



NATIONAL BLOOD AUTHORITY
AUSTRALIA

PREOPERATIVE ANAEMIA IDENTIFICATION, ASSESSMENT AND MANAGEMENT

CASE STUDY

Guidance for Australian Health Providers

JUNE 2014



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The content obtained from this document or derivative of this work must be attributed as the Preoperative Anaemia Identification, Assessment and Management case study.

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PREOPERATIVE ANAEMIA IDENTIFICATION, ASSESSMENT AND MANAGEMENT

CASE STUDY



Acknowledgement

The NBA has commissioned the development of a suite of patient blood management (PBM) tools by various stakeholders as outlined by the PBM Guideline Implementation Strategy. The tools are intended to be used as a resource for health professionals to use in implementing the recommendations and practice points in the PBM Guidelines.

Preoperative Anaemia Identification, Assessment and Management Case Study is intended to provide ideas and clinical practice improvement methodology to implement parts of, or a comprehensive anaemia screening clinic.

Acknowledgements with thanks to

Kathryn Robinson, Haematologist and Transfusion specialist from the Australian Red Cross Blood Service

This resource was project managed by the Transfusion Practice and Education Team at the Blood Service.

Summary

A case study of preoperative iron deficiency anaemia is presented to demonstrate how a hospital has implemented anaemia management strategies outlined in the National Patient Blood Management Guidelines: Module 2 – Perioperative.¹

The pathway illustrated was developed by the hospital using clinical practice improvement methodology (CPI). Use of CPI methodology is recommended for successful implementation to suit local processes and available resources and expertise.

Whilst the case study illustrates a number of potential strategies, implementation of preoperative anaemia management may vary significantly across hospitals, between patient groups and with the urgency of the surgery.

Information on CPI methodology is provided at the end of this case study.

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> BACKGROUND

Patient blood management (PBM) is the management and preservation of a patients' own blood to reduce or avoid the need for a blood transfusion. Key components include strategies to:

- optimise the patient's own blood volume, especially red cell mass
- minimise the patient's blood loss, and
- optimise the patient's physiological tolerance of anaemia¹

The PBM guidelines: Module 2 – Perioperative (PO) recommendations and practice points are frequently referred to throughout the case study. The recommendations are based on evidence from systematic reviews and the practice points are based on consensus decision-making (where insufficient high-quality data was available). To distinguish the recommendations and practice points for the PO module the following terms have been used:

- R - Recommendation
- PP - Practice point

For example R1 refers to recommendation 1 in the Perioperative module.

Optimisation of red cell mass requires identification, assessment and management of preoperative anaemia. Preoperative anaemia is common, and independently associated with an increased risk of morbidity and mortality. Preoperative anaemia is associated with an increased likelihood of red blood cell (RBC) transfusion. RBC transfusion has been associated with increased morbidity, mortality, ICU length of stay and hospital length of stay (**R2, R3**).

The National **Patient Blood Management Guidelines: Module 2 – Perioperative**, highlight the need for preoperative anaemia assessment and management in order to optimise haemoglobin and iron stores prior to elective surgery (**R1, PP1, PP4, PP5**). A summary of the relevant recommendations and practice points are outlined in **Appendix 1**.

The guidelines also contain a **preoperative haemoglobin assessment and optimisation template (Appendix 2)** which guides practice for patients undergoing procedures in which substantial blood loss is anticipated such as cardiac surgery, major orthopaedic, vascular and general surgery. Specific details, including reference ranges and therapies, may need adaptation for local needs, expertise or patient groups.

The PBM approach requires identification of critical opportunities in the continuum of patient care where communication and coordination between different disciplines can reduce the likelihood that a patient will require an allogeneic transfusion.²

Implementation of PBM strategies is central to ensuring organisations meet the [National Safety and Quality Health Service Standard 7: Blood and Blood Products](#)³ as outlined below.

Clinical leaders and senior managers of a health service organisation implement systems to ensure the safe, appropriate, efficient and effective use of blood and blood products. Clinicians and other members of the workforce use the blood and blood product safety systems.

The standard requires that:

- Health service organisations have systems in place for the safe and appropriate prescribing and clinical use of blood and blood products,
- The clinical workforce accurately records a patient's blood and blood product transfusion history and indications for use of blood and blood products,
- Health service organisations have systems to receive, store, transport and monitor wastage of blood and blood products safely and efficiently; and
- Patients and carers are informed about the risks and benefits of using blood and blood products, and the available alternatives when a plan for treatment is developed.

The scope of Standard 7 covers all elements of safe and appropriate prescription, administration and management of blood and blood products. This includes avoiding unnecessary exposure to transfusion through appropriate patient management including the use of PBM strategies. The use of these strategies should be covered in the organisation's policies, protocols and procedures (7.1) and in communication with patients regarding treatment options and their care plan (7.9).

7.1 Developing governance systems for safe and appropriate prescription, administration and management of blood and blood products.	7.1.1 Blood and blood product policies, procedures and/or protocols are consistent with national evidence-based guidelines for pre-transfusion practices, prescribing and clinical use of blood and blood products.
	7.1.2 The use of policies, procedures and/or protocols is regularly monitored.
	7.1.3 Action is taken to increase the safety and appropriateness of prescribing and clinically using blood and blood products.
7.9 The clinical workforce informing patients and carers about blood and blood product treatment options, and the associated risks and benefits.	7.9.1 Patient information relating to blood and blood products, including risks, benefits and alternatives, is available for distribution by the clinical workforce.
	7.9.2 Plans for care that include the use of blood and blood products are developed in partnership with patients and carers.

The following case study illustrates an example of a hospital that has implemented a preoperative anaemia pathway in arthroplasty patients as one of their patient blood management (PBM) strategies. It demonstrates the systems and tools used to assist with implementation within this patient group based on available local expertise, resources and clinical champions.

Tools to assist with education and implementation are provided in [Appendix 3](#). Use of CPI methodology is recommended for successful implementation based on local processes, available expertise and resources (including access to IV iron). Existing tools can be customised to meet local needs.

References:

1. National Blood Authority. [Patient Blood Management Guidelines: Module 2 – Perioperative](#). Australia, 2012.
2. Proposed [Best Practices for a Patient Blood Management Program](#). AABB, Bethesda, MD. 2012.
3. [National Safety and Quality Health Service Standard 7: Blood and Blood Products](#)

>KEY MESSAGES

Implementing a preoperative anaemia pathway

Preoperative anaemia is an independent risk factor for morbidity and mortality, and is predictive for RBC transfusion, which is associated with increased morbidity, mortality, ICU length of stay and hospital length of stay. Identifying, evaluating and managing preoperative anaemia is a key patient blood management strategy for optimising red blood cell (RBC) mass.

The key steps include:

1. Identify

It is important that patients who are undergoing a procedure where blood loss is anticipated are identified early in the preoperative pathway and screened for iron deficiency and anaemia.

2. Screen

Patients should be investigated for anaemia (Hb <130 g/L for males and <120 g/L for females), iron deficiency (ferritin <15–30 µg/L) and suboptimal iron stores for those in whom substantial blood loss is anticipated (ferritin <100 µg/L). Iron deficiency may be present in the elderly or patients with inflammation with ferritin values up to 60–100 µg/L. Investigations should include FBC, iron studies (including serum ferritin), CRP and renal function.

3. Manage

Management of iron deficiency requires assessment of possible causes and concurrent treatment with iron therapy. Oral iron is a suitable first line therapy for most patients; however, IV iron should be considered for those in whom oral iron is contraindicated, not tolerated or effective, or if rapid iron repletion is clinically important (e.g. < 2 months to non-deferrable surgery). A gastroenterologist should be consulted regarding GI investigations and their timing in relation to surgery.

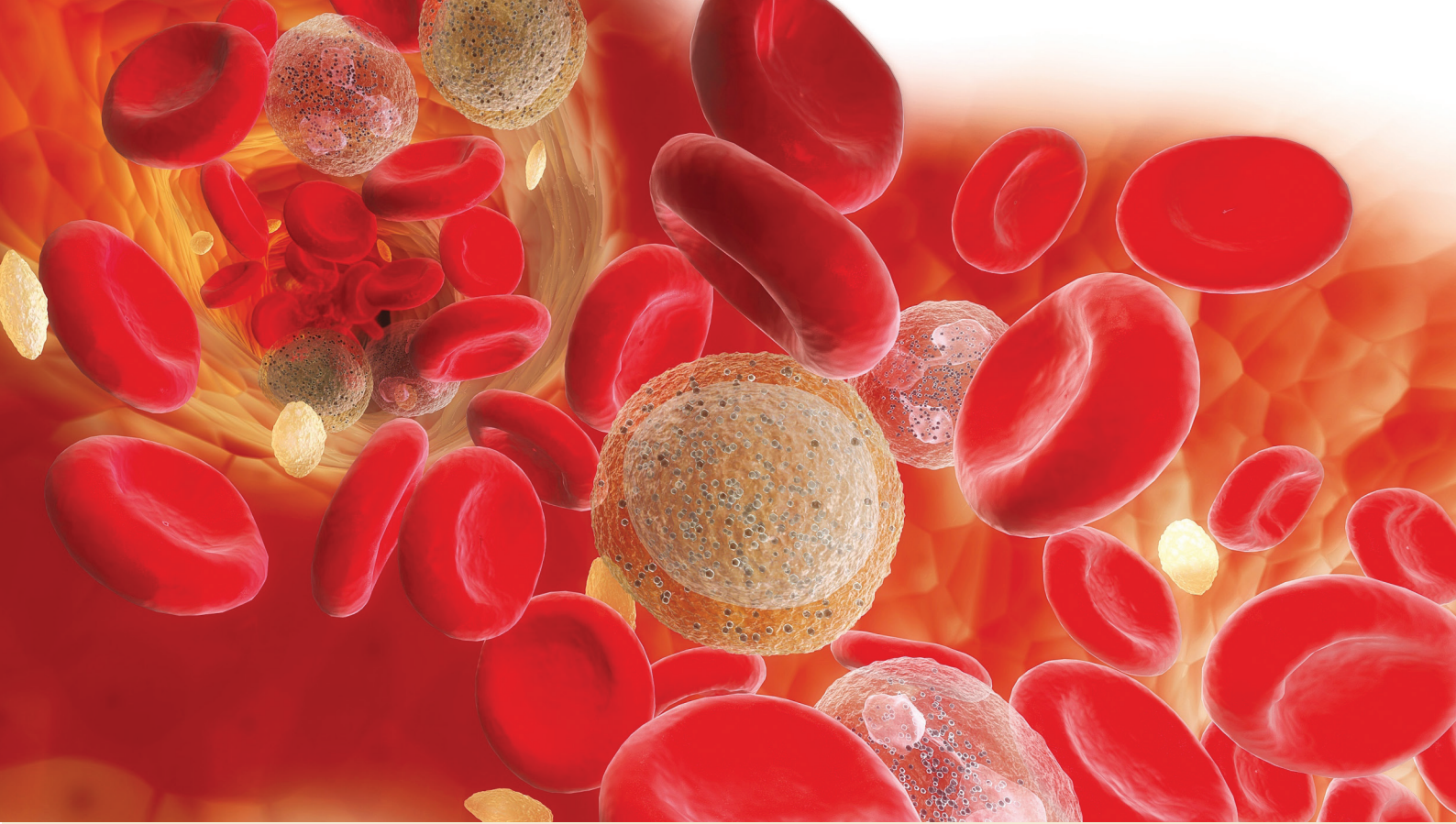
4. Communicate

Successful preoperative anaemia pathways ensure effective communication between the patient and all health care professionals involved in the timely diagnosis and management of iron deficiency, anaemia and the underlying causes.

5. Improve

Use of clinical practice improvement methodology is recommended for successful implementation of a preoperative anaemia pathway.

Refer to the preoperative haemoglobin assessment and optimisation template (Appendix 2) and resources section (Appendix 3) for further information regarding the diagnosis and management of anaemia.



>CASE STUDY

Mrs Smyth, a 63 year old widow is on the waiting list for elective right primary total knee replacement (TKR). Her mobility is significantly limited resulting in sleep disruption and inability to continue working. At the time she was first placed on the waiting list for surgery a letter was sent to Mrs Smyth and to her General Practitioner (GP) to ensure that her Hb and iron stores were assessed and optimised prior to surgery.

The patient letter included a **fact sheet** about the importance of checking for anaemia and optimising iron stores prior to surgery, as well as addressing other comorbidities. The **GP letter** outlined the required blood tests and provided a copy of the **preoperative haemoglobin assessment and optimisation template** to guide the GP in arranging treatment and referral for further investigations as required. As outlined in the letter, the GP was responsible for ordering, follow up, and management of abnormal results, including referral where required.

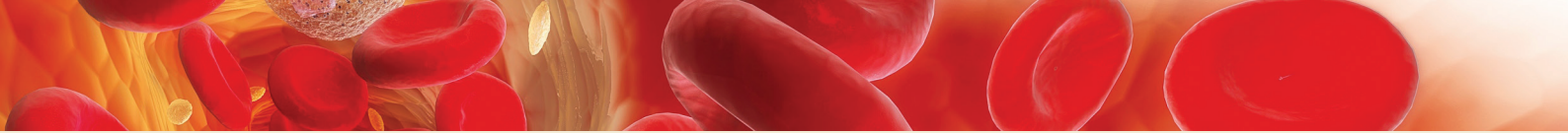
The hospital undertakes a secondary checking process to help minimise the number of patients booked for surgery without having anaemia detected and managed prior to pre-admission clinic.

The preoperative haemoglobin assessment and optimisation template advises: FBC, iron studies (including ferritin), CRP and renal function in patients undergoing major surgery in which substantial blood loss (blood loss of a volume great enough to induce anaemia that would require therapy) is anticipated.

The hospital has implemented a template letter for General Practitioners, advising them of the required preoperative investigations with a copy of the preoperative haemoglobin assessment and optimisation template.

The hospital also has a patient fact sheet – other examples include:
Blood Matters letter

Examples of PBM brochures for patients include:
WA PBM Program brochure



The GP letter requests a copy of the blood results to be sent to the hospital's arthroplasty nurse coordinator. The nurse discusses abnormal results with the haematologist over-seeing implementation of the preoperative anaemia pathway during their scheduled weekly meeting.

The weekly meeting discusses the progress of patients who have been identified as having anaemia while on the waiting list to help ensure appropriate and timely management and referral.

In this hospital, this process is greatly facilitated by the availability of a state-wide public hospital clinical information system. This system provides access to blood results (including historical results) performed by the state pathology provider (commonly used by GPs), hospital attendances (inpatient encounters, outpatient visits including haematology, gastroenterology and high risk preoperative clinic), and procedures (e.g. gastroscopy, colonoscopy).

A weekly review of the electronic waiting list is also undertaken by the arthroplasty nurse coordinator as a secondary checking process for patients who have been allocated a date for surgery. (A "**List of surgical patients who will benefit from preoperative iron/RBC assessment**" has been developed to assist with targeting waiting list reviews in other patient groups).

If anaemia remains unassessed or has not been managed at this point, the patient and/or the GP are contacted and surgery is deferred until after specialist review (usually haematology clinic). This reduces the number of patients attending pre-admission clinic with unassessed anaemia resulting in deferral just prior to surgery.

The haematologist reviews individual patients in clinic or discusses them with their GP (particularly those from rural and remote regions). Other specialists may be contacted as required, for example gastroenterology regarding timing of scopes.

> Preoperative investigation and initial management by GP

Preoperative tests had been ordered by the GP as per the **preoperative haemoglobin assessment and optimisation template**:

- Full blood count (FBC)
- Iron studies including ferritin
- CRP and renal function

Mrs Smyth's FBC result showed anaemia, with haemoglobin (Hb) below the reference range at 108 g/L. The mean corpuscular haemoglobin (MCH) and mean cell volume (MCV) were both low (having been previously normal). These results are suggestive of iron deficiency anaemia (IDA), which was confirmed by the low ferritin level of 8 µg/L. CRP and renal function were normal. Review of the weekly updated arthroplasty waiting list confirmed that she had just been allocated a date for surgery in 4 weeks time.

After reviewing Mrs Smyth's results the haematologist contacted the GP. The GP indicated that Mrs Smyth had been referred to gastroenterology outpatients to investigate the underlying cause of the IDA, and a therapeutic dose of **oral iron** (Ferrotabs) commenced. Mrs Smyth was not tolerating oral iron well and the GP was considering IM iron injections. The haematologist advised that IM iron is not recommended and suggested referral to haematology clinic for consideration of IV iron whilst trialling a lower dose of oral iron to reduce GI upset.

Preoperative tests

- Full blood count
- Iron studies including ferritin
- CRP and renal function

Ref: Preoperative haemoglobin assessment and optimisation template

Anaemia

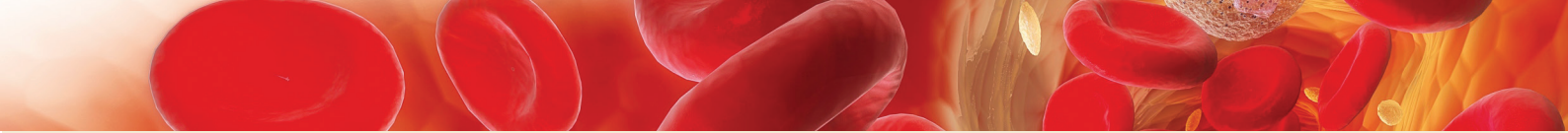
Hb < 130 g/L (male) or
Hb < 120 g/L (female)

Ref: Preoperative haemoglobin assessment and optimisation template

Iron deficiency

In an anaemic adult, a ferritin level <15-30 µg/L is diagnostic of iron deficiency

Ref: Preoperative haemoglobin assessment and optimisation template



The plan for haematology referral and need to reschedule the surgery was discussed. (R3 PP1, PP4, PP5) Mrs Smyth was sent a copy of the **Patient blood management brochure** and “**Boosting your blood with iron**” pamphlet which includes advice about reducing GI upset with oral iron. The electronic waiting list comments were updated to record that Mrs Smyth should not be booked for surgery until cleared by haematology.

Iron deficiency anaemia

Evaluate possible causes based on clinical findings

Discuss with gastroenterologist regarding GI investigations and their timing in relation to surgery

Commence iron therapy

Ref: Preoperative haemoglobin assessment and optimisation template

Iron therapy

Oral iron in divided daily doses.

Evaluate response after one month.

Provide patient information material.

Ref: Preoperative haemoglobin assessment and optimisation template

> Preoperative anaemia assessment

Mrs Smyth underwent preoperative anaemia assessment in haematology outpatients 3 weeks later. (R1, PP1)

History, examination and investigations were as follows:

Past history:

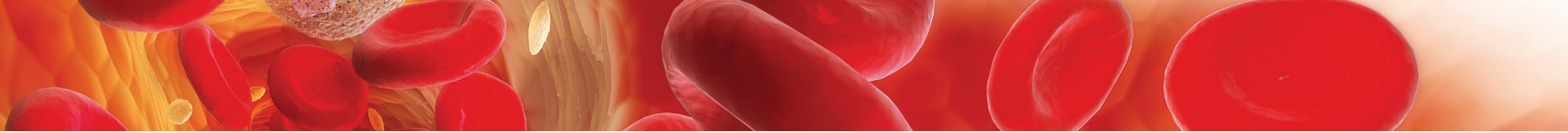
- Osteoarthritis of both knees
- Ischaemic heart disease under the care of a cardiologist – an angiogram 2 years ago showed minor disease
- Hypertension
- Dyslipidaemia
- Diabetes Mellitus type 2 – diagnosed 15 years ago and on insulin for 2 years
- Vertical banding gastroplasty without bypass loop 10 years ago for obesity
- Oesophagitis 15 years ago
- Diverticulitis on colonoscopy approximately 5 years ago
- Non-smoker (never)
- No alcohol

Family history:

- Diabetes Mellitus type 2
- No history of bowel cancer

Medications:

- Medications included opioid analgesia, low dose aspirin, proton pump inhibitor, nitrates and blood pressure medications.



Systems review:

- No overt blood loss apart from a small amount of fresh PR blood loss on the paper
- GI symptoms include intermittent constipation and occasional diarrhoea
- No prior history of blood donation
- No abnormal bleeding with surgery
- Unable to tolerate much red meat post gastropasty, but does eat small serves of mince-meat 1-2 times per week, and chicken and fish 2-3 times per week
- No chest pain or shortness of breath

Examination:

- Obese, otherwise unremarkable

Laboratory tests:

A repeat FBC was ordered to assess response to oral iron. Vitamin B12 and coeliac serology were added given the past history of gastropasty and confirmed iron deficiency.

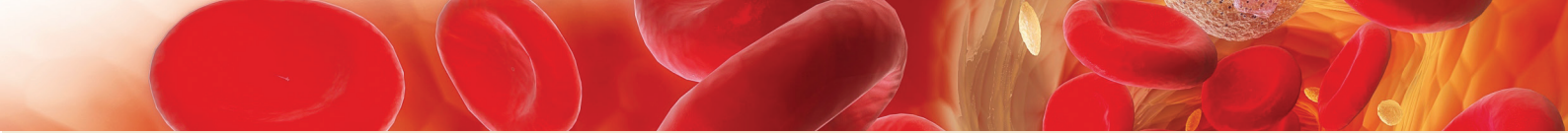
Vitamin B12 was normal and coeliac serology negative. After 3 weeks of oral iron the Hb had increased to 115 g/L. However Mrs Smyth was unable to keep taking oral iron even at a reduced dose due to nausea and diarrhoea that limited her activities and made it difficult to leave the house. Even if she had been able to continue to tolerate oral iron, at least a further 3 months of therapy would have been required to replete her iron stores prior to surgery. Added to this were factors impacting on her absorption of oral iron, such as her previous gastropasty and proton pump inhibitor medication.

> Management

Given the issues with oral iron, the risks and benefits of IV iron were discussed with Mrs Smyth. She was given the "Intravenous (IV) iron infusions" pamphlet to read. The specific risks and benefits of intravenous iron carboxymaltose (the formulation used for outpatients in this hospital) were explained, along with the procedure of administering it as a 15 minute infusion.

The benefits of IV iron in this case included rapid and complete iron repletion without the ongoing GI upset that was experienced with oral iron. Potential absorption issues would also be overcome. The risks included transient infusion related side effects such as headache and nausea, or delayed self-limited joint or muscle aches. The risk of serious allergic reactions is small, and life-threatening reactions with iron carboxymaltose are rare.

The alternatives included continuing with oral iron therapy (with the associated GI upset even at reduced doses), increasing dietary iron (which would only lead to a modest increase in ferritin at best over many months - this is important for secondary prevention but not for treatment) and IM iron which is not recommended as it is painful and can lead to permanent skin staining. Mrs Smyth decided to proceed with IV iron therapy and was asked if she had any remaining concerns or issues.



The IV iron carboxymaltose was administered as an outpatient as per the hospital protocol without any acute or delayed effects. Availability, timely access and facilities to administer IV iron preparations are important considerations in setting up preoperative anaemia pathways.

Mrs Smyth had already been referred to gastroenterology by her GP. She was assessed in gastroenterology outpatients (a few weeks after preoperative anaemia assessment clinic) and plans were made for gastroscopy and colonoscopy. These were performed preoperatively, with no bleeding source found. There was no evidence of helicobacter or coeliac disease.

It was concluded that the iron deficiency was due to the combination of low dietary iron intake due to intolerance of red meat and decreased dietary absorption post gastropasty, which may have been further reduced by proton pump inhibitor therapy.

Mrs Smyth was referred by the haematologist to the hospital's high-risk preoperative clinic for management of her comorbidities, in particular optimisation of blood sugar control prior to surgery and possible obstructive sleep apnoea.

The high risk clinic referred her for preoperative sleep studies based on a positive EPWORTH obstructive sleep apnoea (OSA) score. This confirmed obstructive sleep apnoea which was treated with continuous positive airway pressure (CPAP).

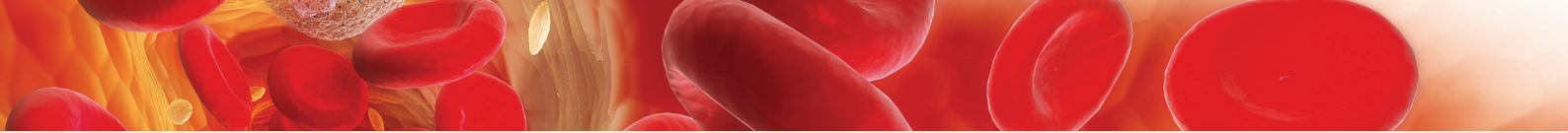
> Surgery

Mrs Smyth's surgery was rescheduled for 6 weeks after her original date. Her preoperative haemoglobin was 132 g/L and fell to 98 g/L post-surgery. Red blood cell transfusion was not required. Post-operative oral iron therapy was not required because she had preoperative IV iron repletion. However, it is also important to note that post-operative oral iron therapy is not recommended in the early postoperative period as it is not clinically effective due to poor absorption associated with the acute inflammatory response after surgery (R6).

> Follow up

Six weeks after surgery for her right TKR, Mrs Smyth's haemoglobin was 135 g/L. The haematologist advised that she should have her Hb and iron studies monitored 3 monthly for 12 months and then, based on her past gastropasty, 6 - 12 monthly after that if stable.

Mrs Smyth was referred to a dietician to assist with adequate iron intake in the future and given a brochure "**Are you getting enough iron?**" to assist with meeting her daily iron needs. It was also recommended by both the haematologist and gastroenterologist that if iron deficiency were to recur in the future, the underlying cause should be reassessed.



> Subsequent surgery

Mrs Smyth was re-entered on the waiting list to have a left TKR six months later. Her FBC and iron studies preoperatively showed a normal Hb of 125 g/L with normal red cell indices. However, her ferritin was at the lower end of the normal range at 36 µg/L (with a normal CRP). This is consistent with suboptimal preoperative iron stores, but not frank iron deficiency.

Blood loss associated with major joint replacement surgery would be likely to deplete iron stores. Iron therapy is advised in the case of suboptimal iron stores, even with a normal haemoglobin (PP6, PP7). Given her previous history of poor tolerance of oral iron and likely reduced absorption due to the past gastropasty, an IV iron infusion to top up her iron stores was arranged. A single dose of IV iron carboxymaltose was administered as a day patient prior to her second knee replacement.

Mrs Smyth's preoperative Hb was 125 g/L and it dropped to 98 g/L postoperatively, with no transfusion required. Six weeks post-surgery her Hb was 131 g/L. As per the previous surgery, she was advised to have ongoing monitoring of her Hb and iron status and follow-up if required.

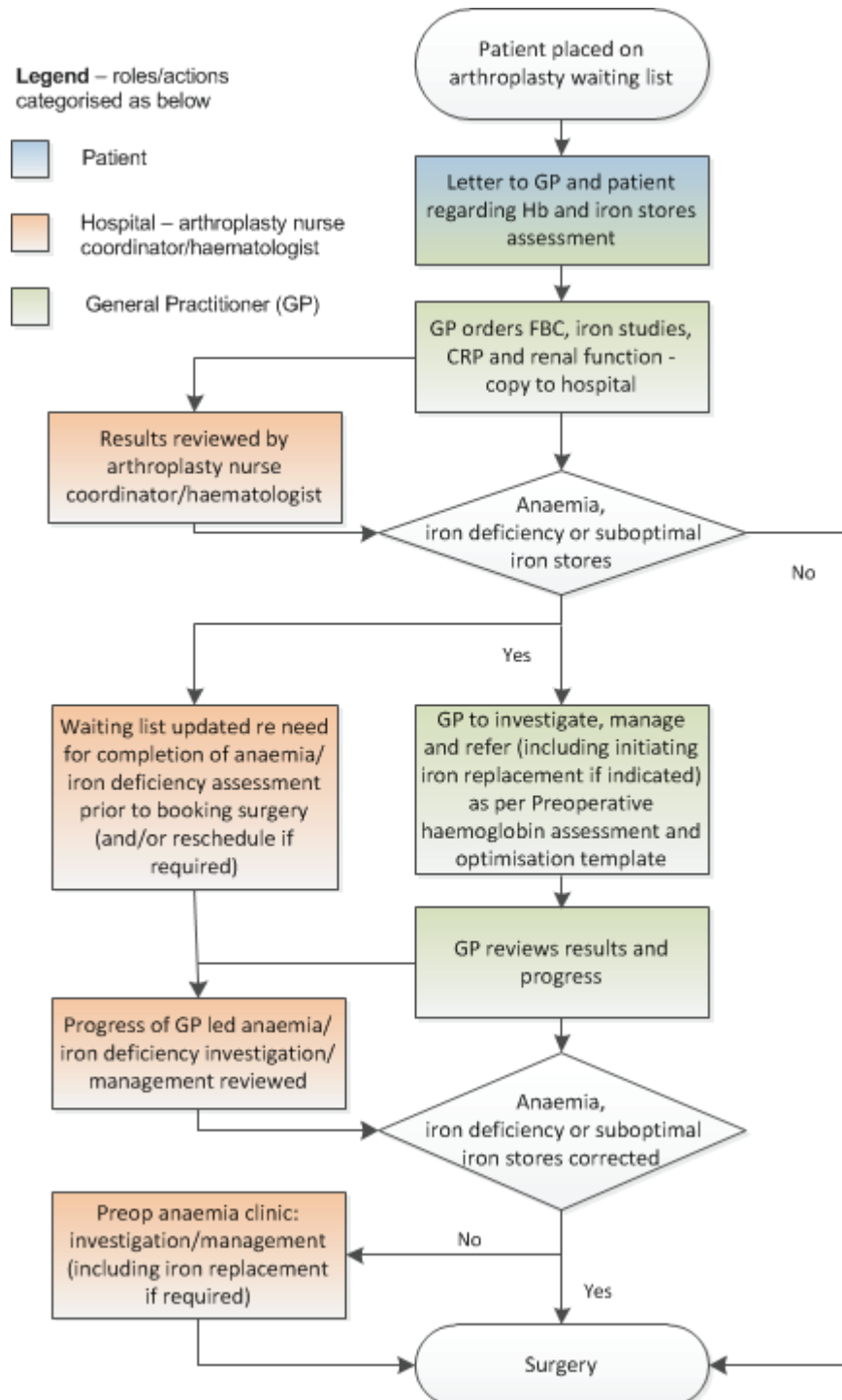
Suboptimal iron stores

1 mcg/L of ferritin is equivalent to 8–10 mg of storage iron. It will take approximately 165 mg of storage iron to reconstitute 10 g/L of Hb in a 70 kg adult.

If preoperative ferritin is <100 µg/L, blood loss resulting in a postoperative Hb drop of ≥30 g/L would deplete iron stores.

Ref: Preoperative haemoglobin assessment and optimisation template

> Example of a preoperative anaemia pathway



> Management of preoperative anaemia – considerations for organisations wanting to improve clinical practice

The case study illustrates an example of a preoperative anaemia pathway implemented in one hospital. This pathway is regularly reviewed and updated to meet changing processes and resources within the hospital. It is important to note that whilst the case study illustrates a number of potential strategies, implementation of preoperative anaemia management may vary significantly across hospitals, between patient groups and with the urgency of the surgery.

Use of clinical practice improvement methodology is recommended for successful implementation to suit local processes and available resources, clinical champions and expertise. Identifying a lead clinician or clinicians (e.g. anaesthetist, haematologist, gastroenterologist, high risk preoperative physician/anaesthetist or general physician with an interest in the area or role in the management of surgical patients) is an important starting point.

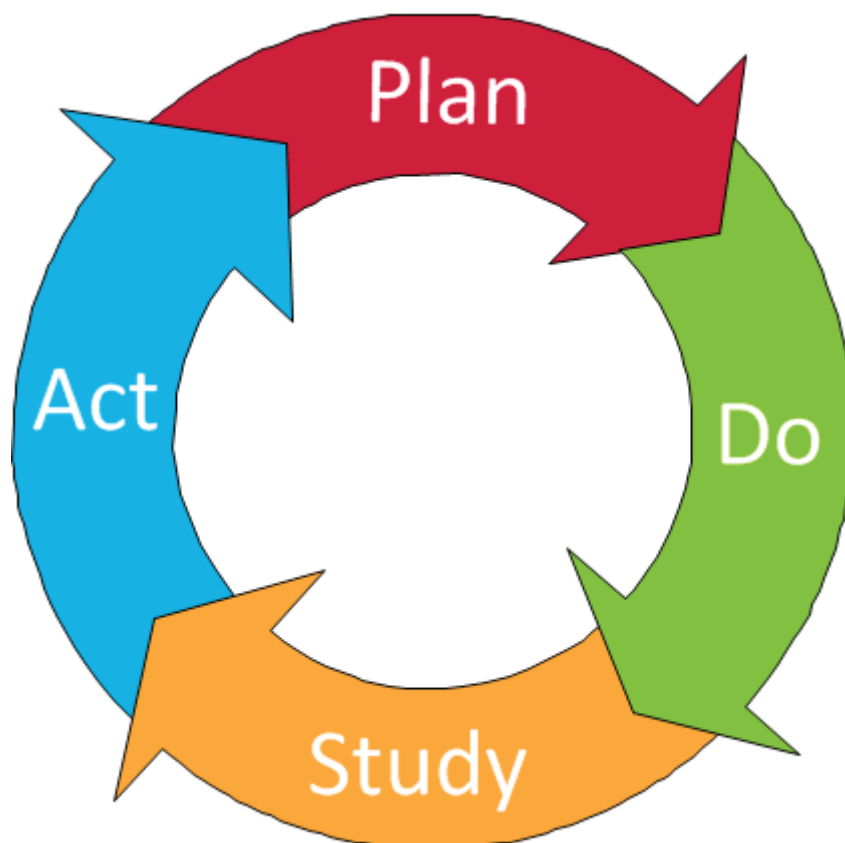
Clinical practice improvement (CPI) is the overarching name for a series of methodologies that can be undertaken to plan, implement and assess the impact of changes in the delivery of health services. Clinical practice improvement is not a one-off event but a continuing cycle of improvement activities. CPI methodology is described in detail in the [Easy Guide to Clinical Practice Improvement](#), and many organisations offer training courses that are based around the participant undertaking a project.

Key steps of the CPI process are outlined below with specific examples given for a project centred around improving the management of preoperative anaemia in arthroplasty patients:

- Form a guidance team: Gain support from relevant hospital heads including orthopaedics, anaesthetics, haematology, nursing and safety and quality.
- Collect baseline data: Undertake an audit of the frequency and current management of preoperative anaemia (20-30 patients) in arthroplasty and use linked datasets (hospital and laboratory/transfusion data) if available either locally or at a state-wide level.
- Establish a multidisciplinary project team consisting of the team leader and people with fundamental knowledge of the process, for example this could include: orthopaedic clinical nurse consultant, arthroplasty nurse coordinator, orthopaedic surgeon, orthopaedic registrar, orthopaedic resident medical officer, orthopaedic physiotherapist, high-risk peri-operative physician, anaesthetist overseeing pre-admission clinic, general practitioner (GP), GP liaison nurse, haematologist, transfusion nurse consultant and a consumer. Include a quality improvement facilitator.
- Develop an aim or mission statement that is SMART, i.e. Specific, Timely, Measurable, Appropriate, Result oriented and Time scheduled. (e.g. To increase the percentage of patients on the arthroplasty waiting list with preoperative anaemia assessed and managed prior to surgery by 75% by MM/YY)
- Diagnostic phase: Map (flow-chart) current hospital processes for arthroplasty patients peri-operatively (starting with initial referral), conduct a brainstorming session of the barriers and enablers to improvement with the project team, construct a cause and effect diagram and prioritise the causes in a Pareto chart.

- Intervention phase: Achieve consensus within the team on where to focus improvement energy. Use a plan-do-study-act (PDSA) framework for improvement cycles. Customisation of the preoperative haemoglobin assessment and optimisation template by local experts may be required to tailor it to the specific patient group and hospital resources/referral pathways.
- Impact and implementation phase: Measure the impact of changes in order to be sure the intervention has resulted in an improvement, and to provide the evidence required to justify permanent implementation of these changes. Measure the number of arthroplasty patients with anaemia assessed and managed in advance of surgery with each improvement cycle.
- Sustaining improvement phase: Mechanisms, such as standardisation of existing systems and process; documentation of associated policies, procedures, protocols and guidelines; training and education of staff; and ongoing measurement and review, need to be established to sustain the improvement.

Note: tools and resources to assist are available in [Appendix 3](#) and considerations regarding implementation are outlined in [Appendix 4](#)



Appendix 1: Recommendations and practice points relevant to preoperative anaemia assessment and management from the Patient Blood Management Guidelines: 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 haemostasis; and tolerance of postoperative anaemia.

PRACTICE POINT – implementation

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.

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 the preoperative haemoglobin assessment and optimisation template [Appendix F] 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).

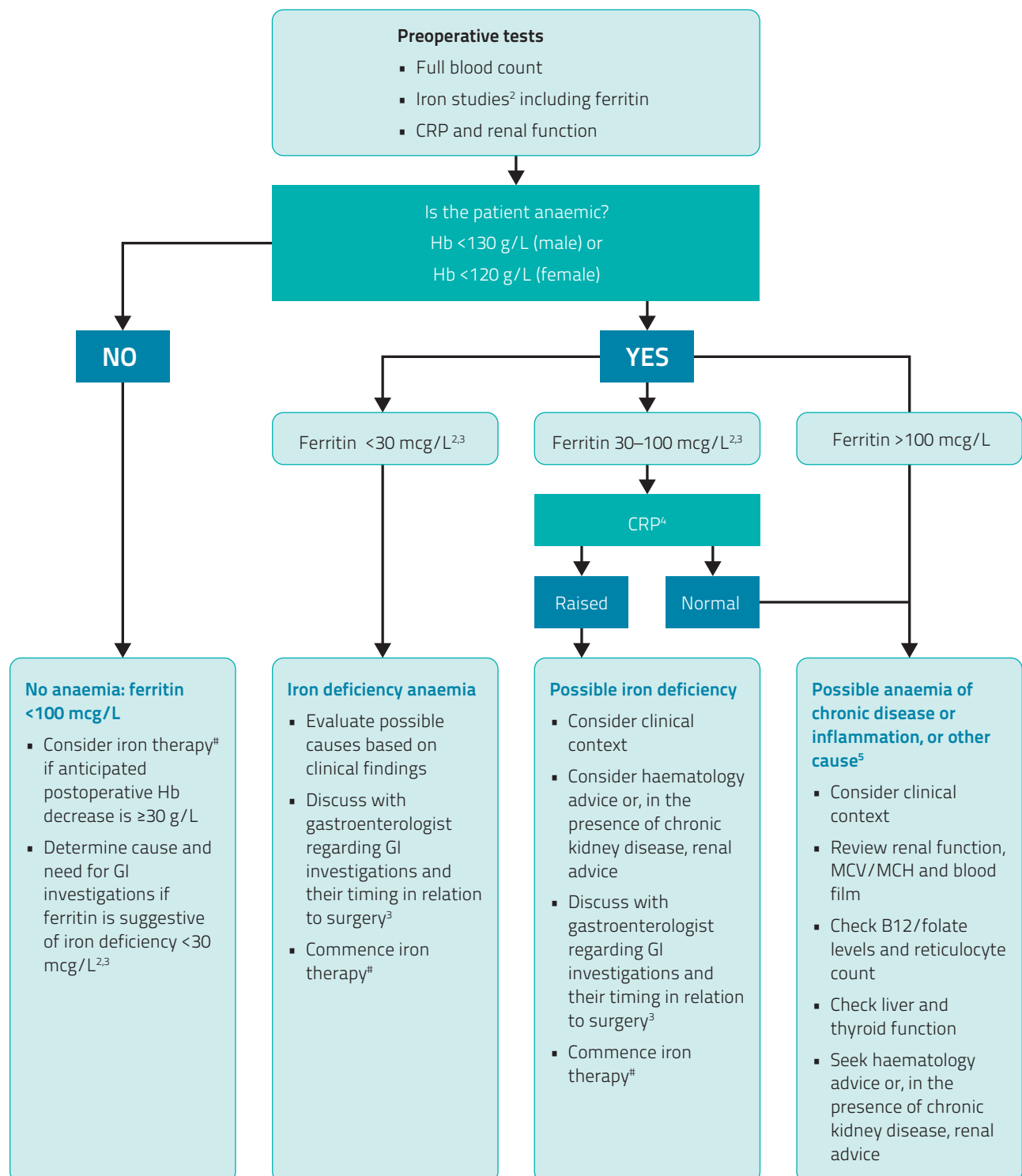
PRACTICE POINTS – iron and erythropoiesis-stimulating agents

PP6	Surgical patients with suboptimal iron stores (as defined by a ferritin level <100 µg/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 [Appendix F] 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 [Appendix F] for further information on the evaluation and management of preoperative patients.

ESA, erythropoiesis-stimulating agent

Appendix 2: Preoperative haemoglobin assessment and optimisation template

The **preoperative haemoglobin assessment and optimisation template** guides practice for patients undergoing procedures in which substantial blood loss is anticipated such as cardiac surgery, major orthopaedic, vascular and general surgery. Specific details, including reference ranges and therapies, may need adaptation for local needs, expertise or patient groups.



Iron therapy

Oral iron in divided daily doses. Evaluate response after 1 month. Provide patient information material.

IV iron if oral iron contraindicated, is not tolerated or effective; and consider if rapid iron repletion is clinically important (e.g. <2 months to non deferrable surgery).

NOTE: 1 mcg/L of ferritin is equivalent to 8–10 mg of storage iron. It will take approximately 165 mg of storage iron to reconstitute 10 g/L of Hb in a 70 kg adult. If preoperative ferritin is <100 mcg/L, blood loss resulting in a postoperative Hb drop of ≥ 30 g/L would deplete iron stores.

In patients not receiving preoperative iron therapy, if unanticipated blood loss is encountered, 150 mg IV iron per 10g/L Hb drop may be given to compensate for bleeding related iron loss (1 ml blood contains ~0.5 mg elemental iron)

Abbreviations

CRP = C-reactive protein

GI = gastrointestinal

Hb = haemoglobin

IV = intravenous

MCV = mean cell/corpuscular volume (fL)

MCH = mean cell/corpuscular haemoglobin (pg)

Available at:

http://www.blood.gov.au/sites/default/files/documents/pbm-preoperative-template_0.pptx

Footnotes:

1. Anaemia may be multifactorial, especially in the elderly or in those with chronic disease, renal impairment, nutritional deficiencies or malabsorption.
2. In an anaemic adult, a ferritin level <15 mcg/L is diagnostic of iron deficiency, and levels between 15–30 mcg/L are highly suggestive. However, ferritin is elevated in inflammation, infection, liver disease and malignancy. This can result in misleadingly elevated ferritin levels in iron-deficient patients with coexisting systemic illness. In the elderly or in patients with inflammation, iron deficiency may still be present with ferritin values up to 60–100 mcg/L.
3. Patients without a clear physiological explanation for iron deficiency (especially men and postmenopausal women) should be evaluated by gastroscopy/colonoscopy to exclude a source of GI bleeding, particularly a malignant lesion. Determine possible causes based on history and examination; initiate iron therapy; screen for coeliac disease; discuss timing of scopes with a gastroenterologist.
4. CRP may be normal in the presence of chronic disease and inflammation.
5. Consider thalassaemia if MCH or MCV is low and not explained by iron deficiency, or if long standing. Check B12/folate if macrocytic or if there are risk factors for deficiency (e.g. decreased intake or absorption), or if anaemia is unexplained. Consider blood loss or haemolysis if reticulocyte count is increased. Seek haematology advice or, in presence of chronic kidney disease, nephrology advice

For more information on the diagnosis, investigation and management of iron deficiency anaemia refer to Pasricha SR, Flecknoe-Brown SC, Allen KJ et al. Diagnosis and management of iron deficiency anaemia: a clinical update. Med J Aust, 2010, 193(9):525–532.

Disclaimer

The information above, developed by consensus, can be used as a guide. Any algorithm should always take into account the patient's history and clinical assessment, and the nature of the proposed surgical procedure.

Appendix 3: Resources

Standards and guidelines:

National Safety and Quality Health Service Standard 7: Blood and Blood Products
(www.safetyandquality.gov.au)

- Standard 7: Blood and Blood Products Safety and Quality Improvement Guide
(www.safetyandquality.gov.au)

National Blood Authority: Patient Blood Management Guidelines: Module 2 – Perioperative
(www.blood.gov.au/pbm-module-2)

- Preoperative haemoglobin assessment and optimisation template. (http://www.blood.gov.au/system/files/documents/pbm-preoperative-template_0.pptx)

Blood Matters Program, Department of Health Victoria: Perioperative patient blood management guidelines (www.health.vic.gov.au)

Clinical practice improvement (CPI)

Easy Guide to Clinical Practice Improvement (www0.health.nsw.gov.au/pubs/2002/pdf/cpi_easyguide.pdf).

Tools and template examples:

BloodSafe Iron deficiency anaemia App (iPhone, iPad, Android) (www.bloodsafelearning.org.au)

Blood Matters Program, Department of Health Victoria templates:

- Template letter – Preoperative clinic review / Anaesthetic clinic preoperative blood testing
(<http://docs.health.vic.gov.au/docs/doc/Preoperative-clinic-review--Anaesthetic-clinic-preoperative-blood-testing>)
- St Vincent's Health – Process from referral to surgery (<http://docs.health.vic.gov.au/docs/doc/St-Vincents-Health--Process-from-referral-to-surgery>)
- Austin Health - Preoperative haemoglobin optimisation in Anaesthesia Preadmission Clinic (APAC) flow chart ([http://docs.health.vic.gov.au/docs/doc/Austin-Health--Preoperative-haemoglobin-optimisation-in-Anaesthesia-Preadmission-Clinic-\(APAC\)-flow-chart](http://docs.health.vic.gov.au/docs/doc/Austin-Health--Preoperative-haemoglobin-optimisation-in-Anaesthesia-Preadmission-Clinic-(APAC)-flow-chart))

WA Department of Health Patient blood management perioperative guideline: implementation tool
(http://www.health.wa.gov.au/bloodmanagement/docs/PBM_Perioperative_Guidelines_Implementation_Tool.pdf)

WA Department of Health Preoperative anaemia in elective orthopaedic procedures
(<http://www.health.wa.gov.au/bloodmanagement/docs/Perioperative-GP-Management-Algorithm.pdf>)

Patient information:

Australian Red Cross Blood Service patient website: Iron deficiency anaemia (<http://www.mytransfusion.com.au/node/iron-deficiency-anaemia>)

BloodSafe: Iron therapy brochures for patients (oral and intravenous – available in 10 languages) (<http://www.sahealth.sa.gov.au/wps/wcm/connect/Public+Content/SA+Health+Internet/Clinical+resources/Clinical+programs/Blood+products+and+programs/BloodSafe/Anaemia+management>)

PBM education/information:

BloodSafe Patient Blood Management eLearning course (www.bloodsafelearning.org.au)

BloodSafe Perioperative eLearning course (www.bloodsafelearning.org.au)

Minck S, Robinson R, Saxon B, Spigiel T, Thomson A. Patient blood management – the GPs guide. Australian Family Physician 2013;42:291-297 (<http://www.racgp.org.au/afp/2013/may/patient-blood-management/>)

Iron deficiency anaemia education/information:

BloodSafe Iron deficiency anaemia eLearning course (www.bloodsafelearning.org.au)
 Blood Service information about Iron deficiency anaemia (www.transfusion.com.au)

Iron deficiency anaemia guidelines:

Pasricha SR, Flecknoe-Brown SC, Allen KJ, Gibson PR, McMahon LP, Olynyk JK, et al. Diagnosis and management of iron deficiency anaemia: a clinical update. MJA 2010;193:525–532. (<https://www.mja.com.au/journal/2010/193/9/diagnosis-and-management-iron-deficiency-anaemia-clinical-update>)

Gastroenterological Society of Australia. Clinical update: Iron deficiency. First edition, Sydney, Australia, Digestive Health Foundation, 2008. (<http://www.gesa.org.au/professional.asp?cid=9&id=124>)

Goddard AF, James MW, McIntyre AS, Scott BB on behalf of the British Society of Gastroenterology. Guidelines for the management of iron deficiency anaemia. Gut 2011;60:1309–1316 (<http://www.bsg.org.uk/clinical-guidelines/small-bowel-nutrition/guidelines-for-the-management-of-iron-deficiency-anaemia.html>)

Oral iron resources:

Oral iron therapy dosing chart (<http://www.sahealth.sa.gov.au/wps/wcm/connect/81d0f6804f7202a8b7aef774733d1f2b/OrallronDosingTreatmentAnaemia-BloodSafe-Oct2011.pdf?MOD=AJPERES&CACHEID=81d0f6804f7202a8b7aef774733d1f2b>)

Intravenous iron therapy resources:

Guiding principles for the development of intravenous (IV) iron infusion practice developed for Victorian health services (http://www.health.vic.gov.au/bloodmatters/management/guiding_principles_iron_infusion.htm)

Additional resources from Victorian health services:

- Intravenous iron infusions: Freemantle Hospital and Health Service (<http://docs.health.vic.gov.au/docs/doc/Intravenous-iron-infusions:-Freemantle-Hospital-and-Health-Service>)
- Ballarat Health 2010 Iron Polymaltose infusion policy (<http://docs.health.vic.gov.au/docs/doc/Iron-Polymaltose-Infusion>)
- Iron Infusion Protocol Remote Health Best Practice Group August 2006 (<http://docs.health.vic.gov.au/docs/doc/Iron-Infusion-Protocol>)
- Iron carboxymaltose Administration guidelines 2012 : Peter MacCallum Cancer centre (<http://docs.health.vic.gov.au/docs/doc/Iron-carboxymaltose-Administration-guidelines-2012:-Peter-MacCallum-Cancer-centre>)

The Queen Elizabeth Hospital IV Iron Prescribing Checklist and IV Ferric Carboxymaltose protocol (under development)

WA Health guidelines regarding intravenous iron use:

- Iron carboxymaltose (<http://www.health.wa.gov.au/bloodmanagement/docs/default.carboxy.pdf>)
- Iron sucrose (<http://www.health.wa.gov.au/bloodmanagement/docs/default.ironsucrose.pdf>)
- Iron polymaltose (<http://www.health.wa.gov.au/bloodmanagement/docs/default.poly.pdf>)

Product information for intravenous iron preparations available in Australia

- Iron carboxymaltose: **Ferinject®** (<https://www.ebs.tga.gov.au/ebs/picmi/picmirepository.nsf/PICMI?OpenForm&t=pi&q=ferinject>)
- Iron sucrose: **Venofer®** (<https://www.ebs.tga.gov.au/ebs/picmi/picmirepository.nsf/PICMI?OpenForm&t=PI&q=venofer>)
- Iron polymaltose: **Ferrum H® injection** (<https://www.ebs.tga.gov.au/ebs/picmi/picmirepository.nsf/PICMI?OpenForm&t=PI&q=ferrum%20H&r=/>)

Patient information for IV iron

Intravenous (IV) iron infusions (BloodSafe) (<http://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/clinical+resources/clinical+programs/blood+products+and+programs/bloodsafe/bloodsafe+information+for+consumers/iron+therapy>)

Appendix 4: Considerations for hospitals wanting to establish a preoperative anaemia clinic

Consideration		Tools/resources/guidance
1	Ensure hospital PBM policy is in place	<ul style="list-style-type: none"> Overarching policy supporting PBM principles including preoperative anaemia management Educational materials/presentations/resources available for staff - consider compulsory requirements e.g. BloodSafe eLearning on IDA
2	Establish a process for identification, assessment and management of preoperative anaemia based on available resources, expertise, clinical champions and relevant patient group(s)	<ul style="list-style-type: none"> Undertake a pilot project in a relevant patient group(s) where a senior lead clinician is available and supported by a nurse coordinator, nurse practitioner or other coordinator / clinician Explore any available funding options for project support or backfill of key staff Seek high level support from relevant heads of departments and establish a multidisciplinary guidance team based on the patient group(s) Use clinical practice improvement methodology to establish, implement and monitor the process (see above) Involve GPs in the process - develop referral forms/template letters for GPs highlighting their roles and responsibilities in preoperative anaemia investigation and management Involve patients in the process – template letter and fact sheet regarding GP visit to assess Hb and iron stores Establish high level support and a mechanism for elective deferrable surgery to be scheduled after identification, assessment and management of preoperative anaemia; or rescheduled if insufficient time, and a process for rapid access to assessment when required
3	Customise the preoperative haemoglobin assessment and optimisation template to suit local needs	<ul style="list-style-type: none"> Tailor to suit local hospital processes, available expertise, time to surgery and relevant patient group(s) with local expertise available for anaemia management (e.g. haematology, gastroenterology, nephrology, anaesthetics, perioperative physicians)

4	Determine roles, responsibilities and senior clinician oversight for each part of the process	<ul style="list-style-type: none"> ▪ Determine roles, responsibilities and senior clinical oversight for each part of the process including identifying training and educational needs as well as processes during leave / absences of staff involved ▪ Ensure there is a robust procedure for preoperative laboratory tests to be reviewed, followed up, actioned, documented and communicated in a timely manner
5	Establish pathways, criteria and rapid access mechanisms for review in 'preoperative anaemia clinic' (or existing specialist clinics) as well as timely access to expert advice	<ul style="list-style-type: none"> ▪ Determine the need for a dedicated 'anaemia clinic' or timely access to existing specialist clinics ▪ Seek relevant experts with an interest in anaemia / iron deficiency in specialty areas including haematology, gastroenterology and nephrology who can be contacted for advice instead of, or prior to referral ▪ Ensure specialty clinics investigating the cause of anaemia also address repletion of iron stores (if required) concurrently
6	Establish requirements for patient information materials	<ul style="list-style-type: none"> ▪ Patient blood management brochure ▪ Dietary/oral/IV iron information ▪ Risks, benefits & alternatives to RBC transfusion
7	Establish systems and procedures to ensure patient information materials are available	<ul style="list-style-type: none"> ▪ Available in clinics ▪ Available in multiple languages as required ▪ Mailed to patients ▪ Available as downloads
8	Establish pathway for access to IV iron when required	<ul style="list-style-type: none"> ▪ Review existing processes, available iron preparations and protocols, current and future capacity / facilities for day patient infusions, training requirements and mechanisms for rapid access to infusions if required ▪ Ensure GP access to advice and referral
9	Establish practice standards and performance indicators for quality assurance purposes	<ul style="list-style-type: none"> ▪ Determine key performance indicators and schedule for ongoing audit ▪ Determine reporting / Clinical governance

FOR NOTES



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