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| Perioperative anaemia assessment and management in elective surgical procedures |
| Preoperative, intraoperative and postoperative audit report 2020 |
| OFFICIAL |

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# Acknowledgements

Blood Matters thanks all the health services that contributed data to this *Perioperative anaemia assessment and management in elective surgical procedures: preoperative, intraoperative and postoperative audit 2020*.

The data submitted has enabled us to prepare this report and compare the results with the *Clinical audit of preoperative anaemia assessment and management in elective surgical procedures* audit conducted in 2015.

Thank you to the project team involved in the various stages of the audit:

* Blood Matters team
* Blood Matters Advisory Committee.

# Abbreviations, acronyms and definitions

## Definitions

**Anaemia**: Module 2 defines anaemia as haemoglobin level < 130 g/L in males and < 120 g/L in females, as defined by the World Health Organization (WHO).

**Elective surgery**: planned, non-emergency surgery that is medically necessary or beneficial to the patient but does not need be done at a particular time.

**Pathway**: a course of action or route to guide actions. It is expected that preoperative anaemia screening pathways for surgical patients with or at risk of anaemia will vary across health services.

**Patient blood management** (PBM): the management and preservation of patients’ own blood to reduce or avoid the need for a blood transfusion (NBA 2012).

**Preoperative period**: ‘pertaining to the period before a surgical procedure. Commonly the preoperative period begins with the first preparation of the patient for surgery, such as when the surgery is scheduled’ (Mosby 2009).

**Postoperative period**: defined as within seven days of surgery.

## Abbreviations

| Abbreviation | Definition |
| --- | --- |
| ACPAN | Australian College of Perianaesthesia Nurses |
| ANH | acute normovolemic haemodilution |
| ACSQHC | Australian Commission on Safety and Quality in Health Care |
| ◦C | degree Celsius |
| CRP | C-reactive protein |
| DoS | day of surgery |
| FBE | full blood examination |
| GI | gastrointestinal |
| GP | general practitioner |
| Hb | haemoglobin |
| IV | intravenous |
| mcg | microgram |
| mL | millilitre |
| Module 2 | National Blood Authority PBM guidelines ‘Module 2: Perioperative’ (Module 2) |
| NBA | National Blood Authority |
| NICE | National Institute for Health and Care Excellence |
| NSQHS | National Safety and Quality Health Services Standards |
| PBM | patient blood management |
| PP (1–6) | NBA PBM guideline practice point |
| R (2–20) | NBA PBM guideline recommendation |
| RBC | red blood cells |
| ROTEM | rotational thromboelastometry |
| TEG | thromboelastography |
| TXA | tranexamic acid |
| UK | United Kingdom |
| WHO | World Health Organization |
| WIP | work in progress |

# Data considerations/limitations

The audit has the following limitations:

* The auditors were not trained; however, the audit forms were accompanied with definitions and instructions for conducting the audit to ensure consistency of data.
* The patient episodes reported were selected at the auditor’s discretion, and may have been influenced by their knowledge and understanding of anaemia assessment and management.
* The auditor determined if anaemia had been assessed. Blood Matters did not include parameters around assessment, such as timeliness or blood test in the instructions.
* Health service participation in the audit was voluntary.
* Health services may have varying thresholds for anaemia and anaemia management compared to those outlined in the National Blood Authority PBM guidelines.

# Executive summary

## Previous audits

Blood Matters has conducted two previous audits of patient blood management (PBM):

* [*Clinical audit of preoperative anaemia assessment and management in elective surgical procedures*: *2015 report*](https://www2.health.vic.gov.au/about/publications/researchandreports/clinical-audit-of-preoperative-anaemia-assessment-and-management-2015)<https://www2.health.vic.gov.au/about/publications/researchandreports/clinical-audit-of-preoperative-anaemia-assessment-and-management-2015>
* [*2020 preoperative anaemia assessment and management in elective surgical procedures survey* *report*](https://www2.health.vic.gov.au/about/publications/ResearchAndReports/preoperative-anaemia-pathway-report-2020) <https://www2.health.vic.gov.au/about/publications/ResearchAndReports/preoperative-anaemia-pathway-report-2020>.

Blood Matters used the results of these audits to develop recommendations for health services to improve PBM.

## Overview of the current audit

The current 2020 audit shows there have been limited improvements with regards to PBM programs. As such, Blood Matters reiterates a number of previous recommendations. Appendix 1 compares the 2015 and 2020 results.

Fifty-nine health services (44 public and 15 private) contributed data to this audit, with 1,541 episodes being included in the final analysis.

Most data was submitted for the orthopaedic group (n = 772, 50 per cent), followed by gynaecology (n = 343, 22 per cent), major gastrointestinal (n = 296, 19 per cent) and cardiothoracic (n = 130, 8 per cent).

## Preoperative anaemia assessment

The audit shows 1,250 patients were assessed for anaemia preoperatively. However, the timeliness, quality and follow-up of the assessment is less than ideal for many. In particular, health services are not providing adequate time for investigation and appropriate treatment if anaemia or iron deficiency are found.

Results indicate that the closer preoperative assessment is to the surgery date, the less likely it is that the patient will have their anaemia identified.

Many patients attending for major surgical procedures were at risk of anaemia in the intra and postoperative periods.

## Intraoperative blood loss

The overall documentation of intraoperative blood loss was low (37 per cent), with the notable exception of the gynaecological group, in which 72 per cent of cases had documented blood loss.

The documented use of intraoperative blood conservation strategies such as cell salvage (3 per cent), deliberate induced hypotension (5 per cent), acute normovolemic haemodilution (ANH) (4 per cent) and near-patient testing of coagulation (2 per cent) were all low.

The use of strategies such as intraoperative tranexamic acid (47 per cent) and the prevention of hypothermia (67 per cent) were more often reported.

## Postoperative anaemia management

Postoperatively, the majority of patients had haemoglobin documented on day one (1,305, 85 per cent), and similarly on discharge (1,364, 89 per cent).

However, it is concerning that 1,026 (75 per cent) patients were anaemic on discharge, and only 70 (7 per cent) of these had anaemia management documented in their discharge plan.

It is unclear whether this is due to anaemia not being appropriately recognised and managed (PBM pillar 3), or whether clinicians assumed the underlying reason for the anaemia had been corrected with surgery. In any case, it is a missed opportunity to improve patient outcomes.

## Transfusion

Consistently across all surgical groups, transfusion was associated with an increased average length of stay (average 10.25 days). This is up to twice the length of stay for those not transfused (average 5.75 days).

## Conclusion

The audit shows that nine years after the publication of the National PBM guidelines, there is still much work to be done to implement and embed timely, quality anaemia assessment and management in the surgical groups reported.

The report includes recommendations for both health services and Blood Matters to help address these gaps.

The ‘Patient blood management checklist’ section provides a checklist for health services to assess their programs and identify areas for action.

Blood Matters strongly advises health services to:

* review their individual and comparative data
* work with the local blood management/transfusion committee to improve timely, quality assessment and management of anaemia in patients where substantial blood loss is anticipated.

# Recommendations

The 2020 audit demonstrates limited improvements in PBM programs following previous audits, so a number of previous recommendations are reiterated.

The recommendations have been linked to the corresponding National Blood Authority PBM guidelines ‘Module 2: Perioperative’ (Module 2) recommendations (R) or practice points (PP) (NBA 2012) and the National Safety and Quality Health Services Standards (NSQHSS) (ACSQHC 2017).

All health services should include this report as an agenda item for blood management/transfusion committee review.

Participating health services should also report their individual and comparative data for review and action to address gaps in anaemia assessment and management.

The governing committee should make recommendations to address deficiencies in anaemia assessment and management practices.

| Recommendations for health services | Module 2 | NSQHSS Standard |
| --- | --- | --- |
| Health services should have in place or develop a multidisciplinary, multimodal PBM program that includes anaemia assessment, optimisation and management. | R 1 | 7.2 |
| PBM programs should clearly define the roles and responsibility for anaemia/iron deficiency assessment, follow-up and management. |  | 7.1 |
| PBM programs should include strategies to educate all staff (medical, surgical, anaesthetic, nursing) in PBM, for example via BloodSafe eLearning Australia’s PBM courses, in particular the ‘Perioperative’ and ‘Iron deficiency anaemia’ courses. Refer to Appendix 2 for resources. |  | 7.1 |
| Provide information to patients to understand what PBM is, and how it can improve their outcomes, for example, via the [‘What you need to know about patient blood management’ consumer information fact sheet](https://www2.health.vic.gov.au/about/publications/factsheets/What-you-need-to-know-about-patient-blood-management) <https://www2.health.vic.gov.au/about/publications/factsheets/What-you-need-to-know-about-patient-blood-management>. |  | 7.3 |
| All patients attending for major surgical procedures where there is the risk of significant blood loss (> 500 mL) should have timely assessment (within the clinical urgency of surgery) for anaemia and iron deficiency (FBE and ferritin at a minimum), with further testing depending on results from these tests. |  | 7.4 |
| Ensure timely anaemia and iron deficiency assessment to allow for follow-up and treatment. Consider starting the process when surgery is booked or waitlisted (within the clinical urgency of surgery), rather than at preanaesthetic clinic or other similar appointment. | PP 1, 4 & 5 | 7.3, 7.4 |
| Inform general practitioners (GPs) when patients are placed on surgical waitlists and provide information (and, where appropriate, instruction) regarding tests that should be taken for preoperative anaemia and iron deficiency testing. Provide a way for GPs to send feedback to the health service, and to facilitate specialist referral or testing. | R 1 | 7.1 |
| Patients treated for anaemia or iron deficiency should be reviewed prior to surgery to assess the effectiveness of treatment. |  | 7.4, 7.5 |
| Consider intraoperative blood conservation strategies early to allow adequate planning, such as cell salvage, tranexamic acid, prevention of hypothermia, near-point patient testing of coagulation and other strategies that may be available and appropriate for the surgical procedure. | R 12-19, PP 11, 12, & 13 | 7.4, 7.5 |
| Ensure there is a process to investigate patients with ongoing anaemia. If anaemia is present on discharge, provide management plans for the patient and GP, and include these in the discharge plan. | PP 6 & 7 | 7.4, 7.5 |
| Regularly evaluate PBM programs, adherence to guidelines/protocols and effects on transfusion and other outcomes. Provide feedback to clinical groups, risk management and/or executive committees. Use the ‘Patient blood management checklist’ (or similar) to determine actions and progress. |  | 7.2 |

|  |
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| Recommendations for Blood Matters |
| Provide this report to relevant colleges and societies, with targeted information highlighting gaps in practice for the clinical specialties audited (infographic and flow chart). |
| Share this report with the National Blood Authority and Patient Blood Management Advisory Committee for consideration and discussion. |
| Prepare a summary article to highlight the number of patients attending for surgery with anaemia/iron deficiency for inclusion in GP primary health networks newsletters. |
| Prepare templates for presentations and tools that health services can use to track performance and promote awareness. |
| Promote patient education resources that are available to promote patient blood management, such as:   * [‘What you need to know about patient blood management’ consumer information fact sheet](https://www2.health.vic.gov.au/about/publications/factsheets/What-you-need-to-know-about-patient-blood-management) <https://www2.health.vic.gov.au/about/publications/factsheets/What-you-need-to-know-about-patient-blood-management>. * [Mytransfusion website](https://mytransfusion.com.au/avoid-transfusion-1) <https://mytransfusion.com.au/avoid-transfusion-1> |
| Promote educational strategies to increase awareness of anaemia and iron deficiency, including:   * [BloodSafe eLearning Australia](https://bloodsafelearning.org.au/) <https://bloodsafelearning.org.au/>   + PBM courses, in particular the ‘Perioperative’ and ‘Iron deficiency anaemia’ courses   + IV iron administration in primary care (video)   + IDA app   + IV iron tools * [Australian Red Cross Lifeblood](https://transfusion.com.au/transfusion_practice/patient_blood_management) <https://transfusion.com.au/transfusion\_practice/patient\_blood\_management>   + ‘Patient blood management pack’   + iTransfuse app   + ‘Blood component prescribing checklist’   + ‘Toolkit for maternity blood management’   + presentations: ‘Understanding iron deficiency anaemia’, ‘Administering iron products’, ‘Anaemia: iron and beyond’, ‘Getting anaemia right’, ‘Obstetric and maternal patient blood management (PBM)’, ‘Improving blood management in obstetrics’ * BloodSafe, SA Health   + [iron deficiency anaemia resources for health professionals](https://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/conditions/blood+organ+and+tissue/iron+deficiency+and+iron+therapy) <https://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/clinical+resources/clinical+programs+and+practice+guidelines/blood+organ+and+tissue/blood+management/anaemia+management>   + [iron deficiency anaemia resources for consumers](https://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/conditions/blood+organ+and+tissue/iron+deficiency+and+iron+therapy) <https://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/conditions/blood+organ+and+tissue/iron+deficiency+and+iron+therapy> |
| Promote audit findings through a variety of media including conferences, newsletters, and peer review literature. |

# Patient blood management checklist

This checklist helps health services provide a quality PBM program. In particular, it determines compliance with strategies included in the:

* *National patient blood management guidelines*, ‘Module 2: Perioperative’
* *ACSQHC National safety and quality health service standards.*

General

| Element | Yes | No | WIP | N/A |
| --- | --- | --- | --- | --- |
| Does your health service have an education program about patient blood management for all staff? (NSQHS Standard 7.1) |  |  |  |  |
| Does the PBM program stipulate the provision of written consumer information? (NSQHS Standard 7.3) |  |  |  |  |
| Is there a process in place for regular review and evaluation of PBM/screening programs, and adherence to guidelines/protocols? (NSQHS Standard 7.2) |  |  |  |  |

Preoperative

| Element | Yes | No | WIP | N/A |
| --- | --- | --- | --- | --- |
| Does your health service have a preoperative anaemia screening and management pathway for surgical patients with or at risk of anaemia? (Module 2 recommendation (R) 1; NSQHS Standards 7.1, 7.4, 7.9) |  |  |  |  |
| Does the anaemia screening/management pathway stipulate the timing of preoperative assessment to allow optimisation of the patient’s haemoglobin and iron stores (according to surgical priorities)? (Module 2, practice point (PP) 1, PP 4, PP 5) |  |  |  |  |
| Are general practitioners or shared care options included in the anaemia screening pathway? (Module 2, R1) |  |  |  |  |
| Does the pathway include a preoperative haemoglobin assessment and optimisation template? |  |  |  |  |
| Does the anaemia screening pathway/template include the following tests?   * full blood examination (FBE) * iron studies including ferritin * CRP * renal function * B12 and folate[[1]](#footnote-1)   (Module 2, Optimisation template) |  |  |  |  |
| Does the PBM/anaemia screening pathway specify roles and responsibilities for each of the steps in the pathway, including whose role it is to identify patients at risk of anaemia to refer for further investigation and/or treatment? |  |  |  |  |
| Does the PBM/screening pathway/template include discussion/advice from or referral to a specialist? (Module 2 – PP6, PP7, template) |  |  |  |  |

Intraoperative

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Element | Yes | No | WIP | N/A |
| Does the PBM program include intraoperative PBM strategies? (Module 2 – R12–19, PP11, PP12, PP13) |  |  |  |  |

Postoperative

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Element | Yes | No | WIP | N/A |
| Does the PBM program include strategies for addressing postoperative anaemia? (Module 2 – R20) |  |  |  |  |
| Does the PBM program promote inclusion of anaemia management in the discharge plan, where appropriate (NSQHS Standards 6 and 7.6) |  |  |  |  |

# Introduction

The National Blood Authority (NBA) Patient Blood Management (PBM) guidelines ‘Module 2: Perioperative’ (Module 2) was released in March 2012 (NBA 2012).

The guidelines are currently being reviewed and updated. The 2012 module remains in place to guide practice during the review period.

It contains six recommendations and five practice points related to the management of anaemia in the perioperative patient to:

* improve practice related to the assessment and management of reversible anaemia prior to surgery
* improve outcomes for patients undergoing elective surgical procedures.

Anaemia is a major public health issue. In surgical patients, preoperative anaemia is associated with adverse outcomes, including increased length of stay, risk of infection and risk of receiving a blood transfusion (Delaforce 2020).

The most common cause of anaemia is iron deficiency. Iron deficiency and iron deficiency anaemia have significant impacts on health and wellbeing (Pasricha 2021).

This audit was designed to determine the processes health services use to assess and/or manage anaemia at all stages of the perioperative patient path (that is, pre-, intra- and postoperatively).

## Audit aims

To assess health services’ compliance with Module 2 in relation to:

* assessment and management of reversible anaemia prior to elective surgery
* blood conservation strategies used intraoperatively to reduce postoperative anaemia
* postoperative strategies to manage and treat anaemia.

## Objectives

To determine health services’:

* practice in relation to assessment, management and prevention of anaemia in the perioperative period (pre-, intra- and postoperative)
* use of intraoperative measures that may influence blood loss and potential postoperative anaemia
* management of postoperative anaemia.

## Inclusions

The audit included patients undergoing major elective orthopaedic, gastrointestinal, cardiothoracic or gynaecological surgical procedures in which substantial blood loss is anticipated, occurring between 15 March 2019 and 15 March 2020.

## Exclusions

The audit excluded:

* minor surgical procedures where there is a low or no expectation of need for transfusion, that is:
  + orthopaedic surgery such as arthroscopy
  + gastrointestinal surgery such as endoscopy and laparoscopic gastric banding
  + interventional cardiology such as coronary angiography and stent insertion
  + gynaecology such as dilation and curettage, colposcopy
* emergency procedures or surgical management of traumatic injury.

# Method

Blood Matters invited 140 health services from Victoria, Tasmania, Australian Capital Territory and the Northern Territory that perform surgery to participate in the audit.

Auditors were not trained. However, the audit forms (Appendix 3) were accompanied with definitions and instructions for conducting the audit (Appendix 4).

The Blood Matters secretariat was available to provide guidance and clarification throughout the audit.

Auditors submitted data via an online tool, LimeSurvey, between 1 August to 12 October 2020.

The audit was undertaken as a quality improvement activity to support the Australian Commission on Safety and Quality in Health Care National Safety and Quality Health Services Standards blood management standards:

* 7.4: Optimising and conserving patients’ own blood
* 7.6: Prescribing and administering blood and blood products appropriately, and in accordance with national guidelines and criteria.

The audit consisted of a series of questions pertaining to a single episode of care to ascertain whether:

* anaemia was screened, identified and managed as per Module 2 prior to scheduled elective surgery
* blood loss was minimised intraoperatively
* anaemia was managed postoperatively.

Health services were requested to audit up to 30 patients (from one site if there were multiple sites within a health service) who had undergone elective surgery in the previous 12 months (15 March 2019 to 15 March 2020) from **one** of the following clinical specialties **only**:

* orthopaedics
* gastrointestinal (upper and/or lower)
* gynaecology, or
* cardiothoracic.

Exclusion criteria included patients who:

* were readmitted to theatre within seven days
* only had minor surgical procedures (that is, substantial blood loss was not anticipated)
* were admitted for emergency procedures or surgical management of traumatic injury.

After the audit, each participating health service was sent a summary of their data for verification and invited to correct any discrepancies or incomplete records.

Following verification and correction, data was imported into an audit-specific Microsoft Access database for validation and analysis.

Each patient episode was compared with the Module 2 template to assess quality of the preoperative anaemia screening assessment, intraoperative and postoperative management of the patient.

For the purposes of this audit patients were considered anaemic if haemoglobin (Hb) was below the values set out in Table 1:

Table 1: Hb levels for different age ranges and sexes

| Age range | Gender | Haemoglobin (Hb) g/L |
| --- | --- | --- |
| Adult | Male | < 130 |
| Adult | Female | < 120 |
| 2–11 years | Boys and girls | < 115 |
| 6–24 months | Boys and girls | < 105 |

Source for adult age range – Module 2 template

Source for child age ranges – Royal Children’s Hospital Melbourne, *Clinical practice guidelines*

# Results

## Preoperative anaemia

For the **purposes of this audit,** a quality preoperative anaemia screening assessment was based on Module 2 recommendations and practice points (Appendix 6) and measured as defined in Table 2:

Table 2: Definition of anaemia assessment

|  |  |  |
| --- | --- | --- |
| Process | Description | Measure |
| Screening | Assessment occurred with sufficient time to correct anaemia, if appropriate  Module 2: R2, R3, PP1, PP4, PP5  (Minck et al. 2013; Goodnough et al. 2011) | Preoperative assessment date was reported to be at least 28 days prior to scheduled surgery date |
| Testing | Blood tests likely to identify anaemia, and an appropriate intervention | Hb and ferritin available at assessment |
| Document | If present, that the anaemia is documented in patient’s clinical notes | Compare the number of patients meeting Module 2 anaemia definition, and those documented as anaemic by the health service (or had reported treatment for anaemia management) |
| Manage | For patients with anaemia, treatment should occur prior to surgery to optimise the patient’s haemoglobin and iron stores  Module 2: R4, PP6 | Patient was reported to have received: Oral iron supplements, IV iron infusion, B12 and/or folate, and/or erythropoietin. If patients were transfused preoperatively this was also captured |
| Evaluate | In order to assess the impact of treatment, it is advised that the Hb should be remeasured after treatment has been instigated, and prior to surgery | Hb reported to be remeasured after treatment and prior to surgery |

As shown in Figure 1, 59 health services submitted data (44 public and 15 private), providing 1,698 patient episodes for review.

One audit was excluded due to the patient returning to theatre within seven days. In addition, one health service submitted more than 30 episodes (186); every sixth episode was kept in the analysis.

The final analysis was completed on 1,541 episodes.

Most data was submitted for the orthopaedic group (n = 772, 50 per cent), followed by gynaecology (n = 343, 22 per cent), major gastrointestinal (n = 296, 19 per cent) and cardiothoracic (n = 130, 8 per cent).

Of the reports received, females accounted for 960 reports (62 per cent) and males 581 (38 per cent).

Age at last birthday ranged from one year to 93 years, with the average age being 62 years. Only 24 (0.2 per cent) people were reported to be aged less than 16 years; and 283 (18 per cent) were aged greater than 75 years.

Figure 1: Flow chart of response received

### Preoperative anaemia: screening

Module 2 states that all elective surgical patients should be assessed as early as possible to allow for optimisation of the patient’s haemoglobin and iron stores.

This means there must be sufficient time to implement any management strategies between the time of the assessment and the surgery.

The Network for Advancement of Transfusion Alternatives guidelines recommend that haemoglobin is measured a minimum of 28 days before scheduled orthopaedic surgery (Goodnough et.al. 2011; Minck et.al. 2013).

The European Society of Anaesthesiology guidelines recommend that patients at risk of bleeding be assessed for anaemia three to eight weeks before surgery to ensure adequate time to investigate and manage anaemia without resorting to transfusion or delaying surgery (Kozek-Langenecker et al. 2017).

In this audit, 1,250 (81 per cent) of patients were reported by the health service to have been assessed for anaemia preoperatively (Figure 1).

This included 654 (85 per cent) orthopaedic surgery, 241 (70 per cent) gynaecologic surgery, 245 (83 per cent) gastrointestinal surgery and 110 (85 per cent) cardiothoracic surgery patients.

However, closer scrutiny of the data, showed 752 (60 per cent) patients were assessed within 28 days prior to surgery, and a further 186 (15 per cent) who had no testing available.

This decreases the percentage of patients assessed in accordance with Module 2 to 312 or 25 per cent of all episodes audited.

When patients are assessed within 28 days of surgery, there is not adequate time for investigation of any anaemia found, nor is there time for adequate treatment to take place without delaying surgery, or potentially resorting to transfusion (Table 3).

For some patients, such as those undergoing major gastrointestinal and cardiothoracic surgery, the median wait time between listing for surgery and surgery date is less than 28 days.

The median waiting times to admission from elective surgery waiting lists in Victoria (2019–20) was 19 days for cardiothoracic surgery, 28 days for gynaecology and 55 days for orthopaedic surgery (AIHW 2020).

This may, in part, contribute to the smaller percentage of patients who were assessed four weeks or more before surgery. However, postponement of major, non-urgent surgery should be considered to allow the diagnosis and treatment of preoperative anaemia, if appropriate (Munoz 2017).

Table 3: Timing of anaemia assessment prior to surgery

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Time of assessment prior to surgery | Ortho-paedic | Gynae-cology | Major gastro-intestinal | Cardio-thoracic | Total |
| 4 weeks and more | 320 (49%) | 104 (43%) | 48 (20%) | 26 (24%) | 498 (40%) |
| Between 1 week and 4 weeks | 252 (39%) | 95 (39%) | 138 (56%) | 59 (54%) | 544 (44%) |
| Less than 1 week | 57 (9%) | 35 (15%) | 48 (20%) | 15 (14%) | 155 (12%) |
| 1 day prior | 25 (4%) | 7 (3%) | 11 (4%) | 10 (9%) | 53 (4%) |

For the majority of patients, 952 (76 per cent), preoperative anaemia screening took place in the health service clinic. Only small numbers of patients were seen in other areas, such as a GP’s or physician’s rooms.

This may highlight a missed opportunity to engage with GPs, where they may be able to review patients with greater time to surgery, thus making use of the time the patients spend on waitlists.

It is important to maintain good, open communication with GPs to keep them informed of when their patients are waitlisted for surgery. This will allow them to follow up and commence the anaemia assessment process.

Greater GP awareness of anaemia and its treatment is a key success factor for PBM.

GPs also need a way to easily refer patients for further investigation with a haematologist, gastroenterologist or other specialist service.

More GP practices now offer intravenous iron therapy. This removes the need for patients to attend a health service for treatment. It also means the therapy can be administered closer to home.

### Preoperative anaemia: testing

Module 2 includes the following as baseline tests for assessment and identification of anaemia:

* full blood count
* iron studies (including ferritin)
* C-reactive protein (CRP)
* renal function.

The audit shows that 1,204 of the 1,250 (96 per cent) had some testing completed as part of the preoperative assessment.

Of those reported as assessed, 1,198 (96 per cent) had FBE. Other tests that might help to determine the cause of anaemia were less commonly performed.

Renal function was assessed in 880 (70 per cent), 588 (47 per cent) had ferritin levels tested, and 343 (27 per cent) had CRP measured.

An FBE only identifies anaemia status. It does not help to determine the cause of anaemia or, for patients who are not anaemic, if the person is at risk of anaemia associated with iron deficiency.

While renal function and CRP may be tested later following abnormal haemoglobin results, all patients should have a ferritin test to check for iron deficiency.

If patients go to surgery with low iron levels, they may have difficulty maintaining or replacing haemoglobin levels when there is substantial intraoperative blood loss, as anticipated in the surgeries included in this audit.

Table 4 documents the screening tests reported in this audit. Note that while some testing was performed for most patients, there was a small number of patients who were reported as assessed, who had no preoperative screening tests recorded (n = 46; 4 per cent).

Table 4: Preoperative screening tests for patients reported as assessed (n = 1,250)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test | Ortho-paedic | Gynae-cology | Major gastro-intestinal | Cardio-thoracic | Total |
| FBE | 635 (97%) | 214 (89%) | 241 (98%) | 108 (98%) | 1,198 (96%) |
| Ferritin | 377 (58%) | 87 (36%) | 83 (34%) | 41 (37%) | 588 (47%) |
| CRP | 210 (32%) | 40 (17%) | 62 (25%) | 31 (28%) | 343 (27%) |
| Renal function | 518 (79%) | 75 (31%) | 189 (77%) | 98 (89%) | 880 (70%) |
| No testing | 15 (2%) | 26 (11%) | 4 (2%) | 1 (1%) | 46 (4%) |

As shown in Table 4 , patients attending for gynaecology surgery were generally less likely to have an FBE, renal function tests or CRP than other surgical groups, with only 87 (36 per cent) having a ferritin test.

This may be because the surgery is seen as a treatment for ongoing blood loss and thus further treatment is unnecessary, or that iron replacement or other appropriate measures are being taken. If the latter is the case, it is still necessary to check that any treatment is having the desired effect.

In an anaemic adult, a ferritin level below 15 g/L is diagnostic of iron deficiency, and levels between 15 and 30 g/L are highly suggestive. Lower thresholds (from 10 to 12 g/L) are used for children.

Ferritin levels alone are of limited value in excluding iron deficiency, as they can become elevated in inflammation, infection, liver and kidney disease, malignancy, obesity and advanced age. Diagnosis of iron deficiency may be obscured by inflammation, as ferritin concentrations are increased (Pasricha et .al. 2021).

The Module 2 template recommends treatment and/or investigation for iron deficiency in patients with a ferritin less than 30 mcg/L. In this audit, 43 patients were anaemic with iron deficiency according to the Module 2 template.

Of the 1,250 patients reported as having a preoperative assessment, 588 (47 per cent) had ferritin levels evaluated as part of the assessment. Of the patients documented as anaemic or iron deficient by the health service (n = 132), 32 (24 per cent) did not have a ferritin level taken as part of the investigations.

The Module 2 template recommends that patients identified as anaemic with a ferritin level of between 30 and 100 mcg/L should have a CRP level tested. Of the 29 patients fitting this cohort, 10 (34 per cent) had a CRP available at the preoperative assessment, with five returning an elevated result, which suggests the ferritin result may be falsely elevated.

For patients who were preoperatively assessed and did not meet the definition of anaemia (n = 1,057), 481 (46 per cent) had ferritin tested. Of these, 55 (11 per cent) were iron deficient, as defined by Module 2 (ferritin less than 30 mcg/L).

A further 174 (36 per cent) patients were possibly iron deplete (ferritin level between 30 and 100 mcg/L). Of these patients, 72 had CRP testing with nine returning an elevated result.

The template recommends that patients with ferritin levels between 30 and 100 mcg/L should be considered for iron therapy if it is anticipated that postoperative Hb decrease is equal to or greater than 30 g/L.

Table 5 shows 174 patients were determined non-anaemic with ferritin 30–100 mcg/L (possible iron depletion – as defined by Module 2). However, 158 (91 per cent) of these were not identified by the health service or treated, whereas the Module 2 template recommends iron therapy.

Table 5: Patients determined as non-anaemic but having ferritin 30–100 mcg/L (possible iron depletion)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Surgery | Total number of patients preoperatively assessed (n = 1,250) | Patients determined non-anaemic and ferritin 30–100 mcg/L (possible iron depletion – as defined by Module 2) (%) | Patients documented or managed by health service as iron deplete (%) | Patients determined non-anaemic and ferritin 30–100 mcg/L (Module 2), but not identified by health service (%) |
| Orthopaedic | 654 | 111 (17%) | 4 (1%) | 107 (96%) |
| Gynaecology | 241 | 34 (14%) | 10 (4%) | 24 (71%) |
| Major gastrointestinal | 245 | 21 (9%) | 2 (1%) | 19 (90%) |
| Cardiothoracic | 110 | 8 (7%) | - | 8 (100%) |
| Total (all surgical types) | 1250 | 174 (14%) | 16 (9%) | 158 (91%) |

### Preoperative anaemia: documentation

This audit defines anaemia and iron deficiency according to the definitions in the Module 2 preoperative haemoglobin assessment and optimisation template. Once these conditions have been identified, the patient needs further investigation or treatment.

For patients found to be anaemic or iron deficient, we asked auditors to indicate whether there was documentation relating to plans of care, or evidence of treatment for either.

Results showed the Hb for adult females ranged from 59–180 g/L, average 132 g/L (results available for 714 of 751 patients, where reported as assessed).

For adult males, Hb ranged from 45–187 g/L, average 143 g/L (results available for 480 of 495 patients, where reported as assessed).

Table 4: Patients documented as non-anaemic iron deficient by age and gender as per Module 2, and those reported as documented or managed by the health service

| Age range | Gender | Total number of patients preoperatively assessed (n = 1,250) | Patients determined non-anaemic iron deficient (%)  Hb average (range) | Patients documented as non-anaemic iron deficient or reported as managed by health service[[2]](#footnote-2) (%)  Hb average (range) |
| --- | --- | --- | --- | --- |
| Adult | Male | 495 | 17 (3%) Hb 142 (130–158) | 7/17 (41%) Hb 134 (130–142) |
| Adult | Female | 751 | 38 (5%) Hb 133 (12–151) | 12/38 (32%) Hb 131 (123–142) |
| 2–11 years | Boys and girls | 4 | 0 | 0 |

Table 5: Patients documented as anaemic[[3]](#footnote-3) by age and gender as per Module 2, and those reported as documented or managed by the health service.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Age range | Gender | Total number of patients preoperatively assessed (n = 1,250) | Patients determined anaemic by Module 2 template definition (%) | Patients documented as anaemic or reported as managed by health service (%) |
| Adult | Male | 495 | 61 (12%) Hb 117 (45–129) | 17/61 (28%) Hb 105 (45–129) |
| Adult | Female | 751 | 89 (21%) Hb 109 (67–119) | 30/89 (34%) Hb 105 (67–119) |
| 2–11 years | Boys and girls | 4 | 0 | 0 |

Table 6: Patients documented as iron deficient anaemia by age and gender as per Module 2, and those reported as documented or managed by the health service.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Age range | Gender | Total number of patients preoperatively assessed (n = 1,250) | Patients determined iron deficient anaemia by Module 2 template definition (%) | Patients documented as iron deficient anaemia or reported as managed by health service (%) |
| Adult | Male | 495 | 10 (2%) Hb 95 (48–128) | 6/10 (60%) Hb 80 (48–118) |
| Adult | Female | 751 | 33 (4%) Hb 99 (67–118) | 24/33 (73%) Hb 95 (67–118) |
| 2–11 years | Boys and girls | 4 | 0 | 0 |

Tables 6–8 report the number of patients who are anaemic and/or iron deficient by age and gender, as determined by the Module 2 definitions.

There were 248 (20 per cent) patients who met the criteria for anaemia or iron deficiency as per the Module 2 template.

Of those 248 patients, health services only documented or reported management of anaemia or iron deficiency for 96 (8 per cent) patients.

This difference may indicate that some health services use a different threshold for the treatment of anaemia rather than that specified in Module 2. In some cases, it may indicate a lack of follow-up on results.

Failure to recognise or manage anaemia, or not routinely performing ferritin testing, is a missed opportunity to assess and manage patients who are at risk of anaemia following surgery where substantial blood loss is anticipated. As shown by current literature, treating underlying iron deficiency early may enhance postoperative recovery (NBA 2012).

Health services should have processes to follow up results and take appropriate action. Table 9 shows that health services did not identify 152 (61 per cent) patients with haemoglobin and/or ferritin levels consistent with the criteria for anaemia and/or iron deficiency in Module 2.

This accounts for 11 per cent (72 of 654) of all orthopaedic patients, 13 per cent (31 of 241) of gynaecological patients, 15 per cent (36 of 245) of gastrointestinal patients and 13 per cent (14 of 110) of cardiothoracic patients assessed.

Table 7: Patients reported as anaemic and/or iron deficient as per Module 2 by surgery type

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Surgery | a: Total number of patients preoperatively assessed (n = 1,250) | b: Patients determined anaemic &/or iron deficient by Module 2 template definition  (% b ÷ a) | c: Patients documented as anaemic &/or iron deficient, or reported as managed by health service (% c ÷ a) | d: Patients who are anaemic &/or iron deficient as defined by Module 2, but not identified by health service (% d ÷ b) |
| Orthopaedic | 654 | 97 (15%) | 25 (4%) | 72 (74%) |
| Gynaecology | 241 | 56 (23%) | 25 (10%) | 31 (55%) |
| Major gastrointestinal | 245 | 78 (32%) | 42 (17%) | 36 (46%) |
| Cardiothoracic | 110 | 17 (15%) | 4 (3%) | 13 (76%) |
| Total (all surgical types) | 1250 | 248 (20%) | 96 (8%) | 152 (61%) |

### Preoperative anaemia: management

Once a patient is identified as anaemic or iron deficient, treatment needs to commence.

For the purposes of this audit, interventions included preoperative red cell transfusions, iron replacement therapies and investigations such as scopes (endoscopy/colonoscopy) and specialist referrals based on preoperative assessment.

Treatment of anaemia and/or iron deficiency was commenced in 68 patients (71 per cent of all patients with anaemia and/or iron deficiency identified by the health service [n = 96], which accounts for only 27 per cent of all patients who met the criteria for anaemia and/or iron deficiency by Module 2 [n = 248]).

The type of treatment received varied, with a number of patients receiving several types of treatment (Tables 8 to 14).

Table 9: All surgery types – types of treatment received for anaemia/iron deficiency as documented by health services (number of patients requiring treatment as per Module 2 = 248, compared with 96 documented and 68 treated by health services)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Treatment[[4]](#footnote-4) | Number of patients treated (%)[[5]](#footnote-5)  n = 68 | Male average Hb (range) (g/L)  at assessment | Female average Hb (range) (g/L)  at assessment | Average ferritin (range) (mcg/L) at assessment |
| Oral iron supplements | 15 (22%) | 114 (101–131) | 116 (67–142) | 107 (7–661) |
| IV iron infusion | 45 (66%) | 104 (57–142) | 104 (70–142) | 55 (3–495) |
| Specialist referral (Haematology, GI or renal) | 13 (19%) | 97 (57–130) | 111 (76–132) | 150 (3–423) |
| Red cell transfusion | 13 (19%) | 69 (45–97) | 79 (59–105) | 171 (3–990) |
| Other[[6]](#footnote-6) | 1 (1%) | - | 112 | 13 |

Table 101: Orthopaedics – types of treatment received for anaemia/iron deficiency as documented by health services (number of patients requiring treatment as per Module 2 = 97, compared with 25 documented and 16 treated by health services)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Treatment[[7]](#footnote-7) | Number of patients treated (%)[[8]](#footnote-8)  n = 68 | Male average Hb (range) (g/L)  at assessment | Female average Hb (range) (g/L)  at assessment | Average ferritin (range) (mcg/L) at assessment |
| Oral iron supplements | 5 (31%) | 101 (101–101) (n = 2) | 119 (112–129) (n = 3) | 118 (20–416) |
| IV iron infusion | 12 (75%) | 131 (131–131) (n = 2) | 117 (107–136) (n = 10) | 30 (5–100) |
| Specialist referral (Haematology, GI or renal) | 2 (13%) | 101 (n = 1) | 117  (n = 1) | 253 (90–416) |
| Red cell transfusion | 1 (6%) | 88 | - | 990 |
| Other[[9]](#footnote-9) | 1 (6%) | - | 112 | 13 |

Table 12: Gynaecology – types of treatment received for anaemia/iron deficiency as documented by health services (number of patients requiring treatment as per Module 2 = 56; compared with 25 documented and 20 treated by health services)

| Treatment[[10]](#footnote-10) | Number of  patients treated (%)[[11]](#footnote-11) n = 20 | Average Hb  (range) (g/L)  at assessment | Average ferritin (range) (mcg/L) at assessment |
| --- | --- | --- | --- |
| Oral iron supplements | 7 (35%) | 115 (67–142) | 21 (7–47) |
| IV iron infusion | 12 (60%) | 92 (80–142) | 22 (4–129) |
| Red cell transfusion | 2 (10%) | 74 (59–89) | 16 (16–16) |

Table 13: Major gastrointestinal – types of treatment received for anaemia/iron deficiency as documented by health services (number of patients requiring treatment as per Module 2 = 78, compared with 42 documented and 30 treated by health services)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Treatment[[12]](#footnote-12) | Number of patients treated (%)[[13]](#footnote-13)  n = 30 | Male Average Hb (range) (g/L)  at assessment | Female Average Hb (range) (g/L)  at assessment | Average ferritin (range) (mcg/L) at assessment |
| Oral iron supplements | 3 (10%) | 121 (111–131) (n = 2) | 119 (n = 1) | 344 (27–461) |
| IV iron infusion | 20 (67%) | 98 (57–131) (n = 10) | 107 (70–132) (n = 10) | 92 (3–495) |
| Specialist referral (Haematology, GI) | 10 (33%) | 87 (57-120) (n = 4) | 110 (76-132) (n = 6) | 138 (3–423) |
| Red cell transfusion | 10 (33%) | 65 (45-97) (n = 6) | 80 (70-105) (n = 4) | 76 (3-500) |

Table 14: Cardiothoracic – types of treatment received for anaemia/iron deficiency as documented by health services (number of patients requiring treatment as per Module 2 = 17, compared with 4 documented and 2 treated by health services)

| Treatment | Number of patients treated (%)[[14]](#footnote-14) n = 2 | Male average Hb (range) (g/L)  at assessment | Female average Hb (range) (g/L)  at assessment | Average ferritin (range) (mcg/L) at assessment |
| --- | --- | --- | --- | --- |
| Oral iron supplements | - | - | - | - |
| IV iron infusion | 1 (50%) | 142 |  | 27 |
| Specialist referrals | 1 (50%) | 130 | - | 30 |
| Red cell transfusion | - | - |  | - |

As outlined in Tables 11–14, 13 patients received a red cell transfusion as part of their treatment for anaemia and/or iron deficiency prior to surgery. Eight (62 per cent) had transfusion as the only treatment reported.

We are unable to comment on the appropriateness of these transfusions. However, even where it may be appropriate to transfuse the patient due to symptomatic anaemia, the underlying cause of the anaemia must still be investigated and treated.

Ninety-six patients were anaemic and/or iron deficient, with 60 patients (61 per cent) receiving iron therapy prior to their surgery, 45 patients receiving intravenous iron (46 per cent) and 15 patients receiving oral iron (15 per cent).

Oral iron use in therapeutic doses should raise Hb by about 20 g/L every three weeks. It is reasonable to replenish iron stores by continuing treatment for three to six months, in adults, beyond normalisation of Hb (Pasricha et al. 2010).

Where patients received oral iron, no further data were collected regarding dose or length of treatment.

Considering 60 per cent of all patients assessed (752) were assessed four weeks or less before surgery, there may not have been time for oral iron to have achieved the desired effect. We acknowledge some patients may be on long-term oral iron for their underlying condition.

No patients received erythropoietin as part of their treatment. The Module 2 guidelines include a practice point: in patients with anaemia of chronic disease (also known as anaemia of inflammation), erythropoietin stimulating agents may be indicated.

Generally, this would be used in conjunction with iron therapy. The lack of use may be related to the Pharmaceutical Benefits Scheme criteria for erythropoietin, which may result in significant cost to the patient in this setting.

Referral to other specialists, such as gastroenterology or haematology, occurred less frequently, with 13 patients in total being referred. No referrals to renal specialists were documented.

177 patients were possibly iron deplete, with only 13 (7 per cent) being reported as treated across all clinical areas (Table 15).

Table 15: Types of treatment provided for patients identified as possibly iron deplete as documented by health services (number of patients requiring treatment according to Module 2 = 174, compared with 16 documented by health services)

|  |  |
| --- | --- |
| Treatment | Number of patients treated (%)[[15]](#footnote-15) n = 13 |
| Oral iron supplements | 10 (67%) |
| IV iron infusion | 5 (33%) |
| Specialist referrals | 2 (13%) |
| Red cell transfusion | 1 (7%) |

Failure to identify and treat anaemia and/or iron deficiency, or iron depletion is concerning, as health services are missing opportunities to optimise patients’ haemoglobin preoperatively.

Current literature suggests that the anaemic patient is at increased risk of transfusion and subsequent increased length of hospital stay (Musallam et al. 2011). In addition, preoperative anaemia is associated with increased patient morbidity and mortality following surgery (Musallam et al. 2011).

The failure of follow-up from screening shows generally poorer performance when assessment is done with less than 4 weeks to surgery date, as shown in Figures 2–6.

Figure 2: All surgery types – screening failures by timeliness of assessment

**Notes**

Denominator for ‘anaemia identified and not treated’ was patients documented as anaemic by health service, with the numerator being patients with no reported interventions.

Denominator for ‘anaemia not identified’ was patients determined to be anaemic as defined by Module 2, with the numerator being patients not identified by health services.

Figure 3: Orthopaedics – screening failures by surgery type and timeliness of assessment

**Notes**

Denominator for ‘anaemia identified and not treated’ was patients documented as anaemic by health service, with the numerator being patients with no reported interventions.

Denominator for ‘anaemia not identified’ was patients determined to be anaemic as defined by Module 2, with the numerator being patients not identified by health services.

Figure 4: Gynaecology – screening failures by surgery type and timeliness of assessment

**Notes**

Denominator for ‘anaemia identified and not treated’ was patients documented as anaemic by health service, with the numerator being patients with no reported interventions.

Denominator for ‘anaemia not identified’ was patients determined to be anaemic as defined by Module 2, with the numerator being patients not identified by health services.

Figure 5: Gastrointestinal – screening failures by surgery type and timeliness of assessment

**Notes**

Denominator for ‘anaemia identified and not treated’ was patients documented as anaemic by health service, with the numerator being patients with no reported interventions.

Denominator for ‘anaemia not identified’ was patients determined to be anaemic as defined by Module 2, with the numerator being patients not identified by health services.

Figure 6: Cardiothoracic – screening failures by surgery type and timeliness of assessment

**Notes**

Denominator for ‘anaemia identified and not treated’ was patients documented as anaemic by health service, with the numerator being patients with no reported interventions.

Denominator for ‘anaemia not identified’ was patients determined to be anaemic as defined by Module 2, with the numerator being patients not identified by health services.

The closer the surgery date was to the preoperative assessment date, the more patients with anaemia were not identified or treated (65 per cent to 78 per cent) (Figure 7). These represent missed opportunities for investigation and treatment.

Figure 7: Treatment type for patients documented/identified with anaemia by timing of preoperative haemoglobin assessment



### Preoperative anaemia: re-evaluation

In order to assess the impact of treatment, Hb and ferritin should be remeasured after treatment has been instigated and prior to surgery.

Different patients will respond differently, but an initial check could be considered between two to four weeks following a non-transfusion intervention.

Testing to assess the impact of treatment for patients with anaemia and/or iron deficiency was reported in 48 of the 68 patients treated (71 per cent), as shown in Table 16.

A total of 15 patients (22 per cent) were documented as having their anaemia/iron deficiency resolved (as defined by Module 2) prior to surgery.

Table 16: Patients re-evaluated after treatment and resolved

| Anaemia/iron status | Number treated | Re-evaluated | Resolved |
| --- | --- | --- | --- |
| Anaemia/iron deficiency | 68 | 48 (71%) | 15 (22%) |
| Iron deplete | 13 | 6 (46%) | 3 (23%) |

#### Preoperative assessment quality

Figure 8 summarises the quality of the assessment process for all patients reported. Figures 9–12 summarise each clinical speciality.

These include screening, testing, evaluation, management and then re-evaluation. For all clinical specialties there is significant room for improvement.

Figure 8: Quality of assessment process for all surgery types

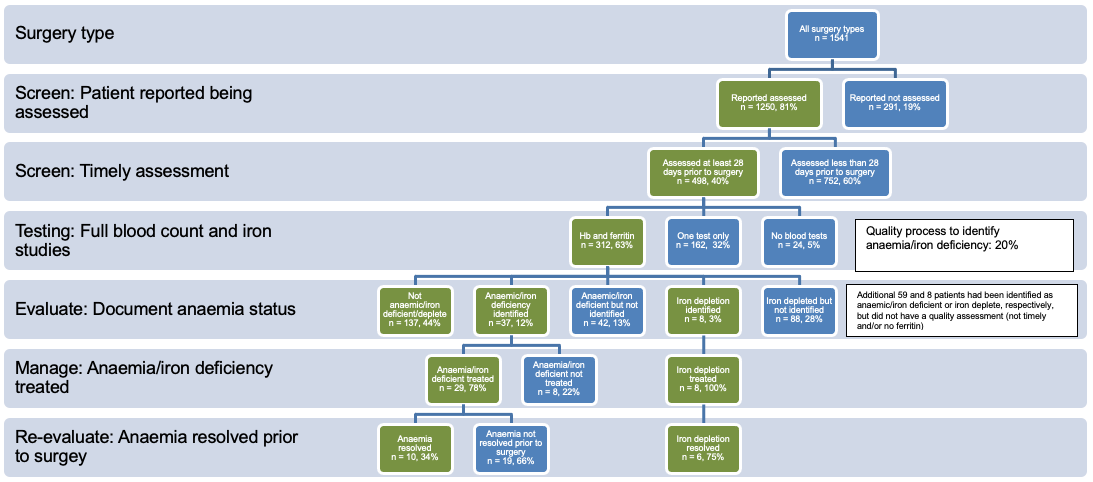


Figure 9: Quality of assessment process for orthopaedic surgery

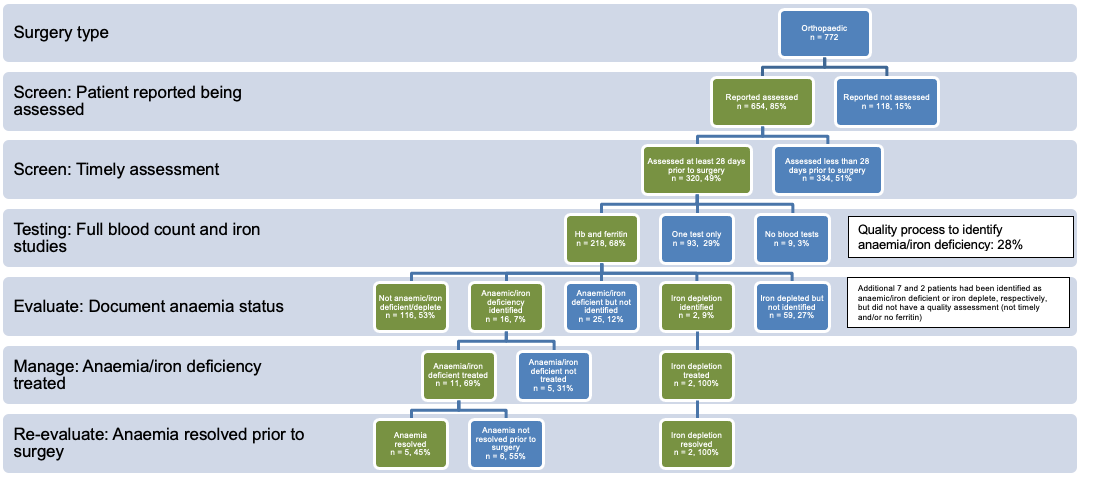


Figure 10: Quality of assessment process for gynaecology surgery

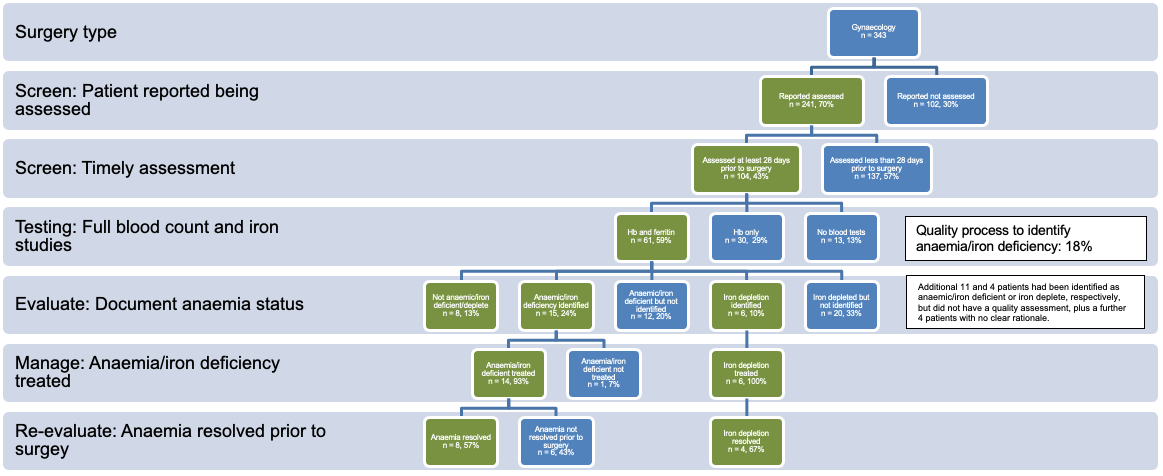


Figure 11: Quality of assessment process for major gastrointestinal surgery

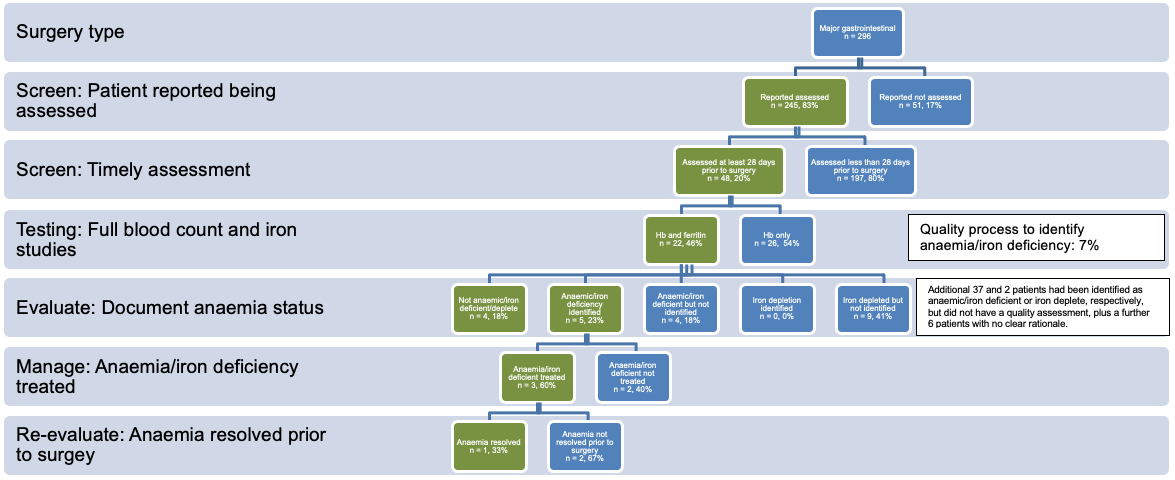
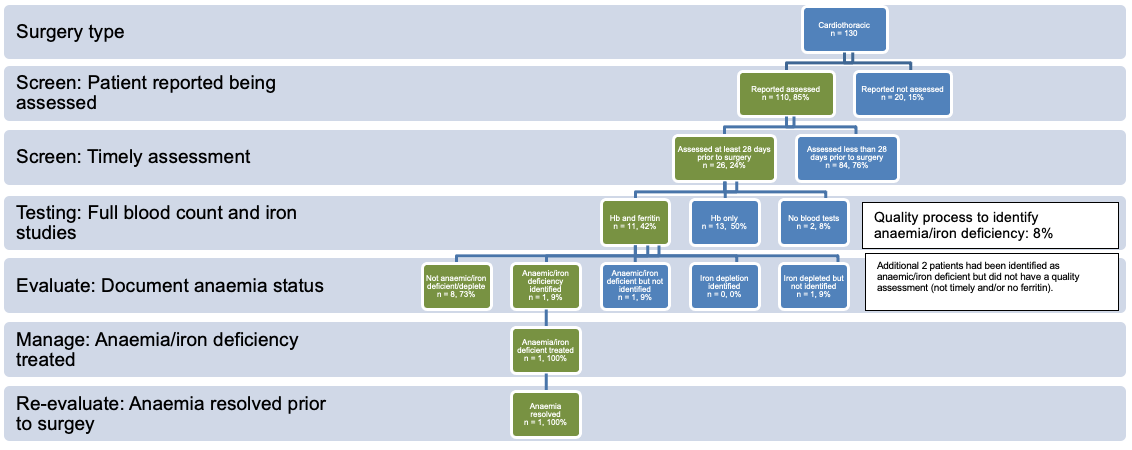


Figure 12: Quality of assessment process for cardiothoracic surgery



### Preoperative anaemia: summary

Overall, 291 (19 per cent) patients attending for elective surgical procedures in the groups audited did not have any reported preoperative screening for anaemia.

A small number (53) of patients who were documented as screened had their testing on the day prior to surgery. This did not allow time for appropriate follow-up investigations or treatment.

Of the groups in the audit, the gynaecology group had fewer patients documented as having preoperative assessment (70 per cent compared with 83–85 per cent in the other groups). These patients often have ongoing blood loss. They may benefit from assessment and the addition of supplements, such as iron, prior to surgery.

While most patients had a documented FBE (1,198, 96 per cent), other tests that might assist in assessing anaemia and its cause were less frequently completed. For example:

* less than half the patients (588, 47 per cent) had a ferritin test
* 343 (27 per cent) had a CRP test
* 880 (70 per cent) had renal function tests.

Simply knowing a patient is anaemic in the preoperative assessment does not help to determine the cause and best treatment. It may also lead to transfusion before other more appropriate management strategies have been considered. This is why it is vital to perform other pathology testing.

Documented treatment showed 5 (5 per cent) patients tested more than 4 weeks before surgery were given a transfusion, and 8 (6 per cent) patients with less than 4 weeks to surgery also received an RBC transfusion.

We are unable to determine the appropriateness of these transfusions. In patients with symptomatic anaemia, transfusion may be appropriate. However, for 8 (62 per cent) of those transfused, this was the only treatment they received.

Health services recognised only a very small proportion of patients (96, 8 per cent) as anaemic based on Module 2 guidelines. Despite this, an additional 20 per cent of all patients (248) should have been recognised and managed to reduce risk.

Hb and ferritin treatment thresholds may differ (Tables 6–8). However, in the preoperative setting, patients should be fit for surgery, and many patients were not provided the opportunity to improve their Hb and/or iron prior to surgery.

Even where treatment of anaemia or iron deficiency was undertaken (n = 68), evaluation of the effect of that treatment only occurred in 48 patients (71 per cent), with 15 (22 per cent) showing resolution of anaemia or iron deficiency.

For those found to be iron deplete but without anaemia, 13 were treated, with 6 (46 per cent) re-evaluated and 3 (23 per cent) found to have resolution of iron reserves.

This leaves many patients attending for major surgical procedures still at risk of anaemia and potentially transfusion in the intra and postoperative periods (Figures 8–12).

This highlights that health services have much work to do to make PBM a routine part of the preoperative care for patients.

## Intraoperative interventions

For the **purposes of this audit,** quality intraoperative patient blood management (minimise blood loss) was based on Module 2 recommendations and practice points (Appendix 6) and measured as defined in Table 17.

Table 17: Module 2 recommendations and measures for intraoperative interventions

|  |  |  |
| --- | --- | --- |
| Process | Description | Measure |
| Blood conservation strategies | In patients undergoing surgery, prevent hypothermia and consider deliberate induced hypotension, as well as acute normovolemic haemodilution.  Module 2: R12, R13, R14 | Blood conservation strategies documented. Please note: some strategies may not be routinely documented in medical notes. |
| Blood conservation strategies | In patients undergoing cardiac surgery, consider the use of TEG or other near-patient testing.  Module 2: R16 | TEG recorded as being used. |
| Blood conservation strategies | Use of tranexamic acid (TXA) is recommended.  Module 2: R17, R18 | TXA reported to be used. |
| Cell salvage | In patients undergoing surgery in which substantial blood loss is anticipated, intraoperative cell salvage is recommended.  Module 2: R15 | Cell salvage reported to be used. |

Patients who are anaemic on the day of surgery are more likely to need an allogeneic red blood cell transfusion than those who have a Hb concentration within normal limits.

Table 18 demonstrates that less than half the patients in the audit population had a Hb taken on the day of surgery. Of the patients who did have Hb taken, 188 (28 per cent) were anaemic as defined by Module 2, exposing them to an increased risk of morbidity and mortality.

Table 18: Day of surgery (DoS) haemoglobin results by surgery type

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Surgery | Number of all patients | Number of patients with DoS Hb (%) | Hb results (g/L) average (range) | Number of patients with DoS Hb with anaemia (%) |
| Orthopaedics | 772 | 282 (37%) | 135 (82–171) | 62 (22%) |
| Gynaecology | 343 | 160 (47%) | 128 (46–173) | 36 (23%) |
| Major gastrointestinal | 296 | 168 (57%) | 125 (50–178) | 71 (42%) |
| Cardiothoracic | 130 | 71 (55%) | 134 (89–173) | 19 (27%) |
| **Total (all surgical types)** | **1541** | **681 (44%)** | **131 (46–178)** | **188 (28%)** |

### Intraoperative blood loss

Estimating intraoperative blood loss is an important factor in the decision to transfuse.

Table 19 shows that only 575 (37 per cent) of patients in this audit had intraoperative blood loss documented/reported.

Table 19: Estimated intraoperative blood loss by surgery type

|  |  |  |  |
| --- | --- | --- | --- |
| Surgery | Number of all patients | Number of patients with reported intraoperative blood loss (%) | Intraoperative blood loss volume (mL) average, (range) |
| Orthopaedics | 772 | 216 (28%) | 363 (10–2,000) |
| Gynaecology | 343 | 246 (72%) | 252 (10–1,600) |
| Major gastrointestinal | 296 | 83 (28%) | 521 (10–3,500) |
| Cardiothoracic | 130 | 30 (23%) | 481 (100–1,500) |
| **Total (all surgical types)** | **1541** | **575 (37%)** | **344 (10–3,500)** |

The data provided for estimated intraoperative blood loss suggests variation in the way blood loss is determined and documented across health services. The audit instructions did not include a description of where auditors could find documentation of blood loss.

The surgical procedures included in the audit are all likely to result in a blood loss of 500 mL or more. Blood loss should be documented on anaesthetic charts or equivalent.

The low percentage of documented blood loss may be due to the:

* difficulty of theatre staff in documenting it
* difficulty of auditors in finding the documentation
* blood loss being too low to warrant documenting.

Documentation of intraoperative blood loss (37 per cent) has changed marginally since the 2015 audit, which showed 31 per cent of operative procedures audited with documented blood loss.

### Intraoperative cell salvage

For surgical procedures in which substantial blood loss is anticipated, intraoperative cell salvage is recommended (Module 2: R15).

Intraoperative cell salvage can be an important component of a PBM program, as it is an autologous blood conservation measure that decreases net perioperative blood loss, maintains postoperative haemoglobin and reduces the requirements for allogeneic blood transfusion (NBA 2012 (1b)).

Only 9 of 59 (15 per cent) health services reported using cell salvage on 52 (3 per cent) patients; of these 36 (69 per cent) patients received returned cell salvaged blood. This is only 2 per cent of all patients audited.

Low collected volume was the reason most frequently cited for not returning the salvaged blood. The audit did not include questions regarding the availability of cell salvage equipment and staff to operate it.

The reasons for not undertaking cell salvage are unclear, but they may be related to logistical and/or financial reasons.

Roets et al. (2019) report that the success of cell salvage relies on specialised equipment and techniques to collect, process, anticoagulate, filter and reinfuse blood.

Table 20: Use of intraoperative cell salvage by surgery type

| Surgery | Number of patients using cell salvage intraoperatively (%) | Number of patients having cell salvage returned (%) | Volume (mL) returned average (range) |
| --- | --- | --- | --- |
| Orthopaedics | 37 (5%) | 31 (84%) | 262 (55–1,000) |
| Gynaecology | - | - | - |
| Major gastrointestinal | 1 (0.3%) | - | - |
| Cardiothoracic | 14 (11%) | 5 (36%) | 628 (150–1,957) |
| **Total (all surgical types)** | **52 (3%)** | **36 (69%)** | **312 (55–1,957)** |

The United Kingdom (UK) Association of Anaesthetists 2018 cell salvage guidelines (Klein et al. 2018) state that the anaesthetist has responsibility in the area of PBM in general and in cell salvage in particular:

During the perioperative care of a patient, the anaesthetist has a fundamental role in advocating PBM strategies. Cell salvage is a key part of PBM and is a relatively simple and effective blood conservation technique that reduces the requirement for and amount of allogeneic blood transfusion and maintains postoperative haemoglobin concentration (Klein et al. 2018).

The guidelines published by the Association of Anaesthetists UK 2018 recommends cell salvage in cancer surgery and infected fields be considered on a case by case basis, with the patient’s consent.

The 2018 guideline Appendix VI, ‘Use of intraoperative cell salvage in malignant disease’ states a number of published reports find the use of intraoperative cell salvage in cancer surgery is not associated with early metastasis or a difference in biochemical recurrence.

It also states that some hospitals routinely use intraoperative cell salvage during cancer surgery. The use of cell salvage in these circumstances is consistent with the literature, although the manufacturers consider these areas as contraindicated.

The NBA guidance for the provision of intraoperative cell salvage (2014) supports the use of intraoperative cell salvage to reduce the need for allogeneic blood.

However, the companion guide states that it is not recommended when bowel content or infected material is present in the surgical field. This is based on a 2008 UK Cell Salvage Action Group recommendation, however it is now included in newer guidelines.

Most studies of cell salvage in gynaecological surgery revolve around its use in obstetric haemorrhage, and this was not included in the audit’s surgery types.

Robson and Leung (2016) state the use of cell salvage in gynaecological settings should follow protocols associated with surgery in non-pregnant women:

A typical setting might be hysterectomy for a massive fibroid uterus, where heavy blood loss is anticipated. It is important to remember that associated bowel injury presents a risk of infection and cell salvage should be commenced after decontamination and with the use of antibiotic cover (Robson and Leung 2016).

None of the gynaecological surgery reported had cell salvage undertaken.

There are some absolute contraindications to intraoperative cell salvage, which include the presence of contraindicated fluids. These include fluids that could cause haemolysis of red blood cells, or solutions that would be toxic if administered IV (antibiotic irrigation, hydrogen peroxide, alcohol or povidone-iodine solutions).

Additionally, cell salvage cannot be used in situations where there is a mixture of haemostatic products (such as topical thrombin, fibrin glue or microfibrillar bovine collagen-based products) or bone cement (UpToDate 2019a).

It remains unclear, however, why intraoperative cell salvage was not reported to be more widely used during the audit, given the broad acceptance of this process.

#### Blood conservation strategies

Module 2 includes multiple blood conservation strategies as recommendations and practice points to assist in minimising blood loss during surgical procedures.

It is not known if all strategies are routinely documented in the medical record (anaesthetic chart) if implemented; however, they were included because the audit sought to cover all components of the PBM guidelines.

#### Deliberately induced hypotension

Five per cent of the procedures audited reported using deliberately induced hypotension, with orthopaedic surgery reporting the highest rate (n = 66, 9 per cent) (Table 21).

Module 2 recommends the use of deliberately induced hypotension (grade C evidence only) for patients undergoing radical prostatectomy or major joint replacement.

Studies, such as the meta-analysis by Jiang et al. (2019) of deliberate hypotension in orthopaedic surgery, have found the occurrence of serious adverse events is rare, although few studies examine mortality and morbidity.

Tegegne et al. (2021) concurs with Jiang et al. about the rarity of serious adverse events. They conclude that deliberate hypotension can be practised safely to limit intraoperative surgical site bleeding in resource-limited areas. They recommend caution, as there is a lack of clear guidance on physiological parameters, standard monitoring requirements and the most appropriate medications to use.

Providing standardised guidelines for clinicians using deliberately induced hypotension may improve safety and promote use, which could reduce the need for RBC transfusion in selected patients.

Health services and clinicians need to weigh up the benefits and risks and ensure there is a procedure in place that outlines when use may be suitable and for which patients.

#### Acute normovolemic haemodilution (ANH)

ANH (PBM guidelines grade C evidence) was used in 63 (4 per cent) patients (Table 21).

There are few current studies that clarify the risks and benefits, although Shander (UpToDate, 2019b) states that the relative contraindications include patients with:

* impaired cardiac function who may have limited ability to increase cardiac output
* impaired renal function with oliguria
* baseline Hb < 110 g/L
* low concentrations of clotting factors or abnormal coagulation or platelet function
* inadequate vascular access
* turnaround time for relevant blood tests of more than five to 30 minutes.

This technique can be considered for patients with normal preoperative Hb.

As noted previously, less than half of the patients in the audit had Hb documented on the day of surgery. Of those 12 per cent (n = 188) were anaemic (Table 18).

This blood conservation technique requires preoperative anaemia assessment and management, as well as good clinical documentation to confirm a normal Hb.

Health services are required to have the correct equipment, bags, anticoagulant and appropriate storage conditions for this procedure to be undertaken safely.

If it is not a routine part of the intraoperative care, the equipment and expertise required to safely remove a unit of the patient’s blood and store it until completion of surgery may not be available.

It is therefore not surprising that ANH was infrequently used in patients in this audit.

ANH should be considered early in the preoperative assessment process to enable the practice intraoperatively.

#### Near-patient testing (such as TEG or ROTEM)

Near-patient testing was not defined in the Blood Matters audit instructions. However, examples of viscoelastic testing types (TEG/ROTEM) were provided.

The NBA systematic review of the guidelines found limited evidence for the effect of point-of-care testing other than thromboelastography (TEG), which was specifically most beneficial in cardiac surgery.

Six of the 59 (10 per cent) health services identified the use of near-patient testing in 28 (2 per cent) patients.

The low numbers may reflect the expense and expertise required for such technologies.

The main areas where viscoelastic testing was used in the audit population were cardiothoracic surgery for 10 (8 per cent) patients, and then orthopaedic surgery for 10 (1 per cent) patients as shown in Table 21.

Viscoelastic testing can be used to both investigate disorders of haemostasis and guide blood product replacement without the use of additional tests, and can be performed in isolation (Sang Medicine 2021).

Where viscoelastic testing is used, the location and management of this testing equipment can vary from the operating suite to pathology laboratory, and hence documentation may also vary.

#### Tranexamic acid (TXA)

Tranexamic acid (TXA) was used in 728 (47 per cent) of patients (Table 21).

This has become a well-established, safe and cost-effective means of minimising surgical bleeding, with few contraindications.

Houston et al. (2019) state that TXA is now routinely used as standard care in cardiac and orthopaedic surgery and in trauma, as it is inexpensive, widely available and has consistently shown to reduce RBC transfusion.

A number of studies demonstrate strong evidence for the safety of TXA and that the risk of thromboembolic events does not differ between the TXA and placebo groups (Franchini and Mannuci 2020).

#### Prevention of hypothermia

Prevention of hypothermia is the strategy most frequently reported to minimise surgical blood loss, with 1,034 (67 per cent) patients (Table 21).

The Australian College of Perianaesthesia Nurses (ACPAN) has a guideline related to the prevention and management of inadvertent perioperative hypothermia in adults. However, this is not related to minimising blood loss specifically.

The Blood Matters audit did not define hypothermia, but the ACPAN guideline defines hypothermia as a patient core temperature of less than 36.0°C. Active warming would not be employed unless the patient’s core temperature was below the specified temperature range.

The audit did not specify what prevention of hypothermia entailed, therefore some management techniques may have been used, but were not documented or identified as such.

Table 21: Blood conservation strategies documented as utilised intraoperatively by surgery type

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Surgery | Prevention of hypothermia | Deliberate induced hypotension | Use of ANH | Near-patient testing | Use of TXA |
| Orthopaedics | 537 (70%) | 66 (9%) | 17 (2%) | 10 (1%) | 606 (78%) |
| Gynaecology | 227 (66%) | 13 (4%) | 26 (8%) | - | 24 (7%) |
| Major gastrointestinal | 189 (64%) | - | 19 (6%) | 8 (3%) | - |
| Cardiothoracic | 81 (62%) | - | 1 (1%) | 10 (8%) | 98 (75%) |
| Total (all surgical types) | 1034 (67%) | 79 (5%) | 63 (4%) | 28 (2%) | 728 (47%) |

Lack of documentation does not necessarily mean the strategy did not occur. Documentation may not be evident to the auditor.

#### Intraoperative red blood cell (RBC) transfusion

The number of patients who received an intraoperative RBC transfusion is very low at 29 (2 per cent).

Table 22: Number of intraoperative red blood cell transfusions by surgery type

| Surgery group | No. of patients receiv-ing intraop RBC | No. of units trans-fused (average per pat-ient) | Anaemic at preop assess-ment + blood loss | Anaemic on DoS | Anaemic at preadmission assess-ment – no blood loss | No anaemia at pre-admiss-ion assess-ment + blood loss | No anaemia pre-admiss-ion assessment – no blood loss |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Ortho-paedics | 3 (0.4%) | 1.7 | 1 | 1[[16]](#footnote-16) | 1 | 1 | - |
| Gynae-cology | 3 (1%) | 2.3 | 1 | 3 | - | 2 | - |
| Major gastro-intestinal | 19 (6%) | 2 | 9 | 11[[17]](#footnote-17) | 8 | 2 | - |
| Cardio-thoracic | 4 (3%) | 1.25 | 2 | 2[[18]](#footnote-18) | - | 2 | - |
| **Total (all surgical types)** | **29 (2%)** | **1.9 (54 units in total)** | **13** | **17** | **9** | **7** | **-** |

Of the 29 patients who received RBC transfusion, 21 were anaemic at the preoperative assessment and 17 were anaemic on the day of surgery.

Thirteen patients received a single unit RBC transfusion, three patients received four or more units of RBC, two patients received three units of RBC, and 11 patients received two units of RBC.

Six of the patients who received RBC transfusion and did not have a day of surgery Hb documented were either anaemic or iron deplete at the preoperative assessment.

The intraoperative transfusion rate is relatively low. However, there were a number of patients where transfusion may have been avoided if preoperative anaemia or iron depletion was appropriately managed.

### Intraoperative: summary

It is pleasing to see the PBM strategies to prevent hypothermia (67 per cent of all patients) and tranexamic acid (47 per cent of all patients) are regularly used.

Areas for improvement include follow-up of patients with anaemia, iron deficiency and depletion, the use of intraoperative cell salvage, particularly in areas such a gynaecological surgery and major gastrointestinal surgery, and the documentation of care.

The reasons other techniques were used less often are unclear.

For any blood conservation strategy, planning is required, along with the specific equipment, expertise and guidelines in place to support their use.

It is important health services ensure patients attending for elective surgical procedures are fully informed and prepared. This should include anaemia and iron deficiency assessment and treatment, and the use of techniques to minimise blood loss.

## Postoperative interventions

For the **purposes of this audit,** a quality postoperative patient blood management was based on Module 2 recommendations and practice points (Appendix 6) and measured as defined below:

Table 23: Module 2 recommendations and measures for postoperative interventions

| Process | Description | Measure |
| --- | --- | --- |
| Cell salvage | Consider postoperative cell salvage in adult patients undergoing cardiac surgery or total knee arthroplasty, in whom significant postoperative blood loss is anticipated.  Module 2: R20 | Cell salvage reported to be used. |
| RBC transfusion | RBC transfusion should not be dictated by a haemoglobin ‘trigger’ alone, but should be based on assessment of the patient’s clinical status. In the absence of acute myocardial or cerebrovascular ischaemia, postoperative transfusion may be inappropriate for patients with a haemoglobin level of > 80 g/L.  Module 2: PP2 | If RBC transfusion was given, the patient had a recent Hb measured less than 80 g/L and/or had anaemia symptoms. |
| Anaemia discharge plan | In patients with postoperative anaemia, early oral iron therapy is not clinically effective; its routine use in this setting is not recommended.  Module 2: R6 | If patient had anaemia, the discharge plan included anaemia management. |

Postoperative anaemia may be present in up to 80 to 90 per cent of patients undergoing major surgery, depending on definitions (Munoz et.al. 2019).

Preoperative anaemia, intraoperative blood loss and postoperative reduced erythropoiesis are the main contributing factors to anaemia after major surgery (Munoz et.al. 2019).

There has been limited research on the consequences of postoperative anaemia in the recovery phase from surgery, with only a small number of studies after cardiac and hip and knee surgery. These demonstrated the association between postoperative anaemia and adverse outcomes such as prolonged recovery, increased mortality and likelihood of readmission (Munoz et.al. 2019).

Module 2 focuses on the preoperative and intraoperative phases of surgery, with minimal recommendations for the postoperative period. This period provides an opportunity to assess and ensure patients are discharged with appropriate Hb levels and the ability to restore Hb due to blood loss associated with their surgery.

Postoperative Hb testing to assess the amount of blood loss was performed in most patients (Table 24), 1,305 (85 per cent) of all groups, with the gynaecology group having the smallest proportion at 60 per cent (n = 205).

Munoz et al. (2019) recommend that all patients who have undergone major surgery (defined as blood loss > 500 mL or lasting > 2 hours), and who had preoperative anaemia or moderate to severe blood loss during surgery, must be screened for anaemia after surgery.

During recovery from uncomplicated major surgery, haemoglobin concentrations should be monitored, either by standard laboratory or point-of-care testing, on a regular daily basis, at least until the third postoperative day, to detect anaemia.

This audit did not ask about ongoing measurement of Hb, except for a predischarge Hb.

Table 24: Haemoglobin on day 1 post surgery by surgery type

|  |  |  |  |
| --- | --- | --- | --- |
| Surgery | Number of all patients | Number of patients with ‘day one post surgery’ Hb (%) | Hb results (g/L) average (range) |
| Orthopaedics | 772 | 702 (91%) | 114 (68–152) |
| Gynaecology | 343 | 205 (60%) | 112 (64–150) |
| Major gastrointestinal | 296 | 272 (92%) | 112 (68–161) |
| Cardiothoracic | 130 | 126 (97%) | 105 (71–157) |
| **Total (all surgical types)** | **1541** | **1305 (85%)** | - |

Postoperative blood loss by surgery type was recorded in 172 (11 per cent) of all cases (Table 25), although we did not ask about volume of blood loss.

Cardiothoracic surgery had the greatest number of patients with reported blood loss in the postoperative period, with 74 patients (57 per cent).

Ongoing postoperative blood loss can occur from surgical drains, or due to repeated phlebotomy during hospitalisation. Phlebotomy blood loss was not included in this data collection.

Table 25: Active blood loss postoperatively by surgery type

|  |  |  |
| --- | --- | --- |
| Surgery | Number of all patients | Number of patients with reported postoperative blood loss (%) |
| Orthopaedics | 772 | 34 (4%) |
| Gynaecology | 343 | 18 (5%) |
| Major gastrointestinal | 296 | 46 (16%) |
| Cardiothoracic | 130 | 74 (57%) |
| **Total (all surgical types)** | **1541** | **172 (11%)** |

Postoperative cell salvage was used infrequently in this audit (Table 26), with just 33 patients (2 per cent) having cell salvage in the postoperative period.

Of these patients, 20 (61 per cent) had salvaged blood returned. Of the 12 patients where cell salvaged blood was not returned, seven were due to low volume, one ‘not needed’, and for the remaining four it was reported as unknown if salvaged blood was reinfused.

It is also noted that three patients who had postoperative cell salvage returned also received a red cell transfusion (9 per cent of all cell salvage patients).

Table 26: Use of postoperative cell salvage by surgery type

|  |  |  |  |
| --- | --- | --- | --- |
| Surgery | Number of patients using cell salvage postoperatively (%) | Number of patients having cell salvage returned (%) | Volume (mL) returned average (range) |
| Orthopaedics | 31 (4%) | 19 (61%) | 338 (100–700) |
| Gynaecology | - | - | - |
| Major gastrointestinal | - | - | - |
| Cardiothoracic | 2 (2%) | 1 (50%) | 155 |
| **Total (all surgical types)** | **33 (2%)** | **20 (61%)** | - |

Ideally, preoperative preparation of patients for surgery and the use of intraoperative strategies provides sufficient reserves to assist patients deal with blood loss associated with the surgery. This could reduce the need for postoperative RBC transfusion.

Table 27 shows that the use of transfusion in both gynaecological and orthopaedic surgery was small (35 and 12 patients respectively, 3 and 5 per cent).

Transfusion was more often used in gastrointestinal and cardiothoracic surgery (46 and 23 patients, 15 and 18 per cent).

The gastrointestinal group had the largest proportion of transfusions in all stages of the operative process, pre, intra and postoperative (Table 27). Gynaecology and orthopaedic groups had the lowest transfusion rates, three and five per cent respectively.

If PBM measures did not prevent the development of severe postoperative anaemia, and transfusion is required for symptomatic anaemia, the adoption of a restrictive transfusion threshold (haemoglobin level: 70–80 g/L, depending on patient comorbidities) is recommended in most adult, clinically stable hospitalised patients (Munoz et.al. 2019).

This is consistent with Module 2, where RBC transfusion should not be dictated by a haemoglobin ‘trigger’ alone, but should be based on assessment of the patient’s clinical status.

In the absence of acute myocardial or cerebrovascular ischaemia, postoperative transfusion may be inappropriate for patients with a haemoglobin level of > 80 g/L.

In the postoperative period, 64 (55 per cent) of all transfused patients had documentation of symptomatic anaemia (Table 27).

In addition, 26 patients without documentation of symptomatic anaemia had a pretransfusion Hb lower than 80 g/L. Transfusion was possibly appropriate for these patients.

In the remaining 26 patients, a higher Hb was reported (average 88 g/L, range 81–102 g/L), with no symptoms documented. Therefore, potentially some of these transfusions may have been inappropriate based on Module 2.

Table 27: Number of postoperative red blood cell transfusions by surgery type

| Surgery | Number of patients receiving RBC transfusion post-operatively (%) | Units transfused average (range) | Hb (g/L) prior to transfusion average (range) | Number of patients with documented symptomatic anaemia (%) | Number of patients[[19]](#footnote-19) transfused post-operatively who were anaemic on the DoS (%) |
| --- | --- | --- | --- | --- | --- |
| Orthopaedics | 35 (5%) | 1.6 (1–4) | 79 (68–97) | 22 (63%) | 8/12 (67%) |
| Gynaecology | 12 (3%) | 2.0 (1–5) | 79 (64–93) | 8 (72%) | 8/11 (72%) |
| Major gastrointestinal | 46 (15%) | 1.9 (1–4) | 78 (50–131) | 23 (53%) | 24/31 (78%) |
| Cardiothoracic | 23 (18%) | 1.8 (1–5) | 76 (66–85) | 11 (48%) | 7/15 (47%) |
| **Total (all surgical types)** | **116 (7%)** | **1.8 (1–5)** | **78 (50–131)** | **64 (55%)** | **47/69 (68%)** |

Throughout the entire surgical period (pre, intra and postoperative), 135 individual patients (9 per cent of all patients) received a transfusion, some on more than one occasion (Table 28).

Considering 248 (20 per cent) patients were found to be anaemic or iron deficient at the preoperative assessment, with only 96 (8 per cent) receiving treatment and 188 (12 per cent) found to still be anaemic on DoS, the low transfusion rate probably has less to do with good perioperative management and more to do with tolerance of anaemia.

Anaemia should be identified and managed in the preoperative phase rather than tolerated. In the postoperative phase, tolerance of anaemia may be appropriate depending on the individual patient’s condition.

Table 28: Transfusion at all stages by surgery type

| Surgery type | Number of all patients | Pre op (%) | Intra op (%) | Post op (%) | Total (%) |
| --- | --- | --- | --- | --- | --- |
| Orthopaedics | 772 | 1 (< 1%) | 3 (< 1%) | 35 (4%) | 37 (5%) |
| Gynaecology | 343 | 3 (< 1%) | 3 (< 1%) | 12 (3%) | 16 (5%) |
| Major gastrointestinal | 296 | 11 (3%) | 19 (6%) | 46 (15%) | 57 (19%) |
| Cardiothoracic | 130 | 0 | 4 (3%) | 23 (18%) | 25 (19%) |
| **Total (all surgical types)** | **1541** | **15 (1%)** | **29 (2%)** | **116 (7%)** | **135 (9%)** |

Auditors reported 245 (16 per cent) patients had anaemia/iron deficiency recognised and documented in the postoperative period.

An additional 33 patients had a treatment reported for anaemia/iron deficiency despite no documentation of the same. In total, 148 patients received treatment.

The most frequent treatment (Table 29) was the use of transfusion (42 per cent). This may be appropriate if the patient was symptomatic, but may not be appropriate if used alone, without further treatment of the underlying cause of anaemia.

A number of patients received either oral or IV iron, and four patients were referred to a specialist.

Table 29: Postoperative treatment of anaemia, by surgery type

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Surgery type | Number of patients documented as anaemic and/or treated | Oral iron | Iron infusion | Transfusion | EPO | Specialist referral |
| Orthopaedics | 100 | 9 (9%) | 10 (10%) | 35 (35%) | - | 1 (1%) |
| Gynaecology | 53 | 10 (19%) | 2 (4%) | 12 (23%) | - | - |
| Major gastrointestinal | 96 | 5 (5%) | 8 (8%) | 46 (48%) | - | 2 (2%) |
| Cardiothoracic | 29 | - | - | 23 (80%) | - | 1 (3%) |
| **Total (all surgical types)** | **278** | **24 (9%)** | **20 (7%)** | **116 (42%)** | **-** | **4 (1%)** |

Only two per cent of patients were reported receiving oral iron immediately after surgery, which would be expected considering Module 2 states: ‘In patients with postoperative anaemia, early oral iron therapy is not clinically effective; its routine use in this setting is not recommended’.

The use of IV iron was slightly higher (3 per cent). The National Institute for Health and Care Excellence in the UK (NICE 2015) recommends considering IV iron after surgery for patients who have iron deficiency anaemia and those who are diagnosed with functional iron deficiency.

Clinicians may be reluctant to use IV iron in the postoperative phase due to concerns of side effects such as anaphylaxis, or infectious risks associated with iron. Newer formulations of iron have reduced the risk of allergic reactions.

Other concerns may relate to elemental iron being an essential growth factor for bacteria; however, data from meta-analyses and large observational studies showed that perioperative IV iron did not increase postoperative infection or 30-day mortality rates in surgical patients (Munoz et al. 2019).

Erythropoietin was not used by any clinicians in this audit in the pre or postoperative period. While it is noted as a practice point for preoperative patients with anaemia of chronic disease, it is not recommended in the postoperative period.

The majority of patients had a Hb available at discharge (Table 30). Of note, two patients were recorded as having very low Hb (30 and 46 g/L).

Interestingly, the patient with the Hb 30 had no Hb results recorded throughout, and no blood loss reported. For the patient with the Hb 46, the only other Hb recorded was preoperatively (Hb 146 and ferritin 60) and no blood loss intra or postoperatively was noted.

These results were lower than those reported in the patients who received transfusions and may have been errors in reporting.

Between day one post op Hb and discharge Hb, there appears to be very little difference.

On average there was a 1–3 g/L rise in Hb from day one to day of discharge, with the average Hb being 106–115g/L at discharge.

Table 30: Haemoglobin on day of discharge by surgery type

|  |  |  |  |
| --- | --- | --- | --- |
| Surgery | Number of all patients | Number of patients with Hb at discharge (%) | Hb results (g/L) average (range) |
| Orthopaedics | 772 | 697 (90%) | 112 (30–150) |
| Gynaecology | 343 | 244 (71%) | 114 (46–173) |
| Major gastrointestinal | 296 | 293 (99%) | 115 (76–170) |
| Cardiothoracic | 130 | 130 (100%) | 106 (78–161) |
| **Total (all surgical types)** | **1541** | **1364 (89%)** | **113 (30–173)** |

For all patients, those without anaemia or iron deficiency at preoperative screening appear to result in a higher average Hb at discharge than all other groups (Table 31).

Patients with anaemia at preoperative screening, whether or not resolved, had the lowest average Hb at discharge.

Numbers in some groups are small, especially those patients treated and anaemia or iron deficiency resolved, so we may not be seeing the benefits of treatment that would be expected.

Table 31: Haemoglobin on day of discharge by preoperative anaemia status

| Preoperative anaemia status | Number of patients | Hb (g/L) at discharge average (range) |
| --- | --- | --- |
| No assessment (or no pathology at assessment) | 340 | 113 (30–173) |
| Assessed (no anaemia/iron deficiency) | 779 | 116 (76–170) |
| Iron depletion (resolved) | 6 | 114 (98–121) |
| Iron depletion (not resolved) | 168 | 113 (46–157) |
| Non anaemia iron deficiency (resolved) | 9 | 112 (102–122) |
| Non anaemia iron deficiency (not resolved) | 46 | 111 (92–138) |
| Iron deficiency anaemia (resolved) | 9 | 106 (85–124) |
| Iron deficiency anaemia (not resolved) | 34 | 100 (80–159) |
| Anaemia (resolved) | 10 | 97 (84–111) |
| Anaemia (not resolved) | 140 | 99 (75–137) |

Preoperative anaemia is associated with the risk of mortality (in hospital and 30 day) and other serious adverse events (Pasricha et al. 2021).

Delaforce et al. (2020) also supports this: in surgical patients, there is an association between preoperative anaemia and adverse outcomes, including increased length of stay, risk of infection, and risk of receiving a blood transfusion.

For most surgical groups in this audit, there appears to be an increased length of stay for those patients who had no or incomplete preoperative assessment and management (Table 32). In addition, Appendix 7 shows impact of anaemia severity at time of surgery on length of stay.

This difference was small in the orthopaedic group, but more significant in the cardiothoracic and gynaecology groups.

For the gastrointestinal group, anaemia (whether treated or not) seems to be associated with an increased length of stay.

The numbers are small in some of these groups, so it is difficult to make an association with length of stay.

Table 32: Average length of stay by preoperative anaemia assessment outcome and surgical type

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Assessment | Orthopaedics | Gynaecology | Major gastrointestinal | Cardiothoracic |
| No preoperative anaemia assessment | 5.1 days n = 118 | 3.8 days n = 102 | 7.1 days n = 51 | 10.2 days n = 20 |
| Preoperative assessment – no anaemia/iron depletion/iron deficiency | 5.2 days n = 444 | 3.4 days n = 151 | 9.0 days n = 146 | 7.2 days n = 85 |
| Preoperative anaemia/ iron depletion/iron deficiency identified – treated and **not resolved** | 3.9 days n = 10 | 2.2 days n=15 | 12.6 days n = 21 | 3.0 days n=1 |
| Preoperative anaemia iron depletion/iron deficiency identified – treated and **resolved** | 4.1 days n = 9 | 2.4 days n=14 | 9.0 days n = 10 | 7.0 days n=1 |
| Preoperative anaemia iron depletion/iron deficiency identified - untreated | 5.0 days n = 191 | 2.7 days n = 61 | 11.5 days n = 68 | 9.0 days n = 23 |

Consistently across all groups, transfusion was associated with an increased average length of stay, up to twice the length of stay for those not transfused (Table 33).

Table 33: Average length of stay by surgery and transfusion

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Assessment | Orthopaedics | Gynaecology | Major gastrointestinal | Cardiothoracic | Total |
| Transfusion intra- or postoperatively | 6 day n = 37 | 5 days n = 13 | 16 days n = 49 | 14 days n = 25 | 10.25 |
| No transfusion intra- or postoperatively | 5 days n = 735 | 3 days n = 330 | 8 days n = 247 | 7 days n = 105 | 5.75 |

Table 34 shows that the majority of patients in all groups were anaemic by Module 2 definition at time of discharge.

Only small numbers had a plan for discharge that included anaemia management.

This may be because many of these patients are tolerating the anaemia and surgery has corrected the problem, that is, bleeding that was leading to their anaemia.

As per pillar 3 of PBM, in the postoperative phase, tolerance of anaemia and restrictive transfusion strategies should be in place.

However, for some patients who were not investigated properly prior to surgery, there may be another cause for their anaemia that has not been found and managed appropriately. This puts them at risk of ongoing anaemia.

Table 34: Patients anaemic at discharge and number with management plan for anaemia

| Surgery | Number of patients with Hb at discharge (%) | Number of patients anaemic at discharge | Number of patients with discharge plan including anaemia management |
| --- | --- | --- | --- |
| Orthopaedics | 697 (90%) | 553 (79%) | 26 (5%) |
| Gynaecology | 244 (71%) | 154 (63%) | 25 (16%) |
| Major gastrointestinal | 293 (99%) | 203 (69%) | 17 (8%) |
| Cardiothoracic | 130 (100%) | 116 (89%) | 2 (2%) |
| **Total (all surgical types)** | **1364 (89%)** | **1026 (75%)** | **70 (7%)** |

Table 35: Number of patients readmitted within 30 days and number who received a transfusion

|  |  |  |  |
| --- | --- | --- | --- |
| Surgery | Number of patients readmitted within 30 days | Number of patients readmitted within 30 days who had received a transfusion | Number of patients readmitted within 30 days that were anaemic on discharge |
| Orthopaedics | 22 (3%) | 3 (14%) | 19 (86%) |
| Gynaecology | 8 (2%) | 2 (25%) | 8 (100%) |
| Major gastrointestinal | 34 (11%) | 8 (24%) | 26 (76%) |
| Cardiothoracic | 10 (8%) | 3 (30%) | 9 (90%) |
| **Total (all surgical types)** | **74 (5%)** | **16 (22%)** | **62 (84%)** |

Table 35 shows the number of patients readmitted within 30 days (n = 74). The audit did not include questions about the reason for readmission. (Appendix 7 shows readmission rates based on anaemia severity at discharge).

It is interesting to note that of those readmitted, 62 (84 per cent) were anaemic on discharge. However, it is unknown if anaemia contributed to the readmission.

### Postoperative: summary

While the main focus of PBM activities in health services has generally been in the pre and intraoperative periods, there is room for improvement in the postoperative period for the management of those patients with ongoing or postoperative anaemia.

This audit indicates there is generally a tolerance of anaemia in patients, leading to low rates of transfusion. However, tolerance of anaemia should not include failing to treat the reversible causes, such as iron deficiency in the preoperative period.

In the postoperative period, there appears to be very little follow-up of patients who are anaemic or may be at risk of ongoing anaemia. Only 70 (7 per cent) of patients had any documented plan for follow-up.

This is a chance to engage with GPs to continue the management of patients who leave the health service with anaemia. However, this audit suggests this is not occurring.

Compared with the 2015 audit, there is little change in the postoperative management of patients.

Transfusion rates (11 per cent 2015; 7 per cent 2020) and use of cell salvage (3 per cent 2015; 2 per cent 2020) remain similar.

Other questions about the treatment of postoperative anaemia were not part of the 2015 audit.

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# Appendix 1: Data comparison of the 2015 and 2020 audit results

## Preoperative

| Module 2 criteria | 2015 (n = 1,142) | 2020 (n = 1,541) |
| --- | --- | --- |
| Documented as preoperatively screened\* | 1,057 (93%) | 1,250 (81%) |
| Screening included FBE | 1027(97%) | 1,198 (96%) |
| Screening included ferritin | 268 (25%) | 588 (47%) |
| Timely screening (>4 weeks prior surgery) | 335 (32%) | 498 (40%) |
| ‘Quality’ screening (timely and pathology) | 101 (9%) | 312 (20%) |
| Anaemia/iron deficiency detected: NBA Module 2 definition | 212 (20%) | 248 (20%) |
| Anaemia/iron deficiency detected: documented by health service | 117 (11%) | 96 (8%) |
| Treated for anaemia/iron deficiency for patients identified by health service: any treatment | 56 (48%) | 68 (71%) |
| Treated for anaemia/iron deficiency for patients identified by health service: red cell transfusion alone | 9 (16%) | 13 (19%) |
| Reassessment after treatment prior to surgery | 37 (66%) | 48 (71%) |
| Anaemia resolved | 5 (9%) | 15 (22%) |
| Iron depletion detected: NBA Module 2 definition | Not reported | 174 (14%) |
| Iron depletion detected: documented by health service | Not reported | 16 (1%) |
| Treated for iron depletion for patients identified by health service: any treatment | Not reported | 13 (81%) |
| Treated for iron depletion for patients identified by health service: red cell transfusion alone | Not reported | 0 (0%) |
| Reassessment after treatment prior to surgery | Not reported | 6 (46%) |
| Iron depletion resolved | Not reported | 3 (23%) |

## Intraoperative

| Module 2 criteria | 2015 (n = 1,142) | 2020 (n = 1,541) |
| --- | --- | --- |
| Blood loss documented | 359 (31%) | 575 (37%) |
| Transfused | 14 (1%) | 29 (2%) |
| Cell salvage  Received salvaged blood | 31 (3%)  25 (81%) | 52 (3%)  36 (69%) |

## Postoperative

| Module 2 criteria | 2015 (n = 1,142) | 2020 (n = 1,541) |
| --- | --- | --- |
| Transfusion | 131 (11%) | 116 (8%) |
| Cell salvage  Received salvaged blood | 40 pts (3%)  23 pts (57%) | 33 pts (2%)  20 pts (61%) |

# Appendix 2: Patient blood management information and education resources

## Blood Matters

[Blood Matters website](https://www2.health.vic.gov.au/hospitals-and-health-services/patient-care/speciality-diagnostics-therapeutics/blood-matters) <https://www2.health.vic.gov.au/hospitals-and-health-services/patient-care/speciality-diagnostics-therapeutics/blood-matters>

* What you need to know about patient blood management consumer information
* What you need to know about patient blood management consumer information – visual

## BloodSafe eLearning Australia

[BloodSafe eLearning website](https://bloodsafelearning.org.au/) **<**https://bloodsafelearning.org.au/>

* Patient Blood Management courses, in particular the ‘Perioperative’ and ‘Iron deficiency anaemia’ courses
* IV Iron administration in primary care (video)
* IDA App
* IV iron tools

## Australian Red Cross Lifeblood

[Australian Red Cross Lifeblood website](https://transfusion.com.au/transfusion_practice/patient_blood_management) <https://transfusion.com.au/transfusion\_practice/patient\_blood\_management>

* Patient blood management pack
* iTransfsue App
* Blood Component Prescribing Checklist
* Toolkit for Maternity Blood Management
* Presentations
  + Understanding iron deficiency anaemia
  + Administering iron products
  + Anaemia: iron and beyond
  + Getting anaemia right
  + Obstetric and maternal patient blood management (PBM)
  + Improving blood management in obstetrics
* [Mytransfusion website](https://mytransfusion.com.au/avoid-transfusion-1) <https://mytransfusion.com.au/avoid-transfusion-1>

## BloodSafe, SA Health

* [BloodSafe iron deficiency anaemia resources (health professionals)](https://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/clinical+resources/clinical+programs+and+practice+guidelines/blood+organ+and+tissue/blood+management/anaemia+management) <https://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/clinical+resources/clinical+programs+and+practice+guidelines/blood+organ+and+tissue/blood+management/anaemia+management>
* [Iron deficiency anaemia resources (consumers)](https://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/conditions/blood+organ+and+tissue/iron+deficiency+and+iron+therapy) <https://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/conditions/blood+organ+and+tissue/iron+deficiency+and+iron+therapy>

## The Australian and New Zealand College of Perfusionists (ANZCP):

[ANZCP website](https://anzcp.org/) <https://anzcp.org/>

* Structured course in clinical perfusion
* Autotransfusion course

# Appendix 3: Audit instructions

Access the [audit instructions on the Blood Matters website](https://www2.health.vic.gov.au/hospitals-and-health-services/patient-care/speciality-diagnostics-therapeutics/blood-matters/transfusion-audits/blood-matters-audits) <https://www2.health.vic.gov.au/hospitals-and-health-services/patient-care/speciality-diagnostics-therapeutics/blood-matters/transfusion-audits/blood-matters-audits>.

# Appendix 4: Data collection tool

Access the [data collection tool on the Blood Matters website](https://www2.health.vic.gov.au/hospitals-and-health-services/patient-care/speciality-diagnostics-therapeutics/blood-matters/transfusion-audits/blood-matters-audits) <https://www2.health.vic.gov.au/hospitals-and-health-services/patient-care/speciality-diagnostics-therapeutics/blood-matters/transfusion-audits/blood-matters-audits>.

# Appendix 5: Consolidated information for specific surgical groups on preoperative management

## Orthopaedic surgery

**Returned:** 772

**Documented screened:** 654 (85%)

The largest proportion of returned audits related to the elective orthopaedic cohort (50 per cent). This group has been a focus of a number of projects to improve preoperative management over the years, including the Australian Commission on Safety and Quality in Healthcare National Patient Blood Management Collaborative (2015-17).

The orthopaedic group has previously been a focus of audits by Blood Matters. In 2009, Blood Matters undertook an audit Patient blood management in elective orthopaedic surgery. In this audit it was found that only 20 per cent of patients had a preoperative haemoglobin available and 40 per cent of patients were transfused.

### Timing of screening

| > 4 weeks | 1–4 weeks | < 1 week | Day prior to surgery |
| --- | --- | --- | --- |
| 320 (49%) | 252 (39%) | 57 (9%) | 25 (4%) |

While 84 per cent of patients were documented as having been screened for anaemia in the preoperative period, two per cent were recorded as having no blood tests performed and four per cent had the screening performed on the day prior to surgery. This provides no opportunity to assess if anaemia is present, and if present, the cause. Without delaying surgery, further investigation or treatment is unable to proceed.

In almost half of the patients who were screened this occurred greater than 4 weeks prior to their surgery. The timing of when the preoperative assessment occurs is important as there needs to be enough time for further investigation of the cause of anaemia, as well as treatment to improve the patients’ postoperative course. Ideally this investigation and treatment will not interfere with the proposed operative date. Delaying needed surgery is not required if investigation and treatment can occur early.

### Investigations

| FBE | Ferritin | CRP | Renal function | No testing |
| --- | --- | --- | --- | --- |
| 635 (97%) | 377 (58%) | 210 (32%) | 518 (79%) | 15 (2%) |

In this audit 97 per cent of patients had an FBE taken and 79 per cent renal function tests. Ferritin was tested in 58 per cent of patients and CRP in 32 per cent. It is recommended that at least FBE and ferritin are tested at baseline. This will allow recognition of those patients who are anaemic and/or iron deficient. Where the patient is anaemic but not iron deficient then further investigation is required to determine the cause of anaemia. In some patients this will be obvious, but does not preclude the need to try and improve their haemoglobin if able.

### Screening results

| Anaemic or iron deficient by Module 2 | Health service documented as anaemic or iron deficient | Non-anaemic and having ferritin <100 mcg/L Module 2 | Patients documented or managed by health service |
| --- | --- | --- | --- |
| 97 (15%) | 25 (4%) | 111 (17%) | 4 (1%) |

Although 15 per cent of all patients were found to be anaemic or iron deficient by the Module 2 definitions, only four per cent of all patients were documented as this by the health services.

In the audit 17 per cent of patients had possible iron deficiency (Ferritin 30-100mcg/L). Without other investigations and testing such as CRP it may not be possible to determine if iron deficiency is a problem for the patient. Ferritin is an acute-phase protein, and its concentration rises in response to infection/inflammation; CRP provides an indication of acute disease (WHO) and when elevated, indicates that the ferritin may also be elevated due to inflammation and is not a true representation of iron levels.

It is important that these tests are reviewed by a clinician who can then follow up and determine the need for any further investigation or treatment and arrange for this to commence in the period prior to surgery.

## Treatment

16 patients total

| Oral iron | IV iron | Specialist referral (Haematology, GI or renal) | Red cell transfusion | Other |
| --- | --- | --- | --- | --- |
| 5 (31%) | 12 (75%) | 2 (13%) | 1 (6%) | 1 (6%) |

Percentage greater than 100 as patients may have received more than one treatment type.

There were no renal referrals or EPO.

Other included: 1 colonoscopy.

For those patients who are not anaemic, but have a low ferritin, treatment with iron prior to surgery is recommended. These patients will have a poorer response to blood loss as they do not have the required levels of iron to build new red cells as needed.

Only 16 of the 97 patients deemed anaemic or iron deficient by Module 2, were treated. Even those patients recognised by the health service as having anaemia or iron deficiency (25) were not all treated for this, only 64 per cent treated. Seventy-five per cent of the patients receiving treatment received intravenous iron. Referral to other specialists occurred for 13 per cent of patients. It is not always necessary to refer to other specialists, but treatment algorithms should indicate for which groups of patients this is necessary, to ensure appropriate referrals occur.

Red cell transfusion was used in one patient in this group. We are unable to comment on the appropriateness of this transfusion as we did not ask questions about symptoms of anaemia. Certainly, where transfusion is necessary for symptomatic anaemia, it should be used in conjunction with other more targeted therapies to treat the cause of anaemia.

## Gynaecologic surgery

**Returned:** 343

**Documented screened:** 241 (70%)

Hysterectomy is a relatively common surgical procedure among premenopausal women. Conditions that lead to the need for a hysterectomy often are accompanied by chronic blood loss that can lead to anaemia. Moreover, hysterectomy and myomectomy may result in significant blood loss, which exacerbates the anaemia. The presence of fatigue associated with anaemia has a substantially negative impact on quality of life and the ability to perform activities of daily living (Rock and Meeks, 2001).

This is a group that may benefit from preoperative blood management to improve outcomes. Due to peroperative blood loss issues, a number of these patients may already be receiving treatment, particularly with iron, to alleviate low Hb and iron levels.

### Timing of screening

| >4 weeks | 1 – 4 weeks | <1 week | Day prior to surgery |
| --- | --- | --- | --- |
| 104 (43%) | 95 (39%) | 35 (15%) | 7 (3%) |

Gynaecologic surgery made up 22 per cent of the responses in this audit with the lowest percentage of patients documented as screened (70 per cent as compared to 83-85 per cent in other surgical groups).

Only 43 per cent of the audits showed screening occurred more than 4 weeks prior to surgery, which would allow time to properly investigate and start treating any anaemia that may be present.

This group of patients may often be having surgery to treat ongoing bleeding issues and so may, in some cases, already be receiving oral iron therapy. The effectiveness of this treatment should, however, be assessed prior to surgery, of note only 36 per cent of patients had a ferritin taken as part of their preoperative screening. Where no treatment has occurred, the ongoing blood loss puts these patients at risk of iron deficiency and this should be investigated.

### Investigations

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **FBE** | **Ferritin** | **CRP** | **Renal function** | **No testing** |
| 214 (89%) | 87 (36%) | 40 (17%) | 75 (31%) | 26 (11%) |

Over 10 per cent of the patients in this group had no testing available prior to surgery. This is a missed opportunity to improve the patient haemoglobin and or iron levels prior to surgery and potentially avoid some of the problems associated with low haemoglobin and iron levels. We acknowledge that a number of these patients may have been treated outside of the health service for ongoing anaemia and iron deficiency and results may not have been available to the auditor. However, it is important that the clinical team performing the surgery have access to these results and are aware of the patient status relating to anaemia and iron deficiency.

### Screening results

|  |  |  |  |
| --- | --- | --- | --- |
| **Anaemic or iron deficient by Module 2** | **Health service documented as anaemic or iron deficient** | **Non-anaemic and having ferritin <100 mcg/L Module 2** | **Patients documented or managed by health service** |
| 56 (23%) | 25 (10%) | 34 (14%) | 10 (4%) |

Twenty-three per cent of patients in this group were found to be anaemic or iron deficient when compared to Module 2 template. This was the second largest proportion of patients who were anaemic, after the gastrointestinal group. In both groups, patients may be experiencing some degree of blood loss over a period of time and so are at greater risk of anaemia and/or iron deficiency.

In the audit 14 per cent of patients had possible iron deficiency (Ferritin 30-100mcg/L). Without other investigations and testing such as CRP it may not be possible to determine if iron deficiency is a problem for the patient. Ferritin is an acute-phase protein, and its concentration rises in response to infection/inflammation; CRP provides an indication of acute disease (WHO) and when elevated, indicates that the ferritin may also be elevated due to inflammation and is not a true representation of iron levels.

### Treatment

20 patients total

| Oral iron | IV iron | Specialist referral (Haematology, GI or renal) | Red cell transfusion | Other |
| --- | --- | --- | --- | --- |
| 7 (35%) | 12 (60%) | 0 | 2 (10%) | 0 |

Percentage greater than 100 as patients may have received more than one treatment type.

There were no renal referrals or EPO.

While less than half the patients found to be anaemic by Module 2 were documented as anaemic, by the health service, 80 per cent of those documented as anaemic by the health service were treated. This was the largest proportion in this audit.

Treatment in 60 per cent of cases was with iron infusions, with a further 35 per cent receiving oral iron. It is important to remember to test, particularly with oral iron, that the treatment has had the desired effect and iron stores have been replaced. In this audit only 30 per cent of the patients receiving treatment had pathology results that demonstrated the anaemia had been resolved prior to surgery (as defined by Module 2). Despite treatment a number of patients may still be going to surgery with suboptimal haemoglobin or iron levels.

It is unclear from this audit if all patients in this group received an appropriate trial of oral iron, but considering 60 per cent of patients were assessed with 4 weeks or less to surgery, there is the potential for this to not have the desired effect. We acknowledge some patients may be on long-term oral iron for ongoing blood loss.

Red cell transfusion was used for two patients in this group. We are unable to comment on the appropriateness of these transfusions as we did not ask questions about symptoms of anaemia. Certainly, where transfusion is necessary for symptomatic anaemia, it should be used in conjunction with other more targeted therapies to treat the cause of anaemia.

**References**

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## Major gastrointestinal surgery

**Returned:** 296

**Documented screened:** 245 (83%)

Patients in this group may have health issues that lead to blood loss or poor ability to absorb iron. These patients are good candidates for preoperative patient blood management because of these issues, but may have a short time to surgery.

### Timing of screening

| >4 weeks | 1 – 4 weeks | <1 week | Day prior to surgery |
| --- | --- | --- | --- |
| 48 (20%) | 138 (56%) | 48 (20%) | 11 (4%) |

In this group of patients, as with the cardiothoracic group, the surgery they are undergoing is often more urgent and the time from waitlist to surgery date is shorter. With this in mind, it is not surprising that only 20 per cent of patients were screened with greater than 4 weeks to surgery.

As with other surgical groups a small percentage were screened the day prior to surgery (4 per cent), a further 2 per cent had no preoperative testing performed. This allows no time to diagnose or treat any anaemia or iron deficiency the patient may have.

Working with general practitioners to address the investigation and commence treatment earlier for this group of patients is something that health services should consider.

### Investigations

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| FBE | Ferritin | CRP | Renal function | No testing |
| 241 (98%) | 83 (34%) | 62 (25%) | 189 (77%) | 4 (2%) |

While 98 per cent had an FBE, only 34 per cent had a ferritin taken. This is a group of patients who may often have an ongoing blood loss associated with their disease and are likely at risk of iron deficiency.

### Screening results

| Anaemic or iron deficient by Module 2 | Health service documented as anaemic or iron deficient | Non-anaemic and having ferritin <100 mcg/L Module 2 | Patients documented or managed by health service |
| --- | --- | --- | --- |
| 78 (32%) | 42 (17%) | 21 (9%) | 2 (1%) |

The gastrointestinal surgery group had the largest proportion of patients with anaemia either according to Module 2 (32 per cent) or health service recognised (17 per cent). Another 9 per cent of patients were found to be potentially iron deficient according to Module 2 with the health services recognising another one per cent.

**Treatment**

30 patients total

| Oral iron | IV iron | Specialist referral (Haematology, GI or renal) | Red cell transfusion | Other |
| --- | --- | --- | --- | --- |
| 3 (10%) | 20 (67%) | 10 (33%) | 10 (33%) | 0 |

Percentage greater than 100 as patients may have received more than one treatment type.

There were no renal referrals or EPO.

Again, as seen in other groups, not all patients received treatment for their anaemia or iron deficiency, 71 per cent of those recognised as anaemic or iron deficient by the health service were treated. Ten per cent of patients received oral iron. Of the surgical groups receiving oral iron as treatment, this was the smallest proportion and is probably due to the nature of illness with many patients poorly absorbing iron due to their gastrointestinal issues.

Two-thirds of patients received IV iron as part of their treatment and one-third were referred to other specialists for further investigation.

This group had the highest recorded treatment with transfusion preoperatively. We are unable to comment on the appropriateness of these transfusions, as no questions were asked regarding symptomatic anaemia. However, even when transfusion is required, it should be followed by more targeted treatment for the anaemia or iron deficiency.

## Cardiothoracic surgery

**Returned:** 130

**Documented screened:** 110 (85%)

Bleeding and transfusion in cardiac surgery are common and associated with poorer outcomes (Meesters and Heymann, 2019). Coagulopathy is recognised as a common occurrence in this group due to preoperative anticoagulant use, cardiopulmonary bypass and the effect it has on coagulation and the use of heparin during the procedure, which all contribute to the coagulopathy that may be seen. Preparing the patient for potential blood loss due to these effects is important to reduce the risk of transfusion in this group.

### Timing of screening

|  |  |  |  |
| --- | --- | --- | --- |
| **>4 weeks** | **1 – 4 weeks** | **<1 week** | **Day prior to surgery** |
| 26 (24%) | 59 (54%) | 15 (14%) | 10 (9%) |

Patients undergoing cardiothoracic surgery were the smallest proportion of audits returned. However, they were the largest proportion of those documented as screened.

Like the gastrointestinal group most patients were screened in the 1 - 4 week period prior to surgery. This is most likely because of the more urgent nature of this surgery, with less overall time from waitlist to actual surgery. However, like the gastrointestinal group there is the opportunity to work with general practitioners to ensure the anaemia assessment and any treatment is started as early as possible.

### Investigations

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **FBE** | **Ferritin** | **CRP** | **Renal function** | **No testing** |
| 108 (98%) | 41 (37%) | 31 (28%) | 98 (89%) | 1 (1%) |

Nine per cent of patients had testing the day prior to surgery, with one per cent having no testing available. This is not sufficient time to assess, investigate and treat any anaemia or iron deficiency found.

While 98 per cent of patients had a FBE, only a little over a third had ferritin taken as part of the assessment. Patients who are iron deficient, but not anaemic, will not be picked up without further testing. Ensuring patients have adequate iron stores to deal with any blood loss is important.

### Screening results

|  |  |  |  |
| --- | --- | --- | --- |
| **Anaemic or iron deficient by Module 2** | **Health service documented as anaemic or iron deficient** | **Non-anaemic and having ferritin <100 mcg/L Module 2** | **Patients documented or managed by health service** |
| 17 (15%) | 4 (3%) | 8 (7%) | 0 (0%) |

The cardiothoracic group had the smallest proportion of patients found to be anaemic (15 per cent by Module 2 and 4 per cent by the health service).

### Treatment

2 patients total

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Oral iron** | **IV iron** | **Specialist referral (Haematology, GI or renal)** | **Red cell transfusion** | **Other** |
| 0 | 1 (50%) | 1 (50%) | 0 | 0 |

Percentage greater than 100 as patients may have received more than one treatment type.

There were no renal referrals or EPO.

Only two patients were provided with treatment prior to surgery, with one patient receiving an IV iron infusion, and the other a specialist referral.

# Appendix 6: Recommendations and practice points relevant to preoperative anaemia assessment and management from PBM Module 2 – perioperative

## Patient blood management program

### Recommendation – establishment

#### R1, Grade C

Health-care services should establish a multidisciplinary, multimodal perioperative patient blood management program (Grade C). This should include preoperative optimisation of red cell mass and coagulation status; minimisation of perioperative blood loss, including meticulous attention to surgical homeostasis; and tolerance of postoperative anaemia.

### Practice point – implementation

#### PP1

To implement the above recommendations, a multimodal, multidisciplinary patient blood management system is required. All surgical patients should be evaluated as early as possible to coordinate scheduling of surgery with optimisation of the patient’s haemoglobin and iron stores.

## Anaemia and haemostasis management

### Recommendations – preoperative anaemia assessment

#### R2, Grade C

In patients undergoing cardiac surgery, preoperative anaemia should be identified, evaluated and managed to minimise RBC transfusion, which may be associated with an increased risk of morbidity, mortality, ICU length of stay and hospital length of stay (Grade C).

#### R3, Grade C

In patients undergoing noncardiac surgery, preoperative anaemia should be identified, evaluated and managed to minimise RBC transfusion, which may be associated with an increased risk of morbidity, mortality, ICU length of stay and hospital length of stay (Grade C).

### Practice points – preoperative anaemia assessment

#### PP1

To implement the above recommendations, a multimodal, multidisciplinary patient blood management program is required. All surgical patients should be evaluated as early as possible to coordinate scheduling of surgery with optimisation of the patient’s haemoglobin and iron stores.

#### PP4

All surgical patients should be evaluated as early as possible to manage and optimise haemoglobin and iron stores.

#### PP5

Elective surgery should be scheduled to allow optimisation of patients’ haemoglobin and iron stores.

### Recommendations – iron and erythropoiesis-stimulating agents

#### R4, Grade B

In surgical patients with, or at risk of, iron deficiency anaemia, preoperative oral iron therapy is recommended (Grade B). Refer to preoperative haemoglobin assessment and optimisation template for further information on the optimal dosing strategy.

#### R5, Grade A

In patients with preoperative anaemia, where an ESA is indicated, it must be combined with iron therapy (Grade A).

#### R6, Grade B

In patients with postoperative anaemia, early oral iron therapy is not clinically effective; its routine use in this setting is not recommended (Grade B).

### Practice points – iron and erythropoiesis-stimulating agents

#### PP6

Surgical patients with suboptimal iron stores (as defined by a ferritin level < 100 ug/L) in whom substantial blood loss (blood loss of a volume great enough to induce anaemia that would require therapy) is anticipated, should be treated with preoperative iron therapy. Refer to the preoperative haemoglobin assessment and optimisation template for further information on the evaluation and management of preoperative patients.

#### PP7

In patients with preoperative iron-deficiency anaemia or depleted iron stores, treatment should be with iron alone. In patients with anaemia of chronic disease (also known as anaemia of inflammation), ESAs may be indicated. Refer to the preoperative haemoglobin assessment and optimisation template for further information on the evaluation and management of preoperative patients.

## Intraoperative

### Recommendation – prevention of hypothermia

#### R12, Grade A

In patients undergoing surgery, measures to prevent hypothermia should be used (Grade A).

### Practice point – appropriate patient positioning

#### PP1

Excessive venous pressure at the site of surgery should be avoided by appropriate patient positioning, both during and after the procedure.

### Recommendation – deliberate induced hypotension

#### R13, Grade C

In patients undergoing radical prostatectomy or major joint replacement, if substantial blood loss (blood loss of a volume great enough to induce anaemia that would require therapy) is anticipated, deliberate induced hypotension (MAP 50–60 mmHg) should be considered, balancing the risk of blood loss and the preservation of vital organ perfusion (Grade C).

### Recommendation – acute normovolemic haemodilution

#### R14, Grade C

In adult patients undergoing surgery in which substantial blood loss (blood loss of a volume great enough to induce anaemia that would require therapy) is anticipated, the use of ANH should be considered (Grade C).

### Practice point – acute normovolemic haemodilution

#### PP12

ANH requires a local procedural guideline that addresses patient selection, vascular access, volume of blood withdrawn, choice of replacement fluid, blood storage and handling and timing of reinfusion.

### Recommendation – intraoperative cell salvage

#### R15, Grade C

In adult patients undergoing surgery in which substantial blood loss (blood loss of a volume great enough to induce anaemia that would require therapy) is anticipated, intraoperative cell salvage is recommended (Grade C).

### Practice point– intraoperative cell salvage

#### PP13

Intraoperative cell salvage requires a local procedural guideline that should include patient selection, use of equipment and reinfusion. All staff operating cell salvage devices should receive appropriate training, to ensure knowledge of the technique and proficiency in using it.

### Recommendation – haemostasis analysis

#### R16, Grade C

In adult patients undergoing cardiac surgery, the use of TEG should be considered (Grade C).

### Recommendations – medication (tranexamic acid)

#### R17, Grade A

In adult patients undergoing cardiac surgery, the use of intravenous tranexamic acid is recommended (Grade A).

R18, Grade B

In adult patients undergoing noncardiac surgery, if substantial blood loss (blood loss of a volume great enough to induce anaemia that would require therapy) is anticipated, the use of intravenous tranexamic acid is recommended (Grade B).

### Recommendation – medication (epsilon-aminocaproic acid)

#### R19, Grade C

In adult patients undergoing cardiac surgery, the use of intravenous epsilon-aminocaproic acid is recommended (Grade C).

## Postoperative

### Recommendation – postoperative cell salvage

#### R20, Grade C

In adult patients undergoing cardiac surgery or total knee arthroplasty, in whom significant postoperative blood loss is anticipated, postoperative cell salvage should be considered (Grade C).

# Appendix 7: Impact of anaemia severity on length of stay and readmission rates

Anaemia severity determined by WHO definitions.

**Anaemia severity at discharge and impact on readmission**

| **Anaemia severity** | **Total patients** | **Number of patients readmitted (%)** |
| --- | --- | --- |
| Non-anaemia | 338 | 12 (4%) |
| Mild | 432 | 18 (4%) |
| Moderate | 574 | 38 (7%) |
| Severe | 20 | 4 (20%) |
| No haemoglobin level available | 177 | 2 (1%) |
| **All patients** | **1541** | **74 (5%)** |

**Anaemia severity closest to day of surgery and impact on length of stay (average, range)**

| **Anaemia severity** | **Orthopaedics** | **Gynaecology** | **Major gastrointestinal** | **Cardiothoracic** |
| --- | --- | --- | --- | --- |
| Non-anaemia | 4.8 (1 – 68) | 3.0 (1 – 65) | 8.6 (1 – 540 | 7.9 (2 – 66) |
| Mild | 4.6 (2 – 11) | 3.1 (1 – 8) | 11.2 (1 – 46) | 8.5 (3 – 17) |
| Moderate | 5.3 (2 – 13) | 4.4 (1 – 9) | 12.9 (3 – 39) | 8.4 (5 – 18) |
| Severe | - | 2.0 (2 – 2) | 10.5 (3 – 14) | - |
| No haemoglobin level available | 3.9 (1 – 12) | 4.5 (1 – 62) | 7.1 (1 – 18) | 6.6 (4 – 10) |
| **All patients** | **4.7 (1 – 68)** | **3.3 (1 – 65)** | **9.5 (1 – 54)** | **8.0 (2 – 66)** |

**Haemoglobin levels (g/L) to determine anaemia severity**

| **Population** | **Non-anaemia** | **Mild** | **Moderate** | **Severe** |
| --- | --- | --- | --- | --- |
| Children 5 – 11 years | 115 or higher | 110 – 114 | 80 – 109 | Lower than 80 |
| Children 12 – 14 years | 120 or higher | 110 – 119 | 80 – 109 | Lower than 80 |
| Women 15 years and above | 120 or higher | 110 – 119 | 80 – 109 | Lower than 80 |
| Men 15 years and above | 130 or higher | 110 – 129 | 80 – 109 | Lower than 80 |

1. B12/folate should not be considered routine testing. However, they are a targeted test based on clinical symptoms or risk factors (refer to Figure 1.3, Australian Government Department of Health 2014). [↑](#footnote-ref-1)
2. This column includes only patients meeting the template definition and consequently documented and/or managed for the same by the health service. In addition, 21 patients not meeting template definitions were reported as being anaemic and/or iron deficient or being managed by the health service. Six patients were documented and/or managed with reported slightly higher haemoglobin (Hb up to 135 g/L for males, Hb up to 125 g/L for females). A further five patients were documented and/or managed, but had incomplete pathology reported so could not confirm anaemia or iron deficiency status. Another 10 patients were reported as being anaemic and/or iron deficient or being managed by the health service with no clear rationale based on data submitted. [↑](#footnote-ref-2)
3. Patients included in ‘anaemic’: anaemic only, anaemia with possible iron deficiency, anaemia with no ferritin results. [↑](#footnote-ref-3)
4. There were no renal referrals or EPO. [↑](#footnote-ref-4)
5. Percentage greater than 100 as patients may have received more than one treatment type. [↑](#footnote-ref-5)
6. Other included 1 colonoscopy. [↑](#footnote-ref-6)
7. There were no renal referrals or EPO. [↑](#footnote-ref-7)
8. Percentage greater than 100 as patients may have received more than one treatment type. [↑](#footnote-ref-8)
9. Other included 1 colonoscopy. [↑](#footnote-ref-9)
10. There was no referrals or EPO. [↑](#footnote-ref-10)
11. Percentage greater than 100 as patients may have received more than one treatment type. [↑](#footnote-ref-11)
12. There were no renal referrals or EPO [↑](#footnote-ref-12)
13. Percentage greater than 100 as patients may have received more than one treatment type. [↑](#footnote-ref-13)
14. Percentage greater than 100 as patients may have received more than one treatment type. [↑](#footnote-ref-14)
15. Percentage greater than 100 as patients may have received more than one treatment type. [↑](#footnote-ref-15)
16. 2 patients had a DoS Hb documented, 1 patient had no Hb documented on DoS [↑](#footnote-ref-16)
17. 13 patients had a DoS Hb documented, 6 patients had no Hb document on DoS [↑](#footnote-ref-17)
18. 2 patients had a DoS Hb documented, 2 patients had no Hb documented on DoS. [↑](#footnote-ref-18)
19. 47 patients receiving postoperative transfusion did not have a DoS Hb taken: 23 orthopaedics, 1 gynaecology, 15 major gastrointestinal, 8 cardiothoracic. [↑](#footnote-ref-19)