National Institute for Clinical Excellence

Preoperative Tests
The use of routine preoperative tests for elective surgery

NCCAC

EVIDENCE, METHODS & GUIDANCE

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Developed by the National Collaborating Centre for Acute Care

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Contents

Abbreviations and Glossary of Terms

Glossary of Terms

TERM	DEFINITION
Comorbidity	Having two or more diagnosable conditions at the same time.
Preoperative	Before surgery.
Procedure	A surgical procedure, operation or investigation.
Generic (routine) testing	Testing carried out for all patients that is not directly related to the operation planned. For example, carrying out electrocardiography (ECGs) in all patients with minor comorbidity over the age of 75 years would constitute generic testing. However, carrying out a preoperative ECG in patients with minor comorbidity undergoing cardiac surgery would not constitute generic testing, because the test is related to the planned surgery. (Note: we have adopted the word 'generic' because of the ambiguity of the term 'routine' but we acknowledge that this definition may become difficult to apply for patients with comorbidity, when it may be difficult to distinguish whether a test is 'indicated' because of the comorbidity or because of the planned procedure. The guidelines are primarily interested in tests that are appropriate and not appropriate given a patient's comorbidity, severity of comorbidity and planned surgical procedure.)
ASA grades	ASA stands for American Society of Anesthesiologists. ASA grades are a simple scale describing fitness to undergo an anaesthetic. The American Society of Anesthesiologists clearly states that it does not endorse any elaboration of these definitions. However, anaesthetists in the UK often qualify (or interpret) these grades as relating to functional capacity, ie comorbidity that does (ASA grade 3) or that does not (ASA grade 2) limit a patient's activity. Table 2.3 in Chapter Two attempts to characterise signs and symptoms associated with ASA grades 2 and 3. Panellists were asked to use their own interpretation of the ASA grades if they used them habitually and to refer to the table for illustration of the 'kinds of patients' likely to be classified in each category. **ASA grade 1** 'normal healthy patient' ie without any clinically important comorbidity and without a clinically significant past/present medical history **ASA grade 2** 'A patient with mild systemic disease' **ASA grade 3** 'A patient with severe systemic disease'

ASA grade 4 'A patient with severe systemic disease that is a constant threat to life'

ASA grade 5 'A moribund patient who is not expected to survive without the operation'

ASA grade 6 'A declared brain-dead patient whose organs are being removed for donor purposes'

Ref: http://www.asahq.org/clinical/physicalstatus.htm

These definitions appear in each annual edition of the *ASA Relative Value Guide*. There is no additional information that will help you further define these categories.

Elective

Scheduled procedure, ie not an urgent or emergency procedure.

Severity of surgery grades

An operation represents a physiological stress. The magnitude of the physiological stress increases with the 'invasiveness' of the procedure. We have not been able to identify any widely accepted and validated system for classifying the stressfulness of operative procedures. We have therefore adopted a simple graded scale, which we have illustrated with examples.

Grade 1 (minor)	Excision of lesion of skin; drainage of breast abscess
Grade 2 (intermediate)	Primary repair of inguinal hernia; excision of varicose vein(s) of leg; tonsillectomy/adenotonsillectomy; knee arthroscopy
Grade 3 (major)	Total abdominal hysterectomy; endoscopic resection of prostate; lumbar discectomy; thyroidectomy
Grade 4 (major+)	Total joint replacement; lung operations; colonic resection; radical neck dissection; neurosurgery; cardiac surgery

NB: In Phase A of the consensus process neurosurgery and cardiac surgery were considered as separate surgical categories. However, in Phase B, these categories of surgery were combined in Grade 4 as shown.

A more extensive list is shown in Appendix 2, CD ROM.

Type of anaesthetic

We have assumed that the type of anaesthetic used for a procedure does not influence decisions about whether generic preoperative tests should be carried out. The reason for this assumption is that an anaesthetist always has to be ready to use a general anaesthetic in the event of a complication when using a regional anaesthetic.

Costs of tests

The decision to implement generic preoperative testing may be influenced by the cost or cost-effectiveness of tests, eg the cost per major complication or death avoided by preoperative testing. We do not have high quality estimates of the number of serious events avoided by different tests. We have, however, been able to calculate the approximate costs of the tests (lower, mid and upper estimates) and these are reported in Appendix 5, CD ROM.

Non-northern European ethnicity

The consensus questionnaire includes questions about the appropriateness of sickle cell testing in different ethnic populations. The descriptions chosen are intended to represent all of the main ethnic groups. Separate questions address the issue of how to determine ethnicity and what factors, in practice, prompt testing for sickle cell disease/trait.

Reference range

The range of test results considered to be normal.

Phase A and Phase B	The population of interest was split into two phases: **Phase A:** all uncomplicated, ASA grade 1 children or adults, undertaking elective surgery. **Phase B:** all adult patients with comorbidity (cardiovascular, respiratory or renal) ASA grade 2 and 3, undertaking elective surgery.

Abbreviations

APTT	Activated Partial Thromboplastin Time
ASA	American Society of Anesthesiologists
CENTRAL/CCTR	CENTRAL is an all-inclusive centralised database that registers all trials or possible trials. The Cochrane Controlled Trials Register (CCTR) is a clean version of CENTRAL, where trials have been checked for quality and duplication (Cochrane Library).
CDSR	Cochrane Database of Systematic Reviews (Cochrane Library)
Chest x-ray	Chest radiograph
COAD	Chronic Obstructive Airways Disease
COPD	Chronic Obstructive Pulmonary Disease
CT	Computed Tomography Imaging
CVD	Cardiovascular Disease
DARE	Database of Abstracts of Reviews of Effectiveness (Cochrane Library)
ECG	Electrocardiography
ECHO	Echocardiography
FBC	Full Blood Count
GDG	Guideline Development Group
GTN	Glyceryl Trinitrate
HDU	High Dependency Unit
HTA	Health Technology Assessment
ICU	Intensive Care Unit
INR	International Normalised Ratio
MeSH®	Medical Subject Heading
MRSA	Methicillin Resistant Staphylococcus aureus
MUGA	Multigated Acquisition Scan
NCCAC	National Collaborating Centre for Acute Care (NICE)

NHS	National Health Service
NICE	National Institute of Clinical Excellence
POSSUM	a Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity
PT	Prothrombin Time
UCLA	University College of Los Angeles

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1. Introduction

1.1 Background

Each year over three million operations are performed in NHS hospitals. For many years it has been usual practice in many hospitals to test apparently healthy patients preoperatively for unsuspected conditions that might affect their treatment. Such investigations include chest x-rays, haemostasis tests, blood glucose tests and sickle cell tests.

The main purpose of preoperative investigations is to provide additional diagnostic and prognostic information to supplement the clinical history of a patient with the aim of:

- **providing information that may confirm or question the correctness of the current course of clinical management;**
- **using this information to reduce the possible harm or increase the benefit to patients by altering their clinical management if necessary;**
- **using this information to help assess the risk to the patient and opening up the possibility of discussing potential increases of risk with the patient;**
- **predicting postoperative complications;**
- **establishing a baseline measurement for later reference (to refer back to postoperatively); and**
- **opportunistic screening that is unrelated to the surgery.**

The clinical value of testing apparently healthy individuals before their operation is, however, uncertain. The possible benefits of routine preoperative investigations include identification of unsuspected conditions that may require treatment before surgery or a change in surgical or anaesthetic management. However, preoperative investigations may also cause harm, for example, from false positive findings leading to unnecessary, costly and possibly harmful treatments or further investigations and delays in surgery.[1] Some evidence also suggests that clinicians do not change the management of their patients even in the light of true positive abnormal preoperative test findings in healthy individuals.[2]

A Health Technology Assessment (HTA) systematic review published in 1997 assessed the evidence for the use of preoperative testing in healthy patients admitted for elective surgery.[2] The review covered preoperative chest radiographs, electrocardiography, haemoglobin and full blood counts, haemostasis tests, biochemistry tests and urine testing. The authors found a wide range of estimates of the proportion of patients with abnormal results in the literature, even in apparently healthy individuals. The clinical importance of these abnormal results was uncertain, because abnormal preoperative test results led to only a small proportion of changes in clinical management, and for some tests there were virtually no reported changes in clinical management. The review concluded that a policy of preoperative testing in apparently healthy individuals is likely to lead to little, if any, benefit. This conclusion is supported by two earlier reviews, one from Sweden[3] and the other from the Basque country.[4] However, it is crucially important to have a definition of what actions constitute a change in management, in order fully to understand the potential value of preoperative investigations to the patient and the clinician. This issue is discussed in more detail in Chapter 2, Methods, and in Chapter 7, Discussion and Research Recommendations.

Chest radiographs were the first preoperative investigation for which clinical guidance was issued in the UK. The guidance was published by the Royal College of Radiologists as part of a document with a wider remit, 'Making the best use of a Department of Clinical Radiology', which is currently in its fourth edition.[5] The guidance recommends that preoperative chest radiographs should not be carried out without a reason and lists a number of specific clinical indications.

The American Society of Anesthesiologists (ASA) published a statement on routine preoperative laboratory and diagnostic screening,[6] which is consistent with the following conclusion from the HTA review:

'No routine laboratory or diagnostic screening is necessary for the preanaesthetic evaluation of patients.'

The ASA recommends that departments should develop local guidelines for selected patient populations. However, ultimate responsibility is left to the clinical judgement of individual clinicians:

'Individual anesthesiologists should order test(s) when, in their judgement, the results may influence decisions regarding risks and management of the anesthesia and surgery.'

More recently the ASA published a guideline on preanaesthesia evaluation. The guideline concludes:

'Routine preoperative tests (ie tests intended to discover a disease or disorder in an asymptomatic patient) do not make an important contribution to the process of perioperative assessment and management of the patient by the anesthesiologist.'[7]

It states that selective preoperative testing, based on indications in the history and examination of patients, or type and invasiveness of the planned procedure and anaesthesia, may help patient management. However the ASA could not give unequivocal guidance because of the lack of available evidence.

For preoperative investigation for the majority of patients, these reviews demonstrate a professional, but not evidence-based, consensus that preoperative testing is not necessary when there are no clinical indications. However, there remains the opportunity for widespread variation with respect to what individual anaesthetists and surgeons regard as 'relevant clinical indications'. Moreover, given that preoperative testing is widely carried out, it is important to distinguish between a lack of evidence of important benefits of preoperative investigations and convincing evidence that preoperative investigations have no important benefits.

1.2 Objectives of the guideline

Clinical guidelines are *'systematically developed statements which assist clinicians and patients in making decisions about appropriate treatment for specific conditions'*.[8] The recommendations in this guideline were arrived at after careful consideration of the available evidence and formal assessment of the opinions of members of two consensus panels using a recognised method for developing consensus. However, the recommendations should be considered only as a guideline. Healthcare professionals involved in pre-, peri- and postoperative care must use their professional knowledge and judgement when applying the recommendations to the management of individual patients.

1.3 The purpose of the guideline

- **To evaluate the evidence relating to the 'value' of routine preoperative testing in elective surgical patients and in selected groups of patients with comorbid conditions by carrying out a systematic review of the literature.**
- **To develop guidance for clinicians on the use of preoperative investigations in normal healthy adults and children (ASA grade 1), and in adults with mild (ASA grade 2) and severe (ASA grade 3) systemic disease arising from selected comorbid conditions.**
- **To produce an illustrative economic model investigating plausible rates of abnormal results, rates of changes in management, rates of postoperative complications avoided by preoperative investigations and the subsequent costs of preoperative investigations and of adverse events and their sequelae.**

1.4 Who developed the guideline?

The development of the guideline was supported by funding from the National Institute for Clinical Excellence (NICE).

The guideline was developed by a Guideline Development Group (GDG) made up of multi-professional and lay working group members who represented the main stakeholders for this guideline (see Acknowledgements). The GDG was convened by the National Collaborating Centre for Acute Care (NCCAC).

Staff from the NICE National Collaborating Centre for Acute Care, the Clinical Effectiveness Unit at The Royal College of Surgeons of England and the Department of Public Health and Policy at the London School of Hygiene and Tropical Medicine were also members of the GDG and provided methodological support and guidance for the development process, undertook systematic searches, retrieval and appraisal of the evidence and drafted the guideline. The Glossary to the guideline contains definitions of terms used by the GDG.

1.5 Scope of the guideline

1.5.1 What the guideline covers

The guideline is aimed mainly at secondary care, but may have relevance to some tests carried out or ordered in primary care. The preoperative tests considered are for the preoperative assessment of patients classified as ASA grade 1 (adults and children) and ASA grades 2 and 3 (adults only) undergoing elective surgery.

The preoperative tests to be considered were agreed at scoping meetings with the GDG and are listed below in Table 1.1. Certain investigations, for example computed tomography (CT) scans of the thorax and multigated acquisition (MUGA) scans, were excluded from the guideline as they did not fulfil the criteria for a 'generic' preoperative investigation as defined by the GDG. More information about included and excluded tests is included in Chapter 2 and the full version of the systematic review (see Appendix 1, CD ROM).

1.5.2 What the guideline does not cover

The GDG concluded that it was beyond the scope of this guideline to address the following issues:

- **other aspects of preoperative assessment such as history and examination;**
- **definitive advice on the assessment and wider clinical management of patients before surgery or during follow-up and treatment of conditions identified by preoperative tests;**
- **innovative technologies that have yet to be established in NHS practice;**
- **the specific needs of patients with rare conditions;**
- **other investigations that are directly related to the condition a patient may have and that are part of the routine care of that patient, such as established tests of cardiovascular function: cardiac echocardiography (ECHO); stress ECG and nuclear cardiology investigations (eg MUGA and Technetium scanning);**
- **tests that are used for screening purposes only, eg detection of methicillin resistant *Staphylococcus aureus* (MRSA);**
- **how tests should be carried out, the frequency of testing and the interpretation of test results (eg specific parameters and criteria for defining abnormalities); and**
- **psychological assessment of patients and assessment of risk of awareness during surgery.**

1.5.3 Consent

The issue of consent to undergo preoperative tests is addressed briefly in relation to specific tests in Chapters 4 to 7 of this guideline. For further guidance clinicians should refer to the 'Good Practice in Consent' guidance on issues of consent in the NHS.[9] This guideline supports the advice given in that publication, that it is *'a general legal and ethical principle that valid consent must be obtained before starting treatment or physical examination, or providing personal care, for a patient'* and that patients should have access to sufficient information about risks, benefits and alternatives to be able to make an informed decision about whether to consent.

TABLE 1.1 The preoperative tests considered in this guideline

TEST	DESCRIPTION
Chest x-ray	Plain chest x-ray (radiograph).
Resting ECG	Resting electrocardiography (ECG).
Full blood count	Full blood count includes haemoglobin measurement, white blood cell count and platelet count. Using current laboratory automated analysers it is not possible to obtain only a haemoglobin measurement. It is possible to measure only haemoglobin with point of care testing, but we have excluded this form of testing from the development of the guideline.
Haemostasis tests	Haemostasis tests include prothrombin time (PT), activated partial thromboplastin time (APTT) and international normalised ratio (INR; derived from the patient's PT and normative data).
Renal function tests	Renal function tests include measurement of potassium, sodium and creatinine and/or urea levels.
Blood glucose test	Blood glucose test is a measurement of glucose from a blood sample, as opposed to measurement in the urine using a urine 'dipstick' test.
Urine 'dipstick' test	Urine dipstick tests are manufactured to test for different conditions separately and together. Urine dipsticks test for pH, protein, glucose, ketones and blood/haemoglobin.
Sickle cell test	Testing for sickle cell disease/trait usually takes place in two stages. First a test is used to detect sickle cell disease/trait (for example the Sickledex test). More detailed (and more expensive) tests are then carried out if the first test is positive.
Pregnancy test	Biochemical testing for pregnancy. In most cases this would be a urine test.
Blood gases (Phase B only)	Arterial blood gas analysis or venous blood gas analysis in combination with pulse oximetry (to measure the oxygen and carbon dioxide content, and acid-base status of the blood) may be used to evaluate patients with severe respiratory or cardiovascular disease.
Pulmonary function tests (Phase B only)	Measurements of peak expiratory flow rate, forced vital capacity and forced expiratory volume.

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2. Methods

2.1 Outline of methods used

There were several steps in the development of these guidelines (see Figure 1):

(a) **Assembly of the Guideline Development Group (GDG)** – comprising multi-professional and lay representatives (see Section 2.2);

(b) **Aims and scope of the guideline** – defined at beginning of the project in collaboration with the GDG and others (see Section 2.3);

(c) **Systematic review of the literature** – to update previous reviews and to carry out a critical appraisal and synthesis of the literature (see Section 2.4, Chapter 3 and Appendix 1, CD ROM);

(d) **Economic review** – to estimate the costs of tests included in the guideline (see Section 2.5, Chapter 6 and Appendix 5, CD ROM);

(e) **Choice of consensus development method** – to formally sample opinions about the appropriateness of preoperative testing (required because of a lack of scientific evidence from literature review; see Section 2.6);

(f) **Interviews to test assumptions made by the GDG** – carried out with trainee surgeons and consultant anaesthetists (see Section 2.7 and Chapter 4);

(g) **Selection of panellists for consensus development** – to reflect a range of users and providers of the tests; patient representatives were present at each meeting (see Section 2.8 and Chapter 5);

(h) **Development of consensus questionnaire** – to elicit opinions from panellists (see Section 2.9 and Chapter 5);

(i) **Consensus round 1** – consensus questionnaire sent to and rated by expert panels (see Section 2.10, Chapter 5 and Appendices C and D, CD ROM);

(j) **Consensus round 2** – meeting of panels: questionnaire statements discussed in turn and re-rated (see Section 2.11, Chapter 5 and Appendices C and D, CD ROM);

(k) **Drafting of guideline** (see Section 2.12 and Chapter 6);

(l) **Comments sought from a wider audience** draft guideline distributed to contributors to the guideline, eg consensus panellists, interviewees and other interested parties not formally registered as stakeholders; and

(m) **Guideline revised in light of comments.**

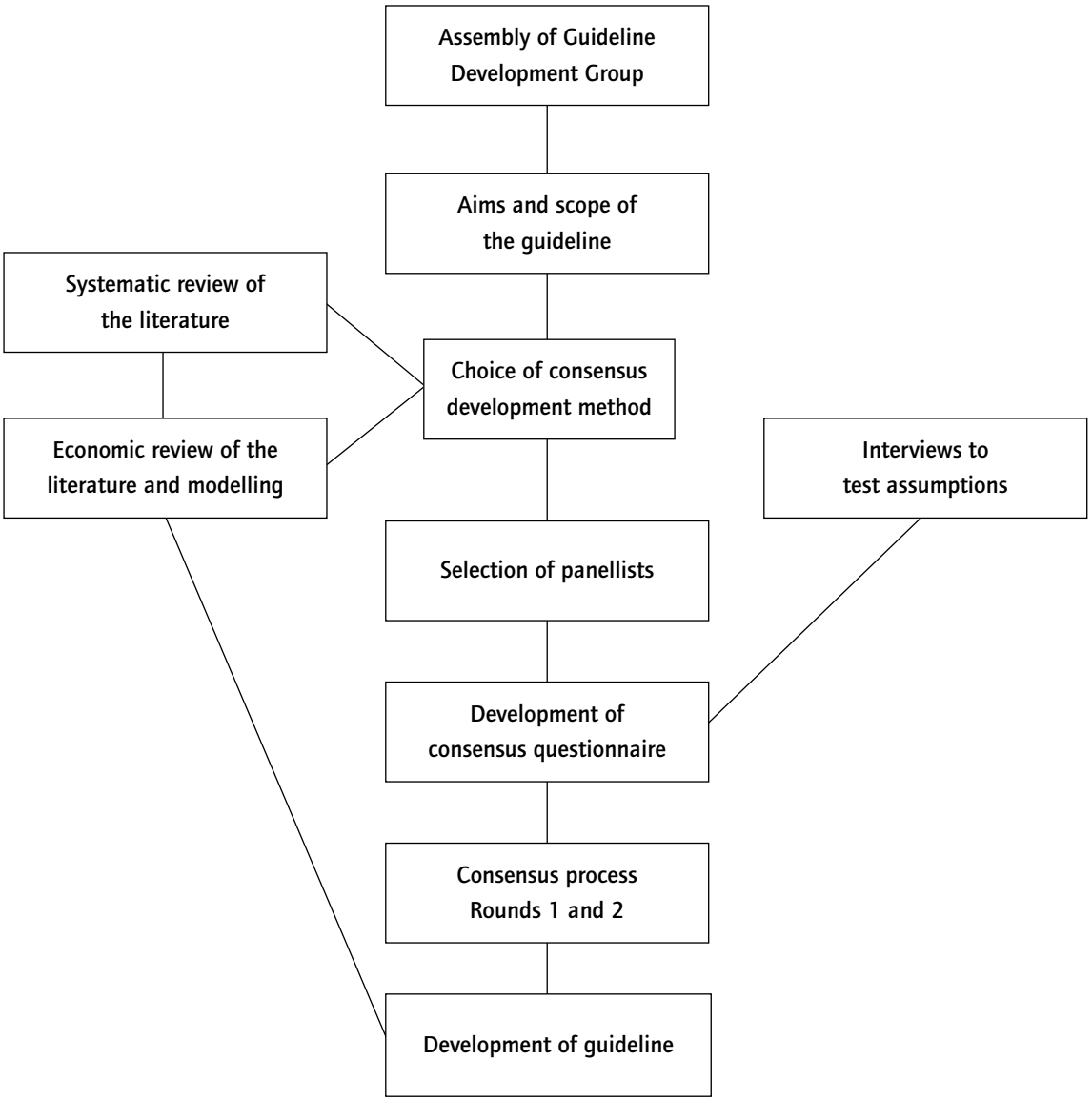
2.2 Assembly of an advisory group

The GDG made executive decisions about the project and was responsible for its day-to-day management. The GDG initially included representatives from all of the key professional bodies. To ensure access to wider expert opinion and patient representation, the GDG was enlarged to include other stakeholders representing a wider range of health care professions and patient/carer groups (see Acknowledgements).

2.3 Aims and scope of the guideline

The GDG established that, for the purposes of developing guidelines, it would not be sufficient simply to 'update' the earlier Health Technology Assessment (HTA) review.[1] There was concern that the review had not consulted with the users of preoperative test information (eg anaesthetists and surgeons), that some of the complexities of preoperative testing had not been explored and

TABLE 1.1 **Outline of methods to develop guideline**



that an over simplistic end point (change in clinical management) had been used.

In agreeing the scope for the guideline, the GDG debated four key issues.

1. Interpretation of the phrase 'routine preoperative testing'

The term 'routine testing' was described in the brief for the guideline. However, the GDG felt that this was ambiguous. At least three possible interpretations were suggested:

- **preoperative testing carried out in 'uncomplicated' patients (requiring further definition of 'uncomplicated');**
- **preoperative testing carried out in the 'majority' of or 'typical' patients (requiring further definition of 'majority' or 'typical'); or**
- **preoperative testing carried out 'habitually'.**

The GDG chose the second interpretation. Members considered the first interpretation to be too limited (see below, with respect to comorbidity) and the third interpretation to be too difficult to define. Because of the difficulty of interpreting the term 'routine', the

word 'generic' is used throughout the guideline to mean testing that is carried out for all patients who satisfy certain criteria (including the presence of one of the comorbidities considered for patients classified as ASA grade 2 or 3) and that is not directly related to the planned procedure.

2. Reasons for testing

A second issue concerned 'legitimate' reasons for testing. The HTA review[1] appeared to require that abnormal test results should bring about changes in clinical management, with the presumed aim of preventing immediate operative complications. The GDG were not satisfied that the value of preoperative testing should be limited in this way, for two reasons. First, most studies have adopted a narrow definition of what constitutes a change in clinical management (see below). Second, anaesthetists in the GDG could envisage other legitimate reasons for preoperative testing that would not necessarily result in any observable change in management. For example, an anaesthetist might document a biochemical variable in advance of an operation in order to interpret a measure of the same physiological variable after the operation; that is, in order to manage the postoperative care of a patient optimally, an anaesthetist or surgeon might need to know whether the variable was abnormal in advance of the operation or whether it became abnormal during the course of the operation.

3. Definition of 'change in clinical management'

The definition of a 'change in clinical management' mentioned above was a third issue of concern (closely related to issue 2, above). The GDG was not satisfied that the frequency of changes in clinical management should be quantified simply by the frequency with which abnormal test results led to operations being postponed or cancelled. It seemed to the GDG that these particular changes in clinical management had often been selected because they were clearly observable or were likely to have been documented (in retrospective studies). However, anaesthetists in the GDG could envisage other, less observable changes in clinical management that might be very important in reducing the risk of a complication, for example a change in the choice of anaesthetic protocol or the selection of a more experienced anaesthetist to administer the anaesthetic.

4. Cost effectiveness

A fourth issue was the cost, and cost-effectiveness, of preoperative testing, which the GDG was explicitly instructed to address. While acknowledging the intrinsic importance of the costs and cost-effectiveness of tests, there was concern that this was not how hospital clinicians considered resource issues. It was felt that while clinicians are aware of the cost implications of tests, they are more concerned with the availability of tests. For example, clinicians may need to weigh up the resource implications to the NHS and potential risks to the patient of going ahead with an operation without a test result, compared with postponing an operation until the test result is available.

With respect to the interpretation of 'routine testing', the GDG agreed that users of the guideline would be disappointed if it only addressed uncomplicated patients, a term which was assumed to imply patients classified as ASA grade 1. For this reason members rejected the first interpretation of routine preoperative testing. Interpreting 'routine' to mean preoperative testing in common or typical patients led the GDG to include patients with common comorbidities within the scope of the review. Members chose to use the framework of ASA grades in order to do so. The GDG acknowledged the difficulty of tackling the use of preoperative tests in patients with comorbidity undergoing elective surgery. However, members were keen to make some progress in this area since it is increasingly common for elective surgical patients to have comorbidity. Also, it was felt that attempting to develop a guideline for these patients would provide a foundation when updating the guideline.

Members of the GDG were aware that additional issues emerged during the course of their work. For example, the timing of preoperative testing, the optimal setting for preoperative testing and issues of consent were raised after formal scoping of the guideline had been completed. Where such issues have not been formally considered in the guideline, the views and concerns of the GDG have been summarised in the Discussion (see Chapter 7).

2.3.1 Steps in developing the guideline

The GDG identified the following six steps in developing the guideline:

1. Tests to be covered by the guideline were selected. Selection took place in two stages, first in the context of patients classified as ASA grade 1 and then in the context of patients classified as ASA grades 2 and 3. The choice of tests was guided by clinical expertise in the GDG about tests that were commonly ordered and tests that might be valuable. The chosen definition of generic testing limited the number of tests considered.

2. A systematic review of the literature was carried out. The earlier HTA review[1] had identified most of the literature. However, there was a need to search for more recent evidence for tests covered by that review[1], to search for evidence on other tests included in the guideline but not in the HTA review and to appraise the quality of the evidence in detail.

3. There was a need to survey opinion about some of the highly relevant issues on which there appeared to be little or no evidence and that were not addressed by the HTA review[1]. The GDG agreed that carrying out interviews about these issues with a sample of consultant anaesthetists and trainee surgeons would help to inform the consensus process and highlight areas of uncertainty.

4. Given the findings of the earlier HTA review[1] the GDG did not expect the systematic review of the literature to identify much evidence that directly addressed the value of preoperative testing (eg because all of the studies in the HTA review were case series, which cannot provide good quality evidence of effectiveness). Therefore the fourth step was to use a formal consensus method to obtain opinions about the appropriateness of preoperative testing in particular circumstances. The findings from the consensus process supplemented the available evidence from the review.

5. Evidence about the costs of tests (consulting primary sources if necessary) was identified and reviewed. The GDG had been instructed to consider costs explicitly in the formal consensus process.

6. The role of economic modelling in assisting recommendations about the appropriateness of preoperative testing was considered.

2.4 Systematic review methods

The aim was to carry out a systematic review of the value of generic preoperative investigations in elective surgical patients. A generic preoperative test was defined as an investigation recommended preoperatively for all patients of a particular type (eg in a certain age range or with a particular comorbidity), that was not directly indicated by either the surgical procedure or the condition for which the procedure is being carried out.

The starting point for this review was to update the HTA report[1] to include additional evidence published between January 1996 and February 2002 and to identify and review all evidence (1966-2002) for additional tests covered by the guideline, ie pregnancy tests, lung function tests and blood gases. (A list of all tests included is presented in Chapter 1, Section 1.5). For a full transcript of the review, please refer to Appendix 1, CD ROM.

2.4.1 Search strategy

A comprehensive search strategy was developed to identify all papers relating to generic preoperative testing. Both MeSH® (Medical Subject Headings) headings and free text searches were used to capture all publications.

2.4.2 Types of investigation

The review considered published evidence about generic investigations carried out before surgery that are required to determine the fitness for anaesthesia and surgery (see Glossary).

Included tests: The investigations considered in this review are listed in Table 1.1 in Chapter 1. These include all investigations reviewed by the HTA[1] and four additional tests: pregnancy testing, sickle cell tests, blood gases and lung function tests.

Excluded tests: Several investigations were excluded from the review. These were:

1. Cardiology investigations

(a) Cardiac echocardiography (ECHO)

(b) Stress electrocardiography (ECG)

(c) Nuclear Cardiology investigations [eg multigated acquisition (MUGA) scanning]

The cardiology investigations listed here were excluded because they are normally only ordered in patients where there is some evidence of cardiovascular disease, and may well lead to a referral to a physician or cardiologist for further investigation and treatment.

2. Computed tomography (CT) scan of the thorax

CT scans were excluded because the test results are used primarily to assist in the staging of malignant disease, to inform prognosis and postoperative management of the patient rather than to inform the anaesthetic and surgical management. These reasons for carrying out a CT scan are directly related to the disease being treated or the operation being carried out, eg as a guide to the anatomy, and are therefore not 'generic'.

3. Haemoglobin electrophoresis

Haemoglobin electrophoresis was excluded as it was considered to be a test for differential diagnosis of haemoglobinopathies used, for example following a positive sickle cell test, rather than for initial risk assessment for any haemoglobinopathy.

4. Blood cross matching

Blood cross matching is used to inform the preparation of a number of units of red blood cells for transfusion that are stored for a limited time for a specific patient. Blood cross matching was excluded because the GDG agreed that its function is procedural rather than diagnostic; it does not change the management of the patient as there are no 'abnormal' results to consider. The need to do cross matching or a 'group and save' is dependent on the severity of surgery and the likelihood of blood loss.

5. Methicillin Resistant Staphylococcus aureus (MRSA)

Screening tests for MRSA were not considered.

6. Preoperative clinical assessment

Preoperative clinical assessment, ie history taking and physical examination, were also excluded. National good practice guidance on preoperative assessment of inpatient surgery, developed by the NHS Modernisation Agency was launched in April 2003. Information is available from www.modern.nhs.uk/theatreprogramme/preop

2.4.3 Types of study population

The population of interest was split into two.

- **all uncomplicated, healthy children or adults (ie classified as ASA grade 1) undergoing elective surgery; or**
- **all adult patients with mild or severe systemic comorbidity (ie classified as ASA grades 2 and 3, respectively) from cardiovascular, respiratory or renal disease undergoing elective surgery.**

Consideration of preoperative tests in these two populations made up Phases A and B.

2.4.4 Types of outcome measures

Outcome measures included estimates of the frequency, risk difference or relative risk of an abnormal result and a change in management (see Table 2.1).

2.4.5 Types of studies

In theory the literature could have yielded three types of relevant evidence (see Table 2.1):

- **comparisons of effectiveness between groups of patients who had and had not undergone preoperative investigations;**
- **estimates of the diagnostic accuracy of preoperative investigations for predicting complications, adverse events or changes in management; and**

- **estimates of the 'yield' for carrying out investigations (ie the proportion of patients undergoing preoperative investigations in whom an abnormal result was observed and whose clinical management changed as a result, or who went on to have an adverse event or perioperative complication).**

Based on the experiences of Munro *et al*[11] we expected to find few studies that provided high quality evidence of effectiveness. We therefore considered all quantitative study designs that might provide information about the 'value' of preoperative investigations for the review.

Exclusion criteria

Papers were excluded from the review if they:

- **did not report primary outcome data relevant to the review;**
- **reported clinically indicated tests;**
- **were not written in English; or**
- **included fewer than ten patients.**

2.4.6 **Search strategy for identification of studies**

Databases were searched from 1995 to December 2001 for tests considered in Phase A and June 2002 for tests considered in Phase B (see section 2.8 for definitions of Phase A and B). In Phase A, the search strategies deliberately included one year overlapping with the HTA review[1] (1995) to ensure that articles were not missed because of a time lag in indexing in bibliographic databases. For tests not included in the HTA review1 (pregnancy testing, sickle cell tests, blood gases and lung function tests) MEDLINE was searched from 1966 and EMBASE from 1989. Studies were identified by the following methods:

a) Electronic searching

i) The Cochrane Library 2001 issue 4 [including Cochrane Database of Systematic Reviews (CDSR), Database of Abstracts of Reviews of Effectiveness (DARE), Cochrane Controlled Trials Register (CCTR), HTA database, National Health Service (NHS) Economic Evaluations Database];

ii) MEDLINE (from 1966/1995 to December 2001/June 2002);

iii) EMBASE (from 1989/1995 to December 2001/June 2002);

TABLE 2.1 Different types of evidence relevant to the review

TYPE OF EVIDENCE/STUDY TYPE	DESCRIPTION	OUTCOME MEASURE
Effectiveness of testing Randomised or nonrandomised controlled trials, cohort studies, case control studies	Analytical comparison of outcomes (adverse events, changes in management, treatment or health outcomes) for patients who have undergone preoperative testing with those who have not	Ratio or difference measures of effect size
Diagnostic accuracy of tests	Diagnostic accuracy of preoperative test, ie ability to predict complications, adverse events or changes in management	Sensitivity and specificity, negative and positive predictive values, likelihood ratios
Estimates of the yield of tests Prospective or retrospective case series	Studies describing the proportion of surgical patients who have an abnormal preoperative test result, who are subject to a change in clinical management or who experience an adverse event/complication	Estimates of the frequency of abnormal results, changes in clinical management, adverse events or complications

iv) Science Citation Index (to December 2001/June 2002); and

v) HealthSTAR (up to the end of the year 2000 when the database ceased to exist).

b) Manual searching of reference lists in identified studies and reviews.

c) Professional contacts.

The search strategies used for MEDLINE and EMBASE are detailed in the full systematic review (Appendix 1, CD ROM). These search strategies were adapted for searching other databases.

2.4.7 Selecting studies

Studies were identified and excluded as follows:

(1) Papers were excluded after reading the titles and abstracts alone if they were considered definitely irrelevant.

(2) Full publications of the remaining articles were obtained and papers were excluded if they were irrelevant. A 10% sample of papers was reviewed by a second reviewer to ensure inter-observer consistency. Disagreements were used to inform the selection and were resolved by discussion. No formal analysis of agreement was performed.

(3) Data were extracted from all eligible papers.

2.4.8 Data extraction

Data regarding the patient population, interventions and outcomes were extracted by one of two reviewers. Again, data extraction for 10% of papers was performed independently by two reviewers. Studies were categorised as descriptive, diagnostic or as addressing effectiveness questions. Characteristics of included studies are shown in the full systematic review (see Appendix 1, CD ROM).

2.4.9 Methodological quality

The methodological quality of all studies was assessed. Three data forms were created to record aspects of quality specific to the three types of evidence. Papers were assessed by one or two reviewers, with a 10% sample assessed independently by two reviewers. Disagreements were discussed with a third reviewer if necessary.

2.5 Economic review of the cost of tests included in the guideline

Methods and results for this aspect of the guideline are presented in Appendix 5, CD ROM.

2.6 Choice of development method by formal consensus

The evidence base available for this guideline was both anticipated to be and found to be extremely poor. Consequently the GDG decided to use formal consensus methods to identify areas of agreement on which to base guidance when the evidence base from the literature was inadequate.

The modified nominal group technique was chosen. This technique is based on the RAND/UCLA (University College of Los Angeles) consensus panel method for assessing appropriateness of procedures.[2,3,4] The method has previously been identified as the method most commonly used for the development of consensus in health care.[5]

Formal consensus development using the nominal group technique was preceded by a stage of informal consensus development.

In scoping the area to be covered by the consensus process a number of assumptions had been made on which the formal consensus process would be based. Because the GDG was concerned that these assumptions might not be acceptable to practising clinicians, the GDG tested the assumptions by *informal* consensus. This involved interviews with a selection of surgical trainees and consultant anaesthetists (clinicians who order the tests and clinicians who use them) to check these key assumptions.

The scope of the *formal* consensus process was limited by time and resources to focus on key dimensions of preoperative testing. Therefore the GDG also used the interviews to explore areas that would not be dealt with in the formal consensus process.

2.7 Testing the assumptions: informal consensus interviews with surgical trainees and consultant anaesthetists

The questionnaire for the interviewees was developed by members of the GDG (see Chapter 4).

2.7.1 The key areas addressed by the interviews

In preparing for the consensus process, a number of assumptions were made and issues considered that were not formally covered in the consensus process.

ASSUMPTIONS

- **A patient classified as ASA grade 1 does not require any preoperative tests as a consequence of being a smoker or being obese, ie these factors are unimportant unless they have already 'shifted' the patient into ASA grade 2.**
- **Severity of surgery determines the degree of physiological stress imposed on a patient by having an operation.**
- **When deciding whether preoperative tests are appropriate for patients undergoing regional anaesthesia, one should always take into account the possibility of the anaesthetic having to be converted to general anaesthesia.**

TO INFORM THE FORMAL CONSENSUS PROCESS

- **To obtain information from interviewees about issues relating to preoperative tests for pregnancy.**
- **To obtain information from interviewees about issues relating to preoperative tests for sickle cell disease/trait, eg ethnic groups perceived to be at risk and whether the need to test for sickle cell disease is affected by other factors of interest, eg age, type of surgery, etc.**

AREAS NOT COVERED BY THE CONSENSUS DEVELOPMENT PROCESS

- **To obtain information from interviewees about reasons for carrying out preoperative tests.**
- **If the above assumption about the severity of surgery influencing the physiological stress is accepted, to obtain information about ways of classifying the severity of surgery.**

2.7.2 Identification of interviewees

The aim was to interview ten consultant anaesthetists and ten surgical trainees. Consultant anaesthetists were initially identified through professional contacts and subsequently through lists of past and potential advisors to the National Confidential Enquiry on Perioperative Deaths. Surgical trainees were identified through lists of research fellows provided by the Research Board of The Royal College of Surgeons of England.

2.7.3 Conducting the interviews

Potential participants were given information about the guideline and the aims and objectives of the interviews were explained either by e-mail or telephone. Those who agreed to participate were sent the questionnaire to answer in their own time and a time was arranged for a member of the development team to telephone to discuss their responses. Interviews lasted approximately one hour. Two surgical trainees were interviewed face-to-face to pilot the questionnaire.

2.8 Consensus: selection of consensus panel

The consensus process was split into two phases.

- **Phase A: appropriateness of preoperative testing of normal healthy patients (including children) varying by age and by grade of surgery (ASA grade 1)**
- **Phase B: appropriateness of preoperative testing of adult patients with three common comorbidities (cardiovascular disease, respiratory disease and renal disease) (ASA grades 2 or 3).**

It was necessary to include in the consensus process representatives from all key health care professions including subspecialities of surgery and anaesthetists from different specialities (including paediatrics). The maximum recommended size of the consensus panels was 11 panellists. To promote the applicability of the guideline, it was decided that two consensus panels would be run in parallel (each dealing with the same material) for each of Phase A and Phase B. The composition of the two parallel consensus groups was planned to be the same in both Phases, provided that panellists agreed to participate in the meeting and the second round of rating (see Table 2.2).

Because the panellists were given the task of reaching consensus about the appropriateness of preoperative tests, a task that requires considerable health care expertise, all members were health care

practitioners. Patient and carer representatives were invited to observe the consensus meetings and participate in the discussion.

TABLE 2.2 Composition of the parallel consensus panels used in each of the two phases

	Group 1 (n=11)	Group 2 (n=11)
Anaesthetists	2	2
Paediatric Anaesthetist	1	1
Radiologist	1	1
Pathologist – Haematologist	1	1
Pathologist – Biochemist	1	1
Cardiologist	1	1
Surgeon – Trainee	1	1
Surgeon – General	1	1
Surgeon – Obstetrics and Gynaecology or Orthopaedic	1	1
Nurse Practitioner	1	1

2.9 Development of the consensus questionnaire

The consensus questionnaires (Phase A: see Appendix 3, CD ROM; Phase B: see Appendix 4, CD ROM) contained statements about the appropriateness of a particular test for particular patients for different types of surgery (defined in the Glossary).

Phase A aimed to explore two key dimensions, namely age (considering children <16 years and adults in separate sections in the consensus questionnaire) and the type of surgery. We also separated out two specific subspecialties, cardiac surgery and neurosurgery, because of their extreme invasiveness.

Phase B explored the appropriateness of preoperative testing in a population with comorbidity. In order to make the consensus process manageable, we restricted it to comorbid patients classified as ASA grade 2 or ASA grade 3 as a consequence of signs and symptoms in three areas of comorbidity: cardiovascular disease (including diabetes), respiratory disease [chronic obstructive airways disease (COAD)/chronic obstructive pulmonary disease (COPD) and asthma] and renal disease. The boundary between ASA grades 2 and 3 is not well defined, so panellists were provided with a table explaining what 'type' of patient they might expect in each category of comorbidity (see Table 2.3). Patients under the age of 16 were omitted from Phase B, since few children have comorbidity of the same kinds or with the same aetiology as those being considered for adults. In Phase A, neurosurgery and cardiac surgery were considered separately from Grade 4 (major+ surgery). However, in Phase B it was decided to include these types of surgery as Grade 4 and ask panellists if there were any specific types of surgery where the consensus reached would not apply.

Evidence about the costs of tests was provided to members of the consensus panel as a list, including plausible upper and lower limits for the costs (see Appendix 5 for further details). This information was also included in each set of statements for each test used for consensus development. However, cost information was not considered explicitly as an independent variable during consensus development.

2.10 Consensus: round 1 – initial rating

Panellists were sent the consensus questionnaire, a short summary of the evidence produced by the GDG and a covering letter giving instructions and definitions.

Panellists were asked to rate their agreement with the statements taking into account the research evidence and their clinical expertise. Ratings were made using a nine-point scale, where one represented least agreement (ie testing was not appropriate) and nine most agreement (ie testing was appropriate).

Panellists were asked to represent their personal opinion about 'best practice', ie what is in the best interests of the patient, rather than necessarily to describe what happens in their own hospital or practice. If they did not have an opinion or if a statement was outside their field of expertise, they were instructed to ring the mid-point on the scale.

TABLE 2.3 **Characterisation of 'mild' and 'severe' comorbidity, corresponding to ASA grades 2 and 3, for cardiovascular, respiratory and renal comorbidities**

	ASA GRADE 2	ASA GRADE 3
ASA definition	'A patient with *mild* systemic disease'	'A patient with *severe* systemic disease'
Cardiovascular (CVD):		
Current angina	occasional use of glyceryl trinitrate (GTN) spray (two to three times per month). Does not include patients with unstable angina who would be ASA grade 3.	regular use of GTN spray (two to three times per week) or unstable angina
Exercise tolerance	not limiting activity	limiting activity
Hypertension	well controlled using a single antihypertensive medication	not well controlled, requiring multiple antihypertensive medications
Diabetes	well controlled, no obvious diabetic complications	not well controlled, diabetic complications, eg claudication, impaired renal function
Previous coronary revascularisation	not directly relevant – depends on current signs and symptoms	
Respiratory:		
COAD/COPD	productive cough, wheeze well controlled by inhalers, occasional episodes of acute chest infection	breathlessness on minimal exertion, eg stair climbing, carrying shopping, distressingly wheezy much of the time, several episodes per year of acute chest infection
Asthma	well controlled by medications/inhalers, not limiting lifestyle	poorly controlled, limiting lifestyle – on high dose of inhaler/oral steroids, frequent hospital admission on account of asthma exacerbation
Renal disease:		
	elevated creatinine (creatinine > 100 µmol/L and < 200 µmol/L), some dietary restrictions	documented poor renal function (creatinine > 200 µmol/L), regular dialysis programme (peritoneal or haemodialysis)

2.11 Consensus: round 2 – meeting

Each group of panellists met for a day to discuss the statements and to re-rate each statement after the discussion. The two panel meetings for Phase A were held in March 2002 and the two panel meetings for Phase B were held in April 2002.

The aim of the panel meetings was to explore possible reasons for disagreements, with the aim of obtaining an improved consensus. At each meeting, the anonymised distributions of responses to each statement were given to all panel members, together with each member's responses to each statement. This enabled participants to see the spread of views and how their own response related to the distribution of responses for each statement.

At the group meeting each statement was discussed, paying particular attention to questions for which the distribution of responses indicated a lack of consensus. After the discussion of one statement , or set of statements, panel members re-rated them before discussing the next statement.

2.11.1 Definition of agreement

Ratings from the second round only were used to develop the guideline. The median (measurement of central tendency or average) and interquartile range (the interval between the 25th and 75th percentile as a measure of distribution) were calculated for each statement from the ratings of the second round (see Table 2.4).[2]

TABLE 2.4 Definition of agreement *within* each consensus panel

AGREEMENT	DEFINITION
100% consensus	Ratings of all panel members fall within a single three point region, ie 1–3 (inappropriate test), 4–6 (equivocal) or 7–9 (appropriate test)
Less than 100% but greater than 75% consensus	For consensus groups with eleven participants: The ratings of at least eight panellists must lie within the three point region of consensus (1–3 or 7–9) For consensus groups with eight to ten panellists: The ratings of at least six panellists must lie within the three point region of consensus (1–3 or 7–9)
No agreement/no consensus	Any distribution of ratings outside the limits described above was regarded as no consensus

TABLE 2.5 Definition of agreement *between* each consensus panel (eg between Group 1 and Group 2 in Phase A)

AGREEMENT	DEFINITION
100% agreement Inappropriate to test	Consensus in both groups – 100% agree that the test is **INAPPROPRIATE**
Less than 100% but greater than 75% agreement Inappropriate to test	Consensus in both groups – 75–100% agree that the test is **INAPPROPRIATE**
Uncertain	**UNCERTAIN** no consensus reached in at least one of the groups One group reached consensus that the test is **APPROPRIATE**, but the other group was **UNCERTAIN** One group reached consensus that the test is **NOT APPROPRIATE**, but the other group was **UNCERTAIN** Both groups were **UNCERTAIN** Both group reached consensus, but consensus was in **OPPOSITE DIRECTIONS**! (That is one group reach consensus that it is appropriate and the other group reach consensus that it was not appropriate).
100% agreement appropriate to test	Consensus in both groups – 100% agree that the test is **APPROPRIATE**
Less than 100% but greater than 75% agreement Appropriate to test	Consensus in both groups – 75–100% agree that the test is **APPROPRIATE**

2.11.2 Presentation of consensus results

As there were parallel groups, we only state when consensus (defined in Tables 2.4 and 2.5) was reached by both groups. For example, if one group agreed that testing patients younger than 40-years-old with a chest x-ray was inappropriate, but the parallel group failed to reach a consensus either way, this was considered to represent no consensus.

2.12 Drafting the guideline

The recommendations were developed from consensus opinion and from the review of the literature. Tables in Chapter 6 summarise the consensus reached by panel members, both about situations in which it is considered appropriate to test and about situations in which testing is considered inappropriate. Where there is uncertainty, ie where no consensus was reached, clinical discretion must be used to determine the appropriateness of a test for a patient. In addition, through discussion with clinicians on the GDG, patient representatives, panellists and other clinicians consulted, we have attempted to identify 'good practice' points. These points relate to areas for which a clear informal consensus was expressed, but which were outside the scope of the consensus meetings.

The draft guideline was distributed for a first round of consultation in July 2002. It was reviewed by stakeholders, collaborators and interested parties (panellists for the consensus processes and clinicians interviewed; see Acknowledgements) in addition to members of the GDG.

2.13 Adjustments made in light of comments from stakeholders

Extensive comments were reviewed and the report was revised. These comments and our responses to them can be viewed on the NICE website. Patient representatives on the GDG contributed to the drafting process. After a second consultation, further modifications were made, with final submission on the 4 April 2003.

Reference List

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3. Findings from the Systematic Review of the Literature

3.1 Papers identified for the review

The full texts of all eligible papers were obtained. Details of the total number of citations identified are described in Table 3.1. The eligible papers for each preoperative test are summarised below and in Table 3.2.

3.1.1 Assessment of methodological quality

Systematic reviews of the literature usually include assessments of the quality of included studies. Different appraisal tools are used for different types of study, for example randomised controlled trials, cohort and case series. In this review, however, it was only necessary to use one appraisal tool as all eligible papers reported case series and no other study design. The quality assessment concentrated on methodological strengths and weaknesses in the recruitment of cases and in the reporting of outcomes. The quality assessment data extraction form is described in Appendix 1, CD ROM.

3.1.2 Presentation of results

Summaries of the results for each test are described here. Detailed descriptions of the results for each test are presented in the full review (see Appendix 1, CD ROM).

3.1.3 Limitations of the available evidence

The evidence suffered from a number of serious weaknesses that limited its usefulness. These limitations are described in more detail in the full text of the review findings (see Appendix 1, CD ROM).

POORLY DEFINED CONTEXT FOR PREOPERATIVE TESTING

Authors did not define what they meant by 'routine' preoperative testing nor how 'routine' testing differed from 'indicated' preoperative testing. It was difficult to interpret differences in authors' criteria for testing because testing described as 'indicated' by some

TABLE 3.1 Search results: number of papers identified for each preoperative test

	PREOPERATIVE INVESTIGATION									
Search strategy results	Chest x-ray	ECG	Haemo-globin & FBC	Haemo-stasis tests	Bio-chemistry test	Urine test	Pregnancy test	Lung function tests	Blood gases test	Total
Citations identified in our search	381	489	333	310	348	68	19	227	79	–
Previously identified articles (HTA[1])	28	16	23	21	7	9	NA	NA	NA	70
Newly identified articles	10	13	6	8	2	6	7	10	4	47
Total	38	29	29	29	9	15	7	10	4	117

NA: not applicable; ECG: electrocardiogram; FBC: full blood count.

authors may have been considered as 'routine' by others. For example, some authors may have considered testing of patients with comorbid conditions as 'indicated' when the preoperative tests were nevertheless carried out on a 'routine' basis, ie on all patients irrespective of their comorbidity. Details of the stated contexts for eligible papers for each preoperative test are summarised in Table 3.2.

INADEQUATE STRATIFICATION OF STUDY FINDINGS

Results for 'healthy patients' (ie ASA grade 1) could not be extracted in isolation. None of the case series included only ASA grade 1 patients and the majority (79%) did not stratify their study populations by ASA grade. In the papers that reported ASA grades (20%), only half reported their results separately for subgroups of patients with different ASA grades and none of these papers reported results for ASA grade 1 patients only. Similarly, case series adopted different age criteria for recruitment of patients to their study populations, but few stratified their findings by patients' age and about one quarter of papers did not state the age criteria used. Key characteristics of study populations reported by eligible papers for each preoperative test are summarised in Table 3.2.

POOR STUDY QUALITY

All of the eligible papers reported case series. Bias and confounding can distort comparisons of outcomes in different patient groups both within, and between, case series because the observed groups may differ in other aspects that are relevant to the outcome in question. For example, patients' characteristics are likely to be different in case series where patients were recruited in different specialities compared with case series where patients were recruited within a single surgical speciality. The direction of the bias arising from confounding depends on the differences in the characteristics of the groups of patients being compared.

Patients who refused surgery or whose procedure was cancelled on the basis of an abnormal preoperative test result might have been omitted from the study sample. Biases of this kind would result in underestimation of the prevalence of abnormalities for the particular preoperative test and underestimation of the proportion of patients whose clinical management was changed following an abnormal test finding.

We hypothesised that case series in which data are collected prospectively or in which patients are recruited consecutively are more likely to be uniformly reliable and complete, and therefore are less likely to be biased, than series in which data are collected retrospectively or where patients are recruited selectively. Only 32% of the identified papers were judged to have collected data prospectively and only one fifth were judged to have been both prospective and to have recruited consecutive patients. Details of these aspects of the quality of the eligible papers for each preoperative test are summarised in Table 3.2.

Where possible we investigated the effects of potential confounding factors, such as patients' age, on the proportion of patients with abnormal preoperative test results, requiring changes in clinical management or experiencing postoperative complications. Patients' age was found to be an important source of heterogeneity between the case series. For example, with preoperative chest x-rays and electrocardiograms (ECGs) the prevalence of abnormal results increased as the proportion of older patients in the study populations increased. We tried to control for confounding by investigating how outcomes varied by patients' age (and by other patient characteristics) *within* case series. However, authors rarely reported their findings stratified by patients' age or by other characteristics.

POORLY DEFINED OUTCOMES

Papers reported one or more of the following three 'outcomes': the proportion of patients (a) who had an abnormal test result; (b) who subsequently underwent a change in clinical management; and (c) who suffered a complication.

Findings that were considered abnormal often differed between papers and some of the abnormalities identified by preoperative tests may not have implications for a patient's clinical management. For example, an old rib fracture shown on preoperative chest x-ray is of little or no

importance to the patient's operative management. As a result, there may be considerable variation between papers in the particular abnormal findings considered important and subsequently reported.

Papers rarely set out in advance what clinical actions or behaviours they considered to constitute a change in a patient's clinical management. When authors failed to define a change in clinical management in advance, they may simply have catalogued observed actions that they considered to represent changes in management without formulating a definition. The changes in clinical management reported also varied between papers.

The situation was similar with the definition and reporting of complications. Authors rarely identified complications that may be avoided by testing. There was an additional difficulty in interpreting reports of complications because reported complications appeared to have occurred despite testing. It may also be possible for complications to occur because of testing and that a change in clinical management may not necessarily be a beneficial one. However, we infer that the complications observed should be interpreted as having been unavoidable (unless clinicians did not act on the test results), rather than as adverse events that might be avoided by testing.

Given the uncertainty about the ways in which abnormal test results, changes in clinical management and complications were defined and reported, we concluded that it would not be meaningful to investigate differences in definitions between papers in more detail. Nevertheless, we remain concerned that such differences represent an important source of heterogeneity between case series. Details of the outcomes reported by eligible papers for each preoperative test are summarised in Table 3.2.

3.2 Preoperative chest x-rays

3.2.1 Papers identified for the review

Table 3.2 provides a summary of the quantity of evidence and heterogeneity in the study populations, patient outcomes and quality of eligible papers reporting case series of patients having preoperative chest x-rays.

The frequency of the three outcomes varied greatly across case series:

- **An abnormal chest x-ray result was recorded in 0.3% to 65.7% of patients.**
- **A change in clinical management was recorded in 0% to 13.3% of patients.**
- **A postoperative complication was recorded in 0% to 8.8% of patients.**

3.2.2 Heterogeneity in the case series reviewed

STUDY QUALITY

Study quality was assessed, including the nature of data collection (prospective or retrospective) and recruitment (consecutive or non-consecutive). The mean proportion of abnormal test results, changes in clinical management and postoperative complications reported did not differ according to the quality of the study, ie between better and poorer quality studies.

CHARACTERISTICS OF THE STUDY POPULATION

Studies used different inclusion criteria for the age of patients considered eligible. The mean proportion of abnormal preoperative chest x-rays was highest in studies whose selected populations were adults aged 60 years or over (43.6%), followed by those which included adults only (24.9%), those which included both adults and children (20.5%) and those which included children only (6.0%). A similar pattern was observed in the mean proportion of reported changes in clinical management and postoperative complications. This pattern of increasing frequency of outcome was confirmed within 11 papers that reported their findings stratified by patients' age. The proportion of abnormalities among patients found on preoperative chest x-rays rose with patients' age in all but one of these case series. The proportion of abnormal preoperative chest x-ray findings appeared to rise most steeply between the ages of 40 and 60 years.

Only six of the 38 papers reported either the ASA grade or the distribution of ASA grade in their study populations. In the two papers that stratified the results by ASA grade, the proportion of patients with abnormal preoperative chest x-rays increased with increasing ASA grade.

TABLE 3.2 **Summary of potential sources of bias and applicability of evidence with respect to our aims across all preoperative tests**

Study characteristic	NUMBER OF STUDIES (%)									
	Chest x-ray	ECG	Haemoglobin & FBC	Haemostasis test	Biochemistry test	Urine test test	Pregnancy test	Lung function test	Blood gases test	All studies
Total number of studies	38	29	29	29	9	15	7	10	4	118
Nature of preoperative tests										
Routine only	23 (60.5)	18 (62.1)	12 (41.4)	17 (58.6)	2 (22.2)	8 (53.3)	7 (100.0)	10 (100.0)	4 (100.0)	68 (58.1)
Routine and indicated	11 (28.9)	6 (20.7)	3 (10.3)	3 (10.3)	2 (22.2)	3 (20.0)	0	0		14 (12.0)
Not stated	4 (10.5)	5 (17.2)	14 (48.3)	9 (31.0)	5 (55.6)	4 (26.7)	7 (100.0)	10 (100.0)	4 (100.0)	35 (29.9)
ASA grade stated										
ASA grades 1 and 2 only	2 (5.3)	4 (13.8)	4 (13.8)	1 (3.4)	3 (33.3)	2 (13.3)	0	0	0	9 (7.7)
ASA grades 1 to 3 only	1 (2.6)	2 (6.9)	1 (3.4)	1 (3.4)	0	1 (6.7)	0	0	0	3 (2.6)
ASA grades 1 to 3 only – stratified	0	1 (3.4)	0	0	0	0	0	0	0	1 (0.9)
ASA grades 1 to 4 only	1 (2.6)	4 (13.8)	1 (3.4)	1 (3.4)	0	0	0	0	0	4 (3.4)
ASA grades 1 to 4 only – stratified	0	0	1 (3.4)	1 (3.4)	0	0	0	0	0	1 (0.9)
ASA grades 2 to 4 only	0	0	0	0	0	0	0	0	0	0
ASA grades 2 to 4 only – stratified	0	0	0	0	0	0	0	0	0	0
ASA grades 1 to 5	2 (5.3)	1 (3.4)	1 (3.4)	1 (3.4)	1 (11.1)	0	0	0	0	1 (0.9)
ASA grades 1 to 5 – stratified	2 (5.3)	1 (3.4)	1 (3.4)	0	0	0	0	0	0	3 (2.6)
ASA grades not stated	32 (84.2)	18 (62.1)	22 (75.9)	25 (86.2)	5 (55.6)	12 (80.0)	7 (100.0)	10 (100.0)	4 (100.0)	96 (82.1)
Data collection:										
Prospective	12 (31.6)	10 (34.5)	9 (31.0)	9 (31.0)	2 (22.2)	4 (26.7)	5 (71.4)	3 (30.0)	1 (25.0)	42 (49.1)
Retrospective or not stated	26 (68.4)	19 (65.5)	20 (69.0)	20 (69.0)	7 (77.8)	11 (73.3)	2 (28.6)	7 (70.0)	3 (75.0)	
Recruitment of patients:										
Consecutive recruitment	16 (42.1)	10 (34.5)	8 (27.6)	27 (93.1)	2 (22.2)	6 (40.0)	2 (28.6)	4 (40.0)	2 (50.0)	74 (63.2)
Nonconsecutive/not stated	22 (57.9)	19 (65.5)	21 (72.4)	2 (6.9)	7 (77.8)	9 (60.0)	5 (71.4)	6 (60.0)	2 (50.0)	
Age group of study population:										
Adults > 60 years	4 (10.5)	3 (10.3)	2 (6.9)	0	1 (11.1)	1 (6.7)	0	1 (10.0)	0	8 (6.8)
Adults	13 (34.2)	15 (51.7)	3 (10.3)	7 (24.1)	3 (33.3)	5 (33.3)	1 (14.3.)	5 (50.0)	2 (50.0)	39 (33.3)
Adults and children	8 (21.1)	4 (13.8)	6 (20.7)	4 (13.8)	0	4 (26.7)	5 (71.4)	1 (10.0)	0	22 (18.8)
Children	3 (7.9)	1 (3.4)	9 (31.0)	6 (20.7)	2 (22.2)	4 (26.7)	0	0	0	15 (12.8)
Not stated	10 (26.3)	6 (20.7)	9 (31.0)	12 (41.4)	3 (33.3)	1 (6.7)	1 (14.3.)	3 (30.0)	2 (50.0)	85 (72.6)
Outcome:										
Abnormal test result	37 (97.4)	28 (96.6)	29 (100.0)	26 (89.7)	9 (100.0)	14 (93.3)	7 (100.0)	10 (100.0)	4 (100.0)	111 (94.9)
Change in clinical management	24 (68.2)	12 (41.4)	19 (65.5)	15 (51.7)	6 (66.7)	15 (100.0)	7 (100.0)	0	1 (25.0)	60 (52.3)
Postoperative complications	14 (36.8)	18 (62.1)	13 (44.8)	14 (48.3)	3 (33.3)	2 (13.3)	1 (14.3)	8 (80.0)	2 (50.0)	59 (50.4)

There was no difference in the mean proportion of patients with abnormal chest x-rays in case series that included routine tests only (17.7%) compared with series that included both routine and indicated tests (18.1%).

DEFINITIONS OF OUTCOMES OF INTEREST

The definition of an abnormal chest x-ray may have been a further source of heterogeneity. Twelve of the 37 papers that reported the proportion of patients who had an abnormal chest x-ray included a definition and the definitions were not consistent across papers. Authors did not make it clear whether their chosen definitions of abnormal chest x-rays were determined at the outset, or whether they merely reflected the abnormalities that were observed.

Definitions of what constituted a change in a patient's clinical management also varied, although only 13 of the 24 papers that reported data for this outcome specified their definitions. Six of the 13 case series included a delay in a patient's surgery or changes in anaesthetic technique as constituting a change in a patient's clinical management. In contrast, the remaining seven case series used broader definitions for a change in clinical management and were therefore likely to report higher rates of change in a patient's clinical management than the series using the narrower definition. However, as with the definition of an abnormal preoperative chest x-ray, in these seven case series the data may simply reflect changes in a patient's clinical management that occurred, rather than actions defined at the outset as representing changes in a patient's clinical management.

A total of 14 papers aimed to estimate the frequency of postoperative complications experienced by patients, but only five reported the specific complications that they observed. The postoperative complications that were reported were not consistent across case series. Again, it seems likely that these data simply reflect the complications that arose among patients, rather than complications that the researchers aimed to quantify at the outset.

3.2.3 Summary of evidence about preoperative chest x-rays

None of the papers compared the health outcomes for patients who had preoperative chest x-rays with patients who did not. The evidence cannot, therefore, directly inform the guideline. There was quite good evidence that the proportion of patients in whom abnormal chest x-rays were observed increased with age, and less good evidence that this proportion increased with comorbidity (ie ASA grade). The literature did not permit quantification of the proportion of abnormal chest x-rays by age and ASA grade because estimates were rarely stratified. These findings suggest that the value of preoperative chest x-rays may increase with a patient's age and ASA grade. However, it is important to emphasise that there is no direct evidence either that carrying out preoperative chest x-rays improves outcomes for patients or that it does not.

3.3 Preoperative ECGs

3.3.1 Papers identified for the review

Table 3.2 provides a summary of the quantity of evidence and heterogeneity in the study populations, patient outcomes and quality of eligible papers reporting case series of patients having preoperative ECGs.

The frequency of the three outcomes varied greatly across case series:

- **An abnormal ECG result was recorded in 0% to 91.4% of patients.**
- **A change in clinical management was recorded in 0% to 37.4% of patients.**
- **A postoperative complication was recorded in 0% to 22.5% of patients.**

3.3.2 Heterogeneity between the case series reviewed

STUDY QUALITY

There was little difference in the mean proportion of abnormal preoperative ECGs reported between case series where patients were recruited prospectively and those where patients were recruited retrospectively (21.8% and 22.5%,

respectively). However, the mean proportion of patients who experienced a change in clinical management or postoperative complications was greater in case series of higher quality than lower quality (5.8% and 4.9% compared with 0.5% and 1.2%, respectively).

CHARACTERISTICS OF THE STUDY POPULATION

Studies used different inclusion criteria for the age of patients considered eligible. There was no obvious trend between mean proportion of patients with abnormal preoperative ECGs and the age of the study population. However, five studies that presented results stratified by age showed that there was a positive relationship between age and the frequency of abnormalities reported.

Only 11 of the 29 papers reported either the ASA grade or the distribution of ASA grades in their study populations. There appeared to be a trend in these 11 papers for the mean proportion of patients with abnormal preoperative ECGs to rise with increasing ASA grade. This trend was supported by two case series that stratified the proportion of patients with abnormal preoperative ECGs by ASA grade and that found a clear increase with increasing ASA grade.

The mean proportion of patients with abnormal preoperative ECGs was lower in papers that specified a context of routine testing only (18.4%) than in papers that included patients who had both routine and indicated tests (37.0%).

DEFINITIONS OF OUTCOMES OF INTEREST

Eleven papers defined an abnormal preoperative ECG but used varying definitions. Definitions of a 'change in clinical management' among patients who had had a preoperative electrocardiogram also varied. All 12 papers that reported data for the latter outcome specified their definitions. For changes in clinical management, the data may simply reflect the test results and changes in clinical management that were observed, rather than actions specified at the outset.

A total of 18 papers aimed to estimate the frequency of postoperative complications among patients, but only five reported the specific complications that they observed (complications were not observed in five case series and were not specified in a further eight). The reported postoperative complications experienced by patients were not consistent across case series. Again, it seems likely that these data reflect the complications that arose, rather than complications that the researchers aimed to quantify at the outset.

3.3.3 Summary of evidence about preoperative ECGs

None of the papers compared the health outcomes for patients who underwent preoperative ECGs with patients who did not. The evidence cannot, therefore, directly inform the guideline. There was quite good evidence that the proportion of patients who had abnormal ECGs increased with age and with comorbidity (ie ASA grade). The literature did not permit quantification of the proportion of patients in whom abnormal ECGs were observed by age and ASA grade because estimates were rarely stratified. These findings suggest that the value of preoperative ECGs may increase with age and ASA grade. It should be emphasised that there is no direct evidence that carrying out preoperative ECGs would or would not improve health outcomes for patients.

3.4 Preoperative haemoglobin, haematocrit and full blood count (FBC) tests

3.4.1 Papers identified for the review

Table 3.2 provides a summary of the quantity of evidence and heterogeneity in the study populations, patient outcomes and quality of eligible papers reporting case series of patients having preoperative haemoglobin, haematocrit and FBC tests.

The frequency of the three outcomes varied considerably across case series. For example, for haemoglobin and haematocrit tests:

- **An abnormal result was recorded in 0.4% to 32.2% of patients.**
- **A change in clinical management was recorded in 0% to 6.5% of patients.**
- **A postoperative complication was recorded in 0% to 1.1% of patients.**

Similar variation was observed in the proportion of abnormal preoperative platelet and white blood cell counts; these findings are described in detail in the full review (see Appendix 1, CD ROM).

3.4.2 Heterogeneity between the case series reviewed

STUDY QUALITY

The mean proportions of abnormal preoperative haemoglobin, haematocrit and FBC tests and changes in clinical management experienced by patients were greater in case series of higher quality than those of lower quality.

CHARACTERISTICS OF THE STUDY POPULATION

Studies used different inclusion criteria for the age of patients considered eligible. The mean proportion of patients having abnormal preoperative haemoglobin, haematocrit and FBC tests was highest in study populations that included adults only compared to study populations that included children only.

Only seven of the 29 papers reported either the ASA grade or the distribution of ASA grade in their study populations. Therefore, it was not possible to investigate the effects of variations in the ASA grade of patients in the study population on the proportion of patients with abnormal preoperative haemoglobin, haematocrit and FBC tests.

Too few case series included both routine and indicated tests to be able to investigate the effect of a difference in context for testing on the proportion of patients having abnormal preoperative haemoglobin, haematocrit and FBC test results.

DEFINITIONS OF OUTCOMES OF INTEREST

Nine papers included definitions of reference ranges (ie a normal test result) for haemoglobin, haematocrit and FBC tests. The reference ranges varied across papers but the differences were small and were therefore not likely to have been a major source of heterogeneity.

Eight of the 19 papers that reported changes in patients' clinical management specified their definitions but these definitions varied.

Only two of 13 papers that aimed to estimate the frequency of patients' postoperative complications reported the specific complications that were observed. Nine papers did not observe any complications experienced by patients and two papers did not describe the complications that were observed.

3.4.3 Summary of evidence about preoperative haemoglobin, haematocrit and FBC tests

None of the papers reviewed compared the health outcomes for patients who underwent preoperative haemoglobin, haematocrit and FBC tests with patients who did not. The evidence cannot, therefore, directly inform the guideline. There was some evidence that the proportion of patients who had abnormal preoperative haemoglobin, haematocrit and FBC tests increased with age. The literature did not permit quantification of the proportion of patients with abnormal test results by age because estimates were never stratified. These findings suggest that the value of preoperative haemoglobin, haematocrit and FBC tests may increase with patients' age. However, it should be emphasised that there is no direct evidence that carrying out preoperative haemoglobin, haematocrit and FBC tests would or would not improve health outcomes for patients.

3.5 Preoperative haemostasis tests

3.5.1 Papers identified for the review

Table 3.2 provides a summary of the quantity of evidence and heterogeneity in the study populations, patient outcomes and quality of eligible papers reporting case series of patients having preoperative tests of haemostasis.

The frequency of the three outcomes varied considerably across case series:

- **Abnormal prothrombin and partial thromboplastin test results were recorded in 0.4% to 45.9% of patients.**
- **A change in clinical management was recorded in 0% to 7.3% of patients.**
- **A postoperative complication was recorded in 0% to 8.1% of patients.**

3.5.2 Heterogeneity between the case series reviewed

STUDY QUALITY

The mean proportion of abnormal preoperative prothrombin tests observed in patients was greater in case series of higher quality than lower quality. There were no clear patterns as a function of study quality for abnormal partial thromboplastin test results, changes in clinical management and postoperative complications experienced by patients.

CHARACTERISTICS OF THE STUDY POPULATION

Twelve papers did not specify the age range of the patients in their study populations. In the other 17 papers, the mean proportion of abnormal preoperative haemostasis tests was higher in case series that included adults only compared to series that included adults and children.

Only four of the 29 papers reported an ASA grade or the distribution of ASA grades in their study populations. Given the small number of case series that included patients of known ASA grade and the fact that the distribution of patients within each of the ASA categories is not known, it is difficult to interpret the data for separate ASA grade groups. However, one case series stratified the proportion of abnormal preoperative haemostasis tests according to patients' ASA grade. In this case series, the proportion of abnormal preoperative haemostasis tests increased with patients' ASA grade.

Too few case series included both routine and indicated tests to be able to investigate the effect of different contexts for testing on the proportion of abnormal preoperative haemostasis tests.

DEFINITIONS OF OUTCOMES OF INTEREST

Nineteen papers defined reference ranges for preoperative haemostasis tests. The reference ranges varied across papers, but the differences were small and were therefore unlikely to have been a major source of heterogeneity.

Fifteen papers set out to examine changes in clinical management for either prothrombin or partial thromboplastin tests. Of these, ten papers observed changes in clinical management experienced by patients. Six defined a change in clinical management as a patient requiring a blood transfusion and the other four papers used broader, and varying, definitions.

A total of 14 papers aimed to estimate the frequency of postoperative complications experienced by patients and six reported the specific complications that were observed (complications were not observed in eight case series). Three of the six papers reported peri- or postoperative bleeding as the only postoperative complication experienced by patients and three adopted broader definitions of postoperative complications.

3.5.3 Summary of evidence about preoperative haemostasis tests

No paper compared the health outcomes for patients who had preoperative haemostasis tests with patients who did not. The evidence cannot, therefore, directly inform the guideline. There was evidence from a single paper, which stratified the study population by ASA grade, that the proportion of patients who had abnormal haemostasis tests increased with comorbidity (ie ASA grade). This finding suggests that the value of preoperative haemostasis tests may increase with comorbidity. However, it should be emphasised that there is no direct evidence that carrying out preoperative haemostasis tests would, or would not, improve health outcomes for patients.

3.6 Preoperative biochemistry tests

3.6.1 Papers identified for the review

Table 3.2 provides a summary of the quantity of evidence and heterogeneity in the study populations, patient outcomes and quality of eligible papers reporting case series of patients having preoperative biochemistry tests (electrolyte, urea/creatinine and glucose tests). The frequency of abnormal results and changes in a patient's clinical management varied considerably across case series and across specific tests (see Table 3.3).

TABLE 3.3 Range of frequencies of abnormal outcomes reported by case series of preoperative biochemistry tests

	ELECTROLYTES	CREATININE/UREA	GLUCOSE
% abnormal results	0.4% to 81.3%	0.2% to 27.0%	0.4% to 71.5%
% change in clinical management	0% to 10.5%	0% to 5.5%	0% to 2.1%
% postoperative complications	0%	0.8%	0.7%

3.6.2 Heterogeneity between the case series reviewed

STUDY QUALITY

There was no clear pattern in the mean proportion of abnormal preoperative biochemistry tests, changes in clinical management and postoperative complications experienced by patients as a function of the quality of study design.

CHARACTERISTICS OF THE STUDY POPULATION

No pattern could be identified between the mean proportion of abnormal preoperative biochemistry tests, changes in clinical management and postoperative complications and the age of patients in the study population.

Only four papers reported either the ASA grade or the distribution of ASA grade in their study populations. Three papers included only patients classified as ASA grade 1 or 2 and the remaining paper included all patients, that is ASA grades 1 to 5. Given the small number of papers that included patients of known ASA grade and the lack of stratification in those that specified the ASA grades of their study populations, it was not possible to investigate whether the proportion of abnormal preoperative biochemistry tests, changes in clinical management and postoperative complications varied by ASA grade.

Five papers did not define clearly the context for testing. In the other four papers, the mean proportion of abnormal preoperative tests was lower in the two case series that included routine tests only compared to the two series that included both routine and indicated tests for all the separate biochemistry tests.

DEFINITIONS OF OUTCOMES OF INTEREST

Five of the nine papers defined reference ranges for preoperative biochemistry tests. The reference ranges varied somewhat across papers, but the differences were small and were therefore unlikely to have been a major source of heterogeneity.

Changes in clinical management were reported as a delay or cancellation of a patient's surgery in four papers and alterations in treatment in five papers. None of the papers specified their definitions of changes in clinical management in more detail.

Two papers reported definitions of postoperative complications experienced by patients. The definitions of postoperative complications reported in these two papers were not consistent.

3.6.3 Summary of evidence about preoperative biochemistry tests

No paper compared the health outcomes for patients who had preoperative biochemistry tests with patients who did not. The evidence cannot, therefore, directly inform the guideline. There was no evidence to suggest that the proportion of patients who had abnormal biochemistry tests increased with age or comorbidity (ie ASA grade). However, there was little evidence about preoperative biochemistry tests. It should be emphasised that the lack of evidence does not mean that a relationship between the proportion of patients with abnormal biochemistry tests and increasing age or comorbidity does not exist.

3.7 Preoperative urine tests

3.7.1 Papers identified for the review

Table 3.2 provides a summary of the quantity of evidence and heterogeneity in the study populations, patient outcomes and quality of eligible papers

reporting case series of patients having preoperative urine tests.

The frequency of the three outcomes varied considerably across case series:

- **An abnormal urine test result was recorded in 0.8% to 34.1% of patients.**
- **A change in clinical management was recorded in 0% to 14.3% of patients.**
- **A postoperative complication was recorded in 0% to 0.6% of patients.**

3.7.2 Heterogeneity between the case series reviewed

STUDY QUALITY

The mean proportions of abnormal preoperative urine tests and changes in clinical management reported were greater in case series of higher quality (26.6% and 6.7%, respectively) than lower quality (9.1% and 0.8%, respectively).

CHARACTERISTICS OF THE STUDY POPULATION

Papers used different inclusion criteria for the age of patients considered eligible. Six papers included adults with one of these including only adults over 60 years of age. Four papers included adults and children and four included children only. The remaining paper did not specify the age range of patients in the study population. The mean proportion of abnormal preoperative urine tests was highest in case series that included adults and children (17.4%), and lowest in series that included children only (8.6%).

Only three of the 15 papers reported either an ASA grade or the distribution of ASA grade in their study populations. Although based only on data from these three papers, the mean proportion of abnormal urine test results and changes in clinical management tended to rise with increasing ASA grade.

Four papers did not define clearly the context for testing. The mean proportion of abnormal urine tests and changes in clinical management or postoperative complications experienced by patients was lower in case series that included both routine and indicated tests compared to series that included routine tests only.

DEFINITIONS OF OUTCOMES OF INTEREST

Six papers defined reference ranges for preoperative urine tests. The reference ranges varied somewhat across papers, but the differences were small and were therefore unlikely to have been a major source of heterogeneity.

A change in a patient's clinical management was defined as a delay or cancellation of surgery in seven studies and alterations in treatment in four papers. The remaining four papers specified broader definitions of a change in clinical management and these definitions varied.

Two papers aimed to estimate the frequency of postoperative complications experienced by patients although neither reported the specific complications that they observed (one study did not observe any complications).

3.7.3 Summary of evidence about preoperative urine tests

No paper compared the health outcomes for patients who underwent preoperative urine tests with patients who did not. The evidence cannot, therefore, directly inform the guideline. There was some evidence that the proportion of patients who had abnormal urine tests increased with age and comorbidity (ie ASA grade). The literature did not permit quantification of the proportion of abnormal urine tests by ASA grade because estimates were not stratified. Although these findings suggest that the value of preoperative urine tests may increase with ASA grade, it should be emphasised that there is no direct evidence that carrying out preoperative urine tests would, or would not, improve health outcomes for patients.

3.8 Preoperative pregnancy tests

3.8.1 Papers identified for the review

Table 3.2 provides a summary of the quantity of evidence and heterogeneity in the study populations, patient outcomes and quality of eligible papers reporting case series of patients experiencing preoperative pregnancy tests.

Seven papers reported the proportion of women who had a positive test result and who experienced a change in clinical management. The proportion of preoperative pregnancy tests that were positive varied across case series and ranged from 0% to 2.2%. In all but one paper, a change in clinical management was observed in every woman who had a positive preoperative pregnancy test. Surgery was always cancelled or postponed because of the risk of fetal injury or loss. In the remaining study, one woman with a positive preoperative pregnancy test had surgery without any change in anaesthetic technique (due to the urgent nature of the operation) and suffered a miscarriage following surgery.

3.8.2 Heterogeneity between the case series reviewed

The variation in the prevalence of positive test findings may be explained by the differences in the ages of the study populations. For example, the highest rate of positive preoperative pregnancy tests (2.2%) occurred in the one study that included adults only and the lowest rate (0%) occurred in the one study that included female patients less than 16 years of age.

3.8.3 Summary of evidence about preoperative pregnancy tests

No paper compared the health outcomes for women (and fetuses) who underwent preoperative pregnancy testing with women who did not. The evidence cannot, therefore, directly inform the guideline. The proportion of women in whom positive pregnancy tests were observed increased with age. The literature did not permit quantification of the proportion of positive pregnancy tests by age because estimates were not stratified.

There were relatively few papers on preoperative pregnancy testing and none provided direct evidence that such testing would improve the outcomes for women. Nevertheless, all of the available studies observed that a positive pregnancy test either led to a decision to cancel or postpone surgery or to loss of the fetus when surgery went ahead despite the positive test result.

3.9 Preoperative sickle cell disease/trait tests

We did not identify any papers that reported primary outcome data for children or adults undergoing elective surgery who were tested preoperatively in a generic manner for sickle cell disease/trait.

3.10 Preoperative lung function tests

3.10.1 Papers identified for the review

Table 3.2 provides a summary of the quantity of evidence and heterogeneity in the study populations, patient outcomes and quality of eligible papers reporting case series of patients having preoperative lung function tests.

The frequency of the three outcomes varied greatly across case series:

- **Restrictive lung function was recorded in 15.5% to 72.7% of patients and abnormal obstructive lung function in 6.4% to 27.2% of patients.**
- **A postoperative complication was recorded in 0.3% to 24.2% of patients.**
- **The proportions of abnormal test results for separate lung function tests were as follows:**
  - **3.5% to 12.0% for forced expiratory volume;**
  - **2.4% to 15.4% for vital capacity; and**
  - **6.1% to 33.3% for the ratio of forced expiratory volume to vital capacity.**

There were no data on peak expiratory flow rates.

3.10.2 Heterogeneity between the case series reviewed

STUDY QUALITY

There were too few case series to be able to compare trends in the proportion of patients with abnormal preoperative lung function tests and postoperative complications by study quality.

CHARACTERISTICS OF THE STUDY POPULATION

Papers used different inclusion criteria for the age of patients considered eligible. There were too few case series within each of the age group categories to be able to compare trends in the proportion of

abnormal test results and postoperative complications experienced by age.

No paper reported either the ASA grade or the distribution of ASA grade in their study populations or their context for preoperative testing.

DEFINITIONS OF OUTCOMES OF INTEREST

Eight papers included a definition of an abnormal lung function test. The definitions used were not consistent. However, the differences in the definitions were small and, therefore, were unlikely to have been a great source of heterogeneity across case series.

No papers reported changes in management

Eight papers also aimed to estimate the frequency of postoperative complications experienced by patients and all reported the specific complications that they observed. The postoperative complications reported were not consistent across case series.

3.10.3 Summary of evidence about preoperative lung function tests

None of the papers reviewed compared the health outcomes for patients who had preoperative lung function tests with patients who did not. The evidence cannot, therefore, directly inform the guideline. There was insufficient evidence to investigate whether the proportion of abnormal lung function tests increased with age or with comorbidity (ie ASA grade).

3.11 Preoperative blood gas tests

3.11.1 Papers identified for the review

Table 3.2 provides a summary of the quantity of evidence and heterogeneity in the study populations, patient outcomes and quality of eligible papers reporting case series of patients undergoing blood gas testing.

The frequency of abnormal blood gases varied across case series from 0% to 22.0% of patients.

No patients were observed to undergo a change in their clinical management. The proportion of patients who suffered postoperative complications ranged from 1.8% to 5.1%.

3.11.2 Heterogeneity between the case series reviewed

STUDY QUALITY

There were too few case series to be able to compare trends in the proportion of abnormal blood gas results and postoperative complications experienced by patients by study quality.

CHARACTERISTICS OF THE STUDY POPULATION

Papers used different inclusion criteria for the age of patients considered eligible. However, there were too few case series within each of the age group categories to be able to investigate trends in the proportion of abnormal preoperative blood gas results and postoperative complications experienced by patients by age.

None of the four papers reported either an ASA grade or the distribution of ASA grades in the patients in their study populations or the context in which preoperative testing was carried out.

DEFINITIONS OF OUTCOMES OF INTEREST

Three papers included a definition of an abnormal blood gas test. The definitions used were not consistent across papers. However, the differences in the definitions were small and were unlikely to have been a great source of heterogeneity between case series.

Only one paper reported changes in clinical management in patients who had abnormal results. This case series did not specify a definition of what constituted a change in clinical management.

Two papers estimated the frequency of postoperative complications experienced by patients and both reported their definitions of postoperative complications. Different postoperative complications were reported in the two papers. Summary of evidence about preoperative blood gas testing

No paper reviewed compared the health outcomes for patients who had preoperative blood gas tests with patients who did not. The evidence cannot, therefore, directly inform the guideline. There was insufficient evidence to investigate whether the

proportion of patients who had abnormal blood gases increased with age or with comorbidity (ie ASA grade).

Reference

1 Munro J, Booth A, Nicholl J. Routine preoperative testing: a systematic review of the evidence. *Health Technol Assess* 1997;**1**(12).

4. Interview Results: Testing the Assumptions

As described in Section 2.3.1, there was a need to survey clinical opinion about a number of relevant issues about which there appeared to be little or no evidence and that were not addressed by the systematic review. This chapter summarises the interviews with a sample of ten consultant anaesthetists and ten trainee surgeons. Further details of the content of the interviews are available from the National Collaborating Centre for Acute Care. (Contact details are given at the beginning of this report.)

4.1 Interview part 1: reasons for testing

Interviewees were asked to list the main reasons why, in their opinion, preoperative tests were carried out. Their responses are summarised under five main headings below. Interviewees maintained that preoperative testing was sometimes carried out for the reasons stated although they did not necessarily consider that these were all legitimate reasons.

The trainee surgeons and consultant anaesthetists were asked specifically whether the following were legitimate reasons for carrying out preoperative tests:

- **predicting/preventing postoperative complications;**
- **advising the patient/informing the carer if there is an increased risk to the procedure so that the patient's preferences and values can be factored in to decision making;**
- **documenting information in case of an adverse event (defensive practice);**
- **deciding if any additional tests are necessary; and**
- **planning the anaesthetic technique and postoperative care.**

Their responses are summarised in Sections 4.1.1 to 4.1.5.

4.1.1 Predicting or preventing postoperative complications

Most interviewees agreed that predicting or preventing postoperative complications was a legitimate reason for preoperative testing. The trainee surgeons and consultant anaesthetists were asked what changes in clinical management might arise following an abnormal preoperative investigation result. The results are shown below.

Changes in clinical management that might arise following an abnormal preoperative investigation result

1) Optimising the clinical management of patients to:

a) predict complications (both peri- and postoperative) with the aim of minimising harm to the patient as a result of surgery;

b) provide information, in addition to the clinical assessment, to better establish potential risks;

c) allow preoperative optimisation and to ensure surgery is being carried out in the best possible environment;

d) detect correctable physiological abnormalities;

e) identify patients who may require a change in anaesthetic technique so that, for example, a patient scheduled for general anaesthetic can have a regional anaesthetic instead to reduce the risk of harm to the patient;

f) prepare the patient for their particular type of surgery;

g) establish the physiological status or 'reserve' of the patient, ie to check that a patient is fit for anaesthesia and surgery; and

h) identify patients at a higher risk than normal from the anaesthesia and surgery.

2) Planning care for patients (to benefit both patients and health services) to:

a) identify patients who might need special care after surgery, eg high dependency unit (HDU), intensive care unit (ICU) and to be able to book the bed in readiness;

b) aid planning, for example to schedule sicker, more complicated cases at the beginning of the week, when staff and facilities are more readily available, rather than at weekends;

c) confirm the feasibility of the planned surgery;

d) assess whether the planned procedure is appropriate and possible; and

e) avoid cancellation on the day of surgery.

3) Informing patients about changes in risk and obtaining consent

a) provide an opportunity to counsel the patient and their family so they are fully informed of the risks of the procedure.

4) Opportunistic 'screening' to:

a) maintain public expectation –the idea that in a hospital environment they will get a 'good check up'; and

b) general assessment of patients.

5) Other reasons

a) Defensive medical practice, ie 'just in case something were to go wrong'.

b) Reassure clinicians.

c) Act as a baseline reference for establishing preoperative standards.

Interviewees were asked what they hoped to achieve by changing a patient's clinical management following an abnormal preoperative investigation result . Their responses are below.

Changes in clinical management that interviewees suggested might arise following an abnormal preoperative investigation result

1) Referral to another specialist.
2) Cancellation or postponement of surgery.
3) Change in the surgical procedure.
4) Change in the anaesthetic technique.
5) Prescription of a new medication.
6) Provision of physiotherapy.
7) Change in existing medication.
8) Proactive (rather than reactive) preparation for possible events during surgery.
9) Correction of physiological abnormalities, eg anaemia, hypertension.
10) Administering a blood transfusion.
11) Planning for higher levels of post-operative care, eg HDU.
12) Planned overnight admission for patients previously scheduled as 'day cases'.

Interviewees also listed events that they were trying to avoid by carrying out specific preoperative tests. These responses are summarised below.

Events that interviewees hoped to avoid or reduce by changing clinical management following an abnormal result of a preoperative investigation

1) Deaths or near misses.
2) Putting patients in a situation where they are more likely to die or suffer a common complication as a result of surgery.
3) Adverse cardiovascular, respiratory and neurological events.
4) Intraoperative blood loss.
5) Unnecessary invasive tests.
6) Cancellation on day of surgery.
7) Overnight admission for day case patients.
8) Carrying out unnecessary surgery.
9) Complications in patients where there may be previously unknown problems, eg malignancy.

4.1.2 Advising the patient/informing the carer if there is an increased risk to the procedure so that the patient's preferences and values can be factored in to decision making

Interviewees agreed that further discussion with a patient, or counselling arising from an abnormal preoperative investigation result, does not in itself constitute a change in management. However, they recognised that such discussion may lead to a change in clinical management that may result in a change in relationship with the patient or delay surgery.

Events listed by interviewees that could be avoided, identified or planned for by carrying out specific preoperative tests

Haemoglobin

- Anaemia (underlying cause of anaemia needs to be identified before any surgery).
- Intraoperative hypoxia or increased cardiac workload.
- Myocardial infarction or cerebrovascular accident.
- Delayed healing.

White blood cell count

- Earlier identification of evidence of underlying infection, which may alter management and avoid a last minute change in anaesthesia or cancellation of surgery.

Urea and electrolytes

- To identify underlying (chronic) renal insufficiency and, therefore, to avoid the patient going into acute renal failure following major general surgery by closer monitoring of urinary output, insertion of a catheter, renal assessment, preoperative perfusion scan, ultrasound or angiography, or a change in medication.

Liver function test

- Detect underlying malnutrition, especially in patients having ASA grade 3 or 4 surgery, which may affect the patients ability to heal.

Calcium test

- To detect an underlying malignancy.

Cross matching

- Urgent cross matching; a requirement for blood transfusion needs to be anticipated with major surgery to avoid a high demand for haematology services and potential error.

Chest x-ray

- To rule out infection and avoid a last minute change in anaesthetic or a delay or cancellation of surgery (especially in patients with a history of smoking, chronic obstructive pulmonary disease or emphysema) .
- Diagnosis of poor response to general anaesthesia.
- Advising the patient of the higher risk of medical complication following surgery.
- Planning for postoperative physiotherapy

Electrocardiogram (ECG)

- To identify patients with silent myocardial infarction.
- To provide a preoperative baseline against which to interpret postoperative cardiac events.

Interviewees stated that counselling aims to inform the patient and their family or carer about any abnormal preoperative test results, the implications of the results with respect to any increased risk of the procedure and any treatment needed to correct the abnormality. The patient and their family can then share the decision about whether or not to go ahead with the surgery after balancing the risk and benefits of the planned procedure. Counselling aims to ensure that the patient and their family understand the risks of the procedure so that they can give their fully informed consent to the procedure.

Some trainee surgeons felt they were educating the patient so that an informed decision could be made jointly with the patient, whilst other surgeons felt that the burden of the decision rested with them, but that they were guiding the patient through the decision-making process.

4.1.3 Documenting information in case of an adverse event (defensive practice)

Most surgeons felt that defensive practice was not a legitimate reason for doing preoperative tests. However, they acknowledged that many preoperative tests are carried out for this reason and that junior staff, ie senior house officers, are more likely than senior staff to order more tests to 'cover their own backs'. However, these junior doctors often have to work across different anaesthetic teams led by consultants with preferences for different preoperative tests. Therefore the perception of over-testing may, in part, arise from junior doctors trying to ensure that the information required by an anaesthetist's team is available, whichever team happens to be responsible for a patient.

4.1.4 Deciding if any additional tests are necessary

Most trainee surgeons felt that the decision to order additional tests following the result of a generic preoperative test constituted a change in clinical management because the outcome of the additional tests may change what happens subsequently, eg delay the next step in the patient's care.
A minority of the trainee surgeons felt that the decision to carry out additional tests did not constitute a change in clinical management in itself, but that the decision may lead to a change in clinical management. Most of the anaesthetists agreed that the decision to do additional tests constituted a change in clinical management.

Interviewees commented that the additional tests ordered are likely to depend on the generic test found to be abnormal and the nature of the abnormality. Examples of additional tests listed by interviewees included additional radiology (eg computed tomography scans), blood film, bone marrow aspiration and biopsy tests, liver function tests, respiratory function tests, thyroid function tests, exercise ECG, angiogram and echocardiogram.

4.1.5 Planning the anaesthetic technique and postoperative care

All the trainee surgeons and consultant anaesthetists agreed that alteration of the planned anaesthetic constituted a change in clinical management.

The planned anaesthetic may be changed from a general anaesthetic to a regional anaesthetic. For example, a spinal anaesthetic rather than a general anaesthetic may be more appropriate for patients found to have respiratory or cardiac problems. However, spinal anaesthesia would not be used for a patient found to have abnormal clotting or a low white blood cell count because of the risk of sepsis or haematoma around the spinal cord. There are less obvious ways in which the anaesthetic management of a patient may be changed, including giving a shorter acting drug, giving drugs that decrease secretions during the operation, keeping the patient's blood pressure at a higher level than usual to maintain organ perfusion, being especially vigilant about the patient's fluid output, giving cardio-protective drugs, deciding to admit the patient to ICU) or HDU after surgery rather than to a normal ward.

Interviewees said that the aims of changing the planned anaesthetic technique are to avoid death, cardiac and pulmonary compromise, perioperative myocardial infarction, peri-and postoperative infection, deep vein thrombosis, sickle cell crisis (in a patient with sickle cell trait), excessive blood loss, admission to ICU or HDU, or a prolonged hospital stay.

4.2 Interview part 2: physiological models

4.2.1 Question A: 'Is there a need to carry out a test preoperatively for some operations but not for others?'

All trainee surgeons agreed that the need to carry out a test preoperatively depends on the operation. However, they added that the need to carry out the test also depends on the patient. All anaesthetists agreed that the need to carry out a test before surgery depends on the operation as physiological stress response is greater with more severe procedures, ie procedures with increasing blood loss expected.

The trainee surgeons and consultant anaesthetists were asked to suggest how operative severity should be classified. Their responses were as follows:

- Existing scales, such as the 'operative severity score' of the POSSUM system(a Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity1) and the BUPA system for classifying operations, are not sufficient measures of operative severity. The POSSUM operative severity score is intended only for general surgical procedures and includes variables that have to be assessed intraoperatively, eg blood loss and peritoneal soiling. The score also includes an 'operative severity' component graded on a four-point scale from 'minor' to 'major+'; and although the scale is illustrated by providing examples of operations for each grade, classification appears to be subjective. The BUPA scale is designed to reward the degree of surgical expertise required for an operation rather than the degree of physiological stress to the patient; thus complex ophthalmological procedures have the same grade as some procedures requiring a laparotomy.
- The severity of a surgical procedure can be graded by taking into account the following factors: type and duration of procedure, the organ systems involved, the type of anaesthesia, the seniority of surgeon required to perform the operation, the potential for blood loss perioperatively, the potential for infection and the expected length of the postoperative recovery period.

4.2.2 Question B: 'What constitutes a surgical procedure?'

Interviewees were asked this question because of the increasingly blurred boundaries between therapeutic and diagnostic procedures and between therapeutic procedures carried out by surgeons and by physicians (eg interventional radiology, endovascular treatments) for the same or similar conditions. Interviewees struggled to provide concise definitions, as illustrated by the following examples of their responses:

- an invasive procedure performed on a patient that involves making an incision;
- an invasion of the body in some way, not necessarily requiring anaesthesia;
- any invasive procedure carried out on a patient involving instrumentation or an anaesthetic;
- any procedure performed by a surgeon, gynaecologist or physician;
- a procedure performed in a surgical theatre setting;
- a procedure with an element of cutting or incision;
- any invasive procedure carried out on a patient by a person with approved qualification and training;
- a procedure carried out by a surgeon with or without an anaesthetist present that almost invariably takes place in an operating theatre;
- any procedure that involves a surgeon with or without an anaesthetist;
- any invasive or noninvasive intervention performed on a patient by an authorised practitioner irrespective of its complexity following fully informed consent;
- an invasive procedure carried out in an operating theatre or critical care unit; and
- any procedure that can result in complications necessitating the intervention of a trained surgeon or likely need of conversion of the procedure to one where a full anaesthetic is required.

4.2.3 Question C: 'Are smoking and obesity unimportant factors in patients classified as ASA grade 1?'

Interviewees were asked whether smoking and obesity are unimportant if their severity is not sufficient to result in a patient being assigned an ASA grade of 2 or above. Their responses were as follows:

- Four trainee surgeons agreed that smoking and obesity were unimportant in patients classified as ASA grade 1. They felt that smoking and obesity should always be considered but that these factors by themselves would not put the patient at a significantly increased risk from surgery. One anaesthetist also felt that smoking and obesity alone were not indications for

carrying out preoperative investigations in patients classified as ASA grade 1.

- **Conversely, eight trainee surgeons felt that smoking and obesity were still important factors in patients classified as ASA grade 1. They justified this opinion by stating that overweight patients and smokers have poorer outcomes than nonobese patients and nonsmokers, for example in terms of infection, wound breakdown and postoperative respiratory problems. Nine of the anaesthetists also felt that smoking and obesity were very important factors affecting the need for preoperative investigations because the physiological reserve of smokers and obese patients can be lower.**

4.2.4 Question D: 'Are preoperative investigations required only because of the risks of a general anaesthetic?'

All interviewees responded that there are risks with regional anaesthetics and risks during surgery as well as risks of general anaesthesia.

Interviewees were asked what is meant by regional anaesthesia. They defined it as a method of providing an environment for safe, painless surgery on a specific part of the body without altering the patient's consciousness. Examples given by interviewees included epidural, spinal, Bier's block, brachial plexus block, femoral block and three in one block.

Interviewees were asked whether there are risks from regional anaesthesia that might also be highlighted by preoperative investigations. They consistently responded that regional anaesthesia can be as physiologically stressful for the patient as general anaesthesia. Risks of regional anaesthesia were stated as including death, cardiac toxicity, bleeding, paralysis and arrhythmias. However, interviewees also said that such events are rare and preoperative tests may not highlight an increased risk. They also commented that certain conditions are possible contraindications to some regional anaesthetic techniques, such as aortic stenosis, ischaemic heart disease and clotting difficulties.

The suggestion had been made in the Guideline Development Group (GDG) that an anaesthetic team always had to be prepared to give a general anaesthetic, even if regional anaesthesia were planned, because of the possible need to convert from regional to general anaesthesia.

Interviewees were asked whether there are circumstances in which conversion from regional to general anaesthesia would *not* occur. Their responses were as follows:

- **Conversion from regional to general anaesthesia is rare. It is important to consider what procedures the patient has consented to. Regional anaesthesia my have been planned because the patient has comorbidities that increase the risk of general anaesthesia; if the risk of general anaesthesia were too great, conversion would not occur.**
- **It is possible, but unlikely, that conversion from regional to general anaesthesia would not occur because of a patient's airways problem.**
- **When an anaesthetist is not present, as in the case for many minor operations under local anaesthetic.**
- **Conversion from regional to general anaesthesia would not occur if the patient were not properly prepared (eg starved).**

4.3 Interview part 3: sickle cell testing

Interviewees were asked if there is a need to test for haemoglobinopathies other than sickle cell disease. They said that they do not need to test 'routinely' for haemoglobinopathies other than sickle cell disease. Clinical history will provide indications of the need to test for other haemoglobinopathies, eg thalassaemia.

Next, interviewees were asked about the need to test for sickle cell disease in patients from a wide range of ethnic groups. They were also asked whether the need to test depended on the degree of relatedness to the 'at risk' ethnic group, ie one or both parents, number of grandparents. Knowledge of the prevalence of sickle cell trait in different ethnic groups varied among interviewees, depending on the extent of their experience of working in hospitals with ethnically diverse catchment populations.

Therefore, opinions about at risk ethnic groups varied, with some interviewees admitting that they had little expertise on which to base their opinions. However, they consistently said that the need to test did not depend on the degree of relatedness.

The trainee surgeons and consultant anaesthetists were then asked whether the need to test for sickle cell disease changed according to other operative risk factors such as age or type of surgery and, if so, what were the factors and how they interacted. Their responses were as follows:

- **The majority of the trainee surgeons said that the need to test for sickle cell disease preoperatively does not change according to the patient's age.**
- **A minority felt that the need to test for sickle cell disease does change with age because older patients with normal haemoglobin levels are very unlikely to have sickle cell disease.**
- **Severity of surgery was felt to be an important determinant of the need to test for sickle cell disease preoperatively; two trainee surgeons suggested that sickle cell testing is not required for minor procedures carried out under regional anaesthesia.**
- **Type of surgery was also considered to be important; some interviewees said that sickle cell testing is necessary if a tourniquet is to be used or if a general anaesthetic is to be given.**
- **Some interviewees stated that the likely duration of the procedure may effect the decision on whether or not to test for sickle cell disease**

4.4 Interview part 4: pregnancy testing

The trainee surgeons and anaesthetists were asked if they felt there is a need to carry out generic preoperative pregnancy tests for female patients of reproductive age undergoing surgery. Their responses were as follows:

- **One trainee surgeon and one anaesthetist stated that all female patients of reproductive age should have a preoperative pregnancy test unless pregnancy is impossible, eg a patient has had a hysterectomy.**
- **Eight trainee surgeons felt that it was unnecessary to test all female patients of reproductive age for pregnancy, although a patient should be advised of the risks to the fetus and a test should be offered to any woman who thinks that it is possible that she may be pregnant.**
- **Six of the anaesthetists felt that preoperative pregnancy testing was unnecessary unless, having been advised of the risks to a fetus, the patient volunteered the possibility that she might be pregnant.**
- **One anaesthetist felt that the need for preoperative pregnancy testing depends on the type of surgery.**

Interviewees who said that there is a need to test all female patients of reproductive age were also asked to suggest how they would approach the issue of consent to test with patients less than 16 years of age. They said that they would explain to the patient and her parents that all female patients of reproductive age are recommended to have a pregnancy test because of the risk of general anaesthesia to a fetus.

Reference

1 Copeland GP, Jones D, Walters M. POSSUM: a scoring system for surgical audit. *Br J Surg* 1991;**78**:355-360.

5. Consensus Results

5.1 Membership of consensus panels

Four multidisciplinary groups were assembled (two groups for each phase of the guideline development). The table below shows the range of expertise represented in each group and the dates on which the meetings were held. The consensus methods are described in more detail in Chapter 2.

5.2 Development of the consensus questionnaire

The consensus questionnaires and the distribution of responses by panellists for each phase are shown in Appendix 3 (Phase A) and Appendix 4 (Phase B).

5.3 First round of consensus

Most panellists were able to complete and send back the questionnaire in time for the consensus meeting. A small number of participants failed either to fill in the questionnaire or to attend the meeting. This limitation led to some clinical specialities being under-represented, as indicated by the gaps in Table 5.1.

5.4 Second round: consensus meetings

The responses of panellists who failed either to fill in the questionnaire or to attend the meeting were excluded from the analysis. The fact that some panellists were unable to attend a meeting, or attend only half a meeting, may have affected the consensus reached.

TABLE 5.1 Membership of the consensus panels

	PHASE A (ASA GRADE 1)		PHASE B (ASA GRADE 2 OR 3)	
	5 March 2002 Group 1 (n=7)	8 March 2002 Group 2 (n=11)	16 April 2002 Group 1 (n=11)	22 April 2002 Group 2 (n=10)
Anaesthetist	1	4	3	3
Paediatric Anaesthetist	1	1	1	1
Radiologist	1	-	1	-
Pathologist – Haematologist	1	1	1	1
Pathologist – Biochemist	1	1	1	1
Cardiologist	-	1	-	1
Surgeon – Trainee	1	1	1	1
Surgeon – General	-	-	1	1
Surgeon – Obstetrics and Gynaecology/Orthopaedic	-	1	1	-
Nurse Practitioner	1	1	1	1

5.5 Presentation of results

The results of the consensus for Phase A (patients classified as ASA grade 1) and Phase B (patients classified as ASA grades 2 or 3) are presented in the tables that follow. The tables show the level of consensus reached in relation to each generic preoperative test and for different groups of patients with comorbidities of cardiovascular disease (CVD), respiratory disease and renal disease. The degree of consensus was classified as (also see Table 2.5 and Section 5.7):

≥ 75% consensus	**YES**	**DO** carry out the test; it is appropriate to do so.
≥ 75% consensus	**NO**	**DO NOT** carry out the test; it is not appropriate to do so.
< 75% consensus	**UNCERTAIN**	The value of carrying out a preoperative test is **UNCERTAIN** and may depend on the specific characteristics or circumstances of patients.

The degree of consensus was defined using results from both groups in each phase. Therefore, if one group had reached 100% consensus that the test was appropriate and the other panel had not reached consensus, the overall degree of consensus is shown to be uncertain. A key to definitions of different degrees of consensus is provided in Section 5.7

In addition to the tables, opinions expressed by panellists are included under each table to highlight the main areas of discussion during consensus meetings. This information helps to explain some of the complexities of making decisions about appropriateness in some situations and why there may have been a lack of consensus. It is important to point out that these comments have been included here to help to explain the lack of consensus. They are not 'evidence-based statements' and they do not represent the conclusions of the group. They simply represent the opinions of one or more panellists.

5.6 General comments and assumptions made by the panellists

1. Panellists recommended that, due to the lack of high quality evidence about the benefits and harms of preoperative testing and the uncertain degree of consensus, the effects of implementing this guideline should be audited. The audit findings should be fed back to the GDG for future revision of the guideline.

2. The need for preoperative tests is usually prompted by clinical assessment. Tests are rarely necessary on a routine basis only. The panel stressed the importance of carrying out a thorough clinical assessment and taking a detailed history from the patient. Where consensus was reached, the panel assumed that these steps have been carried out by someone with sufficient experience to identify relevant signs and symptoms. It should be noted that there was a general perception among panellists that preoperative testing may sometimes be used to cover up inadequacies of history taking and examination at preoperative assessment.

3. Panellists assumed that preoperative test results are examined by someone with appropriate clinical competence before the patient returns to hospital for surgery.

4. In Phase B (ASA grade 2 or 3), panellists often found it difficult to make a decision about the appropriateness of testing for all patients in one stratum of the classification matrix, eg patients aged 60 to 80 years, classified as ASA grade 2 due to cardiovascular comorbidity undergoing grade 3 surgery. Panellists often commented that the decision to test frequently depends on the aetiology of the disease and medications, ie the specific factors that cause a patient to be classified as ASA grade 2 or 3.

5. Some panellists were unsure how to answer the questions for the younger age group (16 to 40 years) since patients in this age group may include people with congenital disease. Consequently, panellists again found it difficult to make a decision about the appropriateness of testing that applied to all patients in this age group.

5.7 Definitions of consensus and key to the results tables

CODE	DEFINITION
	INAPPROPRIATE
No[1]	'No' indicates a consensus in both groups that the test is considered **INAPPROPRIATE**
No[2]	'No' indicates a consensus in both groups that the test is considered **INAPPROPRIATE**
	UNCERTAIN
a	(a) ONE group reached consensus that the test is APPROPRIATE, but the other group was UNCERTAIN
b	(b) ONE group reached consensus that the test is NOT APPROPRIATE, but the other group was UNCERTAIN
c	(c) BOTH groups were UNCERTAIN
d	(d) BOTH group reached consensus, but ONE group agreed it was APPROPRIATE and ONE group agreed it was INAPPROPRIATE
	APPROPRIATE
Yes[2]	'Yes' indicates a consensus in both groups that the test is considered **APPROPRIATE**
Yes[1]	'Yes' indicates a consensus in both groups that the test is considered **APPROPRIATE**

1 indicates the top level of consensus – 100% consensus in both groups.
2 indicates the secondary level of consensus – consensus was reached in BOTH groups but was only 75% in at least ONE group.

Both in this chapter and the next, 'traffic light' colours are used to emphasise the degree of consensus in the tables, ie red shading indicates consensus that a test is inappropriate, green shading indicates consensus that a test is appropriate and yellow shading indicates uncertain consensus and that a test may be appropriate in some situations. The category 'uncertain' means that clinicians responsible for making recommendations to patients about preoperative testing should *consider* whether the test in question is appropriate, given the particular characteristics and circumstances of an individual patient. In this chapter, two levels of consensus are distinguished using dark and light shades of red and green. In the following chapter describing the specific recommendations of the guideline, these two levels of consensus are combined.

5.8 Chest x-ray (radiograph)

Adults

The general consensus was that a chest x-ray should only be carried out when there was a documented clinical or surgical indication and that the exposure to radiation needs to be considered. However there was less certainty about testing patients over 60-years-old because it may become more difficult to assess functionality, and hence more difficult to accurately assign ASA grade.

TABLE 5.2 Chest x-ray for ASA grade 1 children and adults

	AGE CATEGORIES (YEARS)								
Grade of surgery	<6 months	6 to <12 months	1 to <5	5 to <12	12 to <16	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	No[2]	No[2]	No[2]	No[2]	No[1]	No[1]	No[1]	No[1]
2	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]
3	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	c	c
4	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	c	c
Neurosurgery	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	c	c
Cardiac surgery	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[1]	Yes[1]	Yes[1]	Yes[1]

Table 5.2 shows the degree of consensus for carrying out a preoperative chest x-ray in children and adults classified as ASA grade 1. For ASA grade 1 adults, there was a divergence of views for patients over 60-years-old. This lack of consensus arose partly because some panellists suggested it may be useful to test patients over 60 years of age. These panellists believed that these patients, particularly those who smoke, have an increased likelihood of having undetected heart disease, which might not be picked up during a preoperative clinical assessment.

Nevertheless, panellists agreed that it is inappropriate to carry out a chest x-ray on the basis of age alone, unless there is a clinical indication to carry out the test, for example the patient is a smoker. Panellists maintained this opinion for more elderly patients (over 75 years), for whom the risk from a general anaesthetic is a more serious consideration. When panellists considered more major surgery (grades 3 and 4), they also felt it was not appropriate to test a normal healthy patient, even over 80 years of age, unless there is a clinical indication from the type of surgery (eg cardiac surgery or cancer surgery), or signs and symptoms. Some of the uncertainty about the appropriateness of carrying out a chest x-ray for older patients arose from the perceived difficulty in assigning an ASA grade.

Panellists discussed the need to weigh up the benefit of detecting a previously undetected abnormality in a healthy patient with the risk associated with exposure to radiation. They also considered the risk and inconvenience to the patient of over testing (especially if a false positive result is found), given that it is rare to find unexpected findings through a chest x-ray without some other clinical indication.

Royal College of Radiology guidelines suggest that a preoperative chest x-ray is not necessary unless the anaesthetist requires one or the patient is likely to be admitted to the intensive care unit (ICU) after surgery.

Echocardiography, which does not involve exposure to radiation, may be considered more appropriate than chest x-rays in certain cases, although it is not as easily obtained. Again, panellists believed that it should only be carried out for patients in whom there is a specific clinical indication.

In summary, the decision to carry out a preoperative chest x-ray depends on the patient's clinical history (eg smoking, asthma) and the condition necessitating surgery. Many patients will already have had a chest x-ray in their clinical work-up.

Children

Both groups agreed that there was no benefit in testing children except where there is a surgical indication, eg for children with congenital anomalies undergoing cardiac surgery. Children are a difficult group to categorise with respect to comorbidity because ASA grades are not always relevant. Children are unlikely to have acquired undetected CVD or respiratory disease and most comorbidities will be the result of congenital problems. For children undergoing cardiac surgery, a chest x-ray should already have been done. Therefore, panellists concluded that a preoperative chest x-ray would only be carried out as a disease-related investigation.

Surgical indications

Panellists suggested that some specific types of surgery, listed below, may indicate the need for a preoperative chest x-ray (ie nongeneric preoperative testing).

- **All abdominal, thoracic and cardiac surgery, and some oesophageal surgery.**
- **Thyroidectomy and other head and neck surgery.**
- **Neurosurgery (because of prolonged anaesthesia and the need for intensive care after surgery).**
- **Lymph node surgery.**

However, panellists noted that a chest x-ray may already have been carried out as part of the work up for the operation, in which case it would not be necessary to carry out another chest x-ray.

5.1.1 ASA grade 2 and 3 adults with comorbidity from CVD

Tables 5.3 and 5.4 show the degree of consensus for carrying out a preoperative chest x-ray in patients with CVD classified as ASA grade 2 or 3. The tables indicate a divergence in views between consensus panels. For ASA grade 3 patients, one panel agreed that, other than for grade 1 surgery, a chest x-ray would be appropriate; the other group did not

reachconsensus. Some panellists suggested that it may be appropriate to carry out a chest x-ray to provide a baseline assessment, especially if a patient is referred to ICU after surgery.

One group thought that the appropriateness of a preoperative chest x-ray in this group of patients depends on the specific symptoms that a patient presents with at the preoperative assessment clinic. For example, it was suggested that if a patient classified as ASA grade 3 has signs of congestive heart failure, then a chest x-ray would be indicated. Some patients will have had a chest x-ray as part of the clinical work up before the operation; if a chest x-ray has been carried out within the last six months, it would be inappropriate to carry out another chest x-ray unless indicated by changes in the patient's signs and symptoms. Echocardiography may generally be a more useful test for patients with CVD comorbidity.

TABLE 5.3 Chest x-ray for ASA grade 2 adults with comorbidity from CVD

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	b	b	b
2	b	b	d	d
3	b	b	d	d
4	a	a	a	a

TABLE 5.4 Chest x-ray for ASA grade 3 adults with comoribidity from CVD

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	c	c	c	c
2	a	a	a	a
3	a	a	a	a
4	a	a	Yes[2]	Yes[2]

5.1.2 ASA grade 2 and 3 adults with comorbidity from respiratory disease

Tables 5.5 and 5.6 show the degree of consensus for carrying out a preoperative chest x-ray in patients with respiratory disease classified as ASA grade 2 or 3. Some members of the panel argued that chest x-rays may be appropriate if there has been a diagnosis change with age (eg from asthma to chronic lung damage such as bronchitis or chronic obstructive pulmonary disease). Progression of disease or the need for ventilator support were also considered to be indications to carry out a chest x-ray.

TABLE 5.5 Chest x-ray for ASA grade 2 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	b	b	b
2	b	b	b	d
3	d	d	d	a
4	d	d	a	a

TABLE 5.6 Chest x-ray for ASA grade 3 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	a	a	a	a
2	a	a	a	a
3	a	a	a	a
4	a	a	Yes[2]	Yes[2]

5.1.3 ASA grade 2 and 3 adults with comorbidity from renal disease

Tables 5.7 and 5.8 show the degree of consensus for carrying out a preoperative chest x-ray in patients with renal disease classified as ASA grade 2 or 3. Although the tables show some disagreement between the two panels, there was general agreement that it was not necessary to test this group of patients. Panellists believed that the appropriateness of testing depends on the nature of the renal disease. For example, a chest x-ray may be indicated in renal patients who have other related comorbidities such as hypertension or heart failure.

TABLE 5.7 Chest x-ray for ASA grade 2 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[1]	No[1]	No[2]	b
2	No[1]	No[1]	b	b
3	b	b	b	b
4	b	b	b	b

TABLE 5.8 Chest x-ray for ASA grade 3 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	No[2]	b	b
2	b	b	b	b
3	a	a	a	a
4	a	a	a	a

5.9 Resting electrocardiogram (ECG)

Both groups reached consensus at extremes of age and surgical severity, with the appropriateness of carrying out a preoperative ECG clearly increasing with a patient's age (eg for patients over 60 years). Being a smoker was considered to be an important indication in all grades of surgery and the consensus ratings shown are for nonsmokers. For example, panellists considered that asymptomatic CVD is relatively common in postmenopausal women and in male smokers aged 40 years and over and that these patients should therefore have a preoperative ECG.

The consensus findings for children and adults classified as ASA grade 1 are shown in Table 5.9 and demonstrate that the appropriateness of a preoperative ECG was felt to depend primarily on age. Panellists agreed that everyone over the age of 60 years should have a routine ECG, regardless of comorbidity. An ECG is a noninvasive test, is easy to do and abnormalities are found quite often in apparently healthy patients. However, not all abnormalities present an increased operative risk to the patient and would not always indicate that there should be a change in clinical management, unless there were a corresponding clinical finding.

5.1.1 ASA grade 1

Adults

Panellists found it difficult to decide whether to test patients between 40 and 60-years-old; the age cut-off for testing varied from 40 to 65 years for individual panellists. Most panellists believed that testing would only be appropriate in patients under 60 if there was a clinical indication, eg the patient was asthmatic or a smoker.

Appropriateness was not perceived to depend on grade of surgery, with the exception of cardiac surgery (nongeneric testing). However, panellists pointed out that an ECG would already have been carried out in patients undergoing cardiac surgery as part of the assessment of the heart condition prior to the decision to operate. For cardiac surgery, preoperative ECGs are important for assessing cardiac ischaemia and dysrhythmia.

TABLE 5.9 ECG for ASA grade 1 children and adults

	AGE CATEGORIES (YEARS)								
Grade of surgery	<6 months	6 to <12 months	1 to <5	5 to <12	12 to <16	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	b	a	Yes[2]
2	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	c	a	Yes[2]
3	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	c	Yes[2]	Yes[2]
4	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	c	Yes[2]	Yes[2]
Neurosurgery	No[2]	No[2]	No[2]	No[2]	No[2]	b	c	Yes[2]	Yes[2]
Cardiac surgery	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[1]	Yes[1]	Yes[1]	Yes[1]

Children

Panellists agreed that a preoperative ECG is inappropriate for a child unless there is a specific indication, eg cardiac surgery. A preoperative ECG may be useful in a child undergoing cardiac surgery (nongeneric testing) to provide a baseline assessment. Some panellists commented that heart disease is rare in asymptomatic children and a preoperative ECG may not be informative even when heart disease does exist.

Surgical indications

Some panellists believed that endocrine surgery (eg adrenalectomy or thyroidectomy), thoracic surgery, cardiac or oesophageal surgery were indications for carrying out a preoperative ECG.

5.1.2 ASA grade 2 and 3 adults with CVD comorbidity

Tables 5.10 and 5.11 show the degree of consensus for carrying out a preoperative ECG in patients with CVD comorbidity classified as ASA grade 2 or 3. Panellists agreed that testing is indicated for all adult patients (ASA grades 2 and 3), for all grades of surgery, because a baseline assessment is needed before the patient is anaesthetised.

TABLE 5.10 ECG for ASA grade 2 adults with CVD comorbidity

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	Yes[2]	Yes[2]	Yes[2]	Yes[2]
2	Yes[2]	Yes[2]	Yes[2]	Yes[2]
3	Yes[2]	Yes[2]	Yes[1]	Yes[1]
4	Yes[1]	Yes[1]	Yes[1]	Yes[1]

TABLE 5.11 ECG for ASA grade 3 adults with CVD comorbidity

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	Yes[1]	Yes[1]	Yes[1]	Yes[1]
2	Yes[1]	Yes[1]	Yes[1]	Yes[1]
3	Yes[1]	Yes[1]	Yes[1]	Yes[1]
4	Yes[1]	Yes[1]	Yes[1]	Yes[1]

5.1.3 ASA grade 2 and 3 adults with comorbidity from respiratory disease

Tables 5.12 and 5.13 show the degree of consensus for carrying out a preoperative ECG in patients with respiratory disease classified as ASA grade 2 or 3. At least one group agreed that ECGs should be considered for all such patients over 60 years of age, in particular those undergoing grade 4 surgery. Some panellists thought that it may be necessary to consider the possibility of a patient having more than one comorbidity since respiratory disease and CVD can be related, especially in older patients, and may cause similar signs and symptoms.

TABLE 5.12 ECG for ASA grade 2 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	b	a	a
2	No[2]	c	a	a
3	b	a	a	Yes[2]
4	a	a	Yes[2]	Yes[2]

TABLE 5.13 ECG for ASA grade 3 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	c	c	a	a
2	c	c	Yes[2]	Yes[2]
3	c	c	Yes[2]	Yes[2]
4	a	Yes[2]	Yes[2]	Yes[2]

5.1.4 ASA grade 2 and 3 adults with comorbidity from renal disease

Tables 5.14 and 5.15 show the degree of consensus for carrying out a preoperative ECG in patients with renal disease classified as ASA grade 2 or 3. At least one group agreed that testing is appropriate for all patients over 60 years of age, assuming that a renal physician had given optimal treatment. However, panellists also commented that the decision to test is likely to depend on the cause of renal disease. For example, if renal disease arose from diabetes or hypertension, these causes would provide a strong indication to test.

TABLE 5.14 ECG for ASA grade 2 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	c	a	a
2	b	c	Yes[2]	Yes[2]
3	c	a	Yes[2]	Yes[2]
4	a	a	Yes[2]	Yes[2]

TABLE 5.15 ECG for ASA grade 3 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	b	c	a	a
2	c	c	Yes[2]	Yes[2]
3	c	a	Yes[2]	Yes[2]
4	a	Yes[2]	Yes[2]	Yes[2]

5.10 Full blood counts

Consensus opinions about the appropriateness of a preoperative full blood count (FBC) for 'normal healthy patients' (ie ASA grade 1) of different ages undergoing different types of surgery was sought separately for males and females. Panellists commented explicitly that their responses were not dependent on gender, so the consensus findings are presented for both sexes together in Table 5.16. Panellists agreed that the severity of surgery was the main factor influencing their decisions because blood loss is correlated with the severity of surgery.

TABLE 5.16 FBCs for ASA grade 1 children and adults (males and females)

	AGE CATEGORIES (YEARS)								
Grade of surgery	<6 months	6 to <12 months	1 to <5	5 to <12	12 to <16	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	c	c
2	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	c	Yes[2]	Yes[2]
3	a	a	a	a	a	Yes[2]	Yes[2]	Yes[2]	Yes[2]
4	a	a	a	a	a	Yes[1]	Yes[1]	Yes[1]	Yes[1]
Neurosurgery	a	a	a	a	a	a	a	Yes2	Yes[2]
Cardiac surgery	Yes[1]	Yes[1]	Yes[1]	Yes[1]	Yes[1]	Yes[2]	Yes[2]	Yes[2]	Yes[2]

5.10.1 ASA grade 1

Adults

Panellists commented that older patients (females *or* males, over 60-years-old) may have occult blood loss and may require diagnostic tests. Panellists believed that they would be more inclined to test the oldest patients (≥ 80-years-old) and patients undergoing more severe surgery, because these patients are more likely to require a transfusion. However, it was also pointed out that point-of-care testing allows a FBC to be carried out in the operating theatre, if required, and that the decision to test preoperatively may therefore depend on whether this facility is available.

Children

Panellists also considered that the appropriateness of testing for children increases with severity of surgery although it may be preferable to carry out tests in the operating theatre as required, rather than preoperatively. However, panellists agreed that FBCs are unnecessary in patients undergoing grade 1 or 2 surgery unless specifically indicated. The requirement for a preoperative FBC was felt to depend, in part, on the specific operation as well as the severity grade; for example, testing is indicated for tonsillectomy or if an abscess is being drained. Preoperative FBCs may be useful in grade 3 or 4 surgery to allow blood loss during the operation to be estimated. Even a small loss of blood may be significant in younger children.

Surgical indications

Panellists commented that a FBC may be indicated for patients undergoing lymph node operations.

5.10.2 ASA grade 2 and 3 adults with CVD comorbidity

Tables 5.17 and 5.18 show the degree of consensus for carrying out a preoperative FBC in patients with CVD classified as ASA grade 2 or 3. Responses were again sought separately for male and female patients. For men with CVD, except for those under 60-years-old classified as ASA grade 2 undergoing grade 1 surgery, or men under 40-years-old undergoing grade 2 surgery, at least one group agreed that a FBC was an appropriate generic test. At least one group agreed that a FBC was an appropriate generic test for all women with CVD.

TABLE 5.17 FBCs for ASA grade 2 adults with CVD comorbidity

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	c	c	a	a
2	c	a	a	a
3	Yes[2]	Yes[2]	Yes[2]	Yes[2]
4	Yes[1]	Yes[1]	Yes[1]	Yes[1]

TABLE 5.18 FBCs for ASA grade 3 adults with CVD comorbidity

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	a	a	a	a
2	a	a	a	a
3	Yes[2]	Yes[2]	Yes[2]	Yes[2]
4	Yes[1]	Yes[1]	Yes[1]	Yes[1]

5.1.3 ASA grade 2 and 3 adults with comorbidity from respiratory disease

Tables 5.19 and 5.20 show the degree of consensus for carrying out preoperative FBCs in patients with respiratory disease classified as ASA grade 2 or 3. With the exception of ASA grade 2 patients under 60-years-old undergoing grade 1 or 2 surgery, at least one group agreed that a FBC was an appropriate generic test.

TABLE 5.19 FBCs for ASA grade 2 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	c	c	a	a
2	c	c	a	a
3	Yes[2]	Yes[2]	Yes[2]	Yes[2]
4	Yes[1]	Yes[1]	Yes[1]	Yes[1]

TABLE 5.20 FBCs for ASA grade 3 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	a	a	a	a
2	a	a	a	Yes[2]
3	Yes[2]	Yes[2]	Yes[2]	Yes[2]
4	Yes[1]	Yes[1]	Yes[1]	Yes[1]

5.1.4 ASA grade 2 and 3 adults with comorbidity from renal disease

Tables 5.21 and 5.22 show the degree of consensus for carrying out preoperative FBCs in patients with renal disease classified as ASA grade 2 or 3. For all grades of surgery and age groups, at least one group agreed that FBCs were appropriate for all patients with renal disease (especially more severe renal disease) because surgery can cause anaemia. FBCs would definitely be indicated if the patient had endocrine disease.

TABLE 5.21 FBCs for ASA grade 2 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	a	a	a	a
2	a	a	a	a
3	Yes[2]	Yes[1]	Yes[1]	Yes[1]
4	Yes[1]	Yes[1]	Yes[1]	Yes[1]

TABLE 5.22 FBCs for ASA grade 3 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	Yes[2]	Yes[2]	Yes[2]	Yes[2]
2	Yes[2]	Yes[2]	Yes[2]	Yes[2]
3	Yes[1]	Yes[1]	Yes[1]	Yes[1]
4	Yes[1]	Yes[1]	Yes[1]	Yes[1]

5.11 Haemostasis tests

The consensus findings for patients classified as ASA grade 1 are shown in Table 5.23. Panellists agreed that preoperative tests of haemostasis should never be carried out without a specific indication. Important indications include patients:

- **taking warfarin (or other anticoagulants);**
- **on haemodialysis; and**
- **undergoing specific types of surgery.**

Panellists assumed that such indications were not present when responding to the consensus statements.

Adults

Decisions to carry out preoperative haemostasis tests may be justified on the basis of the morbidity associated with postoperative bleeding. However, although borderline abnormalities are not uncommon, most are insignificant and the probability of detecting an undiagnosed and clinically important clotting abnormality is rare. A previous history of bleeding is likely to be a more useful indicator than a preoperative haemostasis test. Predisposing risk factors, surgery involving liver function or clotting mechanisms and medications that affect coagulation increase the likelihood of an abnormal haemostasis test. The disagreement indicated in the table may have arisen because panellists lacked specific expertise in the areas of neurosurgery and cardiac surgery.

Children

Again, panellists agreed that preoperative haemostasis tests are inappropriate unless indicated. Clinical and family history are the most important indications. Other indications include surgery that causes a haemostasis abnormality, planned regional analgesia or surgery likely to cause a large blood loss with a consequent requirement for transfusion. Disturbance of haemostasis is common with neurosurgery, therefore haemostasis should be measured prior to operation.

Surgical indications

Haemostasis tests may be indicated for patients undergoing arterial reconstruction, to provide baseline values in cardiac surgery or for patients having surgery for cancer (since patients may have liver metastases). There is an increased incidence of

TABLE 5.23 Haemostasis tests for ASA grade 1 children and adults

	AGE CATEGORIES (YEARS)								
Grade of surgery	<6 months	6 to <12 months	1 to <5	5 to <12	12 to <16	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	No[2]	No[2]	No[2]	No[2]	No[1]	No[1]	No[1]	No[1]
2	No[2]	No[2]	No[2]	No[2]	No[2]	No[1]	No[1]	No[1]	No[1]
3	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]
4	No[2]	No[2]	No[2]	No[2]	No[2]	b	b	b	b
Neurosurgery	d	d	d	d	d	d	d	d	d
Cardiac surgery	a	a	a	a	a	d	d	d	d

haemostatic disturbance with neurosurgery and preoperative haemostasis tests may be useful to provide baseline values. Like FBCs, haemostasis tests are available using point-of-care testing equipment. It may therefore be more appropriate to carry out a haemostasis test during the operation, for example because of loss of blood and the need for transfusion, if the facility to do so is available in the operating theatre.

5.1.1 ASA grade 2 and 3 adults with CVD comorbidity

Tables 5.24 and 5.25 show the degree of consensus for carrying out a preoperative haemostasis test in adults with CVD classified as ASA grade 2 or 3. These tests are only required when a patient has a past history or family history of abnormal bleeding, clinical evidence of bleeding, has liver or vascular disease, or is taking anticoagulant medication. However, the decision to test may also depend on the severity of surgery.

TABLE 5.24 Haemostasis tests for ASA grade 2 adults with CVD comorbidity

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[1]	No[1]	No[1]	No[1]
2	No[1]	No[1]	No[1]	No[1]
3	No[2]	No[2]	No[2]	No[2]
4	d	d	d	d

TABLE 5.25 Haemostasis tests for ASA grade 3 adults with CVD comorbidity

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[1]	No[1]	No[1]	No[1]
2	No[1]	No[1]	No[1]	No[1]
3	b	b	b	b
4	d	d	d	d

5.1.2 ASA grade 2 and 3 adults with comorbidity from respiratory disease

Tables 5.26 and 5.27 show the degree of consensus for carrying out a preoperative haemostasis test in patients with respiratory disease classified as ASA grade 2 or 3. As for ASA grade 1 adults, panellists mainly agreed that a preoperative haemostasis test is not appropriate unless clinically indicated.(years)

TABLE 5.26 Haemostasis tests for ASA grade 2 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[1]	No[1]	No[1]	No[1]
2	No[1]	No[1]	No[1]	No[1]
3	No[1]	No[1]	No[1]	No[1]
4	b	b	b	b

TABLE 5.27 Haemostasis tests for ASA grade 3 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[1]	No[1]	No[1]	No[1]
2	No[1]	No[1]	No[1]	No[1]
3	No[1]	No[1]	No[1]	No[1]
4	b	b	b	b

5.1.3 ASA grade 2 and 3 adults with comorbidity from renal disease

Tables 5.28 and 5.29 show the degree of consensus for carrying out a preoperative haemostasis test in patients with renal disease classified as ASA grade 2 or 3. Some panellists stated that the cause of the renal disease is important, but that relevant causes should be considered to be specific indications.

TABLE 5.28 Haemostasis tests for ASA grade 2 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	No[2]	No[2]	No[2]
2	No[2]	No[2]	No[2]	No[2]
3	c	c	c	c
4	c	a	a	a

TABLE 5.29 Haemostasis tests for ASA grade 2 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	b	b	b	b
2	b	b	b	b
3	c	c	c	c
4	a	a	a	a

5.12 Renal function tests

The consensus findings for patients classified as ASA grade 1 are shown in Table 5.30. Panellists agreed that the appropriateness of preoperative renal function tests depends primarily on age, ie it is more appropriate to test patients in the older age categories. Other indications include diabetes, hypertension and medications that are likely to affect renal function.

5.1.1 ASA grade 1

Adults

The decision to test is influenced by age because older patients tend to have deteriorating renal function, which can be asymptomatic and which, if detected, is likely to change management. Preoperative renal function tests can be useful to assess whether a patient is suitable to be given nonsteroidal analgesics.

Children

Most panellists agreed that renal function tests are not appropriate for children. For children having grade 1 or 2 surgery, there may be specific surgical indications, eg urological surgery. For children having grade 3 or 4 surgery, there is a potential for haemorrhage and the need for intravenous fluid or blood transfusions that can cause an electrolyte abnormality. Therefore, some panellists believed that preoperative renal function tests may be important in children undergoing major surgery. Panellists also agreed that renal function tests are appropriate for

TABLE 5.30 Renal function tests for ASA grade 1 children and adults

	AGE CATEGORIES (YEARS)								
Grade of surgery	<6 months	6 to <12 months	1 to <5	5 to <12	12 to <16	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[1]	No[1]	No[1]	No[1]	No[1]	No[1]	No[2]	b	c
2	No[1]	No[1]	No[1]	No[1]	No[1]	No[2]	No[2]	c	c
3	b	b	b	b	b	a	a	Yes[2]	Yes[2]
4	d	d	d	d	d	Yes[2]	Yes[2]	Yes[2]	Yes[1]
Neurosurgery	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]
Cardiac surgery	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]

children undergoing neurosurgery and cardiac surgery, but not for children undergoing minor cardiac surgery such as cardiac catheter procedures.

Surgical indications

Major surgery can affect renal function that, in turn, can affect anaesthetic management. Renal function is an especially important consideration for patients undergoing neurosurgery (many neurological diseases affect biochemistry) and cardiac surgery. For grades 3 and 4 surgery, preoperative renal function tests may provide useful baseline information because intravenous fluid administration and intraoperative fluid losses can alter renal function and electrolyte levels.

5.1.2 ASA grade 2 and 3 adults with CVD comorbidity

Tables 5.31 and 5.32 show the degree of consensus for carrying out preoperative renal function tests in patients with CVD classified as ASA grade 2 or 3. Renal function tests were judged to be appropriate for all adult CVD patients (ASA grades 2 and 3). It is particularly important to test all patients suffering from diabetes.

TABLE 5.31 Renal function tests for ASA grade 2 adults with CVD comorbidity

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	a	a	a	a
2	a	a	Yes[2]	Yes[2]
3	Yes[2]	Yes[2]	Yes[1]	Yes[1]
4	Yes[1]	Yes[1]	Yes[1]	Yes[1]

TABLE 5.32 Renal function tests for ASA grade 3 adults with CVD comorbidity

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	Yes[2]	Yes[2]	Yes[2]	Yes[2]
2	Yes[1]	Yes[1]	Yes[1]	Yes[1]
3	Yes[1]	Yes[1]	Yes[1]	Yes[1]
4	Yes[1]	Yes[1]	Yes[1]	Yes[1]

5.1.3 ASA grade 2 and 3 adults with comorbidity from respiratory disease

Tables 5.33 and 5.34 show the degree of consensus for carrying out preoperative renal function tests in patients with respiratory disease classified as ASA grade 2 or 3. Panellists believed that testing was not appropriate for patients with respiratory disease unless they are taking medication such as steroids, theophylline or salbutamol. However, as for ASA grade 1 patients, testing is more appropriate in older patients and patients undergoing major surgery.

Panellists noted that fluid balance is likely to be a more important factor than undetected renal function abnormalities in avoiding perioperative complications.

TABLE 5.33 Renal function tests for ASA grade 2 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	No[2]	c	c
2	No[2]	b	c	c
3	a	a	Yes[2]	Yes[2]
4	Yes[2]	Yes[2]	Yes[1]	Yes[1]

TABLE 5.34 Renal function tests for ASA grade 3 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	d	a	a	a
2	d	a	a	a
3	Yes[2]	Yes[2]	Yes[2]	Yes[2]
4	Yes[1]	Yes[1]	Yes[1]	Yes[1]

5.1.4 ASA grade 2 and 3 adults with comorbidity from renal disease

Tables 5.35 and 5.36 show the degree of consensus for carrying out preoperative renal function tests in patients with renal disease classified as ASA grade 2 or 3. Panellists agreed that preoperative testing was appropriate for these patients, irrespective of age or grade of surgery.

TABLE 5.35 Renal function tests for ASA grade 2 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	Yes[2]	Yes[2]	Yes[2]	Yes[2]
2	Yes[2]	Yes[2]	Yes[2]	Yes[2]
3	Yes[1]	Yes[1]	Yes[1]	Yes[1]
4	Yes[1]	Yes[1]	Yes[1]	Yes[1]

TABLE 5.36 Renal function tests for ASA grade 3 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	Yes[2]	Yes[2]	Yes[1]	Yes[1]
2	Yes[1]	Yes[1]	Yes[1]	Yes[1]
3	Yes[1]	Yes[1]	Yes[1]	Yes[1]
4	Yes[1]	Yes[1]	Yes[1]	Yes[1]

5.13 Random blood glucose tests

Table 5.37 shows the degree of consensus for carrying out a preoperative random blood glucose test in ASA grade 1 children and adults. Although there was agreement *within* consensus panels about the appropriateness of a preoperative random blood glucose test in various settings, there was little agreement *between* the two parallel panels. The disagreement between panels was caused by a lack of evidence about the relative merits of random blood glucose testing versus urine analysis and uncertainty about the validity of urine analysis tests when carried out in typical NHS settings. Therefore, this section and Section 5.14 should be considered together.

One panel agreed that random blood glucose testing was not useful in adults and preferred to use urine analysis (dipstick testing), because they believed that urine analysis is effective in detecting blood glucose levels and is cheaper and more convenient. If urine analysis were to show an abnormality then a fasting blood glucose estimation would be recommended. The parallel panel agreed that a preoperative random blood glucose test is more appropriate than urine analysis because they thought that urine analysis is not a valid test. The value of random blood glucose tests was questioned by members of both panels, who agreed that fasting blood glucose tests are more informative. However, they believed that it is impracticable to request all patients attending a preoperative assessment clinic to fast.

TABLE 5.37 Random blood glucose test for ASA grade 1 children and adults

	AGE CATEGORIES (YEARS)								
Grade of surgery	<6 months	6 to <12 months	1 to <5	5 to <12	12 to <16	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]
2	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	b	b	b
3	No[2]	No[2]	No[2]	No[2]	No[2]	b	b	b	b
4	No[2]	No[2]	No[2]	No[2]	No[2]	b	b	b	b
Neurosurgery	No[2]	No[2]	No[2]	No[2]	No[2]	d	d	d	d
Cardiac surgery	No[2]	No[2]	No[2]	No[2]	No[2]	d	d	d	d

Institutions responsible for preoperative assessment need to weigh up (a) the advantages and disadvantages of using a random blood glucose test versus urine analysis and (b) the practicability of carrying out a preoperative fasting blood glucose test (see Section 7.2.1). The debate about the relative merits of the two tests would become irrelevant if a practicable method for obtaining a fasting blood glucose test, ideally well in advance of the scheduled date for surgery, could be devised.

5.1.1 ASA grade 1

Adults

Panellists agreed that it is important to know whether a patient has previously undetected diabetes, especially if undergoing arterial surgery, as patients with a high blood sugar tend to have a worse outcome after surgery. However, they also agreed that a preoperative random blood glucose test should not be ordered unless there are specific indications. Testing is indicated for patients on medication such as steroids or diuretics. Panellists assumed that patients with diabetes would monitor their blood glucose, so an additional preoperative test would not be necessary.

Elevated blood glucose may be common in patients undergoing neurosurgery or cardiac surgery due to stress (causing excessive catecholamine secretions) and both panels agreed that it is important to determine preoperative blood glucose levels in such patients (but disagreed about the best test).

The need to determine preoperative blood glucose levels may depend on the specific type of procedure as well as the severity of the procedure. For example, a preoperative random blood glucose test would be appropriate in a patient undergoing drainage of an abscess because abscesses occur more commonly in people with diabetes.

Children

Panellists agreed that a preoperative random blood glucose test is not appropriate unless a child has a specific indication. They noted that some younger children (< 1 years) may be hypoglycaemic.

Surgical indications

Panellists agreed that testing is indicated for all cardiac and neurosurgery cases (see above), irrespective of comorbidity. Some panellists also proposed other surgical indications, including peripheral vascular surgery, hepatic surgery and pancreatic surgery.

5.1.2 ASA grade 2 and 3 adults with CVD comorbidity

Tables 5.38 and 5.39 show the degree of consensus for carrying out a preoperative random blood glucose test in patients with CVD classified as ASA grade 2 or 3. Panellists agreed that generic testing for patients with CVD was not appropriate. At first sight, this judgement may appear inconsistent with the judgements for ASA grade 1 patients (Table 5.37). However, panellists assumed that

they were considering patients without surgical indications. The disagreement between the two parallel panels in Phase A was also discussed with both panels in Phase B.

Panellists considered the relationship between diabetes, CVD and renal failure. They believed that all three conditions should be being monitored in patients with known diabetes and that separate guidance about testing these patients may be appropriate.

TABLE 5.38 Random blood glucose test for ASA grade 2 adults with CVD comorbidity

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[1]	No[1]	No[1]	No[1]
2	No[2]	No[2]	No[2]	No[2]
3	No[2]	No[2]	No[2]	No[2]
4	No[2]	No[2]	No[2]	No[2]

TABLE 5.39 Random blood glucose test for ASA grade 3 adults with CVD comorbidity

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[1]	No[1]	No[1]	No[1]
2	No[2]	No[2]	No[2]	No[2]
3	No[2]	No[2]	No[2]	No[2]
4	No[2]	No[2]	No[2]	No[2]

5.1.3 ASA grade 2 and 3 adults with comorbidity from respiratory disease

Tables 5.40 and 5.41 show the degree of consensus for carrying out a preoperative random blood glucose test in patients with respiratory disease classified as ASA grade 2 or 3. Panellists concluded that generic testing in such patients is not appropriate. However, testing is indicated for patients on long-term steroid medications because steroids can lead to elevated blood glucose levels.

TABLE 5.40 Random blood glucose test for ASA grade 2 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	No[2]	No[2]	No[2]
2	No[2]	No[2]	No[2]	No[2]
3	No[2]	No[2]	No[2]	No[2]
4	No[2]	No[2]	No[2]	No[2]

TABLE 5.41 Random blood glucose test for ASA grade 3 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	No[2]	No[2]	No[2]
2	No[2]	No[2]	No[2]	No[2]
3	d	d	d	d
4	d	d	d	d

5.1.4 ASA grade 2 and 3 adults with comorbidity from renal disease

Tables 5.42 and 5.43 show the degree of consensus for carrying out a preoperative random blood glucose test in patients with renal disease classified as ASA grade 2 or 3. Again, most panellists agreed that generic testing is not appropriate. A *fasting* blood glucose test may be more informative in renal disease patients, especially the elderly, because of the relationship between diabetes and renal disease. Some panellists commented that insulin resistance is common in patients with severe renal disease and that testing may be appropriate in patients having more severe surgery (grades 3 and 4).

TABLE 5.42 Random blood glucose test for ASA grade 2 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	No[2]	No[2]	No[2]
2	No[2]	No[2]	No[2]	No[2]
3	b	b	b	b
4	b	b	b	b

TABLE 5.43 Random blood glucose test for ASA grade 3 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	b	b	b	b
2	b	b	b	b
3	b	b	b	b
4	b	b	b	b

5.14 Urine analysis

Table 5.37 shows the degree of consensus for carrying out preoperative urine analysis in ASA grade 1 children and adults. As already described, the two panels disagreed about the most cost-effective test for detecting blood glucose levels sufficiently elevated to cause a change in clinical management and the table reflects this disagreement. The panels agreed that a random blood glucose test or urine analysis (dipstick testing) is appropriate in particular circumstances.

Some panellists pointed out that urine analysis tests can be used to detect more than one abnormality. Therefore, urine analysis may be a good test for detecting protein, irrespective of the debate about its validity for detecting elevated blood glucose levels. Panellists agreed that it is essential to have well trained staff performing the tests and that staff reading the test results should use an objective meter. Some panellists expressed concern that urine analysis has a high false positive rate (perhaps as the result of a failure to follow strict protocols for testing). Therefore, any comparison of the cost-effectiveness of urine analysis and random blood glucose testing needs to consider the costs of performing unnecessary extra tests in patients with false positive test results as well as the immediate costs of testing.

5.1.1 ASA grade 1

Adults

As described in Section 5.13, Table 5.44 indicates that the panels disagreed (both groups reaching consensus but one concluding that testing is appropriate and the other that testing is not appropriate), except in the case of children having less severe surgery.

The panel that was in favour of urine analysis believed that it provides a cheap way to identify potentially significant problems such as diabetes and nephrosis. This panel assumed that urine analysis is carried out by a trained individual, according to a recommended protocol. The panel that was against urine analysis believed that testing without a clinical indication, eg infection, is a waste of time. However, this panel thought that testing

TABLE 5.44 Urine analysis for ASA grade 1 children and adults

	AGE CATEGORIES (YEARS)								
Grade of surgery	<6 months	6 to <12 months	1 to <5	5 to <12	12 to <16	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	No[2]	No[2]	No[2]	No[2]	d	d	d	d
2	No[2]	No[2]	No[2]	No[2]	No[2]	d	d	d	d
3	d	d	d	d	d	d	d	d	d
4	d	d	d	d	d	d	d	d	d
Neurosurgery	d	d	d	d	d	d	d	d	d
Cardiac surgery	d	d	d	d	d	d	d	d	d

would be appropriate if a patient were having any form of urinary tract surgery.

The panel that favoured urine analysis concluded that testing is appropriate for some specific procedures, giving the example of abscess drainage, described in Section 5.13.

Children

The panel that favoured urine analysis thought that testing provides a noninvasive and convenient method for detecting potentially significant conditions such as diabetes. However, panellists agreed that it was unnecessary for grade 1 or 2 surgery unless indicated, such as for a child undergoing urinary tract surgery.

Surgical indications

Urine analysis may be indicated for patients having urogenital surgery and for testing for a urinary tract infection in patients having prostheses implanted, eg heart valves or joint replacements.

5.1.2 ASA grade 2 and 3 adults with CVD comorbidity

Tables 5.45 and 5.46 show that there was no agreement within the panels about the appropriateness of testing patients with CVD classified as ASA grade 2 or 3 undergoing minor surgery. The panel that favoured urine analysis judged that it is appropriate to carry out preoperative urine analysis for all patients undergoing major surgery.

TABLE 5.45 Urine analysis for ASA grade 2 adults with CVD comorbidity

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	c	c	c	c
2	c	c	c	c
3	a	a	a	a
4	a	a	a	a

TABLE 5.46 Urine analysis for ASA grade 3 adults with CVD comorbidity

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	c	c	c	c
2	c	c	c	c
3	a	a	a	a
4	a	a	a	a

5.1.3 ASA grade 2 and 3 adults with comorbidity from respiratory disease

Tables 5.47 and 5.48 show that there was no agreement within the panels about the appropriateness of testing patients with respiratory disease classified as ASA grade 2 or 3 undergoing grade 1 surgery. The panel that favoured urine analysis concluded that testing is appropriate for all patients undergoing other grades of surgery.

TABLE 5.47 Urine analysis for ASA grade 2 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	c	c	c	c
2	c	c	a	a
3	a	a	a	a
4	a	a	a	a

TABLE 5.48 Urine analysis for ASA grade 3 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	c	c	c	c
2	a	a	a	a
3	a	a	a	a
4	a	a	a	a

5.1.4 ASA grade 2 and 3 adults with comorbidity from renal disease

Tables 5.49 and 5.50 show that both panels each reached consensus about testing in patients with renal disease classified as ASA grade 2 or 3. However, one panel concluded that testing is appropriate and the other that testing is not appropriate. It should be noted that patients with renal disease are likely to have other tests done, eg blood tests, and that urine analysis may not provide additional information.

TABLE 5.49 Urine analysis for ASA grade 2 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	d	d	d	d
2	d	d	d	d
3	d	d	d	d
4	d	d	d	d

TABLE 5.50 Urine analysis for ASA grade 3 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	d	d	d	d
2	d	d	d	d
3	d	d	d	d
4	d	d	d	d

5.15 Testing of blood gases (ASA grades 2 and 3 only)

The consensus questionnaire originally asked about the appropriateness of testing arterial blood gases to determine the pH, oxygen and carbon dioxide content of the blood. Arterial blood gases are not easily tested in an outpatient setting since the methods for obtaining an arterial blood sample require expertise and are often unpleasant and painful for the patient. Although tests of arterial blood gases may provide additional or more precise information, these tests should be reserved for patients who are very unwell (almost certainly classified as ASA grade 4), to assess the severity and type of the problem (ie respiratory versus metabolic failure).

Both panels agreed that, in many circumstances, similar information can be obtained by measuring pH and carbon dioxide content in a venous blood sample and measuring oxygen saturation with a pulse oximeter. These are tests that can easily be carried out in an outpatient setting with no more distress to a patient than for any blood test. Therefore, they concluded that there is no case for preoperative generic testing of arterial blood gases. However, an arterial blood sample can be readily obtained in patients with arterial lines already in place, although this is unlikely in patients having elective surgery. In such patients, testing arterial blood gases would be preferable to using a venous blood sample and measuring oxygen saturation with a pulse oximeter.

Panellists were therefore asked to rate the appropriateness of blood gas testing using the combination of a venous blood sample and pulse oximetry. Tables 5.51 to 5.56 in this section show their responses to this modified question for patients classified as ASA grade 2 or 3 as a result of CVD, respiratory or renal disease. One panel reached consensus that it is appropriate to measure oxygen saturation and venous blood gases in patients with renal disease classified as ASA grade 3 having grade 4 surgery. Some panellists also judged that it is appropriate to measure oxygen saturation and venous blood gases in patients with serious chronic obstructive pulmonary disease or respiratory failure associated with CVD.

If blood gas testing is carried out with the intention of improving the status of the patient before surgery, the results of blood gas testing need to be interpreted at a preoperative assessment clinic, not when the patient is admitted for surgery. Therefore, staff at preoperative assessment clinics need the expertise to do this.

Surgical indications

Panellists identified the following surgical indications for testing blood gases and oxygen saturation: thoracic surgery, pneumonectomy, oesophagectomy, head and neck surgery (to determine if surgery should go ahead or not).

5.1.1 ASA grade 2 and 3 adults with CVD comorbidity

TABLE 5.51 Testing of blood gases for ASA grade 2 adults with CVD comorbidity

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	No[2]	No[2]	No[2]
2	No[2]	No[2]	No[2]	No[2]
3	b	b	b	b
4	b	b	b	b

TABLE 5.52 Testing of blood gases for ASA grade 3 adults with CVD comorbidity

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	b	b	b	b
2	b	b	b	b
3	b	b	b	b
4	b	b	c	c

5.1.2 ASA grade 2 and 3 adults with comorbidity from respiratory disease

TABLE 5.53 Testing of blood gases for ASA grade 2 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	b	b	b	b
2	b	b	b	b
3	b	b	c	c
4	b	b	c	c

TABLE 5.54 Testing of blood gases for ASA grade 3 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	b	b	b	b
2	b	b	b	b
3	b	b	b	b
4	b	b	b	b

5.1.3 ASA grade 2 and 3 adults with comorbidity from renal disease

TABLE 5.55 Testing of blood gases for ASA grade 2 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	No[2]	No[2]	No[2]
2	No[2]	No[2]	No[2]	No[2]
3	b	b	b	b
4	c	c	c	c

TABLE 5.56 Testing of blood gases for ASA grade 3 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	b	b	b	b
2	c	c	c	c
3	c	c	c	c
4	a	a	a	a

5.16 Lung function tests

Panellists agreed that pulmonary function tests should not be considered as generic preoperative testing. These tests should only be carried out for specific groups of patients at the discretion of the consultant surgeon or anaesthetist, eg patients with chronic bronchitis or CVD. Tables 5.57 to 5.62 show panellists' responses for patients classified as ASA grade 2 or 3 as a result of CVD, respiratory or renal disease.

An expert clinical assessment of the patient may be more appropriate. However, although such an assessment may be sufficient to judge a patient's fitness for surgery, it does not provide baseline information against which to assess change in lung function. The findings of a clinical assessment may also be difficult to communicate to other staff responsible for caring for the patient 'out of hours'.

Surgical indications

Lung function tests were considered to be appropriate for patients undergoing spinal surgery, for ASA grade 3 patients having thoracic surgery, for patients having thoracotomies and for surgery in which the chest is opened in patients with respiratory disease, eg oesophagectomy, lung excision or resection.

5.16.1 ASA grade 2 and 3 adults with CVD comorbidity

TABLE 5.57 Lung function tests for ASA grade 2 adults with CVD comorbidity

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[1]	No[1]	No[1]	No[1]
2	No[1]	No[1]	No[1]	No[1]
3	No[1]	No[1]	No[1]	No[1]
4	No[1]	No[1]	No[1]	No[1]

TABLE 5.58 Lung function tests for ASA grade 3 adults with CVD comorbidity

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[1]	No[1]	No[1]	No[1]
2	No[1]	No[1]	No[1]	No[1]
3	No[1]	No[1]	No[1]	No[1]
4	No[2]	No[2]	No[2]	No[2]

5.1.2 ASA grade 2 and 3 adults with comorbidity from respiratory disease

TABLE 5.59 Lung function tests for ASA grade 2 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[1]	No[1]	No[1]	No[1]
2	No[2]	No[2]	No[2]	No[2]
3	No[2]	b	b	b
4	b	b	b	b

TABLE 5.60 Lung function tests for ASA grade 3 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	No[2]	No[2]	No[2]
2	c	c	c	c
3	a	a	a	a
4	a	a	a	a

5.1.3 ASA grade 2 and 3 adults with comorbidity from renal disease

TABLE 5.61 Lung function tests for ASA grade 2 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[1]	No[1]	No[1]	No[1]
2	No[1]	No[1]	No[1]	No[1]
3	No[1]	No[1]	No[1]	No[1]
4	No[1]	No[1]	No[1]	No[1]

TABLE 5.62 Lung function tests for ASA grade 3 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[1]	No[1]	No[1]	No[1]
2	No[1]	No[1]	No[1]	No[1]
3	No[1]	No[1]	No[1]	No[2]
4	No[2]	No[2]	No[2]	No[2]

5.17 Tests for sickle cell disease/trait

Panellists discussed the difficulties in identifying patients at risk from sickle cell disease or trait. Panellists' knowledge about the prevalence of the sickle cell gene in specific ethnic groups varied, depending on the nature of the populations served by hospitals in which panellists worked. Because of varying knowledge, panellists found it difficult to respond to questions about the appropriateness of testing in specific ethnic groups.

Information about the prevalence of the sickle cell gene in different ethnic groups is available[1]. However, this information does not remove the need to set a level of prevalence, or 'cut-off', above which testing is judged to be appropriate. Panels were not asked to try to reach consensus about a cut-off prevalence, primarily because panellists believed that choosing an appropriate cut-off for testing was not the key issue in promoting more appropriate testing (see below). Even if the approach of choosing a cut-off prevalence were taken, the choice of cut-off should be made by people with expert knowledge of the field. Moreover, setting a cut-off prevalence does not avoid the difficult task of classifying individual patients into ethnic groups for which the prevalence of the sickle cell gene is known. Some patients may not know their ethnicity, for example those who have been adopted. Physical appearance may help in identifying a patient's ethnic origin, but it may also be misleading.

Panellists identified particular ethnic groups in whom they agreed that testing for the sickle cell gene is appropriate (see Section 6.12). However, they would prefer to offer testing to all patients whose sickle cell status is unknown *and* who are uncertain about whether they are of northern European ethnicity *and* who do not have a surgical history.

Concern was expressed for patients who find out that they have the sickle cell gene close to the time of surgery, potentially without adequate counselling about the nature and consequences of having sickle cell disease or trait. It is therefore particularly important that patients are able to receive counselling before the test so that they are fully informed about the reason for carrying out the test and the consequences of a positive result. Ideally, testing for the sickle cell gene should occur well in advance of the scheduled date for surgery so that appropriate counselling can be arranged for patients with positive results (see Section 6.14.3).

Panellists noted that testing for sickle cell trait need only be carried out once, providing that the test result can be stored and communicated effectively during an individual's lifetime (see Section 7.2.4).

TABLE 5.63 Pregnancy testing	
Pregnancy testing should be carried out in female patients of reproductive age:	
> with history of last menstrual period	c
> who say it is not possible for her to be pregnant	c
> who say it is possible that she may be pregnant	Yes[2]
Should informed consent be obtained?	Yes[2]

5.18 Pregnancy testing

Table 5.63 shows that panellists agreed that preoperative pregnancy testing is appropriate in female patients who say that it is possible they may be pregnant. Panellists also agreed that informed consent should be obtained to carry out a pregnancy test. No consensus was reached for female patients of reproductive age in other circumstances.

Most panellists believed that pregnancy testing for female patients over 16 years did not raise any particular problems. The risks of surgery and the unsatisfactory nature of 'history of last menstrual period' can be explained clearly so that the patient is aware of the potential consequences of surgery if she is pregnant and that she takes responsibility if she says that it is not possible for her to be pregnant. Most panellists thought that it would not be appropriate to offer a pregnancy test if the patient says that it is not possible for her to be pregnant.

Panellists acknowledged the difficulties involved in obtaining consent for females aged between 12 and 16 years of age. Female patients of this age may say that it is not possible for them to be pregnant, particularly if the consent to test is sought in consultation with their parents, either because of embarrassment or because they know that sexual activity is illegal under the age of 16 years. Panellists agreed that it is sufficient to obtain consent from a female patient under 16-years-old if she is judged to be competent, ie it is not necessary to inform parents of the decision to test. However, obtaining consent from a female patient under 16-years-old judged to be competent without informing her parents may undermine the relationship between health care staff and the parents if the test is positive.

Opinions varied about the best way of proceeding for a female patient under 16 years judged *not* to be competent. Discussing whether or not to test for pregnancy may cause offence to some parents and some panellists believed that there were real difficulties in raising the matter of possible pregnancy. A few suggested that it may be appropriate to test without obtaining consent although the dangers of taking such action were acknowledged, eg a breakdown in trust between the patient, her parents and the health care staff if the test is positive.

Reference

1 Hickman M, Modell B, Greengross P, Chapman C, Layton M, Falconer S *et al.* Mapping the prevalence of sickle cell and beta thalassaemia in England: estimating and validating ethnic-specific rates. *Br J Haematol* 1999;**104**:860-867.

6. Guideline for Preoperative Investigations in Patients Undergoing Elective Surgery

6.1 Types of recommendation

For each preoperative test, three types of recommendation are given that take into consideration the different reasons for preoperative testing and the likely risk/benefit to patients. The recommendations are based on the findings of the consensus process. The three types of recommendation are:

YES	**Test recommended**
NO	**Test not recommended**
CONSIDER	The value of carrying out a preoperative test is not known, and may depend on specific patient characteristics; **CONSIDER** carrying out a preoperative test

All three types of recommendation are important. We have summarised the consensus opinion in 'look-up' tables rather than as text statements, to reduce ambiguity. Readers might otherwise conclude from text statements that tests should *not* be carried out unless there is consensus that they *should* be, or they may conclude that tests *should* be carried out unless there is consensus that they should not be.

Areas in which consensus was not obtained are particularly complex to interpret, since a lack of consensus could arise for a variety of reasons. We recommend that, in such circumstances, a clinician *should* carry out the test if there is a specific clinical reason for doing so. Conversely, a clinician should *not* carry out the test if there is no specific clinical reason for doing so. When a decision is made to carry out the test, we recommend that the clinician responsible for a patient's care should *document* the reason for carrying out the test.

6.2 Level of evidence and grading for recommendations

The evidence for the recommendations in the look-up tables comes entirely from the consensus process, since none of the literature addressed the question of the value (clinical effectiveness/cost-effectiveness) of preoperative testing. This evidence is Level IV (expert opinion), using the internationally accepted framework for grading evidence.[1] The level of evidence for the recommendations does not vary, so we have not labelled each recommendation in the look-up tables as based on Level IV evidence. Since all recommendations are based on Level IV evidence, they are all graded D according to the accepted grading scheme.[1]

Case series studies considered in the literature review (also Level IV evidence) sometimes indicated that the probability of obtaining an abnormal test result, requiring a change in clinical management because of an abnormal test result or experiencing a complication, increased with age or ASA grade. However, since none of the literature addressed the value (effectiveness) of preoperative testing, none of the recommendations are based on the literature.

Panellists who took part in the consensus development process were asked to represent their personal opinion about 'best practice', ie what is in the best interests of the patient, rather than necessarily to describe what happens in their own hospital or practice.

Nevertheless, it should be borne in mind that consensus opinion may not reflect the likelihood

of reducing the risk of a complication of surgery by preoperative testing. Instead it may reflect panellists' perceptions about the risk of a complication of surgery and how this risk changes in different circumstances.

It is important to stress that the lack of high quality evidence about the effectiveness of preoperative testing does not imply that preoperative testing is unnecessary and should not be carried out. Indirect methods for estimating the effectiveness of preoperative testing, such as the crude cost-effectiveness models described in Appendix 5 (CD ROM), may, in principle, help to inform decisions about whether to test or not. However, at present, there are no reliable data from which to estimate parameters even for the simple models described, and we are not confident that these parameters adequately characterise the complexity of clinical practice.

6.3 How to use this guideline

These recommendations are to help guide the appropriate generic use of preoperative tests for patients before elective surgery. The guideline is described in look-up tables that provide guidance on when to test and when not to test, based on weighing up the potential harms and benefits of testing for the patient.

The look up tables are structured so that the appropriate information can be accessed for each patient according to their age (age categories are listed along the top), ASA grade and grade of surgery. The recommendations suggest which tests should be done, these are colour coded like traffic lights: YES recommended (in green); may be considered (yellow); or NO not recommended (in red) (see key in Section 6.3.1).

There are two sets of these look-up tables, the first shows the tables organised by ASA grade and the second by grade of surgery. We show the same information in two ways to improve accessibility of the information. The look-up tables were piloted amongst NHS clinicians who suggested that information organised by grade of surgery is useful when the ASA grade of a patient is uncertain.

ASA grade: Each table represents consensus opinion for one ASA grade and for one grade of surgery. ASA grades considered include ASA grade 1, and ASA grades 2 and 3 specific to three common comorbidities (cardiovascular disease, respiratory disease and renal disease). These recommendations are designed for general guidance only and will require modification when used with patients with other specific comorbidities. For a patient with more than one comorbidity, follow the recommendations in all relevant tables. Definitions of ASA are provided in the Glossary and definitions of comorbidities are provided in Chapter 2, Table 2.3.

Grade of surgery: There is no widely accepted and validated system for classifying the physiological stressfulness of operative procedures, and the surgical grades used in the tables are a simple graded scale, from Grade 1 (minor surgery) to Grade 4 (major + surgery). Examples of the kinds of procedures that fall into each grade are shown in the Glossary; a more extensive list is provided in Appendix 2 (CD ROM).

Preoperative tests considered: In each Table (square) for each grade of surgery and ASA grade, the preoperative tests considered are listed on the left:

- **Chest x-ray**
- **ECG**
- **Full blood count**
- **Haemostasis**
- **Renal function**
- **Random glucose**
- **Urine analysis**
- **Blood gases (For ASA grade 2 and 3 patients only)**
- **Lung function (For ASA grade 2 and 3 patients only)**

Within each table, recommendations about the appropriateness of the tests considered for different age groups are tabulated. Footnotes describe exceptions, additional information or insights arising from the consensus panel or the Guideline Development Group (GDG).

To help the user find the right square, both sets of look-up tables are preceded by a flow chart. The flow chart identifies the corresponding look-up table for a patient's ASA grade, age, the severity grade of the surgery planned and specific common comorbidities.

In the first set of look-up tables (Sections 6.4 to 6.11), each page represents a patient's ASA grade, and tables are provided in the corresponding sections:

Adults ASA grade 1	Section 6.4
Children ASA grade 1	Section 6.5
Adults with comorbidity from CVD ASA grade 2 and 3	Sections 6.6 and 6.7
Adults with comorbidity from respiratory disease ASA grade 2 and 3	Sections 6.8 and 6.9
Adults with comorbidity from renal disease ASA grade 2 and 3	Sections 6.10 and 6.11

In the second set of tables (Sections 6.12 to 6.17), each page represents a patients' surgical grade and tables are provided in the corresponding sections:

Surgical grade 1	Section 6.12
Surgical grade 2	Section 6.13
Surgical grade 3	Sections 6.14
Surgical grade 4	Sections 6.15
Neurosurgery	Sections 6.16
Cardiovascular surgery	Sections 6.17

Recommendations for sickle cell testing and pregnancy testing are also provided:

Advice on testing for the sickle cell gene	Section 6.18
Advice on pregnancy testing	Section 6.19

An example of using the look-up tables

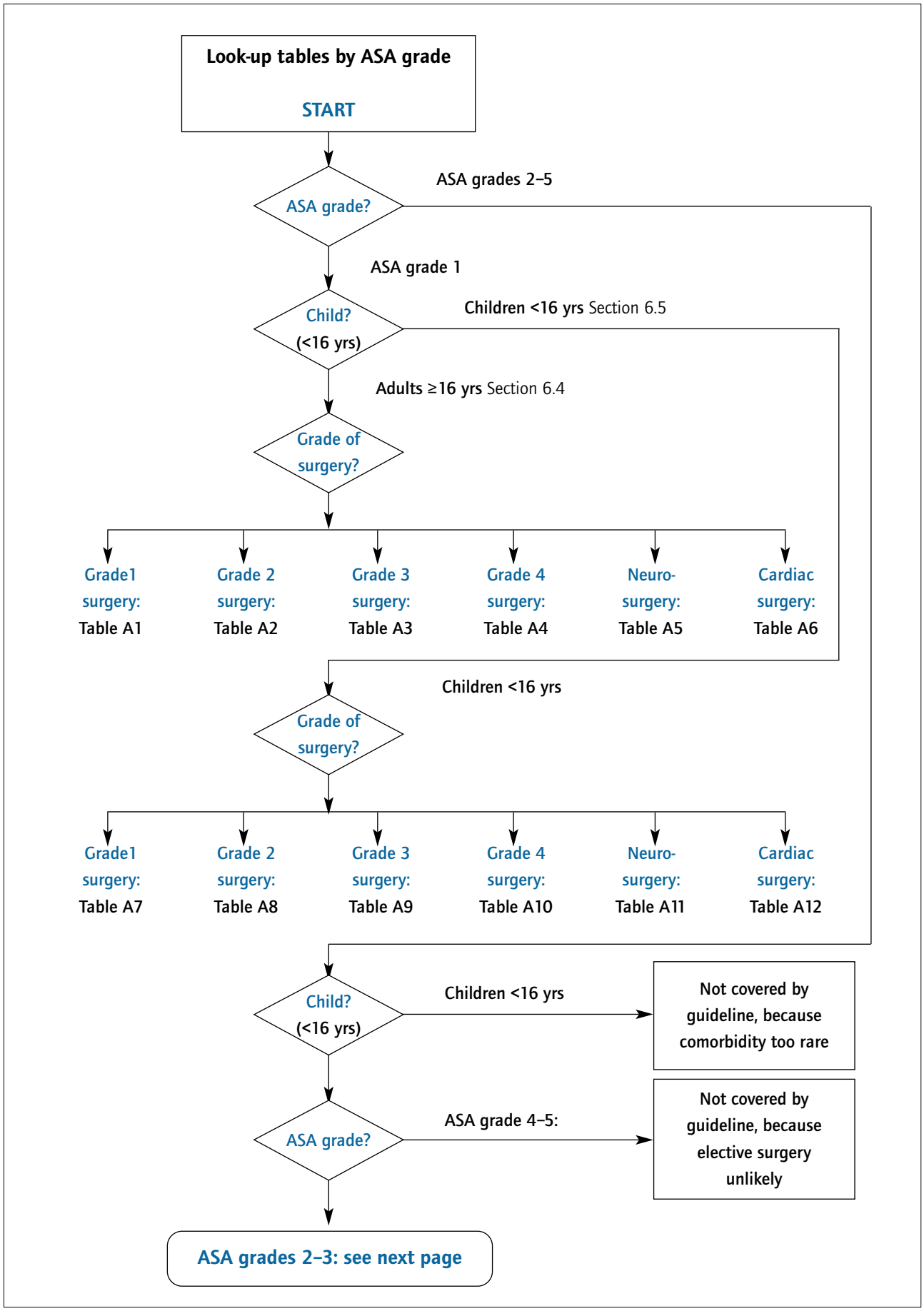
Consider a patient classed as ASA grade 3 with comorbidity from respiratory disease and cardiovascular (CVD), aged 60, undergoing grade 3 (major) surgery. The recommendations for each of the comorbidities for this patient are described in look-up tables A19 and A27 or S20 and S24.

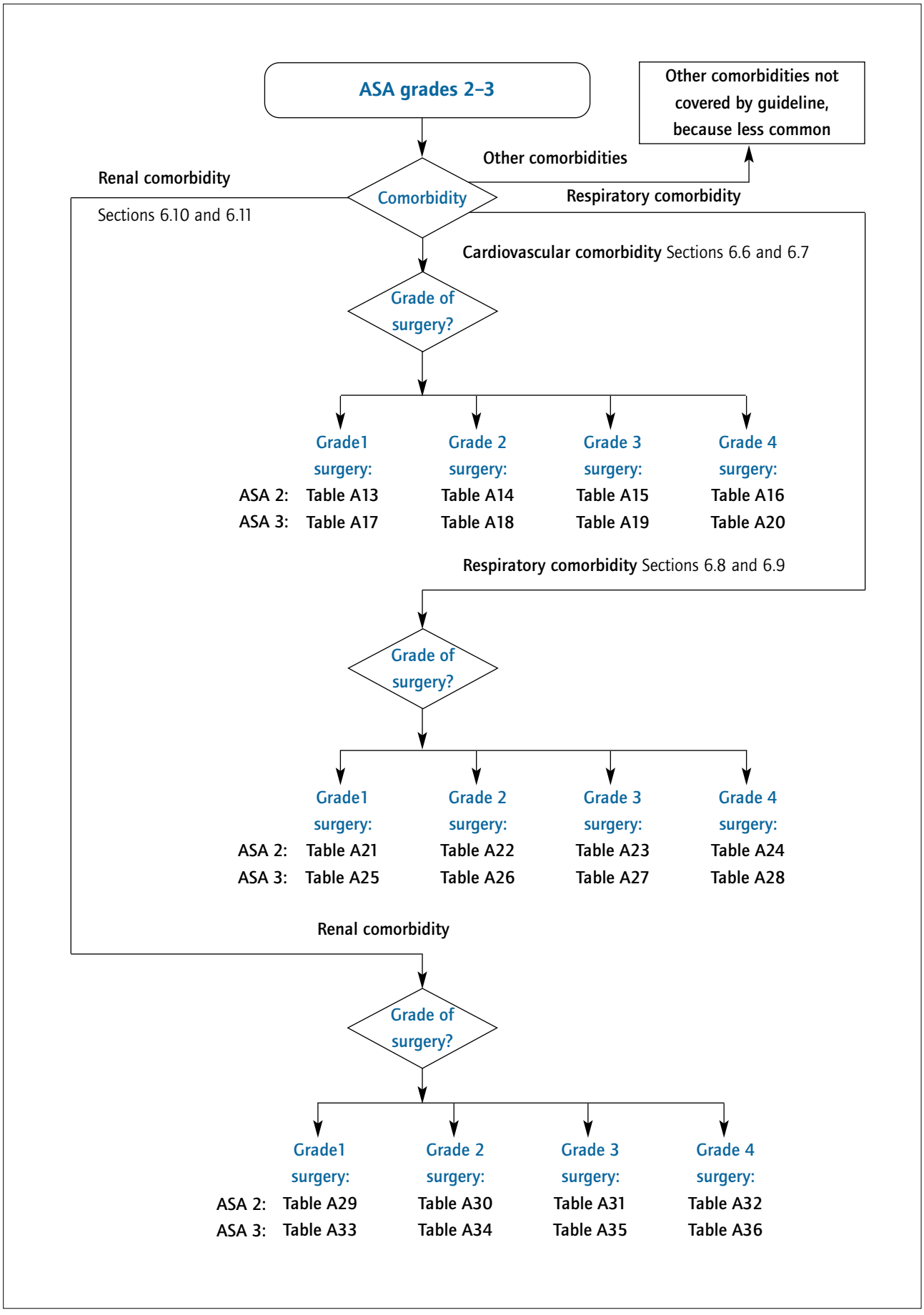
The recommendations suggest that an ECG, full blood count and renal function tests are appropriate. Haemostasis and a random glucose test are not recommended. Other tests, where the benefit is uncertain, may be considered, such as chest x-ray, urine analysis and blood gas tests.

6.3.1

Key to look-up tables
Definitions and derivations of types of recommendation

RECOMMENDATION	DEFINITION	DERIVATION
YES	**Test recommended**	*Both* groups of panellists* reached a consensus that the test is an appropriate routine test for that group of patients
NO	**Test not recommended**	*Both* groups of panellists* reached a consensus that the test is NOT an appropriate routine test for that group of patients
CONSIDER	**Test to be considered** The value of carrying out a preoperative test is not known, and may depend on specific patient characteristics	No agreement or consensus was reached in at least one of the groups (consensus for or against may have been reached by only one of the groups)


Look-up tables by ASA grade
START
ASA grade?
ASA grades 2–5
ASA grade 1
Child? (<16 yrs)
Children <16 yrs Section 6.5
Adults ≥16 yrs Section 6.4
Grade of surgery?
Grade1 surgery: Table A1
Grade 2 surgery: Table A2
Grade 3 surgery: Table A3
Grade 4 surgery: Table A4
Neuro-surgery: Table A5
Cardiac surgery: Table A6
Children <16 yrs
Grade of surgery?
Grade1 surgery: Table A7
Grade 2 surgery: Table A8
Grade 3 surgery: Table A9
Grade 4 surgery: Table A10
Neuro-surgery: Table A11
Cardiac surgery: Table A12
Child? (<16 yrs)
Children <16 yrs
Not covered by guideline, because comorbidity too rare
ASA grade?
ASA grade 4–5:
Not covered by guideline, because elective surgery unlikely
ASA grades 2–3: see next page


ASA grades 2–3
Other comorbidities not covered by guideline, because less common
Other comorbidities
Renal comorbidity
Sections 6.10 and 6.11
Comorbidity
Respiratory comorbidity
Cardiovascular comorbidity Sections 6.6 and 6.7
Grade of surgery?
Grade1 surgery:
Grade 2 surgery:
Grade 3 surgery:
Grade 4 surgery:
ASA 2: Table A13 Table A14 Table A15 Table A16
ASA 3: Table A17 Table A18 Table A19 Table A20
Respiratory comorbidity Sections 6.8 and 6.9
Grade of surgery?
Grade1 surgery:
Grade 2 surgery:
Grade 3 surgery:
Grade 4 surgery:
ASA 2: Table A21 Table A22 Table A23 Table A24
ASA 3: Table A25 Table A26 Table A27 Table A28
Renal comorbidity
Grade of surgery?
Grade1 surgery:
Grade 2 surgery:
Grade 3 surgery:
Grade 4 surgery:
ASA 2: Table A29 Table A30 Table A31 Table A32
ASA 3: Table A33 Table A34 Table A35 Table A36

6.4 ASA grade 1

Adults (age ≥ 16 years)

TABLE A1 Grade 1 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray	No	No	No	No
ECG	No			Yes
Full blood count	No	No		
Haemostasis	No	No	No	No
Renal function	No	No		
Random glucose	No	No	No	No
Urine analysis[a]				

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE A2 Grade 2 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray	No	No	No	No
ECG	No			Yes
Full blood count	No		Yes	Yes
Haemostasis	No	No	No	No
Renal function	No	No		
Random glucose	No			
Urine analysis[a]				

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE A3 Grade 3 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray	No	No		
ECG	No		Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis	No	No	No	No
Renal function			Yes	Yes
Random glucose				
Urine analysis[a]				

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE A4 Grade 4 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray	No	No		
ECG	No		Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis[a]				

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE A5 Neurosurgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray	No	No		
ECG			Yes	Yes
Full blood count			Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis[a]				

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE A6 Cardiovascular surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray	Yes	Yes	Yes	Yes
ECG	Yes	Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis[a]				

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

6.5 ASA grade 1
Children (age < 16 years)

TABLE A7 Grade 1 surgery

Test	<6 months	6 to 12 months	1 to 5 years	5 to 12 years	12 to 16 years
Chest x-ray	No	No	No	No	No
ECG	No	No	No	No	No
Full blood count	No	No	No	No	No
Haemostasis	No	No	No	No	No
Renal function	No	No	No	No	No
Random glucose	No	No	No	No	No
Urine analysis[a]	No	No	No	No	No

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE A8 Grade 2 surgery

Test	<6 months	6 to 12 months	1 to 5 years	5 to 12 years	12 to 16 years
Chest x-ray	No	No	No	No	No
ECG	No	No	No	No	No
Full blood count	No	No	No	No	No
Haemostasis	No	No	No	No	No
Renal function	No	No	No	No	No
Random glucose	No	No	No	No	No
Urine analysis[a]	No	No	No	No	No

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE A9 Grade 3 surgery

Test	<6 months	6 to 12 months	1 to 5 years	5 to 12 years	12 to 16 years
Chest x-ray	No	No	No	No	No
ECG	No	No	No	No	No
Full blood count					
Haemostasis	No	No	No	No	No
Renal function					
Random glucose	No	No	No	No	No
Urine analysis[a]					

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE A10 Grade 4 surgery

Test	<6 months	6 to 12 months	1 to 5 years	5 to 12 years	12 to 16 years
Chest x-ray	No	No	No	No	No
ECG	No	No	No	No	No
Full blood count					
Haemostasis	No	No	No	No	No
Renal function					
Random glucose	No	No	No	No	No
Urine analysis[a]					

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE A11 Neurosurgery

Test	<6 months	6 to 12 months	1 to 5 years	5 to 12 years	12 to 16 years
Chest x-ray	No	No	No	No	No
ECG	No	No	No	No	No
Full blood count					
Haemostasis					
Renal function	Yes	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No	No
Urine analysis[a]					

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE A12 Cardiovascular surgery

Test	<6 months	6 to 12 months	1 to 5 years	5 to 12 years	12 to 16 years
Chest x-ray	Yes	Yes	Yes	Yes	Yes
ECG	Yes	Yes	Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes	Yes
Haemostasis					
Renal function	Yes	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No	No
Urine analysis[a]					

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

6.6 ASA grade 2
Adults with cardiovascular disease comorbidity

TABLE A13 Grade 1 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray	No			
ECG	Yes	Yes	Yes	Yes
Full blood count				
Haemostasis	No	No	No	No
Renal function				
Random glucose	No	No	No	No
Urine analysis				
Blood gases	No	No	No	No
Lung function	No	No	No	No

TABLE A14 Grade 2 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG	Yes	Yes	Yes	Yes
Full blood count				
Haemostasis	No	No	No	No
Renal function			Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases	No	No	No	No
Lung function	No	No	No	No

TABLE A15 Grade 3 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray	Yes	Yes	Yes	Yes
ECG	Yes	Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis	No	No	No	No
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

TABLE A16 Grade 4 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG	Yes	Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

6.7 ASA grade 3
Adults with cardiovascular disease comorbidity

TABLE A17 Grade 1 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG	Yes	Yes	Yes	Yes
Full blood count				
Haemostasis	No	No	No	No
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

TABLE A18 Grade 2 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG	Yes	Yes	Yes	Yes
Full blood count				
Haemostasis	No	No	No	No
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

TABLE A19 Grade 3 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG	Yes	Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

TABLE A20 Grade 4 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray			Yes	Yes
ECG	Yes	Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

6.8 ASA grade 2
Adults with comorbidity from respiratory disease

TABLE A21 Grade 1 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray[a]	No			
ECG	No			
Full blood count				
Haemostasis	No	No	No	No
Renal function	No	No		
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

[a] Chest x-rays may be considered if there has been a change in patients symptoms or if the patient needs ventilator support

TABLE A22 Grade 2 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray[a]				
ECG	No			
Full blood count				
Haemostasis	No	No	No	No
Renal function	No			
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

[a] Chest x-rays may be considered if there has been a change in patients symptoms or if the patient needs ventilator support

TABLE A23 Grade 3 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray[a]				
ECG				Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis	No	No	No	No
Renal function			Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No			

[a] Chest x-rays may be considered if there has been a change in patients symptoms or if the patient needs ventilator support

TABLE A24 Grade 4 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray[a]				
ECG			Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function				

[a] Chest x-rays may be considered if there has been a change in patients symptoms or if the patient needs ventilator support

6.9 ASA grade 3
Adults with comorbidity from respiratory disease

TABLE A25 Grade 1 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG				
Full blood count				
Haemostasis	No	No	No	No
Renal function				
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

TABLE A26 Grade 2 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG			Yes	Yes
Full blood count				Yes
Haemostasis	No	No	No	No
Renal function				
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function				

TABLE A27 Grade 3 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG			Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis	No	No	No	No
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function				

TABLE A28 Grade 4 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG		Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function				

6.10 ASA grade 2
Adults with comorbidity from renal disease

TABLE A29 Grade 1 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray[a]	No	No	No	
ECG	No			
Full blood count				
Haemostasis	No	No	No	No
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases	No	No	No	No
Lung function	No	No	No	No

[a] Chest x-ray may be considered if the patient has signs of other comorbidities often associated with renal disease, such as hypertension and coronary heart failure.

TABLE A30 Grade 2 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray[a]	No	No		
ECG			Yes	Yes
Full blood count				
Haemostasis	No	No	No	No
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases	No	No	No	No
Lung function	No	No	No	No

[a] Chest x-ray may be considered if the patient has signs of other comorbidities often associated with renal disease, such as hypertension and coronary heart failure.

TABLE A31 Grade 3 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG			Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function	No	No	No	No

TABLE A32 Grade 4 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG		Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function	No	No	No	No

6.11 ASA grade 3
Adults with comorbidity from renal disease

TABLE A33 Grade 1 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray[a]	No	No		
ECG	No			
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function	No	No	No	No

[a] Chest x-ray may be considered if the patient has signs of other comorbidities often associated with renal disease, such as hypertension and coronary heart failure.

TABLE A34 Grade 2 surgery

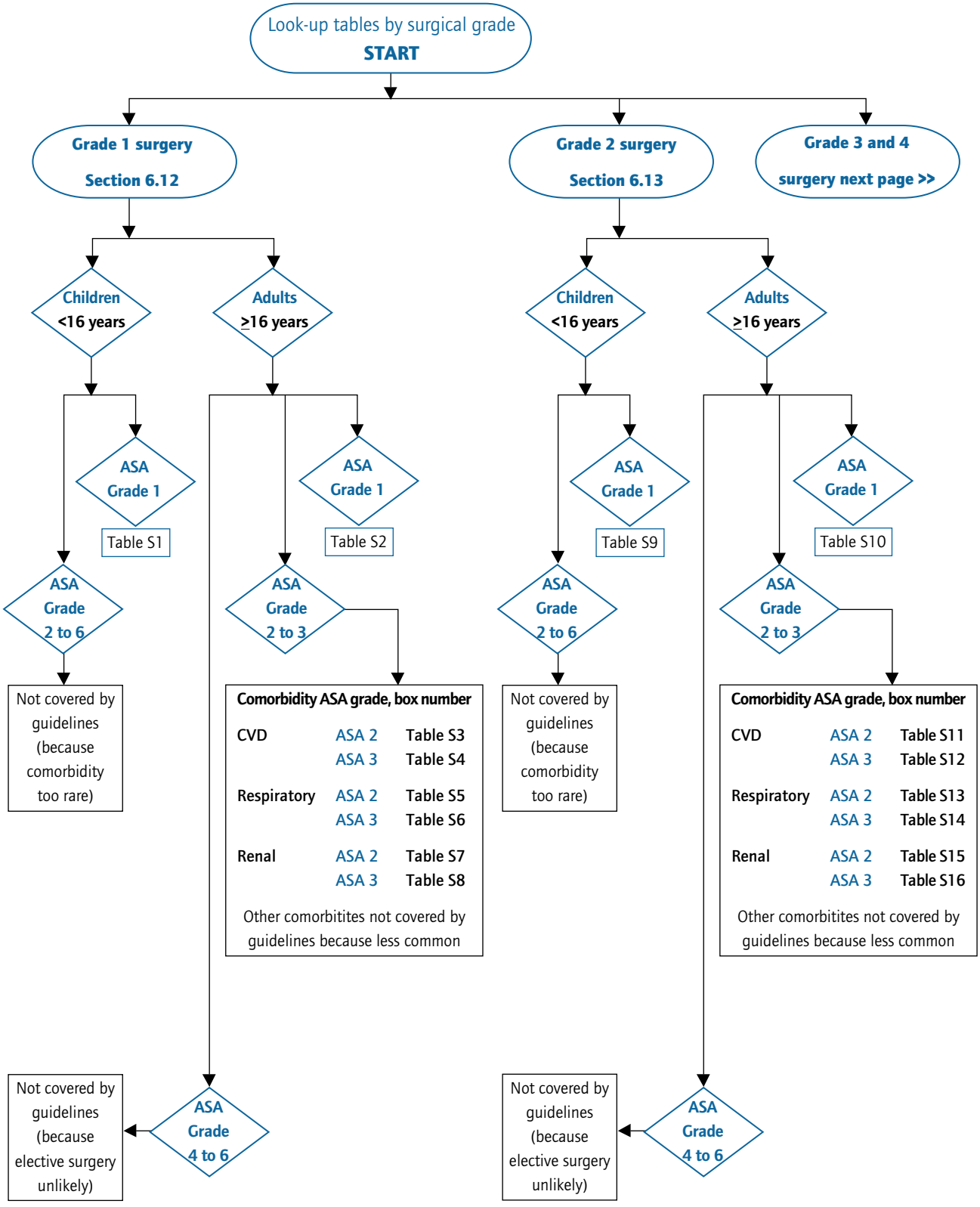
Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG			Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function	No	No	No	No

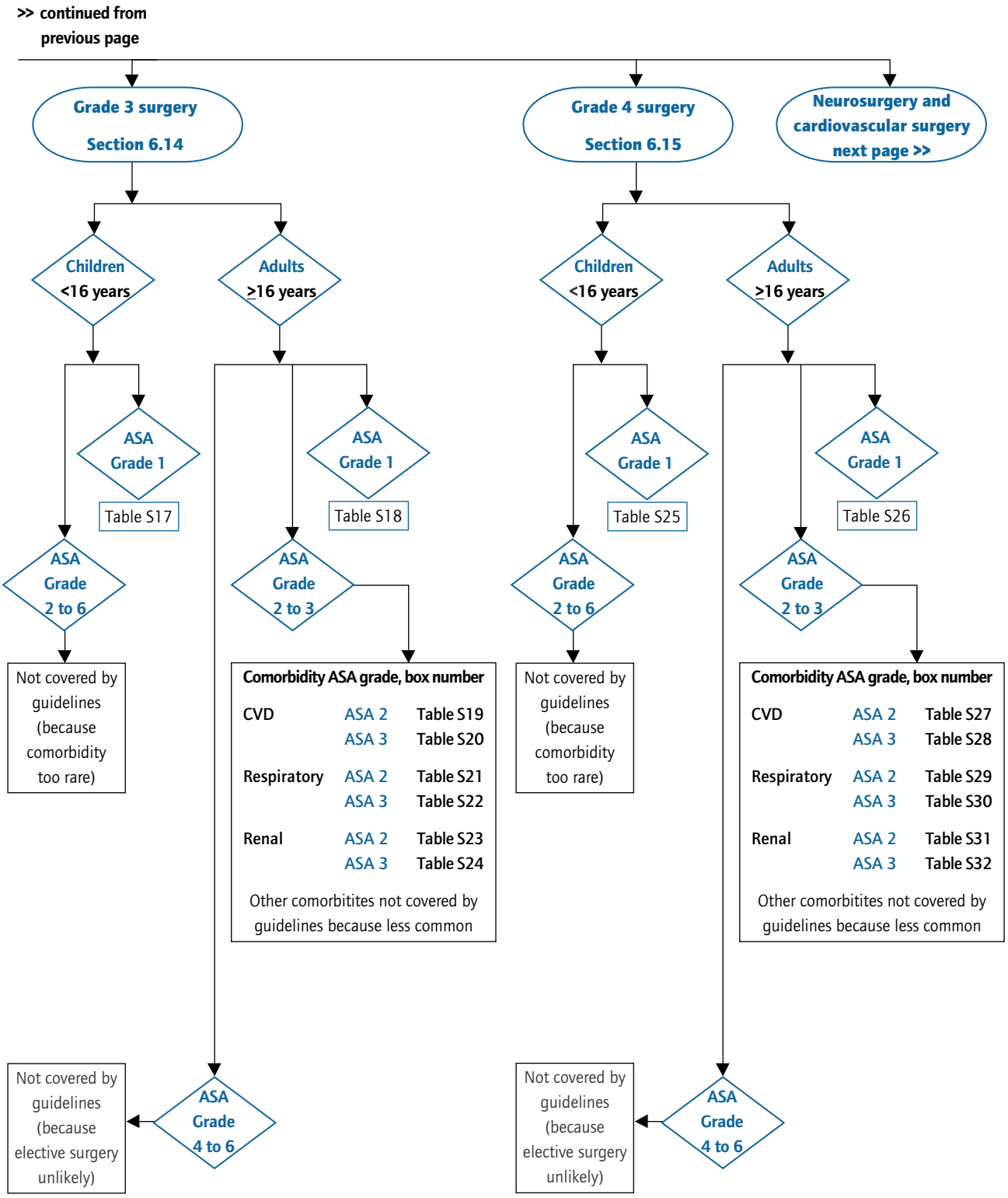
TABLE A35 Grade 3 surgery

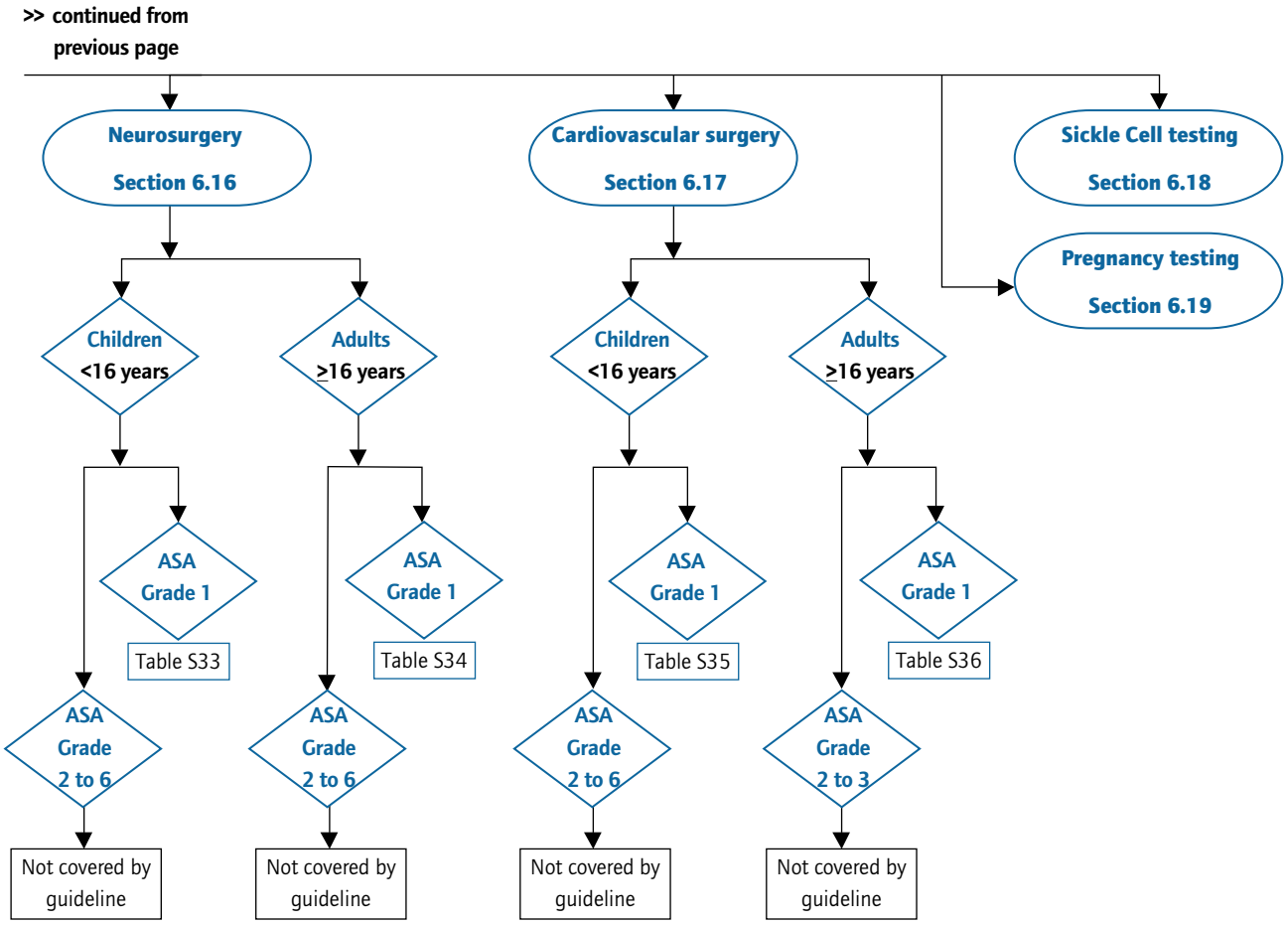
Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG			Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function	No	No	No	No

TABLE A36 Grade 4 surgery

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG		Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function	No	No	No	No


Look-up tables by surgical grade
START
Grade 1 surgery
Section 6.12
Grade 2 surgery
Section 6.13
Grade 3 and 4
surgery next page >>
Children
<16 years
Adults
≥16 years
Children
<16 years
Adults
≥16 years
ASA
Grade 1
Table S1
ASA
Grade 1
Table S2
ASA
Grade 1
Table S9
ASA
Grade 1
Table S10
ASA
Grade
2 to 6
ASA
Grade
2 to 3
ASA
Grade
2 to 6
ASA
Grade
2 to 3
Not covered by guidelines (because comorbidity too rare)
Comorbidity ASA grade, box number
CVD ASA 2 Table S3
ASA 3 Table S4
Respiratory ASA 2 Table S5
ASA 3 Table S6
Renal ASA 2 Table S7
ASA 3 Table S8
Other comorbitites not covered by guidelines because less common
Not covered by guidelines (because comorbidity too rare)
Comorbidity ASA grade, box number
CVD ASA 2 Table S11
ASA 3 Table S12
Respiratory ASA 2 Table S13
ASA 3 Table S14
Renal ASA 2 Table S15
ASA 3 Table S16
Other comorbitites not covered by guidelines because less common
Not covered by guidelines (because elective surgery unlikely)
ASA
Grade
4 to 6
Not covered by guidelines (because elective surgery unlikely)
ASA
Grade
4 to 6


>> continued from previous page
Grade 3 surgery Section 6.14
Grade 4 surgery Section 6.15
Neurosurgery and cardiovascular surgery next page >>
Children <16 years
Adults ≥16 years
Children <16 years
Adults ≥16 years
ASA Grade 1
Table S17
ASA Grade 1
Table S18
ASA Grade 1
Table S25
ASA Grade 1
Table S26
ASA Grade 2 to 6
ASA Grade 2 to 3
ASA Grade 2 to 6
ASA Grade 2 to 3
Not covered by guidelines (because comorbidity too rare)
Comorbidity ASA grade, box number
CVD ASA 2 Table S19
ASA 3 Table S20
Respiratory ASA 2 Table S21
ASA 3 Table S22
Renal ASA 2 Table S23
ASA 3 Table S24
Other comorbitites not covered by guidelines because less common
Not covered by guidelines (because comorbidity too rare)
Comorbidity ASA grade, box number
CVD ASA 2 Table S27
ASA 3 Table S28
Respiratory ASA 2 Table S29
ASA 3 Table S30
Renal ASA 2 Table S31
ASA 3 Table S32
Other comorbitites not covered by guidelines because less common
ASA Grade 4 to 6
ASA Grade 4 to 6
Not covered by guidelines (because elective surgery unlikely)
Not covered by guidelines (because elective surgery unlikely)


>> continued from previous page
Neurosurgery Section 6.16
Cardiovascular surgery Section 6.17
Sickle Cell testing Section 6.18
Pregnancy testing Section 6.19
Children <16 years
Adults ≥16 years
Children <16 years
Adults ≥16 years
ASA Grade 1
ASA Grade 1
ASA Grade 1
ASA Grade 1
Table S33
Table S34
Table S35
Table S36
ASA Grade 2 to 6
ASA Grade 2 to 6
ASA Grade 2 to 6
ASA Grade 2 to 3
Not covered by guideline
Not covered by guideline
Not covered by guideline
Not covered by guideline

6.12 Grade 1 surgery

TABLE S1 ASA grade 1: Children (< 16 years)

Test	< 6 months	6 to 12 months	1 to 5 years	5 to 12 years	12 to 16 years
Chest x-ray	No	No	No	No	No
ECG	No	No	No	No	No
Full blood count	No	No	No	No	No
Haemostasis	No	No	No	No	No
Renal function	No	No	No	No	No
Random glucose	No	No	No	No	No
Urine analysis[a]	No	No	No	No	No

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE S2 ASA grade 1: Adults (≥ 16 years)

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray	No	No	No	No
ECG	No			Yes
Full blood count	No	No		
Haemostasis	No	No	No	No
Renal function	No	No		
Random glucose	No	No	No	No
Urine analysis[a]				

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE S3 ASA grade 2: Adults with comorbidity from CVD

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray	No			
ECG	Yes	Yes	Yes	Yes
Full blood count				
Haemostasis	No	No	No	No
Renal function				
Random glucose	No	No	No	No
Urine analysis				
Blood gases	No	No	No	No
Lung function	No	No	No	No

TABLE S4 ASA grade 3: Adults with comorbidity from CVD

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG	Yes	Yes	Yes	Yes
Full blood count				
Haemostasis	No	No	No	No
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

6.12 Grade 1 surgery (continued)

TABLE S5 ASA grade 2: Adults with comorbidity from respiratory disease

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray[b]	No			
ECG	No			
Full blood count				
Haemostasis	No	No	No	No
Renal function	No	No		
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

[b] Chest x-rays may be considered if there has been a change in patient's symptoms or if the patient needs ventilator support

TABLE S6 ASA grade 3: Adults with comorbidity from respiratory disease

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG				
Full blood count				
Haemostasis	No	No	No	No
Renal function				
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

TABLE S7 ASA grade 2: Adults with comorbidity from renal disease

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray[b]	No	No	No	
ECG	No			
Full blood count				
Haemostasis	No	No	No	No
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases	No	No	No	No
Lung function	No	No	No	No

[b] Chest x-rays may be considered if there has been a change in patient's symptoms or if the patient needs ventilator support

TABLE S8 ASA grade 3: Adults with comorbidity from renal disease

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray	No	No		
ECG	No			
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function	No	No	No	No

6.13 Grade 2 surgery

TABLE S9 **ASA grade 1:** Children (< 16 years)

Test	< 6 months	6 to 12 months	1 to 5 years	5 to 12 years	12 to 16 years
Chest x-ray	No	No	No	No	No
ECG	No	No	No	No	No
Full blood count	No	No	No	No	No
Haemostasis	No	No	No	No	No
Renal function	No	No	No	No	No
Random glucose	No	No	No	No	No
Urine analysis[a]	No	No	No	No	No

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE S10 **ASA grade 1:** Adults (≥ 16 years)

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray	No	No	No	No
ECG	No			Yes
Full blood count	No		Yes	Yes
Haemostasis	No	No	No	No
Renal function	No	No		
Random glucose	No			
Urine analysis[a]				

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE S11 **ASA grade 2:** Adults with comorbidity from CVD

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG	Yes	Yes	Yes	Yes
Full blood count				
Haemostasis	No	No	No	No
Renal function			Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases	No	No	No	No
Lung function	No	No	No	No

TABLE S12 **ASA grade 3:** Adults with comorbidity from CVD

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG	Yes	Yes	Yes	Yes
Full blood count				
Haemostasis	No	No	No	No
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

6.13 Grade 2 surgery (continued)

TABLE S13 ASA grade 2: Adults with comorbidity from respiratory disease

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray[b]				
ECG	No			
Full blood count				
Haemostasis	No	No	No	No
Renal function	No			
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

[b] Chest x-rays may be considered if there has been a change in patient's symptoms or if the patient needs ventilator support

TABLE S14 ASA grade 3: Adults with comorbidity from respiratory disease

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG			Yes	Yes
Full blood count				Yes
Haemostasis	No	No	No	No
Renal function				
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function				

TABLE S15 ASA grade 2: Adults with comorbidity from renal disease

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray[b]	No	No		
ECG			Yes	Yes
Full blood count				
Haemostasis	No	No	No	No
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases	No	No	No	No
Lung function	No	No	No	No

[b] Chest x-rays may be considered if there has been a change in patient's symptoms or if the patient needs ventilator support

TABLE S16 ASA grade 3: Adults with comorbidity from renal disease

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG			Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function	No	No	No	No

6.14 Grade 3 surgery

TABLE S17 ASA grade 1: Children (< 16 years)

Test	< 6 months	6 to 12 months	1 to 5 years	5 to 12 years	12 to 16 years
Chest x-ray	No	No	No	No	No
ECG	No	No	No	No	No
Full blood count					
Haemostasis	No	No	No	No	No
Renal function					
Random glucose	No	No	No	No	No
Urine analysis[a]					

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE S18 ASA grade 1: Adults (≥ 16 years)

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray	No	No		
ECG	No		Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis	No	No	No	No
Renal function			Yes	Yes
Random glucose				
Urine analysis[a]				

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE S19 ASA grade 2: Adults with comorbidity from CVD

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG	Yes	Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis	No	No	No	No
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

TABLE S20 ASA grade 3: Adults with comorbidity from CVD

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG	Yes	Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

6.14 Grade 3 surgery (continued)

TABLE S21 ASA grade 2: Adults with comorbidity from respiratory disease

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray[b]				
ECG				Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis	No	No	No	No
Renal function			Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No			

[b] Chest x-rays may be considered if there has been a change in patient's symptoms or if the patient needs ventilator support

TABLE S22 ASA grade 3: Adults with comorbidity from respiratory disease

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG			Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis	No	No	No	No
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function				

TABLE S23 ASA grade 2: Adults with comorbidity from renal disease

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray[b]				
ECG			Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function	No	No	No	No

[b] Chest x-rays may be considered if there has been a change in patient's symptoms or if the patient needs ventilator support

TABLE S24 ASA grade 3: Adults with comorbidity from renal disease

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG			Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function	No	No	No	No

6.15 Grade 4 surgery

TABLE S25 ASA grade 1: Children (< 16 years)

Test	< 6 months	6 to 12 months	1 to 5 years	5 to 12 years	12 to 16 years
Chest x-ray	No	No	No	No	No
ECG	No	No	No	No	No
Full blood count					
Haemostasis	No	No	No	No	No
Renal function					
Random glucose	No	No	No	No	No
Urine analysis[a]					

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE S26 ASA grade 1: Adults (≥ 16 years)

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray	No	No		
ECG	No		Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis[a]				

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE S27 ASA grade 2: Adults with comorbidity from CVD

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG	Yes	Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

TABLE S28 ASA grade 3: Adults with comorbidity from CVD

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray			Yes	Yes
ECG	Yes	Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

6.15 Grade 4 surgery (continued)

TABLE S29 ASA grade 2: Adults with comorbidity from respiratory disease

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray[b]				
ECG			Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function				

[b] Chest x-rays may be considered if there has been a change in patient's symptoms or if the patient needs ventilator support

TABLE S30 ASA grade 3: Adults with comorbidity from respiratory disease

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG		Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function				

TABLE S31 ASA grade 2: Adults with comorbidity from renal disease

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray[b]				
ECG		Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function	No	No	No	No

[b] Chest x-rays may be considered if there has been a change in patient's symptoms or if the patient needs ventilator support

TABLE S32 ASA grade 3: Adults with comorbidity from renal disease

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray				
ECG		Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function	No	No	No	No

6.16 Neurosurgery

TABLE S33 ASA grade 1: Children (< 16 years)

Test	< 6 months	6 to 12 months	1 to 5 years	5 to 12 years	12 to 16 years
Chest x-ray	No	No	No	No	No
ECG	No	No	No	No	No
Full blood count					
Haemostasis					
Renal function	Yes	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No	No
Urine analysis[a]					

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE S34 ASA grade 1: Adults (≥ 16 years)

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray	No	No		
ECG			Yes	Yes
Full blood count			Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis[a]				

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

6.17 Cardiovascular surgery

TABLE S35 ADA grade 1: Children (< 16 years)

Test	< 6 months	6 to 12 months	1 to 5 years	5 to 12 years	12 to 16 years
Chest x-ray	Yes	Yes	Yes	Yes	Yes
ECG	Yes	Yes	Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes	Yes
Haemostasis					
Renal function	Yes	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No	No
Urine analysis[a]					

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

TABLE S36 ASA grade 1: Adults (≥ 16 years)

Test	>16 to <40	>40 to <60	>60 to <80	>80
Chest x-ray	Yes	Yes	Yes	Yes
ECG	Yes	Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis[a]				

[a] Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

6.18 Tests for the sickle cell gene in adults and children

TABLE 37 Testing for the sickle cell gene

Appropriateness of testing in patients from the following ethnic groups	
North African	Yes
West African	Yes
South/sub Saharan African	Yes
Afro Caribbean	Yes
Should informed consent be obtained?	Yes

The following recommendations and observations are in addition to those shown in Table 37:

- **The sickle cell gene is found in many nationalities including families that come from Africa, the Caribbean, the Eastern Mediterranean, Middle East and Asia. It has also been detected in Cypriot people and a few other white ethnic groups.**
- **It is important to offer to test all people considered to be at risk before an anaesthetic, both at hospital and dental clinics.**
- **This is especially important for people of ethnic groups considered to be at risk, who have a family history of homozygous sickle cell anaemia or sickle cell trait and do not have a surgical history where it may have been detected previously.**
- **People should be offered screening, with genetic counselling before and after screening.**
- **Appropriate counselling for this test is important so that patients are able to give their informed consent, as there may be implications for patients who discover they are carriers of the sickle cell gene. The results of testing, even when negative, should be reported to families, with the patient's consent, and documented in the patient's medical record to avoid unnecessary repeat testing.**

6.19 Pregnancy testing

The following recommendations and observations are in addition to those shown in Table 38:

- **The need to test for pregnancy depends on the risk presented to the fetus by the anaesthetic and surgery. All women of child-bearing age should be asked sensitively whether or not there is any chance that they may be pregnant.**
- **Women must be made aware of the risks of surgery to the fetus.**
- **A pregnancy test should be carried out with the woman's consent if there is any doubt about whether she may be pregnant.**
- **Before having a chest x-ray, all women of child-bearing age should be asked sensitively whether they may be pregnant.**

TABLE 38 Pregnancy testing

Pregnancy testing should be carried out in female patients of reproductive age:	
With history of last menstrual period	
Who says it is not possible for her to be pregnant	
Who says it is possible that she may be pregnant	Yes
Should informed consent be obtained?	Yes

6.20 Good practice recommendations

During the development of this guideline, the GDG agreed certain principles of good practice. Although the aspects of preoperative testing to which they relate were not strictly within the scope of the guideline, it is important to describe them because the guideline was developed with the assumption that these principles were in place.

6.20.1 Ensuring clinical competence

It is important to ensure that staff undertaking clinical preoperative assessments receive appropriate education and training to allow them to apply the guideline correctly.

6.20.2 Preoperative assessment

It is crucial to ensure that a thorough medical history is taken from the patient to inform the recommendations about which preoperative tests to carry out. Taking a thorough medical history requires someone with the appropriate training.

6.20.3 Timing and setting of tests

The consensus process did not cover the issue of who should carry out the preoperative tests. However, it is clear that preoperative tests are often ordered or carried out by nurses in preoperative assessment clinics. The timing of tests should be appropriate for the tests concerned. It may be appropriate both from the doctor's and patient's perspective to test for certain conditions at the earliest stage possible, after a patient has been placed on the waiting list for an operation, so that there is time for the patient to be treated and for their condition to stabilise, ensuring patients are in the best possible state when they have surgery.

Some tests could be carried out in the primary care setting by the patient's GP or practice nurse. For example, when a patient is listed for a particular operation it may be appropriate for the consultant in charge of the patient's care to consider the possible tests that may be required for the patient and, after discussion with the patient, to inform their GP. Excellent communication between primary and secondary care, to ensure that test results are shared, would be essential if such changes in the responsibility and timing of testing were to be implemented.

Whoever carries out the tests, protocols for testing should be followed. This is particularly important for tests like urine analysis (dipstick), where not following the recommended protocol may render the result of the test meaningless.

6.20.4 Patient information and consent

Staff undertaking clinical preoperative assessments should discuss with patients which tests are recommended (or required), what they involve and why they are being carried out.

Decisions about whether or not to test should follow discussion between the patient and the doctor or nurse, especially where there is uncertainty about whether a test should be recommended or not. For some tests, a positive result carries a far greater significance for the patient than others, such as testing for previously undetected diabetes, the sickle cell gene and pregnancy.

Patients should have access to information about the tests and the possible implications of a positive result so that they can give their informed consent. Doctors or nurses carrying out or ordering tests should write in the patient's notes that they have discussed the recommended tests and their implications with the patient.

Patients should be informed of the results of tests and about the implications for treatment, and any longer term implications for their health, if the results are abnormal.

For further guidance, clinicians should refer to the *Good Practice in Consent*[2] guidance on issues of consent in the NHS (available from: www.doh.gov.uk/consent). This guideline supports the advice given in that publication – that it is "a general legal and ethical principle that valid consent must be obtained before starting treatment or physical examination, or providing personal care, for a patient" and that patients should have access to sufficient information about risks, benefits and alternatives to be able to make an informed decision about whether to consent.

DATA COLLECTION RECOMMENDATIONS

The evidence underpinning the guideline is weak. It is therefore not justified to enforce compliance with the recommendations about when to test and when not to test. However, as with other guidance issued by NICE, we believe that the collection of the information described below (the 'minimum dataset') should be mandatory when a person is ordering tests in the NHS in contravention to the guideline or where the guideline is uncertain. We recognise that such a policy will be difficult to enforce, especially with paper-based systems for test ordering. However, Trust directors with responsibility for clinical governance need to recognise that auditing compliance with the guideline (see 6.22, below) will be much more difficult if the minimum dataset is not collected at the time of ordering.

Minimum dataset

1 **ASA grade of patient (potentially available from other sources since it is proposed that this item of information will become part of the Hospital Episode Statistics minimum dataset).**

2 **Main comorbidity (eg renal, respiratory and cardiovascular; main categories could be precoded on the test order form).**

3 **Grade of surgery.**

4 **Reasons for ordering.**

Ideally, given the weak evidence for the guideline's recommendations, the minimum dataset should be collected when any preoperative test is ordered, ie even when ordering the test is consistent with the guideline's recommendations. High quality datasets collected in this way would provide evidence about why tests are ordered for different types of patients undergoing different operations, which would be very valuable when this guideline is revised. Clearly, collection of these data also has implications for data entry for Trusts without electronic test ordering systems.

6.21 Implementation in the NHS

NHS Trusts carrying out elective surgery have a responsibility to implement this guideline. We recommend that implementation is audited (in addition to auditing compliance with the guideline) and that the methods for auditing implementation are maintained to provide a mechanism for regular review, ensuring that a revised guideline or relevant new evidence is disseminated promptly as it becomes available and new recommendations are incorporated into local guidance.

Trusts may want to consider the following steps in deciding how best to implement the guideline:

- **review existing practice against the recommendations of the guideline;**
- **where available, review relevant local clinical guidelines and protocols in the light of this guideline and revise them, if appropriate;**
- **if no local clinical guidelines exist, disseminate this guideline or write local guidance customising this guideline to take account of local circumstances;**
- **customise the guideline for local settings to describe specific common clinical indications and exceptions and to reflect the kinds of patients assessed in particular preoperative assessment clinics; and**
- **ensure that this guideline (or other local guidance) is available and effectively displayed in locations where preoperative tests are ordered.**

This guideline should be used in conjunction with the guidance from the NHS Modernisation Agency on preoperative assessment for inpatients and day surgery[3, 4] which is available from www.modern.nhs.uk/theatreprogramme.

6.22 Audit criteria

In addition to auditing the implementation of the guideline, Trusts should also put in place methods for auditing compliance with the recommendations of the guideline. The sophistication of the methods that Trusts can establish is likely to depend crucially on the flexibility of their IT systems. Trusts with state-of-the-art systems providing electronic ordering of tests and access to test results at the point-of-care should be able to implement several of the suggestions described below.

In Trusts with inflexible or ageing IT systems, periodic random sampling of case notes (over time, to cover the range of surgical specialities) should be carried out to review compliance with the guideline. These audits would be similar to existing periodic audits of the quality of documentation in medical records (and could be 'piggy-backed' on to medical record audits).

We strongly recommend that the following summary statistics are derived:

- **the percentage of patients who are not tested, in compliance with the guideline;**
- **the percentage of patients who are tested, in compliance with the guideline;**
- **the percentage of patients who are not tested, against the recommendations of the guideline;**
- **the percentage of patients who are tested, against the recommendations of the guideline;**
- **the percentage of patients who are tested and for whom one or more reasons for testing are documented; and**
- **the percentage of patients for whom the minimum dataset (see above) is available.**

The consistency of information also needs to be audited, eg check whether patients coded as having 'grade 2' surgery actually have grade 2 operations or that comorbidities are consistently described. Doctors and nurses responsible for ordering tests may change their criteria for classifying patients in order to justify continuing to order preoperative tests.

For Trusts with more up-to-date and flexible IT systems, it should be possible to collect the minimum dataset at the time of ordering (eg by selecting from drop-down menus), allowing the above audit statistics to be produced for all elective operations by a standard database query run periodically. Checks on the consistency of information may be unnecessary if classification of patients is implemented in the ordering software or can be carried out much more easily.

With electronic ordering and state-of-the-art IT systems, it may also be possible to implement some of the following suggestions:

- **provide interactive feedback about the guideline criteria for testing, as the person ordering the test enters information about the patient;**
- **implement mapping of operation codes to scale of severity of surgery (see Appendix 2, CD ROM);**
- **audit whether test results are 'opened', and by whom, before the operation takes place;**
- **audit the proportion of test results that are abnormal for different categories of patient; and**
- **trigger e-mail queries to the person who ordered a test or who opened the test results, asking whether the test results altered the clinical management and, if yes, how.**

6.23 Costs and cost-effectiveness

The economic aspects of preoperative testing are discussed in full in Appendix 5 (CD ROM) and are summarised by the following key points.

- **Preoperative testing represents a substantial drain on the resources of the NHS in England and Wales.**
- **Published evidence, mainly from the USA, suggests that substantial cost savings can be achieved by eliminating 'unnecessary' preoperative testing (see Appendix 5, CD ROM).**

- **Such cost savings may not be achievable in England and Wales, if:**
  - the prevalence of testing is lower; or
  - there are subsequent cost-savings attributable to testing.
- **Our cost impact analysis suggests that testing costs could potentially be reduced. However, in any Trust, the costs may be either increased or decreased depending on current testing practices (see Appendix 5, CD ROM). Any cost savings would be offset by implementation costs.**
- **Tests that add to NHS costs are justified if they are accompanied by substantial improvements in patient outcomes (ie if they are cost-effective).**
- **The level of cost-effectiveness of each preoperative test has not been established for any population subgroup. Estimating cost-effectiveness would require carefully collected empirical evidence on:**
  - the number of cases detected;
  - the health outcomes associated with detecting a case; and
  - resources used (and their cost) as a consequence of detecting a case.

The context of testing may have important resource implications. The literature suggests that, wherever possible, tests should be conducted in advance of the day of surgery to avoid last-minute cancellations and to ensure optimal use of operating theatres. More research is needed in this area.

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7. Discussion and Research Recommendations

7.1 Limitations of the guideline

7.1.1 Difficulties in interpreting and applying the guideline

The lack of empirical evidence about the benefits of preoperative testing from studies comparing alternative strategies for testing is a major limitation of the guideline. Poor quality of study design, execution and reporting also limited the usefulness of the noncomparative studies that were identified and reviewed.

Despite the strengths of the consensus process, there is a danger that agreement between participants in the groups reflects the status quo rather than an explicit weighing up of the benefits, harms and costs of testing. There are also difficulties in interpreting a lack of consensus among panellists.

We ran parallel groups for both stages of the consensus process to promote the applicability of the findings, ie to reduce the chance of the overall consensus being dominated by individual panellists. For example, anaesthetists are the key users of the results of preoperative tests yet only three anaesthetic representatives (one of whom was a specialist paediatric anaesthetist) were included on each panel. The situation was even more constrained for other clinical specialists. However, the use of two parallel groups meant that there could be agreement within each group but not between groups, agreement in one group and not in the other; or disagreements between groups but for different reasons.

The two main reasons for a lack of consensus were (a) true collective uncertainty about the value of testing; and (b) differing views about the relevance of unusual clinical circumstances (which tended to cause some panel members to want to test). There was relatively little opportunity to gain a detailed understanding of the variety of different opinions when there was lack of consensus within a group. We have tried to report important exceptions when there was otherwise consensus in a group (see Chapter 5), but we are not confident that the groups' discussions fully explored all combinations of relevant clinical characteristics, especially for patients with common comorbidities.

There is a danger that the nature of the consensus questionnaire, which explicitly permuted different dimensions (eg age and grade of severity of surgery), could have strongly influenced the judgements of panel members. For example, there are strong intuitive (face valid) reasons for expecting the value of testing to increase with increasing age and severity of surgery. Participants may have responded in line with these expectations rather than giving detailed consideration to the possible benefits and harms of testing for different age and surgical severity strata. The chair of the consensus meetings made a point of 'drawing out' participants about their reasons for holding particular views but this process was mainly restricted to clinical scenarios in which there was a lack of consensus at the outset.

Panel members and interviewees agreed with the principle that the appropriateness of testing depended on the severity or invasiveness of the operation. However, we were unable to find an established scale for classifying operations. Panel members agreed about the classification of some common operations, such as abdominal surgery or joint replacement, on the four-point scale used for the consensus process. However, in discussion during the consensus meetings it was also clear that they

disagreed about the classification of some other operations. Furthermore, it is important to point out that any scale that might be developed would need to be reviewed regularly because of technological innovations in surgery, such as new applications of minimally invasive techniques.

There were similar problems in defining ASA grades 2 and 3 for different comorbidities. During development of the consensus questionnaire for Phase B, the guideline team consulted several anaesthetists about the defining characteristics of ASA grades 2 and 3. Although they were familiar with the ASA grading system and used it in their clinical work to assign ASA grades to their patients, it was clear that different anaesthetists were interpreting the definitions provided by the ASA in different ways. For example, some volunteered that ASA grades 2 and 3 were usually distinguished on the basis of whether or not a patient's functional ability was affected by a comorbidity. This interpretation is not supported by the ASA, which explicitly states that it does not endorse any more detailed criteria for classifying patients than those described in the table of Abbreviations and Glossary of Terms at the beginning of this report.

The imprecise criteria currently available for classifying patients by grade of surgery and ASA grade mean that classification of some patients on these dimensions is likely to be unreliable between doctors. Without standardisation, variation in the use of preoperative tests within and between hospitals is likely to arise at least in part from the application of different criteria for classification. These imprecise criteria will also allow doctors to apply criteria variably to their own patients, in order to justify carrying out preoperative tests on patients for whom they want test results on the basis of their clinical intuition.

7.1.2 Conceptual difficulties in developing the guideline

From their first meeting the Guideline Development Group (GDG) were concerned about the ambiguity of the phrase 'routine' preoperative testing. At least three possible interpretations were suggested: (a) testing in uncomplicated patients (eg ASA grade 1); (b) testing in frequent or 'typical' patients (not only uncomplicated patients, but also patients with common comorbidities); or (c) testing without appropriate clinical consideration. The group decided unanimously to adopt the second interpretation as this was likely to result in the guideline having the widest possible application.

The group was also concerned about the range of tests that should be included. Many tests are carried out before an operation as part of a diagnostic work-up, primarily to make appropriate treatment decisions. There was unanimity that such tests did not fall within the remit of the guideline. However, this decision did not necessarily preclude certain tests, since a test that is used for diagnostic work-up in one patient might also be used to characterise a comorbidity in another patient.

These concerns led the group to adopt the term 'generic testing', meaning preoperative testing not related to the primary condition being treated. The intention was that this term should embrace testing applied to 'groups' of people meeting certain criteria, eg those in a particular age group undergoing particular types of operation, or affected by particular comorbidities. The group recognises that this definition of generic testing is not watertight. For example, the definition was sometimes difficult to apply during Phase B of the consensus process, eg when considering whether generic testing included carrying out lung function tests in a patient with respiratory comorbidity undergoing cardiac surgery. (The GDG agreed that this example did represent generic testing.) Nevertheless, the GDG hopes that this definition represents a starting point for future debate.

The GDG's second major conceptual concern was the simplistic approach to 'valuing' preoperative testing previously taken by most researchers, namely that preoperative tests only have value if they directly result in postponement or cancellation of the planned operation or, in some cases, an explicit change in clinical management.

From the outset, the GDG believed that there is a need to establish a wider framework for valuing preoperative tests. This belief was supported by information from the interviews with anaesthetists

and trainee surgeons. The GDG appreciated that such a framework needs to consider carefully possible harms (and costs) of preoperative testing as well as benefits. First, there needs to be agreement about actions contingent on the results of preoperative tests that are potentially sufficiently valuable to justify the preoperative tests. Second, the benefits and harms of testing need to be valued and the costs of testing estimated. Empirical research on less tangible actions, such as a change in the seniority of the anaesthetist scheduled for an operation, also requires the development of reliable methods for documenting and measuring actions. Data collection to measure the frequency of such actions will almost certainly have to be prospective. Prospective documentation of actions creates its own difficulties. At best it will be an additional cost (since most previous studies have relied on case note review to collect outcomes); at worst, the need to document and measure actions may bias clinical behaviour.

7.1.3 Practical/logistical difficulties in developing the guideline

The GDG spent a considerable amount of time scoping the detail of the guideline. As already noted, issues that caused difficulty include interpretation of the phrase 'routine' preoperative testing and definition (and concern) of what constitutes a valuable change in clinical management. The group had to decide whether to limit the scope of the guideline to ASA grade 1 patients. The clinician members of the GDG were unanimous in choosing to interpret the brief more widely than this, given that it is common for surgeons to carry out elective surgery on patients with comorbidities. The proportion of operations carried out on such patients is likely to increase in the future, with the introduction of less invasive surgical technologies and the growing number of elderly people in the population. The decision was not taken lightly since the GDG were aware of the difficulties of investigating preoperative testing in patients classified as ASA grade 2 or 3. For all the limitations of the current guideline for these patients, the GDG believe that it provides a useful foundation for future research and subsequent revisions of this guideline.

The importance of the specialist clinical members of the GDG cannot be overemphasised. They provided invaluable insights about preoperative testing, most of which arose during discussion in committee rather than from queries or drafts sent to individuals for independent comment. However, it was very difficult to convene meetings, given the commitments of GDG members employed by the NHS. Despite their enthusiasm for the project, individuals often commented that it was not possible for them to prioritise the development of the guideline over their clinical responsibilities to their Trusts. The project management team was often faced with the difficult decision of whether to postpone a meeting (with consequences for the timetable for the development of the guideline) or to go ahead with some key people missing (with consequences for the depth and breadth of the discussion in committee). Uncertainties about the detailed scope of the guideline and the amount of time required to achieve key milestones compounded this difficulty. Future projects to develop guidelines need to be aware of these issues. It would be advantageous if clinicians were afforded protected time allocated to study, research and development or clinical governance.

Similar problems arose in convening the consensus panels and in achieving appropriate representation of clinical interests in each panel. We were unable to identify any surgeons who were able to or willing to participate in the consensus panels in the time we had to search for panel members. Other panel members were sometimes only able arrange to attend for half a day. Even when people had completed the pre-meeting consensus questionnaires, we had to exclude their responses if they could not attend the subsequent meetings.

7.2 Issues not considered in the development of the guideline

7.2.1 Optimal setting for preoperative testing

The guideline has been formulated, as far as possible, to apply to current practices in the NHS. However, members of the GDG and participants in consensus meetings pointed out that the ways in which preoperative testing is currently carried out may not be optimal. This concern was also raised by patient representatives who stressed that the week or two before a scheduled operation is not the ideal

moment for a patient to learn that there may be a problem with an aspect of his or her health. Preoperative testing to rule out undetected diabetes of a severity that would require a change in clinical management exemplifies this issue. It was widely believed that it would be more convenient both for the patient and the NHS if a fasting blood glucose test (the optimal test for identifying diabetes) were to be carried out in the primary care setting well in advance of the scheduled date of surgery, rather than one or two weeks before at a preoperative assessment clinic managed by the secondary care provider. If general practices had the capacity to implement comprehensive strategies for 'case-finding' for common chronic diseases, then the need for some specifically *preoperative* tests might be removed.

In summary, the GDG recognised that the setting for preoperative testing is potentially an important issue that could impact on the guideline, but considered it to be outside the scope of the current project. The optimal setting could also change as a result of future technological innovations in testing, information technology or the organisation of care. The issue is highlighted here as a prompt for future revisions of the guideline.

7.2.2 'Timeliness' of the results of preoperative testing

Early in the project, members of the GDG pointed out that the relevance of a test result reduces with increasing time from the date of testing. This is a complicated issue since the 'expiry date' of a result is likely to depend on the test, the clinical characteristics of the patient including comorbidities and the planned operation. Patient representatives also raised this as an issue, since unnecessary repeat testing may be inconvenient, cause discomfort and increase the chance of a false positive result.

Ideally, the guideline would have tried to obtain consensus about expiry dates for different tests in different clinical circumstances. However, the GDG considered that it would be too complex to investigate this aspect of preoperative testing in addition to the other dimensions considered by the consensus panels. The guideline therefore assumes that clinicians will make appropriate decisions about the need to repeat particular tests prior to an operation, based on the individual clinical circumstances of a patient. Again, this issue is highlighted here as a reminder of its potential importance for future revisions of the guideline.

7.2.3 Innovations in preoperative testing

When defining the scope of the guideline, the GDG was faced with difficult choices about whether to include innovative testing technologies. Examples include multigated acquisition scanning (MUGA) for evaluation of cardiovascular comorbidity and point-of-care testing. Although both technologies are currently available in the NHS, they are not widely used for preoperative testing and the GDG agreed to exclude them.

The point of discussion here is not the exclusion or inclusion of particular tests but rather the possible impact of technological innovations on the guideline. MUGA scanning is currently an expensive technology and its application is almost entirely confined to the diagnostic work-up of patients with cardiovascular disease. The GDG decided to exclude MUGA scanning for this reason, namely its application is primarily the evaluation of the condition being treated. However, it is possible that in the future MUGA scanning could be used to evaluate cardiovascular comorbidity in, for example, patients undergoing joint replacement, which would represent generic testing.

Similarly, point-of-care testing is used in the NHS in certain circumstances, eg Accident and Emergency Departments, but is not used widely in preoperative assessment clinics. This situation could change in the future with further technological advances, which might make point-of-care testing more cost-effective.

7.2.4 Innovations in information technology

The guideline is likely to need revision in the future because of innovations in information technology. The NHS is currently upgrading its information technology infrastructure to include support for electronic patient/health records and more efficient communication between the primary and secondary care sectors. We described above how primary care might be the preferred setting for some testing and effective information technology will help to promote the timely and fail-safe communication between a

general practice and the surgical/anaesthetic team that would be a prerequisite for this change in practice. In the future, electronic health records should mean that health information about a patient that does not change, eg blood group or sickle cell status; can be collected once, ideally in the first few years of life. The information can then be stored reliably and securely, but accessibly and permanently, for use when required.

7.2.5 Issues about consent for preoperative testing

The GDG initially discussed the question of consent for testing in the context of preoperative tests for pregnancy and sickle cell trait. These tests were singled out because of the sensitivity of the issues involved, for example broaching the possibility of pregnancy in girls under 16 years of age or older girls who are living with their parents who may not know that their daughters are sexually active; with sickle cell testing there are sensitivities about identifying a patient's ethnic origin. However, consent for testing is clearly a wider issue and one which has been considered by a separate working party (see Section 1.5.3). The reader is directed to the report of this working party for general recommendations about consent for testing.

The GDG felt that the issue of obtaining consent for testing for pregnancy and sickle cell trait remains a difficult problem in some circumstances. For example, interviewees suggested that doctors typically make a judgement from a patient's appearance about the likely need to ask a patient about their ethnicity, in order to decide whether it is appropriate to carry out a test for sickle cell trait. In some circumstances this might, inadvertently, cause offence. Some GDG members felt that nurses often deal with the issue of testing for pregnancy in girls under 16 years of age by waiting until the girl is alone to explain the importance of testing for pregnancy if a girl is sexually active and to seek at least verbal consent for testing. However, an informal arrangement of this kind does not seem satisfactory and is unlikely to result in consistent practice. It may also create a problem on rare occasions when a test is positive, and parents realise that their daughter has been tested for pregnancy without any discussion of the matter and without seeking their consent.

7.2.6 Guidance for children with comorbidities

The guideline does not include information on routine testing in children with comorbidities. This was because GDG members felt that children with comorbidity have a different aetiology to adult patients and should therefore be considered separately.

7.3 Research recommendations

7.3.1 Research to make the guideline more applicable

Research is needed to minimise the difficulties in applying the guideline that were discussed in Section 7.1.1, specifically the problems arising from the likely imprecision of classification of patients using the current ASA grading system and the scale of severity of surgery.

With respect to ASA grades, we recommend that the criteria for classifying patients into different grades should be refined and clarified. Anaesthetists should be trained in the assignment of ASA grades to promote consistency in their application.

With respect to the scale of the severity of surgery, we recommend that surgical specialties should collaborate to produce a scale similar to the one we used. The collaboration should aim to classify each procedure using the scale, rather than relying on examples to illustrate operations that are typical of different grades. Operation codes, used across the NHS for Hospital Episode Statistics (ie OPCS-4 codes), could then be mapped on to the scale of the severity of surgery within software applications for test ordering, allowing a person ordering a test to be prompted about the appropriateness of a test for a particular operation on the basis of this guideline.

7.3.2 Research to provide better quality evidence/recommendations

Implementation of the recommendations of this guideline together with improved information technology to support routine data collection have the potential to create large datasets that can provide answers to many of the descriptive questions that remained unanswered by the systematic review of the literature. We recommend that careful consideration is given to the possibility of

establishing standardised minimum datasets across Trusts. These datasets would serve two functions, namely assessing compliance with this guideline (for example, with respect to documentation of the reasons for ordering a test) and providing data describing testing practice and the frequency of health outcomes. Summary statistics from the datasets could provide some of the parameter estimates required for a detailed economic model (see below).

One of the most striking findings of the systematic review was that there are no published studies comparing the effectiveness of alternative strategies of preoperative testing. In principle, better information technology to support routine data collection could also provide the infrastructure for a large cluster-randomised controlled trial, eg by randomising NHS Trusts that carry out elective surgery to different testing strategies. Such a trial would undoubtedly give the best quality evidence to inform the guideline. However, a trial of this kind would require unprecedented collaboration and organisation across the NHS and we believe that it is not feasible. It should be noted that the NHS R&D Health Technology Assessment prioritised research to evaluate the effectiveness of preoperative testing in high risks groups but did not commission any project. A trial of the use of appropriately trained nurses compared with pre-registration house officers for preoperative assessment was commissioned but did not vary guidance about the criteria for testing.

An alternative approach is to model the costs and consequences of carrying out preoperative tests in different patient populations. We have described the principles of this approach in Appendix 5 (CD ROM), but acknowledge that the generalised model presented is unavoidably crude due to the data constraints. There is a need to develop, with the help of relevant clinicians, specific models to create a better representation of the complexities of decision-making for each preoperative test and also to collect data to estimate the key parameters (ie the frequencies, health outcomes and costs of different consequences).

7.3.3 Research to extend the guideline

We believe that it is important to use the time between now and a future revision of the guideline (planned for 2005) to clarify some of the areas of conceptual uncertainty highlighted by the GDG. Two closely linked issues are of particular importance. First, agreement needs to be sought about the reasons for preoperative testing, ie what are legitimate aims of preoperative testing? We obtained some information about this from the interviews with anaesthetists and trainee surgeons (see Chapter 4), but further research is required. Second, wide consultation is required about the range of actions that may occur as a direct result of preoperative testing and the potential value of these actions.

7.3.4 Research to optimise preoperative testing

Ongoing research is needed to optimise preoperative testing. Potential topics for evaluation should be proposed by test 'providers', who are most likely to be aware of technological innovations and existing suboptimal tests, and short-listed with wider consultation.

Research may be needed to identify the best test or the best way to carry out a test. Both issues are illustrated by controversy in the consensus meetings about urine analysis as a method of identifying undiagnosed diabetics. Some panel members believed that urine analysis had good sensitivity and specificity for detecting patients with diabetes sufficiently severe to require a change in clinical management. Others were confident that a random blood glucose test was preferable. Issues about quality control in carrying out urine analysis explained some, but not all, of the disagreement. All agreed that a fasting blood glucose test was more appropriate, but some were sceptical about the feasibility of carrying out this test in a preoperative assessment clinic, raising the question of whether there might be a better setting for carrying out the test, eg testing in primary care when a patient is listed for surgery.

Finally, we recommend that further consideration is given to the level or formality of informed consent that is required from patients for preoperative tests. There may be a need to distinguish between tests depending on the significance to the patient of a positive result. For example, it may be appropriate to require written informed consent to carry out a test for the sickle cell gene but not for a test to measure a patient's haemoglobin. In the latter case, it may be sufficient for the doctor or nurse ordering or carrying out the test to document in the patient's notes that the reasons for doing the test and the implications of a positive test result have been discussed.

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The use of preoperative tests for elective surgery