Patient Blood Management: At the Forefront of Quality and Value in Healthcare

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- No conflicts of interest to disclose.

Objectives

- Define patient blood management (PBM) and summarize what comprises the discipline
- Appraise evidence for blood transfusion indications
- Start to brainstorm how you can develop a patient blood management program
- Evaluate strategies for effective collection, organization, and application of data at your hospital to optimize practice and monitor quality

Outline

- Part 1: Reducing unnecessary transfusions
- Part 2: Comprehensive PBM
- Part 3: Data and the future

PBM – What is it?

- Rationally optimizing anemia and hemostasis
- Goal of restricting use of blood components
- Improve patient outcomes, efficiency, and value

Value = Quality / Cost

PBM – Why do we care?

- Blood transfusion = most common procedure in US*
- Blood transfusion = one of the most overused procedures**
- PBM now considered standard of care

**HCUP Survey*

***Joint Commission Overuse Summit*

Units Transfused in the United States

Year	RBCs	Platelets	Plasma
2013	13.2 million	2.3 million	3.6 million
2015	11.3 million	2.0 million	2.7 million

NBCUS; hhs.gov

PBM Program – What might it encompass?

- Education program
- Optimize blood component use
- Diagnose and treat preoperative anemia
- Reduce/optimize blood loss in surgery/from lab draws

Project Management

Meybohm et al. Perioper Med (London). 2017.

Part 1: Reducing Unnecessary Transfusions

Blood transfusion is an epidemiologic activity

- Ordered by a variety of specialties
- Administered by a variety of health care staff

- Quality management perspective: education and training are essential
  - Those transfusing regularly may be more up to date on transfusion indications

Indications for blood transfusion - RBCs

- Significant acute hemorrhage
- Symptomatic anemia

Summary of Major RBC Threshold Trials

Trial	Population	Participants (n)	Thresholds (hemoglobin)	Primary outcome
TRICC	Critical care	838	7 g/dL vs 10 g/dL	30d mortality 18.7% vs 23.3%, P=0.11
FOCUS	Hip fracture	2016	8 g/dL vs 10 g/dL	Death or inability to walk across room at 60d, 35.2% vs 34.7%, P=0.9
Villanueva et al.	Upper GI Hemorrhage	921	7 g/dL vs 9 g/dL	Mortality at 45d, 5% vs 9% P=0.02
TRISS	Septic Shock	998	7 g/dL vs 9 g/dL	90d mortality, 43% vs 45% P=0.44
TITRE2	Post-cardiac surgery	2003	7.5 g/dL vs 9 g/dL	Infection or ischemic event in 3mo, 35.1% vs 33.0% P=0.3
TRICS-III	Cardiac surgery	4860	7.5 g/dL vs 8.5 or 9.5 g/dL	Composite, 11.4% vs 12.5% P<0.001 for noninferiority

Liberal RBC Transfusion Triggers

- Cause infections in 1 in 20 patients?
- Transfusions alter immune system
  - Transfusion related immunomodulation (TRIM)
- Meta-analysis: 21 trials, N=7593, restrictive vs liberal
  - Infection rate
    - RR 0.82 (95% CI, 0.72-0.95, p = 0.006)
    - If 7 threshold, NNT 20
  - RR in subgroup
    - Orthopedics: 0.70 (95% CI, 0.54-0.91)

Rhode et al. JAMA. 2014.

Liberal vs Restrictive Hemoglobin Triggers

- Systematic review, 31 trials, N=12587
- Range of clinical scenarios
- Restrictive thresholds
  - 43% reduction in overall transfusions
  - No difference in 30-day mortality or morbidity
  - No difference in pneumonia, wound infection, or bacteremia
  - Insufficient data for: ACS/MI, brain injury, stroke, thrombocytopenia, cancer/heme malignancy, bone marrow failure

Carson et al. Cochrane Database Syst Rev. 2016.

Society Guidelines – RBC Triggers

Year	Society	Hemoglobin Number
2001	Australasian Society for Blood Transfusion	7g/dL
2006	American Society of Anesthesiologists	No number
2009	American College of Critical Care Medicine	7g/dL
2009	Society for Critical Care Medicine	7g/dL
2011	Society for Advancement of Blood Management	8g/dL
2011	Society of Thoracic Surgeons	7 or 8g/dL
2012	National Cancer Care Network	7-9g/dL
2012	British Committee for Standards in Hematology	7-8g/dL
2016	AABB	7-8g/dL
2017	HVPAA	7-8g/dL

Indications for platelet transfusion

- Prophylaxis
  - General: platelet count <5-10k
  - Procedures: ?
- Therapeutic
  - Depends on stress to hemostatic system

Indications for plasma transfusion

- Massive hemorrhage
- Disseminated intravascular coagulation
- Thrombotic thrombocytopenic purpura
- Replacement of missing plasma constituent for which concentrates are not available

- Relevant to PBM: MTP, hemorrhage monitoring, thresholds, etc

What about cryoprecipitate?

- Contains fibrinogen, FVIII, vWF, FXIII, fibronectin
- Lower volume per unit
- Hemostasis hard to achieve without fibrinogen!

- Consider how you might identify patterns of over and underuse, particularly in patients with hemorrhage

The Cost of a Transfusion

- Acquisition cost (e.g. ~$200/RBC unit)
- Total activity-based cost model (e.g. ~$800/RBC unit)

- If all ICU patients in US hospitals treated with restrictive transfusion strategy → significant cost savings and many thousands of complications avoided

Shander et al. Transfusion. 2010.

The Science of Choosing Wisely — Overcoming the Therapeutic Illusion

David Casarett, M.D.

In recent years, the United States has seen increasing efforts to reduce inappropriate use of medical treatments and tests. Perhaps the most visible has been the Choosing Wisely campaign, in which medical societies have identified many tests, medications, and treatments that are used inappropriately. The result is recommendations advising against using these interventions or suggesting that they be considered more carefully and discussed with pa-

The success of such efforts, however, may be limited by the tendency of human beings to overestimate the effects of their actions. Psychologists call this our tendency to infer causality where none exists, the "illusion of control."[1] In medicine, it may be called the "therapeutic illusion" (a label first applied in 1978 to "the unjustified enthusiasm for treatment on the part of both patients and doctors"[2]). When physicians believe that their actions or tools are more effective than they actually are, the results can be unnecessary and costly care. Therefore, I think that efforts to promote more rational decision making will need to address this illusion directly.

The best illustration of the illusion of control comes from studies in which volunteers were asked to figure out how to press a button in order to cause a panel to light up.[3] The volunteers searched enthusiastically for strategies and were generally confident that they'd succeeded. They didn't know, however, that their success was determined entirely by chance.

The phenomenon has since been described in widely varied settings. Gamblers, for example, consistently overestimate the control they have over outcomes, both in gambling and in everyday life. Their belief leads them to engage in seemingly bizarre or ritualistic behaviors such as throwing dice in a certain way or wearing specific colors. But the illusion of control is widespread, and its effects may be enhanced when people are placed in posi-

Caveats of threshold approaches

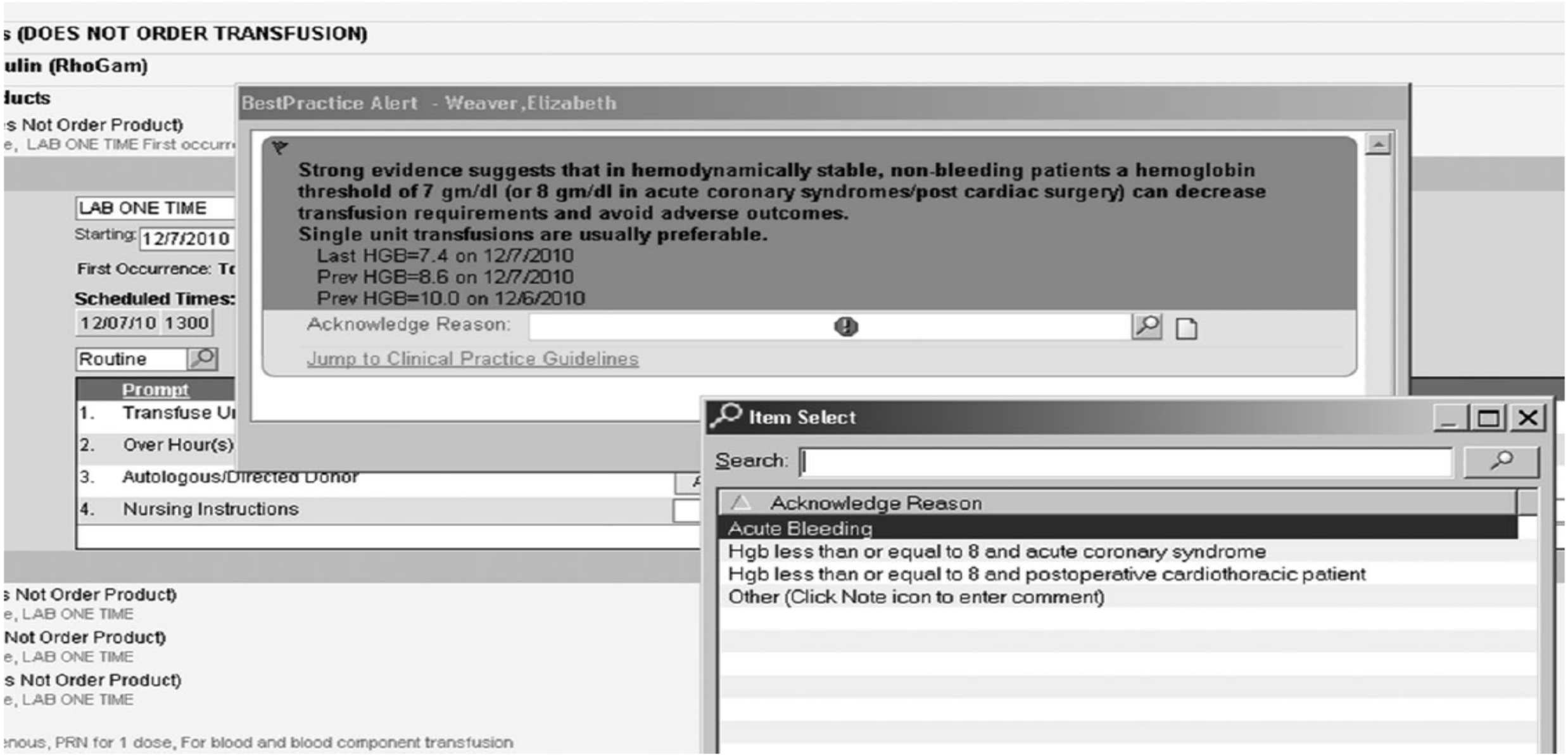
- Every patient is different
  - Symptomatic anemia
  - Patient-centered decision making
    - Consent

PBM strategies to reduce unnecessary transfusions

- Clinical Decision Support appears to improve RBC usage and successful efforts reduce costs
- RBC transfusion interventions reduce the proportion of patients transfused

Hibbs et al. Transfus Med Rev. 2015.
Soril et al. BMJ Open. 2018.

Clinical Decision Support – Design



Goodnough et al. Transfusion. 2014.

Education program

- Indications for transfusion, risks, evidence
  - Materials: e.g. learning modules
  - In-person: e.g. grand rounds

- Develop hospital guidelines, protocols for specific clinical situations

Soril et al. BMJ Open. 2018.

Part 2: Comprehensive PBM

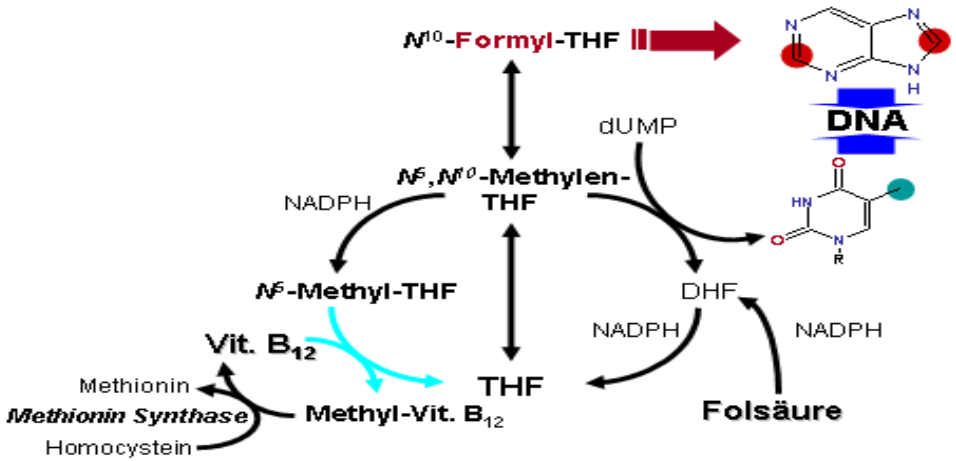
Project Management

- People
- Local standard operating procedures
    - Anemia and coagulopathy management
    - Blood conservation
    - Maximal surgical blood ordering schedule (MSBOS)
  - Massive hemorrhage protocols
    - Trauma, cardiac surgery, obstetrics

Meybohm et al. Transfus Med Rev. 2017.

Anemia Management

- Preoperative
  - Screening: 3-4 wks preop
  - Diagnose and treat iron/B12/folate deficiency anemia
- Optimize cardiac and pulmonary function
  - Acute normovolemic hemodilution
- Postoperative
  - Avoid unnecessary RBC transfusion



Meybohm et al. Transfus Med Rev. 2017.

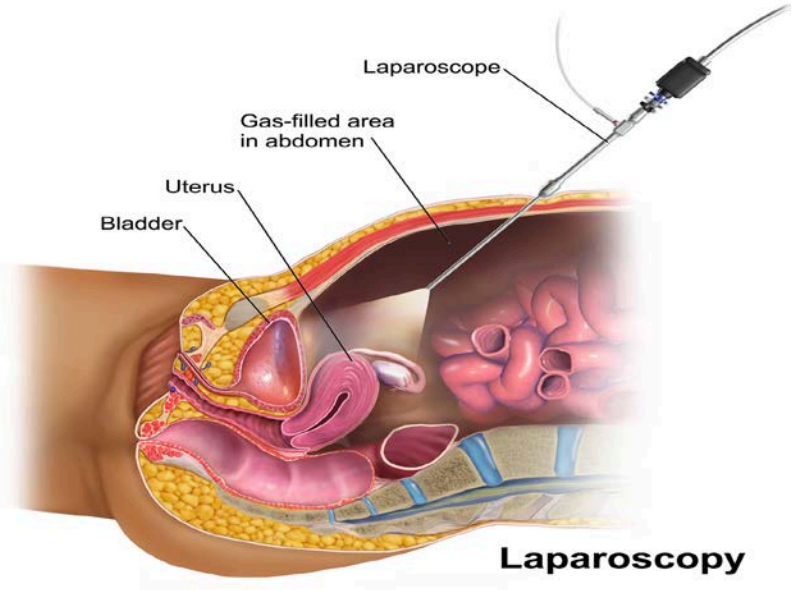
Optimizing Coagulopathy

- Preoperative
  - Algorithm for patients on anticoagulation or anti-platelet medication
- Management in hospitalized patients
  - Body temp > 36C
  - pH > 7.2
  - Hemorrhage monitoring (e.g. ROTEM/TEG, lab values)
- Coagulation algorithm for administration of blood components, factor concentrates, tranexamic acid
- Tranexamic acid for cardiac, ortho, obstetric hemorrhage, massive hemorrhage surgeries
- Uremic platelet dysfunction (e.g. DDAVP)

Meybohm et al. Transfus Med Rev. 2017.

Interdisciplinary Blood Conservation

- Diagnostic blood loss
  - Reduced tube size
  - Fewer draws
  - Appropriate timing (not daily)
- Surgical blood loss
  - Close attention
  - Minimally invasive techniques
  - Cell salvage



Meybohm et al. Transfus Med Rev. 2017.

Optimal Blood Use with Patient-Centered Decision Making

- Individual plan with triggers based on risk profile
- Informed consent
- Single unit policy
- Intelligent electronic ordering system
- Able to identify ordering physician
- Indication list (e.g. pocket card, posters)
- Documentation of the indication for each component

Meybohm et al. Transfus Med Rev. 2017.

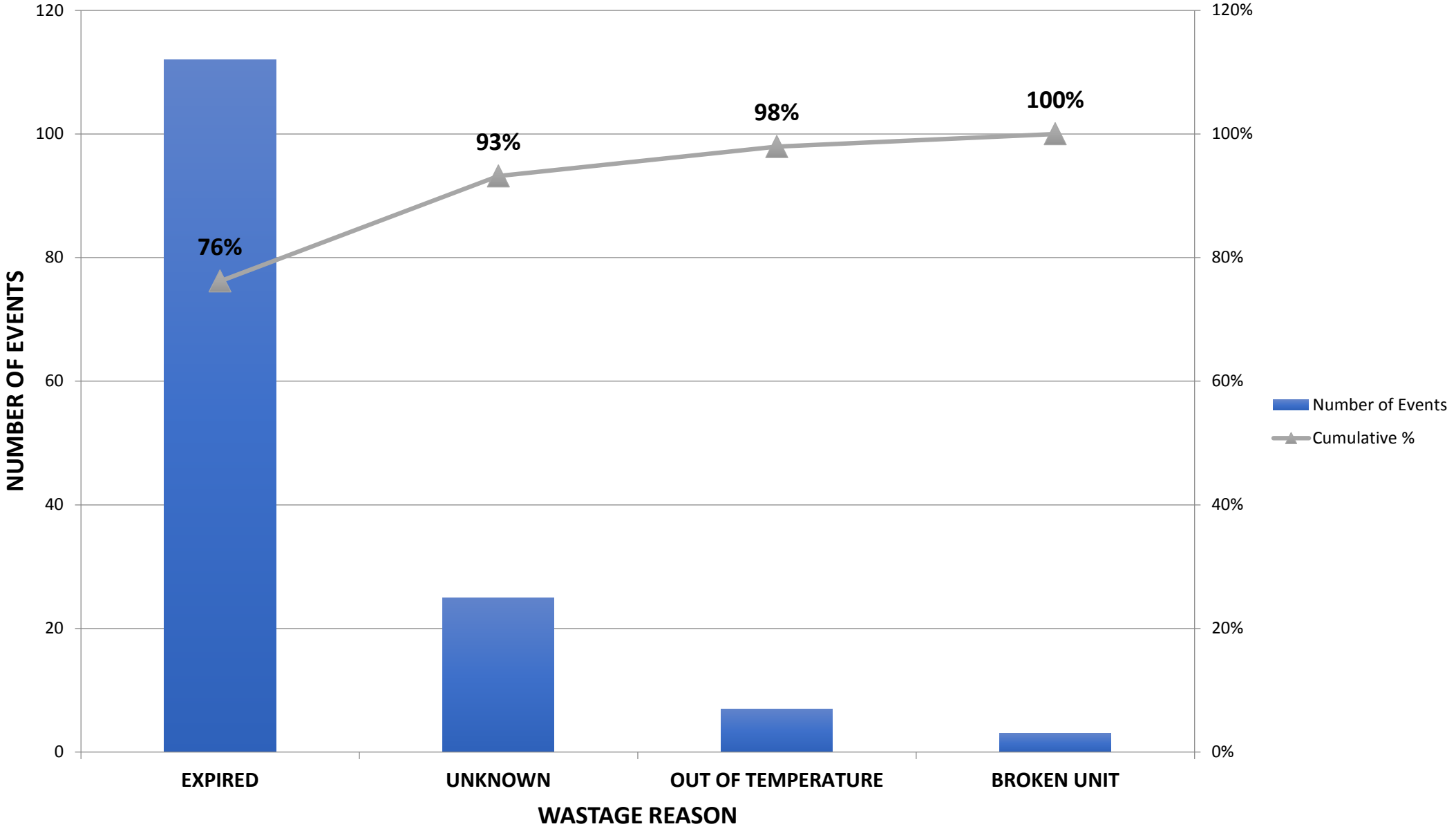
PBM-Related Metrics & Benchmarks

- Track anemia: preop, hospital-acquired, treated patients
- Blood conservation (e.g. TXA, cell salvage)
- Product usage by dept or procedure or physician: # units/patient
- Blood wastage
  - Crossmatch : transfusion ratio (<1.7:1)
  - Issue : transfusion ratio
  - Discarded products

Physician	RBCs Transfused / Procedure
Smith	0.5
Jones	8
Doe	1
Adams	1.2

Meybohm et al. Transfus Med Rev. 2017.

PLASMA WASTAGE AUDIT JULY - SEPTEMBER 2016

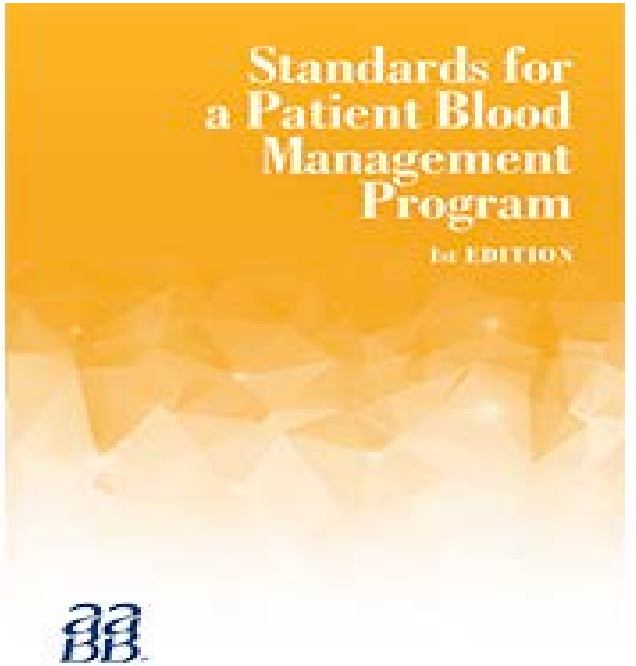


PBM-Related Metrics & Benchmarks

- Report to clinicians/hospital admin
- Patient outcomes
  - In-hospital mortality
  - Morbidity (infections, MI, stroke, etc)
  - Length-of-stay (LOS)
  - Hemovigilance

PBM-Related Metrics & Benchmarks

- Benchmarking
  - E.g. certain surgical procedures
- Program budget for PBM
  - Initial costs
  - Cost savings
- Hospital accreditation for PBM
  - E.g. AABB



Meybohm et al. Transfus Med Rev. 2017.

Example blueprints for PBM implementation

- *Meybohm et al. Patient Blood Management Bundles to Facilitate Implementation. Transfus Med Rev. 2017;31(1):62-71.*
- *Meybohm et al. Simplified International Recommendations for the Implementation of Patient Blood Management. Perioper Med (Lond). 2017;6:5.*

- *Sadana et al. Promoting High-Value Practice by Reducing Unnecessary Transfusions With a Patient Blood Management Program. JAMA Intern Med. 2018;178(1):116-122.*

- Know your hospital culture

Comprehensive PBM at your hospital

Perform a needs assessment, identify feasible interventions most likely to be effective

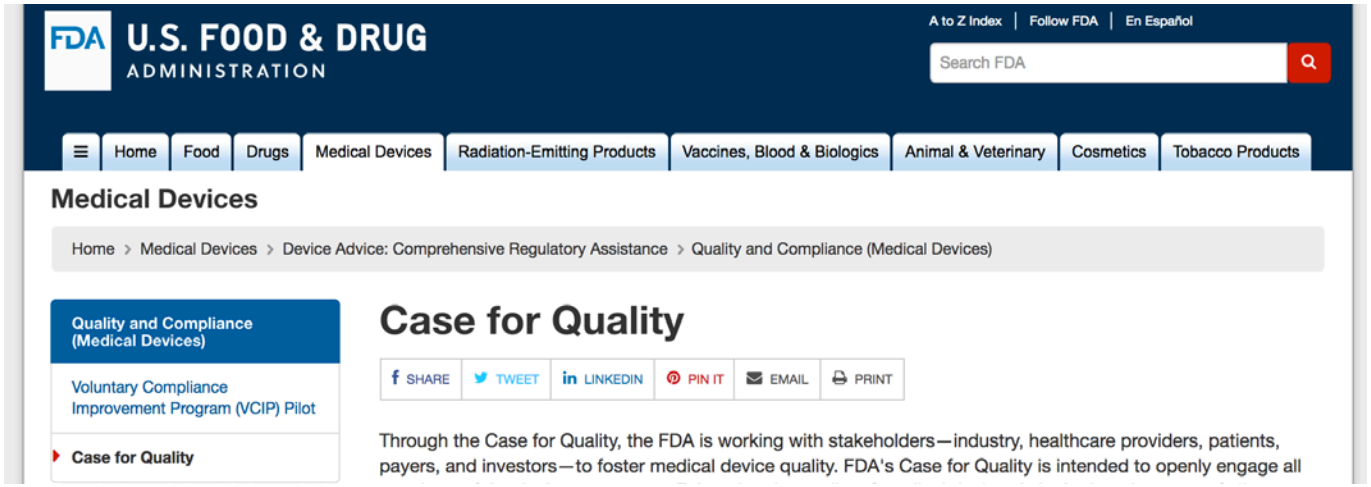
What is your hospital culture?

Use data to guide your approach

Part 3: Data and the future

FDA: Case for Quality

- Shifting from primary goal of compliance
- Drive industry beyond compliance by focusing on quality
- Core Components
  - Shift focus to quality
  - Enhance data transparency
  - Stakeholder engagement

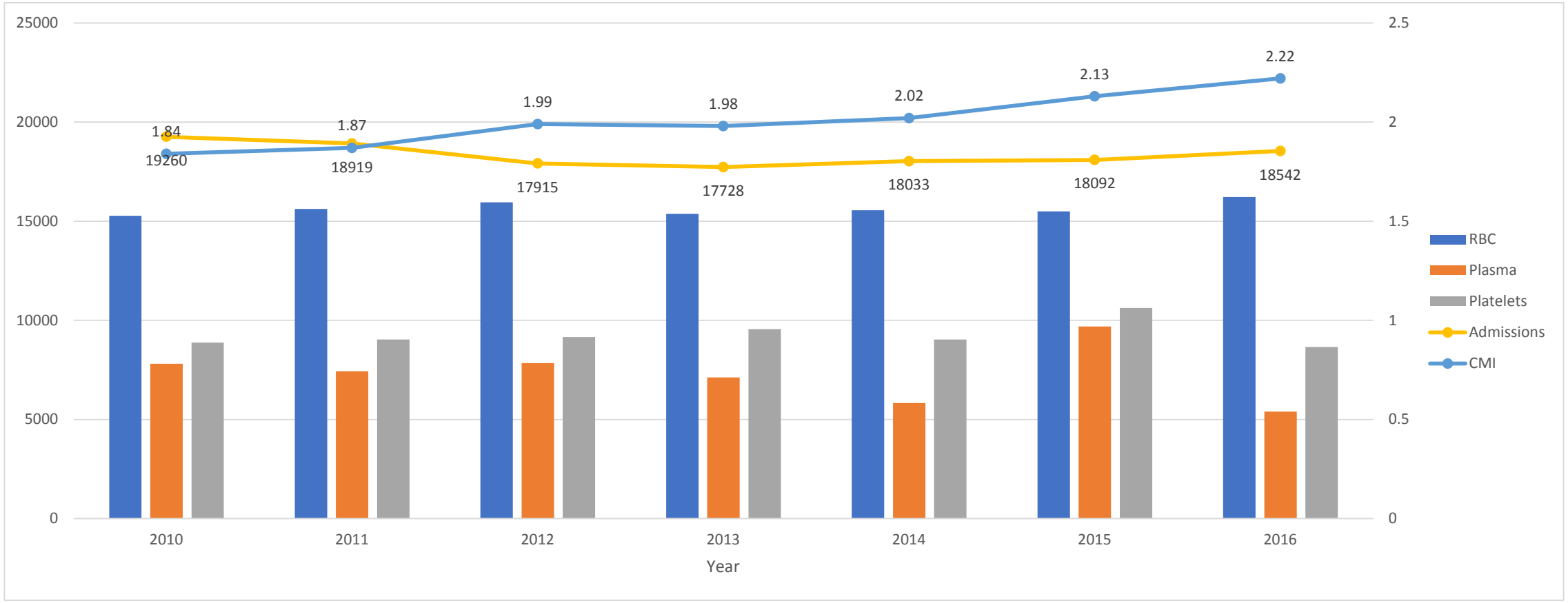


https://www.fda.gov/MedicalDevices/DeviceRegulationandGuidance/MedicalDeviceQualityandCompliance/ucm378185.htm

How to use data

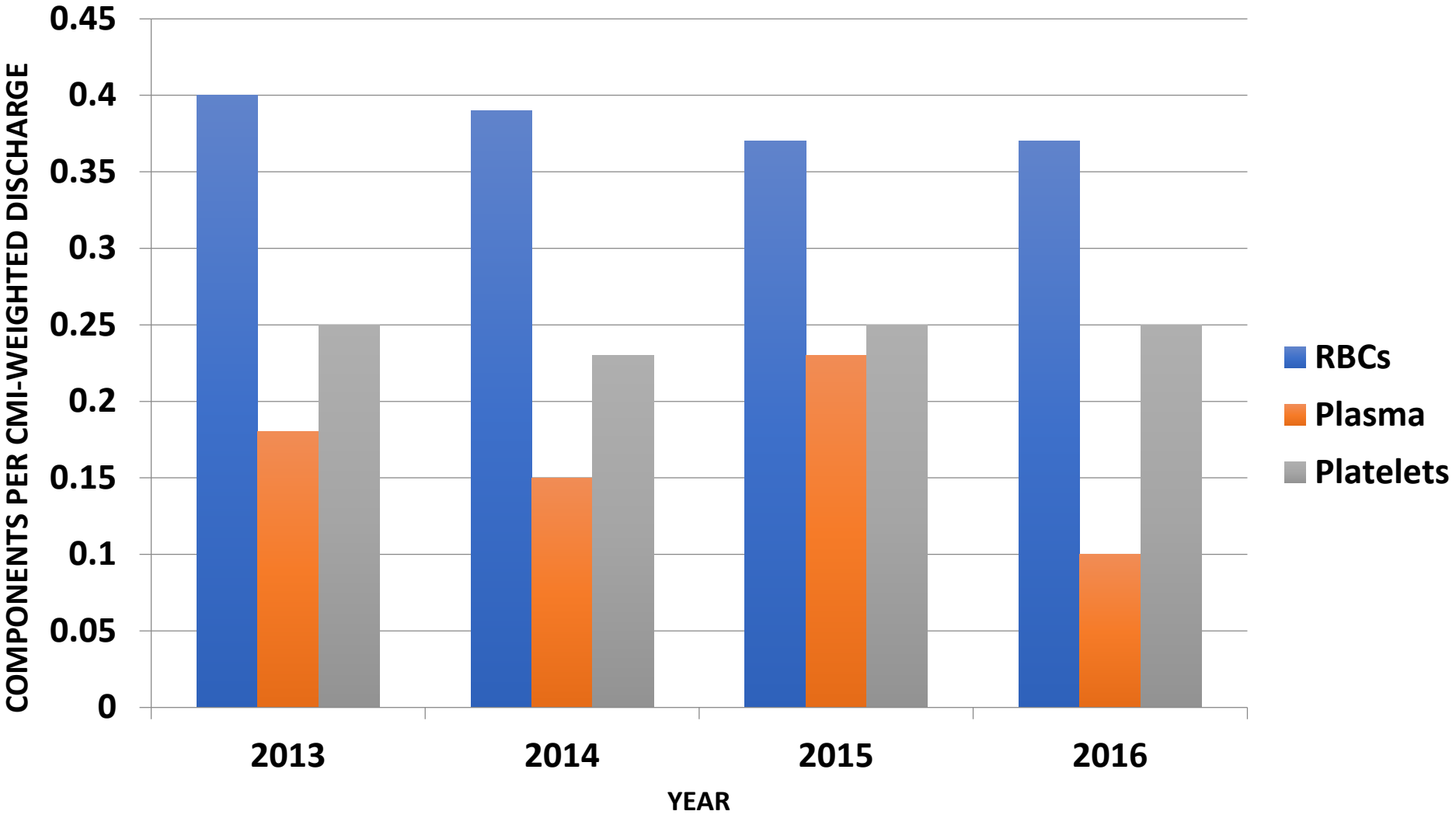
- Global transfusion utilization data
- Individual provider utilization data
- Risk-adjustment
- Predictive modeling

Global Blood Utilization By Year



CMI = Case Mix Index

BLOOD COMPONENTS TRANSFUSED PER CMI-WEIGHTED DISCHARGE



*Discharges exclude normal newborn encounters and clinical research subjects.

Individual Provider Utilization Data

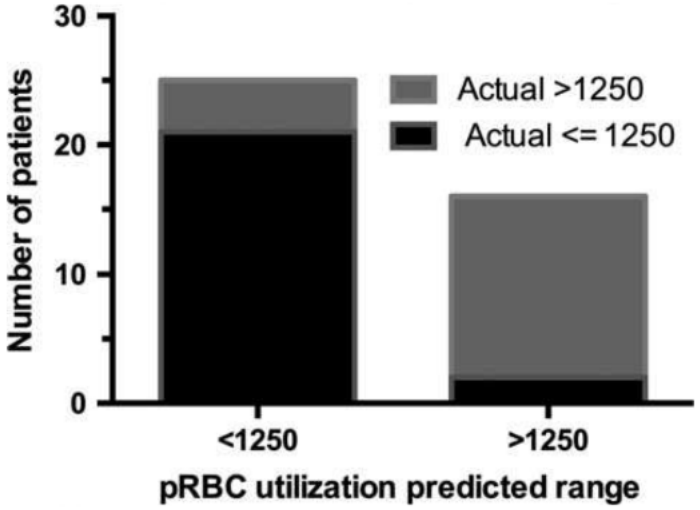
Admit Physician	Number of Admits	RBC Usage (mean)	FFP Usage (mean)	PLT Usage (mean)	DRG weight (mean)	RBC usage / DRG weight	Length of Stay (mean)	Severity of Illness	Risk of Mortality
Dr. X	30	9.6	13.8	7.9	13.9	0.69	20.1	3.7	3.6
Dr. Y	23	13.7	21.4	10.3	15.7	0.84	24.9	3.8	3.7
Dr. Z	50	7.1	11.2	5.5	14.8	0.48	17.5	3.6	3.4

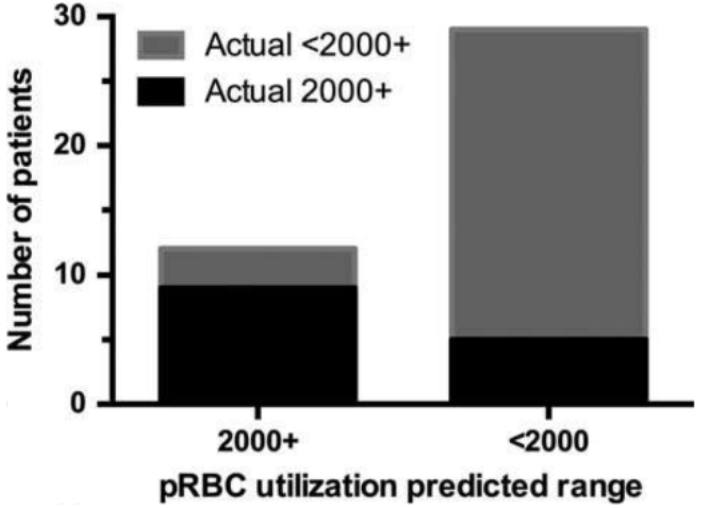
This example is over the entire hospital stay, but can look intraoperatively as well.

DRG = Diagnosis Related Group

Data-driven modeling

- 207 liver transplants with varied blood use
- Multivariable analysis to develop model predictive of intraoperative RBC transfusion volumes
- Preop Hgb, INR, spontaneous bacterial peritonitis, hemodialysis within prior week
- Easily plug variables into website, recommended preop blood order size





Metcalf et al. Vox Sang. 2018.

Big Data

- 3 Vs: Volume, variety, velocity (Laney)
- Generalizable transfusion medicine research vs applied use for your hospital
- Must carefully consider bias

Artificial Intelligence & Machine Learning

- Statistics vs machine learning (ML)
  - Inference vs generalizable predictive patterns

- Use of ML in transfusion medicine
  - Development of strong models to tackle research questions
  - Probabilistic predictive modeling using wide data for local application

Bzdok et al. Nature Methods. 2018.

Summary

- PBM interventions to reduce unnecessary transfusions appear to be effective
- Comprehensive PBM has several facets
- Take a practical approach for your hospital and its culture
- The future of healthcare will involve sophisticated use of data and hospitals with effective applications will succeed
  - PBM a perfect fit

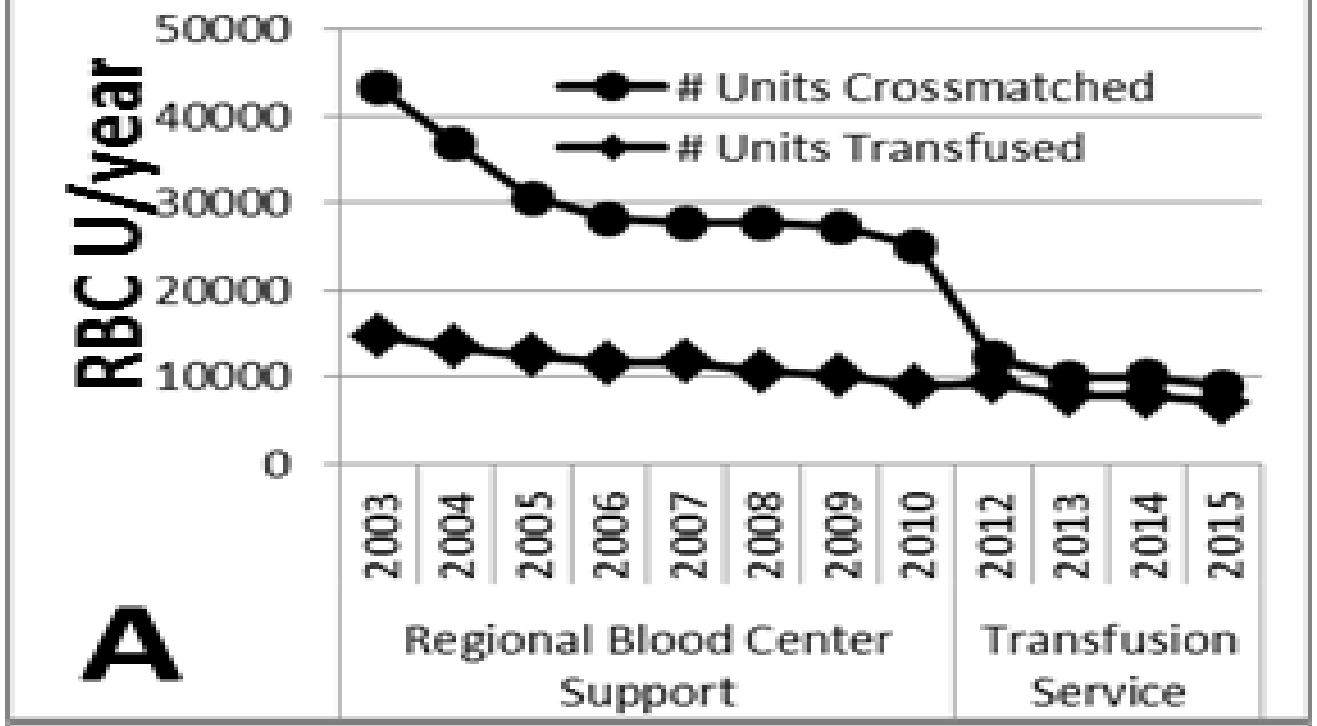
Summary: Strategy for your organization

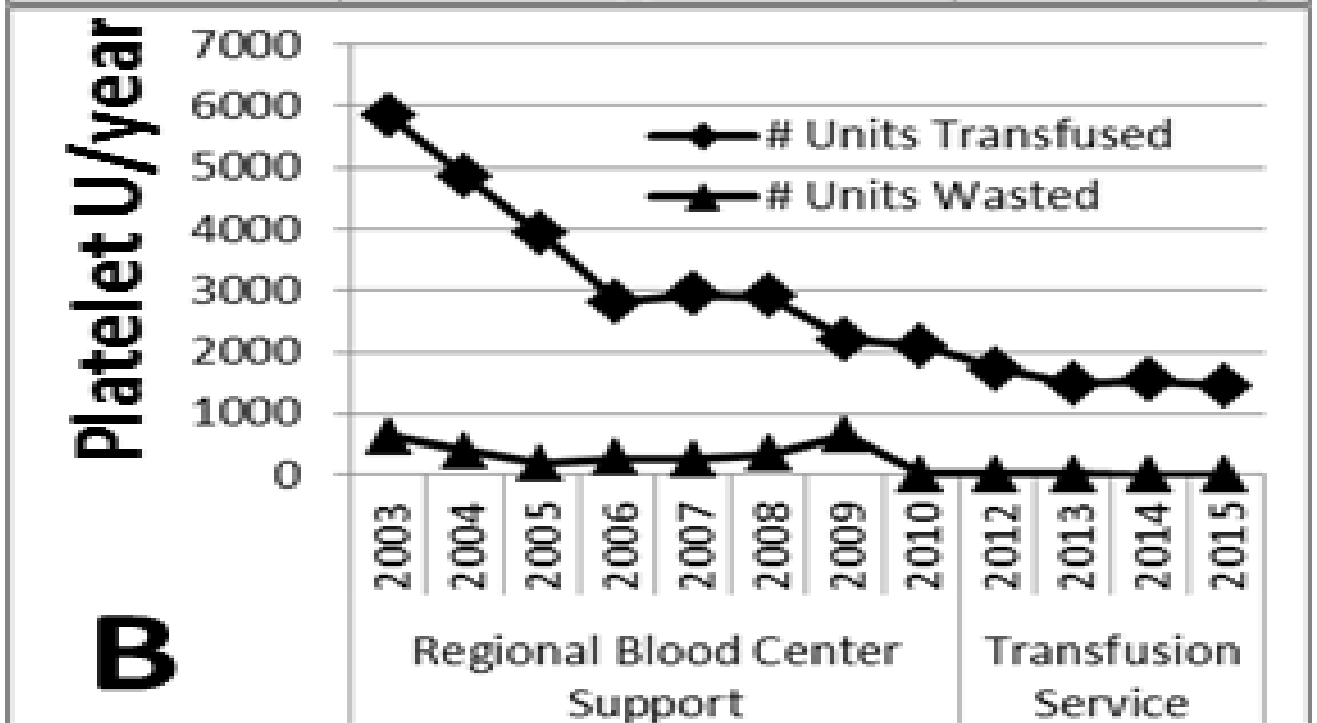
- Needs assessment
- Plan with timeline
  - Short term easy wins, longer term systematic approach

- People (e.g. leadership, other stakeholders, etc)
- Meeting / committee size
- Current training effectiveness
- Financial support
- Data and IT support

Every program is different; a blueprint isn't always needed!

Hess et al. Am J Clin Pathol. 2017.





Thank you

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