Actionable Patient Safety Solutions (APSS) #5:

Patient blood management

How to use this guide

This guide gives actions and resources for creating and sustaining safe practices for patient blood management. In it, you'll find:

Patient Safety MOVEMENT

Executive summary checklist

Patient Blood Management (PBM) is the timely application of evidence-based medical and surgical concepts designed to manage anemia. Optimize hemostasis and minimize blood loss in order to improve patient outcomes. PBM strives to return to the 'medical model' where the clinician identifies the disease first and then looks for the appropriate treatment. Errors in the use of blood components are a significant cause of hospital patient morbidity and mortality (Meybohm *et al.*, 2017).

Use this checklist to help prioritize your actions and measure your institution's progress.

Ensure accountability

- ☐ Establish a Patient Blood Management Committee and appoint an MD to be responsible and accountable for leading this group
- ☐ Prepare and deliver a monthly report to senior healthcare leadership on system-wide blood components usage
- ☐ Develop a Patient Blood Management education program for any staff involved with blood transfusions
- ☐ Constantly check the success of the Patient Blood Management program and use these results in medical staff educational sessions as a part of Continuous Quality Improvement (CQI)
- ☐ Use patient stories – in written and video form – to identify gaps and inspire change in your staff

Establish PBM protocols

- ☐ Use interdisciplinary and conservative blood management practices, including:
  - ☐ Minimize unnecessary laboratory tests
  - ☐ Minimize how often providers draw blood, as well as the amount drawn
  - ☐ Minimize discarded dead space blood volumes (the volume of blood from within a catheter that a staff discards to reach a clean blood sample)
  - ☐ Use a consistent protocol to manage platelet inhibitors (and other anticoagulants) before surgery
- ☐ Integrate proven technology for bloodwork to improve patient care, such as:
  - ☐ Continuous, non-invasive hemoglobin monitoring
  - ☐ Dynamic volume assessments to determine plasma volume
  - ☐ Red cell recovery technology in the operating room
- ☐ Before surgery, providers should test for and treat anemia in a patient when possible, including checking patient hemoglobin levels to identify who may need a blood transfusion
- ☐ Set a single unit transfusion policy for non-bleeding patients who need a transfusion and advocate for more restrictive transfusion practices
- ☐ Record hemoglobin levels before and after each blood transfusion
- ☐ Minimize transfusion with proper anemia treatment tailored to the cause of the anemia
- ☐ (such as intravenous iron or erythropoietin stimulating agents (ESAs)

What is patient blood management?

Patient Blood Management (PBM) is the use of properly timed, evidence-based practices when managing anemia in patients. The causes of anemia include blood loss, problems with red blood cell formation, and malnutrition.

While healthcare providers normally use blood transfusions to treat anemia, these often don't treat the underlying cause and introduce risk of error each time a patient receives a transfusion. Errors in the use of blood components are a significant cause of hospital patient harm and death (Meybohm *et al.*, 2017).

To lower this risk for patients, healthcare institutions should:

- Find the cause of anemia in a patient and use the proper treatment
- Improve practices to reach hemostasis (stop patient bleeding)

These will lower the need for transfusions, the risks of errors they present, and the preventable patient deaths connected to this issue.

What we know about patient blood management

Anemia is a worldwide problem

The usual symptoms of anemia include feeling weak, tired, and having problems concentrating. Healthcare providers often overlook or ignore anemia since these symptoms are vague and a part of daily life for many people.

However, anemia is the most common blood disorder worldwide, affecting around 1 in 3 people across the globe (Kassebaum *et al.*, 2014). This is especially true for women of childbearing age – around 500 million women worldwide in this group have anemia (Friedman *et al.*, 2012).

Patients in both developing countries and the industrialized world experience anemia and it's the source for 68.3 million years lived with disability (YLD) and 8.8% of all ailments worldwide (McLean *et al.*, 2009). Being a worldwide epidemic with significant consequences (Kassebaum *et al.*, 2014), anemia requires prompt evaluation and treatment (Meybohm *et al.*, 2017).

Anemia increases surgery risks

Recent studies show that anemia can have a serious impact on surgical outcomes making it an independent risk factor for patients. Musallam and colleagues looked back at data including 227,425 patients undergoing any kind of non-cardiac surgery:

- Non-anemic patients had a 30-day mortality rate of **0.78%** (over 158,000 patients)
- In contrast, patients with only mild anemia (Hb level of 10-13 g/dL in men and 10-12 g/dL in women) had a mortality rate **4.5 times higher than non-anemic patients** (3.52% in over 57,000 patients)
- When patients were severely anemic (Hb level below 10 g/dL) their 30-day mortality rate increased to **13 times more than non-anemic patients** (more than 11,000 patients). (Musallam *et al.*, 2011)

A separate study looked at medical reports of more than 39,000 patients confirming the association between mild anemia and increased death (+20% in multivariate models), longer

stays at hospitals, and a greater need for intensive care (Baron *et al.*, 2014). Longer hospital stays are associated with greater cost and greater risk for other healthcare-associated conditions like falls and healthcare-associated infections (HAIs).

The risks of blood transfusions

Healthcare providers often give red blood cell (RBC) transfusions to patients with anemia to raise their oxygen carrying capacity. Yet many RBC transfusions are overused and may cause undue risk or harm. The Institute of Medicine (IOM) defines overuse as "in circumstances where the likelihood of benefit is negligible or zero, and therefore the patient is exposed to the risk of harm". Often, healthcare institutions aren't aware of the serious impact this overuse has on safety of patients or the resource savings of avoiding RBC overuse.

1 in 10 in-patients receive at least 1 unit of blood, making RBC transfusion one of the most common procedures for hospitals in the U.S. and Europe (Cost *et al.*, 2009). However, laboratory hemoglobin values, a primary indicator for RBC transfusions, are only checked on occasion and often delayed – leading to transfusion decisions without knowing if they will help (Frank, er al., 2012). If a patient has their blood drawn too often for lab tests, it can even lead to anemia or make it worse (Ranasinghe and Freeman, 2014; Salisbury *et al.*, 2011).

The evidence for PBM

The PBM was officially established under the Wolff Center in 2013. Over the past 5 years, their PBM strategy has resulted in significant blood and blood product procurement and services cost reductions ($10M), while increasing patient safety (Patient Safety Movement Award 2015). The University of Pittsburg Medical Center (UPMC) PBM program is nationally and internationally recognized as a model of excellence in blood management. (**Figure 1**)

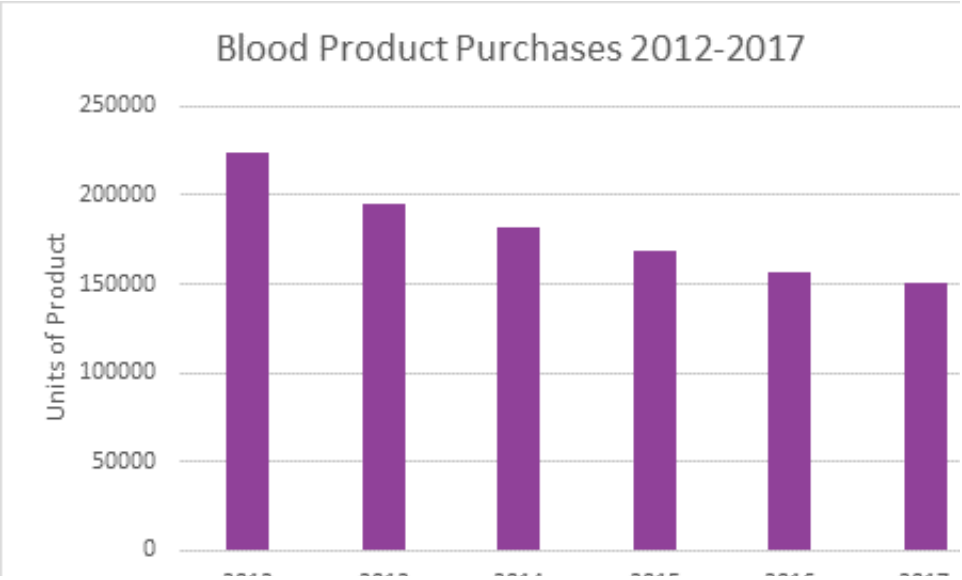

Figure 1: The reduction in blood product used over the last 5 years at the Wolff Center, which reduced costs by $10M by implementing the 6-point strategy for PBM

The largest multicenter trial (almost 130,000 patients) in the world shows that integrating PBM greatly reduces the amount of transfused blood, costs, and kidney damage. Overall, the implementation of PBM is safe and effective (Meybohm *et al.*, 2016).

Technology to support laboratory hemoglobin measurements, such as noninvasive and continuous hemoglobin monitoring, can give clinicians more real-time trending information to

determine if hemoglobin values are changing, which permits clinicians to make more informed and early RBC transfusion decisions.

Hospitals with robust PBM programs commit, not only to reduce transfusion as a safety measure, but also to recognize and incorporate the diagnosis and proper treatment of anemia. A careful assessment of the patient's condition includes finding the cause of their anemia and should direct the clinician to employ the best and safest intervention.

Research shows that fewer RBC transfusions through process changes and using technology can save the U.S. healthcare system more than **$5 billion per year**, while greatly improving quality and safety (Masimo Corp, 2012). Healthcare institutions must commit to action with specific leadership, action, and technology plans to close their performance gap on this issue.

Leadership plan

Hospital governance, senior administrative leadership, clinical leadership, and safety/risk management leadership need to work collaboratively to increase awareness of anemia and minimize its risks (Meybohm *et al.*, 2017; Shander, Isbister, and Gombotz, 2016; Moskowitz et al., 2010; Leahy et al., 2014; Theusinger et al., 2014; Freedman, 2014; Oliver, Griffin, Hannon, and Marques,2014):

- Hospital governance, senior administrative leadership, and clinical/safety leadership should close their institution's performance gap with a plan that includes:
  - A comprehensive approach
  - A timeline with defined deliverables to implement the plan
  - Measurable quality indicators
- Governance boards and senior administrative leaders should evaluate and approve the resources needed for the plan
- Clinical/safety leadership should endorse the plan and drive implementation across all providers and systems
- Include changes in the plan outlined in the National Quality Forum (NQF) safe practices, including awareness, accountability, ability, and action (National Quality Forum, 2010)
- Identify a physician champion for the PBM program who is a thought leader within the organization to help drive change among providers
- Utilize patient stories – in written and video form – to identify gaps and inspire change in your staff

Action plan

Ensure accountability

- Establish a PBM Committee and appoint a leader to be responsible and accountable for its actions. This committee and leader should:
  - Communicate early with key stakeholders
  - Set up a complete plan for anemia management
  - Set measurable goals and outcomes for individuals and departments
- Develop a broad education program that targets healthcare staff and focuses on the PBM program's goals, structure, and scope:
  - Consider an online course and "Patient Blood Management certificate"

Create PBM protocols

- Cooperate with all stakeholders to set guidelines, checklists, SOP's, and transfusion thresholds for anemia therapy
- Use proactive review instead of the more common retroactive review
- Establish both out-patient and in-patient systems to address anemia
- Set protocols for lab work that incorporate (Goodnough and Shander, 2013):
  - Fewer unneeded blood tests
  - Fewer blood samples taken
  - Reducing wasted dead space blood volumes
  - Using closed arterial blood sampling systems, when appropriate
  - Consulting blood conservation specialists early for patients with worsening health or complications
- Set protocols for transfusions:
  - Advocate for more restrictive transfusion practices
  - Check for and maintain normal blood volume (normovolemia) before restricting transfusion
  - Set a protocol for RBC transfusion decision-making
  - Set a single unit transfusion policy
  - Use the Mercuriali algorithm to calculate RBC deficit
  - Consider alternative therapies to RBC transfusions such as intravenous iron and erythropoietin stimulating agents (ESAs)
  - Set a stricter limit on the hemoglobin level needed for a transfusion
  - Consider both the change in a patient's hemoglobin level from their baseline, as well as their current level, as indicators for transfusion
  - Use hemoglobin monitoring and NIRS tissue oxygen monitoring technologies to augment lab tests
  - Make transfusion decisions based on signs and symptoms, in addition to hemoglobin level and NIRS tissue oxygen values
- Set protocols for surgery patients:
  - Test and treat all patients for anemia surgery, allowing enough lead time for treatment
  - Promptly assess anemia during and after surgery
  - Before surgery, test for problems with blood coagulation and manage platelet inhibitors and other anticoagulants
  - Use minimally invasive surgical techniques
  - Use surgical techniques to minimize bleeding including use of electrocoagulation, bipolar, and argon beam
  - Consider acute normovolemic hemodilution (minimize blood loss by removing blood before surgery and replacing it afterward)
  - Many blood sparing techniques exist for cardiac surgery, such as minimized extracorporeal circuits, retrograde autologous priming, modified ultrafiltration, blood cardioplegia, and meticulous hemostasis in saphenous vein graft removal
- Consider other techniques to minimize blood loss such as:
  - Vasoconstrictors, topical coagulation agents, and tourniquets

- Controlled hypotension
- Blood salvage technologies
- Basic conditions for hemostasis
- Reversal of anticoagulants
- Point-of-care diagnostics in coagulopathic patients
- Optimized coagulation management with the use of clotting factor concentrates
- Antifibrinolytic agents or desmopressin
- Basic conditions for hemostasis, reversal of anticoagulants, point-of-care diagnostics in coagulopathic patients, optimized coagulation management with the use of clotting factor concentrates, and the use of antifibrinolytic agents or desmopressin are further important considerations

- Create protocols for hemorrhage identification and control:
  - Identify patients at risk for development of hemorrhage (OB)A massive and have a hemorrhage protocol in place
  - Where needed, massive hemorrhage protocols should be extended by specific algorithms for different subgroups of high-risk patients, such as postpartum and trauma (**Figure 2**)

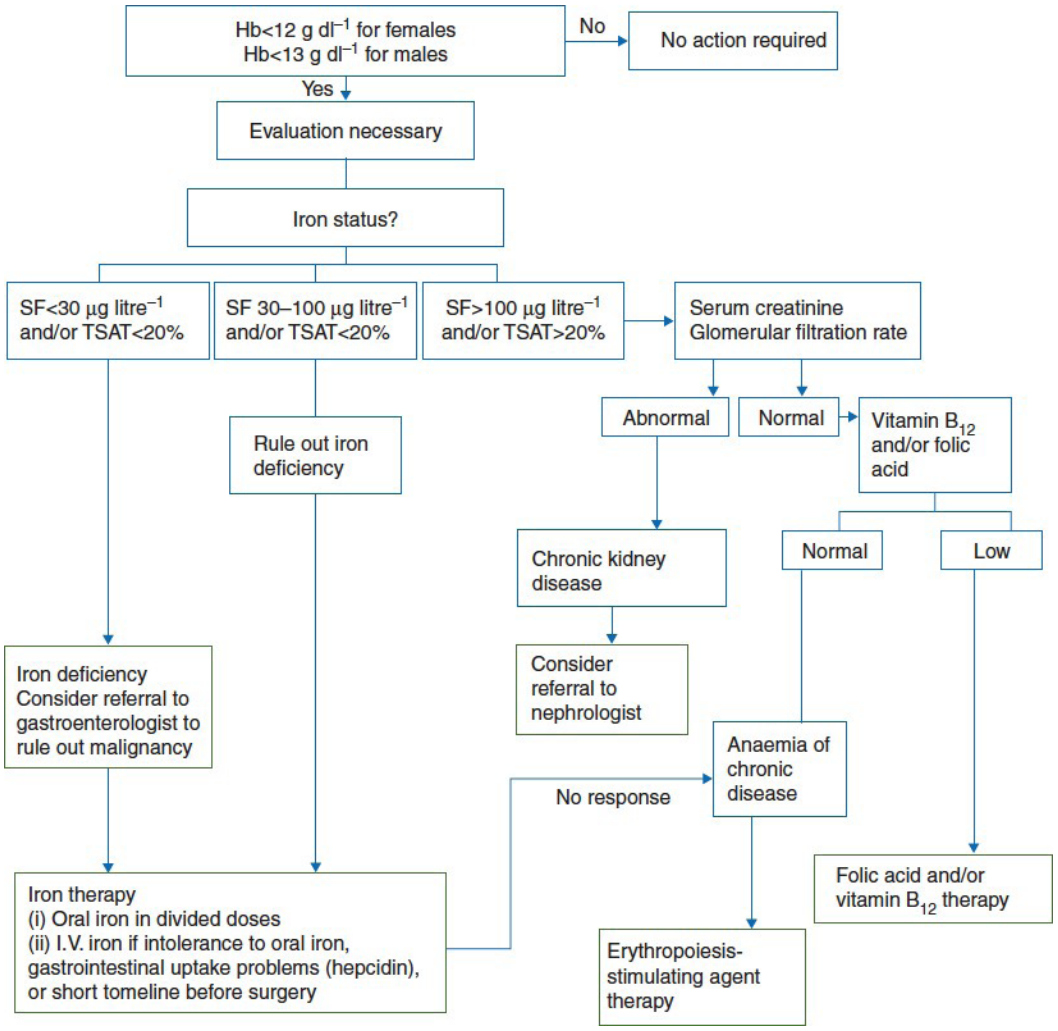

Figure 2: Preoperative anemia management workup algorithm (Goodnough *et al.*, 2011) to optimize coagulation and reduce bleeding

Technology plan

These suggested practices and technologies have shown proven benefit or, in some cases, are the only known technologies for certain tasks. If you know of other options not listed here, please complete the form for the PSMF Technology Vetting Workgroup to consider: **http://patient.sm/dgQogJ**

System or Practice	Available technology
ONC Meaningful Use Certified EHR system Electronic Health Record (EHR) System with the following capabilities: • Computerized Provider Order Entry (CPOE) • Drug-drug interaction check • Drug-allergy interaction check • Clinical Decision Support tools (CDS)	• For example, if a physician is planning on putting an order in for blood product, instead of filling the order immediately, the EHR can have it "ON RESERVE". This prevents product being unused and wasted.
Leverage the electronic health record (EHR) to provide real-time decision support for all blood and blood product orders, based on evidence-based transfusion rationale	• Decision support iForms
Noninvasive and continuous hemoglobin monitoring	
Cell recovery technology in the operating room	
Point of care coagulation testing	
Smaller blood test tube volumes	
Reducing priming volume of extracorporeal circuits	
Closed blood sampling systems for arterial and central venous lines	
An IT structure for benchmarking	

Measuring outcomes

Key performance indicators

Anemia and transfusion management:

For patients with untreated and treated preoperative anemia, find:

- Rate of transfusion (Number of preoperative patients with anemia who receive a transfusion per total number of preoperative patients with anemia)
- Adverse events (AE)
- Patient deaths

per 1,000 patients who undergo elective surgery

Outcome measure formula:

Establish Baseline Harm using:

Numerator: the number of patient deaths with untreated and treated preoperative anemia (you may keep these numbers separate or combine for this measure)

Denominator: Total number of anemic patients undergoing elective surgery

Metric recommendations

Direct Impact:

All patients undergoing elective surgery

Lives Spared Harm:

Lives Spared Harm = (Adverse Events $_{baseline}$ *– Adverse Events* $_{measurement}$*) X Elective Anemic Surgery Patients* $_{measurement}$

Lives Saved:

Lives Saved = (Mortality Rate $_{baseline}$ *– Mortality Rate* $_{measurement}$*) X Elective Anemic Surgery Patients* $_{measurement}$

Notes

The table below contains the levels WHO uses to define anemia (WHO, 2011):

Table 1

Haemoglobin levels to diagnose anaemia at sea level (g/l)±

Population	Non -Anaemia*	Anaemia*		
		Mild[a]	Moderate	Severe
Children 6 - 59 months of age	110 or higher	100-109	70-99	lower than 70
Children 5 - 11 years of age	115 or higher	110-114	80-109	lower than 80
Children 12 - 14 years of age	120 or higher	110-119	80-109	lower than 80
Non-pregnant women (15 years of age and above)	120 or higher	110-119	80-109	lower than 80
Pregnant women	110 or higher	100-109	70-99	lower than 70
Men (15 years of age and above)	130 or higher	110-129	80-109	lower than 80

± Adapted from references 5 and 6

* Haemoglobin in grams per litre

a "Mild" is a misnomer: iron deficiency is already advanced by the time anaemia is detected. The deficiency has consequences even when no anaemia is clinically apparent.

Data collection

Data sources may include electronic billing data, data through manual chart review, or a hybrid method of chart review and electronic billing data.

Settings:
All in-patients (≥ 18 years) undergoing a surgical procedure and with at least one overnight stay

Mortality:
This will be calculated by the Patient Safety Movement Foundation

Conflicts of interest disclosure

The Patient Safety Movement Foundation partners with as many stakeholders as possible to focus on how to address patient safety challenges. The recommendations in the APSS are developed by workgroups that may include patient safety experts, healthcare technology professionals, hospital leaders, patient advocates, and medical technology industry volunteers. Some of the APSSs recommend technologies that are offered by companies involved in the Patient Safety Movement Foundation. The workgroups have concluded, based on available evidence, that these technologies work to address APSS patient safety issues. Workgroup members are required to disclose any potential conflicts of interest.

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