



ANEMIA PREVENTION AND MANAGEMENT PROGRAM IMPLEMENTATION GUIDE

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Section I: Introduction

It is estimated that nearly one-third of the world's population suffers from anemia. The prevalence in North America is even higher, approaching 40 percent. The dominant etiologies vary from region to region. Infectious diseases are most common in sub-Saharan Africa, hematologic disorders lead the list in Europe and nutrition deficits are also common. Across the globe, iron deficiency is the most common cause.¹

The prevalence of anemia in hospitalized patients ranges from what is normally seen in the general population to much higher numbers, depending on the reason for admission, comorbidities and patient factors such as age and gender. The reported prevalence is at least 25-50 percent and may be substantially higher, with elderly patients and those with chronic conditions (e.g., chronic kidney or heart failure) at increased risk.²⁻⁴

Anemia in hospitalized patients has been accepted as an “innocent bystander.”⁵ However, anemia is an independent risk factor for a handful of unfavorable outcomes, including increased risk of hospitalization or readmission, prolonged hospital length of stay (LOS), loss of function, diminished quality of life and increased risk of morbidity and mortality.^{3,6,7} Additionally, while anemia can be caused or exacerbated by a number of chronic conditions, it can also exacerbate the underlying chronic condition in a positive feedback loop that further increases patients' negative outcomes.⁸ Finally, anemia is a leading (yet modifiable) risk factor for allogeneic blood transfusion^{9,10} and the evidence of the harmful effects of unwarranted allogeneic blood is indisputable.⁶

Anemia in hospitalized patients is a dynamic condition that evolves in both character and severity. As LOS increases, more initially non-anemic patients develop hospital-acquired anemia (HAA), while anemia in those who had it at admission continues to worsen.¹¹ In a study of more than 180,000 non-anemic patients admitted to 10 U.S. hospitals, three-fourths developed HAA, which is associated with an increased risk of death, LOS and resource utilization.¹² HAA may even be more harmful than pre-existing anemia. An analysis of data from more than 3,700 patients hospitalized with heart failure indicated that anemia at discharge, not at admission, was independently associated with increased all-cause mortality.¹³ Moreover, the prevalence of anemia and iron deficiency may continue to rise in the months following discharge from the hospital,^{1,2,14} and iron deficiency anemia can easily be overlooked or ignored in follow-up visits.¹⁵ Unfortunately, ignoring anemia does little to treat it or prevent it from harming patients and often results in transfusion with added risks and cost.

As stated above, anemia is often ignored or inappropriately treated with transfusion but it can be treated effectively; it is a modifiable and preventable risk factor.³ Early detection and treatment can reduce or eliminate anemia-related risks.¹⁶ Strategies span a wide array of approaches, including various hematinics, management of underlying causes and preventive measures, such as minimization of blood loss,¹⁷ which could be something as conspicuous as surgical hemorrhage, or something as seemingly mundane as unnecessary phlebotomy.¹⁸ While some evidence suggests the potential impact of broad anemia management strategies in the inpatient setting, more is known about the advantages of restrictive transfusion practices, which have been successfully implemented in real-world settings.

This *Guide* is intended to improve patient outcomes by providing a framework for hospital-based anemia management quality improvement projects. It will review each step of the process from forming a multidisciplinary team, obtaining institutional support, assessing baseline performance and defining key metrics, to implementing changes and monitoring their effects, with a focus on blood transfusion best practices. Such projects can be expected to improve patient outcomes, improve the utilization of scarce resources (such as allogeneic blood), and decrease transfusion-related adverse events, enabling hospitals to provide a better quality of care at a lower cost. In today's competitive healthcare environment, these are quality gains and cost savings that hospitals cannot afford to miss.



Section II: How to Implement and Sustain an Anemia Quality Improvement Project at Your Hospital

Step 1: Form an Interdisciplinary Team with a Common Goal

1.1 Quality Improvement Team

The first step on the journey toward improved anemia prevention and management is assembling an interdisciplinary team that has the appropriate representation. Defining the stakeholders and getting the right people on the team is critical to any successful quality improvement (QI) initiative. Thinking about who has a stake in anemia prevention and management and putting them in the following buckets can be a helpful way to start.

1. *Which people or departments play an active role in current or future workflows?*

This is likely to include nurses and physicians from multiple areas who currently prescribe or administer blood and/or manage anemia. The blood bank, of course, also has a role, but there may be other departments to engage, depending on the specifics of the project. For example, the laboratory and phlebotomy personnel are needed for initiatives related to phlebotomy overuse, and pharmacy is likely to have a stake in increasing appropriate use of vitamin K or parenteral iron.

2. *Which people or departments control resources that you may need?*

These people determine how resources are allocated at your organization and usually include the chief medical officer (CMO), vice president for medical affairs (VPMA), chief quality officer (CQO), chief financial officer (CFO) or others in similar roles.

3. *Which people or departments are impacted by the outcomes of current or future workflows?*

It is important to identify those who may be impacted by your work, even if they are not actively involved in carrying out workflows related to transfusion or anemia management. For example, if you adopt a restrictive transfusion strategy, you will need your primary care and nursing home physicians to be comfortable receiving patients with lower hemoglobin levels than they are accustomed to. In addition, if anesthesiologists are not on board, they may cancel or inappropriately transfuse cases for patients who are more anemic than they are accustomed to. If your outpatient hematologists are accustomed to giving two unit red blood cell (RBC) doses to their myelodysplastic patients, they are likely to resist any order set that makes this difficult. Identifying these departments and individuals ahead of time and engaging them is critical to avoid resistance or frank backlash. Again, they do not all need to be formally involved in your core team, but they do need to be included and informed.

4. *Which people or departments might thwart your efforts?*

This may be a subset of people from groups that you have already identified in the first three buckets, but they deserve special consideration. Reaching out to those individuals and including

them in the process, either formally or informally, will be time well spent and can prevent road-blocks through the implementation process.

There is likely to be overlap between these buckets, and you will identify more people and departments than you would want to include in your core team. However, it is key that you have individuals who can fill the following roles:

- 1. Executive Sponsor** — This is typically a senior leader, such as a CMO, CQO, VPMA and/or department chair. The executive sponsor should have the authority and influence necessary to secure necessary resources and prioritize the effort within the organization, so that other stakeholders get the message that this is important and that there is a timetable. For example, if you are having trouble getting a request for a data report prioritized, the executive sponsor should be able to help move your request up the queue to ensure you get what you need in a timely fashion.
- 2. Team Leader** — Typically a physician leader with knowledge and interest in anemia and/or transfusion, the team leader's background may be, but is not limited to, hospital medicine, critical care medicine, transfusion medicine, hematology, anesthesiology or surgery. In addition to interest and content expertise in anemia/transfusion, this individual should be perceived as credible and respected by others at your organization. This role involves a substantial time commitment and ideally would include some protected time for the work effort that will be required. This person is responsible for coordinating meetings, keeping the team on track and up to date, being the face of the initiative and ultimately for the overall success of the effort.
- 3. Process Owners** — These are the front-line providers who may contribute to the onset or exacerbation of anemia via operative blood loss, phlebotomy. They are also responsible for diagnosing and treating anemia and ordering transfusions. Not all process owners can be part of the committee, but others can provide ad hoc input. Whom you choose to include may also depend on where you are choosing to focus your efforts. For example, if you are focusing on promotion of a restrictive approach to transfusion, you will need representation from those who order or recommend transfusions (e.g., hospitalists, critical care doctors, surgeons, anesthesiologists and others). However, if you are focusing on improving preoperative anemia management, it may be important to include someone from pre-admission testing. If you anticipate a broader role for parenteral iron, it may be important to have representation from pharmacy and your infusion center. You should consider those who are already managing anemia (e.g., hematology, nephrology) and those who care for patients in whom treating anemia may be particularly beneficial (e.g., heart failure specialists, nephrologists and obstetricians).
- 4. QI Facilitator** — You will need someone who is able to help obtain baseline data, as well as a performance dashboard, to measure the impact of your initiative. This may be someone in your QI department and they should have experience with data management and analysis. If they cannot generate the data that you need, the facilitator should be able to help find out who can and make it happen.

5. **IT Liaison** — Having representation from someone who is able to make changes in the electronic health record (EHR) will be essential. For example, multiple organizations have implemented computerized provider order entry screens and best practice alerts to drive a restrictive approach to RBC transfusion. This person may or may not also be someone who can help your QI facilitator with data extraction.

1.2 Create a Shared Need for a Quality Improvement Program

Developing a common vision for the future is essential. The vision will determine the scope of the undertaking and should be tailored to the needs/capabilities of your organization. For example, you may be focusing on specific areas or on multiple areas such as decreasing overuse of RBC transfusions, improving preoperative anemia management, decreasing unnecessary phlebotomy or increasing appropriate use of vitamin K for warfarin reversal.

Taking on projects that are not a high organizational priority or taking on more than can be handled is likely to lead to failure. Within the team, it is important to gauge the priorities and concerns of individuals. Establishing common interests and a shared need for change is essential. Some examples of areas that people may rally around include:

1. The financial costs of RBC overuse to their organization
2. The potential impact on LOS and hospital-acquired infections associated with RBC transfusion
3. The mortality associated with untreated anemic patients going for surgery (although you certainly do not want to send the message that transfusion is the desired treatment)
4. The potential harm associated with iatrogenic anemia

Using an actual clinical vignette from your organization can also be a very powerful talking point to help garner support. An example of this may include a complication of an unnecessary transfusion such as circulatory overload requiring ventilator support. Assessing the readiness for change within the formal team and within those stakeholders not included in the formal team comes next.

As noted in the previous section when discussing stakeholders, you should pay particular attention to those who are likely to resist change. If there are stakeholders who will resist change, but are reasonable, thoughtful and respected, it will be essential to engage them. They can become your best champions if you can win them over.

Step 2: Obtain Institutional Support

Institutional support is critical to QI project success, as it provides access to the resources required to change current hospital culture and practices. QI efforts should align with the hospital's mission and vision, while addressing issues identified as care delivery and operational priorities. The clinical rationale for improving anemia prevention and management was presented in this *Guide's* introduction. There is a compelling business case to be made for improved anemia prevention and management that can help secure “buy-in” from the hospital's senior leadership. Gaining this high-level endorsement will help garner the core components needed for a successful QI initiative (status as something important to do, personnel, IT assistance, etc.).

2.1 Anemia Prevention and Management as Healthcare Issues that Impact Both Cost and Quality

There is growing body of evidence that RBC transfusion is overused and incurs avoidable costs to healthcare organizations and avoidable harm to patients (**Please see Section 2.1.1 and Section 4.3**). A recent study published by the Agency for Healthcare Research and Quality found that transfusion is the most common procedure associated with hospitalization and is growing rapidly, with a 126 percent increase from 1997 to 2010.¹⁹ The 2011 National Blood Collection and Utilization Survey estimated that more than 12 million units of RBCs are transfused annually in the United States.²⁰ The total costs of RBC transfusion are in excess of \$10 billion per year.^{20,21} In spite of the extraordinary cost, there is wide variation in practice that is not explained by patient characteristics, and it has been estimated that greater than 50 percent of all transfusions may be inappropriate.²²⁻²⁵ Given this evidence of overuse and the associated cost in terms of both dollars and potential harm, it should not be surprising that regulators and professional societies have taken notice.

Effective practices targeting anemia prevention and management are increasingly seen as indicators of quality care. The Department of Health and Human Services, the Association of American Blood Banks and The Joint Commission have all recognized the value of improving blood management practices.^{20,26} In 2012, The Joint Commission and the American Medical Association jointly convened a summit on overuse that identified blood transfusion as one of five areas of overuse that may expose patients to harm. More recently, multiple societies have endorsed recommendations from the American Board of Internal Medicine's *Choosing Wisely*[®] Campaign that are directed at better anemia prevention and management. The relevant recommendations from the Society for Hospital Medicine (SHM) include:

- Avoid transfusions of red blood cells for arbitrary hemoglobin or hematocrit thresholds and in the absence of symptoms of active coronary disease, heart failure or stroke.
- Do not perform repetitive CBC and chemistry testing in the face of clinical and lab stability.

As healthcare financing becomes increasingly focused on paying for value, the business case for reducing costs by addressing overuse (e.g., transfusion, phlebotomy) becomes more compelling. In addition, improving practices related to anemia and transfusion has the potential to impact value-based payments in other ways as outlined below.

2.1.1 Opportunities for Expense Reductions — Decreasing Use of Red Blood Cell Transfusions

The direct cost of a unit of red blood cells ranges from a low \$200 to as high as \$300 depending on location and the unit provided; accounting for the administrative and supply costs (i.e., cost of transfusion can exceed \$1,100.)²¹ Many hospitals transfuse thousands of units of red blood cells annually, so the opportunities for expense reductions are significant. Annual savings in direct costs of \$1 million or more and indirect cost savings of several million have been realized by some hospitals due to quality initiatives aimed at decreasing overuse of RBC transfusion (Geisinger Health System: Wehler, A. 2014. Unpublished data, cited with permission) without any detriment of patient outcome.^{27,28} A 2012 Premiere Healthcare Alliance Analysis concluded that if the 464 hospitals in the analysis all performed similarly to the highest quartile, \$165 million would be saved annually.²⁹ As you will read in **Step 4**, there are both proven strategies (i.e., a restrictive approach to RBC transfusion and a one-unit dose in non-bleeding patients) and proven tools (i.e., order sets and decision support) that have been used to achieve these results.

2.1.2 Opportunities for Expense Reductions — Decreasing Phlebotomy Overuse

As mentioned previously, SHM has recommended avoiding “routine” daily lab testing in hospitalized patients. Excessive phlebotomy is associated with anemia which in turn is associated with morbidity, mortality and increased LOS.^{18,30} Several recent QI projects have successfully decreased phlebotomy.^{31,32} This remains an emerging area of QI work, and a potential area for your organization to realize savings.

2.1.3 Potential Impact on Hospital LOS

Hospitals have been receiving a fixed payment based on the diagnosis-related group (DRG) rather than cost-based reimbursement since 1983, and many commercial insurance companies have similar contracts with hospitals. The combination of high occupancy rates and DRG payments have made managing LOS a priority and have contributed to the rise of hospital medicine as a specialty. It is worth noting that both anemia and transfusion have been associated with increased LOS and that better prevention and management of anemia concomitant with decreasing transfusion may favorably impact LOS, which in turn increases the revenue per day for the organization. Although this might be a useful bullet point in a formal presentation, it should not be a primary selling point as it will be hard to deliver a measurable impact that is attributable to your efforts.

2.1.4 Potential Impact on the Hospital Value-Based Purchasing Program

The Hospital Value-Based Purchasing Program (HVBP) was created by the Patient Protection and Affordable Care Act (Affordable Care Act or ACA). Initially focused on process of care measures and patient experience, the program has evolved to decrease emphasis on process and to focus more on outcomes and efficiency. Outcome measures for fiscal year 2016 include 30-day mortality for acute myocardial infarction (AMI), congestive heart failure (CHF) and pneumonia as well as measures of hospital-acquired infections including central line-associated bloodstream infection (CLABSI), catheter associated urinary tract infection (CAUTI) and some surgical site infections (SSIs).

The prevalence of anemia in the high-risk populations targeted by the Centers for Medicare & Medicaid Services (CMS) in HVBP and other pay-for-performance initiatives is extraordinary. Studies have shown that anemia may be present in 50 percent or more of patients with chronic obstructive pulmonary disease (COPD), CHF and pneumonia.³³⁻³⁵ Although anemia is endemic in these key patient populations, it is both under-recognized and undertreated. Anemia is an independent predictor of mortality, which has the potential to negatively impact outcomes in the very patient populations where 30-day mortality will impact HVBP calculations. Unfortunately, transfusion has not been shown to mitigate this risk and may even exacerbate it.

2.1.5 Potential Impact on the Hospital-Acquired Condition Reduction Program

Both anemia and transfusion have also been associated with increased rates of infection. A recent meta-analysis calculated a number needed to treat of 48 with a restrictive rather than liberal transfusion strategy to avoid one serious infection.³⁶ It is worth noting that hospital-acquired infections (HAIs) can negatively impact a hospital beyond the implications for the HVBP program. Those hospitals in the highest quartile for HAIs will also be subject to a one percent reduction in payment from CMS due to the Hospital-Acquired Condition Reduction Program. Furthermore, since the Inpatient Prospective Payment System (IPPS) for Fiscal Year 2009, hospitals have not been reimbursed for the additional costs incurred in managing a number of hospital-acquired conditions including CAUTI, CLABSI and certain SSIs.

2.1.6 Potential Impact on the Hospital Readmissions Reduction Program

Also created by the ACA, the Hospital Readmissions Reduction Program (HRRP) is another example of the move by CMS toward value-based payments. HRRP penalizes hospitals with readmission rates that are above expected for certain diagnoses, and not surprisingly focuses on the familiar high-cost diagnoses of CHF, AMI, pneumonia, COPD and major joint arthroplasty. As noted previously, these are conditions in which anemia is both common and morbid. Several studies have shown that anemia is a predictor of readmission,^{37,38} and efforts at better prevention and treatment may mitigate this risk.

Using the information presented above to position anemia prevention and management as a healthcare quality issue that impacts the financial performance of your hospital or health system will help prioritize your QI efforts and garner the necessary support from senior leadership. In addition, buttressing this information with a real patient story from your organization illustrating a harm done by an unnecessary transfusion will make your case even more effective.

Step 3: Assess the Current State of Anemia Recognition and Management and Transfusion in Your Facility

Understanding the current state of anemia management in your facility will help identify targets for intervention while defining the scale of your project. This baseline knowledge can also be used to allocate project resources appropriately and to establish realistic performance improvement goals. SHM suggests conducting this current state evaluation through the series of assessments described in **Sections 3.1-3.6**.

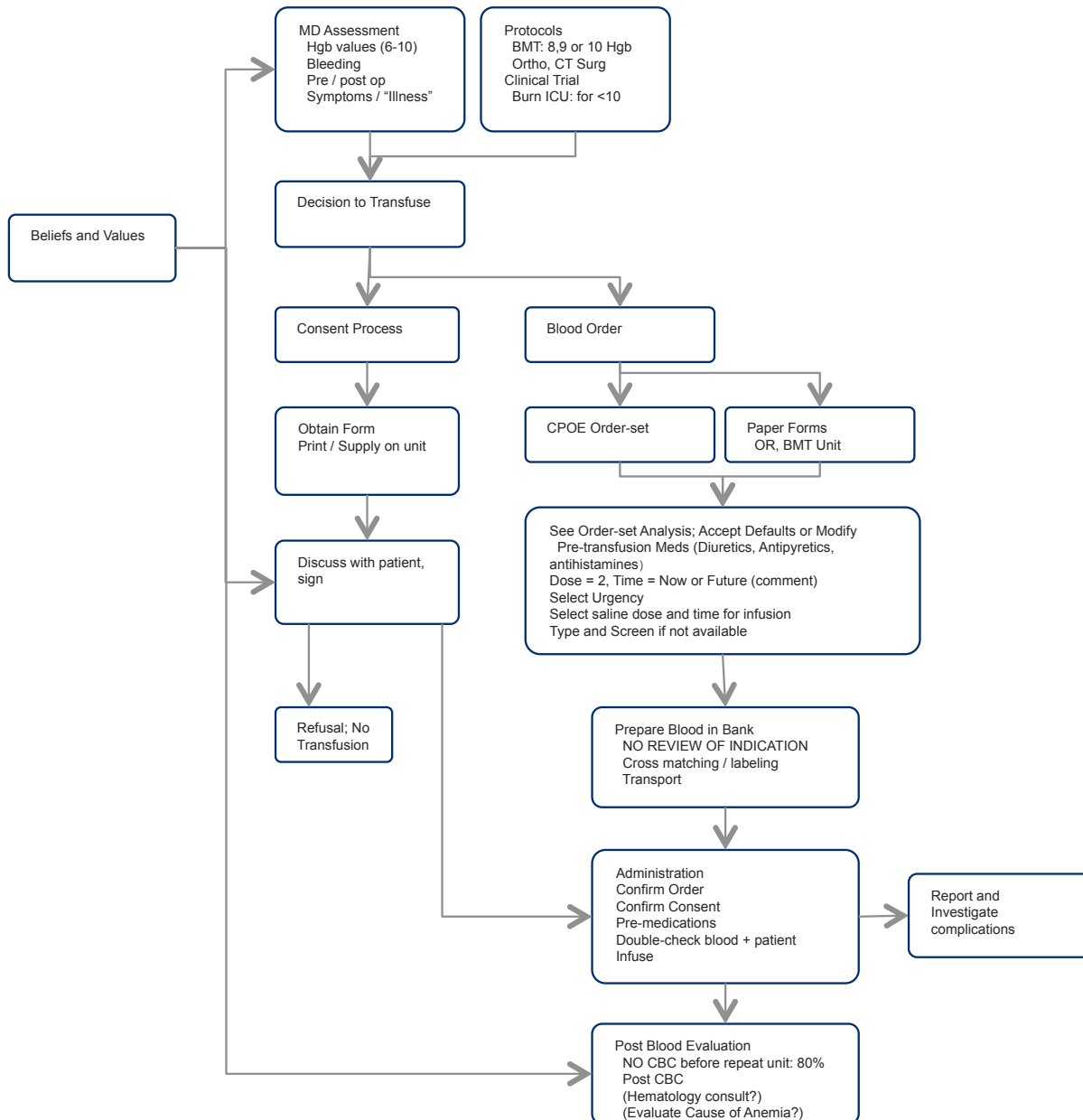
3.1 Create a High-Level Process Map

Summarizing the key steps in a care delivery process is essential to understanding the scope of the QI project and identifying specific targets for improvement. Anemia is a common and complex condition, so creating a process map for all anemia recognition, diagnosis and management components is not feasible. However, creating a process map focused on a more specific process (e.g., transfusion of red cells) can help you identify the right places in a process to make your interventions. Ideally, the collective expertise of the team is used to create high-level process maps by:

- Defining the major function (output) of the process
- Identifying all participants (e.g., surgeons, clinic nurses, possibly IT staff in the case of elective surgery clinics)
- Delineating beginning and ending points
- Brainstorming on critical steps and determining the process sequence
- Validating workflow by “test driving” the process

Here is an example (**Figure 1**). Your institution's map may look different depending on your processes and the focus of your effort, but the map should identify the key leverage points for change as well as vulnerabilities (e.g., multiple pathways that could result in variable practice if not addressed).

FIGURE 1



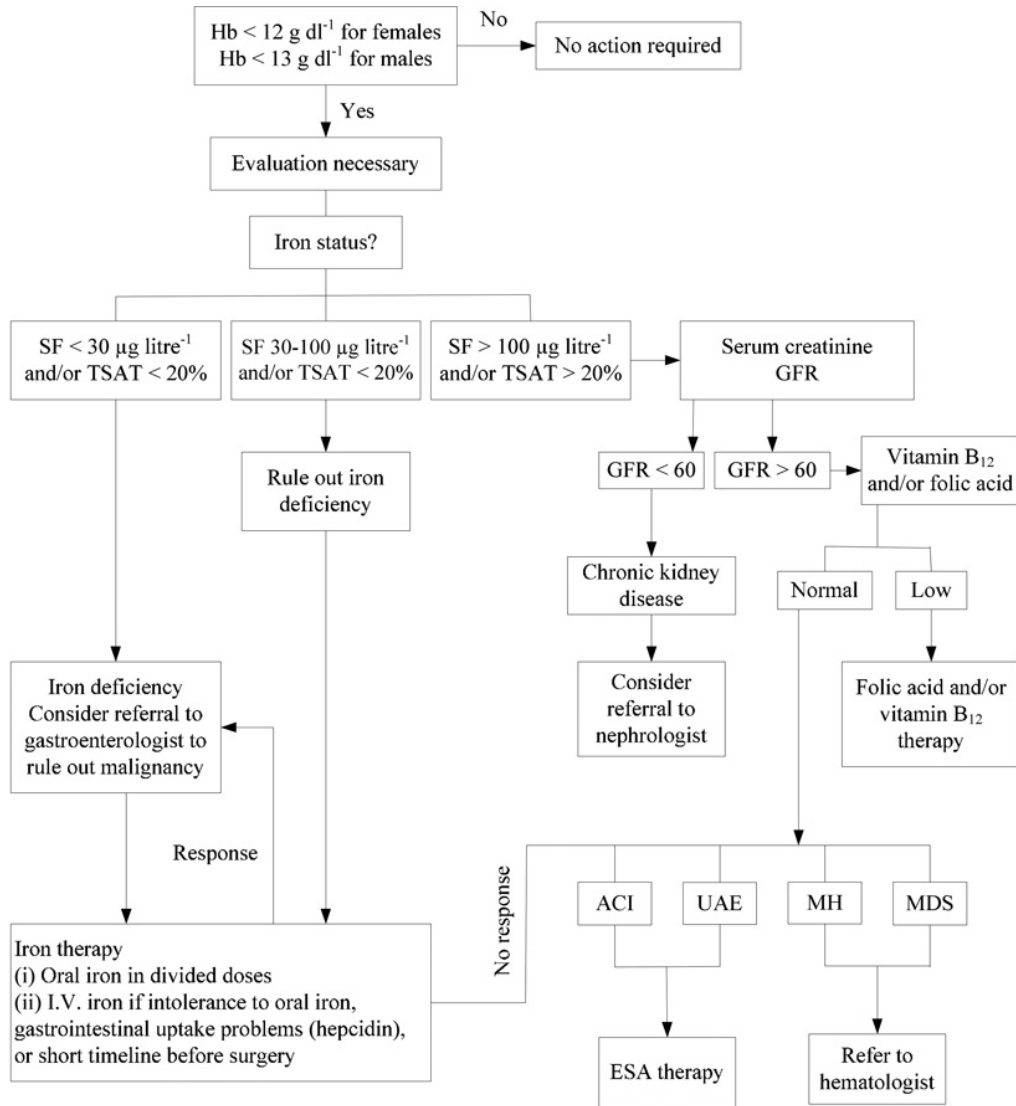
3.2 Determine Anemia Prevalence and Severity

The prevalence of anemia, defined by the World Health Organization (WHO) as a hemoglobin <13 g/dL in men and <12 g/dL in women, varies across different populations.³⁹ In the preoperative setting, 30 percent of patients undergoing major non-cardiac surgery are anemic.⁴⁰ Also, 74 percent of hospitalized patients will develop a hospital-acquired anemia (HAA)¹² with 95 percent of patients admitted to the intensive care unit (ICU) developing anemia by the third ICU day.⁴¹

Because anemia is so common, from a pragmatic standpoint, it is important to decide on the population(s) (e.g., hospitalized patients vs. ICU patients vs. preadmission surgical patients) and the hemoglobin threshold of interest. This is particularly important because the response to therapy for anemia varies across different populations. For example, oral iron therapy may benefit preoperative patients, but it is ineffective for most critically ill patients.⁴²

Despite the anemia “problem,” most improvement teams will want to focus on optimizing RBC transfusion practices unless baseline performance in that area is already excellent. Initial efforts to change RBC transfusion practice could be directed either toward a specific hospitalized population (e.g., the critically ill) or all hospitalized patients, particularly if you find that hospital-wide order set implementation would be simpler. On the other hand, elective surgical patients are one population at risk of transfusion where there may be time to evaluate the etiology of anemia and initiate treatment (**Figure 2**).³⁹ A pilot project focusing on a specific population that is both easily identifiable and has been shown to benefit from an anemia management strategy (e.g., elective orthopedic surgery) would be an appropriate way to start.^{16,43}

FIGURE 2



Hb Hemoglobin

SF Serum Ferritin

GFR Glomerular Filtration Rate

ACI Anemia of Inflammation

UAE Undifferentiated Anemia of the Elderly

MDS Myelodysplastic Syndrome

ESA Erythropoiesis Stimulating Agent

MH Malignant Hematology (e.g. chronic lymphocytic leukemia)

From Goodnough LT, Schrier S. Am J Hematol 2014; 89:88-96.

3.3 Transfusion Rates

The RBC transfusion rate is best assessed as total RBCs transfused per patient, expressed per 100 patient-days, or admissions, or discharges, depending on the data available.^{16,43} You may want to exclude transfusions given perioperatively or for bleeding, or at least analyze them separately. Data may be extractable by type of procedure and physician or service,⁴⁴ as well as specific clinical unit. Other key metrics include the percent of RBC transfusions given above a specific hemoglobin threshold, according to an institutional protocol, and the percent of transfusions with a dose of two or more units. Examining this information by service or clinical unit can sometimes uncover major differences in transfusion practices.

3.4 Environmental Scan for Existing Anemia and Transfusion Resources

The aim here is to identify components within your facility that may be readily integrated into your QI project, to avoid duplication of effort and to ensure a consistent care approach. Examples include:

- Clinical decision support tools embedded into paper documents or computerized physician order entry (CPOE) order sets. You may find these are poorly implemented (available but hard to find, for example) or need revision (recommending inappropriate transfusion thresholds or failing to provide guidance).
- Active or prior QI projects overlapping with anemia management, e.g., preoperative consultation clinics, care plans developed for oncology patients, quality/value or “*Choosing Wisely*®” educational initiatives. These may be found by surveying departmental and institutional order sets and guidelines involving transfusion or hemostasis or regulating use of iron supplementations and erythropoietin-stimulating agents (ESAs). Pre-existing order sets will help to identify variation in RBC transfusion practice and anemia management across the institution and will need to be modified for consistency with any institutional change in practice.
- Discharge/continuity of care initiatives, which may be engaged to increase referral to outpatient anemia clinics.

3.5 Determine Data Extraction and Management Capabilities

How anemia and RBC transfusion data is stored and the administrative support available to access data will vary among institutions. While you assess what data is retrievable from your EHR and the availability of IT support to access the necessary information, consider that in some institutions, transfusion data may be more easily obtained from the Blood Bank than the EHR. Some patient care locations such as the operating room may have separate data systems that must be queried for a complete picture of transfusion practices.⁴⁴ Pharmacy is an important source of data on utilization of iron and ESAs. If data are not easily obtainable, it may require a specific institutional initiative to develop mechanisms to obtain the transfusion data that are necessary. However, determining an RBC transfusion rate per admission or patient-day should always be feasible.

However you obtain data, you also want to know if reliable information can be obtained electronically (e.g., accurate identification of all transfusions given for hemoglobin >7g/dL) or whether additional chart review will be required (e.g., to identify bleeding or instability not captured by coding data, but which justified transfusion) — and decide if you need additional help to do this review. Avoid designing a project your data acquisition capabilities cannot support.

This is also a good time to plan data analysis. Instead of tables of numbers, or aggregate “before and after” rates, data are best presented in the form of a control chart (either P-chart or U-chart) that allows evaluation of performance over time, and easy recognition of whether you’ve achieved statistically significant improvement.

3.6 Determine Baseline Performance

It is important to obtain current performance both to generate leadership support and to identify initial areas for the project’s focus. Do not embark on a complex, time-consuming project without a clear understanding of the room for improvement and the potential return on investment at your institution. The necessary performance data will initially depend upon the specific project(s) you’re planning, and the data available. At a minimum, global institutional performance data should be obtained (e.g., RBC transfusion rates and procurement costs). As noted in **Section 3.3**, the more the data can be focused down to specific units or services or providers the more helpful it will be in identifying outliers — this can help you decide if an institution-wide change or service-specific education makes the most sense.

Step 4: Identify Best Practices in Anemia Detection, Prevention and Treatment

4.1 Assessing the Risk of Anemia

Over the last three decades, RBC transfusion practice has come under more scrutiny and there has been an increase in interest in the “tolerability” or risk of anemia. Anemia is common in critical illness and is independently associated with worse clinical outcomes.⁴¹ Similarly, in the general hospitalized population, individuals who develop either moderate (hemoglobin 9-11 g/dL) or severe (hemoglobin <9 g/dL) hospital-acquired anemia have an increase in mortality (moderate OR 1.51, 95% CI 1.33-1.71; severe OR 3.28, 95% CI 2.90-3.72).¹²

Carson et al. studied the risk of death and morbidity in Jehovah’s Witness patients undergoing non-cardiac surgical procedures.⁴⁵ They observed that even mild anemia was associated with increased mortality risk and that this risk was substantially higher for those individuals with cardiovascular disease. In a recent study of non-cardiac surgery in patients from the American College of Surgeons’ National Surgical Quality Improvement Program database, the adjusted 30-day mortality and morbidity was increased even in patients with mild anemia (HCT 29-39 percent in men or 29-36 percent in women).⁴⁰

On the other hand, there is considerable evidence that low levels of hemoglobin can be tolerated in healthy subjects. Hematocrits of 10-20 percent have been achieved in animals using normovolemic hemodilution without untoward effects.^{46,47} Similarly, studies in individuals with preserved left ventricular function undergoing coronary artery bypass grafting demonstrated that hemodilution to a target hematocrit of 15 percent was well tolerated.^{48,49} Weiskopf et al. induced normovolemic hemodilutional anemia to a hemoglobin concentration of 5 g/dL in healthy individuals prior to surgery as well as normal volunteers. They found no evidence of reduced oxygen delivery associated with this acute anemia.⁵⁰ Similar, data regarding the impact of anemia on surgical outcome comes from studies of patients who refuse RBC transfusion. In these patients, Carson et al.⁵¹ and more recently Shander et al.⁵² observed that it is not until nadir hemoglobin concentration falls below 5 to 6 g/dL that morbidity and mortality increases substantially.

Assessing the tolerability or risk of anemia, either acute or chronic, has been made more difficult because recent clinical studies have focused on the risks and benefits of RBC transfusion and other interventions in anemic patients rather than risk of the anemia per se.⁵³ While RBC transfusions may not be beneficial when the hemoglobin concentration is 7-8 g/dL, it is also clear that even mild degrees of anemia are associated with increase in risk across a broad range of clinical situations. This suggests that the degree of anemia chosen as a target for treatment will depend on the efficacy and risk of any potential treatment intervention.

4.2 Detection, Evaluation and Treatment of Anemia

Anemia is an independent predictor of morbidity and/or mortality in the community⁴⁵ preoperatively,⁴⁰ and in the hospitalized population,¹² even if it is only mild. Therefore, detection of anemia is important, and any degree of anemia warrants evaluation and treatment if necessary. From a practical standpoint the preoperative elective surgery setting may be a productive area to focus on detection and evaluation of anemia. For these patients, evaluation should take place at least two to four weeks before surgery to allow response to treatment. Any degree of anemia in the preoperative setting warrants treatment.

An algorithm outlining the approach to evaluation and management of anemia was presented in **Figure 2**.³⁹ If oral iron is not tolerated or is not effective, then intravenous iron should be administered.^{54,55} New iron preparations are now available that have been demonstrated to be safe and effective.⁵⁶ Intravenous iron therapy may be particularly useful in the preoperative setting when more rapid correction of anemia is desired.^{39,54} If hepcidin testing is available, a high level may identify patients who will not respond to oral iron.⁵⁶ Supplemental iron may improve the response to ESAs. ESAs may also have a role in correcting preoperative anemia, although the balance of risk versus benefit needs to be assessed.⁵⁷

4.3 Assessing the Risk of Red Blood Cell Transfusion

For much of the last century, RBC transfusions were viewed as a safe and effective means of treating anemia and improving oxygen delivery to tissues. Beginning in the early 1980s, RBC transfusion practices began to come under scrutiny. While the risks of RBC transfusion are clear, most clinical studies over the past two decades have either failed to demonstrate a benefit to RBC transfusion or have shown that RBC transfusion can worsen clinical outcomes^{58,59} (**Table 1**). A number of large, randomized clinical trials and prospective observational studies have assessed the effectiveness of allogeneic RBC transfusion and demonstrated that restrictive RBC transfusion practices result in at least equivalent patient outcomes as liberal approaches, and may actually reduce morbidity and mortality rates in some patients.^{58,60} A Cochrane systematic review⁶¹ compared “high” versus “low” hemoglobin thresholds in 19 prospective, randomized trials involving 6,264 patients. The authors found that “low” hemoglobin thresholds were well-tolerated and that RBC transfusions were reduced by 34 percent, with a mean reduction of 1.2 RBC units in the “low” hemoglobin cohort. A subsequent meta-analysis from trials with 2,364 participants found that a restrictive RBC transfusion strategy (targeting a Hb transfusion trigger <7 g/dL) was accompanied by reduced cardiac events, rebleeding, bacterial infections and mortality.⁶² When 19 trials from the primary (Hb <7 g/dL) and secondary (Hb >7 g/dL) analyses for restrictive transfusion strategies were pooled together with a total of 6,936 patients, the restrictive strategy was still associated with a significant reduction in hospital mortality, 30-day mortality, pulmonary edema, bacterial infections and re-bleeding.⁶² In a systematic review of 45 observational studies with 272,596 participants, RBC transfusion was associated with increased morbidity and mortality.⁵³

KEY CLINICAL TRIALS

There are seven key randomized, clinical trials in adult patients that have compared ‘restrictive’ vs. ‘liberal’ RBC transfusion strategies in various clinical settings (**Table 2**).⁶³ The Transfusion Requirements in Critical Care (TRICC) trial⁶⁴ found that critical care patients randomized to a restrictive transfusion strategy (hemoglobin range 7 to 9 g/dL, 8.2 g/dL on average) had no difference in 30-day mortality rate compared to patients transfused more liberally (hemoglobin range 10 to 12 g/dL, 10.5 g/dL on average).

The TRACS (Transfusion Requirements after Cardiac Surgery) trial⁶⁵ was a large, single-center study of patients randomized to receive either restrictive (hematocrit >24 percent) or liberal (hematocrit >30 percent) RBC transfusions postoperatively. Thirty-day all-cause mortality was not different (10 percent vs. 11 percent, respectively) between the two cohorts.

The FOCUS trial found that elderly (mean >80 years of age) patients who underwent hip fracture surgery tolerated a postoperative transfusion trigger as low as 8 g/dL^{66,67} (although patients could be transfused at higher hemoglobin levels, if symptomatic). More recently, a single-center prospective study⁶⁸ of patients with upper gastrointestinal bleeding demonstrated that patients randomized to a

restrictive (hemoglobin <7 g/dL) instead of a liberal (hemoglobin <9 g/dL) transfusion threshold had significantly improved outcomes, including mortality at 45 days and rates of re-bleeding.

The MINT trial⁶⁹ was a pilot study of liberal (hemoglobin ≥ 10 g/dL) versus restrictive (hemoglobin <8 g/dL) transfusion thresholds in patients with symptomatic coronary artery disease (acute coronary syndrome or stable angina undergoing cardiac catheterization), but was terminated after enrollment of only 110 of 200 planned patients. Of the screened patients who were eligible, only 12 percent were enrolled (**Table 2**).⁶³ The primary outcome (death, myocardial infarction or revascularization) occurred in only 10.9 percent of the liberal transfusion cohort, compared to 25.9 percent of the restrictive cohort ($p=0.054$); mortality occurred in 1.8 percent and 13.0 percent, respectively ($p=0.032$). This pilot,⁶⁹ with the caveat that it was a failed trial with a high risk of bias, provides questionable support for a more liberal transfusion practice for high-risk patients with coronary artery disease. However, this must be interpreted in the context of a number of other studies suggesting that a more restrictive approach to RBC transfusion practice in patients with acute coronary syndromes is at least equivalent, and possibly better, to a more liberal strategy.^{62,66,67,70,71} In the absence of a large randomized trial of RBC transfusion in acute coronary syndrome, the transfusion threshold for this population will remain controversial.

A recently published trial in patients with septic shock⁷² shock of lower (<7 g/dL) vs. higher (<9 g/dL) hemoglobin thresholds for transfusion, found equivalent 90-day mortalities (43 vs. 45 percent, respectively) in the two patient cohorts but a higher incidence of transfusion-related complication in the liberal group. The recent TITRe2 trial of liberal or restrictive transfusion after elective cardiac surgery studied whether patients randomized to single RBC unit transfusions at a threshold of hemoglobin 7.5 g/dL had a better primary outcome for composite ischemic events (stroke, myocardial infarction, ischemic bowel and acute renal injury) than patients randomized to a 9 g/dL hemoglobin threshold. While only 53.4 percent vs. 92.2 percent of patients received RBC transfusions in the restrictive and liberal cohorts, there was no difference in the primary outcome (35.1 percent and 33.0 percent, respectively).

One limitation of these trials is that eligible patients who agreed to participate in the studies may not be reflective of every patient receiving care in these clinical settings. Only 41 percent of eligible patients eligible for the TRICC trial⁶⁴ and 56 percent of patients for the FOCUS trial⁶⁶ were actually enrolled in these studies, leading to possible selection bias. In the most recently published TITRe2⁷³ trial, the average daily hemoglobin levels were not that far apart (8.0 to 9.0 g/dL vs. 9.2 to 9.8 g/dL); moreover, deviations from the protocol occurred in 30 percent and 45 percent, respectively, of the restrictive vs. liberal threshold cohorts, perhaps accounting for the inability to demonstrate a predicted difference in the primary outcome. The authors also included a post hoc analysis of 90-day mortality, which was higher in the restrictive compared to the liberal group (4.2 percent vs. 2.6 percent, $p=0.045$), despite demonstrating that 30-day mortality was not different.

Another important limitation is the interpretation of the hemoglobin threshold level as a ‘transfusion trigger’ from the results in these studies. For example, the mean pre-transfusion hemoglobin for patients in the ‘restrictive’ RBC transfusion arm of the TRACS trial was 9.1 g/dL. Similarly, the mean pre-transfusion hemoglobin for patients in the ‘restrictive’ arm of the TRICC trial was 8.5 g/dL; yet the conclusion from this study was that a hemoglobin of 7 g/dL is the ‘correct’ number that should be used as a transfusion trigger for critical care patients.⁷⁴ Finally, and most importantly, since hemoglobin g/dL is a concentration and not an absolute value, it is not only affected by changes in plasma volume but also poorly reflects the degree of anemia (reduced RBC mass) in dynamic situations such as acute blood loss.

CLINICAL PRACTICE GUIDELINES

The number of published clinical practice guidelines for RBC^{25,75-92} transfusions attest to the increasing attention paid to transfusion practices by professional societies (**Table 3**).⁵⁸ The selection of a discrete hemoglobin as a ‘trigger’ for RBC transfusion has been controversial. The guidelines from the American College of Physicians did not identify a discrete hemoglobin threshold as a transfusion trigger⁷⁶ and instead, recommended a full clinical assessment of the patient, along with transfusion of only one RBC unit per transfusion event, with re-assessment of the patient in between transfusion events. The clinical practice guidelines published by medical societies acknowledge the necessity of considering patient co-variables or other patient-specific criteria for making transfusion decisions. It is generally agreed that transfusion is not of benefit when the hemoglobin is greater than 10 g/dL, but may be beneficial when the hemoglobin is less than 6-8 g/dL.^{25,78,80,81,84-89}

It is also important to recognize that the hemoglobin level selected should be viewed as a threshold rather than a trigger; if the hemoglobin is below the threshold level, a transfusion may be considered but is not mandatory. Recent editorials have summarized the implications of these trials and meta-analyses by identifying a “new normal” hemoglobin level of 7 g/dL, or even suggesting that “6 g/dL could be the new 7 g/dL”,⁹³ to be used for making transfusion decisions. Another stated “it is no longer acceptable to recommend that we transfuse using vague approaches such as clinical judgment or in the hope of alleviating symptoms”.^{74,94} This approach advocates the use of a laboratory number, to the exclusion of clinical assessment for variables that are relevant for making transfusion decisions. However, this approach risks over-interpreting the available evidence for a ‘transfusion trigger’ by underestimating the heterogeneity of anemias (e.g., acute versus chronic) and the heterogeneity of patients (e.g., comorbidities such as age), especially considering the suboptimal participation rate (less than 60 percent in three of seven trials) of patients who were eligible for some of these trials. Nevertheless, many clinicians, particularly in intensive care units, mainly use hemoglobin values to guide transfusion decisions.^{95,96}

Despite the fact that the appropriate transfusion threshold in a given clinical setting may be unclear, there is increasing evidence that RBC transfusions are ineffective and possibly harmful in many of the clinical settings in which they are administered. Thus, the guiding principle for RBC transfusion

therapy should be that less is more. In the American Board of Internal Medicine's *Choosing Wisely*[®] campaign, the American Association of Blood Banks (AABB) recommended that single-unit RBC transfusions be administered for non-bleeding hospitalized patients,⁹⁷ echoing recommendations originally published more than 20 years ago by the American College of Physicians.⁹⁸ Additional RBC units should be prescribed only after reassessment of the patient between RBC transfusion events. This best practices framework is supported by the recent meta-analysis by Holst et al. that concluded that liberal transfusion strategies have not been shown to convey any benefit to patients.⁹⁹

Physician compliance with clinical practice guidelines is often incomplete, as multiple barriers limit guideline adherence.¹⁰⁰ However, recently programs utilizing clinical decision support (CDS) directed toward more appropriate RBC transfusion practice have been successfully implemented and have been effective in reducing RBC utilization with equivalent or improved patient outcomes.^{27,101-103}

Development and initiation of a best practice program for RBC transfusion involves several steps⁶³:

- Forming a multidisciplinary team to develop an institutional RBC transfusion guideline that is accepted throughout the institution (see Step 1)
- Incorporating the RBC guidelines into a computer order set (see Step 6)
- Smart best practices alerts (BPAs) for RBC transfusions outside the clinical practice guideline (see Step 6)
- An educational program starting prior to initiation of the computer order set and continuing post-implementation (see Step 6)
- Ongoing evaluation post-implementation with provider feedback (see Step 6)

4.4 Blood Conservation

Phlebotomy for diagnostic testing is common in the hospitalized patient and can result in iatrogenic anemia and RBC transfusion. This was highlighted almost 30 year ago with the coining of the term "Medical Vampires".¹⁰⁴ In a study of critically ill patients almost half of the variation in the amount of blood transfused was accounted for by diagnostic phlebotomy.¹⁰⁵ A variety of approaches have been taken to reduce phlebotomy blood loss:

- Reduction of unnecessary blood testing has been identified as a *Choosing Wisely*[®] recommendation of the Society of Hospital Medicine.¹⁰⁶ An educational intervention focusing on unnecessary phlebotomy modestly reduced laboratory testing.¹⁰⁷
- Reduction of discarded blood volume using blood conservation devices has been demonstrated to reduce blood loss as well as RBC transfusion.¹⁰⁸
- Noninvasive hemoglobin monitoring is now becoming more available and may be useful in decreasing blood loss for patients requiring frequent hemoglobin monitoring.¹⁰⁹

A variety of approaches have been employed to reduce perioperative blood loss. The development of protocols involves multidisciplinary collaboration between surgeons, anesthesiologists, hematologists, transfusion medicine and pharmacy. The approach may vary depending on surgical procedure.

- Reversal of antithrombotic medications
- Point of care testing/thromboelastography, to assess coagulation and guide blood product use
- Topical hemostatic agents (fibrin glue)
- Hemostatic drugs
 - Procoagulant
 - Antifibrinolytic
- Perioperative blood salvage

4.5 Optimizing Coagulation

Preoperative patients should be questioned for factors that could increase risk of bleeding. There is little value in the indiscriminate use of coagulation testing in patients with a negative history undergoing low-risk procedures.¹¹⁰ Screening protocols should be established for invasive procedures and surgery. Protocols are also needed to manage patients receiving antithrombotic and antiplatelet therapy prior to surgery.¹¹¹ Recent data suggests that perioperative bridging anticoagulation may not be necessary for patients receiving warfarin for atrial fibrillation.¹¹²

Reversal of vitamin K antagonists (VKAs) should be based on the international normalized ratio (INR), the bleeding risks associated with the planned procedure and whether rapid reversal is needed.

- INR <4.5 without bleeding
 - Hold warfarin.
 - If reversal of VKA if bleeding is desired, administer oral vitamin K 5-10 mg. For more rapid reversal, slow infusion IV vitamin K at similar doses is required. Many institutions are moving away from oral to IV when “rapid” reduction is needed.
 - For reversal <2 hours, 4-factor prothrombin complex concentrate (4F-PCC) is recommended or fresh frozen plasma (FFP) (15 mL/kg) if 4-F PCC is not available. Slow IV infusion of vitamin K should be given concomitantly.
- INR 4.5-10 without bleeding
 - Hold warfarin.
 - For more rapid reversal, give vitamin K 5-10 mg slow infusion IV.
 - For reversal <2 hours, 4-F PCC is recommended or FFP (15 – 30 mL/kg) if 4-F PCC is not available. Slow IV infusion of vitamin K should be given concomitantly.

- INR >10 without bleeding
 - Hold warfarin.
 - Give vitamin K, 5-10 mg IV (slow infusion).
 - For reversal <2 hours, 4-F PCC is recommended or FFP (20 – 30mL/kg) if 4-F PCC is not available. Slow IV infusion of vitamin K should be given concomitantly.
- For serious or life-threatening bleeding at any INR:
 - Give vitamin K 10 mg IV (slow infusion).
 - Give 4-F PCC or if 4-F PCC not available, give FFP 20-30 mL/kg).
- Protocols for FFP use should be developed. There is widespread inappropriate use of FFP, both inadequate dosing and unnecessary transfusion.¹¹³ Guidelines have been suggested, however there still remains uncertainty in the use of FFP in some clinical situations.¹¹⁴
- Protocols for appropriate use of hemostatic agents (procoagulant and antifibrinolytic) should be developed in collaboration with surgery, anesthesiology, hematology, pharmacy and transfusion medicine.
- Point-of-care testing, e.g., thromboelastography, to assess coagulation and guide blood product use should be utilized in appropriate clinical settings.

4.6 Patient-centered Decision Making

When patients are asked to consent to RBC transfusion, they rarely decline, unless they have religious objections to transfusion. However, the discussion is often cursory. Shared decision-making is a collaborative process that allows patients and physicians to make treatment decisions, taking into account patients' values and preferences as well as scientific evidence. The current RBC transfusion consent process does not necessarily meet this goal. Patients and physicians often place different values on potential outcomes, and patients often change their decisions when presented with more detailed information.^{115,116} In many, particularly non-emergency, circumstances RBC transfusion can be viewed as “preference-sensitive” care, meaning that how a patient values the benefit versus harm will impact choice.¹¹⁶ The value of shared decision-making has been demonstrated in a variety of clinical situations and is facilitated by the development of decision aids that outline the details of the clinical choice.^{115,116} An ideal RBC transfusion consent process would use decision support tools to better inform patient decisions. For example, if the transfusion consent process reviewed your institution's indications for transfusion, or permitted patients to specify under which conditions they would accept blood, the consent process could serve to educate both doctors and patients about appropriate indications.

TABLE 1. POTENTIAL RISKS OF BLOOD TRANSFUSION⁵⁹

I. Infectious Agents

Transfusion-transmitted disease for which donors are tested*

Hepatitis B virus (HBV; 1970 [surface antigen]; 1986-1987 [core antibody]; 2009 [nucleic acid])
 Human immunodeficiency virus (HIV; 1985 [antibody]; 2000 [nucleic acid])
 Hepatitis C virus (HCV; 1986-1987 [alanine aminotransferase]; 1990 [antibody]; 1999 [nucleic acid])
 Human T-cell lymphotropic virus (HTLV; 1988 [antibody])
 West Nile virus (WNV; 2003 [nucleic acid])
 Bacteria (in platelets only; 2004)
Trypanosomacruzi (2007 [antibody])
 Cytomegalovirus (CMV)
 Syphilis

Transfusion-transmitted disease for which donors are not routinely tested

Hepatitis A virus (HAV)
 Parvovirus B19
 Dengue fever virus (DFV)
 Malaria
Babesia sp
Plasmodium sp
Leishmania sp
Brucella sp
 New variant Creutzfeldt-Jakob disease (nvCJD) prions
 Unknown Pathogens

II. Transfusion Reactions

III. Medical Errors (wrong blood to patient due to mislabeled specimen or patient misidentification)

IV. Transfusion-associated Acute Lung Injury (TRALI)

V. Transfusion-associated Circulatory Overload (TACO)

VI. Iron Overload

VII. Immunomodulation

VIII. Storage Lesions: Age of Blood

*The target of the screening assay (antibody, microbial antigen or microbial nucleic acid) and the year of assay implementation are indicated in parentheses.

TABLE 2. SEVEN KEY CLINICAL TRIALS OF BLOOD TRANSFUSION IN ADULTS⁶³

Clinical Setting (Ref)	Hemoglobin Threshold (g/dL)	Age (Years)	(Percent) Patients Transfused	(Percent) Deviation from Protocol	Mean Hemoglobin (g/dL)	Participation (Percent)
Intensive Care⁶⁴	7 10	57.1 58.1	67 99	1.4 4.3	8.5 10.7	41
CT Surgery⁶⁵	8 10	58.6 60.7	47 78	1.6 0.0	9.1 10.5	75
Hip Fracture Repair^{66,67}	8 10	81.5 81.8	41 97	9.0 5.6	7.9 9.2	56
Acute Upper GI Bleeding⁶⁸	7 9	NA NA	49 86	9.0 3.0	7.3 8.0	93
Symptomatic CAD⁶⁹	8 10	74.3 67.3	28.3 NA	1.8 9.1	7.9 9.3	12.2
Septic Shock Trial⁷²	7 9	67 67	64 99	5.9 2.2	7.7 9.3	82
Cardiac Surgery⁷³	7.5 9	69.9 70.8	53.4 92.2	30 45	8–9 9.2–9.8	98
NA = Not Available GI = Gastrointestinal CT = Cardiothoracic CAD = Coronary Artery Surgery						

TABLE 3. CLINICAL PRACTICE GUIDELINES FOR BLOOD TRANSFUSION⁵⁸

Year	Society	Recommendations	Reference
1988	NIH Consensus Conference	<7 g/dL (acute)	<i>JAMA</i> . 1988;260:2700 ⁷⁵
1992	Am Coll Physicians (ACP)	No number	<i>Ann Int Med</i> . 1992;116:393-402 ⁷⁶
1996/2006	AmerSocAnesth (ASA)	<6 g/dL (acute) No number	<i>Anesth</i> . 1996;84:732-747 ⁷⁷ <i>Anesth</i> . 2006;105:198-208 ⁷⁸
1997/1998	Can Med Assoc (CMA)	No number 6g/dL *	<i>Can Med Assoc J</i> . 1997;156:S1-24 ⁷⁹ <i>J Emerg Med</i> . 1998;16:129-31 ⁸⁰
1998	Coll Amer Path (CAP)	6 g/dL (acute)	<i>Arch Path Lab Med</i> . 1998;122:130-8 ⁸¹
2001/2012	Br Com Stand Haematol	7-8 g/dL No number	<i>Br J Haematol</i> . 2001;113:24-31 ⁸² http://www.bcsghguidelines.com/documents/BCSH_Blood_Admin_-_addendum_August_2012.pdf ⁸³
2001	Australasian Soc Blood Trans	7 g/dL	http://www.nhmrc.health.gov.au ⁸⁴
2007/2011	Soc Thor Surg (STS) Soc Cardvasc Anesth (CVA)	7 g/dL or 8 g/dL *	<i>Ann Thorac Surg</i> . 2007;83:S27-86 ⁸⁵ <i>Ann Thorac Surg</i> . 2011;91:944-82 ⁸⁶
2009	ACCM SCCM	7 g/dL 7 g/dL	<i>Crit Care Med</i> . 2009;37:3124-57 ⁸⁸ <i>J Trauma</i> . 2009;67:1439-42 ⁸⁷
2011	SABM	8 g/dL	<i>Trans Med Rev</i> . 2011;232-246 ²⁵
2012	National Blood Authority, Australia	No number	http://www.nba.gov.au/guidelines/review.html ⁹²
2012	AABB	7 g/dL or 8 g/dL **	<i>Ann Int Med</i> . 2012;157:49-58 ⁸⁹
2012	KDIGO	No number	<i>Kid Int</i> . 2012;2:311-316 ⁹⁰
2012	National Cancer Center Network (NCCN)	7-9 g/dL	<i>JNCCN</i> . 2012;10:628-53 ⁹¹
KDIGO – Kidney Dialysis Improvement Global Outcomes * For patients with acute blood loss ** For patients with symptoms of end-organ ischemia			

Step 5: Choose Metrics and Develop a Data Collection Plan

5.1.1 Existing Transfusion Performance Metrics

To curtail inappropriate and potentially injurious transfusion practices, agencies such as the AABB and The Joint Commission (TJC) have promoted initiatives in patient blood management (PBM). PBM, as defined by the Society for the Advancement of Blood Management (SABM), refers to “the timely application of evidence-based medical and surgical concepts designed to maintain haemoglobin concentration, optimize haemostasis and minimize blood loss in an effort to improve patient outcome.”¹¹⁷

In a 2012 guideline, the AABB recommended restrictive transfusion practices (hemoglobin 7-8 g/dL) in hospitalized stable patients, using a threshold of eight or less (or symptoms) for patients with cardiovascular disease, and considering symptoms and not just hemoglobin levels in transfusion decisions; data was insufficient to make a recommendation for patients with acute coronary syndrome.⁸⁹ Additional AABB recommendations from the *Choosing Wisely*[®] campaign include avoiding blood products in hemodynamically stable patients with iron deficiency, using blood products to reverse warfarin only if a patient has serious bleeding or requires emergency procedures, and avoiding serial blood counts in stable patients.⁹⁷

TJC developed seven performance measures in PBM (**Table 4**),²⁶ placing these in their Topic Library to be used by provider institutions as accreditation goals (patient safety activities and/or quality improvement projects), including certification by TJC in PBM.²⁶ While these measures are important, they are not enough to drive improvement. For example, measure PBM-02 covers pre-transfusion hemoglobin and transfusion indication documentation, but does not specify appropriateness criteria. In addition, all the measures are process measures, while demonstration of meaningful improvement with outcome measures would be ideal. However, the comprehensive TJC program also calls for more proactive anemia management and use of pharmacologic alternatives to transfusion.

TABLE 4. PERFORMANCE MEASURES FOR PBM PROPOSED BY THE JOINT COMMISSION²⁶

TABLE 4. Final measure set*			
Number	Measure name	Measure	Comments
PBM-01	Transfusion consent	<i>N:</i> Patients with a signed consent who received information about the risks, benefits, and alternatives before the initial blood transfusion or the initial transfusion was deemed a medical emergency. <i>D:</i> Patients who received a transfusion of RBCs, PLTs, or plasma.	Include all patients
PBM-02	RBC transfusion indication	<i>N:</i> Number of RBC units (bags) with pretransfusion Hb or Hct result and clinical indication documented. <i>D:</i> Number of transfused RBC units evaluated.	Include all patients
PBM-03	Plasma transfusion indication	<i>N:</i> Number of plasma units (bags) with pretransfusion laboratory testing and clinical indication documented. <i>D:</i> Number of transfused plasma units evaluated.	Include all patients
PBM-04	PLT transfusion indication	<i>N:</i> Number of PLT doses with pretransfusion PLT testing and clinical indication documented. <i>D:</i> Number of transfused PLT doses evaluated.	Include all patients
PBM-05	Blood administration documentation	<i>N:</i> Number of transfused blood units/doses (bags) with documentation for all of the following: <ul style="list-style-type: none"> • Patient identification and transfusion order (or blood identification number) confirmed before the initiation of transfusion • Date and time of transfusion • Blood pressure, pulse, and temperature recorded before, during, and after transfusion. <i>D:</i> Number of transfused RBC, plasma, and PLT units/doses (bags) evaluated.	Include all patients
PBM-06	Preoperative anemia screening	<i>N:</i> Patients with documentation of preoperative anemia screening 14-45 days before anesthesia start date. <i>D:</i> Selected elective surgical patients.	Elective orthopedic and hysterectomy surgeries; patients >18 years of age
PBM-07	Preoperative blood type screening and antibody testing	<i>N:</i> Patients with documentation of preoperative type and screen or type and crossmatch completed before anesthesia start time. <i>D:</i> Selected elective surgical patients.	Elective cardiac, orthopedic, and hysterectomy surgeries; patients >18 years of age

* http://www.jointcommission.org/patient_blood_management_performance_measures_project/
D = denominator; N = numerator.

5.1.2 Benchmarking

Internal benchmarking is done to identify variations in blood product use and potential opportunities for improvement. For example, different surgical services can be compared to identify practice variations and stimulate discussions about best practices. If volume is sufficient, individual physician prescribing patterns can be compared for similar lessons.

External benchmarking establishes how a hospital compares to other institutions. One good source of information for surgical specialties is the data from the National Surgical Quality Improvement Program (NSQIP).¹¹⁸ Other benchmarks are available as well; in data from a 2011 AABB survey of 506 hospitals, the average pre-transfusion hemoglobin was 7.9 with a range of 6-12 g/dL. In a large analysis of blood transfusion practices (464 hospitals and 7.4 million discharges from April 2011-March 2012), substantial variation was noted — representing an opportunity to save 800,000 units of blood and \$165 million annually.²⁹ You can also look at your use of blood products per adjusted discharge, taking into account factors such as whether your hospital has special populations, like a bone marrow transplantation service.

Checking your performance against that of others can help you estimate the improvement you are likely to achieve. For example, if your performance is better than the pre-intervention performance in a published QI project you intend to mimic, you may not see the same cost savings.

5.2 Suggested Initial Metrics for Transfusion Projects

Good performance measures share attributes of being correlated to patient outcomes, validity and feasibility (particularly in terms of time and effort required for data collection). Based on these principles, we recommend consideration of the following initial metrics (can analyze data by service or physician adjusted by volume):

Stable, non-bleeding patients

1. Total RBC units per patient days at risk
2. Percent RBC units transfused with Hb level ≥ 8 g/dL (AABB)
3. Hgb level at transfusion
4. Percent single-unit transfusions in non-bleeding patients (ACP, AABB)
5. Hgb level after transfusion (OB or trauma) or at discharge (look for over-transfusion)
6. Reason for transfusion if Hgb ≥ 8 (in non-bleeding patient). TJC recommends documenting the reason for all transfusions.
7. For elective OR cases that have blood requested on surgical schedule:
 - a. Percent patients transfused
 - b. Percent cases preoperative Hgb < 12 (SABM, NATA)
 - c. Percent cases with no T&S before day of surgery (TJC)
 - d. Compliance with patient safety checklist
 - i. cross-matched blood available
 - ii. surgery/anesthesia team discussion on how to manage blood loss
8. Total cost = Acquisition cost per RBC unit X total RBC transfused

You may also be able to measure transfusion-related complications by reviewing adverse event reports, but you may not be able to show a decline in these relatively rare events.

5.3 Define Data Collection Strategies

The main decision point regarding data extraction for anemia and transfusion QI relates to the availability of EMRs within your facility and the extent to which these systems contain data elements of interest that can be collected without manual chart review. For data elements that can be extracted electronically, a 100 percent case sampling approach should be used; coordinate with your IT team members to make sure that CPOE changes are built considering how data will be collected from the new process.

For data requiring manual extraction, a random sampling approach (10 charts a month is typically adequate for a given unit or hospital) is a cost-conscious and well-accepted approach for process performance measurement. **Figure 3** shows an example of a chart review tool for patients with pre-transfusion hemoglobins of >8 g/dL. When designing your own for use, make sure that it collects all necessary information but that it is as easy to use as possible. For example, if you would refer off-protocol transfusions for peer review, you would probably want to check the chart for evidence of a specific rationale/special circumstance for transfusion, but if you are only using the information as a metric to track progress, collecting that level of detail would likely be unnecessary and onerous.

Depending on your interventions, you may be able to measure your processes and intervene at the same time (“measurvention”). For example, if indications will be confirmed by blood bank staff, they can simultaneously gather indication data for 100 percent of transfusions.

FIGURE 3. CHART REVIEW TOOL FOR PATIENTS WITH PRETRANSFUSION HEMOGLOBINS OF >8 G/DL

Indications: <i>(must check one box below)</i>	Donor Bag# _____ (Blood Bank #)
1) Acute Anemia <i>*Before considering transfusing, all efforts should be made to control active bleeding.</i>	
<input type="checkbox"/> Acute blood loss & Symptomatic	<i>(>30% of estimated blood volume with Hgb <7) (Tachycardia or hypotension not corrected by adequate volume replacement alone, or mixed venous Hgb O₂ saturation <55%, Crystalloids or colloids should be used to correct hypovolemia)</i>
<input type="checkbox"/> Evidence of ACTIVE Ischemia	<i>(new EKG changes AND symptomatic)</i>
2) Chronic Anemia	
<i>*Treatable causes of anemia should be ruled out first. Including: Iron, Folate, Vitamin B¹² deficiencies. Consider dosing with Erythropoiesis Stimulating Agents to stimulate bone marrow production.</i>	
<input type="checkbox"/> Patient is symptomatic	<i>(Tachycardia or hypotension not corrected by adequate volume replacement alone, or mixed venous Hgb O₂ saturation <55%)</i>
<input type="checkbox"/> Patient is undergoing active treatment anticipated to cause significant anemia	<i>(See pharmacy guidelines)</i>

Step 6: Deploy Interventions and Monitor Impacts

6.1 Implementing Your Protocol

After you have identified your anemia performance metrics and determined your baseline performance on those metrics, your QI team will need to develop solutions and intervention strategies for various points of the patient encounter.

This section will provide possible strategies to improve the prevention, assessment and management of anemia in both the preoperative clinic and inpatient settings. Because the clinic and inpatient settings are so different, and because anemia has diverse causes (and therefore diverse prevention and treatment strategies), you cannot tackle them all. You will need to select one or a few key strategies to start with, depending on factors such as your baseline performance, resources and stakeholder engagement.

For most sites, a multi-pronged effort to improve transfusion practices (involving education and a transfusion protocol with guidance at the point of care) will be the best initial strategy. However, you may find significant opportunities to intervene on preoperative surgical patients with anemia, or to reduce phlebotomy-related blood loss. Layering multiple interventions usually improves results compared to a single intervention (e.g., education + a transfusion protocol + audit and feedback). However, avoid tackling every potential intervention at once because depending on your team's size and resources, this may starve your highest-yield approaches of the focused attention they will need (e.g., adding multi-service educational drives on phlebotomy practice while acceptance and awareness of the transfusion protocol is poor). As you evaluate opportunities for systems change, remember these key patient safety principles:

- Reduce reliance on memory. Education *alone* is unlikely to produce major changes, although education will be an important strategy to prepare your clinicians for changes to their workflow and secure their engagement with the other strategies you employ.
- Provide guidance at the point of care. In contrast to lectures, posters or policies that are separate in space and time from clinical decisions, concise decision support embedded in order sets (or possibly hyperlinked from the order set) puts information in the clinician's hands at the optimal moment, and serves as ongoing reinforcement of best practices.
- Use fail-safe systems and forcing functions. By using methods that automate key steps or using hard stops to require clinician attention, you will have better success than if you rely on clinicians to remember to do something or use an "opt-in" approach that clinicians can skip. However, make sure that any hard stops or electronic alerts are truly necessary and do not disrupt the clinical workflow.

- Default the best choice. Some institutions find old protocols still in use that reinforce outdated practices. For example, a hematology service admit order set that allows clinicians to opt for transfusions whenever the hemoglobin drops below 8, 9 or 10 g/dL encourages bad practice and gives the impression the hospital endorses those thresholds. Defaulting the threshold to 7 g/dL should promptly improve practice, and clinicians can take the extra steps to change the default to higher values in the rare patients for whom this is appropriate. Defaulting the transfusion dose to one unit is another good example.
- Standardize and simplify processes. Criteria for transfusion should be as consistent across different services and environments as possible, as well as simple and easy to remember. Clinicians will more likely accept processes that are simple, easy to use and avoid redundancy. One example would be best practice alerts that pop up only when an order appears off-protocol and provides the relevant lab values so clinicians don't have to look for them.
- Improve quality and cycle time. The goal of any QI project will be to improve the outcome of interest, in a timely manner. Use a SMART aim statement (specific, measurable, attainable, relevant and timely) to keep your team on track, and avoid getting bogged down by data or excessive analysis. Instead, try to do the easiest, simplest measurements you can that still provide the necessary data to make rapid sequential improvements to your process.

6.1.1 Intervention 1: Focus on Provider Education

As previously mentioned, current evidence indicates that many transfusions are unnecessary, that these transfusions have important negative consequences and costs, and that anemia and common anemia drivers like phlebotomy are underappreciated. A significant contributor to this quality gap is a clinician knowledge gap in assessing the risks and benefits of transfusion, and lack of attention to prevention and treatment strategies for anemia.

The first step in a successful anemia initiative is to ensure that you have educated all providers at your institution on the rationale for your initiative as well as any changes to clinician workflow, such as any new or revised protocols and forms. Your QI team should engage providers on the importance of anemia management and the intervention(s) you have selected (the examples below concern restrictive transfusion practices). *Make sure you conduct adequate education and stakeholder consultation before you implement your protocol, or you may generate substantial resistance from clinicians who resent workflow and practices changes being thrust on them.* Some approaches to address the knowledge gap include:

- Development of educational programs on restrictive transfusion practices for events such as grand rounds, noon conferences or division meetings. Review your project in a concise and memorable way.
- Distribution of educational materials (e.g., pocket cards or ID badge attachments with evidence-based transfusion indications; one-page handouts)

- Guidance at the point of care. You can place links to educational materials within order sets in the EMR environment. Concise messages may fit in a paper or computer order set; e.g., “Whenever restrictive and liberal transfusion practices were compared, the lower Hgb target was equal or better.”
- Posters, signs and project boards, displayed throughout your institution. These can range from large displays on clinical units to one-page fliers posted in bathrooms.
- A nurse education campaign. By including education for all members of the healthcare team, you create advocates for restrictive transfusion who can speak up during interdisciplinary rounds or in one-on-one discussions about transfusion orders for individual patients.
- Development of conference-delivered or Web-based educational programs. Providers can be encouraged to attend presentations or use your Web tools in a number of ways. Programs can be worked into regular conference schedules or required for credentialing. Clinicians can be incentivized by provision of CME credit.
- Dissemination of information about your project at medical staff meetings.

Education will be a necessary component of your anemia management project, correcting knowledge deficits and contributing to culture change at your institution. Clinicians may begin viewing transfusion as a risk-conferring procedure that requires clear justification, beyond physician unease with hemoglobin numbers; they may recognize that daily “morning labs” are uncomfortable and costly, disrupt sleep and contribute to anemia, and are not benign, routine or required. However, other interventions will need to be layered into your QI project for best results.

6.1.2 Intervention 2: Development of a Transfusion Protocol

Having developed a list of acceptable indications for transfusion at your hospital, your challenge now is to develop an order set based on those indications which 1) educates providers at the point of care, 2) encourages best practices, 3) allows for protocol deviations in special circumstances, 4) accomplishes these goals without creating additional work for your clinicians — or if possible, makes their work easier, faster and more pleasant. This is likely to be your most powerful intervention. A properly designed order set — emphasizing a lower transfusion threshold and single-unit dose — reduced off-protocol transfusions in one hospital by about half, with a substantial cost savings;¹⁰² a similar effort reduced transfusions by 20 percent in another facility.¹¹⁹ Institution-wide protocols have obvious advantages, but if consensus across an entire hospital cannot be reached, a protocol can also be implemented by a specific service, e.g., cardiothoracic surgery.¹²⁰

Your order set should ask for a transfusion indication, usually via boxes to check on a paper form or buttons to click on a CPOE order set (**see Figure 4 for one example**).

FIGURE 4

The screenshot shows two sections of an EMR interface. Section 4, 'Transfusion Indications', has a red warning icon and contains several buttons: 'Anticipated surgery', 'Active blood loss', 'Hgb < 7', 'Hgb < 8 and acute coronary syndrome', 'Hgb < 8 and acute cerebral ischemia', 'Apheresis', and 'Other (See comment)'. Section 5, 'Special Needs/Attributes?', has a magnifying glass icon and contains a search box, a blue 'None' button, and a button for 'Heme malignancy patient (Irradiated)'. Both sections have empty text input fields to the right.

If your team has decided on thresholds that vary by hemoglobin value (e.g., <7g/dL, except in the setting of stroke or myocardial ischemia), special circumstances can be listed among the options. Alternatively, your EMR may have the capacity to vary the options displayed according to the patient's most recent hemoglobin value.

To improve adherence, default the best choice: since single units are the best choice in most situations, design your order set to emphasize this preference. Consider adding requirements such as physician certification of rapid bleeding for exceptions to this rule, but make sure these certifications are as easy as possible to complete (e.g., a box to click, instead of a blank to fill out).

Do not forget standardization across your institution. There may be several service- or provider-specific transfusion protocols embedded in admission order sets or as stand-alone protocols at your institution, and working with those stakeholders to ensure they are replaced with the updated version will be necessary for maximum impact.

You may recognize other opportunities for improvement as you review your existing order sets. For example, your protocol may order pre-transfusion medications as a default option or as options without any guidance. Your order set can advise best practices and refer users to resources (**Figure 5**).¹²¹

FIGURE 5

The screenshot shows a section titled 'Medications' with a dropdown arrow. Underneath is a sub-section 'Transfusion Medications' also with a dropdown arrow. A bolded note states: 'NOTE: There is no evidence to support universal pre-medication for blood product transfusion.' Below the note is a blue hyperlink: 'View 2010 Cochrane Review on Pre-Medication for Blood Product Transfusion'. At the bottom, there is a checkbox labeled 'Select if Pre-Medication is Desired with Blood Transfusion'.

When designing your order set, you will have to balance idealism and pragmatism. For example, you might want to make it quite difficult to order transfusions off-protocol. However, providers determined to transfuse their patients might find “work-arounds” to their protocol such as misidentifying the indication for transfusion. If you define your success as an improved percentage of packed red blood cells (PRBC) transfusions for Hgb <7 in non-bleeding patients, providers identify patients as bleeding to speed through your protocol, and you limit your analysis to patients who are non-bleeding according to the order set indication, your data may become unreliable. An educational program, and dialog with providers who recommend off-protocol transfusions, will be more effective than trying to force them to change their practices with an order set.

Educational materials (for patients or providers) and consent forms can be linked to your order set to save your clinicians the time they would have spent looking for them elsewhere.

6.1.3 Intervention 3: Real-Time Decision Support for Transfusion

If your institution has low rates of off-protocol transfusions, but you want to aim for near perfect compliance with your protocol, real-time expert consultation is one potential solution. With this intervention, *non-emergency* blood product requests would require approval from a designated blood bank staff member. Such a strong intervention and significant change to workflow requires considerable institutional will, stakeholder agreement and staff education. However, it sends a powerful message: blood is a “liquid transplant” that carries serious risks, and this scarce and expensive resource should not be used without clear justifications — which can generally be listed as on-protocol indications. Such a program allowed one hospital to reduce blood use by 38 percent, save more than \$2 million and cut utilization of plasma and platelets as well.¹²²

If a requirement for approval would not be acceptable to your stakeholders, a softer version of this approach could be used: bedside clinicians would retain ultimate decision-making authority, but the blood “czar” would contact ordering providers about off-protocol transfusions to confirm orders, allowing a moment for education about relevant clinical trials, or discussion of alternatives (e.g., waiting for thresholds to be reached intra- or post-operatively instead of transfusing prophylactically; tolerating asymptomatic anemia; treating underlying causes). If you lack full-time staffing for such a position, partial implementation would still allow you to reach some providers for real-time support while collecting information about their concerns and intentions that could help you revise your protocol.

6.1.4 Intervention 4: Identify and Treat Anemia in the Preoperative Setting

Sites that have successfully implemented transfusion protocols, achieving low rates of off-protocol transfusions, may identify opportunities for improvement in the area of prevention — e.g., can anything be done to prevent or reduce anemia in elective surgery patients, avoiding transfusion? In some ways, this intervention would be a separate QI project.

First, identify any additional team members you would need to involve to change how anemia is managed before elective surgery, and confirm that stakeholders and the institution support your effort. Second, to assess your baseline performance, ask clinical staff from key surgical specialties how anemia is managed in preoperative patients. Acquire data by searching for elective surgery patients who required transfusion, or whose last pre-hospitalization tests revealed anemia, and reviewing some of their charts to see if anemia was recognized, diagnosed and treated before surgery was scheduled.

Third, decide on best practices for preoperative anemia intervention (this may include a flowchart defining anemia evaluation and when to refer), and choose metrics and a data collection plan around these practices (e.g., process measures like percent of eligible patients who have preoperative CBCs, or percent of patients with Hgb values below a threshold who receive an intervention before surgery is performed, or outcome measures, like the percent of elective surgery patients [or percent of those who were anemic on preoperative testing] who require transfusion).

Fourth, consider clinic workflows and design an intervention. Options could include a checklist, CPOE best practice alerts or templated preoperative evaluation notes or paper forms that prompt anemia evaluations. You will likely want to focus on a well-defined population with a common preoperative workflow and an anticipated blood loss of 500 mL or more, e.g., elective major joint arthroplasty. Once your intervention has been vetted by stakeholders and piloted on a small scale, proceed with full implementation and monitor the results. Then consider applying your protocol to other surgical populations with a high anticipated blood loss.

6.1.5 Intervention 5: Reduce Blood Loss Due to Phlebotomy

As with preoperative anemia management, your team may identify opportunities to improve phlebotomy practices, reducing the incidence of anemia requiring transfusion and other harms, such as non-severe anemia, exhaustion of veins for phlebotomy/need for central access, pain, sleep disruption and increased costs. As with preoperative anemia, reducing excess phlebotomy would be its own QI project.

A phlebotomy project can be approached with the same framework used throughout this *Guide*, but there are some unique aspects and challenges. For example, it is hard to define “excess” phlebotomy. SHM’s *Choosing Wisely*[®] recommendations include avoiding “repetitive CBC and chemistry testing in the face of clinical stability,” but stability is subjective, and studies that define the optimal frequency of lab tests for diverse patient populations are lacking. Also, lab ordering is so frequent, any changes to the process could be onerous. Thus, your phlebotomy reduction project will need to be less proscriptive than your transfusion protocol. Possible strategies include:

- Educational initiatives aimed at shifting lab-ordering culture from a morning default to mindful consideration of need.

- Eliminating or limiting the ability to order daily labs within your EHR.
- Considering a switch to low volume collection tubes so less blood is removed for standard tests/tubes. (This does not necessarily mean pediatric tubes, which can have implications for compatibility with lab equipment; there are adult tubes designed to collect less blood.)
- CPOE modifications that suggest using add-on testing if the lab has a suitable sample, notify the provider if the requested test has already been obtained within predefined intervals, eliminate the option to order ongoing repetitive tests or notify providers about lab costs. Such changes could reduce phlebotomy by 20 percent.¹²³
- Individual or service-specific feedback on performance, or financial incentives.
- Reconfiguring workflows in which multiple tubes are drawn “prophylactically,” so that samples are available for any conceivable test. Changing sample collection tubes so less blood is drawn per stick.
- To address blood loss apart from phlebotomy, consider acquiring a team member who can assess surgical techniques including blood salvage to reduce post-operative anemia.

Demonstrating a clear relationship between this effort and improved hemoglobin values or reduced transfusion rates may be challenging given the numerous causes of inpatient anemia. However, you could demonstrate reductions in lab costs or draws, or calculate how much blood you saved — all worthwhile measures of success.

6.1.6 Intervention 6: Diagnose and Treat Inpatient Anemia

There are likely patients at your institution with anemia due to iron or vitamin deficiencies, chronic kidney disease (CKD) or inflammation, who are at risk for anemia progression or transfusion, but who do not receive proper evaluation and/or treatment. Anemia in inpatients is so common it can be perceived as normal, and clinicians may be focused on more acute problems.

There may be ways to search your EMR for patients with anemia of a certain severity, rate of progression or diagnosis that may benefit from intervention (e.g., transfusion recipients with a low MCV, or elevated creatinine). If you are able to identify a treatment population, you might consider intervention with triggered consultation, or a best-practice alert on the EMR recommending action or referring providers to an anemia evaluation protocol. You could develop a protocolized approach to anemia in CKD patients, and work with nephrologists to address anemia in their consultation work.

While such strategies would be appropriate and evidence-based, the target population is large, the diagnoses and interventions are diverse, and published experience with anemia QI interventions that changed important clinical outcomes is lacking. However, if you have addressed “lower hanging fruit” already, your team may have enough bandwidth or EMR capability to attempt an anemia intervention — or you may be able to change the practice of a focused set of clinicians (e.g., the

nephrologists in the example above, or gastroenterology consultants who see iron deficiency often) without expending much time or money.

6.1.7 Intervention 7: Patient Education

Most of your interventions will focus on improving the decisions made by clinicians. However, patient knowledge about anemia and its treatment can affect transfusion rates, and creative approaches to the consent process could improve the success of a restrictive transfusion protocol.

If you investigate the blood consent process at your institution, you are likely to find that it involves a decision by the clinician that a transfusion is required (often without rigorous evidence) followed by a brief warning about uncommon complications of transfusion and the acquisition of permission to proceed. These discussions may not be meaningful: the clinician feels that blood is needed, the patient is expected to agree and the consent form is a formality. However, consent could be reframed as a review of options with their own rationales, risks and benefits.

First, the consent form could be redesigned to reflect your institutional best practices, such that the clinician must identify the evidence-based indication for transfusion (or in the case of preemptive consents, under which circumstances blood will actually be transfused). When the indication is a hemoglobin threshold, the consent form can reinforce the patient-centered option of waiting for anemia symptoms — treating the patient, not the number. Such a change could increase patient engagement and knowledge, and serve to reinforce the education to clinicians, who could be required to check off boxes indicating they discussed which indication (or that their choice was off-protocol) was present, the alternatives and risks, and that they reviewed the preference for single units. A form previously used to document consent for blood can be transformed into a form that records a discussion of options, including no transfusion. A brief video with examples of poorly and properly obtained consents could make a powerful tool to educate clinicians on this change.

Second, patients at high risk for needing transfusion (such as those in preoperative clinics, or oncology patients) could be given easy-to-understand educational materials like handouts or videos that emphasize your institution's list of indications for transfusion and advise them of the risks of blood. This can facilitate true “informed” consent rather than acquiescence to a clinician's decisions.

6.1.8 Intervention 8: Feedback of Performance to Providers

Feedback to providers regarding the progress in achieving your anemia QI project outcomes can be an effective method to support the change process. Reports detailing outcomes can be hospital-, unit-, service- or provider-specific. In addition, the results can be provided in real-time, or after retrospective audits. To provide real-time feedback, your EMR would have to track processes like recent CBC results or completion of an anemia evaluation in preoperative clinic, or perhaps whether

key anemia diagnostic tests were obtained in patients with hemoglobins below a certain threshold. To reduce unnecessary phlebotomy, providers could be notified that a lab they are ordering has already been obtained within a pre-specified time frame (e.g., hemoglobin A1c within three months) or seems appropriate to be batched with other labs or added on to existing samples.

Real-time outcomes information is actionable and can improve your results. For example, a real-time report could identify all the patients who have ongoing daily labs ordered, allowing a clinician to reconsider their lab ordering practices. Other information, however, can be collected retrospectively. Transfusion decisions should be enhanced and assisted at the point of care; once transfusions have been given, immediate feedback won't change outcomes. However, a retrospective review of off-protocol transfusions can provide valuable information to the QI team (e.g., which services and providers order the most off-protocol blood and why, permitting targeted education and other interventions). Retrospective data about transfusion practices can be stratified by service and distributed to service leaders, allowing comparisons of different services and possibly creating some healthy competition for improvement. Data can also be stratified at the physician level, providing feedback to individuals; clinicians who give blood without documenting sufficient justification could be sent reminders about the protocol or referred for peer review. This can motivate low performers and allow you to recognize the highest performers. Exactly what feedback is provided to whom depends on your institution's norms and culture, and your data collection capabilities.

6.1.9 Intervention 9: Hospital-Based Policy and Incentives

An important aspect of change management is the formation of hospital policy that supports the processes developed within your anemia QI project. For example, to ensure that restrictive transfusion practices are followed, a hospital may develop policies requiring the use of a protocol with identification of an approved transfusion indication or documentation of special circumstances. In addition, the hospital might have external financial incentives based on achievement of transfusion performance goals, and could reward the highest-performing groups or physicians with recognition or actual financial incentives.

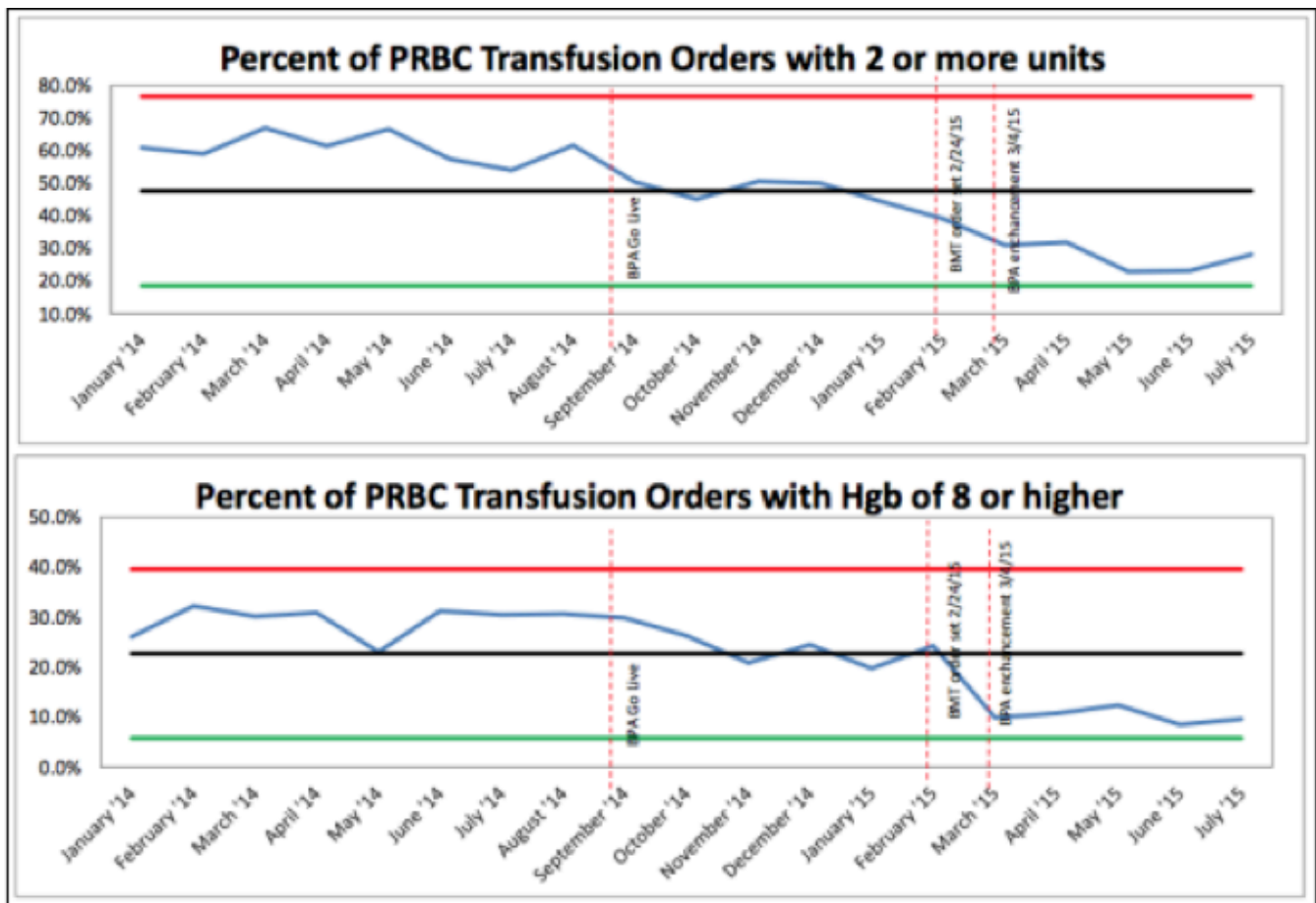
6.2: Monitoring the Effect of Your Interventions

Tracking and trending data over time will be important to monitor the progress of your QI project. Robust data collection strategies will be needed to track your performance over time through the EMR or by random sample abstraction of paper charts.

Your QI team may choose to track a variety of different outcomes, such as rates of transfusion for hemoglobin levels above target thresholds, or phlebotomy rates. It may be helpful to track your measures by hospital unit, service or individual providers. The duration and frequency of evaluation will need to be determined by your QI team. Graphs and run charts may enhance your ability to

understand and communicate your results (**Figure 6**). Analysis of inappropriate transfusions or other deviations from protocols can illustrate the changes needed for your next improvement cycle.

FIGURE 6. GRAPH FROM A FACILITY WHICH SUBSTANTIALLY REDUCED INAPPROPRIATE TRANSFUSION



6.3: Sustainability

Before embarking on any QI project, the team must consider how its efforts can be made sustainable. Without this essential step, any improvements can be lost when a planned intervention period ends or when busy individuals are inevitably required to move on to other projects. There are two main strategies for sustainability.

The first and easier strategy is the use of hardwired changes and redesigned workflows. As one obvious example, a CPOE change (e.g., that reminds providers that one-unit doses and a transfusion trigger not higher than 7-8 g/dL are preferred) will continue to yield results with almost no further

effort (any care protocol requires occasional edits as new clinical evidence becomes available). Having a team member contact individuals with off-protocol prescribing habits, however, is labor intensive and unlikely to be sustainable, although this strategy can be helpful at the beginning of a project to spread the word and gather clinician feedback. Similarly, automated data collection is vastly preferable to collection by chart review; if manual collection cannot be avoided, then obtaining the minimum essential information at designated intervals rather than continuously may be helpful. For example, you could check on total blood usage per admission relatively easily, and do periodic spot checks to see if pre-transfusion hemoglobins are appropriate.

The second major strategy for sustainability is culture change. The importance of culture can be illustrated by considering how often clinicians ignore multiple hand hygiene stations on their way to providing patient care despite knowing how important hand hygiene is. Similarly, an intern ordered to order two units of blood for a target Hgb of 9-10 g/dL by an attending who has always done it that way is likely to comply no matter what your order set says. You can attempt to shift culture by employing respected local leaders to drive change, making moral/emotional pleas by using patient vignettes along with facts, using incentives to reward change (e.g., recognition, prizes or financial incentives) and using systems to eliminate hierarchies and promote safe cultures, e.g., the TeamSteps or OntheCUSP systems.¹²⁴ However, culture change can be a long, difficult process and you may also want to leverage your executive sponsor to obtain a top-down message that cooperation with institutional anemia protocols is expected.

Even if you have a project ideally designed for sustainability and you have achieved your goals, anticipate doing some periodic maintenance. For example, you may want to educate new clinicians to the protocol, particularly if you are an academic center and you receive an influx of interns every July. You will also want to spot-check on your transfusion rates or other processes, and investigate any signal that practice has regressed toward old habits.

Step 7: Improve Transitions of Care for Patients with Anemia

This step focuses on optimizing the care transition at discharge from the hospital. Much of the advice is not specific or unique to anemia management. One of the challenges is that anemia is often a secondary diagnosis and may get lost in the transition where the focus is likely to be on CHF, pneumonia, AKI or whatever the primary problem may be.

7.1 Initiating Anemia Therapy Using “Teach Back”

Although patients with newly prescribed anemia therapies should be educated about multiple aspects of medication management such as drug-drug interactions (e.g., PPIs and oral iron) and new dietary restrictions (e.g., dairy products and oral iron), the most important items to stress at discharge are:

- Follow-up that assesses response to treatment (e.g., a repeat hemoglobin after discharge)
- Follow-up to pursue further investigations to determine etiology (e.g., colonoscopy to evaluate for source of blood loss in iron deficiency)

Studies indicate that up to 40–80 percent of medical information that patients receive is forgotten immediately and that nearly half of the information retained is incorrect.¹²⁵ Clinicians have a duty to provide information in simple, clear and plain language and to check that patients have understood the information. The *Teach Back* method is one effective way to ensure that the information you provided was understood.

Teach Back means that the clinician educates the patient, then asks the patient to repeat, in his or her own words, what the patient needs to know or do. *Teach Back* is not a test of the patient but of how well the clinician has explained the information. It is also a chance to check for understanding and, if necessary, to re-teach the information. Finally, *Teach Back* creates the opportunity for dialog in which the provider gives information, and then asks the patient to respond and confirm understanding before adding any new information.

Despite recent research showing the many benefits of *Teach Back*, surprisingly few providers actually use it every day. Clinicians may not be familiar with the *Teach Back* method or may find it difficult to change their communication style. *Teach Back* is not time consuming and only takes a minute or two, but this technique may require a little practice to master. Clinicians can practice *Teach Back* with a few patients at first, and use the method more often once they are more confident of their skills. It is important to remember the *Teach Back* process can be used any time health information is provided to patients, including providing instructions, teaching a technique for medication administration or even explaining a diagnosis. In the instance of anemia management, proper understanding of the need for follow-up and medication management may lead to better adherence.

7.2 Post-discharge Phone Call

Studies indicate that the first 48 hours after discharge from the hospital represent a vulnerable time for patients to present back to the emergency room or hospital setting due to factors such as lack of understanding of medication management, symptom onset without having an action plan or anxiety relating to their illness. Although it is suggested that patients follow up with their primary care doctor after discharge, there may be a time lag between hospital discharge and outpatient follow-up. The discharge phone call is an effective method to communicate with patients during this gap in time to further discuss their medical concerns, reinforce the discharge plan or help with problem-solving.

The post-discharge phone call may be done by the nurse who managed the patient or by a staff member from the unit from which the patient was discharged. The caller should review a copy of the discharge summary and instructions prior to speaking with the patient. Typically the phone call is done the day after discharge.

Important questions to ask the patient during the post-discharge phone call include:

1. Were you able to obtain all of the medications that were prescribed to you?
2. Do you have any confusion regarding the brand and generic names of your medications?
3. Are you having any side effects from your medications?
4. Do you have any questions about the information provided in your discharge instructions?
5. If you develop symptoms, do you know which are severe enough to call 911 or which can be addressed by a phone call with our doctor?
6. Do you know when your follow-up appointment is scheduled with your doctor?

The above approach is not specific to anemia, and many organizations will struggle to reliably institute even this general approach, so adding further anemia-specific elements may not be realistic. That being said, if you think your organization is up to the task, the most important anemia-specific item to include would fall under Question 6 above:

- Do you understand the need/plan to reassess your anemia at your follow-up appointment to ensure proper treatment AND evaluation?

7.3 Elements of a “Quality” Discharge

It is imperative that there is a safe, evidence-based transition from the inpatient to the outpatient setting for all patients. Some components of the discharge process include careful medication reconciliation, completion of a discharge summary with forwarding to the primary care doctor within 24 hours, education of the patient on a symptom management plan and the placement of a call to the primary care doctor to discuss the hospital course and all follow-up issues (if the primary care doctor is receptive and particularly if there are things that may not be adequately conveyed in a discharge summary). It is very important to assist the patient in the scheduling of a timely follow-up appointment with the primary care doctor. The discharge process should also include a review of the medication profile to reduce polypharmacy and thus reduce risk of non-compliance and drug-drug interactions.

7.3.1 Assess Risk for Nonadherence

At the time of discharge, it is also important to consider the direct and indirect costs for anemia treatment options. Ideally, insurance coverage should be checked and an estimate of out-of-pocket costs provided to the patient. If intravenous iron or therapy with an erythropoiesis-stimulating agent is recommended, it is appropriate to verify that the patient has access to an infusion center, insurance coverage for proposed treatments and any prior authorizations that may be required.

7.3.2 Ensure Adequate Patient Education

Patients should be educated about their anemia and the implications for both therapy and further diagnostics. For example, patients with iron deficiency anemia should be able to teach back that they will need follow-up and further evaluation for a source of blood loss (e.g., colonoscopy) if the source of blood loss remains unclear at discharge. Similarly, patients should receive education about new medications for anemia. If patients are being prescribed oral iron, they should be educated about the possible side effects (e.g., nausea, constipation, black stools) along with potential mitigation strategies such as stool softeners, anti-emetics and ultimately the possibility of transitioning to IV iron if they cannot tolerate (or do not respond to) oral iron. Reliable attention to patient education at the point of discharge from an acute care hospitalization may increase the likelihood of patient compliance and decrease the likelihood of readmission.



Section III: Conclusion

Although hazardous, anemia is frequently ignored, exacerbated by wasteful practices such as excess phlebotomy, or inappropriately treated, most often with inappropriate transfusion. However, anemia is easily treated, and effective protocols have been developed to guide physicians in their care of anemic patients. Improving the management of anemia therefore represents a great opportunity to improve patient outcomes and reduce costs and adverse events.

SHM hopes you found this *Guide* to be a useful compendium of information regarding how to improve the management of transfusions and other anemia-related care processes at your hospital. SHM recognizes the challenges facing a QI team that has embarked on an anemia management project, given the scope and complexity of the problem. A systematic approach to the process (including forming a multidisciplinary team, obtaining institutional support, assessing baseline performance, thoughtful design and implementation of interventions, and careful monitoring) increases the chance of success.

This *Guide* should assist your hospital in achieving success in implementing known anemia management strategies, but there is much to be learned about broad-based anemia management, anemia prevention and even optimizing well-studied aspects of anemia care with transfusion protocols. Therefore, hospitals are encouraged to publish their improvement experiences, or share any novel tools or strategies, by submitting them to anemia@hospitalmedicine.org for possible distribution on SHM's Anemia Management website.

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