Modernising Care for Patients Undergoing Major Surgery

Improving Patient Outcomes and Increasing Clinical Efficiency

A report by the Improving Surgical Outcomes Group

Executive Summary

Over 20,000 patients die a year following surgery. Questions have recently been raised about the possibility that the National Health Service as a whole may have significantly higher mortality rates compared with the health care systems in comparable countries.

In many other countries, patients undergoing major surgery routinely receive a level of post-operative care significantly higher than that provided to the vast majority of NHS patients. It is recognised that the NHS has a lower proportion of hospital beds allocated to critical care compared to comparable countries, although there are initiatives to increase this number.

Many of the patients who die within 30 days of their surgery do so in general wards, without being admitted to a critical care facility. Only a minority of NHS patients undergoing major surgery go to intensive care units (ICU), high dependency units (HDU) or receive outreach critical care from a specialist team. Furthermore, due to medical advances and an aging population, the proportion of patients who are at risk of dying following surgery is increasing over time. Of those patients who die following surgery, the vast majority have significant medical co-morbidities at the time of surgery, although data from the National Confidential Enquiry into Patient Outcome and Deaths suggest that patients' actual risk of death is not being fully appreciated prior to their surgery.

However, the outlook is not completely dire. There have been encouraging studies both in the UK and abroad, using clinically proven technologies and techniques to both improve the outcome for patients undergoing major surgery, including reducing complications following surgery and the mortality rate, and make better use of resources.

In a health system where resources are always going to be tight, it is unrealistic to provide critical care beds for everyone who may need them. We support the Department of Health's initiatives to increase ICU bed numbers. There are, however, additional approaches that have been successful, and which could be readily adopted in the NHS. These affect three interlinked areas of surgical care and decision making:

- *improved pre-operative assessment, triage and preparation:* objective evaluation prior to planned major surgery can identify patients with an increased risk profile and, for some, this may result in the decision not to proceed to major surgery. Decisions about appropriate treatment options and possible outcomes are best achieved with a multi-disciplinary team approach that carefully considers all the available information and plans intra- and post-operative care. For operative patients, interventions such as exercise and nutritional supplementation can improve the preparation for surgery of patients with particular needs. Better handling of planned surgery may also improve resource availability for urgent and emergency cases.
- *improved intra-operative care:* haemodynamic optimisation and other interventions significantly reduce both the rates of post-operative complications and mortality, as well as significantly reducing both the length of hospital stay and the overall number of ICU / HDU bed days used.
- *improved use of post-operative resources:* the planned transfer of patients to ICU or HDU, or to receive outreach critical care, can lead to improved post-operative outcomes. This can reduce the overall number of total bed days as well as critical care bed days used.

A number of patients undergoing complex major surgery at specialised centres already benefit from such care. A much larger group of patients, including those undergoing intra-abdominal and major orthopaedic surgery could benefit from similar standards of care.

These improvements will help improve patient outcomes by reducing the number and severity of complications suffered following major surgery as well as decreasing the mortality rate. In turn, despite increasing the number of patients who receive critical care, improvements in peri-operative care can significantly reduce the overall number of ICU and HDU bed days used and shorten hospital stays. This will provide a more efficient utilisation of the NHS' critical care resources.

Much of the resource required for modernisation is already available, although it needs to be appropriately allocated. The capital and running costs are marginal in comparison with the potential savings and, overall, the improvements would be cost effective.

The following actions are needed to implement the modernisation of care.

Proposed actions

- There is a requirement to implement new standards of care that incorporate improved pre-operative assessment, preparation and triage, intra-operative care, and improved use of post-operative resources.
- There is a need to establish pre-operative assessment at a much earlier stage in the patient pathway, before surgery planning occurs, in order that decisions can be made about fitness for various procedures.
- There is a need to break out from the 'silo' budgeting approach that currently inhibits clinical teams from spending relatively small amounts of money on technology that will save greater amounts of money in other areas.
- There is a need to prioritise the rational use of critical care resources, taking patients undergoing major surgery as a priority group.
- There is a need to analyse data about the current situation and evaluate the differences seen in patient outcomes between NHS centres and those in other countries.

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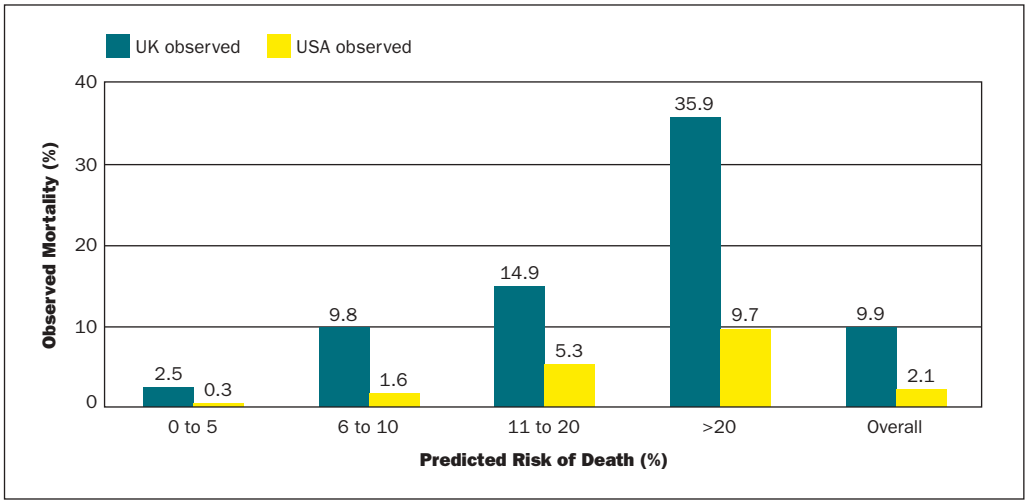
Introduction and Background

1.1 Approx. 3 million surgical operations a year are conducted in the UK, with a hospital mortality rate of 0.8–1.0%.

1.2 It is known from the National Confidential Enquiry into Patient Outcome and Deaths (NCEPOD; formerly the National Confidential Enquiry into Perioperative Deaths) data that there are over 20,000 deaths a year in patients following surgery.[1] NCEPOD data covers England, Northern Ireland and Wales as well as the Channel Islands and the Isle of Man (but excludes Scotland), and includes deaths following surgery at independent hospitals as well as the National Health Service.

1.3 At present there are inequities in the standards of peri-operative care across the NHS. Questions have recently been raised about the possibility that the NHS as a whole may have significantly higher mortality rates compared with the US health care system in comparable hospitals and populations.[2,3,4] For example, a direct comparison of risk-adjusted outcomes following major surgery at one US university-associated hospital with a similar UK centre demonstrated a four-fold higher level of observed mortality (see Figure 1).[2] The same UK team performed the scoring and risk adjustment for both cohorts.

Figure 1. Predicted and observed deaths for case-mix adjusted patients undergoing major, non-cardiac surgery in UK and USA cohorts over the same time period and in comparable hospitals.[2]



What do we know?

1.4 NCEPOD have reported that:

- Over 50% of post-operative deaths occurring within 30 days of the surgery are in patients who were never admitted to an intensive care or therapy unit (ICU):
  - 42% occur in patients transferred to a general ward;[5]
  - 7% occur in patients transferred to a high dependency unit (HDU);[5]
  - 36% occur in patients transferred directly to ICU;[5]
  - 15% occur in the operating theatre or recovery area;[5]
  - peer review of sample data suggest that there was an indication for ICU or HDU care in a further 10% of the patients;[6]
  - sample data suggest that few patients (2–3%) are transferred to ICU or HDU after they had been admitted to a general ward;[6]

- 6% of post-operative deaths could not be transferred to an ICU, HDU or other specialised nursing area where clinically indicated;[5]
- 38% of hospitals have no HDU facility;[5]
- in 46% of post-operative deaths, the consultant surgeon was not involved in the care of the patient;[5]
- in 39% of post-operative deaths, the consultant anaesthetist was not involved in the care of the patient.[5]

A comparison of two cohorts of patients undergoing major surgery showed that:

- **in a London teaching hospital, of the 265 patients followed, only 13% were immediately transferred to a critical care facility following surgery;**
- **in a Scottish teaching hospital, of the 56 patients followed, 95% were immediately transferred to a critical care facility following surgery.[10]**

1.5 In many other countries, patients undergoing major surgery routinely receive a level of post-operative care significantly higher than that provided to the vast majority of NHS patients. There is a lower proportion of hospital beds allocated to critical care in the UK compared to other comparable countries. Denmark has the highest proportion amongst other European countries at 4.1%, compared to the UK's 2.6%.[7] In Europe, 18% of critical care units had less than 6 beds whereas in the UK, 48% had less than 6 beds.[7]

1.6 At present in the NHS, pre-operative care and the majority of post-operative care is provided in general wards. Such wards may have staffing ratios of one nurse to 10–15 patients.

1.7 A minority of NHS patients go to an HDU or ICU if the patient is thought to be at particular risk of death or developing complications in the immediate post-operative period. These units have higher staffing ratios than general wards, with one nurse to two or three patients in HDU and one nurse per patient in ICU.

1.8 Some hospitals operate outreach critical care, where a specialist team including ICU-trained nurses supplement the post-operative care of surgical patients on the general wards.

Encouraging signs of improving outcomes in the NHS

1.9 There have been examples demonstrating better use of surgical/anaesthetic resources by:

- Improving surgical outcomes by intra-operative haemodynamic optimisation and other techniques. These interventions reduce both the number and severity of post-operative complications;
- Reducing complications, leading to shorter hospital stays and increased hospital efficiency.

Improvements in peri-operative care in other countries have reduced mortality rates over time. In France, mortality after major elective surgery fell from 17.7% in 1976–79 to 8.1% in 1992–95;[12]

Even in other countries, it is recognised that there are huge variations in mortality rates between different hospitals. In an 890-patient study in 10 US centres, the mortality rate for colorectal surgery ranged from 0.8% to 15.4%, with a mean of 2.25%.[13]

1.10 A study conducted at York District Hospital on the use of improved intra-operative care involving haemodynamic optimisation and other interventions, combined with the planned transfer of patients to ICU, resulted in a reduction of the mortality rate to 3% compared with 18% in the control group.[8] The study also demonstrated a reduction in the patients' length of hospital stay – in terms of total bed days as well as ICU bed days – without increasing costs.[8]

1.11 In other countries, improvements in peri-operative care have also been used to reduce mortality and bed days. In a long-running programme conducted in Melbourne, Australia, improvements in pre-operative assessment and triage, peri-operative care and post-operative support have reduced the mortality rate and decreased both total bed days and ICU bed days (see Table 1).[9]

Table 1. ICU bed utilisation and mortality for elective major abdominal surgery.[9]

	<1985	<1999
Number triaged to ICU	40	22
Total bed days	600	66
Average days in ICU	15	3.0
Non-surgical mortality	19%	0.5%

1.12 The blunderbuss approach of providing ICU beds for everyone who may need them is unrealistic in a health system where resources are always going to be tight. There are alternative approaches that have been demonstrated in other countries to be successful which could be readily adopted in the NHS. These affect three interlinked areas of surgical care and decision making:

- improved pre-operative assessment, triage and preparation;
- improved intra-operative care;
- improved use of post-operative resources.

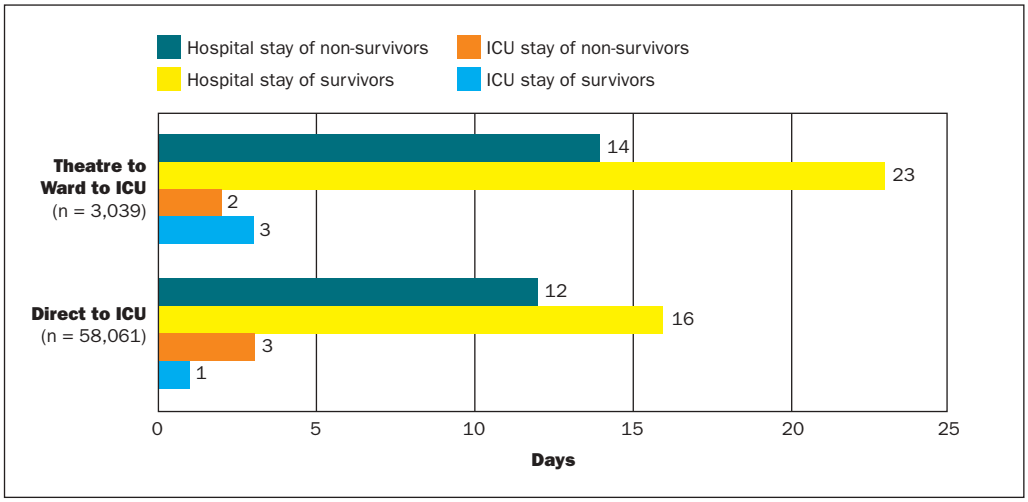
1.13 A significant number of patients could benefit from such modernisation including those:

- undergoing intra-abdominal or thoracic surgery;
- undergoing major orthopaedic surgery.

1.14 This document provides an overview of the clinically proven technologies and techniques that can enable the modernisation of surgery within the NHS, and which can provide both improved outcomes for patients and better use of NHS resources.

The mortality rate is higher amongst patients who are transferred from surgery to a general ward and then to ICU, compared to those transferred directly to ICU (42.5% vs. 19.9%), and the total length of hospital stay is reduced in those patients transferred directly to ICU (see Figure 2.)[11]

Figure 2. Length of hospital and ICU stays for those transferred initially to a general ward before ICU, compared with those transferred directly to ITU.[11]



What are the causes of poor patient outcomes?

2.1 The toll of major surgery on the energy reserves of patients is considerable, i.e. equivalent to running a half-marathon or marathon for a fit person. Recovery time from major surgery to pre-operative levels of fitness can take 3 to 6 months.

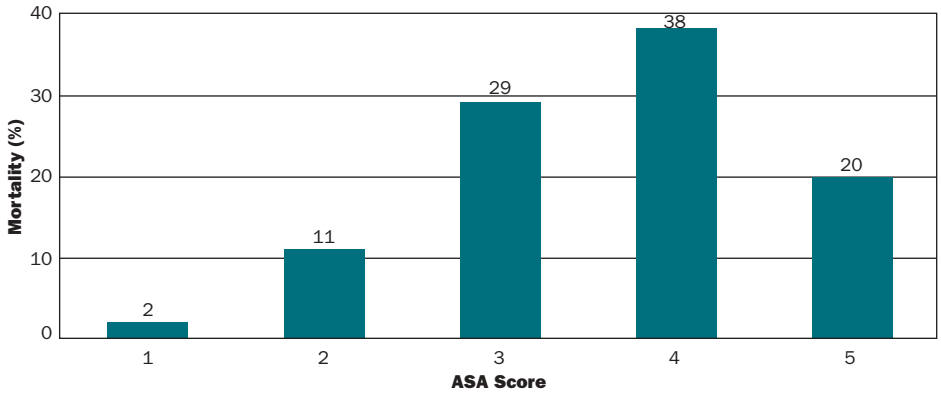
2.2 Only a tiny minority of deaths following surgery are due to misadventure by the surgeon or anaesthetist at the time of surgery (<1%). It is important to note that the vast majority of problems (>99%) are due to the patient's underlying disease that in many cases has been underestimated or impossible to quantify prior to surgery.

- 96% of patients dying within 30 days of surgery have significant medical co-morbidities at the time of surgery;[5]
- the majority have a co-existing cardiovascular (76%) or respiratory pathology (56%).[5]

2.3 It is easy to underestimate the individual risk of surgery to patients, and to not recognise those patients that have a high risk of mortality and morbidity.

- A substantial proportion (42%) of those who die following surgery had been scored pre-operatively as ASA 3 or less, suggesting that the severity of their illness had not been fully appreciated by the pre-operative assessment (see Figure 3).[5]

Figure 3. ASA scores* assigned to patients who died following surgery.[5]

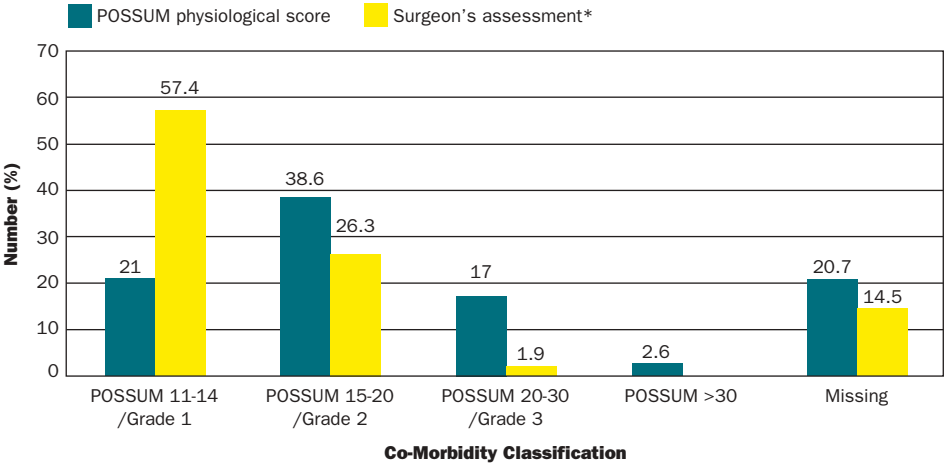


*ASA 1: A normal healthy patient;
ASA 2: A patient with mild systemic disease;
ASA 3: A patient with severe systemic disease that limits activity but is not incapacitating;
ASA 4: A patient with incapacitating systemic disease that is a constant threat to life;
ASA 5: A moribund patient who is not expected to survive for 24 hours with or without an operation.

The definitions are those in use during 2000/01. The wording of ASA grades 3-5 was modified and a sixth grade added in 1999, but was changed too late for inclusion in this study.

- Subjective assessment typically underestimates the risk of death for patients undergoing surgical procedures (see Figure 4).[14]

Figure 4. Comparison of co-morbidity scores for 955 patients undergoing oesophageal or gastric resection.[14]



Grade 1: Patient considered fit for surgery;
Grade 2: Patient potentially fit for major resection, but significant co-morbidity problems identified;
Grade 3: Serious co-morbidity problems identified that present considerable risk to survival in post-operative period.

A typical patient journey at present

3.1 A patient presents to their GP with symptoms that lead the GP to suspect a diagnosis of colorectal cancer.*

3.2 The GP refers the patient for an urgent out-patient appointment with the local colorectal surgeon.

3.3 At the out-patient appointment, diagnostic tests are organised including a barium enema.

3.4 The surgeon reviews the radiologist's report and agrees that the patient appears to have a tumour. In the majority of cases, surgery to excise the tumour is the appropriate option, although in a few patients with severe co-morbidities, surgery may be considered too risky.

3.5 The patient's case and possible treatment options are discussed at a multi-disciplinary team (MDT) meeting attended by the surgeon, oncologist, and other members of the clinical team. At this stage, an anaesthetist has not yet assessed the patient to determine their level of fitness for surgery, and so surgery is planned without having this important information.

3.6 Given that the tumour is not currently obstructing the bowel, the surgeon has to consider using relatively blunt decision-making tools whether to operate or not, given the predicted post-operative mortality rate of 8%.

3.7 The surgeon discusses with the patient the common complications that may follow major surgery and which occur in up to 35% of cases. The patient agrees to proceed and is scheduled for surgery in 3 to 5 weeks' time.

3.8 A week before the operation the patient attends the hospital to be assessed by a trainee doctor prior to admission, and is given a physical examination and routine blood tests.

3.9 The patient is admitted to a general ward two days before the operation. The day prior to surgery the patient is given drugs to evacuate the bowel. This causes the patient to have diarrhoea for about 24 hours immediately before the operation and may lead to significant dehydration.

3.10 The patient is reviewed by an anaesthetist, usually only a few hours before the operation. This system relies on all pre-operative investigations having been performed in the preadmission clinic, and the results being available. As the anaesthetist's visit is so close to the operation, there is little time to further optimise any chronic medical problems – it is intended that these are picked up in the preadmission clinic, and steps taken then.

3.11 The patient is anaesthetised and surgery commences. During the operation, the anaesthetist uses clinical judgement to administer fluids in order to keep the patient adequately perfused. Dehydration will result in reduced circulation to the tissues and this increases the likelihood of post-operative complications. The anaesthetist has to balance this against the risk of overloading the patient with fluids, which is equally dangerous. Judging the correct amount of fluids without sophisticated monitoring equipment is notoriously difficult.

3.12 The patient is removed to the recovery room where their status is monitored by the anaesthetist until they have sufficiently recovered to be transferred to the post-operative ward.

*Chosen as example. Techniques discussed equally applicable to other surgery.

3.13 From what appears to be an identical patient journey, there are three possible outcomes:

3.13.1 the patient makes a good recovery and is discharged after 10 days (approx. 65% of cases);

3.13.2 the patient develops post-operative complications (i.e. cardiovascular problems, difficulty breathing, confusion etc), and may be transferred to an HDU or ICU setting for a period of time but eventually recovers and is discharged home (approx. 25-30% of cases);

3.13.3 the patient develops severe complications and eventually dies (approx. 8% of cases), sometimes being transferred to an HDU or ICU setting for a prolonged period prior to death.

3.14 The possibility of the patient developing complications and dying increases further if surgery is carried out on an emergency or urgent basis.

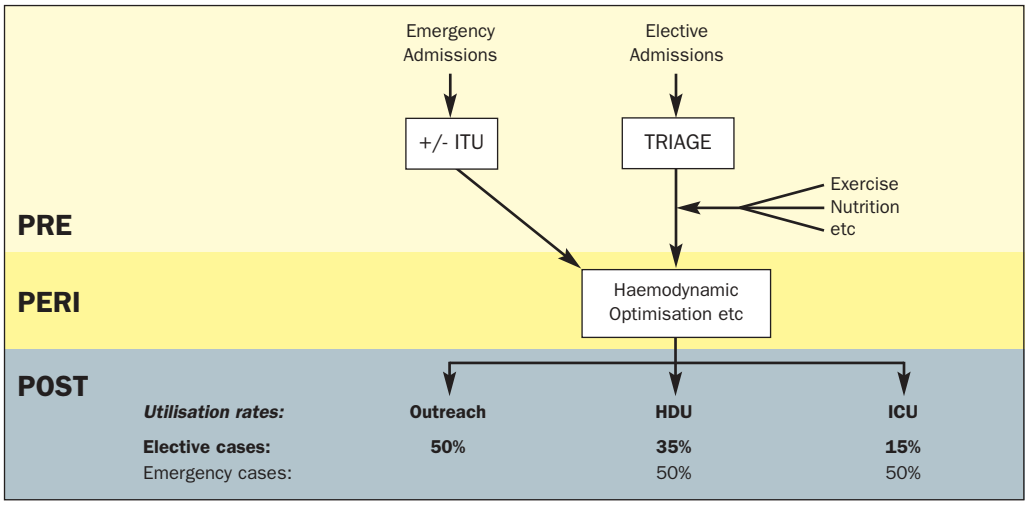
How and at what stages can decision making and care be improved

4.1 As can be seen from the patient journey above, planning of surgery occurs at the MDT meeting, at which there is no representation from anaesthetics or critical care. If these groups were involved in the assessment of patients at a much earlier stage (i.e. before the MDT meeting), then more appropriate planning of surgery could occur (e.g. more limited surgery, or non-operative management).

4.2 In the UK, the vast majority of cases are transferred to general wards immediately following surgery. Although approximately 50% of patients are sufficiently fit to recover rapidly in this low-intensity environment, many others develop post-operative complications.

4.3 Experience in other countries has demonstrated that approx. 35% of patients would benefit from a HDU setting following surgery, and approx. 15% require ICU (see Figure 5).[9] Use of preventative measures (such as better peri-operative care, pre-operative assessment, triage and preparation, and improved post-operative care) can avoid post-operative complications, which ultimately reduces the overall cost of care.

Figure 5. Potential flow of patients through critical care and outreach teams.[Adapted from 9]



4.4 This will result in more efficient utilisation of HDU and ICU resources.

Provide Better Pre-Operative Assessment and Preparation

Introduce better evaluation of patients prior to planned surgery

"The principle of pre-operative investigations is to gain information about patients that leads to modification of their peri-operative management, and to improve the outcome from major surgery."[20]

5.1 The standard tests currently used for the pre-operative evaluation of patients prior to surgery are expensive and poor at predicting actual risk.[15, 16, 17, 18]

5.2 For some patients, the risk of death following surgery is greater than the risk of death from the underlying condition. The problem for surgeons and anaesthetists is how to identify such patients.

5.3 The surgeon and anaesthetist may know the overall risk of mortality and complications for a particular procedure. However, this is not individualised for a particular patient.

"...if a patient is unable to elevate cardiac output and Do_2 [oxygen delivery] to the required levels, they are more likely to have a poor outcome after major surgery. To identify the high-risk surgical patient, objective information on dynamic cardiorespiratory function is needed in order to assess peri-operative needs and to provide accurate information on the risks and benefits of the procedure to the patient."[20]

5.4 There are objective techniques and tests, not commonly utilised in the NHS at present, which can provide an individual assessment of risk. For example:

5.4.1 Objective cardio-pulmonary exercise testing (CPX) has been shown to determine pre-operative fitness. This correlates well with post-operative survival.[19]

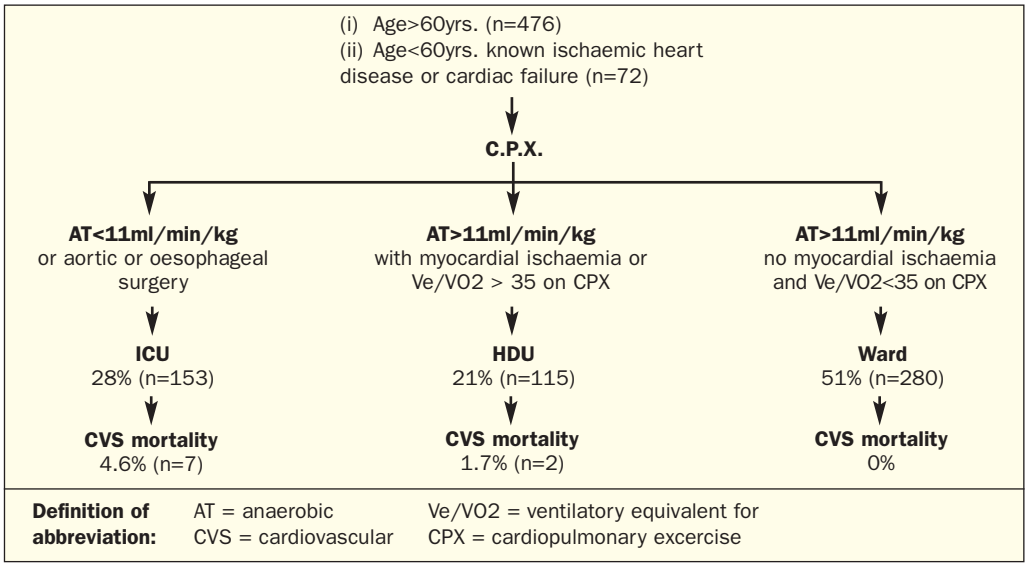
Use of CPX enables triage of patients to the general ward, HDU or ICU for the immediate post-operative period (see Figure 6).[9] CPX testing can also identify those patients unfit for major surgery or who should undergo a less-risky operation.

Cardiopulmonary exercise testing (CPX testing) examines the ability of the cardiorespiratory systems to deliver oxygen to tissues under stress.

Patients with an anaerobic threshold (AT) below 11 ml/kg/min had a significantly higher mortality rate compared with those who had a higher AT level (18% vs 0.8% in a study of 187 elderly patients undergoing major abdominal surgery).[19] Pre-admission to ICU and use of haemodynamic optimisation to monitor cardiac function enabled the mortality in the high-risk group (low AT) to be halved.[19]

Poor ventricular function, and hence poor oxygen delivery to the tissues as measured by AT, predicts a high risk for major surgery, particularly when coupled with evidence of myocardial ischaemia.[20]

Figure 6 Results of triage based on cardiopulmonary excercise (CPX) testing.[9]



"In summary, the AT identifies a population that is less able to mount the appropriate increase in DO_2 [oxygen delivery] demanded after major surgery and in which a strategy of invasive monitoring and optimisation of cardiac function is more likely to improve outcome."[20]

5.5 These objective tests can identify those patients with an increased risk profile for whom major surgery would be inappropriate. This would help to avoid some of the last-minute cancellations of surgery, and reduce the excessive post-operative complications and mortality in patients who are not sufficiently fit for major surgery.

Improve the preparation of patients prior to planned surgery

6.1 Some patients do not tolerate pre-operative dehydration and develop poor perfusion to major organs resulting in an increased incidence of major post-operative complications. This can be avoided pre-operatively with standardised fluid and electrolyte replacement regimens, and intra-operatively by using sophisticated monitoring techniques that measure cardiac output during surgery. This helps the anaesthetist to optimise the patient's haemodynamics by administration of the appropriate amount of fluids.[21]

6.2 Nutritional supplementation has been shown to improve the post-operative outcome of patients who may be malnourished prior to surgery, due to poor diet or underlying disease (i.e. upper gastrointestinal tract cancer patients).[22]

6.3 A small minority of very high-risk patients will benefit from a short period in ICU prior to surgery in order to obtain pre-operative cardiovascular optimisation, and it may be possible to achieve this by more rational use of ICU resources.

6.4 Exercise has also been shown to dramatically improve anaerobic threshold and by inference may improve fitness for operation.[23, 24, 25]

Improve the resources for emergency and urgent surgery

7.1 By handling planned surgery better, ICU resources can be freed-up to enable direct admission of appropriate urgent and emergency cases, which improves the outcomes in terms of reduced total bed stay and ICU bed stay, and decreases mortality.[9]

In the York study of patients undergoing major elective surgery, haemodynamic optimisation combined with planned ICU admission resulted in a significant reduction in mortality to 3%, compared to 18% with routine care. Patients receiving haemodynamic optimisation used fewer ICU or HDU bed days and were discharged from hospital earlier, even though fewer control patients were transferred to ICU or HDU.[8]

In a study of patients undergoing cardiac surgery, the group receiving haemodynamic optimisation for fluids had a 28% reduction in ICU bed days and a 17% reduction in hospital days.[33]

"Consensus Statement: Accurate assessment of fluid and electrolyte status can be difficult and the treatment of a particular patient must be individualised and reviewed frequently in the light of the response to treatment."[35]

"Consensus Statement: Volume depletion should be avoided as this can lead to poor perfusion and problems such as anastomotic breakdown, cerebral damage, renal failure and multiple organ failure."[35]

Improve Peri-Operative Care

Introduce haemodynamic optimisation of patients during surgery

8.1 Intra-operative hypovolaemia is common and a cause of organ dysfunction, increased post-operative morbidity and death.[26]

8.2 Optimisation of the fluid balance of patients during surgery (haemodynamic optimisation) guided by a cardiac output algorithm can significantly reduce both the rates of complications and mortality, as well as significantly reducing the length of hospital stay.[8, 21, 27, 28, 29, 30, 31, 32]

8.3 Haemodynamic optimisation has been made much simpler to perform through the development of less-invasive techniques and is now considered by many to be the standard of care. [26, 29, 30, 31, 32, 33, 34]

8.4 There are other examples of peri-operative interventions showing benefit, including:

- patient warming during surgery;
- beta-blockade;
- higher supplemental inspired oxygen;
- optimised administration of blood products during surgery.

Improve Post-Operative Care

Better utilise critical care resources

"Consensus Statement: Patients requiring frequent monitoring of multiple variables should be considered for care at level 2 [HDU] or above."[35]

9.1 The NHS needs to provide a level of post-operative care that is appropriate to the patient's assessment and current condition, i.e. ICU, HDU, outreach critical care teams, or general wards.

9.2 It is recognised that more patients need to be transferred directly to ICU and HDU following surgery than current NHS bed numbers allow, and a combination of improvements in intra-operative care and increasing planned critical care admission for those at increased risk of complications is now known to reduce the overall number of ICU and HDU bed days used.

9.3 Where they do not already exist, introduce:

- outreach critical care teams consisting of ICU-trained nurses focused on monitoring and providing care for surgical patients in a general ward;
- HDU, where the nurse-to-patient ratio is 1:2 or 1:3 with appropriately trained staff.

How can this modernisation be made to work?

10.1 Much of the resource is already available although it needs to be appropriately allocated by preventing avoidable complications and increasing efficiency.

10.2 We need to learn from the experience of other health care systems and apply strategic thinking to re-organise resources.[3]

10.3 Use of particular measures noted i.e. pre-operative assessment and haemodynamic optimisation can dramatically reduce the numbers of patients who suffer complications thereby freeing up the resources to complete the modernisation of care.

10.4 We must enable and encourage the hospital management and different clinical teams (intensivists, surgical etc) to work together.

How can this modernisation be funded?

11.1 Improvements in pre-operative assessment and preparation, peri-operative care and post-operative support have provided an important reduction in the mortality rate as well as decreasing the number and severity of complications suffered by patients following surgery, which has in turn provided savings in terms of ICU/HDU bed days per patient.

11.2 These savings have enabled more patients to receive the appropriate level of care, whether it is in ICU, HDU or through outreach critical care teams in general wards settings.

11.3 In addition to reducing the mortality rate, the study conducted at York demonstrated that haemodynamic optimisation and the use of dopexamine reduced the number of ICU or HDU bed days used by 40% compared with routine care (median 3.3 days vs. 5.5 days), and total bed days per patient were reduced by 41% (median 22 days vs. 13 days).

11.4 The capital and running costs for providing improved pre-operative, peri-operative and post-operative support are marginal in comparison with the potential savings:

- CPX testing is no more expensive than many of the tests that are currently conducted but which are poor at predicting actual risk;
- for haemodynamic optimisation, the potential savings in terms of reduced hospital stays have been estimated for an average NHS trust to be in the order of over £2 million, based on reduction in stays of 22–31% and taking into account capital outlay of £60,000 and running costs of £150,000.

11.6 Overall, the package of improvements described would be cost effective.

11.7 By adopting the improvements in pre-operative assessment and preparation, peri-operative care and post-operative support, the NHS could:

- decrease the mortality rate following surgery;
- reduce the number and severity of complications that occur post-operatively due to better peri-operative care (i.e. haemodynamic optimisation and other procedures), and which use less ICU / HDU resources;
- provide better pre-operative assessment and preparation by redeploying the staffing/resource that has been liberated;
- provide appropriate post-operative care environments through redeploying the savings in staffing/resources.

11.8 In addition to improving outcomes for patients following surgery, these measures will address the NHS' record on mortality and morbidity rates following surgery as well as helping lead to better, more-efficient use of NHS' resources.

Proposed actions

- There is a requirement to implement new standards of care that incorporate improved pre-operative assessment, preparation and triage, intra-operative care, and improved use of post-operative resources.
- There is a need to establish pre-operative assessment at a much earlier stage in the patient pathway, before surgery planning occurs, in order that decisions can be made about fitness for various procedures.
- There is a need to break out from the 'silo' budgeting approach that currently inhibits clinical teams from spending relatively small amounts of money on technology that will save greater amounts of money in other areas.
- There is a need to prioritise the rational use of critical care resources, taking patients undergoing major surgery as a priority group.
- There is a need to analyse data about the current situation and evaluate the differences seen in patient outcomes between NHS centres and those in other countries.

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