antibiotic prescribing and then compare your thoughts with the influences identified in this section.

There is an abundance of evidence to suggest that non-clinical factors are also considered when making the decision to prescribe medication, including antibiotics. These factors have been categorised into those relating to the patient and those relating to the prescriber.

Prescriber-related factors include:

- personal characteristics
- knowledge
- features of clinical practice
- prescribing preferences
- local management policies
- patient expectation
- fear of uncertainty about diagnosis, complications, experience
- evidence and policy
- drug companies
- patient demand or satisfaction.

Patient-related factors include:

- socio-economic status
- quality of life
- expectations and wishes
- lack of knowledge
- beliefs of health and illness
- previous treatment with antibiotics.

2 :: ANTIBIOTICS: HELP OR HINDRANCE?

SARAH PYE AND CLARE HANCOCK

Macro and micro decisions relating to prescribing practice have been observed in a small study examining variations in prescribing practice among general practitioners (GPs).

Where non-clinical influences on prescribing have an effect on the number of prescriptions for antibiotics, it seems that measures to reduce antibiotic prescribing will need to respond to these factors in addressing the issues highlighted by the World Health Organization and the International Forum on Antibiotic Resistance colloquium. These factors, it would seem, require intervention at several levels. For example, public education is required to raise awareness of the role of antibiotics in disease; prescribers need to be judicious in their decisions to prescribe an antibiotic. These strategies aim to reduce the risks associated with misuse or overuse of antibiotics.

The factors listed earlier could be considered in the context of the following:

- the prescriber–patient relationship
- uncertainty of diagnosis and progression of illness
- lack of knowledge and understanding of the role of antibiotics.

THE PRESCRIBER–PATIENT RELATIONSHIP

There is some evidence to suggest that patients are more likely to be given an antibiotic if they ask for one, or when they exert pressure on the prescriber to prescribe.

> REFLECTION EXERCISE
>
> Reflect upon why patients may exert pressure on the prescriber to prescribe and compare your thoughts with the suggested list outlined in this section.

- To prove they are ill
- To feel something is being done
- Because they have faith in medicines
- Rather not alter their lifestyle
- Because it has worked before
- To avoid cost of purchasing medicine
- Addiction
- As an alternative to other treatment

- 'Just in case'
- Direct-to-consumer advertising (United States and New Zealand)

Prescriber–patient relationship factors may be linked to the personal characteristics of prescribers or fear of retribution if an antibiotic is not prescribed and the patient becomes more unwell. A study considering the use of broad-spectrum antibiotics found that GPs were likely to prescribe because of a desire to do the best for the patient and society. Factors relating to the wider healthcare system could also be contributing to the possible misuse of antibiotics. In Germany, cost considerations may influence the prescriber. Patients have to pay for weekend call-outs and this was considered as a possible reason for the increase in prescribing on a Friday. This study showed a 23.3% increase in antibiotic prescribing before the weekend. The authors of this study considered that there may have been an increase in the number of patients presenting on Friday with diagnoses that required antibiotics. However, they found that the number of patients presenting with urinary tract infection or respiratory infection was almost the same as on other days of the week. In the UK, patients requiring out-of-hours or weekend treatment are unlikely to be seen by their own GP, so prescribing may occur as a result of the desire to maintain continuity of care. While in the UK weekend care does not have a cost implication, there is perhaps a tendency to prescribe in order that the continuity of care is not compromised. In a study examining the views of diabetic patients regarding their consultations with nurse prescribers, continuity of care was noted as important by almost all of the 41 patients interviewed. The mood of the doctor has also been shown to influence prescribing. A study exploring the association of mood on five behaviours including prescribing found a correlation between negative moods and increased prescribing.

UNCERTAINTY OF DIAGNOSIS AND PROGRESSION OF ILLNESS

Prescribers may be more likely to give a prescription for an antibiotic on a Friday because of the lack of services over the weekend. It may not be clear that a patient requires an antibiotic at the time of consultation but there could be the potential for infection to develop. Prescriptions may be given 'just in case', requiring the patient to make the decision whether to commence treatment. This relies on good information being given at the time of the consultation and the patient understanding both the risks of taking an antibiotic if not necessary and the risks of not taking the antibiotic if the condition becomes worse. In India, patients are known to use their old prescriptions to obtain a new course of antibiotics when experiencing similar conditions that resulted in a prescription for antibiotics previously. This is

possible in India as prescriptions are not kept by the pharmacist but given back to patients, which enables reuse. In the UK this would not be possible, as prescriptions are retained by the pharmacist. A lack of understanding by patients of the role of antibiotics can lead to inappropriate prescribing. Prescribers may be pressured to prescribe in circumstances when a patient experiences similar symptoms to those that have previously resulted in a prescription being issued. Some patients may even visit a specific doctor who has previously prescribed. A small study describes instances where nurse practitioners have issued delayed prescriptions despite their better judgement, to 'keep the peace' for children with suspected otitis media, despite guidelines that suggest antibiotics provide little benefit. The risks of antibiotic resistance and the effect on individual patients have been identified through a systematic review. The authors reviewed 24 studies that explored the effect of antibiotic resistance in individuals. They found strong evidence to suggest that those patients who were prescribed an antibiotic for a respiratory or urinary tract infection developed resistance. The resistance was strong in the first month following treatment but could last for up to a year. A 'vicious cycle of resistance' is described, and the authors suggest the way of breaking the cycle is to avoid the prescribing of antibiotics in the first place. By highlighting the effect on individual patients, prescribers may be less likely to consider prescribing an antibiotic where the clinical presentation is uncertain.

LACK OF KNOWLEDGE OR UNDERSTANDING OF THE ROLE OF ANTIBIOTICS

PATIENTS

There is a global need to raise awareness of the role of antibiotics. The United States-based CDC has been running campaigns focused on appropriate antibiotic use since 1995. In 2003 they renamed the campaign 'Get Smart: Know When Antibiotics Work'. The campaign aims to reduce AMR, targeting healthcare providers and the general public by:

- promoting adherence to appropriate prescribing guidelines among providers
- decreasing demand for antibiotics for viral upper respiratory tract infections among healthy adults and parents of young children
- increasing adherence to prescribed antibiotics for upper respiratory tract infections.

The efforts of the CDC are reflected across the globe. The 'Get Smart about Antibiotics' week is supported across the United States by organisations such as the Alliance for the Prudent Use of Antibiotics. In November 2015 the campaign will coincide for

2 :: ANTIBIOTICS: HELP OR HINDRANCE?

SARAH PYE AND CLARE HANCOCK

the fourth year with similar week-long campaigns in Australia (NPS Medicine Wise), Canada (Antibiotic Awareness) and across Europe (European Antibiotic Awareness Day). The UK is one of 28 European countries participating in the campaign. These campaigns provide online resources for healthcare workers and the public aimed at educating people about the appropriate use of antibiotics. They also provide advice for treating minor ailments such as coughs and colds at home, and explain that in these cases people do not require a visit to the doctor. A range of posters, videos, webinars, factsheets and advice sheets are available from these providers for public and professional use. Campaigns raise awareness of the risks associated with taking antibiotics and how to take them responsibly. They are targeted at the general public, healthcare workers and prescribers in hospital and primary care. Interestingly, in 2009, the UK Department of Health found that, in general, people were confused about bacteria and viruses and what conditions could be treated with antibiotics. The autumn antibiotic campaign was cancelled as a result of this lack of understanding, as well as lack of knowledge in the general public; there was a view that due to the use of antibiotics for secondary infections it may not be the best time to run the campaign, as the public was already confused. It appears there may be little change in public perception of the role of antibiotics since 2009, as more recent qualitative research revealed that of 1767 patients surveyed regarding the use of antibiotics in respiratory infection, 24% of patients believed antibiotics would work for coughs and colds and 38% thought antibiotics would kill viruses. This lack of understanding of the role of antibiotics for certain illnesses has the potential to further increase the misuse of antibiotics. It is possible for the general public across the world to purchase antibiotics over the Internet, although import of prescription-only drugs is illegal in the UK and the United States, and in some countries illegal sale of antibiotics over the counter persists. It has been noted that the media, the Internet and other non-credible sources of information are used extensively by patients when searching for information about healthcare-associated infection, which may account for the apparent lack of understanding about the role of antibiotics in infection and the rise of resistant bacteria. Information was viewed as generic with little specific, understandable information available. However, comprehensive advice for patients is available through websites such as NHS Choices and Patient UK in the UK, CDC and the US Department of Health and Human Services Food and Drug Administration in the United States and the European Centre for Disease Prevention and Control, which would seem to address the issue of specificity by providing clear advice aimed at reducing the number of antibiotics prescribed for viral throat infection, for example. Another problem related to understanding that has been identified is that patients may stop taking an antibiotic

when they feel better. Patients who do not complete a full course of antibiotics could be at risk of prolonged infection and this could contribute to the rise in resistant bacteria.

PRESCRIBERS

Not all prescribers themselves are knowledgeable and up to date with current practice guidelines for the use of antibiotics. Numerous guidelines exist for the treatment of infection that are designed to assist the prescriber in their decision that an antibiotic is necessary, but there is evidence to suggest that such guidelines are not always adhered to. In 1998 a report by the UK Standing Medical Advisory Committee stated that many cases of otitis media did not need antibiotics. It was reported later that it was not clear that this had any influence over GP prescribing and that declines in antibiotic prescribing has stabilised since 2000. It has been reported that a similar study undertaken in 2009 showed the continual use of broad-spectrum antibiotics despite guidelines that recommend penicillin V as first choice in acute respiratory tract infection. This study also noted that the higher the number of consultations, the higher the use of antibiotics. In one study designed to explore equality in prescribing across race and insurance status in the United States, it was discovered that despite guidance in 2004 that recommended 'watchful waiting' for acute otitis media, little change in the level of prescribing has been noted, although doctors are using the first-line recommended antibiotic.

It would seem that all health professionals have a role in ensuring the message about the risks of overuse and misuse of antibiotics is clear and consistent. Prescribing of antibiotics should be accompanied with clear instructions and advice about how to take them for the best effect. Prescribing influences should be recognised and acted upon, prescribers must be aware of existing guidance and policy related to antibiotic prescribing, and action to reduce the threat of resistant bacteria should be taken. Prudent prescribing requires a multifaceted approach by all healthcare practitioners.

ANTIMICROBIAL STEWARDSHIP

Antimicrobial stewardship aims to reduce inappropriate antibiotic prescribing, therefore reducing the risks of antibiotic-resistant infection and improving outcomes for patients. Antimicrobial stewardship is a worldwide initiative for both hospital and outpatient or primary care settings. This initiative is supported in the United States by the 'Get Smart for Health Care' campaign CDC, by the Australian Commission on Safety and Quality in Health Care, and across Europe. and in the UK, 'Start Smart – Then Focus' reminds practitioners of the legal obligation to 'ensure procedures

are in place to ensure prudent prescribing and antimicrobial stewardship'. The publication provides clear extensive guidelines for antibiotic prescribing and ongoing management.

The clear message in this document for UK practitioners is only to start antibiotics where a bacterial infection has been clearly identified: once culture has been obtained. Once started, the prescription should be reviewed. Antibiotics should be switched as quickly as possible if necessary when treatment has started prior to cultures being obtained. Intravenous antibiotics should be changed to oral as soon as possible. The programme is focused on use of guidelines, education and audit of practice. Similar guidance is available from the CDC website in the United States. A small study suggests that 'introducing the policy maker' to the decision to prescribe may damage the doctor–patient relationship. The study, while not focused on antibiotic prescribing, found that doctors may wish to preserve the relationship with the patient by using a flexible approach to guidelines. A study undertaken in five European countries and Argentina examined the use of antibiotics in acute exacerbation of chronic obstructive pulmonary disease. The study explored the predictors for prescribing an antibiotic and whether the use of C-reactive protein (CRP) testing reduced prescribing. They found that GPs who used the CRP test were less likely to prescribe an antibiotic. CRP was used as a supplementary test and resulted in fewer antibiotics being prescribed. Tests such as these could be useful in reducing the rate of antibiotic prescribing through clinical presentation alone. Purulent sputum was the highest indicator for a prescription.

There have been calls for all primary care nurses in the UK to be involved in increasing awareness in patient groups of the risks associated with inappropriate antibiotic prescribing. Nurses working in primary care and community are well placed to educate patients about alternatives to antibiotics because nurses were seen as key practitioners, as they spent more time with patients than other healthcare workers. It is indicated that if antimicrobial stewardship programmes are to be successful, they need to take into account the underlying influences that affect prescribing behaviour and not be focused on policy and guidelines. Prescribers want to do the best for patients, to protect them from the harmful effects of infection, to preserve their unique relationships and to ensure practice is responsive to patient need. It is clear that prescribing is a complex process and that many factors influence the decision to prescribe. This is supported by a systematic review undertaken to determine the most effective method of improving antibiotic prescribing in primary care. The review noted that lectures, providing literature and giving feedback did not improve prescribing. Meetings improved prescribing, but it was not clear if

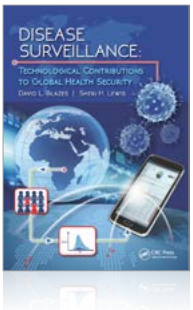
visits by educators had any effect. It was noted that the use of delayed prescriptions did decrease antibiotic use. The review concluded that no one intervention was particularly successful on its own but that using different methods together could be successful. Interestingly, a review of the literature relating to interventions for effective antibiotic stewardship in hospitals in 2013 revealed that restriction (e.g. needing additional agreement for prescription) and persuasion (e.g. giving feedback or advice on how to prescribe) did improve antibiotic prescribing. The review found that the restrictive methods seemed to have a greater effect.

Much evidence exists to imply that antibiotics are a hindrance in infection control; indeed, it has been stated: 'Control of prescribing would probably be just as effective a measure in our fight against healthcare-associated infection as conventional infection control measures', prescribers need to be supported if we are to 'beat the bugs'. Much more needs to be learned about the factors that influence the decision to prescribe antibiotics; it seems to be clear that there will not be a 'one size fits all' solution.

INTERNATIONAL HEALTH REGULATIONS: POLICY

3 :: INTERNATIONAL HEALTH REGULATIONS: POLICY

REBECCA KATZ, SARAH KORNBLET, ERIN M. SORRELL, CLAIRE STADLEY AND JULIE FISCHER



The following is excerpted from *Disease Surveillance: Technological Contributions to Global Health Security*, by David L. Blazes, Sheri H. Lewis

BACKGROUND

Advances in transportation and communications technologies have steadily reduced the time and costs of moving travelers, goods, and information across once-daunting distances. Starting in the nineteenth century, the falling costs of international travel and trade allowed the practical integration of markets across Europe, Asia, and the Americas. Goods and labor began to flow freely between regions, transforming economies worldwide. The factors that lowered barriers to trade also eroded natural barriers to the spread of communicable diseases, contaminants, and other hazards among vulnerable populations. Starting in the early 1800s, successive waves of cholera spread from South Asia along water and railway routes, causing devastating outbreaks in the crowded cities of Europe and the Americas. Each pandemic prompted governments to take steps of varying effectiveness to detect and halt the spread of disease.

Concerns about the impact of these measures on the movement of travelers and trade goods, coupled with the need to prevent the cross-border spread of infectious disease, catalyzed a series of diplomatic conferences among maritime powers starting in 1851. In 1892, delegates to the seventh of these International Sanitary Conferences agreed to the first International Sanitary Convention, a narrowly focused agreement that addressed quarantine regulations related to cholera along specific westbound maritime routes. By 1938, delegates from an increasing number of participating states, armed with growing awareness of the principles of disease transmission, would negotiate a series of these conventions addressing a short list of priority diseases. Regional organizations in Europe and in the Americas developed to govern disease reporting and information sharing under such agreements, which focused on protecting trade and travel while relying primarily on state mechanisms to prevent the spread of disease at ports and borders.

In the mid-twentieth century, the newly created World Health Organization (WHO) became the primary steward for such agreements, which were consolidated into the International Sanitary Regulations, later revised as the International Health Regulations of 1969. By 1981, revisions had reduced the scope of reportable diseases under IHR (1969) to yellow fever, plague, and cholera—diseases of great historical importance but no longer major public health risks among high- income trading nations. At the same time, globalization and urbanization created risks for the spread of new diseases. Public health leaders worldwide began to report an increasing number of emerging and re-emerging diseases, marked by the transmission of

3 :: INTERNATIONAL HEALTH REGULATIONS: POLICY

REBECCA KATZ, SARAH KORNBLET, ERIN M. SORRELL, CLAIRE STADLEY AND JULIE FISCHER

zoonotic diseases along an increasingly complex animal–human interface, often in regions with weak capacities for disease surveillance and response.

In 1995, the World Health Assembly (WHA), the governing body of the WHO, agreed to revise the IHR with the goal of promoting early detection of and response to epidemics before they became international public health crises. This precipitated nearly a decade of debate on the best approach to an agreement that would allow nations and the global community to anticipate emerging threats, to ensure timely and transparent reporting, and to facilitate evidence-based decision making. The agreement also had to accommodate different national capacities, address concerns over the collection and dissemination of potentially sensitive information, and protect individuals and economies from unmerited actions. In 2003, the spread of severe acute respiratory syndrome (SARS) from China via air travel to more than two dozen countries inspired new action. In 2005, WHA agreed to revise the IHR to "prevent, protect against, control and provide a public health response to the international spread of disease in ways that are commensurate with and restricted to public health risks and which avoid unnecessary interference with international traffic and trade" (WHO 2005a).

IHR ARTICLE BY ARTICLE

The revised IHR include 66 articles and nine annexes, summarized in **Figure 3.1**. Many of these articles focus on process and form, as is typical of most international agreements. A significant number of articles relate to measures designed to prevent the spread of disease through the international movement of goods and international traffic, primarily the responsibilities of States Parties for infection control and sanitation in ships, aircraft, and ground conveyances and at points of entry (PoE). These measures trace their origins to the IHR (1969) and earlier agreements that sought to harmonize standards for disease control at ports and borders.

Other articles of the IHR (2005) directly address national capacities for disease detection and response. First, every State Party must designate a National IHR Focal Point (NFP) to be responsible for communications to and from the WHO, and dissemination of information on public health events to national stakeholders, on a 24-hour basis. Although a relatively simple measure, this article created a novel network for rapid information sharing on public health events within and across borders. The State Party must also establish a framework to ensure that the NFP has the authority and means to notify the WHO within 24 hours of determining that a domestic event might constitute a potential public health emergency of international

3 :: INTERNATIONAL HEALTH REGULATIONS: POLICY

REBECCA KATZ, SARAH KORNBLET, ERIN M. SORRELL, CLAIRE STADLEY AND JULIE FISCHER

concern (PHEIC). Most importantly, articles in the IHR (2005) call upon each State Party to develop the minimum public health capacities required to detect unusual diseases or deaths, assess the risks posed by an out- break or other event, report pertinent public health information to the most appropriate levels of government and to the WHO when required, and initiate appropriate response measures to control and mitigate the consequences of the event.

In addition to the 66 articles in the IHR, there are nine annexes, each of which provides explicit guidance on how States Parties can achieve an IHR obligation. As with the articles themselves, several of these annexes focus on treatment of travelers and conveyances at designated points of entry (particularly the documenting of ship sanitation), while others clarify the processes by which States Parties implement the detection and reporting of, and response to, public health emergencies.

Table 3.1

Table 3.1
IHR articles and annexes. **Note:** Articles and annexes that directly address disease surveillance, reporting, and response mechanisms are highlighted in light purple. Articles directly related to travelers, international traffic and trade, or points of entry are highlighted in dark purple.

Articles 1–4: Definitions, purpose, and scope	
Article 1	*Definitions*: The first article focuses entirely on definitions.
Article 2	*Purpose and Scope of the Regulations:* To prevent, protect against, control and provide a public health response to the international spread of disease in ways that are commensurate with and restricted to public health risks, and which avoid unnecessary interference with international traffic and trade.
Article 3	*Principles:* This section sets forth three principles for implementation of the IHR, including that implementation be guided by the Charter of the United Nations and the WHO Constitution, with full respect for human rights and with the goal of protecting all people of the world from spread of disease. Additionally, States have the sovereign right to legislate and to implement policies consistent with the IHR.
Article 4	*Responsible Authorities:* Each State shall designate an NFP for communication to and from the WHO and dissemination of information within the country; in turn, the WHO will designate IHR Contact Points within WHO regional and headquarters organizations.
Articles 5–14: Information and public health response	
Article 5	*Surveillance:* Each State shall develop, strengthen, and maintain the capacity to detect, assess, notify, and report potential PHEICs. The initial capacity-building period is defined as 5 years, with an option for States to request up to two 2-year extensions. The WHO's roles are defined as providing capacity-building assistance to States on request, collecting information regarding public health events, and assessing the potential for diseases to spread internationally.
Article 6	*Notification:* Using the decision instrument in Annex 2, each State will assess public health events and notify the WHO through the NFP within 24 hours of determining that an event constitutes a potential PHEIC. Following initial notification, States shall continue to share pertinent information about the event with the WHO. This article also notes that the WHO will immediately notify the International Atomic Energy Agency (IAEA) if the event is relevant to that organization.
Article 7	*Information Sharing:* If there is evidence of a potential PHEIC within a State's territory, regardless of origin or source, the State shall provide all relevant information to the WHO.

3 :: INTERNATIONAL HEALTH REGULATIONS: POLICY

REBECCA KATZ, SARAH KORNBLET, ERIN M. SORRELL, CLAIRE STADLEY AND JULIE FISCHER

Table 3.1 (continued)
IHR articles and annexes. **Note:** Articles and annexes that directly address disease surveillance, reporting, and response mechanisms are highlighted in light purple. Articles directly related to travelers, international traffic and trade, or points of entry are highlighted in dark purple.

Article 8	*Consultation:* States may ask the WHO for assistance in assessing epidemiologic evidence and consult with the WHO on appropriate health measures, even when the event does not constitute a potential PHEIC.
Article 9	*Other Reports:* The WHO can use reports other than official notifications or consultations to assess whether there is a potential PHEIC occurring. The WHO can use these unofficial reports to seek verification and to consult with States, which are obligated to report any evidence of a potential PHEIC detected outside of their territories to the WHO within 24 hours.
Article 10	*Verification:* The WHO shall inform a State (through the NFP) if a report is received about a potential PHEIC in that State's territories. The State Party must respond to the WHO's inquiry within 24 hours and provide the WHO with available public health information upon request. The WHO shall offer to collaborate with any State to assess potential PHEICs; if the State does not accept the offer of collaboration, the WHO can share information about the event with other States Parties if the Director-General (DG) determines that action is justified.
Article 11	*Provision of Information by the WHO:* The WHO will share relevant information with other International Organizations (IOs) and States Parties as needed to prevent or respond to public health risks but will not make the information generally available unless the event is declared a PHEIC or the WHO determines that the international spread of disease or contamination is either confirmed or inevitable, necessitating immediate action.
Article 12	*Determination of a PHEIC:* The WHO DG determines whether an event is a PHEIC, taking into account information provided by the affected State(s), the Annex 2 decision instrument, the advice of the Emergency Committee (subject-matter experts convened to evaluate potential PHEICs), scientific evidence and principles, and an assessment of the risks to human health, trade, and travel. After making a preliminary determination that a PHEIC is occurring, the DG consults with the affected State; if they do not reach consensus on the determination within 48 hours, the DG proceeds on the basis of advice from the Emergency Committee, as outlined in Article 49. The DG also determines when the PHEIC has ended.
Article 13	*Public Health Response:* States shall develop, strengthen, and maintain the capacity to respond to public health risks and PHEICs within 5 years (with the option to request up to two 2-year extensions). Should States request assistance in the response to public health risks or events, the WHO shall provide technical guidance and assistance, including the mobilization of international experts, and during a declared PHEIC, can provide further assistance to assess risk and the adequacy of control measures on-site. States Parties are called upon to support WHO-coordinated response activities on request.
Article 14	*Cooperation of the WHO with IOs and Other International Bodies:* The WHO will coordinate with other IOs or international bodies to implement the IHR, particularly when an event is primarily within the competence of other IOs.
Articles 15–18: Recommendations	
Article 15	*Temporary Recommendations:* Once an event has been determined a PHEIC, the DG shall issue temporary recommendations on measures that States Parties can take to reduce the international spread of disease and avoid unnecessary interference with travel and trade. These recommendations expire after 3 months, but they may be modified or extended for additional 3-month periods.
Article 16	*Standing Recommendations:* The WHO may make standing recommendations for appropriate health measures for specific public health risks to prevent or reduce the international spread of disease.
Article 17	*Criteria for Recommendations:* When issuing, modifying, or terminating temporary or standing recommendations, the DG shall consider advice of the Emergency Committee, views of States Parties, scientific principles and evidence, non-restrictive health measures, international standards, and activities taken by other relevant international bodies.

3 :: INTERNATIONAL HEALTH REGULATIONS: POLICY

REBECCA KATZ, SARAH KORNBLET, ERIN M. SORRELL, CLAIRE STADLEY AND JULIE FISCHER

Table 3.1 (continued)
IHR articles and annexes. **Note:** Articles and annexes that directly address disease surveillance, reporting, and response mechanisms are highlighted in light purple. Articles directly related to travelers, international traffic and trade, or points of entry are highlighted in dark purple.

Article 18	*Recommendations with Respect to Persons, Baggage, Cargo, Containers, Conveyances, Goods, and Postal Parcels:* This article outlines the type of advice the WHO may recommend, including reviews of travel history, quarantine, isolation, refusing entry of persons or goods, and implementation of exit screening.
Articles 19–22: Points of entry (PoE)	
Article 19	*General Obligations:* States will develop capacities to detect, assess, report, and respond to potential PHEICs at designated PoE, identify competent authorities at each designated PoE, and provide information on specific public health risks at PoE to the WHO.
Article 20	*Airports and Ports:* States shall designate airports and ports that will be responsible for developing capacities per Annex 1 and list all ports authorized to offer Ship Sanitation Control Certificates. The WHO may arrange to certify that an airport or port has met these obligations, and the WHO will publish certification guidelines and lists of certified airports and ports.
Article 21	*Ground Crossings:* States may designate ground crossings as PoE, taking into account the public health risks and volume of international traffic.
Article 22	*Role of Competent Authorities:* The competent authority at each PoE shall monitor conveyances and property (such as baggage, cargo, containers, or goods) departing and arriving from affected areas; ensure that facilities used by travelers are sanitary; supervise deratting, disinfection, or decontamination of conveyances and property; advise conveyance operators of intent to apply control measures; supervise safe disposal of any contaminated substances from conveyances; monitor and control discharge by ships that might contaminate waterways; supervise services concerning travelers and property, including medical examinations and inspections; develop contingency plans for public health events; and communicate with the NFP.
Articles 23–34: Public health measures for movement of people and goods	
Article 23	*Health Measures on Arrival and Departure:* States may require information from travelers for public health purposes upon arrival or departure, including itinerary, contact information, and applicable health records, and may require a noninvasive medical examination (limited to the least intrusive exam required to meet the public health objectives). Medical exams, vaccinations, or other health measure require informed consent and must be done per international safety guidelines. Baggage and other goods may be inspected.
Article 24	*Conveyance Operators:* Conveyance operators must comply with WHO recommended health measures adopted by the State, inform travelers of these health measures, and keep conveyances free from infection or contamination.
Article 25	*Ships and Aircraft in Transit:* No health measures shall be applied to ships passing through a State Party's territories (including ships from unaffected areas that stop only to take on fuel and supplies, or any ship that does not stop at all) or to aircraft in transit at an airport, although the movement of passengers and materials may be restricted.
Article 26	*Civilian Lorries, Trains, and Coaches in Transit:* Unless authorized by international agreements, no health measures shall be applied to trucks, trains, or buses from unaffected areas that are only passing through a territory.
Article 27	*Affected Conveyances:* If evidence of a public health risk (such as clinical signs or symptoms or sources of infection or contamination) is found on board a conveyance, the competent authority may take appropriate control measures. If the competent authority is not able to carry out control measures, the authority can allow the affected conveyance to depart after notifying competent authorities at the next known PoE (and, for ships, documenting the required measures).

3 :: INTERNATIONAL HEALTH REGULATIONS: POLICY

REBECCA KATZ, SARAH KORNBLET, ERIN M. SORRELL, CLAIRE STADLEY AND JULIE FISCHER

Table 3.1 (continued)
IHR articles and annexes. **Note:** Articles and annexes that directly address disease surveillance, reporting, and response mechanisms are highlighted in light purple. Articles directly related to travelers, international traffic and trade, or points of entry are highlighted in dark purple.

Article 28	*Ships and Aircrafts at PoE:* A ship or aircraft will not be prevented from calling on a point of entry for public health reasons, but in the case that a PoE is not equipped to carry out the IHR requirements, the ship or aircraft may be ordered to proceed at its own risk to the nearest suitable PoE. The movement of travelers and cargo from ships and aircraft (including taking on water, food, fuel, and supplies) should not be prevented for public health reasons, unless measures are needed to prevent the spread of disease or contamination first. Officers in command of ships or aircraft must notify port/airport authorities of any infections or other health risks as soon as possible before arrival. Suspect ships and aircrafts that land or berth elsewhere than their expected ports/airports shall inform the nearest competent authority without delay so that appropriate health measures may be applied. Any emergency measures taken by the officer in command of a ship or pilot to protect the health and safety of travelers shall be communicated to the competent authority.
Article 29	*Civilian Lorries, Trains, and Coaches at PoE:* The WHO shall develop guiding principles for the application of health measure to trucks, trains, and buses at PoE and ground crossings.
Article 30	*Travelers Under Public Health Observation:* A traveler placed under public health observation at arrival may continue on if the traveler does not pose an imminent public health risk.
Article 31	*Health Measures Relating to Entry of Travelers:* States Parties may subject travelers to medical examinations, vaccinations, or other prophylaxis to determine whether a public health risk exists as a condition for residence, or as a condition for entry. The traveler can refuse to consent but may be denied entry. If there is evidence of an imminent public health risk, the State Party may advise or compel the traveler to undergo a medical exam, vaccination, or measures such as quarantine, isolation, or observation (in accordance with national laws).
Article 32	*Treatment of Travelers:* Travelers shall be treated with respect for dignity, human rights, and freedoms, taking into account gender, sociocultural, ethnic, or religious concerns. Travelers who are quarantined, isolated, or subject to other public health measures must be provided with adequate food, water, accommodations, medical treatment, and means of communication.
Article 33	*Goods in Transit:* Goods, other than live animals, in transit shall not be subject to health measures or detained for public health purposes.
Article 34	*Container and Container Loading Areas:* States Parties shall ensure that container shippers use containers that are free from infection or contamination, that container loading areas are kept free from infection or contamination, and that competent authorities conduct inspections.
Articles 35–41: Health documents and charges for travelers	
Article 35	*General Rule:* No health documents (other than those provided under the IHR or WHO recommendations) shall be required in international traffic, except for travelers seeking temporary or permanent residence. Travelers may be required to complete contact forms or questionnaires for public health purposes.
Article 36	*Certificates of Vaccination or Other Prophylaxis:* A traveler who has a certificate of vaccination or other prophylaxis shall not be denied entry as a consequence of the disease on the certificate.
Article 37	*Maritime Declaration of Health:* The master of a ship has to declare the health status of those on board before the vessel's arrival in port.
Article 38	*Health Part of the Aircraft General Declaration:* The pilot should supply any information on the health of those on board, when appropriate, to the competent authority.
Article 39	*Ship Sanitation Certificates:* Ship Sanitation Control Certificates, which note that a ship is free of contamination or infection, are valid for 6 months.
Article 40	*Charges for Health Measures Regarding Travelers:* With the exception of travelers seeking temporary or permanent residence, the State Party cannot charge travelers for measures to protect public health (rather than for the benefit of the traveler), including isolation and quarantine, vaccinations that are not a published requirement, or medical exam required for entry. If the State Party does level charges for health measures, they must be uniformly applied, must not exceed the costs of service, and must be published.

3 :: INTERNATIONAL HEALTH REGULATIONS: POLICY

REBECCA KATZ, SARAH KORNBLET, ERIN M. SORRELL, CLAIRE STADLEY AND JULIE FISCHER

Table 3.1 (continued)
IHR articles and annexes. **Note:** Articles and annexes that directly address disease surveillance, reporting, and response mechanisms are highlighted in light purple. Articles directly related to travelers, international traffic and trade, or points of entry are highlighted in dark purple.

Article 41	*Charges for Baggage, Cargo, Containers, Conveyances, Goods, or Postal Parcels:* When there are charges for health measures, there can only be one tariff that does not exceed the costs of service and applies to all equally.
Articles 42–46: General provisions for health measures	
Article 42	*Implementation of Health Measures:* Health measures under the IHR should be implemented without delay, transparently, and nondiscriminatorily.
Article 43	*Additional Health Measures:* IHR does not prevent States from adopting health measures for specific public health risks or emergencies that achieve the same or greater health protection than WHO recommendations, in accordance with national and international laws. These measures shall not be more restrictive of international trade or more invasive/intrusive to persons than reasonably available alternatives, and should be based on scientific principles, evidence, or specific guidance from the WHO. If a State Party's actions interfere with international travel and trade, national authorities must notify the WHO of the measures and the rationale for implementing them within 48 hours. The WHO will share this information with other States Parties and may request that the State reconsider the action. This article also applies to mass gatherings.
Article 44	*Collaboration and Assistance:* States shall collaborate with each other and, to the extent possible, provide support for detection and response, technical assistance, financial assistance, and logistical support to help build and maintain core capacities. The WHO will collaborate upon request to evaluate and assess public health capacities, facilitate technical assistance, and mobilize financial resources. This assistance may be provided through multiple channels.
Article 45	*Treatment of Personal Data:* Health information collected or received by a State shall be kept confidential and processed per national laws. Personal information may be disclosed to assess and manage a public health risk, although it must be treated fairly and lawfully.
Article 46	*Transport and Handling of Biological Substances, Reagents, and Materials for Diagnostic Purposes:* States Parties shall facilitate the transport, processing, and disposal of biological substances, reagents, and other materials for diagnostic purposes, subject to national laws and international guidelines.
Articles 47–53: IHR roster of experts, emergency committee, and review committee	
Article 47	*IHR Roster of Experts Composition:* The DG shall establish a roster of experts in all fields relevant to the IHR. The DG shall also appoint one member at the request of each State Party and relevant IO.
Article 48	*Emergency Committee Terms of Reference and Composition:* The DG shall establish an Emergency Committee to provide views on whether an event constitutes a PHEIC, and, if so, to propose temporary recommendations. The DG selects experts for the Emergency Committee from the IHR Roster of Experts, including at least one expert nominated from the State experiencing the event, and from other WHO advisory panels.
Article 49	*Emergency Committee Procedure:* The DG convenes the Emergency Committee (including via teleconference, videoconference, or other electronic communication) to consider potential PHEICs and invites the State Party in whose territory the event originated to make presentations to the Committee. After each meeting, the Emergency Committee summarizes and forwards its findings and recommendations to the DG. Based on this advice, the DG makes the final determination on whether an event constitutes a PHEIC and communicates the temporary recommendations and the views of the Emergency Committee to the States Parties and subsequently to the public.
Article 50	*Review Committee Terms of Reference and Composition:* The Review Committee provides the DG with technical advice on the IHR themselves and on standing recommendations. Members are appointed from the IHR Expert Roster or other WHO technical advisory panels and shall be representative of gender, geography, development, and scientific opinions.

3 :: INTERNATIONAL HEALTH REGULATIONS: POLICY

REBECCA KATZ, SARAH KORNBLET, ERIN M. SORRELL, CLAIRE STADLEY AND JULIE FISCHER

Table 3.1 (continued)
IHR articles and annexes. **Note:** Articles and annexes that directly address disease surveillance, reporting, and response mechanisms are highlighted in light purple. Articles directly related to travelers, international traffic and trade, or points of entry are highlighted in dark purple.

Article 51	*Review Committee Conduct of Business:* Decisions of the Review Committee shall be taken by majority.
Article 52	*Review Committee Reports:* For each session, the Review Committee shall draw up a report to submit to the DG. Dissenting professional reviews can be expressed.
Article 53	*Review Committee Procedures for Standing Recommendations:* Proposals for standing recommendations/modifications/termination may be submitted to the Review Committee through the DG. The DG can appoint technical experts to advise the committee.
Articles 54–66: Final provisions	
Article 54	*Reporting and Review:* States Parties and the DG shall report on implementation of IHR to the WHA, which will periodically review the functionality of the IHR. The WHO will periodically conduct studies to review the functionality of Annex 2.
Article 55	*Amendments:* Amendments to the IHR may be proposed by any State Party or the DG and submitted to the WHA for consideration.
Article 56	*Settlement of Disputes:* States Parties should first attempt to settle disputes regarding IHR application through negotiation. If that fails, the issues can be referred to the DG. States Parties may agree to accept the DG's arbitration as compulsory; alternatively, they may resort to dispute settlement mechanisms under other international agreements or organizations to which they may be parties. Disputes between the WHO and a State Party shall be submitted to the WHA.
Article 57	*Relationship with Other International Agreements:* IHR should be compatible with other international agreements, and IHR shall not affect the rights and obligations derived from other agreements. Nothing in the IHR shall prevent States Parties from concluding special treaties or arrangements to facilitate application of the IHR.
Article 58	*International Sanitary Agreements and Regulations:* IHR replaces the previous International Sanitary Agreements and Regulations. It does not replace the Pan American Sanitary Code, except for relevant IHR articles.
Article 59	*Entry into Force:* Period for Rejection or Reservations: The period for rejection of reservations shall be 18 months. The IHR enter into force 24 months after adoption, unless a State has rejected the IHR or an amendment, the State has made a reservation, or a State becomes party to the IHR after the date of notification.
Article 60	*New Member States of the WHO:* Any State that becomes a member of the WHO after 2005 has 12 months to communicate any reservations or rejections.
Article 61	*Rejection:* If a State notifies the DG of a rejection to the IHR or an amendment, the IHR will not enter into force for that State. In this case, the previous international health agreements (listed in Article 58) remain in force for that State.
Article 62	Reservations: States Parties may notify the DG of reservations to the IHR, either before or after the regulations enter into force. The DG shall notify the other States Parties of the objections; if one-third of the other States Parties object to the reservation within 6 months, the DG shall notify the State to consider withdrawing the reservation. If one-third of States do not object, the reservation stands. If the State does not withdraw its reservation despite objections from one-third of States Parties, the DG can refer the matter to the Review Committee at the State's request. The DG submits the reservation and any views of the Review Committee to WHA, which determines whether the reservation will be accepted or not by majority vote.
Article 63	*Withdrawal of Rejection and Reservation:* A rejection or a reservation may be withdrawn at any time through notification of the DG.
Article 64	*States Not Members of the WHO:* A State that is a member of previous international sanitary regulations, but not a member of the WHO, may become a party to the IHR through notification to the DG.

3 :: INTERNATIONAL HEALTH REGULATIONS: POLICY

REBECCA KATZ, SARAH KORNBLET, ERIN M. SORRELL, CLAIRE STADLEY AND JULIE FISCHER

Table 3.1 (continued)
IHR articles and annexes. **Note:** Articles and annexes that directly address disease surveillance, reporting, and response mechanisms are highlighted in light purple. Articles directly related to travelers, international traffic and trade, or points of entry are highlighted in dark purple.

Article 65	*Notification by the DG:* The DG shall notify all States and other parties to any international sanitary regulation of the adoption of the IHR, as well as any amendments.	
Article 66	*Authentic Texts:* The IHR will be equally authentic in Arabic, Chinese, English, French, Russian, and Spanish.	
Annexes		
Annex 1	*Part A. Core Capacity Requirements for Surveillance and Response:* Part A of Annex 1 defines the minimum core capacities required of States Parties at the local/ community level (to detect unusual disease or deaths, report essential information to the appropriate level, and implement preliminary control measures); the intermediate level (to support control measures, confirm and assess events, and report essential information to the national level); and the national level (to assess reports or urgent events within 48 hours, notify the WHO of potential PHEICs, determine control measures, provide technical and logistical support to local investigations, share information and coordinate actions across levels and sectors, and establish a national public health emergency response plan and multisectoral rapid response teams). Annex 1 calls on States to meet these requirements through existing structures and resources, developing plans of action to strengthen them as necessary after a 2-year assessment period.	*Part B. Core Capacity Requirements for Designated Airports and Ground Crossings:* Part B delineates the core capacities required at designated points of entry at all times (to provide appropriate medical services and transport for ill travelers, train personnel to inspect conveyances, and ensure the safety and sanitation of PoE facilities) and during events that might constitute a PHEIC (establish a public health emergency contingency plan, evaluate and care for affected travelers and animals, isolate or quarantine affected travelers as necessary, apply entry and exit controls to travelers, treat goods and conveyances as necessary to prevent or remove public health risks, and equip and train personnel for the safe transport of travelers who might carry infection or contamination).
Annex 2	*Decision Instrument for the Assessment and Notification of Events That May Constitute a PHEIC:* This instrument provides an algorithm for States to determine when an event constitutes a potential PHEIC that should be notified to the WHO.	
Annex 3	*Model Ship Sanitation Control Exemption Certificate/Ship Sanitation Control Certificate:* This Annex provides examples of certificates that States Parties can adapt and use to document ship inspections at designated PoE.	
Annex 4	*Technical Requirements Pertaining to Conveyances and Conveyance Operators:* This Annex provides detailed information about the role of conveyance operators and control measures to be applied to conveyances at designated PoE.	
Annex 5	*Specific Measures for Vector-Borne Diseases:* This Annex details how to treat conveyances and other measures to reduce the threat of vector-borne diseases at designated PoE.	
Annex 6	*Vaccination, Prophylaxis, and Related Certificates:* This annex specifies that only WHO-approved vaccines or prophylaxis should be administered under the IHR, and when they are given, travelers will be provided a certificate (a model of which is provided in the annex).	
Annex 7	*Requirements Concerning Vaccination or Prophylaxis for Specific Diseases:* This annex provides the specific recommendations and requirements associated with vaccination and documentation of vaccination against yellow fever.	
Annex 8	*Model of Maritime Declaration of Health:* This is an example of a form that can be adapted and used by States Parties for documentation by masters of ships for submission to competent authorities at designated PoE.	
Annex 9	*Health Part of the Aircraft General Declaration:* This document is part of the Aircraft General Declaration promulgated by the International Civil Aviation Organization (ICAO) for use in declaring health conditions for persons on board a flight with illness other than airsickness or accidents.	

3 :: INTERNATIONAL HEALTH REGULATIONS: POLICY

REBECCA KATZ, SARAH KORNBLET, ERIN M. SORRELL, CLAIRE STADLEY AND JULIE FISCHER

ANNEX 1: PART A. CORE CAPACITY REQUIREMENTS FOR SURVEILLANCE AND RESPONSE

Annex 1 of the IHR provides the clearest guidance in the regulations for the infrastructure States must develop, strengthen, and maintain at all levels of government. Annex 1 calls on each State to conduct an assessment of existing national infrastructure and resources to meet minimum requirements for surveillance, reporting, notification, verification, response, and collaborating activities within 2 years of the treaty entering into force. Based on this initial assessment, States are to develop and implement plans of action to ensure that core capacities are developed and maintained.

Annex 1 calls for the development of different capacities at different levels of government. At the local level, States must be able to detect unexpected disease or deaths, report essential information to the appropriate level (intermediate or national) based on national systems, and implement initial control measures. At the intermediate level (e.g., a state, province, territory, county, or other identified administrative entity between the local and national level), the public health system must be able to confirm reports from the local level, support control measures, assess the urgency of events, and report relevant information up to the national level. Finally, at the national level, States must be able to assess reports from the local and intermediate levels within 48 hours, and when appropriate, notify the WHO through the NFP. The national level is also responsible for supporting the public health response on a 24-hour basis, through determination of control measures, laboratory analysis, logistical assistance, and epidemiologic support. The national level ensures communications among all appropriate government ministries and manages dissemination of relevant information from the national level and from the WHO to clinics, hospitals, points of entry, laboratories, and other pertinent entities. The national level must also develop and maintain a public health emergency response plan that includes the ability to deploy multidisciplinary rapid response teams within 48 hours of an event.

ANNEX 1: PART B. CORE CAPACITY REQUIREMENTS FOR DESIGNATED AIRPORTS, PORTS, AND GROUND CROSSINGS

Part B of Annex 1 outlines the core capacities required at points of entry at all times. Points of entry shall provide access to medical services to ill travelers, provide equipment and personnel to transport ill travelers when necessary, have trained personnel available to inspect conveyances, and ensure a safe environment

for travelers. States should also provide trained personnel to control vectors and reservoirs near points of entry. Points of entry shall also have an emergency response plan, with a coordinator and contact points. As part of a response, States shall have the capacity to care for ill travelers or animals, have arrangements in place for isolation and treatment at appropriate facilities, have private space for interviews with affected travelers, have quarantine capability away from the point of entry, and be able to disinsect, derat, disinfect, and decontaminate any goods. States must be able to apply entry or exit controls. The State is also responsible for applying entry and exit controls for travelers and being able to transport using the appropriate equipment and personnel any infected traveler.

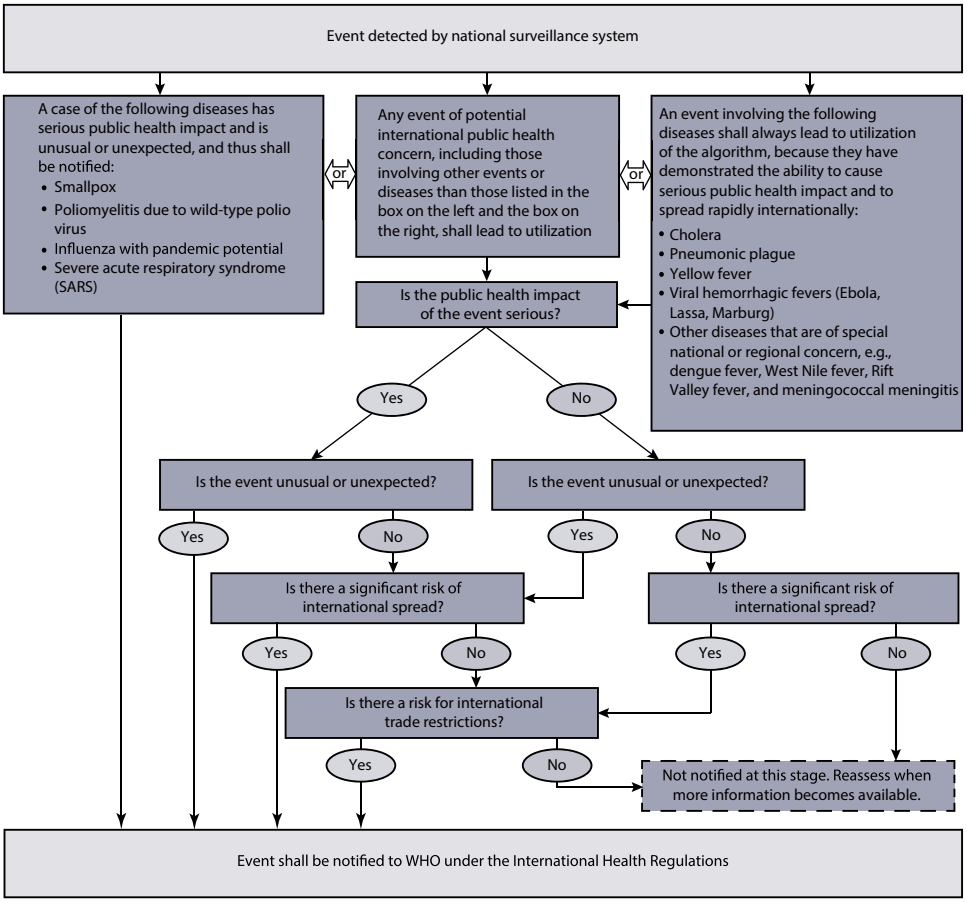
ANNEX 2: DECISION INSTRUMENT FOR THE ASSESSMENT AND NOTIFICATION OF EVENTS THAT MAY CONSTITUTE A PHEIC

Annex 2 of the IHR replaces what was once—in previous international sanitary agreements—a fixed list of notifiable diseases with a decision algorithm designed to anticipate emerging infections and other unusual or unexpected events. This algorithm has a list of four "always notifiable" diseases: smallpox, wild-type polio, new subtypes of human influenza, and SARS. If a single case of any of these diseases is detected, the State must notify the WHO through the NFP. The algorithm also lists a series of diseases that can cause serious public health events; any case of these diseases necessitates that the State utilize this instrument to determine whether the event is a potential PHEIC. These diseases include cholera, pneumonic plague, yellow fever, viral hemorrhagic fevers, West Nile fever, or other diseases of national or regional concern, such as dengue or dengue hemorrhagic fever. For these diseases and for all other public health events, the State should assess whether the event is serious, whether it is unusual or unexpected, whether there is a significant risk of international spread, and whether there is a significant risk of international travel or trade restrictions. This assessment will lead to the determination of whether the NFP should notify the WHO under the IHR (**Figure 3.2**).

3 :: INTERNATIONAL HEALTH REGULATIONS: POLICY

REBECCA KATZ, SARAH KORNBLET, ERIN M. SORRELL, CLAIRE STADLEY AND JULIE FISCHER

Figure 3.2 • Annex 2 decision instrument for determination of a potential PHEIC



Each State develops its own processes for making national assessments under Annex 2 and then reporting potential PHEICs to the WHO. In the United States, reports of unusual or unexpected events come from clinicians or laboratories to the local health departments. Local health departments then report the information to the state-level health department, which voluntarily sends information forward to the federal level. At the federal level, the public health event is assessed with the assistance of relevant agencies. Human health communicable disease events are assessed by the U.S. Centers for Disease Control and Prevention, whereas zoonotic disease events may be assessed by U.S. Department of Agriculture. Once an assessment is made at the relevant agency, the finding is sent to the U.S. Department of Health and Human Services Operations Center, which is the official NFP for the United States. The United States then makes several simultaneous notifications. The NFP notifies the relevant

3 :: INTERNATIONAL HEALTH REGULATIONS: POLICY

REBECCA KATZ, SARAH KORNBLET, ERIN M. SORRELL, CLAIRE STADLEY AND JULIE FISCHER

WHO authorities in the Pan American Health Organization (PAHO)—the WHO Regional Office for the Americas—and the WHO Regional Office for the Western Pacific (WPRO), since the United States spans both regional organizations (see Figure 3.5). The NFP simultaneously informs other federal agencies through their Emergency Operations Centers, the localities from which the event originates, and both Canada and Mexico through trilateral agreements. Once the report is received by the WHO regional offices, it is forwarded to WHO headquarters, which then makes an assessment. The reports to the WHO are done through an electronic notification system that only relevant authorities can access. As at the national level, the WHO will bring in the relevant expertise of other IOs when appropriate. The assessment is then forwarded to the DG, who will call together an Emergency Committee, which will make a recommendation back to the DG on whether the event constitutes a PHEIC and what travel and trade recommendations they advise. Once an event is declared a PHEIC, the WHO is then in charge of coordinating communication and governance of the event.

OTHER GUIDANCE

Since the IHR entered into force in 2007, the WHO has released an extensive collection of guidance documents, procedures, monitoring tools, and training materials to support States as they build, strengthen, and maintain capacity and work to implement the regulations. These guidance documents range from tutorials on how to use the Annex 2 decision instrument (WHO 2014d) to case definitions for the "always notifiables" (WHO 2014a). In response to requests for guidance on legal issues related to IHR implantation, the WHO created a *Toolkit for Implementation in National Legislation*. The document includes a section on general questions and answers, legislative references, and a tool on how to conduct internal assessments of laws and regulations (WHO 2009a). There is also a toolkit to assist countries in establishing the function of NFP (WHO 2009b).

The WHO has provided links to specific guidance related to building laboratory capacity (WHO 2014c) and extensive guidance related to points of entry. The guidance on points of entry includes handbooks for inspection of ships and issuance of ship sanitation certificates (WHO 2011) and guidelines for public health contingency planning at points of entry (WHO 2012b) and how to test the efficacy of insecticides in planes (WHO 2012a). There are also sample passenger locator cards, certificates, and activity reports.

Most relevant to developing national capacities for surveillance and response is the WHO guidance called the IHR Core Capacity Monitoring Framework, initially

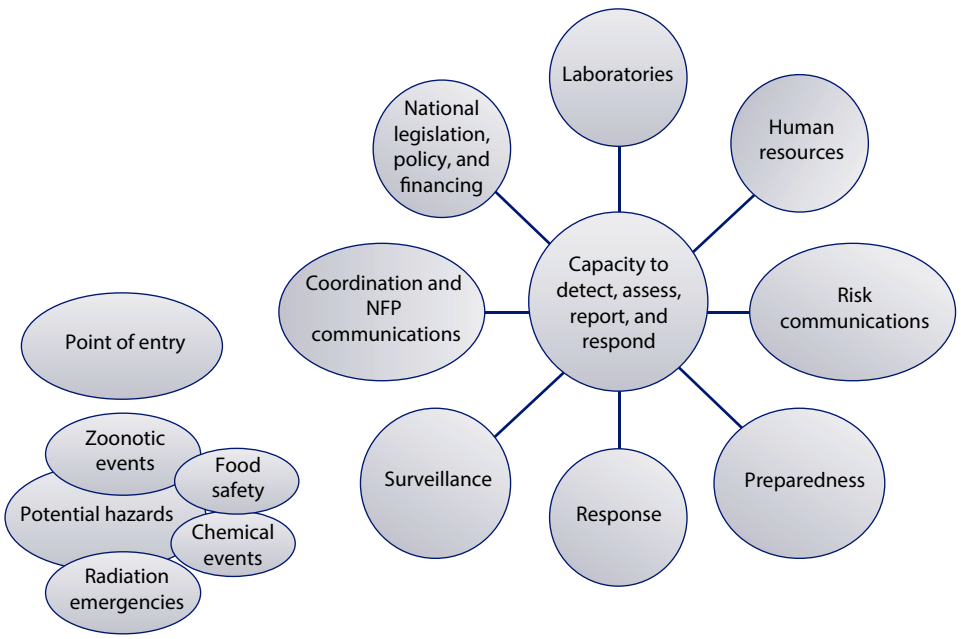
3 :: INTERNATIONAL HEALTH REGULATIONS: POLICY

REBECCA KATZ, SARAH KORNBLET, ERIN M. SORRELL, CLAIRE STADLEY AND JULIE FISCHER

published in 2010 and then updated yearly. The Monitoring Framework, and an accompanying Monitoring Tool, provide a set of country-level indicators for IHR implementation that link to eight core capacities (National Legislation, Policy, and Financing; Coordination and NFP Communications; Surveillance; Response; Preparedness; Risk Communications; Human Resources; Laboratory), as well as points of entry and four specific hazards (zoonotic diseases, food safety, chemical, and radiological and nuclear events). For Surveillance, the WHO determined that each State should have indicator-based surveil- lance that includes an early warning function for the detection of public health events and an event-based surveillance system. Response indicators include surveillance for antimicrobial resistance and systems for infection prevention and control.

For each of the 13 core capacities, the WHO identified attributes within each country-level indicator and then a series of 256 actions. These attributes are sorted into capability levels: foundational capacities are categorized as <1; inputs and processes as Level 1; outputs and outcomes as Level 2; and "additional" attributes that reflect advanced capabilities as Level 3 (WHO 2013). Defining these baseline capacities and capabilities assists countries in implementing the IHR (2005) but offers flexibility to countries in defining how activities fit into their own systems and priorities (**Figure 3.3**).

Figure 3.3 • IHR Monitoring Framework: core capacities.



3 :: INTERNATIONAL HEALTH REGULATIONS: POLICY

REBECCA KATZ, SARAH KORNBLET, ERIN M. SORRELL, CLAIRE STADLEY AND JULIE FISCHER

ISSUES NOT COVERED BY IHR

While IHR addresses many aspects of detection, reporting, and response to a public health emergency, the IHR do not address preventive or curative health services comprehensively. For example, the IHR do not call for countries to engage in preventative actions unrelated to an existing emergency, such as vaccinating against childhood diseases, ensuring preventative health-care check- ups for the population, or guaranteeing access to clinical care. The IHR do not address chronic dis- ease, so although the public health community may describe obesity or other conditions as public health emergencies, these types of conditions are not applicable to the IHR. And while Article 46 of the IHR calls for the transport and processing of reagents and other materials for diagnostic purposes, the IHR does not obligate States to share biological samples with other States Parties.

IHR IN USE: DECLARED PHEICS

Recent and ongoing infectious disease outbreaks around the world, such as pandemic (H1N1) 2009 influenza and the novel Middle East respiratory syndrome coronavirus (MERS-CoV), are examples of how countries are using the IHR and confronting these challenges while building their capacities to detect, assess, report, and respond to such events. The 2009 H1N1 pandemic was the first-ever declared PHEIC under the IHR. The second declared PHEIC was wild-type polio in May 2014, representing a very different use of the IHR. The Ebola virus dis- ease outbreak in West Africa was declared a PHEIC in August 2014. MERS-CoV has been circulating since 2012, and while it has been debated on multiple occasions, it has not been declared a PHEIC under the IHR (as of January 2015).

H1N1 INFLUENZA PANDEMIC OF 2009

The 2009 H1N1 influenza A virus pandemic was the first declared PHEIC by the DG under the IHR. The United States and Mexico both reported cases of novel influenza to the WHO, per the text of the Regulations. The WHO then assessed the reports, consulted back with the United States and Mexico, convened an Emergency Committee to provide travel and trade recommendations, and on April 25, 2009, the DG declared a PHEIC. The IHR were followed to the letter with regard to declaring, reporting, and ongoing communication for global governance of the pandemic. The timely alert of the H1N1 outbreak to the WHO allowed other countries to put their pandemic plans into action and prepare at the community level, allowing for faster reaction. Most agree the overall response under the revised IHR was efficient,

especially in comparison with responses during previous global outbreaks. The creation of NFPs enabled real-time communication and facilitated information sharing and notification.

There were, however, countries that ignored the WHO and Emergency Committee evidence-based recommendations and took their own national actions to control disease, including some actions that have less evidentiary support. And while the WHO was criticized for how and when it declared H1N1 an official pandemic (June 11, 2009)—leading to a revision of the pandemic planning documents to take into account severity along with global spread—the IHR worked as intended.

Countries such as Mexico have used the lessons learned during the 2009 H1N1 influenza pandemic to strengthen national capacities and thus enhance IHR implementation efforts. Despite the relatively early detection of cases, close coordination with PAHO, and quick information sharing with other North American countries, Mexico's laudable surveillance efforts were still not sufficient to instigate successful containment and did not prevent the spread of cases. Mexico benefited from having an existing pandemic influenza preparedness plan, developed using WHO guidelines. This plan was successfully adapted to handle the emergence of H1N1 in 2009, and in particular facilitated multisectoral coordination and enhanced surveillance. However, the biology of pandemic (H1N1) 2009 influenza virus as a less pathogenic but more readily transmitted infection challenged Mexico's diagnostic capabilities and revealed that there was a significant lack of capacity at the state level that could handle viral identification and diagnosis. Since this time, Mexico has invested significantly in its peripheral health facilities and now has 28 laboratories at the state level that can perform molecular diagnosis for influenza.

POLIO—THE SECOND DECLARED PHEIC

On May 5, 2014, based on the recommendation of the IHR Emergency Committee, the DG declared the second PHEIC in response to the renewed spread of polio. The global community had been moving toward polio eradication, with renewed efforts and a flood of resources lowering global prevalence to all-time lows in 2013 (WHO 2014e). In early 2014, however, the number of cases had increased, and the location and status of affected States increased the risk of international spread of the disease. The WHO identified Pakistan, Cameroon, and Syria as the States posing the greatest risk of exporting the disease. These States are experiencing internal conflict and are surrounded by fragile States, leading to weak health systems and fruitful conditions for spreading polio. Domestic conflict in Syria caused vaccination coverage to drop

3 :: INTERNATIONAL HEALTH REGULATIONS: POLICY

REBECCA KATZ, SARAH KORNBLET, ERIN M. SORRELL, CLAIRE STADLEY AND JULIE FISCHER

from 95% in 2010 to just 45% in 2013, and in Pakistan, vaccination workers have been targeted by militants, who have killed approximately 25 health workers to date.

The WHO and the IHR Emergency Committee decided that the increased rates of infection and the geographic location of these new cases constituted a PHEIC, and the WHO called upon a discrete list of countries—Afghanistan, Equatorial Guinea, Ethiopia, Iraq, Israel, Somalia, and Nigeria—to conduct vaccination campaigns and document vaccination coverage for travelers. States currently exporting polio—Pakistan, Cameroon, and Syria— were called upon to ensure that all residents and visitors receive vaccinations and all those engaging in international travel be vaccinated and demonstrate proof. In this instance, the WHO decided to use the power of the IHR to try to contain a resurgence of a known disease and ensure affected nations take all necessary action to eliminate cases.

EBOLA—THE THIRD DECLARED PHEIC

In December 2013, a 2-year-old boy in Guinea became sick and died; he would later be described as the index case of the largest Ebola virus disease outbreak in history. The disease spread for more than 2 months in the rural forest region of Guinea, misdiagnosed first as cholera and then as Lassa fever, until samples sent to laboratories in Europe tested positive for Ebola virus in March 2014. Guinea immediately reported the cases to the WHO, and by the end of March 2014, Liberia had also reported laboratory-confirmed cases to the WHO. In response, WHO issued a public alert as well as a subsequent emergency flash appeal for financial resources to assist in the response. In April, Médecins Sans Frontières (MSF)—the nongovernmental organization on the front lines of treating Ebola cases—described the outbreak as "unprecedented" because of the broad geographical distribution of cases, including in Guinea's capital Conakry, as well as the rapid increase in case numbers. In June, MSF declared the outbreak to be "out of control" (MSF 2014). Ebola continued to spread throughout the region, with case counts exploding in Sierra Leone after its initial confirmed case in May and a cluster of cases reported in Nigeria, which were fortunately controlled relatively quickly through massive contact tracing efforts. Despite the exponential case counts and clear evidence of international spread, including by air in the case of Nigeria, the WHO did not declare the outbreak a PHEIC until August 8, by which point the virus had spread widely through- out Guinea, Liberia, and Sierra Leone. Later in 2014, Ebola virus spread to additional countries, including Mali—two separate introductions, both of which required intensive contract tracing efforts to stop transmission; the United States—two cases imported from West Africa and two health-care workers infected through

3 :: INTERNATIONAL HEALTH REGULATIONS: POLICY

REBECCA KATZ, SARAH KORNBLET, ERIN M. SORRELL, CLAIRE STADLEY AND JULIE FISCHER

caring for the first patient; Spain—one imported case and a health-care worker secondarily infected; the United Kingdom—one imported case; and several other European nations that took care of individuals who were evacuated from West Africa (WHO 2015).

The Ebola virus disease outbreak presented all the hallmarks of a true public health emergency of international concern, yet the international response was sluggish. When the WHO finally made the PHEIC declaration, the Emergency Committee issued evidence-based travel and trade recommendations, but fear, public opinion, and political pressure led some nations to take aggressive actions outside of the recommendations, including border closures and flight restrictions that may have further hampered the response effort. The PHEIC declaration also did not trigger the level of resources necessary to contain the out- break, although individual nations, foundations, and philanthropists came forward with assistance. Several weeks after the PHEIC declaration, WHO released a "roadmap for response," which outlined the steps needed to curb the outbreak as well as a request for the financial, technical, and logistical resources required to implement the roadmap (WHO 2014b). The global community began to make significant financial contributions. Despite these investments, the outbreak continued to grow such that in September 2014, the United Nations Secretary-General took responsibility for the response, noting that the Ebola outbreak had moved beyond just a public health response, and required a coordinated multiagency effort. The WHO still managed the health aspects through IHR mechanisms, but overall responsibility was transferred to the United Nations Mission for Ebola Emergency Response (UNMEER), head-quartered in Accra, Ghana.

The West Africa Ebola virus outbreak demonstrated the efficacy of the IHR, but only to a point. Guinea and the WHO shared information effectively and efficiently in the days leading up to the initial formal notification, and Guinea promptly reported the outbreak through formal channels as soon as laboratory confirmation was made. WHO also chose, per the IHR, to share publically relevant information regarding the out- break. However, despite the failure of early efforts to stem transmission, clear evidence of international spread, and the subsequent rapid escalation of cases, WHO did not declare a PHEIC until 5 months after the initial report from Guinea. Perhaps, if the PHEIC had been declared earlier, the global community might have taken comprehensive mitigating actions more promptly. Similarly, the initial delay in detecting and diagnosing the disease, capacities mandated by the IHR, likely contributed to the spread of the disease. Had these West African nations more fully implemented the IHR, they would have been better equipped to detect, report, and respond in a timely fashion.

3 :: INTERNATIONAL HEALTH REGULATIONS: POLICY

REBECCA KATZ, SARAH KORNBLET, ERIN M. SORRELL, CLAIRE STADLEY AND JULIE FISCHER

ANTICIPATING NEW CHALLENGES: THE CURRENT STATUS OF MERS-COV SURVEILLANCE

As the 2009 H1N1 influenza virus pandemic demonstrates, even where preparedness plans are in place and executed well, challenges can arise with respect to adequate surveillance systems. The MERS-CoV emerged in the Middle East in 2012 and has since spread throughout the region, with occasional cases in other regions of the world. Most of the reported cases of human- to-human transmission of MERS-CoV have involved nosocomial transmission and family clusters, with limited evidence of widespread community-acquired cases. However, the number of cases is still rising, as is the list of countries in which cases are being confirmed. The IHR Emergency Committee has met several times to discuss whether MERS-CoV constitutes a PHEIC, but as of January 2015, they have not recommended that a declaration be made. While MERS-CoV has yet to be declared a PHEIC, the global community is using the IHR framework to monitor the situation, provide guidance, and continue to assess the situation. The situation highlights the challenges xin remaining diligent in conducting active surveillance and response activities around MERS-CoV, while continuing to increase global capacity and willingness to detect, report, and respond to emerging public health threats.

TIMELINE AND CURRENT STATUS

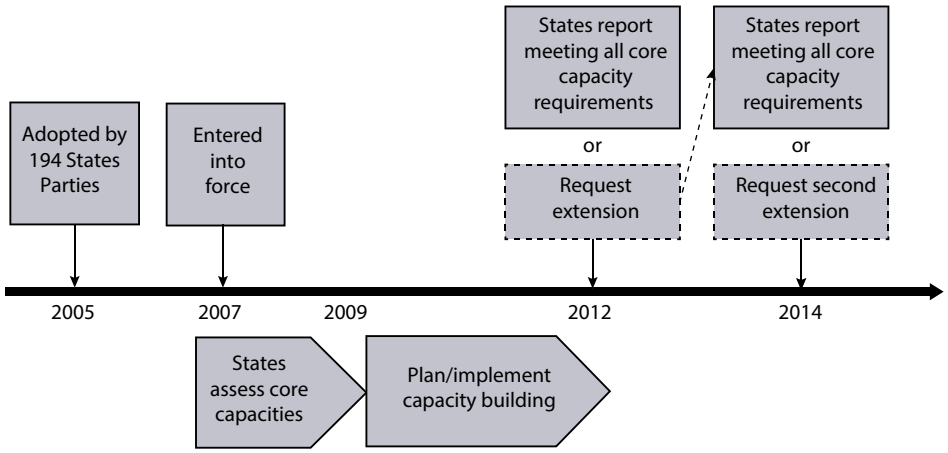
Per Article 5, States Parties were given 5 years from entry into force to establish national core capacities, with the opportunity to apply for a 2-year extension in June 2012, and in exceptional cases, a second 2-year extension in June 2014. It is not clear at this time what will happen in 2016—whether the WHO will continue to require monitoring of capacity- building efforts or whether the IHR will converge with other international efforts to build global capacity to address public health emergencies (**Figure 3.4**). In 2012, only 40 of the then-196 States Parties reported that they had achieved the core capacities for implementation by their own self-assessments. An additional 118 countries requested and received 2-year extensions and submitted action plans for building the necessary capacities for implementation. The remaining 38 States failed to submit a national plan for achieving compliance with the IHR. When nations reported again in 2014, the numbers had not greatly improved. After two more years, only 65 States Parties reported they had fully implemented the IHR. Eighty-one requested another 2-year extension, and 48 failed to report (WHO 2005b).

3 :: INTERNATIONAL HEALTH REGULATIONS: POLICY

REBECCA KATZ, SARAH KORNBLET, ERIN M. SORRELL, CLAIRE STADLEY AND JULIE FISCHER

The inability of so many nations to develop and implement capacities to detect, assess, report, and respond to public health emergencies successfully illustrates the challenge of meeting the IHR's ambitious scope.

Figure 3.4 • Timeline for IHR implementation.

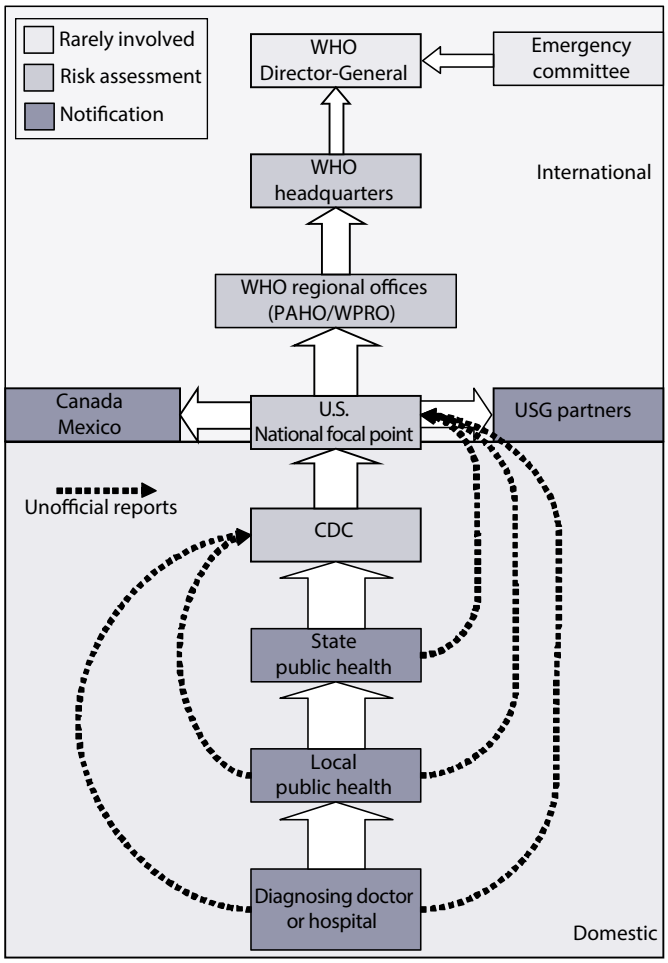


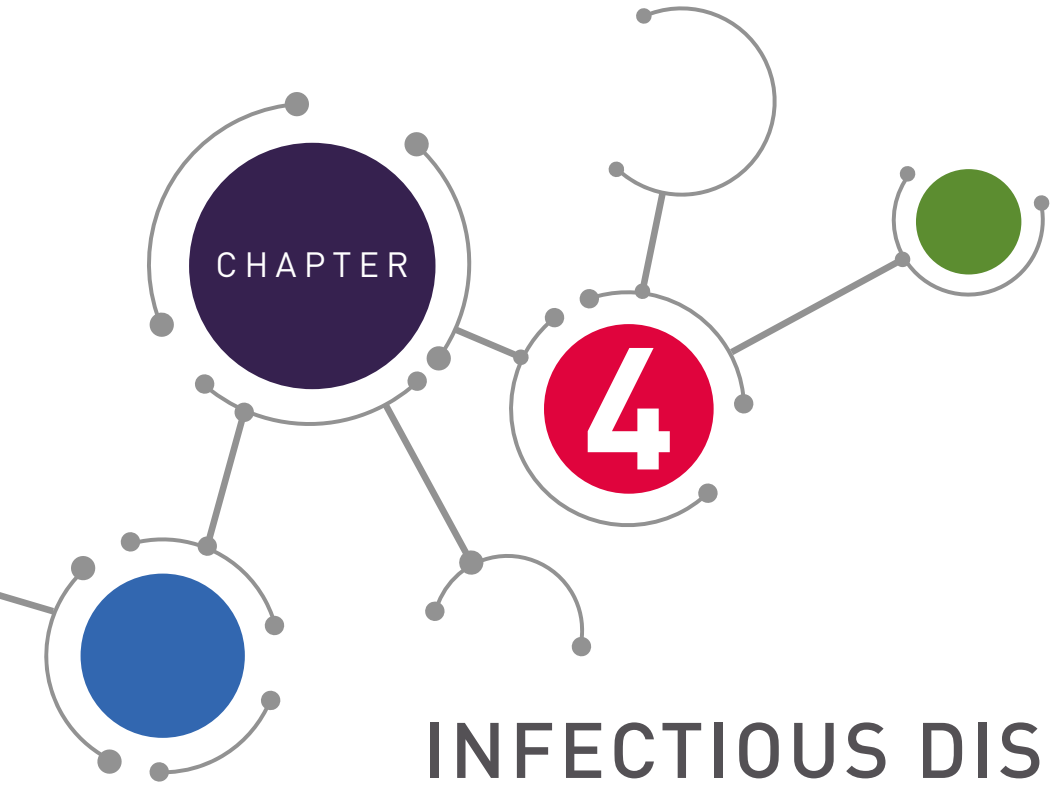
For many countries, IHR requires the development of surveillance and diagnostic platforms upon very minimal foundations. Detecting and controlling disease at points of entry demands resources and a framework for communication and coordination across borders that are simply not available in many nations and regions. Anticipating these challenges, WHA included Article 44 in the IHR (2005), calling upon countries to work together to ensure that all states have adequate health capacity.

In February 2014, the U.S. government, in partnership with 27 other nations, the WHO, the World Organization for Animal Health, and the United Nations Food and Agriculture Organization, launched the Global Health Security Agenda (GHSA). GHSA is, in part, designed to accelerate progress toward building the capacities described in the IHR, moving toward a world that is protected from infectious disease threats and is better able to prevent, detect, and respond to public health emergencies (U.S. HHS 2014). In September 2014, President Obama hosted the now 44 members of the GHSA, along with WHO, World Organization for Animal Health (OIE), and Food and Agriculture Organization of the United Nations (FAO), to reaffirm commitments to the GHSA and to devote resources toward 11 different action packages that were designed to align with many of the core capacities mandated under the IHR. Hopefully this effort, and others like it, will guide nations toward capacity building,

eventually enabling all nations of the world to detect, assess, report, and respond to a public health emergency (**Figure 3.5**).

Figure 3.5 • U.S. process of reporting a potential PHEIC.

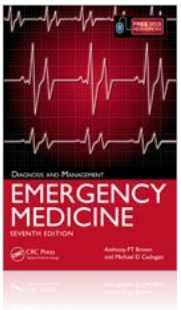




INFECTIOUS DISEASE AND FOREIGN TRAVEL EMERGENCIES

4 :: INFECTIOUS DISEASE AND FOREIGN TRAVEL EMERGENCIES

ANTHONY F. T. BROWN AND MIKE D. CADOGAN



FEBRILE NEUTROPENIC PATIENT

Neutropenia has a significant generalized infection risk with a temperature >38°C (100°F) in patients with an absolute neutrophil count <0.5 × 109/L, or <1.0 × 109/L if the count is rapidly falling.

DIAGNOSIS

1 Neutropenic patients may already know their diagnosis and/or be receiving treatment, or can present as a new case.

2 Causes of neutropenia include:

   (i) Reduced neutrophil production:
   (a) aplastic anaemia
   (b) leukaemia, lymphoma
   (c) myeloproliferative syndrome
   (d) metastatic bone marrow disease
   (e) drug-induced agranulocytosis, including chemotherapy
   (f) megaloblastic anaemia crisis.

   (ii) Reduced neutrophil survival:
   (a) systemic lupus erythematosus (SLE)
   (b) immune-mediated
   (c) drug-related
   (d) Felty syndrome.

   (iii) Reduced neutrophil circulation:
   (a) septicaemia
   (b) hypersplenism.

3 Ask about constitutional symptoms including fever and malaise, plus organ-specific features such as cough, frequency and dysuria, diarrhoea or headache and confusion.

   (i) Take a detailed drug history, contact and travel history.

4 Record the vital signs and note any focal sources of sepsis including the skin, ears, throat and perineum, indwelling catheters, and for evidence of anaemia or bruising suggesting a pancytopenia.

5 Establish venous access with strict asepsis, and send blood for full blood count (FBC), coagulation profile, electrolyte and liver function tests (ELFTs)and two sets of blood cultures from different venepuncture sites.

6 Request a chest radiograph (CXR) and send a midstream urine (MSU) sample.

4 :: INFECTIOUS DISEASE AND FOREIGN TRAVEL EMERGENCIES

ANTHONY F. T. BROWN AND MIKE D. CADOGAN

MANAGEMENT

1 Start empirical antibiotic therapy initially, unless there is a clear focus of infection, and discuss with an infectious disease physician or microbiologist.

   (i) Urgent empirical i.v. therapy with broad-spectrum antimicrobials is universal, although the optimal regimen will depend on local bacteriological susceptibilities and preference. Give:
   (a) piperacillin 4 g with tazobactam 0.5 g i.v. 6-hourly, *plus* gentamicin 4–7 mg/kg i.v. once daily when critically ill
   (b) ceftazidime 2 g i.v., t.d.s. if penicillin-sensitive, *plus* gentamicin 4–7 mg/kg i.v. once daily when critically ill
   (c) add vancomycin 1.5 g i.v. 12-hourly for possible line sepsis, MRSA or if the patient is shocked.

2 Admit the patient under the medical team, even if the patient looks well with only a fever, as rapid deterioration may occur.

   (i) Refer haemodynamically unstable patients to the intensive care unit (ICU).

HEPATITIS

DIAGNOSIS

1 Causes of hepatitis include:

   (i) Viruses such as enterically transmitted hepatitis A or E, or parenterally spread hepatitis B, C, D or G, and infectious mononucleosis, cytomegalovirus (CMV) or herpes simplex virus (HSV).

   (ii) Toxins and drugs such as alcohol, antibiotics, methyldopa, statins, chlorpromazine, isoniazid and paracetamol (remember the possibility of acute poisoning), herbal medication and *Amanita* mushrooms.

   (iii) Bacteria such as leptospirosis, or amoebae.

2 Hepatitis presents with anorexia, malaise, nausea, vomiting, abdominal pain and joint pain.

3 Look for a raised temperature, jaundice, tender hepatomegaly and splenomegaly. Assess for confusion or an altered conscious level.

4 Send blood for serology for hepatitis A, B or C, plus FBC, coagulation profile, ELFTs and lipase.

   (i) AST is two to three times higher than ALT in alcoholic hepatitis.

5 Test the urine for bilirubin and urobilinogen.

4 :: INFECTIOUS DISEASE AND FOREIGN TRAVEL EMERGENCIES

ANTHONY F. T. BROWN AND MIKE D. CADOGAN

MANAGEMENT

1 Admit unwell patients to the medical team.

   (i) This should include those with fever and malaise, persistent vomiting, dehydration, encephalopathy or a bleeding tendency with a prolonged prothrombin time.

2 Otherwise, discharge the well patient with advice to avoid preparing food for others and to use their own knife, fork, spoon, cup and plate (assuming the patient could have hepatitis A or E).

3 Advise the patient to avoid alcohol and cigarettes.

4 Give the patient a referral letter to medical outpatients or to their general practitioner (GP) for definitive diagnosis and follow-up.

GASTROINTESTINAL TRACT INFECTION

DIAGNOSIS

1 The most common manifestation is sudden acute diarrhoea, often with vomiting.

2 Causes of infectious diarrhoea include:

   (i) *Toxin-related* diarrhoea from staphylococcal food poisoning which has a precipitate onset in hours, as does *Bacillus cereus* enterotoxin from rice, in which vomiting and abdominal cramps predominate.

   (ii) *Viral* diarrhoea from the rotavirus in young children, and norovirus in older children and adults with an incubation period of 1–2 days, sometimes occurring in outbreaks of non-bloody diarrhoea. Other viral causes include enteric adenovirus and astrovirus.

   (iii) *Salmonella* with an incubation period of 6–72 h and *Shigella* infections with an incubation period of 1–3 days result in fever, malaise, diarrhoea (which may be blood-stained), vomiting and abdominal pain.

   (iv) *Campylobacter* infection has an incubation period of 2–5 days and presents with colicky abdominal pain, which may precede the onset of diarrhoea, that is watery and offensive, and sometimes blood-stained.

   (v) '*Traveller's diarrhoea*' is most often due to enterotoxigenic *Escherichia coli*, and is usually self-limiting over 2–5 days, causing watery stools and occasionally vomiting
   (a) fever is unusual, and may indicate a more serious infection that needs active investigation, including malaria or even epidemic influenza.

(vi) *Amoebiasis* may cause an acute, relapsing diarrhoea, with stools containing blood and mucus. Ask about travel to Africa, Asia or Latin America.

(vii) *Giardiasis* with an incubation period of 3–25 days causes explosive watery diarrhoea, which often persists for weeks. Chronic infection may eventually cause malabsorption with steatorrhoea. Ask about travel to Russia or North America, and contact with children in day care who have had recent diarrhoea.

3. The most important feature in all cases, after establishing any contact or travel history, is clinical evidence of dehydration.

   (i) Dehydration causes thirst, lassitude, dry lax skin, tachycardia and postural hypotension, leading to oliguria, confusion and coma when critical.

4. Also consider other causes of acute diarrhoea including drug-related, Clostridium difficile antibiotic-related diarrhoea (CDAD), Crohn's disease, ulcerative colitis, ischaemic colitis, irritable bowel syndrome, and 'spurious' from faecal impaction.

5. Send blood for FBC and ELFTs, and commence an i.v. infusion of normal saline in all dehydrated, febrile or toxic patients.

   (i) Send a stool specimen for *C. difficile* toxin assay, if antibiotic associated diarrhoea is suspected following any antibiotic use in the previous 12 weeks.

MANAGEMENT

1 Admit dehydrated, toxic, very young or elderly, and immunosuppressed patients for rehydration.

2 Allow other patients home and encourage them to drink plenty of fluid.

   (i) Alternatively, give the patient an oral glucose and electrolyte rehydration solution, which may also be purchased over the counter.

   (ii) Give an antimotility agent such as loperamide 4 mg initially, followed by 2 mg after each loose stool to a maximum of 16 mg/day (not in children, and not with fever or bloody diarrhoea).

3 Ask the patient to return within 24–48 h if symptoms persist:

   (i) Send stools for microscopy and culture then.

   (ii) Consider empirical treatment for moderate to severe systemic illness with bloody diarrhoea or for associated rigors
   (a) give ciprofloxacin 500 mg orally b.d. for 2–3 days (not in children).

   (iii) Give tinidazole 2 g orally once if *Giardia* is suspected.

4 Arrange follow-up in medical outpatients or by the local GP.

(i) Stop any antibiotics if CDAD is confirmed and give metronidazole 400 mg orally t.d.s. for 10 days, with a reminder to avoid alcohol.

SEXUALLY TRANSMITTED DISEASES

DIAGNOSIS

1 A sexually transmitted disease (STD) may be caused by non-specific infection, *Chlamydia*, gonococcus, HSV, human papilloma virus, *Trichomonas*, scabies or lice, syphilis, and of course human immunodeficiency virus (HIV).

2 Males may present with dysuria, urethral discharge, penile ulceration, warts, epididymo-orchitis and balanitis.

3 Females may present with vaginal discharge, vaginal pruritus, ulceration, warts, menstrual irregularities and abdominal pain.

(i) Pelvic inflammatory disease is commonly sexually acquired.

4 Take swabs for bacterial, viral and chlamydial studies for microscopy, culture and nucleic acid amplification, if you intend to commence treatment.

(i) Discuss the swabs and transport medium with your microbiology lab if you are unsure

(ii) Arrange a first-voided urine specimen for PCR nucleic acid testing for *Chlamydia trachomatis* or *Neisseria gonorrhoeae*.

MANAGEMENT

1 All STDs deserve expert diagnosis, treatment, follow-up and partner-contact tracing most readily available from the local GP, or in a genitourinary medicine clinic (Special Clinic).

2 As patients are reluctant to attend these clinics, explain carefully the local appointment system, what to expect, and how to locate the clinic, and refer the patient on.

(ii) Advise males not to empty the bladder for at least 4 h before attendance.

3 Commence empirical antibiotic treatment in the homeless or itinerant patient considered unlikely to attend any clinic.

(i) Give azithromycin 1 g orally as a single dose plus ceftriaxone 500 mg i.m. for urethritis.

4 In addition, consider treating the patient with an immediately painful condition such as genital herpes simplex:

   (i) Give aciclovir 400 mg orally t.d.s., famciclovir 250 mg orally t.d.s. or valaciclovir 500 mg b.d. all for 5 days.

5 Admit a patient under the medical or gynaecology team for treatment of the acute manifestations of HIV infection, secondary syphilis, acute Reiter's syndrome, disseminated gonococcal infection, severe primary genital herpes, or acute severe salpingitis.

NEEDLESTICK AND SHARPS INCIDENTS

INOCULATION INCIDENT WITH HIV RISK

DIAGNOSIS

1 The risk of seroconversion is 0.1–0.5% following accidental inoculation of blood or infectious material from a suspected HIV-positive person.

2 This risk depends on the nature and extent of the inoculation, and the viral disease activity of the HIV-positive source.

3 Take 10 mL clotted blood from the injured person, and if possible 10 mL with consent from the source. Send for HIV, hepatitis B and C testing, clearly marking the specimen as 'needlestick/sharps injury'.

MANAGEMENT

1 Wash wounds, and clean and flush mucous membranes immediately after exposure. Use a skin antiseptic such as 0.5% chlorhexidine in 70% alcohol and encourage bleeding by local venous occlusion.

2 When the source is known to be HIV-positive with a high viral load or latestage disease, and higher-risk exposure has occurred, e.g. a deep needlestick or laceration with blood inoculated, proceed as follows:

   (i) Discuss the situation immediately with an infectious diseases specialist.

   (ii) On their advice, commence (within hours) antiretroviral therapy such as lamivudine 150 mg with zidovudine 300 mg orally b.d., plus lopinavir 400 mg with ritonavir 100 mg orally b.d. usually for 4 weeks. Check your local policy for regional variations.

   (iii) The side effects of these drugs are complex and significant, including rash, malaise, fatigue, headache, nausea, vomiting, diarrhoea, hepatitis, pancreatitis and blood dyscrasias.

3 When the source is HIV-positive with a low viral load and lower-risk exposure has occurred, e.g. superficial scratch or mucous membrane contamination, commence zidovudine and lamivudine alone, or according to local policy.

4 Refer the injured person to Occupational Health for follow-up with repeat serology and monitoring blood tests, advice and ongoing counselling with psychological support.

   (i) Report the incident to the senior ED doctor and infection control officer.

   (ii) The exposed person requires follow-up for up to 6 months, should practise safe sex, should not donate blood, and should avoid pregnancy.

   (iii) Assure confidentiality and sensitivity for all concerned.

5 Consider the additional possibility of transmission of hepatitis B and the need for tetanus prophylaxis.

INOCULATION INCIDENT WITH HEPATITIS RISK

DIAGNOSIS

1 The risk of seroconversion in a non-immunized person following a needlestick injury with HBV-positive blood is 5–40%, and following injury with hepatitis C virus-positive blood is <3%.

2 Take 10 mL clotted blood from the injured person, and if possible 10 mL with consent from the source. Send for hepatitis B and C and HIV testing, clearly marking the specimen as 'needlestick/sharps injury'.

Table 4.1 • Hepatitis B prophylaxis following significant percutaneous, ocular or mucous membrane exposure for persons without adequate immunity

Exposure source	Exposed person
Test for HBsAg	**Test for anti-HBs (unless recent satisfactory level of ≥10 IU/mL is known)**
HBsAg +ve, or cannot be identified and tested rapidly	**anti-HBs** –ve or <10 IU/mL, give: **HBIG** [a] HB vaccine [b]
HBsAg –ve	**anti-HBs** –ve offer **HB vaccine** [c]

anti-HBs, antibody to HBsAg; HB vaccine, hepatitis B vaccine; HBIG, hepatitis B immunoglobulin; HBsAg, hepatitis B surface antigen.

[a] HBIG: 400 IU i.m. for adults, or 100 IU i.m. for children <30 kg, within 72 hours.

[b] HB vaccine: 1 mL i.m. within 7 days, then at 1–2 months, and a third dose at 6 months.

[c] Injury indicates evidence that the work area represents a significant exposure risk, so full vaccination is encouraged for the injured (exposed) person.

4 :: INFECTIOUS DISEASE AND FOREIGN TRAVEL EMERGENCIES

ANTHONY F. T. BROWN AND MIKE D. CADOGAN

MANAGEMENT

1 Wash the area with soap and water, dress the wound, and give tetanus prophylaxis.

2 Use **Table 4.1** to determine the need for hepatitis B prophylaxis following significant percutaneous, ocular or mucous membrane exposure in persons without adequate immunity, i.e. anti-HBs levels unrecordable or <10 IU/mL. Check your local policy for regional variations.

3 Refer the injured person to Occupational Health for follow-up, with repeat serology and monitoring blood tests for up to 6 months.
   (i) Inform the senior ED doctor and infection control officer.
   (ii) The exposed person requires follow-up for 6 months, should practise safe sex, should not donate blood and should avoid pregnancy.
   (iii) Assure confidentiality and sensitivity for all concerned.

HUMAN IMMUNODEFICIENCY VIRUS INFECTION

DIAGNOSIS

1 HIV is a cytopathic RNA retrovirus. It is transmitted by sexual contact, by syringe sharing in i.v. drug abusers, transplacentally and rarely now by blood transfusion.
   (i) Remember acute HIV infection may present after international travel.

2 HIV risk groups include:
   (i) Men who have sex with men.
   (ii) Intravenous drug users.
   (iii) Heterosexual partners of HIV/AIDS patients.
   (iv) Children of HIV/AIDS affected mothers.
   (v) Blood product recipients in the early 1980s.

3 *The Revised Surveillance Case Definition for HIV Infection – United States, 2014* was published by the US Centers for Disease Control and Prevention in 2014. It is designed for use in all age groups, and is adapted to recent changes in diagnostic criteria.
   (i) Four stages of CD4+ count are recognized for medical management purposes:
      (a) Stage 1. CD4 count ≥500/mm^3
      (b) Stage 2. CD4 count 200–499/mm^3
      (c) Stage 3. CD4 count <200/mm^3
      (d) Unknown Stage. No information available on CD4 count or percentage.

4 :: INFECTIOUS DISEASE AND FOREIGN TRAVEL EMERGENCIES

ANTHONY F. T. BROWN AND MIKE D. CADOGAN

(ii) A CD4+ count <200/mm^3 or <14% can be used to define HIV infection stage 3 or acquired immune deficiency syndrome (AIDS).

4 Presentation varies according to the disease stage and progression.

(i) *Acute infection:*
   (a) 50–70% of patients infected with HIV develop an acute illness with lethargy, fever, pharyngitis, myalgia, maculopapular rash and lymphadenopathy about 2 weeks after exposure. Acute meningitis or encephalitis are occasionally seen
   (b) although the patient is infectious, serology for HIV antibodies at this early stage will be negative
   (c) if the HIV test remains negative at 6 months, this is then termed stage 0.

(ii) *Asymptomatic infection:*
   (a) the acute infection symptoms usually resolve by 3 weeks
   (b) infected patients seroconvert to HIV-positive over the next 6 months, most within 2–12 weeks of exposure
   (c) 50% of these patients used to have fully developed AIDS by 8–10 years, although disease progression has now slowed to an almost normal life expectancy with modern highly active anti-retroviral therapy (HAART).

(iii) *Persistent generalized lymphadenopathy/intermediate phase:*
   (a) enlarged nodes in two or more non-contiguous extrainguinal sites for at least 3 months and not due to a disease other than HIV
   (b) apparently minor but debilitating complaints such as recalcitrant dermatitis, oral candida, extensive warts, varicella zoster and thrombocytopenia may occur
   (c) otherwise the patient is relatively well usually with a CD4 count >500/mm^3, and enters a latency period of 2–10 years or more.

(iv) *Symptomatic infection* (delayed and less common now with HAART):
   (a) subgroup A: constitutional disease with persistent fever, unexplained weight loss of 10% body mass or diarrhoea for over 1 month
   (b) subgroup B: neurological disease, including encephalopathy, myelopathy and peripheral neuropathy
   (c) subgroup C: secondary infectious diseases due to opportunistic infections usually as the CD4+ count drops below 200/mm^3. These include *Pneumocystis jirovecii* pneumonia, recurrent pneumonia, *Mycobacterium tuberculosis*, atypical mycobacteria, toxoplasmosis, cryptosporidiosis, isosporiasis, strongyloidosis, cytomegalovirus, systemic candidiasis, cryptococcosis and many others
   (d) subgroup D: secondary cancers including Kaposi's sarcoma, high-grade

non-Hodgkin's lymphoma, primary lymphoma of the brain and invasive cervical cancer

(e) subgroup E: other conditions such as the HIV-wasting syndrome and chronic lymphoid interstitial pneumonitis in adults.

5 AIDS-defining illnesses in an HIV-positive patient are in subgroups B to E, most commonly *P. jirovecii* pneumonia and *Cryptococcus neoformans* meningitis.

6 Thus, patients encountered in the ED infected with HIV range from the asymptomatic carrier state in the majority to non-specific illness or to acute problems as varied as collapse, cardiac disease, respiratory failure, gastrointestinal bleeding, skin disorders, depression, dementia, stroke and coma.

(i) Alternatively those on HAART may present with side effects of these drugs ranging from rashes including hypersensitivity reactions to hepatitis, pancreatitis, lactic acidosis and marrow suppression.

7 Always maintain a high index of suspicion to identify an HIV-risk patient, if necessary by direct questioning.

8 Send blood for HIV antigen if the patient is acutely unwell with a possible new HIV illness, requesting nucleic acid amplification (NAA) testing such as a polymerase chain reaction (PCR) assay for HIV RNA, viral load and p24 antigen, as well as standard 4th generation ELISA antibody testing.

9 'Routine' HIV antibody testing in the ED is inappropriate if skilled counselling and follow-up are not available.

(i) Also relying on a single serum test for HIV antibody to establish or exclude HIV infection is unwise as:
(a) occasional false positives occur
(b) false negatives occur in those infected due to:
– early infection
– lack of seroconversion in the first few months.

MANAGEMENT

1 Consider every patient to be potentially infectious and adopt standard infection control precautions including designated hospital hand hygiene practice, and the use of personal protective equipment to minimize body substance exposure.

(i) Precautions must be consistently observed with every ED patient in order to prevent any HIV dissemination and consequent exposure to disease risk.

(ii) Always wash hands before and after contact with a patient.

(iii) Wear gloves when handling blood specimens and body fluids.

(iv) Wear a disposable apron if there is likely to be contamination of clothing (e.g. from bleeding), and a face mask and goggles if splashing is even a small possibility.

(v) Take great care handling needles or scalpel blades, particularly on disposal.

(vi) Clean blood spills immediately with a suitable chlorine-based disinfectant.

2 Refer the patient to the medical team in the usual way if he or she is acutely ill.

(i) Otherwise refer the patient to infectious disease, genitourinary medicine (special clinic), or to the medical outpatient service for complete and ongoing care.

TUBERCULOSIS

1 Tuberculosis is an unusual diagnosis in the ED, particularly in developed countries such as Australia and the UK. However, as tuberculosis is a treatable and potentially curable disease its diagnosis must be considered.

2 Pulmonary tuberculosis has a significant risk of secondary transmission. Although the risk to staff and other patients in the ED is small, the patient should be isolated and wear a face mask.

3 Request an acid-fast stain for *Mycobacteria* in the following clinical settings, even though their differential diagnosis is wide-ranging and obviously includes malignancy:

(i) Family history of tuberculosis.

(ii) Previous migration from overseas, particularly Africa, Asia and southern Europe.

(ii) Fever and cough in a patient with HIV/AIDS, or risk behaviour.

(iii) Fever, productive cough and haemoptysis, particularly if immunosuppressed, diabetic, homeless or indigenous.

(iv) Otherwise unexplained fever, chronic cough, weight loss and night sweats.

4 Perform a chest X-ray, although the appearances are not diagnostic.

(i) Radiographic presentations include apical shadowing, hilar lymphadenopathy, consolidation, cavitation, effusion, fibrosis and calcification, or a miliary pattern.

5 Send blood and sputum for microscopy with Ziehl–Neelsen staining, culture and polymerase chain reaction (PCR) assay for *M. tuberculosis*.

(i) An acid-fast smear is rapid but less sensitive than culture, although culture may take several weeks to produce a definitive result.

(ii) A negative sputum smear does not rule out pulmonary tuberculosis, and a positive smear does not confirm *M. tuberculosis*, as atypical mycobacteria have the same appearance.

MANAGEMENT

1 Assess any patient with suspected pulmonary tuberculosis in a separate room (isolation room), and not in a standard ED resuscitation or observation cubicle.

2 Pulmonary tuberculosis is rarely severe enough to warrant commencing immediate antimycobacterial therapy. Rather ensure that you:

(i) Send a series of sputum samples for microscopy and culture.

(ii) Liaise with the on-call infectious disease team or respiratory medicine team to determine the best treatment course and area for admission:
(a) standard short-course therapy consists of 2 months treatment with daily isoniazid, rifampicin, pyrazinamide and ethambutol followed by 4 months of daily isoniazid and rifampicin
(b) starting therapy in the ED is rarely ever indicated.

(iii) Contact the infection control service for a patient with suspected pulmonary tuberculosis to determine an infection control risk assessment and to initiate contact tracing.

3 Tuberculosis is a notifiable disease to the relevant public health authority.

BITES WITH RABIES OR OTHER LYSSAVIRUS RISK

RABIES AND LYSSAVIRUS RISK

DIAGNOSIS

1 Transmission of rabies or other lyssaviruses usually occurs from the bite of a dog, other canids such as foxes and wolves, cats, monkeys, bats, raccoons and skunks.

2 Rabies is endemic in most continents apart from Australia, but several cases of a similar disease caused by the Australian bat lyssavirus (ABLV), a zoonotic virus closely related to rabies virus, have occurred following a bat bite or scratch.

3 The incubation period is 3–8 weeks, but may be 3 months or more, by which time a travel history and animal or bat bite history may have been forgotten.

4 Clinical signs of infection include anorexia, fever, pain at the bite site and headache, progressing to confusion and agitation from encephalitis with pre-fatal hypersalivation, hyperthermia and hydrophobia.

5 Discuss any laboratory test with the infectious diseases team or pathology laboratory prior to sample collection.

   (i) Laboratory confirmation includes immunofluorescent stain of a skin biopsy from the nape of the neck, antibody detection in blood or CSF, or PCR assay of saliva, blood or CSF.

MANAGEMENT

1 Established rabies is inevitably fatal. All cases of rabies exposure that have survived have been vaccinated before the onset of clinical disease.

2 Immediately wash and flush all bite wounds and scratches for at least 5 min. Check the patient's tetanus immunization status, and give adsorbed diphtheria and tetanus toxoid (ADT) as required.

3 Try to evaluate the exposure risk:

   (i) Category I – touching or feeding animals, licks on intact skin.

   (ii) Category II – nibbling of uncovered skin, minor scratches or abrasions without bleeding.

   (iii) Category III – single or multiple transdermal bites or scratches, contamination of mucous membrane with saliva from licks, licks on broken skin.

4 Discuss post-exposure rabies and ABLV prophylaxis (post-exposure prophylaxis [PEP]) immediately with an infectious diseases specialist or the on-call population health unit specialist.

   (i) PEP is a combination of human rabies immunoglobulin (HRIG) and rabies vaccine, and should be given within 48 h of the bite:
   (a) category I exposure – no further treatment required
   (b) category II exposure – administer rabies vaccine i.m.
   (c) category III – administer rabies vaccine and HRIG i.m.

   (ii) Depending on the vaccine type, PEP in the previously unvaccinated immunocompetent person includes rabies vaccine 1 mL i.m. in the deltoid muscle to a total of four doses over two weeks on day 0, 3, 7 and 14. In addition, HRIG 20 IU/kg is infiltrated around the wound site on the first day.

4 :: INFECTIOUS DISEASE AND FOREIGN TRAVEL EMERGENCIES

ANTHONY F. T. BROWN AND MIKE D. CADOGAN

COMMON IMPORTED DISEASES OF TRAVELLERS

- Ask any patient who has been travelling abroad specifically about the time, place and type of travel. Ask how long they spent in each foreign country and when they arrived back.
- Enquire specifically about malaria prophylaxis and whether it was taken for 4 weeks after leaving a malarial zone, and about immunizations before going abroad.
- The CDC Travelers' Health website (see http://wwwnc.cdc.gov/travel/) has information to assist travellers and their healthcare providers in deciding on the vaccines, medications, and other measures necessary to prevent illness and injury during international travel. It covers all aspects of foreign travel, including lists of recent disease outbreaks, and information on illnesses in alphabetical order from African tick-bite fever to yellow fever.
- Remember that the returned traveller may well have a condition that is not considered 'tropical', such as an STD including HIV infection, meningococcal infection, pneumonia, pyelonephritis, and enteric infection other than traveller's diarrhoea.
- Some of the tropical diseases discussed below can be endemic, but mostly are contracted abroad.

MALARIA

DIAGNOSIS

1 Falciparum malaria is the most dangerous form of malaria. Cases are imported to Australia from Africa, Asia and Papua New Guinea, but other tropical sources include the western Pacific, Amazon basin and Oceania.

   (i) Malaria is a potentially fatal infection. Survivors may experience damage to the brain, kidneys, liver, heart, gastrointestinal tract and lungs.

   (ii) Cerebral malaria is an abrupt onset of encephalopathy with headache that can progress rapidly to confusion, seizures and coma.

   (iii) Other malaria presentations include an influenza-like illness, diarrhoea and vomiting, jaundice, acute renal failure, acute respiratory distress, postural hypotension or shock, progressive anaemia and thrombocytopenia.

   (iv) The patient may not look ill in the first few days, but the nonimmune or splenectomized patient may then deteriorate rapidly over a few hours and die.

2 The patient usually presents within 4 weeks of returning from a malarious area with fever, rigors, nausea, vomiting, diarrhoea, and headache. Hepatosplenomegaly is common.

3 Infection may persist for months due to the release of parasites from the hepatic extra-erythrocytic phase in the liver, even after apparently successful treatment.

   (i) Late onset acute presentation can occur months or even more than a year after return from overseas.

   (ii) This relapse due to persistent dormant hepatic hypnozoites does **not** occur in falciparum malaria.

4 Send blood for FBC, coagulation profile, ELFTs, two sets of blood cultures and:

   (i) Request at least two sets of thick and thin blood films for malarial parasites in every patient returning from abroad with fever and with any of the above symptoms or signs.

   (ii) Perform a PCR test when available particularly for mixed infection, or if microscopy is negative.

5 Request an MSU.

MANAGEMENT

1 Falciparum malaria is a medical emergency requiring prompt treatment with oral or i.v. artemisinin derivative therapy.

   (i) Call the senior ED doctor if you suspect falciparum malaria.

   (ii) Give immediate artesunate 2.4 mg/kg i.v. repeated at 12 and 24 h, then once daily, if there is an altered conscious level, jaundice, oliguria, severe anaemia, hypoglycaemia, vomiting, acidosis or respiratory distress, or if over 2% red cells are parasitized. Admit these *severe* cases to the ICU
   (a) give quinine 20 mg/kg up to 1.4 g infused over 4 h if artesunate is not immediately available, with BP, blood sugar (risk of hypoglycaemia) and electrocardiographic monitoring.

   (iii) Admit other less severe patients under the medical team when falciparum malaria is even considered possible, and begin treatment immediately – if necessary before definitive blood results are available
   (a) give those who can tolerate oral treatment artemetherlumefantrine combination therapy.

2 Refer patients with other types of malaria (*P. vivax*, *P. ovale*, *P. malariae* and *P. knowlesi*) to the medical team; some may be suitable for treatment as an outpatient. 3 Ask a patient with two sets of negative thick and thin blood films, but a suggestive history, to return for repeat malaria blood films in 48 h or earlier if symptoms persist.

   (i) Inform the GP of the possibility of malaria by email and letter.

Warning: do not diagnose the flu in a febrile patient without asking about recent foreign travel and considering malaria.

TYPHOID

DIAGNOSIS

1 The incubation period is up to 3 weeks following travel to India, Latin America, the Philippines and South-East Asia. There is an initial insidious onset of fever, malaise, headache, anorexia, dry cough, and constipation in the first week.

2 The illness then progresses to abdominal distension and pain associated with diarrhoea, splenomegaly, a relative bradycardia, bronchitis, confusion or coma.

   (i) The characteristic crop of fine rose-pink macules on the trunk is rare.

3 Send blood for FBC that may show a leucopenia with a relative lymphocytosis. Send ELFTs and two sets of blood cultures in all suspected cases.

4 Request an MSU and a stool culture if diarrhoea is prominent.

   (i) Blood cultures are positive in up to 90% in the first week.

   (ii) Stool culture becomes positive in 75% and urine culture in 25% in the second week.

MANAGEMENT

1 Commence i.v. rehydration with normal saline or Hartmann's.

2 Refer all suspected cases to the medical team for azithromycin 1 g i.v. or orally daily for 5 days.

   (i) Or give ciprofloxacin 400 mg i.v. 12-hourly or ciprofloxacin 500 mg b.d. orally for 7–10 days, if the infection was not acquired in the Indian subcontinent or South-East Asia.

4 :: INFECTIOUS DISEASE AND FOREIGN TRAVEL EMERGENCIES

ANTHONY F. T. BROWN AND MIKE D. CADOGAN

DENGUE

DIAGNOSIS

1 Dengue occurs after a short 1-week incubation period from infection by one of four serotypes of mosquito-borne flavivirus, particularly in Central or South America and South-East Asia.

2 There are abrupt fever, chills, retro-orbital or frontal headache, myalgia, back pain, lymphadenopathy and rash.

   (i) The initial rash is a transient, generalized, blanching macular rash in the first 1–2 days.

   (ii) A secondary maculopapular rash with areas of sparing occurs lasting 1–5 days.

   (iii). A later haemorrhagic rash may be associated with thrombocytopenia.

3 Dengue haemorrhagic fever (DHF) and dengue shock syndrome (DSS) occur in repeat infections with a different serotype.

4 Send blood for FBC, coagulation profile, ELFTs, two sets of blood cultures and dengue IgM serology and/or PCR.

MANAGEMENT

1 Admit the patient under the medical team for supportive care with i.v. fluids and antipyretic analgesics.

2 Admit patients with DHF or dengue shock syndrome to the ICU.

TYPHUS AND SPOTTED FEVERS

DIAGNOSIS

1 Typhus includes several diseases caused by *Rickettsiae*, such as epidemic and murine (endemic) typhus.

2 Scrub typhus is one of the spotted fevers, and is caused by an acute bacterial infection by *Orientia tsutsugamushi*, transmitted by trombiculid mites ('chiggers'). Foci of scrub typhus occur in South-East Asia, northern Japan and northern Australia.

   (i) Other tick-borne spotted fevers include Queensland tick typhus, Rocky Mountain and Mediterranean.

3 Infection is characterized by high fevers, headache, lymphadenopathy and a fine vasculitic maculopapular rash, with a characteristic black necrotic eschar at the site of the original chigger bite in scrub typhus.

4 Potential complications include pneumonitis, encephalitis and myocarditis, which usually occur in the late phase of the illness.

5 Send blood for FBC, coagulation profile, ELFTs, blood cultures and serology.

   (i) Leucopenia and deranged LFTs are common in the early phase of infection.

6 Scrub typhus can be confirmed by PCR assay on ethylenediaminetetraacetic acid (EDTA) blood in its early stages, or serological tests in the later or convalescent stage.

MANAGEMENT

1 Give doxycycline 100 mg orally b.d. for 7–10 days.

2 Refer the patient to an infectious disease specialist for exclusion of additional travel-related infections, and follow up.

HELMINTH INFECTIONS

DIAGNOSIS

1 *Schistosomiasis* (bilharzia) caused by fresh-water trematodes (flukes) rarely presents acutely, but should be suspected in acute cases from endemic areas such as Africa, South America, the Middle East and Asia presenting with fever, urticarial rash, hepatosplenomegaly and diarrhoea associated with eosinophilia (Katayama fever).

   (i) Chronic infection may present up to years later with painless terminal haematuria or obstructive uropathy, portal or pulmonary hypertension and seizures.

2 *Roundworm* infection (ascariasis) is discovered when the adult worm is passed in the stool, although occasionally allergic pneumonitis, abdominal pain, diarrhoea or urticaria occur.

3 *Tapeworm* infection usually presents with lassitude, weight loss and anaemia or with disease-specific complications such as seizures in cysticercosis, and mass effects in hydatid disease (*Echinococcus*).

PANDEMIC INFLUENZA

- A pandemic is a global outbreak of a new type of infection in susceptible individuals, with rapid person-to-person spread and the potential to affect millions.

4 :: INFECTIOUS DISEASE AND FOREIGN TRAVEL EMERGENCIES

ANTHONY F. T. BROWN AND MIKE D. CADOGAN

- International travel is the main reason for the speed of pandemic spread, so international travellers are among the first cases of a variant of influenza to be seen in any new location.
- World Health Organisation website has the latest influenza updates (http://www.who.int/influenza/en/), as well as the Centers for Disease Control and Prevention (CDC).

DIAGNOSIS

1 Influenza is an acute illness with an abrupt onset and peak symptoms in the first 24–48 h.

   (i) These most commonly include sudden fever, chills, headache, dry cough, sore throat and muscle aches.

   (ii) Diarrhoea can be a presenting complaint.

2 Ask patients presenting with fever or respiratory symptoms specifically about interstate and international travel, or about contact with anyone who has an acute respiratory illness ideally at triage, **before** entering the ED.

   (i) Check the status of the current 'at-risk' countries at http://wwwnc.cdc.gov/travel/ or refer to local policy information concerning global infection threats.

MANAGEMENT

1 Place a suspected case of influenza in isolation, preferably a negative pressure room, and give him or her a surgical mask to wear.

2 All attending staff must wear a correctly fitted, high-filtration mask (N95), long-sleeved gown, gloves, and full eye protection.

3 Inform the senior ED doctor, the local infectious disease physician, and hospital infection control officer.

   (i) Call the clinical microbiologist and take FBC, ELFTs, blood cultures and 30 mL serology including for atypical pneumonia.

   (ii) Send a nose/throat swab and arrange a chest X-ray:
   (a) alert the radiographer to the infection risk.

   (iii) A nasopharyngeal aspirate (NPA) has a higher risk to staff and is not recommended.

4 Specialist consultation and local policy will determine further management.

4 :: INFECTIOUS DISEASE AND FOREIGN TRAVEL EMERGENCIES

ANTHONY F. T. BROWN AND MIKE D. CADOGAN

FURTHER READING

Australian Government Department of Health (2013). *The Australian Immunisation Handbook*, 10th edn. http://www.health.gov.au/internet/immunise/publishing.nsf/Content/Handbook10-home (hepatitis B, HIV, rabies).

Australian Prescriber (2012). http://www.australianprescriber.com/magazine/35/1/article/1248.pdf (fever in the returned traveller).

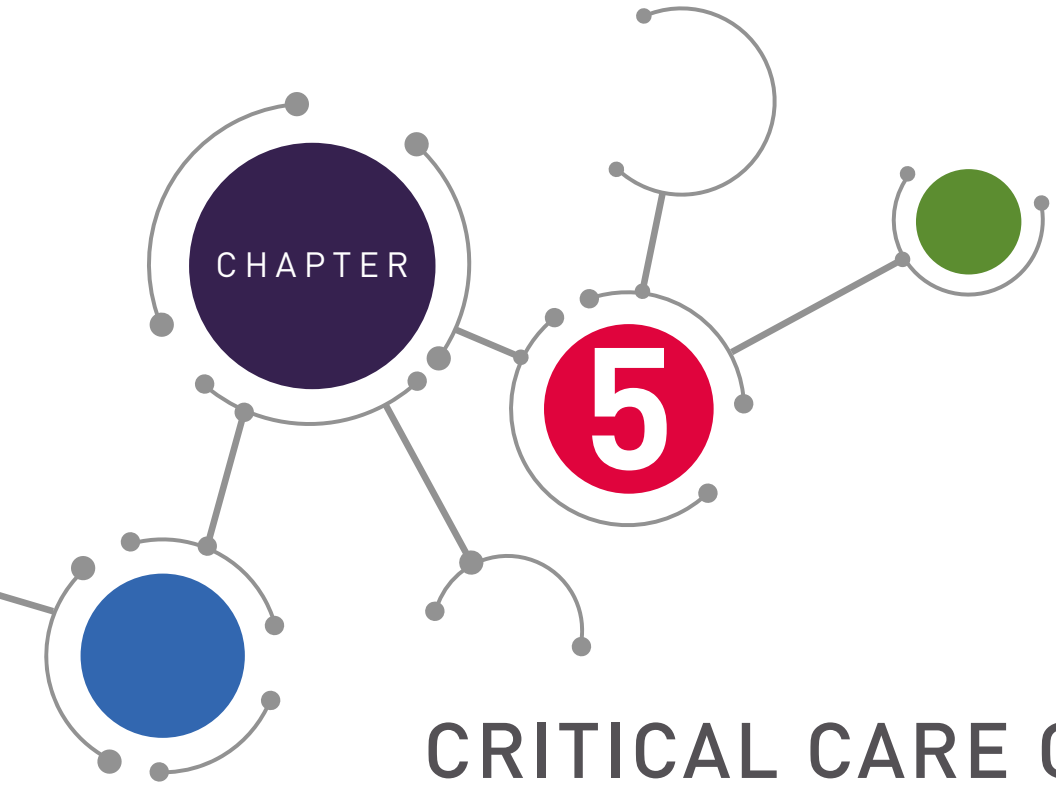
CDC Travelers' Health. http://wwwnc.cdc.gov/travel/ (travellers' health).

Department of Health UK. Immunisation Against Infectious Disease 2013. 'The Green Book'. www.gov.uk/government/collections/immunisation-against-infectious-disease-the-green-book#the-green-book (immunisation).

Public Health England. https://www.gov.uk/government/organisations/public-health-england (infectious diseases).

Therapeutic Guidelines. eTG complete 2015. http://www.tg.org.au/

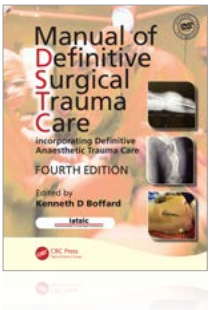
World Health Organization. http://www.who.int/rabies/human/postexp/en/ (rabies).



CRITICAL CARE OF THE TRAUMA PATIENT

5 :: CRITICAL CARE OF THE TRAUMA PATIENT

KENNETH D BOFFARD



5.1 INTRODUCTION

Most trauma mortality in the intensive care unit (ICU) occurs during the first few days of admission, primarily as a result of closed head injury, severe respiratory failure or refractory haemorrhagic shock, some of which are largely deemed as non-preventable deaths. The remainder, many of which may be preventable, occur late and are caused by multiple organ failure, infection or both.

5.2 GOALS OF TRAUMA INTENSIVE CARE UNIT (ICU) CARE

The fundamental goals of trauma intensive care unit (ICU) care are early restoration and maintenance of tissue oxygenation, diagnosis and treatment of occult injuries, and prevention and treatment of infection and multiple organ failure. Trauma ICU care is best provided by a multidisciplinary team focussed on resuscitation, monitoring and life support. In the ICU, those who take care of a patient admitted with lethal brain injury play a vital role in the support and maintenance of potential organ donors.

5.3 PHASES OF ICU CARE

5.3.1 RESUSCITATIVE PHASE (FIRST 24 HOURS POST-INJURY)

During this phase, management is focussed on haemostatic resuscitation, and the goal of treatment is the maintenance of adequate tissue oxygenation. At the same time, occult life-threatening or limb-threatening injuries are carefully sought and should be recognized. Performing secondary and tertiary survey of all trauma patients will minimize and reduce significantly the missed injuries.

Inadequate tissue oxygenation must be recognized and treated immediately. Deficient tissue oxygen delivery in the acutely traumatized patient is usually caused by impaired perfusion or severe hypoxaemia. Although several different types of shock can be present, inadequate resuscitation from hypovolaemia and blood loss is most common.

After major trauma, some patients experience considerable delay before organ perfusion, primarily in the splanchnic circulation, is fully restored, despite apparently adequate systolic blood pressure and normal urine output. This phenomenon has been called 'occult hypoperfusion'. A clear association has been identified between occult hypoperfusion or persistent hypovolemia after major trauma and increased rates of infections, length of stay, days in surgical/trauma ICU, hospital charges,

multiple organ dysfunction/failure and mortality. Rapid control of bleeding and early identification and aggressive resuscitation aimed at correcting hypovolemia have been shown to improve survival and reduce complications in severely injured trauma patients, particularly with severe traumatic brain injury (TBI). However, the previously advocated practice of supranormal resuscitation to somehow drive perfusion is associated with excess lactated Ringer infusion, and an increased incidence of intra-abdominal hypertension, elevated intracranial pressure (ICP), abdominal compartment syndrome, multiple organ failure (MOF) and death. An elevated fluid balance alone is an independent risk factor for adult respiratory distress syndrome (ARDS) and MOF. Currently, a more balanced approach utilizes an initial restricted or controlled volume resuscitation (SBP approximately 90 mm Hg) until surgical bleeding is controlled. A concomitant damage control resuscitation with early institution of blood components in the patient requiring more than 1–2 L of crystalloid in a 1:1:1 ratio of red blood cells (RBCs) to fresh frozen plasma (FFP) to platelets to mimic the ongoing blood losses in the severely injured, likely coagulopathic patient limits the overall amount of crystalloid infused. Simultaneously, the presence of an early trauma associated coagulopathy (TAC) is optimally treated to minimize blood loss and reduce the recognized early mortality from coagulopathic bleeding.

5.3.1.1 'TRADITIONAL' ENDPOINTS OF RESUSCITATION

These generally include the following:

- Clinical examination: cold and clammy, blood pressure, central venous pressure, heart rate, arterial partial pressure of oxygen (PaO2), etc., but may not identify occult hypoperfusion.
- Base deficit and lactic acidosis.
- Pulmonary artery catheter measurements, which may be used to derive measures of cardiac index and oxygen delivery.
- Gastric tonometry.
- Tissue oximetry

5.3.1.2 POST-TRAUMATIC ACUTE LUNG INJURY

Aetiology

- Chest trauma.
- Fluid overload.
- Shock.

- Aspiration.
- Post-traumatic ARDS.
- Fat embolism syndrome.
- Pre-existing respiratory disease.

5.3.1.3 RESPIRATORY ASSESSMENT AND MONITORING

- Work of breathing.
- Respiratory rate.
- Arterial blood gases.
- Oxygen delivery and consumption.
- Bronchoscopy.

Ventilatory support should be instituted earlier rather than later; select a mode of ventilation tailored to the patient's need using appropriate volumes (frequently requires high pressures to achieve adequate ventilation in severely injured) and amounts of positive end-expiratory pressure (PEEP) (frequently greater than 10 cm/H_2O to treat progressive hypoxia).

- Non-invasive ventilation is rarely adequate in the acute setting.
- Pressure support ventilation (PSV) is poorly tolerated following severe injury.
- Lung protective ventilation (LPV) with low volume and low peak pressures is frequently not possible early in resuscitation due to severe hypoxia and low compliance – use adequate volumes despite high pressures.
- High PEEP (>10 up to 20–25 cm H_2O) for hypoxia is applied to recruit alveoli.

5.3.2 EARLY LIFE SUPPORT PHASE (24–72 HOURS POST-INJURY)

During this phase, treatment is focussed on identifiable injuries, the management of post-traumatic respiratory failure and of progressive intracranial hypertension in patients suffering from severe head injury. Usually, the diagnostic evaluation for occult injuries is now complete. Evidence of early multiple organ failure may become apparent during this time.

Major life-threatening problems that may develop at this time include intracranial hypertension, systemic inflammatory response syndrome (SIRS), early multiple organ dysfunction syndrome (MODS) and continued respiratory insufficiency. The main priorities of the early life support phase are the maintenance of tissue oxygenation,

the control of ICP, an ongoing search for occult injuries, and the institution of nutritional support and withdrawal or replacement of trauma resuscitation lines or devices that may have been placed in less than ideal conditions. Further establishment of the medical history or events of the injury is also completed.

5.3.2.1 PRIORITIES

- Gas exchange and ventilatory support.
- Haemostatic resuscitation.
- Intracranial pressure (ICP) monitoring and control.
- Fluid and electrolyte balance.
- Haematological parameters.
- Occult injuries.
- Delayed intracranial haematoma formation.
    - Follow-up computed tomography (CT) scan of the head.
- Intra-abdominal injuries.
    - Follow-up CT scan or ultrasound of the abdomen.
- Cervical spine injury.
    - Completion of the radiographic survey and clinical examination if possible.
- Thoracic and lumbar spine injury.
- Extremity injury: hands and feet.
- Nerve injuries.

5.3.3 PROLONGED LIFE SUPPORT (>72 HOURS POST-INJURY)

The duration of the prolonged life support phase depends on the severity of the injury and its associated complications. Many of those who are critically injured can be successfully weaned from life support, while the more seriously injured enter a phase in which ongoing life support is necessary to prevent organ system failure. Predominant clinical concerns that arise include infectious complications that may lead to the development of late multiple organ failure or death.

The main objective of the management of patients developing MODS is to provide support for failing organ systems while attempts are made to isolate and eliminate inflammatory foci that could be perpetuating the organ system failure. In addition,

prolonged immobility can cause problems with muscle wasting, joint contractures and skin compromise in pressure areas. Physiotherapy should be commenced early, with the proper use of splints, early exercise and ambulation when possible.

5.3.3.1 RESPIRATORY FAILURE

- Unexplained respiratory failure – look for occult infection or necrotic tissue.
- Tracheostomy – early.

5.3.3.2 INFECTIOUS COMPLICATIONS

The following are some infectious complications that can arise:

- Nosocomial pneumonia.
    - Gram stain of sputum and microbiological culture.
- Lung abscess and empyema.
- Surgical site infection.
    - Superficial incisional surgical site, e.g. wound infection.
    - Deep incisional surgical site infection.
    - Organ/space surgical site infection, e.g. intraabdominal abscess.
- Intravenous catheter-related sepsis.
- Bloodstream infections.
- Urinary tract infection.
- Acalculous cholecystitis.
- Sinusitis and otitis media.
- Ventriculitis and meningitis.

Antibiotic and antifungal therapy should ideally be of limited spectrum and directed toward cultures. Remember the risk of antibiotic-associated colitis, and other antibiotic-associated complications.

5.3.3.3 NON-INFECTIOUS CAUSES OF FEVER

- Drugs.
- Pulmonary embolus (PE).
- Deep venous thrombosis (DVT).

5 :: CRITICAL CARE OF THE TRAUMA PATIENT

KENNETH D BOFFARD

5.3.3.4 PERCUTANEOUS TRACHEOSTOMY

Percutaneous tracheostomy has been shown to have fewer perioperative and postoperative complications compared with conventional tracheostomy and is now the technique of choice in critically ill patients.

Various techniques are described, with dilation by forceps or multiple or single dilators. Patient selection is important, and percutaneous tracheostomy should not be attempted if the procedure is non-elective, the landmarks are obscure in the neck or the patient has a coagulopathy. Confirmation of correct placement by fibre-optic bronchoscopy is valuable. Ultrasound scanning of the neck and routine endoscopy during the procedure appear to reduce early complications. Percutaneous tracheostomy is not suitable for children.

5.3.3.5 WEANING FROM VENTILATORY SUPPORT

During the recovery phase, the most important transition made is that from mechanical ventilation to unassisted breathing, known as weaning. Weaning begins when the causes of respiratory failure have resolved. When signs of infection, respiratory failure or multisystem failure abate, recovery from critical illness requiring prolonged ICU care is imminent.

5.3.3.6 EXTUBATION CRITERIA ('SOA2P')

S – Secretions – minimal

O – Oxygenation – good

A – Alert

A – Airway: without injury or compromise

P – Pressures or parameters: measurements of tidal, volume, vital capacity, negative inspiratory force, etc.

5.3.4 RECOVERY PHASE (SEPARATION FROM THE ICU)

During the recovery phase, the patient is weaned from full ventilatory support until he or she is breathing spontaneously and invasive monitoring devices can be removed. The patient and family are prepared for the transition from the ICU to general patient or intermediate care unit, and plans for further convalescence and rehabilitation are developed.

5 :: CRITICAL CARE OF THE TRAUMA PATIENT

KENNETH D BOFFARD

5.4 HYPOTHERMIA

Hypothermia is a potential complication of trauma. While hypothermia may itself cause cardiac arrest, it is also protective to the brain through a reduction in metabolic rate and thus reduced oxygen requirements. Oxygen consumption is reduced by 50 per cent at a core temperature of 30°C. The American Heart Association guidelines recommend that the hypothermic patient who appears dead should not be considered so until a near-normal body temperature is reached. However, hypothermia is on balance extremely harmful to trauma patients, especially by virtue of the way it alters oxygen delivery. Therefore, the patient must be warmed as soon as possible, and heat loss minimized at all costs, in all injured patients.

5.4.1 RE-WARMING

Hypothermia is common after immersion injury. Re-warming must take place with intensive monitoring. Patients who have spontaneous respiratory effort and whose hearts are beating, no matter how severe the bradycardia, should not receive unnecessary resuscitation procedures. The hypothermic heart is very irritable and fibrillates easily. Patients with a core temperature of less than 29.5°C are at high risk of ventricular arrhythmias, and should be re-warmed as rapidly as possible. Recent studies have not shown any increase in ventricular arrhythmias with rapid re-warming.

A hypothermic heart is resistant to both electrical and pharmacological cardioversion, especially if the core temperature is below 29.5°C, and cardiopulmonary resuscitation should be continued if necessary.

If the core temperature is greater than 29.5°C and fibrillation is present, one attempt at electrical cardioversion should be made. If this is ineffective, intravenous amiodarone may be helpful.

Patients with a core temperature of between 29.5°C and 32°C can generally be passively re-warmed, and if haemodynamically stable may be re-warmed more slowly. However, active core re-warming is still generally required.

Patients with a core temperature of over 32°C can generally be re-warmed using external rewarming.

Methods of re-warming include the following:

5 :: CRITICAL CARE OF THE TRAUMA PATIENT

KENNETH D BOFFARD

External

- Removal of wet or cold clothing and drying of the patient.
- Infrared (radiant) heat.
- Electrical heating blankets.
- Warm air heating blankets.

Note: In the presence of hypothermia, 'space blankets' are ineffective, since there is minimal intrinsic bordy heat to reflect.

Internal

- Heated, humidified respiratory gases to 42°C.
- Intravenous fluids warmed to 37°C.
- Gastric lavage with warmed fluids (usually saline at 42°C).
- Continuous bladder lavage with water at 42°C.
- Peritoneal lavage with potassium-free dialysate at 42°C (20 mL/kg every 15 minutes).
- Bilateral intrapleural lavage with warmed fluid.
- Extracorporeal rewarming via a femoral arteryfemoral vein bypass.

Resuscitation should not be abandoned while the core temperature is subnormal, since it may be difficult to distinguish between cerebroprotective hypothermia and hypothermia resulting from brainstem death.

5.5 SYSTEMIC INFLAMMATORY RESPONSE SYNDROME

Two large studies have shown that 50 percent of patients with 'sepsis' are abacteraemic. It is also recognized that the aetiology in these abacteraemic patients may be burns, pancreatitis or significant destructive tissue injuries particularly when associated with shock, which all cause the release of inflammatory mediators called DAMPs. Danger activated molecular patterns (DAMPs) activate the innate and adaptive immune responses with excessive systemic inflammation and massive bystander tissue injury leading to diffuse organ injury and failure (i.e. MOF).
The common theme through all of these various injuries and sepsis is that the inflammatory cascade has been initiated and runs amok. Once the inflammatory response is initiated it leads to systemic symptoms which may or may not be beneficial or harmful. The primary symptoms associated with SIRS include:

- Temperature <36°C or >38°C.
- Heart rate >90 beats per minute.
- Respiratory rate >20 breaths per minute.
- Deranged arterial gases: partial pressure of carbon dioxide ($PaCO_2$) <32 mm Hg (4.2 kPa).
- White blood count >12 × 109/L or <4 × 109/L or 0.10% immature neutrophils.

Patients who have one or more of these primary components are thought to have SIRS. A further classification of SIRS is that sepsis is SIRS plus documented infection. Severe sepsis is sepsis plus organ dysfunction, hypoperfusion abnormalities or hypotension. Finally, septic shock is defined as sepsis-induced hypotension despite fluid resuscitation. The treatment goals for septic shock include source control, early use of broad-spectrum antibiotics and circulatory support with ino-pressor agents as well as maintaining adequate organ system function.

There is no evidence for mortality reduction with the use of steroids, tight glycaemic control or use of activated protein C.

5.6 MULTISYSTEM ORGAN DYSFUNCTION SYNDROME (MODS) OR MULTIPLE ORGAN FAILURE (MOF)

Multisystem organ dysfunction syndrome is a clinical syndrome characterized by the progressive failure of multiple and interdependent organs. The 'dysfunction' identifies a phenomenon in which organ function is not capable of maintaining homeostasis, so it occurs along a continuum of progressive organ failure, rather than absolute failure. The lungs, liver and kidneys are the principal target organs; however, failure of the cardiovascular and central nervous system may be prominent as well. The main inciting factors in trauma patients are haemorrhagic shock and infection. As life support and resuscitation techniques have improved, the incidence of MODS has increased. The early development of MODS (<3 days post-injury) is usually a consequence of shock or inadequate resuscitation, while late onset is usually a result of severe infection.

The MODS/MOF develops as a consequence of local inflammation with activation of the innate immune system and a subsequent uncontrolled or inappropriate systemic inflammatory response to inciting factors such as severe tissue injury (e.g. brain, lung or soft tissue), hypoperfusion or infection. Two basic models have emerged: the 'one-hit' model involves a single insult that initiates a SIRS, which may result in

5 :: CRITICAL CARE OF THE TRAUMA PATIENT

KENNETH D BOFFARD

progressive MODS, whereas the 'two-hit' model involves sequential insults that may lead to MODS. The initial insult may prime the inflammatory response such that a second insult (even a modest one) results in an exaggerated inflammatory response and subsequent organ dysfunction.

Early factors that increase the risk for MODS include persistent and refractory shock with lactic acidosis and elevated base deficit, a high injury severity score (ISS) and the need for multiple blood transfusions. Advanced age or pre-existing disease may also increase a patient's risk of developing MODS because of co-morbid disease or decreased organ reserves secondary to normal ageing.

Specific therapy for MODS is currently limited, apart from providing adequate and full resuscitation, treatment of infection and general ICU supportive care. Strategies to prevent MODS include adequate fluid resuscitation to establish and maintain tissue oxygenation, debridement of devitalized tissue, early fracture fixation and stabilization, early enteral nutritional support when possible, the prevention and treatment of nosocomial infections and early mobility and resumption of exercise.

5.7 COAGULOPATHY OF MAJOR TRAUMA

Trauma patients are susceptible to the early development of coagulopathy, and the most severely injured patients are coagulopathic on hospital admission (see also Chapter 4). The coagulopathy is worsened by:

- Haemodilution: Dilutional thrombocytopenia is the most common coagulation abnormality in trauma patients.
- Consumption of clotting factors.
- Hypothermia: Causes platelet dysfunction and a reduction in the rate of the enzymatic clotting cascade.
- Acidosis: Metabolic derangements (especially acidosis), which also interfere with the clotting mechanism.

More recently in trauma, the focus has shifted from a disseminated intravascular coagulation (DIC) type coagulopathy without microthrombi, to extensive tissue trauma in combination with reduced perfusion in which the endothelium shows an increased expression of thrombomodulin, thus binding thrombin.

With the reduced levels of thrombin there is a reduced production of fibrin. The thrombin-thrombomodulin complex activates protein C (aPC). The aPC inactivates co-factors V and VIII, causing anticoagulation. The aPC also inactivates the

plasminogen activator inhibitor type 1 (PAI-1), increasing fibrinolysis. The thrombin-thrombomodulin complex also binds the thrombin activated fibrinolysis inhibitor (TAFI), reducing the inhibition of fibrinolysis. In trauma-induced coagulopathy, the shifting balance between the binding of protein C and TAFI may be the cause of the different clinical presentations. Long-standing hypotension, acidosis and ischaemia give a release of a tissue plasminogen activator. Together with a reduced liver function, consumption of coagulation factors, activated plasmin and fibrin degradation products, haemostasis is compromised. In addition, platelet survival is short and severe thrombocytopenia is common. There is also a consumptive deficiency of coagulation factors. Excess plasmin generation is reflected by reduced plasma levels of fibrin and elevated levels of fibrinogen degradation products (FDPs), with abnormal concentrations being found in 85 per cent of patients.

5.7.1 MANAGEMENT

The management of diffuse bleeding after trauma relies on haemorrhage control, active re-warming and replacement of blood products. The empirical transfusion of platelets, fresh frozen plasma and cryoprecipitate is recommended in patients with major injuries (i.e. the damage control group).

Clinically, it is difficult to identify DIC as a separate entity from the coagulopathy of major trauma described above. The distinction is, however, largely academic; the key step in the management of DIC is resolution of the condition predisposing to the coagulopathy. The condition will not resolve until the underlying cause has been corrected; while this is being achieved, component therapy is indicated. Currently, a ratio of 1:1:1 for RBC:FFP:platelets is considered most appropriate as similar to the blood being lost. In addition, tranexamic acid may have a major role in clot stabilization and reversal of the coagulopathy if given early within 3 hours of injury. Despite the increased use of tranexamic acid, the gathering and validity of the data have been called into question in a major trauma centre environment. In addition, a recent study indicated that the majority of severely injured patients have a fibrinolysis shutdown, and therefore, tranexamic acid may have no effect.

5.8 RECOGNITION AND TREATMENT OF RAISED INTRACRANIAL PRESSURE

Early mortality in blunt trauma patients in the ICU is often caused by head injury. The primary goal in the ICU management of the patient with a severe head injury is to prevent secondary neuronal injury. One important factor that can contribute to secondary brain injury is increased ICP. Consequently, monitoring and controlling

5 :: CRITICAL CARE OF THE TRAUMA PATIENT

KENNETH D BOFFARD

ICP and cerebral perfusion pressure is a high priority in this phase of ICU care. Other conditions that worsen brain injury include:

- Hypotension.
- Hypoxia.
- Hyperglycaemia.
- Hyperthermia.
- Hypercarbia.

5.9 RECOGNITION OF ACUTE RENAL FAILURE (ARF) AND ACUTE KIDNEY INJURY (AKI)

While the frequency of acute renal failure (ARF) is relatively low due to improved early resuscitation and restoration of perfusion, severely injured patients are still at significant risk for the development of acute kidney injury (AKI) and ARF. Several indicators of physiologic injury severity including the lowest body temperature, the highest lactate level and the need for packed red blood cells and cryoprecipitate transfusion are independently associated with a higher risk for developing ARF. Other factors include tissue damage and necrosis, hypotension, rhabdomyolysis, the use of iodinated contrast for diagnostic tests and pre-existing conditions such as diabetes. The development of ARF complicates the ICU management of a patient, increases the length of stay, and is associated with an increased mortality of approximately 60 per cent. Approximately one-third of acute post-traumatic renal failure cases are caused by inadequate resuscitation, while the remainder develop as part of MODS. To prevent renal insult avoid and/or treat:

- Nephrotoxic contrast dyes and drugs.
- Hypovolaemia.
- Rhabdomyolysis.
- Abdominal compartment syndrome.
- Obstructive uropathy.

There is no indication for a 'renal protective' dopamine strategy in ARF or the initiation of dialysis in myoglobinemia. The use of treatment with diuretics in patients at risk of development of ARF cannot prevent impending ARF but can prolong the interval to dialysis for the treatment of overhydration.

5 :: CRITICAL CARE OF THE TRAUMA PATIENT

KENNETH D BOFFARD

5.10 EVALUATION OF METABOLIC DISTURBANCES

Disturbances in acid-base and electrolyte balance can be anticipated in patients in shock, those who have received massive transfusions and the elderly with co-morbid conditions.

Typical abnormalities may include:

- Acid-base disorders.
- Electrolyte disorders.
  - Hypokalaemia.
  - Hyperkalaemia.
  - Hypocalcaemia.
  - Hypomagnesaemia.
- Hypophosphataemia.

In acid-base disorders acidosis is most commonly due to hypoperfusion with inadequate oxygenation and anaerobic metabolism. One must identify and correct the aetiology of the disturbance, e.g. metabolic acidosis caused by hypoperfusion secondary to occult pericardial tamponade.

5.11 PAIN CONTROL/SEDATION/DELIRIUM

A number of adverse consequences result when pain is inadequately treated. These include increased oxygen consumption, increased minute volume demands, psychic stress, sleep deprivation and impaired lung mechanics with associated pulmonary complications. Subjective pain assessment is best documented objectively and, after initiation of treatment, requires serial re-evaluation. Inadequate pain relief can be determined objectively by the failure of the patient to achieve adequate volumes on incentive spirometry, persistently small radiographic lung volumes or a reluctance to cough and cooperate with chest physiotherapy. If the patient can cooperate, visual analogue pain scores may be helpful.

Early pain control in the ICU is primarily achieved through the use of intravenous opiates. Other techniques are employed and tailored to the individual patient and injury:

- Bolus opiates.
- Morphine or fentanyl titrated intravenously.
- Patient-controlled analgesia (PCA).

- Epidural analgesia (patient-controlled epidural analgesia).
- Intrapleural anaesthesia.
- Extrapleural analgesia.
- Intercostal nerve blocks.
- Catheter techniques for peripheral nerve blocks (e.g. femoral nerve, brachial plexus, popliteal nerve and paravertebral nerve blocks).

A growing body of evidence is advocating the strategy of non-sedation to intubated patients in the ICU. A well-performed randomized control trial (RCT) has shown beneficial effects on length of stay and time in ventilator when adopting this strategy. Whether this strategy can be effectively applied to trauma patients has yet to be shown.

Delirium is a recognized complication in patients in the ICE. A breakdown of treatment strategies is beyond the scope of this chapter, but identification of causative factors, re-establishing day/night rhythm and medicamental strategies should be attempted.

5.12 FAMILY CONTACT AND SUPPORT

It is very important to establish early contact, and maintain ongoing relationships with family members in an open, honest, clear and completely transparent manner, by using simple language that is understandable when describing to explain the injuries, clinical condition and prognosis of the patient. This provides family members with essential information and establishes a relationship between the ICU care team and the family. Administrative facts, such as ICU procedures, visiting hours and available services, should also be explained. With the elderly, identifying the existence of living wills or other pre-determination documents is important. Patients and their families should be familiar with the multidisciplinary approach to patient care in the ICU as well.

5.13 ICU TERTIARY SURVEY

The tertiary survey is a complete re-examination of the patient, plus a review of the history and all available results and imaging. Missed injuries are a potent cause of morbidity, and the majority will be identified by a thorough tertiary survey. A tertiary trauma survey has much to recommend it in minimizing the delay in the ultimate diagnosis of missed injury. Nevertheless, it is not a complete solution, and an ongoing analysis of errors should be undertaken at any major trauma centre.

5 :: CRITICAL CARE OF THE TRAUMA PATIENT

KENNETH D BOFFARD

5.13.1 EVALUATION FOR OCCULT INJURIES

Factors predisposing to missed injuries:

- Mechanism of injury – re-verify the events surrounding the injury.

High-priority occult injuries:

- Brain, spinal cord and peripheral nerve injury.
- Thoracic aortic injury.
- Intra-abdominal or pelvic injury.
- Vascular injuries to the extremities.
- Cerebrovascular injuries – occult carotid/vertebral artery injury.
- Cardiac injuries.
- Aerodigestive tract injuries – ruptured bowel.
- Occult pneumothorax.
- Compartment syndrome – foreleg, thigh, buttock or arm.
- Eye injuries (remember to remove the patient's contact lenses).
- Other occult injuries – hands, feet, digits or joint dislocations.
- Vaginal tampons.

5.13.2 ASSESS CO-MORBID CONDITIONS

- Medical history (including drugs and alcohol).
- Contact the patient's personal physicians.
- Check pharmacy records.

5.14 NUTRITIONAL SUPPORT

5.14.1 OVERVIEW

Trauma patients are hypermetabolic and have increased nutritional needs due to the immunological response to trauma and the requirement for accelerated protein synthesis for wound healing. Early enteral feeding has been shown to reduce post-operative septic morbidity after trauma. A meta-analysis of a number of randomized trials demonstrated a twofold decrease in infectious complications in patients treated

5 :: CRITICAL CARE OF THE TRAUMA PATIENT

KENNETH D BOFFARD

with early enteral nutrition compared to total parenteral nutrition which actually increases risk of complication compared to no supplemental enteral nutrition for up to 7 days post-injury.

Nutrition support for critically ill and injured patients has undergone significant advances in recent decades – the direct result of scientific progress and our increased knowledge of the biology and biochemistry of key nutrient changes induced by injury, sepsis and other critical illnesses, both in adults and in children. The science of nutrition support (or, more accurately, of nutrition therapy) has become more disease based. Also called 'specialized' or 'artificial' nutrition support, nutrition therapy refers to the provision of either enteral nutrition (EN) via tube feeding or total parenteral nutrition (TPN). In contrast, 'standard therapy' refers to a patient's own volitional intake, without the provision of nutrition therapy.

Depending on the individual patient's metabolic needs, nutrition therapy helps ensure that key nutrient substrates are replenished, or added in larger amounts, to supplement specific deficiencies or to simply prevent further deterioration and clinical consequences. The benefit of early institution of either EN or TPN in the overall care of critically ill and injured patients has now been well established. After a critical illness or injury, the patient's energy and overall metabolic requirements greatly increase, in order to sustain increased metabolism and the process of wound repair.

The pre-admission nutritional status of patients is a critical factor. If patients are malnourished or have a limited nutritional reserve, their outcome is poorer. Having a low body mass index (BMI) is an independent predictor of increased mortality and of multiple organ failure. Thermal injuries, severe central nervous system (CNS) insult, sepsis and certain co-morbidities, such as cancer, chronic obstructive pulmonary disease (COPD), alcoholism and heart disease, produce added metabolic challenges and complications. Such conditions exacerbate energy expenditure and protein catabolism brought on by severe injury and critical illness, thereby evoking variation even among patients with the same disease process. It is imperative to evaluate the nutritional status of patients upon admission.

Patients with traumatic brain injury (TBI) appear to have similar outcomes whether fed enterally or parenterally. A Cochrane review has confirmed that early (either parenteral or enteral) feeding is associated with a trend toward better outcomes in terms of survival and disability compared with later feeding. Patients with a TBI exhibit protein wasting and gastrointestinal dysfunction, which may be risk factors for

a septic state. However, standard nutritional support may not allow restoration of the nutritional state of TBI patients.

To prevent malnutrition and related adverse effects, all ICU patients who are not expected to be on a full oral diet within 3 days should receive EN. Accordingly, EN is recommended as the first choice for nutrition therapy in ICU patients; however, in critically ill patients on nutrition therapy, there is a large discrepancy in the frequency of use of EN.

The American Society for Parenteral and Enteral Nutrition (ASPEN) Board of Directors and the American College of Critical Care Medicine Guidelines Committee expressed concern that continuing to provide standard therapy (that is, no nutrition therapy) beyond 7 days would lead to deterioration of the patient's nutritional status and would have an adverse effect on clinical outcome. If EN cannot be provided and if the patient has evidence of protein–calorie malnutrition (usually defined by recent weight loss of 10–15 per cent or by an actual body weight <90 per cent of the ideal body weight), then the use of TPN is mandatory. The use of TPN (versus standard therapy) in malnourished ICU patients is associated with a significantly lower rate of overall complications. Yet, the best timing for the initiation of TPN in ICU patients has not been demonstrated. On the other hand, the European Society of Parenteral and Enteral Nutrition (ESPEN) and the Canadian Society for Nutritional Sciences (CSCN) both recommend early EN initiation after ICU admission (within 24 h, per ESPEN; within 24–48 h, per CSCN). It seems reasonable to assume that all patients who are not expected to be on normal nutrition within 2–3 days after ICU admission should receive TPN, if EN is contraindicated or not tolerated. No significant differences in clinical outcome have been shown between EN versus TPN in ICU patients.

Enteral nutrition should be used when the gut is accessible and functioning. Enteral nutrition is not invariably safer and better than parenteral nutrition, but a mix of the two modalities can be used safely. 'Immunonutrition' holds promise for the future.

Patients at risk include those with:

- Major trauma.
- Traumatic brain injury (TBI).
- Burns.
- Sepsis.

5 :: CRITICAL CARE OF THE TRAUMA PATIENT

KENNETH D BOFFARD

It is critical to:

- Determine energy and protein requirements.
- Determine and establish a route of administration.
- Set a time to begin nutrition support.

5.14.2 CHOOSING NUTRITIONAL FORMULA

In critically ill and injured patients, immune-modulating or immune-enhancing enteral formulations that are supplemented with agents such as arginine, glutamine, nucleic acid, omega-three fatty acids and antioxidants should be used, depending on their clinical condition. Patients with acute lung injury (ALI) or acute respiratory distress syndrome (ARDS) should be on an enteral formulation characterized by an anti-inflammatory lipid profile (that is, omega-3 fish oil, borage oil) and antioxidants. Furthermore, nutritional therapy must be tailored to the individual patient's disease or disorder and unique metabolic changes. The seemingly logical strategy would be to replace deficiencies of key nutrients (such as amino acids, proteins, vitamins, minerals and trace elements) in the dose required. Early oral feeding (enteral, and/or parenteral) is most conducive to helping prevent cellular injury and clinical consequences, but, given so many complicating factors, many immune-enhancing and immune-modulating formulas have been developed for use in critically ill and injured patients.

Although it is difficult to demonstrate the precise impact of nutrition therapy, and in particular the individual effects of certain nutrients, enteral formulas fortified with immune-enhancing substrates have been associated with a significant reduction in the risk of infectious complications and a reduction in overall hospital stay. Certain nutrients can modulate inflammatory, metabolic, and immune processes. Amino acids such as arginine and glutamine improve body defenses and tumour cell metabolism, increase wound healing and reduce nitrogen loss. Also, RNA and omega-3 fatty acids modulate immune function.

5.14.3 INITIATION FOR ENTERAL OR PARENTERAL NUTRITION

Enteral feeding should be started early, within the first 24–48 hours after admission if possible, but patients should be resuscitated and hemodynamically stable. Then, over the next 48–72 hours, the feedings should be advanced toward the nutrition goal for the individual patient. In the ICU patient population, the initiation of enteral feeding does not require either the presence or the absence of bowel sounds, and it does not require any evidence of passage of flatus and stool. In the setting of hemodynamic

compromise (that is, when significant hemodynamic support is required to maintain cellular perfusion, including high-dose catecholamine agents, alone or in combination with large-volume fluid or blood product resuscitation), EN should be withheld until the patient is fully resuscitated and/or stable.

Either gastric or small-bowel feedings are acceptable in ICU patients. If critically ill patients are at high risk for aspiration or if they are intolerant to gastric feeding, they should be fed via an enteral access tube placed in the small bowel. The need to withhold enteral feedings because of repeated high gastric residual volumes may be a sufficient reason to switch to small-bowel feedings.

Early nutrition therapy via TPN has the potential to reduce disease severity, diminish complications and decrease the ICU length of stay, when EN is not possible, by providing ongoing requirements for calories, protein, electrolytes, vitamins, minerals, trace elements and fluids. The major indication for TPN is failure of the gastrointestinal (GI) tract. In general, TPN should be started when the GI tract cannot be used for more than 5 days in patients in a catabolic state (with or without evidence of malnutrition), or when patients cannot be fed for 3 days after major surgery. The underlying clinical conditions include short gut syndrome, severe gut dysfunction, mesenteric vascular insufficiency, bowel obstruction, GI bleeding, severe diarrhea, large volume fistulas, sepsis, severe burns and trauma associated with continuous hemodynamic instability and with severe fulminant acute and chronic pancreatitis. In many of these patient subgroups, TPN is life-saving.

5.14.4 GUT ACCESS FOR ENTERAL NUTRITION

5.14.4.1 SIMPLE

- Nasogastric tube.
- Nasoduodenal tube.
- Nasojejunal tube.

Most critically ill trauma patients should be started on early enteral nutrition. The majority do not require prolonged feeding (beyond 10–14 days), and simple nasoenteric tube feeding is then all that is required. For patients who have prolonged tube-feeding requirements, nasoenteric tubes are inconvenient, as they tend to dislodge, worsen aspiration and are uncomfortable.

5.14.4.2 MORE COMPLICATED

- *Percutaneous endoscopic gastrostomy*. This does not interfere with swallowing, is easy to nurse and has target feeding rates that are more likely to be achieved compared with nasoenteric tubes. However, it is an invasive procedure with some risk.
- *Jejunostomy*. Jejunostomy can be placed endoscopically or during laparotomy. Rates of major complications should be less than 5 per cent.

5.15 PREVENTIVE MEASURES IN THE ICU

5.15.1 STRESS ULCERATION

Stress ulceration and associated upper GI bleeding has been on the decline in most ICUs for the past decade. This is, in great part, due to the improved resuscitation efforts in the prehospital environment, emergency department and operating room. Additionally, the use of acid-blocking and cytoprotective therapies has become commonplace.

Those patients at greatest risk for stress ulcer development are those with a previous history of ulcer disease, those requiring mechanical ventilation and those with a coagulopathy, regardless of whether it is intrinsic or chemically induced. Burn patients have also been labelled as high risk in historical studies.

Cytoprotective agents (e.g. sucralfate) as a preventive measure have been shown to be the most cost-effective by statistical analysis in several trials, although there are fewer cases of stress ulcer bleeding in the H_2-receptor blockade arm of these trials. However, the marked decrease in the rate of development of ventilator-associated pneumonia seen in the sucralfate population does make this therapeutic option quite attractive.

Intravenous H_2-receptor blockade therapy (e.g. ranitidine) to some degree blocks the production of stomach acid. Most studies demonstrating its efficacy in stress ulcer prevention do not attempt to neutralize gastric pH. Newer intravenous proton pump inhibitors may well replace H_2 blockade as the mainstay of therapy.

Perhaps the simplest and safest method of stress ulcer prevention is adequate resuscitation and early intragastric enteric nutrition. During the early resuscitative phase and while vasoactive drugs to elevate blood pressure are in use, it is not always prudent to provide nutrition enterally. It is in these circumstances that the use of acid blockade, cytoprotective agents or both is necessary.

5 :: CRITICAL CARE OF THE TRAUMA PATIENT

KENNETH D BOFFARD

5.15.2 DEEP VENOUS THROMBOSIS AND PULMONARY EMBOLUS

Pulmonary embolus (PE) from DVT continues to be a leading preventable cause of death in the injured patient. Recognizing the risk factors for the development of DVT and instituting an aggressive management regimen can reduce this risk from DVT in the ICU with little added morbidity. The incidence of DVT in trauma patients is 12–32 per cent and those at highest risk of fatal PE include those with spinal cord injuries, weight-bearing pelvic fracture and combined long bone fracture/TBI or long bone fracture/pelvic fracture.

A high index of suspicion in these severely injured patients should result in preventative therapy and diagnostic screening measures to be taken in the ICU. Unless haemorrhagic TBI or spinal cord epidural haematoma precludes the use of subcutaneous heparin therapy, these patients should all receive fractionated low-molecular weight subcutaneous heparin. Unfractionated heparin does not appear to be nearly as effective in this severely injured population. Similarly, unless extremity injury precludes their use, graded pneumatic compression devices should be used on all such patients. Foot pumps may also be of some benefit.

5.15.3 INFECTION

In patients with any open wounds from trauma, it is imperative that the tetanus immunization status of the patient is addressed. For those patients immunized within the previous 5 years, no additional treatment is generally needed, while booster tetanus toxoid should be administered to those who have previously received the initial tetanus series but have not been re-immunized in the preceding 5–10 years. Tetanus immune globulin should be administered to those patients who lack any history of immunization.

Patients undergoing splenectomy require immunization for *Haemophilus influenzae* type B, meningococcus and pneumococcus. Debate continues regarding the timing of administration of these vaccines in trauma patients, but it is clear that adult patients do not benefit from the antibacterial chemoprophylaxis needed in paediatric patients post-splenectomy. Due to the multiple strains of each organism, the immunizations are not foolproof in preventing overwhelming post-splenectomy infection (OPSI). Therefore, patients must be carefully counselled to seek medical attention immediately for high fevers, and healthcare providers must be aggressive in the use of empirical antibiotics in patients who may have OPSI upon presentation in the outpatient setting. Currently, booster immunization with Pneumovac is indicated every 5 years for these splenectomized patients.

5 :: CRITICAL CARE OF THE TRAUMA PATIENT

KENNETH D BOFFARD

Adequate wound debridement and irrigation are necessary to eliminate non-viable tissue and debris from all traumatic wounds, in order to limit infection of these wounds. Whenever possible, these wounds should be thoroughly prepared as above and closed primarily. If skin coverage is lacking, or more than 6 hours has elapsed since injury, moist dressings (to prevent tissue desiccation and further non-viable wound tissue) should be applied and changed twice per day, further wound debridement performed as indicated and skin grafts or flap coverage performed once the health of the wound can be assured. Special attention must be given to difficult wounds of the perineum consider faecal diversion), complex fractures with soft tissue injury and contamination (osteomyelitis) and wounds on the back and occiput (as pressure may cause additional wound necrosis).

Thrombophlebitis and sepsis from intravenous cannulae are significant considerations as these intravenous lines are frequently placed under less than optimal circumstances and technique in the field and in the resuscitation areas. Removal and replacement of all such lines as early as possible, but in every instance in less than 24 hours, is paramount to avoid these infectious complications.

5.16 ANTIBIOTICS

The goal of antibiotic treatment is to improve survival; however, preventing the emergence of antibiotic resistance is also important.

There is good evidence to support the limited use of antibiotics in the critically ill trauma patient. Many institutions will administer a single dose of a cephalosporin in the emergency area in all patients with open injury, irrespective of its origin. There is no evidence to support this unless surgical operation is required. There is conflicting evidence regarding the need for routine antibiotics with tube thoracostomy.

For thoracoabdominal injuries requiring operation, a single dose of broad-spectrum antibiotics is indicated. Prolonged courses of antibiotics, extending beyond 24 hours, are not currently indicated in these patients.

Patients with open fractures are frequently treated with both Gram-negative and Gram-positive prophylaxis for long periods. There is no evidence for this practice or for whether the correct management should be any different from that for torso injury.

Patients in the ICU on mechanical ventilation, with or without known aspiration, have no indication for antibiotics to prevent pneumonia. In fact, this practice has hastened the onset of antibiotic resistance worldwide.

5 :: CRITICAL CARE OF THE TRAUMA PATIENT

KENNETH D BOFFARD

According to the Centers for Disease Control and Prevention, a diagnosis of pneumonia must meet the following criteria:

- Rales or dullness to percussion *and* any of the following:
  - New purulent sputum or a change in sputum.
  - Culture growth of an organism from blood or tracheal aspirate, bronchial brushing or biopsy.
- Radiographic evidence of new or progressive infiltrate, consolidation, cavitation or effusion, and any of the following:
  - Isolation of virus or detection of viral antigen in respiratory secretions.
  - Diagnostic antibody titres for pathogen.
  - Histopathological evidence of pneumonia.

For ventilator-associated pneumonia (VAP) there are new guidelines.

5.16.1 VENTILATOR-ASSOCIATED PNEUMONIA (VAP) DIAGNOSIS

Ventilator-associated pneumonia (VAP) diagnosis interventions considered most appropriate for inclusion in the care bundle are as follows:

- Early chest X-ray with expert interpretation within 1 hour.
- Immediate reporting of respiratory secretions and Gram-stain findings, including cells.

5.16.2 VAP TREATMENT

VAP treatment interventions considered most appropriate for inclusion in the care bundle are as follows:

- Immediate treatment after microbiological sampling.
- Empirical therapy based on a knowledge of local pathogens and an assessment of risk factors.
- De-escalation of antibiotics in responding patients once culture results are available.
- Assessment of response to treatment within 72 hours.
- Short-therapy duration (8 days) if the patient is on an appropriate regimen and not infected by a multidrug-resistant pathogen.

5 :: CRITICAL CARE OF THE TRAUMA PATIENT

KENNETH D BOFFARD

Given the variations in antibiotic susceptibility profiles of VAP pathogens, both in location and with respect to changes over time, it is inappropriate to specify the use of specific antibiotic regimens.

5.17 RESPIRATORY SUPPORT

- Mechanical ventilation should be 'gentle' as high tidal volumes and pressures can damage the lungs.
- Aspiration must be prevented.
- Early tracheostomy should be undertaken.
- Pulmonary toilet and pain control should be used in patients with rib fractures.
- Lung protective ventilation (LPV) with low volume, low peak pressures and high PEEP should be used for significant or progressive hypoxia of ARDS.
- Prone ventilation may improve oxygenation in patients with ARDS or severe sepsis.
- VAP is the common hospital-acquired infection in ICU.
- Form early liaison with centres offering extracorporeal membrane oxygenation (ECMO).

5.18 SURVIVING SEPSIS GUIDELINES

Updated *Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock* were published in 2012.

A full summary of the guidelines in table form appears in **Table 5.1**.

Table 5.1 • Summary of Surviving Sepsis Guidelines 2012

A. Initial Resuscitation – Goals

Sepsis-induced hypoperfusion is defined as hypotension persisting after initial fluid challenge or a blood lactate of ≥4 mmol/L.

1. Central venous pressure (CVP) 8–12 mm Hg
2. Mean arterial pressure (MAP) ≥65 mm Hg
3. Urine output ≥0.5 mL/Kg
4. Central venous oxygen saturation ≥70% or arterial saturation ≥90%

B. Screening for Sepsis

1. Cultures should be taken within 45 min of initial diagnosis and *before* initiation of appropriate antibiotic therapy

Table 5.1 (continued)
Summary of Surviving Sepsis Guidelines 2012

C. Diagnosis

1. Cultures as in B above (two samples)
   a. Through intravenous device
   b. Percutaneous
2. Identify source through imaging studies
3. Draw procalcitonin level (PCT) – preferable to CRP

D. Antimicrobial Therapy

1. Initiate empiric therapy to provide antimicrobial activity against the most likely pathogens, based on the illness, and local patterns of antibiotic surveillance.
2. Administration should occur within the first hour following recognition of sepsis, with or without septic shock.
3. Empiric therapy should not be administered for more than 3 days. Antibiotic regimen should be assessed daily, for de-escalation.
4. Duration of therapy should be 7–10 days, and antibiotics should be discontinued based on low procalcitonin, taken at days 3, 5, 7 or 10.
5. Antibiotic therapy should ideally consist of an extended spectrum beta lactam, and a fluoroquinolone (for *Pseudomonas*) or a macrolide (for *Streptococcus* or *Klebsiella*).

E. Source Control

1. A specific anatomical diagnosis for the source should be sought and intervention taken for source control within 12 h after diagnosis.
2. If intravascular devices are identified as a possible source, they should be removed as soon as possible after new access has been established.

F. Infection Prevention

1. Selective oral decontamination using oral chlorhexidine gluconate should be used throughout, to reduce the risk of ventilator-associated pneumonia.

G. Fluid Therapy

1. Crystalloid is the initial fluid of choice.
2. An initial fluid challenge of 30 mL/kg of crystalloid is suggested.
3. Fluid challenge techniques should be applied as long as there is haemodynamic improvement and there is improvement in the variables.

H. Vasopressors

1. Vasopressor therapy can be used to achieve a minimum MAP of 65 mm.
2. Adrenaline is to be used as the agent of first choice. (Noradrenaline is not available.)
3. Vasopressin (DDAVP) should only be used in selected circumstances.
4. Dopamine is *only* recommended in highly selected patients (e.g. patients with a low risk of tachyarrhythmias and absolute or relative bradycardia).
5. Phenylephrine is not recommended except in the presence of serious arrhythmias, cardiac output is known to be high and blood pressure is consistently low, and where other measures have failed.
6. Low-dose dopamine should not be used for renal protection.
7. All patients on vasopressors should have an arterial line placed.

Table 5.1 (continued)
Summary of Surviving Sepsis Guidelines 2012

I. Inotropes

1. A trial of dobutamine infusion up to 20 μgm/kg/min may be administered in the presence of:
   a. Myocardial dysfunction (elevated cardiac filling pressures and low cardiac output)
   b. Ongoing signs of hyperperfusion, despite adequate volume and MAP
2. Do *not* use a strategy to increase cardiac index to supranormal levels

J. Corticosteroids

1. Steroids should not be administered for the treatment of sepsis in the *absence* of shock.
2. Do *not* use intravenous hydrocortisone to treat adult septic shock patients if adequate fluid resuscitation and vasopressor therapy are able to restore haemodynamic stability.
3. If this is *not* achievable, add hydrocortisone at a dose of 200 mg/day, preferably by infusion.
4. In treated patients, hydrocortisone should be tapered when vasopressors are no longer required.
5. When cortisone is given, use continuous flow.

K. Blood Product Administration

1. Once tissue hypoperfusion has been resolved, and in the absence of extenuating circumstances (e.g. active haemorrhage, myocardial ischaemia), transfusion should *only* take place if the haemoglobin is <7 Gm/dL, to achieve a target of 7–9 Gm/dL.
2. Fresh frozen plasma (FFP) should *not* be used to correct clotting abnormalities in the absence of active bleeding or planned invasive procedures.
3. Use TEG or ROTEM goal-directed maintenance of coagulation parameters.
4. In patients with severe sepsis, administer platelets:
   a. In the absence of bleeding *only* when counts are <10 000 mm3
   b. If risk of bleeding, administer platelets when count is >20 000 mm3
   c. If actively bleeding, administer platelets for a minimum of >50 000 mm3

L. Immunoglobulin Administration

1. Immunoglobulins should *not* be administered.

M. Mechanical Ventilation of Sepsis-induced ARDS (See protocol – page 87)

1. Tidal volume of 6 mL/kg based on predicted body weight.
2. Plateau pressures to be less than 30 cm H_2O.
3. PEEP should be routine, using a higher level of PEEP (8–12 cm H_2O).
4. Recruitment can be used in patients with sepsis with severe hypoxaemia.
5. Prone positioning should be used when PaO2/FiO2 ratio is <100.
6. Mechanical ventilation should mandate a 'head-up' position of >30°.
7. Non-invasive mask ventilation should be considered where the benefits exceed the risks.
8. A weaning protocol should be in place and mechanically ventilated patients should undergo spontaneous breathing trials regularly to evaluate weaning potential.
   The patient *must* satisfy the following criteria:
   a. The patient must be arousable.
   b. The patient must be haemodynamically stable without vasopressors.
   c. There may be no new potentially serious conditions.
   d. There are low ventilatory requirements.

Table 5.1 (continued)
Summary of Surviving Sepsis Guidelines 2012

i. PEEP <8 cm H_2O

ii. Pressure support <10 cm H_2O

iii Rate <8 b.p.m.

e Low FiO2 requirements (≤0.4) which can safely be delivered by face mask.

f. Extubate when successful and safe.

N. Sedation and Neuromuscular Blockade

1. Continuous (and even intermittent) sedation should be minimized.
2. Neuromuscular blocking agents (NMBAs) should be avoided in the septic patients *without* ARDS.
3. If required, intermittent bolus administration of NMBA should be used.
4. A *short* course only (<48 hours) of NMBA should be used with ARDS.

O. Glucose Control (See glucose protocol)

1. A protocol-based approach to blood glucose management is required.

P. Bicarbonate Therapy

1. Do *not* use sodium bicarbonate therapy for the purpose of improving haemodynamics or reducing vasopressor requirements with low pH.

Q. Deep Vein Thrombosis Prophylaxis

1. Patients should receive daily pharmacoprophylaxis against thrombo-embolism (VTE) with low-molecular-weight heparin (LMWH).
2. Patients should be treated with LMWH and intermittent compression devices.

R. Stress Ulcer Prophylaxis

1. Patients with no risk factors need no prophylaxis.
2. Trauma patients should receive sucralfate.
3. High-risk patients with bleeding risk should receive protein pump inhibitors.

S. Nutrition (See feeding protocol)

1. Administer enteral feeds within 48 h.
2. Avoid full mandatory caloric feeding during the first week or on inotropes.
3. Use nutrition with *no* immuno-modulation supplementation in severe sepsis.

5.19 ABDOMINAL COMPARTMENT SYNDROME (ACS)

5.19.1 INTRODUCTION

Raised intra-abdominal pressure (IAP) has far-reaching consequences for the physiology of the patient. There have been major developments in our understanding of IAP and intra-abdominal hypertension (IAH). The syndrome that results when organs fail as a result is known as 'abdominal compartment syndrome'. Increasingly, it is being recognized that ACS is not uncommon in trauma patients, and failure to consider its prevention, detect it in a timely fashion and treat it aggressively results in a high mortality.

5.19.2 DEFINITION OF ACS

The first World Congress on ACS was held in 2004. An internal consensus agreement relating to definitions, updated in 2013, is shown in **Table 5.2**. Various aspects were defined, including IAP (Definition 1), abdominal perfusion pressure (APP) (Definition 2) and IAH (Definitions 7 and 8).

Table 5.2 • Consensus definitions relation to intra-abdominal pressure (IAP), intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS) (Updated 2013 consensus)

Definition 1	Intra-abdominal pressure (IAP) is the steady state pressure concealed within the abdominal cavity
Definition 2	The reference standard for intermittent IAP measurements is via the bladder with a maximal instillation volume of 25mL of sterile saline
Definition 3	IAP should be expressed in mm Hg and measured at end-expiration in the complete supine position after ensuring that abdominal muscle contractions are absent and with the transducer zeroed at the level of the mid-axillary line
Definition 4	Normal IAP is approximately 5–7 mm Hg in critically ill adults
Definition 5	IAH is defined by a sustained or repeated pathological elevation of IAP > 12 mm Hg
Definition 6	ACS is defined as a sustained IAP ≥ 20 mm Hg (with or without an APP < 60 mm Hg) that is associated with new organ dysfunction/failure
Definition 7	IAH is graded as follows: Grade I: IAP 12–15 mm Hg Grade II: IAP 16–20 mm Hg Grade III: IAP 21–25 mm Hg Grade IV: IAP > 25 mm Hg
Definition 8	Primary IAH or ACS is a condition associated with injury or disease in the abdominopelvic region that frequently requires early surgical or interventional radiological intervention
Definition 9	Secondary IAH or ACS refers to conditions that do not originate from the abdominopelvic region Abdominal perfusion pressure (APP) = Mean arterial pressure (MAP) – IAP
Definition 10	Recurrent IAH or ACS refers to the condition in which ACS redevelops following previous surgical or medical treatment of primary or secondary IAH or ACS
Definition 11	Abdominal Perfusion Pressure (APP) = Mean Arterial Pressure (MAP – Intra Abdominal Pressure (IAP)
Definition 12	A polycompartment syndrome is a condition where two or more anatomical compartments have elevated compartmental pressuresv
Definition 13	Abdominal compliance is a measure of the ease of abdominal expansion, which is determined by the elasticity of the abdominal wall and diaphragm. It should be expressed as the change in intra-abdominal volume per change in IAP
Definition 14	The open abdomen is one that requires a temporary abdominal closure due to the skin and fascia not being closed after laparotomy
Definition 15	Lateralization of the abdominal wall is the phenomenon where the musculature and fascia of the abdominal wall, most exemplified by the rectus abdominus muscles and their enveloping fascia, move laterally away from the midline with time

Specifically, ACS is defined as a sustained IAP of 20 mm Hg or more (with or without an APP <60 mm Hg) that is associated with new organ dysfunction/failure (Definition 9). The ACS is also classified as follows:

- Primary ACS (Definition 10) – ACS that develops due to conditions associated with injury or illness in the abdominopelvic region. This includes conditions requiring emergency surgical or angioradiological intervention (including damage control laparotomy, bleeding pelvic fractures, massive retroperitoneal haematomas and failed non-operative management of solid organ injuries, and following disease processes such as severe acute pancreatitis.
- Secondary ACS (Definition 11) – ACS that develops from causes originating outside the abdomen, such as sepsis, capillary leak, major burns and overenthusiastic fluid resuscitation.
- Recurrent ACS (Definition 12) – ACS that develops following initially successful surgical or medical treatment of either primary or secondary ACS, or following the closure of a previously performed decompressive laparotomy.

5.19.3 PATHOPHYSIOLOGY

The incidence of IAH in post-operative trauma patients ranges from 20 per cent to 50 per cent. It is common after many forms of emergency surgery. The causes of acutely increased IAP are usually multifactorial and are shown in **Table 5.3**. Raised IAP occurs commonly with overenthusiastic fluid resuscitation. In addition to the direct causes shown in **Table 5.3**, hypothermia, acidosis and overall injury severity will further exacerbate the problem.

5.19.4 CAUSES OF RAISED IAP

See **Table 5.3**.

5.19.5 EFFECT OF RAISED IAP ON INDIVIDUAL ORGAN FUNCTION

5.19.5.1 RENAL

In 1945, Bradley and Bradley, in a study of 17 volunteers, demonstrated that there was a reduction in renal plasma flow and glomerular filtration rate in association with increased IAP. In 1982, Harman et al. showed that as IAP increased from 0 to 20 mm Hg in dogs, the glomerular filtration rate decreased by 25 per cent. At 40 mm Hg, the dogs were resuscitated, and their cardiac output returned to normal. However, their glomerular filtration rate and renal blood flow did not improve, indicating a local effect on renal blood flow. The situation in seriously ill patients may,

however, be different, and the exact cause of renal dysfunction in the ICU is not clear owing to the complexity of critically ill patients.

The most likely direct effect of increased IAP is an increase in the renal vascular resistance, coupled with a moderate reduction in cardiac output. Pressure on the ureter has been ruled out as a cause, as investigators have placed ureteric stents with no improvement in function. Other factors that may contribute to renal dysfunction include humeral factors and intraparenchymal renal pressures.

The absolute value of IAP that is required to cause renal impairment is probably in the region of 15 mm Hg. Maintaining adequate cardiovascular filling pressures in the presence of increased IAP also seems to be important.

5.19.5.2 CARDIOVASCULAR

Increased IAP reduces cardiac output as well as increases central venous pressure, systemic vascular resistance, pulmonary artery pressure and pulmonary artery wedge pressure. Cardiac output is affected mainly by a reduction in stroke volume, secondary to a reduction in pre-load and an increase in after-load. This is further aggravated by hypovolaemia. Paradoxically, in the presence of hypovolaemia, an increase in IAP can be temporarily associated with an increase in cardiac output. It has been identified that venous stasis occurs in the legs of patients with abdominal pressures above 12 mm Hg. In addition, recent studies of patients undergoing laparoscopic cholecystectomy show up to a fourfold increase in renin and aldosterone levels.

Table 14.3 Causes of Raised Intra-abdominal Pressure

Massive resuscitation
Major intra-abdominal and retroperitoneal haemorrhage
Tissue oedema secondary to insults such as ischaemia and sepsis
Paralytic ileus
Ascites

5.19.5.3 RESPIRATORY

In association with increased IAP, there is diaphragmatic stenting, exerting a restrictive effect on the lungs, with a reduction in ventilation, decreased lung compliance, an increase in airway pressures and a reduction in tidal volumes.

In critically ill ventilated patients, the effect on the respiratory system can be significant, resulting in reduced lung volumes, impaired gas exchange and high ventilatory

pressures. Hypercarbia can occur, and the resulting acidosis can be exacerbated by simultaneous cardiovascular depression as a result of raised IAP. The effects of raised IAP on the respiratory system in ICU can sometimes be life-threatening, requiring urgent abdominal decompression. Patients with true ACS undergoing abdominal decompression demonstrate a remarkable change in their intraoperative vital signs.

5.19.5.4 VISCERAL PERFUSION

Interest in visceral perfusion has increased with the popularization of gastric tonometry, and there is an association between IAP and visceral perfusion as measured by gastric pH. This has recently been confirmed in 18 patients undergoing laparoscopy in whom a reduction of between 11 per cent and 54 per cent in blood flow was seen in the duodenum and stomach, respectively, at an IAP of 15 mm Hg. Animal studies suggest that the reduction in visceral perfusion is selective, affecting intestinal blood flow before, for example, adrenal blood flow. We have demonstrated, in a study of 73 post-laparotomy patients, that IAP and pH are strongly associated, suggesting that early decreases in visceral perfusion are related to levels of IAP as low as 15 mm Hg.

5.19.5.5 INTRACRANIAL PRESSURE

Raised IAP can have a marked effect on intracranial pathophysiology and cause severe rises in intracranial pressure

5.19.6 MEASUREMENT OF IAP

The gold standard for IAP measurement involves using a urinary catheter. The patient is positioned flat on the bed. A standard Foley catheter is used, with a T-piece bladder pressure device attached between the urinary catheter and the drainage tubing. This piece is then connected to a pressure transducer online to the monitoring system. The pressure transducer is placed in the mid-axillary line and the urinary tubing is clamped. Approximately 50 mL isotonic saline is inserted into the bladder via a three-way stopcock. After zeroing, the pressure on the monitor is recorded.

Increasingly, it is recognized that IAP is not a static condition and should be measured continuously. In addition, whether IAP is measured intermittently or continuously, consideration should be given to abdominal perfusion measurement.

5.19.6.1 MEASUREMENT OF ABDOMINAL PERFUSION PRESSURE (APP)

As with the concept of cerebral perfusion pressure, calculation of the 'abdominal perfusion pressure', which is defined as mean arterial pressure minus IAP, assesses

not only the severity of IAP present but also the adequacy of the patient's abdominal blood flow.

The APP has been studied as a resuscitation endpoint in four clinical trials. These demonstrated statistically significant differences in APP between survivors and non-survivors with IAH/ACS. Cheatham et al., in a retrospective trial of surgical and trauma patients with IAH (mean IAP 22 ± 8 mm Hg), concluded that an APP of greater than 50 mm Hg optimized survival based upon receiver operating characteristic curve analysis. Abdominal perfusion pressure was also superior to global resuscitation endpoints such as arterial pH, base deficit, arterial lactate and hourly urinary output in its ability to predict patient outcome.

Malbrain et al.32–34 in three subsequent trials in mixed medical-surgical patients (mean IAP 10 ± 4 mm Hg) suggested that 60 mm Hg represented an appropriate resuscitation goal. A persistence of IAH and a failure to maintain an APP of 60 mm Hg or more by day 3 following the development of IAH-induced acute renal failure was found to discriminate between survivors and non-survivors.

5.19.6.2 TIPS FOR IAP MEASUREMENT

A strict protocol and staff education on the technique and interpretation of IAP are essential.

Very high pressures (especially unexpected ones) are usually caused by a blocked urinary catheter and should be repeated. The volume of saline instilled into the bladder is not critical but should be less than 50 mL and the same every time. A central venous pressure manometer system can be used, but it is more cumbersome than online monitoring. The size of the urinary catheter does not matter. Elevation of the catheter and measurement of the urine column provide a rough guide and are simple to perform. If the patient is not lying flat, IAP can be measured from the pubic symphysis. Real-time continuous monitoring of IAP is effective and shows trends as well as actual pressures.

5.19.7 TREATMENT

5.19.7.1 PREVENTION

To avoid ACS developing in the first place, in the emergency department, concepts of damage control coupled with adequate pre-hospital information will help identify patients at high risk even before they arrive in the emergency room. Avoiding excessive fluid resuscitation (damage control resuscitation) is an important factor

in reducing the risk of developing subsequent ACS. In patients undergoing damage control laparotomy, it is mandatory to leave the abdomen open to prevent ACS and in anticipation of a second operation.

5.19.7.2 TREATMENT

There are a number of key principles in the management of patients with potential ACS:

- Regular appropriate monitoring of IAP in the ICU.
- Optimization of systemic perfusion, circulating volume and organ function in the patient with IAH grades I and II (i.e. ≤20 mm Hg).
- Institution of specific medical procedures to reduce IAP and the end-organ consequences of IAH/ACS, including diuretics, and removing excess ascites if present by percutaneous puncture.
- In patients with grades III to IV IAH (IAP >20 mm Hg) with evidence of new-onset organ failure not responding to non-operative management, a decompressive laparostomy performed as soon as possible.

The decompressed abdomen should be closed using a low-vacuum sandwich technique.

5.19.7.3 REVERSIBLE FACTORS

The second aspect of management is to correct any reversible cause of ACS, such as intra-abdominal bleeding. Massive retroperitoneal haemorrhage is often associated with a fractured pelvis, and consideration should be given to measures that would control haemorrhage, such as pelvic fixation or vessel embolization. In some cases, severe gaseous distension or acute colonic pseudoobstruction can occur in ICU patients. This may respond to drugs such as neostigmine, but if it is severe, surgical decompression may be necessary. A common cause of a raised IAP in ICU is related to the ileus. There is little that can be actively done in these circumstances apart from optimizing the patient's cardiorespiratory status and serum electrolytes, and inserting a nasogastric tube.

Remember that ACS is often only a symptom of an underlying problem. In a prospective review of 88 postlaparotomy patients, Sugrue et al. found that those with an IAP of 18 mm Hg had an increased odds ratio for intra-abdominal sepsis of 3.9 (95 per cent confidence interval 0.7–22.7). Abdominal evaluation for sepsis is a priority, and this should obviously include a rectal examination as well as investigations such as ultrasound and computed tomography (CT) scanning. Surgery is the obvious mainstay of treatment in patients whose rise in IAP is due to post-operative bleeding.

5 :: CRITICAL CARE OF THE TRAUMA PATIENT

KENNETH D BOFFARD

5.19.8 SURGERY FOR RAISED IAP

As yet, there are few guidelines for exactly when surgical decompression is required in the presence of raised IAP. Some studies have stated that abdominal decompression is the only treatment and that it should be performed early in order to prevent ACS. This is an overstatement and not supported by level l evidence. The indications for abdominal decompression are related to correcting pathophysiological abnormalities as much as to achieving a precise and optimum IAP.

In general, temporary abdominal closure is superior to conventional techniques for dealing with intraabdominal sepsis. Indications for performing temporary abdominal closure include:

- Abdominal decompression.
- When re-exploration is planned.
- To facilitate re-exploration in abdominal sepsis.
- Inability to close the abdomen.
- Prevention of ACS.

A large number of different techniques have been used to facilitate a temporary abdominal closure, including intravenous bags, Velcro, silicone and zips. Whatever technique is used, it is important that effective decompression be achieved with adequate incisions.

5.19.8.1 TIPS FOR SURGICAL DECOMPRESSION FOR RAISED IAP

- There should be early investigation and correction of the cause of raised IAP.
- Ongoing abdominal bleeding with raised IAP requires urgent operative intervention.
- Reduction in urinary output is a late sign of renal impairment. Gastric tonometry may provide earlier information on visceral perfusion.
- Abdominal decompression requires a full-length abdominal incision.
- The surgical dressing should be closed using a sandwich technique using two suction drains placed laterally to facilitate fluid removal from the wound.
- If the abdomen is very tight, pre-closure with a silo should be considered.

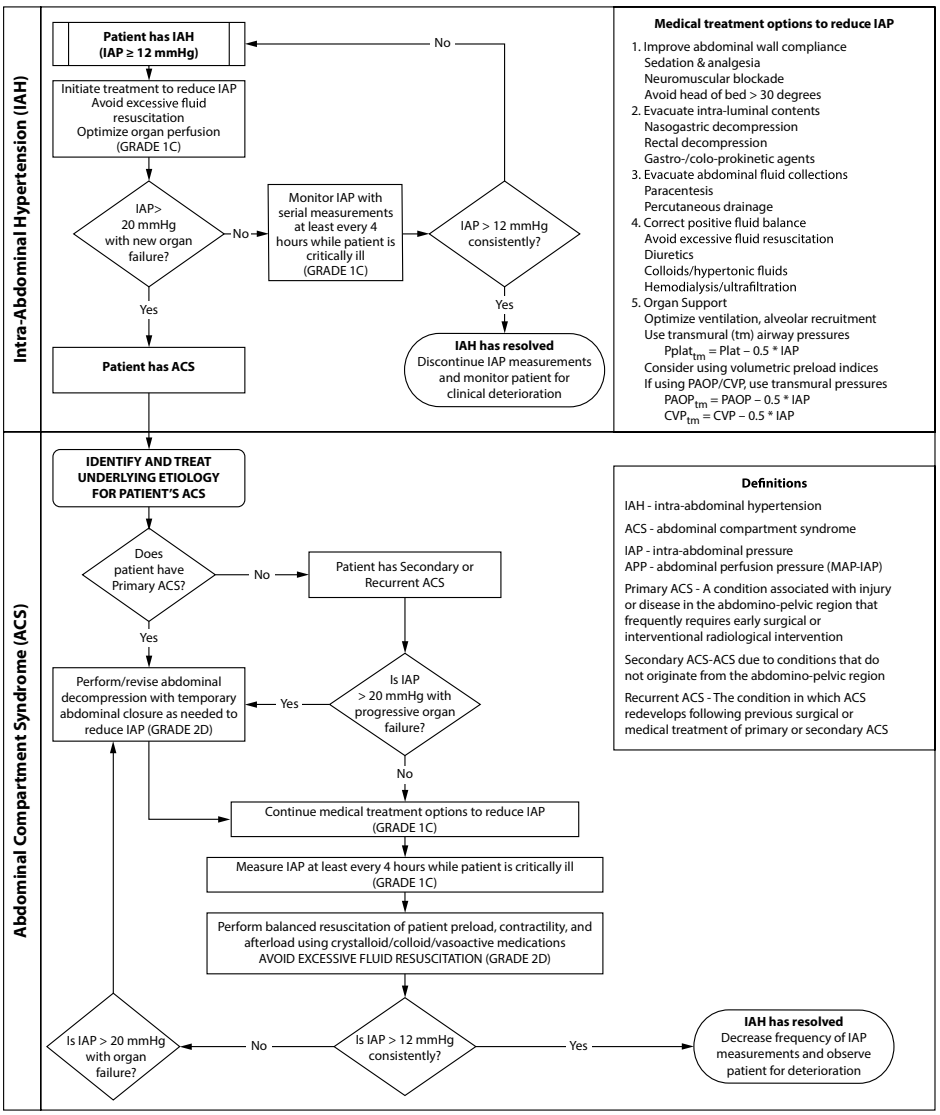
Unfortunately, clinical infection is common in the open abdomen, and the infection is usually polymicrobial. Particular care needs to be taken in patients undergoing post-aortic surgery as the aortic graft may become colonized. The mesh in this situation

should be removed, and the abdomen left open. It is desirable to close the abdominal defect as soon as possible. This is often not possible due to persistent tissue oedema.

5.19.9 MANAGEMENT ALGORITHM

Figure 5.1 outlines an algorithm for the management of IAH and ACS.

Figure 5.1 • Intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS) management algorithm. (Adapted from Intensive Care Medicine 2006;32(11):1722–1732 and 2007;33(6):951–962. © World Society of the Abdominal Compartment Syndrome. All rights reserved.)



5 :: CRITICAL CARE OF THE TRAUMA PATIENT

KENNETH D BOFFARD

5.19.10 WORLD SOCIETY OF THE ABDOMINAL COMPARTMENT SYNDROME

The concept of IAP measurement and its significance is increasingly important in the ICU and is rapidly becoming part of routine care. Patients with raised IAP require close and careful monitoring, aggressive resuscitation and a low index of suspicion for the requirement of surgical abdominal decompression.

The formation of the World Society of the Abdominal Compartment Syndrome (now WSACS – the Abdominal Compartment Society) (http://www.wsacs.org) has been a major advance, with the production of consensus definitions, the formation of a research policy, multicentre trials and the publication of the consensus guidelines on ACS.

5.20 ORGAN DONATION

Identification of potential organ donors from among brain-dead patients is an important role in every critical care department. It is difficult to balance the requirements of the organ transplant teams with a sympathetic and understanding approach to grieving relatives. Specific training is *vital*.