

# Practical Guidance for Treating Anemia in Cardiac Surgical Patients Including Next Generation Iron Therapies

## A surgeon's perspective

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October 24<sup>th</sup> 2025

The Korean Society of Patient  
Blood Management



# Disclosures

Baxter – Medical  
Consultant

hc1 – Medical Advisory  
Board

Pharmacosmos –  
Medical Advisor

# Objectives



Recognition of anemia in preoperative cardiac patients



Understand the various types of anemia



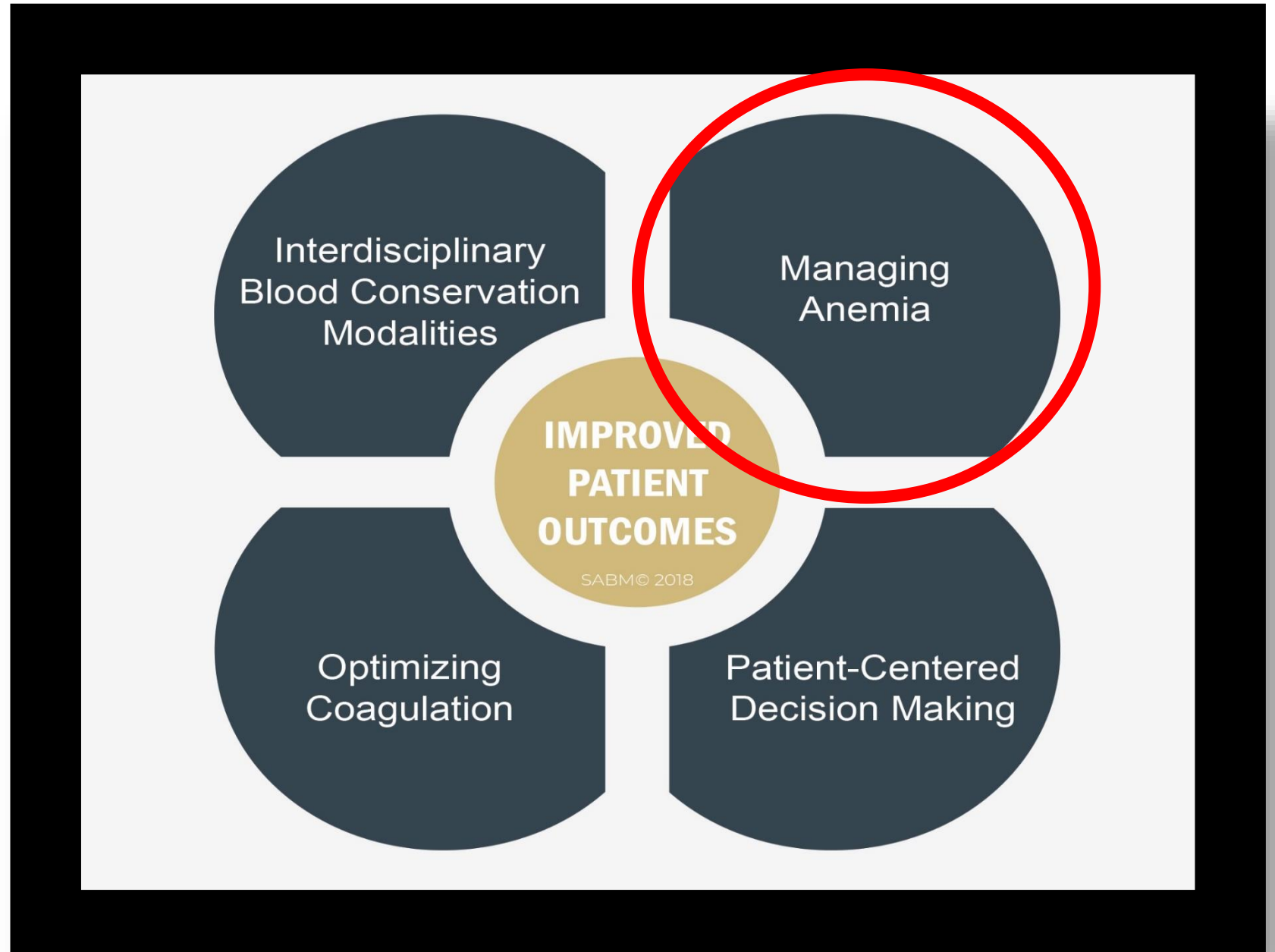
Discuss treatment for patients who are anemic or iron deficient undergoing heart surgery including Next-Gen Options

# QUESTIONS TO BE ANSWERED

***Cardiac surgery  
accounts for 15-20%  
of all perioperative  
blood transfusions***

- Why is iron deficiency with or without anemia important in cardiac surgery?
- What is the current therapy for iron deficiency and ID anemia in cardiac surgery??
- How can successful treatment be promoted?
- What is on the horizon in the treatment of ID and ID anemia in cardiac surgery?

# SABM/STS FOUR PILLARS OF PBM





So....whose  
role is it to  
manage  
anemia in a  
heart patient  
in the US?

Primary Care?  
Admitting Physician?  
Anesthesiologist?  
Intensivist/Hospitalist?

Only pre-op  
Only pre-op  
Only intra-op  
Only post-op

**It has to be the surgeon's role!!!!**



**Pre-op**



**Intra-op**



**Post-op**

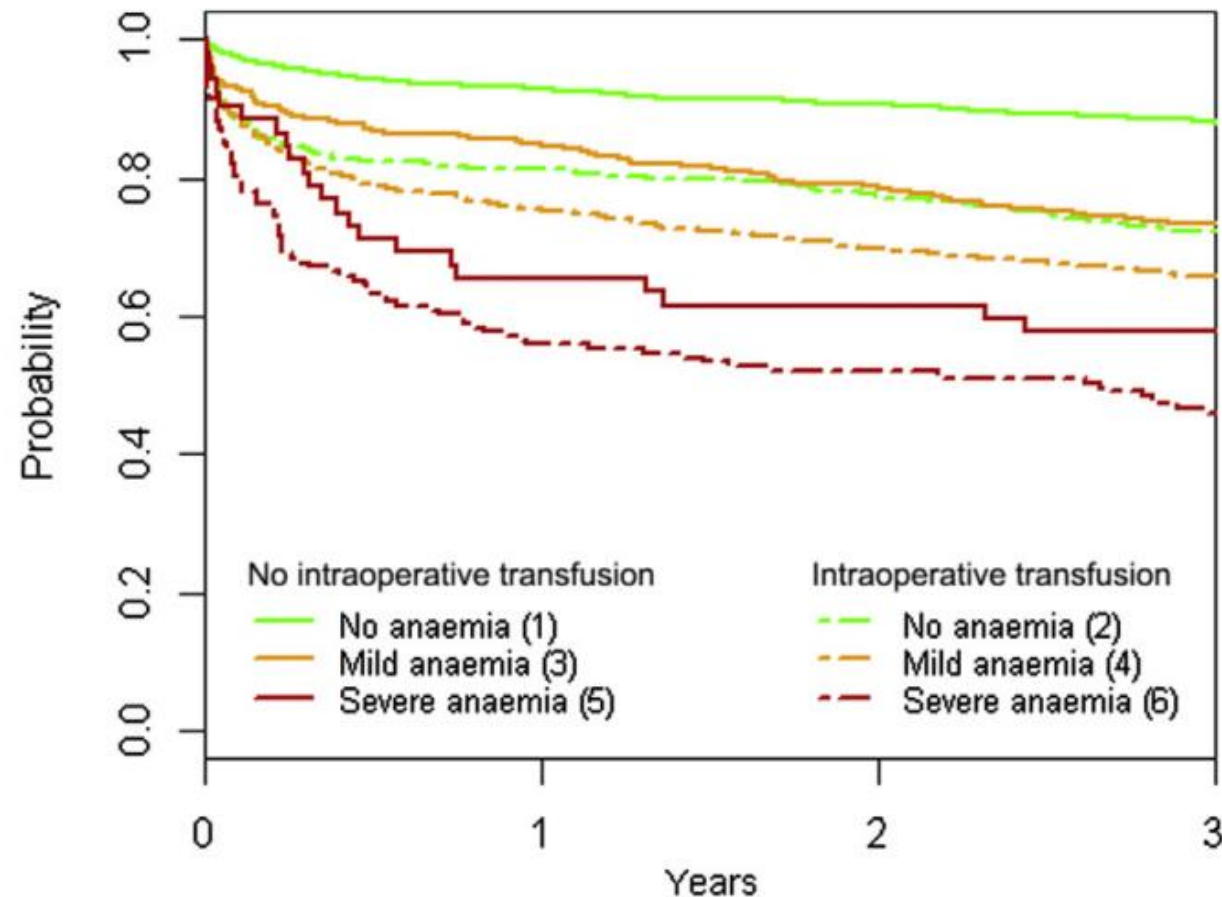
PBM spans the full spectrum of care and is to be practiced long before admission, surgery or any need for transfusion other than immediate and overwhelming blood loss. The surgeon is in the best position to do so.



# Does the severity of preoperative anemia or blood transfusion have a stronger impact on long-term survival after cardiac surgery?

von Heymann *et al.*  
*J Thorac Cardiovasc Surg*  
2016;152(5):1412–20

Kaplan-Meier curves depicting long-term survival of patients depending on anemia and/or transfusion.



Preoperative anemia has been shown to impact long-term survival in CTS patients


# Updated Guidelines Inform Surgical Practice

*In patients undergoing cardiac surgery, a restrictive perioperative allogeneic red blood cell (RBC) transfusion strategy is recommended in preference to a liberal transfusion strategy for perioperative blood conservation, as it reduces both transfusion rate and units of allogeneic RBCs without increased risk for mortality or morbidity. Class I, Level A*

Tibi et al. *J Cardiothorac Vasc Anesth* 2021;35(9):2569–91.

## PATIENT BLOOD MANAGEMENT GUIDELINES

### STS/SCA/AmSECT/SABM Update to the Clinical Practice Guidelines on Patient Blood Management

 Check for updates

Pierre Tibi, MD, R. Scott McClure, MD, FRCSC, Jiapeng Huang, MD, Robert A. Baker, PhD, CCP, David Fitzgerald, DHA, CCP, C. David Mazer, MD, Marc Stone, MD, Danny Chu, MD, Alfred H. Stammers, MSA, CCP Emeritus, Tim Dickinson, CCP, Linda Shore-Lesserson, MD, Victor Ferraris, MD, Scott Firestone, MS, Kalie Kissoon, and Susan Moffatt-Bruce, MD, FRCSC

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#### EXECUTIVE SUMMARY

Owing to the constantly evolving nature of the medical literature, The Society of Thoracic Surgeons (STS) clinical practice guidelines periodically undergo evaluation and updating. A multidisciplinary panel of experts was convened by STS, which includes members of the Society of Cardiovascular Anesthesiologists (SCA), the American Society of Extracorporeal Technology (AmSECT), and the Society for the Advancement of Blood Management (SABM), to review the latest data on patient blood management and to update the 2011 *Update to The Society of Thoracic Surgeons and the Society of Cardiovascular Anesthesiologists Blood Conservation Clinical Practice Guidelines*.

The concept of patient blood management informs the recommendations in this document and stresses the importance of an evidence-based, multimodal, and multidisciplinary approach to not just conserving blood resources but also optimizing outcomes in patients at high risk for transfusion. The individual recommendations are meant to be conceived of as part of an all-inclusive protocol-based and shared decision-making approach rather than isolated interventions to reduce blood loss and transfusion.

Because standards for clinical practice guidelines have evolved since 2011, the authors were tasked with prioritizing topics for systematic review, while still aiming for the comprehensive approach of previous versions of this article. These high-priority topics make up the bulk of this article and resulted in 23 new or updated recommendations. Additionally, all previous recommendations not directly addressed were voted on by consensus and can be found in [Table 1](#). Together, these recommendations address the full spectrum of care for patients undergoing cardiac surgery, as seen in [Table 2](#).

Blood transfusion is a critical and life-saving facet of the care for cardiothoracic surgery patients. Inherent to the transfusing of blood is the understanding of the preservation of blood as well as the appropriateness of techniques to prevent hemorrhage through the clinical

Dr Stammers discloses a financial relationship with SpecialtyCare.

The Appendices can be viewed in the online version of this article [<https://doi.org/10.1016/j.athoracsur.2021.03.033>] or <https://www.annalsthoracicsurgery.org>.

This article has been published in *The Annals of Thoracic Surgery*, the *Journal of Extracorporeal Technology*, and the *Journal of Cardiothoracic and Vascular Anesthesia*.

The Society of Thoracic Surgeons requests that this article be cited as: Tibi P, McClure RS, Huang J, et al. STS/SCA/AmSECT/SABM Update to the Clinical Practice Guidelines on Patient Blood Management. *Ann Thorac Surg*. 2021;112:985–1004.

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# Society of Thoracic Surgeons Guidelines

Preoperative identification of high-risk patients should be performed, and **all available preoperative and perioperative measures of blood conservation should be undertaken** in this group as they account for the majority of blood products transfused. **Class I, Level A**

“Patients with preoperative anemia are more likely to require transfusions, and **it is obvious that if the ability to treat iron-deficiency anemia is available without any untoward effects, it should be instituted before surgery.** Differentiation must be made between anemias caused by iron deficiency as opposed to other causes of anemia. Iron-deficiency anemia is usually microcytic, whereas normocytic or macrocytic anemia stem from a variety of causes. **Routine iron studies** are of importance in the determination of the type of anemia present and **should be done routinely in the careful preoperative assessment of patients** so that treatment can be instituted if warranted.”



# INCIDENCE AND IMPACT OF A SINGLE-UNIT RED BLOOD CELL TRANSFUSION: ANALYSIS OF THE SOCIETY OF THORACIC SURGEONS DATABASE 2010–2019

- Girardi *et al. Ann Thorac Surg* 2023;115:1035–42
  - 10 years
  - Isolated CABG and AVR
  - 2,151,430 encounters
  - 847,442 received transfusions
    - 1,303,988 received 0 units
    - 206,555 received 1 unit
  - Propensity matching of 206,555 pairs for comparison

**TABLE 4 Outcomes of Propensity-Matched Cohort**

Variable	No RBCs (n ¼ 206,555)	1 Unit of RBCs ( n ¼ 206,555)	P Value
Operative mortality	2058 (1.0)	2990 (1.4)	<.001
Stroke	2492 (1.2)	3458 (1.7)	<.001
Sternal wound infection	1070 (0.5)	1343 (0.7)	<.001
Prolonged ventilation	6990 (3.4)	13,305 (6.4)	<.001
New hemodialysis	1816 (0.9)	3703 (1.8)	<.001
Reoperation for bleeding	1064 (0.5)	2685 (1.3)	<.001

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## THE ANNALS OF THORACIC SURGERY

Volume 115 Number 4 April 2023

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The Society of Thoracic Surgeons Congenital Heart Surgery Database: 2022 Update on Outcomes and Research  
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**Coronary Research**  
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*Sohn, Huang, and coauthors, p. 905*

**Valve Research**  
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**Perioperative & Critical Care Research**  
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**Education & Professional Development Research**  
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**Mediastinum & Esophagus Review**  
Use of Indocyanine Green Fluorescence Imaging in Thoracic and Esophageal Surgery  
*Ng, Kim, and coauthors, p. 1068*




Use of indocyanine green staining to identify the intersegmental plane for sublobar resection. For related article, see Ng, Kim, and coauthors, p. 1068.



WATCH Video Summary—  
“Socioeconomic Distress Associated With Increased Use of PCI Over CABG”

ELSEVIER  
ISSN 0003-4975

Official Journal of The Society of Thoracic Surgeons  
and the Southern Thoracic Surgical Association



AVR, aortic valve replacement CABG, coronary artery bypass grafting; RBCs, red blood cells.

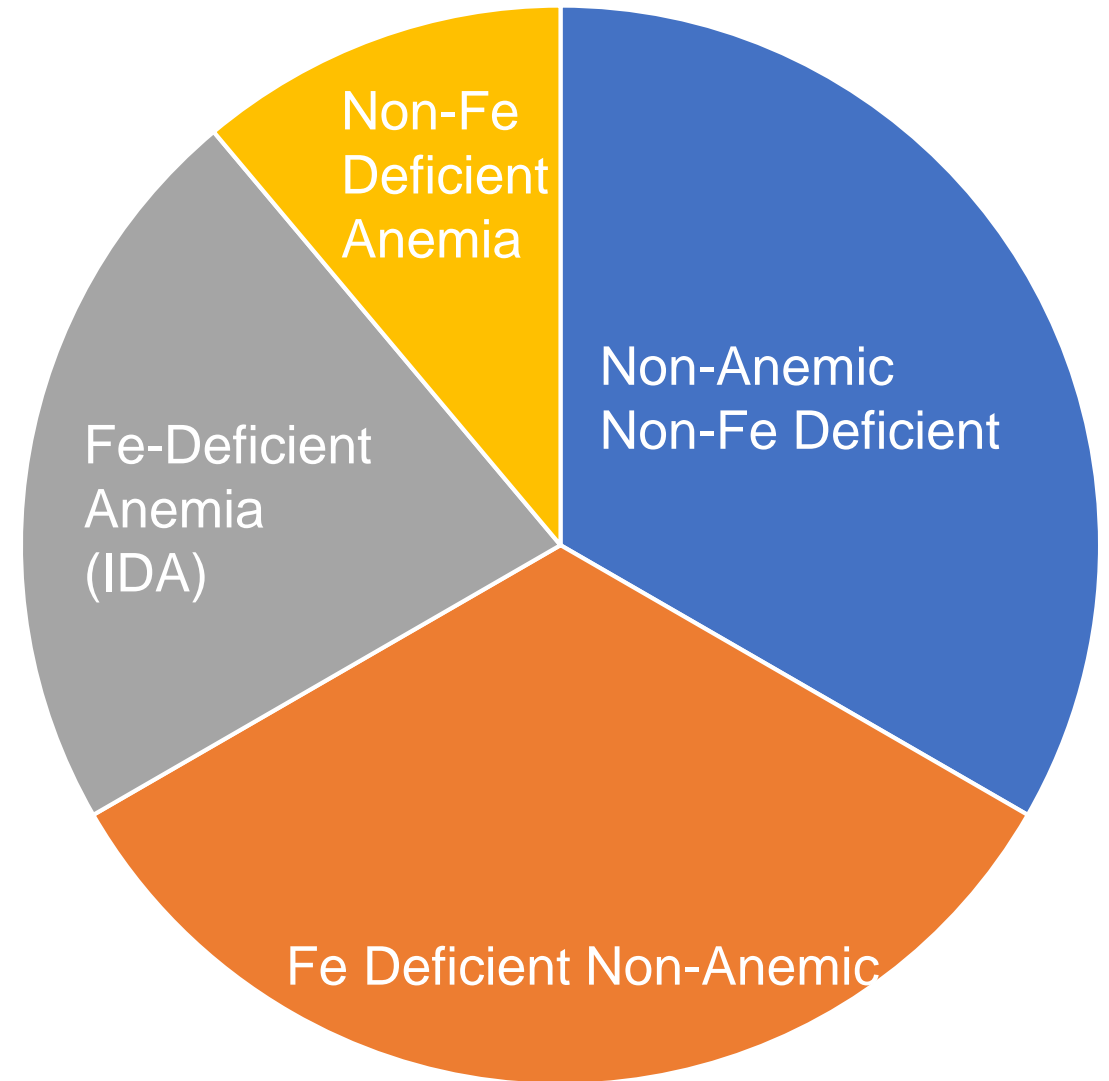
# All Cardiac Surgical Patients

## Management of Preoperative Iron Deficiency in Cardiac Surgery

*Corwin HL, Shander A, Spiess B, Munoz M, Faroni D, Calcaterra D, Welsby I, Ozawa S, Arnofsky, A Goldweit RS, Tibi P, Ann Thor Surg 2022;113:316-323*

In the US, high-risk groups for anemia include:<sup>2</sup>

- The elderly
- Reproductive-age & pregnant women
- Hispanic and non-Hispanic black Americans



All Cardiac Surgical Patients

# Management of Perioperative Iron Deficiency in Cardiac Surgery

Corwin HL, Shander A, Spiess B, Munoz M, Faroni D, Calcaterra D, Welsby I, Ozawa S, Arnofsky, A Goldweit RS, Tibi P  
*Ann Thor Surg*  
2022;113:316–23

**Recommendation 1:** All patients undergoing cardiac surgery be evaluated for ID, whether or not anemia is present

**Recommendation 2:** The evaluation for ID includes iron studies (serum iron, TIBC, transferrin saturation, serum ferritin) and reticulocyte hemoglobin content

**Recommendation 3:** Patients found to be non-ID anemic be referred for further evaluation

**Recommendation 4:** All cardiac surgical patients identified with preoperative ID (with or without anemia) should be treated with parenteral iron

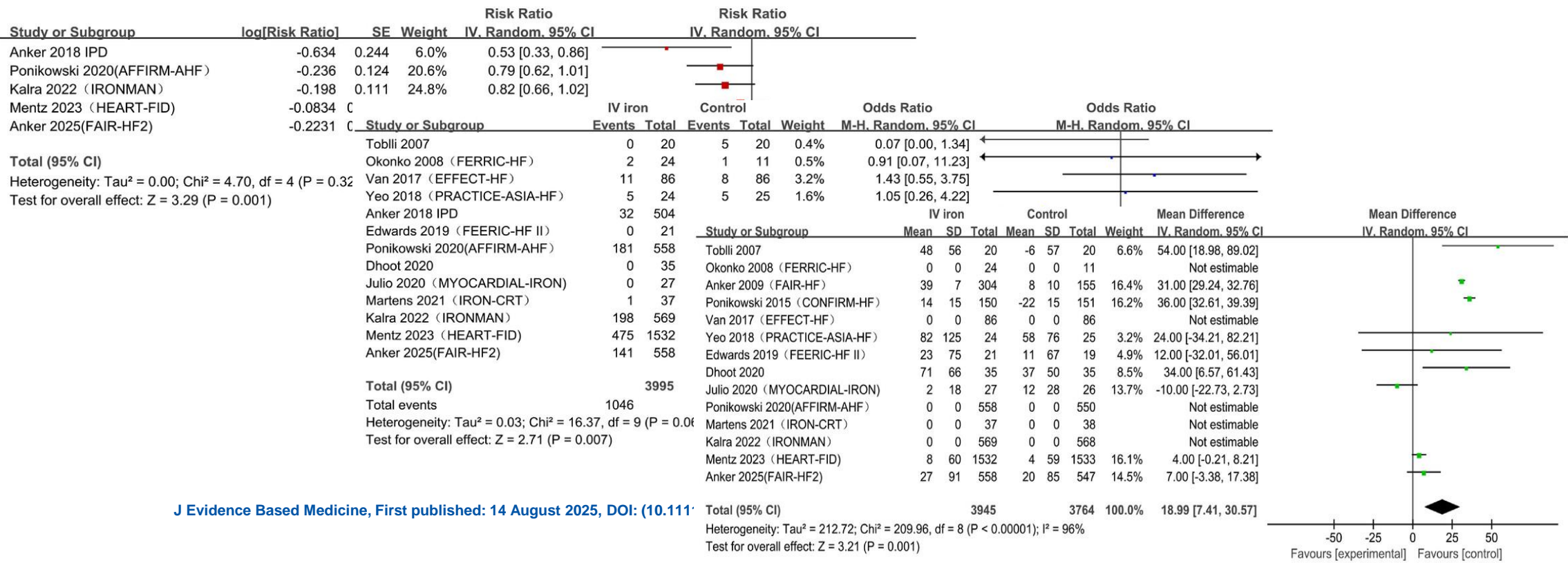
**Recommendation 5:** ESAs should be considered for treating patients with preoperative anemia on a case-by-case basis



# Intravenous Iron in Heart Failure Patients With Iron Deficiency: A Meta-Analysis of Randomized Controlled Trials

<https://doi.org/10.1111/jebm.70057>

For HF patients with ID, intravenous iron therapy can decrease the risk of hospitalization for HF, CV death and improve their exercise capacity. Patients with ischemic cardiomyopathy or with TSAT <20% may derive greater benefit from intravenous iron therapy





# STS Recommendations

1. Evaluate all cardiac surgical patients for iron deficiencies
2. Full iron studies including Serum Fe, TIBC, Transferrin Saturation, Serum Ferritin, & Retic Count
3. Hematology consult in patients with anemia without iron deficiency
4. Treat all patients with iron deficiency ***regardless of anemia status***
5. Use ESAs in select patients

# Guidelines for Assessment and Treatment of Anemia and Iron Deficiency in Cardiac Patients

1. Universal assessment of anemia and Iron Deficiency in ALL cardiac patients if possible.
2. Determination of cause of iron deficiency or anemia
3. Development of treatment plan for patients taking into account timing/urgency of planned procedure
4. Discussion with patient regarding importance of treatment to ensure compliance
5. Careful coordination with PBM team or anemia clinic

# Oral Iron Supplements

- ◆ Ferrous Sulfate, Ferrous Gluconate, Ferrous Fumarate
- ◆ Maltofer, Accrufer (bound to carbohydrate)
- ◆ Ferrous Bisglycinate (bound to glycine molecules)
- ◆ \*Sucrosomial iron (Sideral) (iron pyrophosphate encapsulated in a phospholipid + sucreser matrix)

# IV Iron Products

Agent	Test Dose	Dosing	Infusion Time
Sodium ferric gluconate (Ferrlecit)	N*	125–250 mg/dose	125 mg: 1 hr 250 mg: 2–4 hrs Min: 2.1 mg/min
Iron sucrose (Venofer)	N*	100–500 mg/dose	IV push: 2–5 mins (into HD line) 100–200 mg: 15 mins 300 mg: 1.5 hrs 500 mg: 3.5–4 hrs
Iron dextran, LMW (INFeD)	Y (25 mg prior to 1 <sup>st</sup> dose)	Multiple doses of 100 mg or single dose of 1000 mg/250 mL NS	100 mg: 50 mg/min 1000 mg: infusion over 1 or more hours
Ferric carboxymaltose (Injectafer)	N	750 mg/dose; max 20 mg/kg per dose	750 mg: 15 mins
Ferumoxytol (Feraheme)	N	510–1020 mg/dose	510 mg: 15 mins 1020 mg: 30 mins
Iron isomaltoside (Monoferic)	N	1000 mg; max 20 mg/kg per dose	1000 mg: 15 mins

\*Not required but recommended if patient has history of multiple drug allergies

HD, hemodialysis; IV, intravenous; LMW, low molecular weight; N, no; NS, normal saline; Y, yes.

# The Safety of Intravenous Iron Preparations

Tomer Avni MD, Amir  
Bieber MD, Alon  
Grossman MD, MHA, Hefziba  
Green MD, Leonard  
Leibovici MD and Anat Gafter-  
Gvili MD  
*Mayo Clinic Proceedings*  
2015;90(1):12–23

**103 trials** published between 1965–2013 were included

**10,390 patients** were treated with IV iron compared with **4,044 patients** treated with oral iron, 1,329 with no iron, 3,335 with placebo, and 155 with intramuscular iron

**No increased risk of SAEs with IV iron** (RR, 1.04; 95% CI, 0.93–1.17;  $I^2 = 9\%$ )

Decreased rate of SAEs when IV iron was used to treat heart failure (RR, 0.45; 95% CI, 0.29–0.70;  $I^2 = 0\%$ )

**No increased risk of infections and reduced GI AEs with IV iron**

# Studies on Preoperative Anemia Treatment

## *Iron Only*

- Garrido-Martin 2012 (RCT), Padmanabhan 2019 (RCT)
- Johansson 2015 (RCT), Peters 2018 (PO), Xu 2019 (RCT)

*No change in Hb*  
*Increased Hb*

## *EPO Only*

- Sowade 1997 (RCT), D'Ambra 1997 (RCT), Song 2009 (RCT), Weltert 2010 (RCT), Oh 2012 (RCT), Tasanorong 2013 (RCT), Weltert 2015 (RCT)
- Deseigneux 2012 (RCT), Kim 2013 (RCT), Duce 2018 (RO)

*Increased Hb, decreased transfusion and/or improved renal AKI*

*No difference*

## *EPO + Iron*

- Yoo 2011 (RCT), Spahn 2019 (RCT)

*Increase Hb and/or decreased transfusions*



# Clinical Studies using EPO +/- Iron

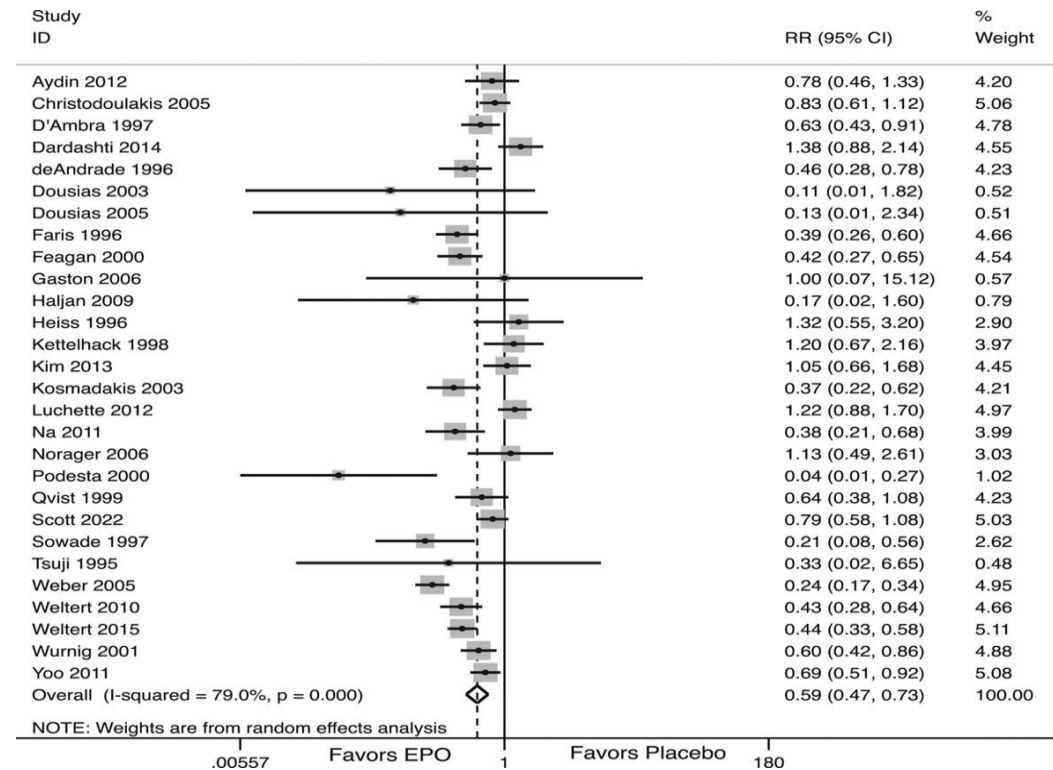
	Weltert <i>et al.</i> 2010 <sup>1</sup>	Yoo <i>et al.</i> 2011 <sup>2</sup>	Weltert <i>et al.</i> 2015 <sup>3</sup>	Spahn <i>et al.</i> 2019 <sup>4</sup>
Design	Prospective, randomized study	Prospective, single-site, single-blind	Prospective single-blind randomized study	Single center, randomized, double-blind, parallel group, controlled
N	320	74	600	484
Population	Isolated coronary vessel disease with Hgb <14.5 g/dL undergoing off-pump CABG	Pre-op Hgb <12 g/dL (women) and <13 g/dL (men) undergoing valvular surgery	Pre-op Hgb ≤14.5 g/dL undergoing cardiac surgery	Elective cardiac surgery (valve, CABG, or combined)  Anemia or iron deficiency (ferritin <100 mcg/L)
Pre-op Baseline Hgb	13 g/dL	9.3 g/dL	12.1 g/dL	12.8 g/dL
Intervention	EPO 14,000 U x 2 days pre-op EPO 8,000 U day of surgery EPO 8,000 U x 2 days post-op	Given day before surgery: EPO 500 U/kg + iron sucrose 200 mg IV	Two days before surgery: EPO 80,000 U + oral iron 40 mg/day (also given in the placebo arm)	Given day before surgery: Ferric carboxymaltose 20 mg/kg IV EPO 40,000 U SC Vitamin B12 1 mg SC Folic acid 5 mg PO
Efficacy Endpoints	On POD4, Hgb was 15.5% higher in EPO group <b>which required 0.33 units/blood per patient vs 0.76 units/blood per patient</b> (p=0.008)	Total of <b>86% vs 59% required transfusions</b> of RBCs (p=0.009)	Total of <b>17% vs 39% required transfusions of RBCs</b> (p<0.01); no difference in patients with baseline Hgb ≥13 g/dL	Tx reduced RBC transfusions from <b>median of 1 in the placebo group to 0</b> in the tx group (p=0.036); no differences in clinical end points
Safety Endpoints	No adverse events were recorded related to EPO	No difference in adverse events or mortality	No difference in adverse event rates or mortality	<b>No difference in thromboembolic events</b> including stroke, MI

CABG, coronary artery bypass grafting; EPO, erythropoietin; Hgb, hemoglobin; IV, intravenous; MI, myocardial infarction; PO, per os, orally; POD4, postoperative day 4; RBC, red blood cell; SC, subcutaneous; tx, treatment; U, unit.  
 1. Weltert L, et al. *J Thorac Cardiovasc Surg* 2010;139(3):621–627; 2. Yoo YC, et al. *Anesthesiology* 2011;115(5):929–937; 3. Weltert L, et al. *Transfusion* 2015; 55(7):1644–1654; 4. Spahn DR, et al. *Lancet* 2019; 393(10187):2201–2212.

# Impact of Preoperative Erythropoietin on Allogeneic Blood Transfusions in Surgical Patients: Results From a Systematic Review and Meta-analysis

Cho *et al.*  
*Anesth Analg*  
 2019;128(5):981–92

The weighted (pooled) estimate for the effect of preoperative EPO administration on incidence of whole hospitalization allogeneic transfusions (RR, 0.59; 95% CI, 0.47–0.73;  $p < 0.001$ ) compared with placebo administration



**“preoperative erythropoietin** is not only a viable agent for **reducing perioperative transfusion** requirements, but it may also be time to reconsider its **routine use as a tool for preoperative optimization**, particularly for procedures associated with high incidence of blood product administration such as cardiac and orthopedic surgeries.”

## Recommendations From the International Consensus Conference on Anemia Management in Surgical Patients (ICCAMS)

Aryeh Shander, MD,\*†‡, Howard L. Corwin, MD,†, Jens Meier, MD,§||  
 Michael Auerbach, MD,¶# Elvira Bisbe, MD,||\*\* Jeanna Blitz, MD,††  
 Jochen Erhard, MD,‡‡ David Faraoni, MD,§§ Shannon L. Farmer, DHS,|||¶¶  
 Steven M. Frank, MD,## Domenico Girelli, MD,\*\*\* Tiffany Hall, RN,†††  
 Jean-François Hardy, MD,||††† Axel Hofmann, Dr rer medic,§§§  
 Cheuk-Kwong Lee, MD,|||| Tsin W. Leung, MD,¶¶¶ Sherri Ozawa, RN,####  
 Jameela Sathar, MD,\*\*\*\* Donat R. Spahn, MD,†††† Rosalio Torres, MD,‡‡‡‡  
 Matthew A. Warner, MD,§§§§ and Manuel Muñoz, MD,|||||||



### Article

## Prognostic Implication of Preoperative Anemia in Redo Cardiac Surgery: A Single-Center Propensity-Matched Analysis

Antonino Salvatore Rubino <sup>1,\*</sup>, Luca Salvatore De Santo <sup>2,†</sup>, Antonio Pio Montella <sup>2</sup>,  
 Caterina Golini Petrarcone <sup>2</sup>, Lucrezia Palmieri <sup>2</sup>, Denise Galbiati <sup>3</sup>, Nicola Galdieri <sup>4</sup> and Marisa De Feo <sup>2</sup>

- <sup>1</sup> Cardio-Thoraco-Vascular Department, Division of Cardiac Surgery, Papardo Hospital, 98158 Messina, Italy
  - <sup>2</sup> Department of Translational Medical Sciences, University of Campania "Luigi Vanvitelli", Monaldi Hospital, Via Leonardo Bianchi, 80131 Naples, Italy
  - <sup>3</sup> Cardiovascular Department, Cardiac Surgery Unit of the IRCCS Humanitas Research Hospital, 20089 Rozzano, Italy
  - <sup>4</sup> Cardiac Intensive Care Unit, Monaldi Hospital, Via Leonardo Bianchi, 80131 Naples, Italy
- \* Correspondence: antonio.rubino@hotmail.com  
 † These authors contributed equally to this work.



### Review Article

## Treatment Strategies in Anemic Patients Before Cardiac Surgery

Raphael Kloeser, MD\*, Andreas Buser, MD†,  
 Daniel Bolliger, MD\*,<sup>1</sup>

\*Clinic for Anesthesia, Intermediate Care, Prehospital Emergency Medicine and Pain Therapy, University Hospital Basel, Basel, Switzerland

<sup>1</sup>Regional Blood Transfusion Service, Swiss Red Cross, Basel, and Department of Hematology, University Hospital Basel, Basel, Switzerland



### Patient Blood Management

#### ORIGINAL CLINICAL RESEARCH REPORT

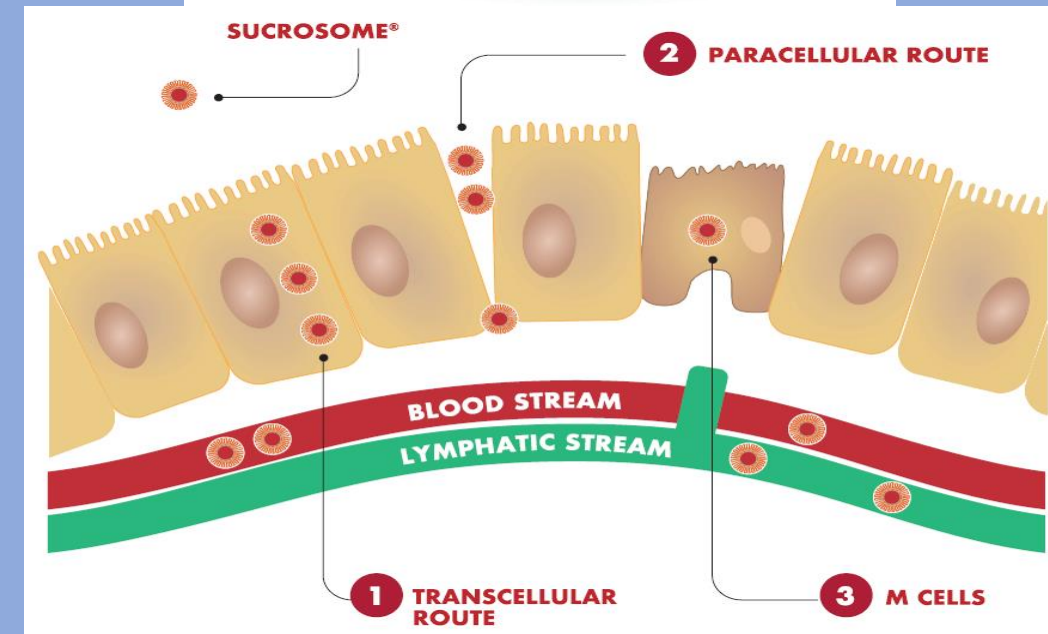
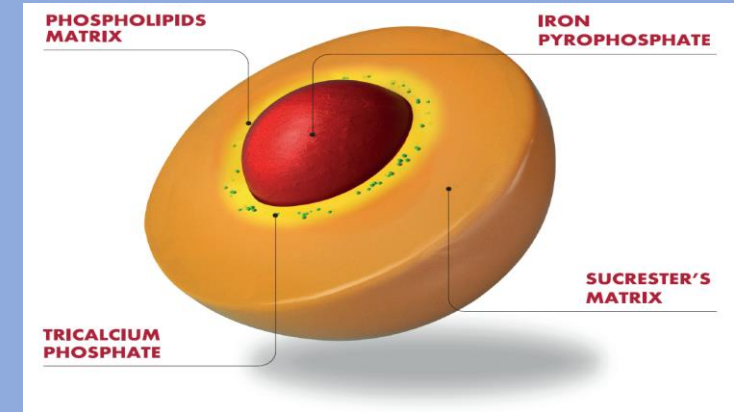
## Preoperative Anemia and Postoperative Outcomes in Cardiac Surgery: A Mediation Analysis Evaluating Intraoperative Transfusion Exposures

Matthew A. Warner, MD,\* Andrew C. Hanson, MS,† Phillip J. Schulte, PhD,† Juan Ripoll Sanz, MD,\*  
 Mark M. Smith, MD,\* Marissa L. Kauss, MD,\* Juan A. Crestanello, MD,‡ and Daryl J. Kor, MD\*

# Sucrosomial<sup>®</sup> Components + MOA

## INTRAVENOUS IRON

- Expensive
- Insurance issues
- Infusion center
- Possible need for multiple treatments
- Discomfort
- Adverse reactions



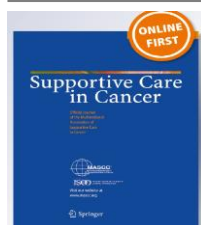
# 23 Studies on Sucrosomial® Iron

## Selected studies on the effectiveness of Sucrosomial iron compared to iron IV

### Journal

### Article

### Results

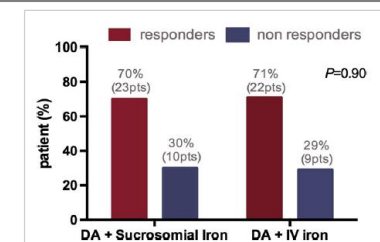
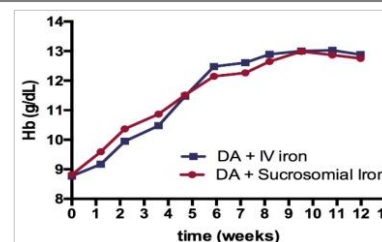


Supportive Care Cancer  
DOI 10.1007/s00520-017-3690-z

ORIGINAL ARTICLE

**Oral sucrosomial iron versus intravenous iron in anemic cancer patients without iron deficiency receiving darbepoetin alfa: a pilot study**

Antonino Mafodda<sup>1</sup> · D. Giuffrida<sup>2</sup> · A. Prestifilippo<sup>2</sup> · D. Azzarello<sup>1</sup> · R. Giannicola<sup>1</sup> · M. Mare<sup>3</sup> · R. Maisano<sup>4</sup>



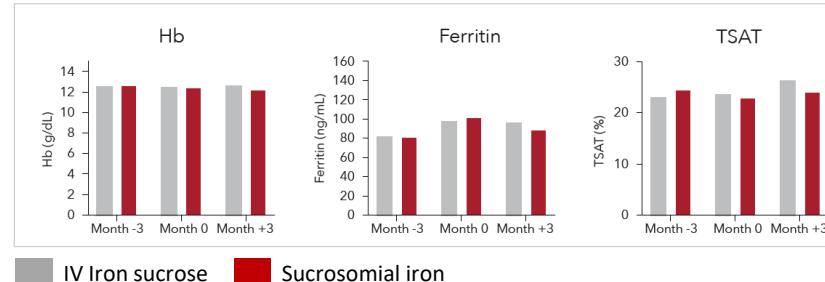
70% of SI population achieved erythropoietic response vs 71% of IV gluconate group (Increase 2 g/dL or target of 12 g/dL)



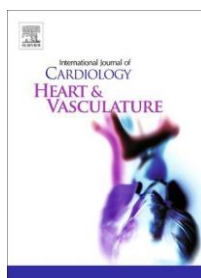
**Endocrinología, Diabetes y Nutrición**

Volume 64 | Issue 1 | January 2017

English Edition



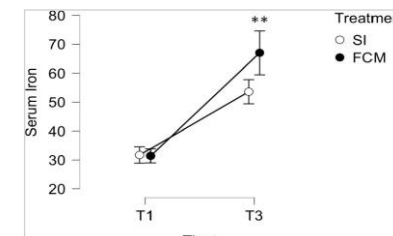
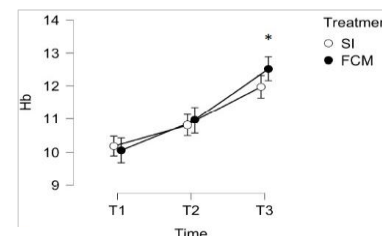
Sucrosomial iron proved to deliver equivalent results to IV sucrose in maintaining hemoglobin, ferritin and TSAT in bariatric patients after 3 months of use



**Short-term treatment of iron deficiency anemia after cardiac surgery**

Elio VENTURINI<sup>a</sup>, Gabriella IANNUZZO<sup>b</sup>, Anna DI LORENZO<sup>c</sup>, Gianluigi CUOMO<sup>c</sup>, Andrea D'ANGELO<sup>c</sup>, Pasquale MERONE<sup>c</sup>, Giuseppe CUDEMO<sup>c</sup>, Mario PACILEO<sup>d</sup>, Antonello D'ANDREA<sup>d</sup>, Carlo VIGORITO<sup>e</sup>, Francesco GIALLAURIA<sup>e</sup>

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<sup>b</sup> Department of Clinical Medicine and Surgery, "Federico II" University, 80131 - Naples, Italy  
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<sup>d</sup> Department of Cardiology and Intensive Coronary Care, "Umberto I Hospital", 84014 - Nocera Inferiore (SA), Italy



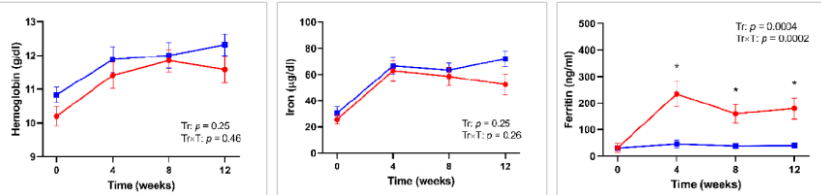

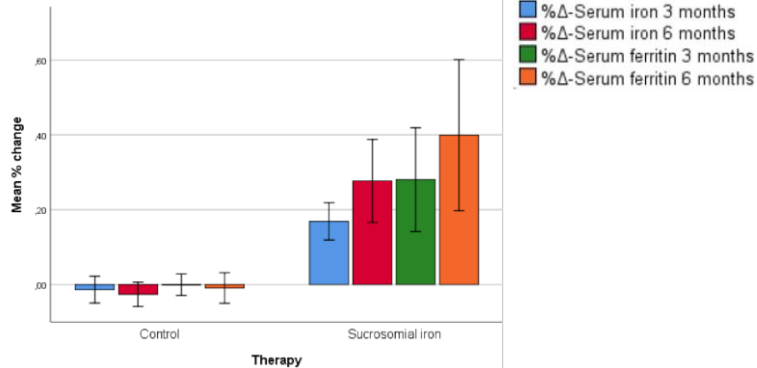


Sucrosomial Iron proven to be non-inferior to FCM in recovering HB/serum iron levels and functional capacity post cardiac surgery



# Studies on Sucrosomial® Iron

- Selected studies on the effectiveness of Sucrosomial iron compared to iron IV

Journal	Article	Results	
	 <p><b>Article</b>  <b>Oral Sucrosomial Iron Is as Effective as Intravenous Ferric Carboxy-Maltose in Treating Anemia in Patients with Ulcerative Colitis</b>            Lorenzo Bertani <sup>1,*</sup>, Domenico Tricò <sup>2</sup>, Federico Zanzi <sup>1</sup>, Giovanni Baiano Svizzero <sup>1</sup>, Francesca Coppini <sup>1</sup>, Nicola de Bortoli <sup>1</sup>, Massimo Bellini <sup>1</sup>, Luca Antonoli <sup>3</sup>, Corrado Blandizzi <sup>3</sup> and Santino Marchi <sup>1</sup></p>	 <p>Tr: <math>p = 0.25</math> Tr+T: <math>p = 0.46</math></p> <p>Tr: <math>p = 0.25</math> Tr+T: <math>p = 0.26</math></p> <p>Tr: <math>p = 0.0004</math> Tr+T: <math>p = 0.0002</math></p>	<p>SI demonstrated to increase HB and serum iron levels comparably to FCM in patients with UC while avoiding iron overload</p>
	<p><b>Oral sucrosomial iron improves exercise capacity and quality of life in heart failure with reduced ejection fraction and iron deficiency: a non-randomized, open-label, proof-of-concept study</b>            Apostolos Karavidas<sup>1</sup>, Efstratios Troganis<sup>1</sup>, George Lazaros<sup>2</sup>, Despina Balta<sup>1</sup>, Ioannis-Nektarios Karavidas<sup>3</sup>, Eftihia Polyzogopoulou<sup>4</sup>, John Parissis<sup>4</sup>, and Dimitrios Farmakis<sup>5*</sup></p> <p><sup>1</sup>Department of Cardiology, G. Gennimatas General Hospital, Athens, Greece; <sup>2</sup>First Department of Cardiology, Hippokraton General Hospital, National and Kapodistrian University of Athens Medical School, Athens, Greece; <sup>3</sup>University of Thessaly Medical School, Larissa, Greece; <sup>4</sup>Department of Emergency Medicine, Attikon University Hospital, National and Kapodistrian University of Athens Medical School, Athens, Greece; and <sup>5</sup>University of Cyprus Medical School, Nicosia, Cyprus</p>	 <p>Mean % change</p> <p>Control Sucrosomial iron</p> <p>Therapy</p> <p>       ■ %Δ-Serum iron 3 months        ■ %Δ-Serum iron 6 months        ■ %Δ-Serum ferritin 3 months        ■ %Δ-Serum ferritin 6 months     </p>	<p>SI shown to improve ferritin, exercise capacity and QOL in heart failure with reduced ejection fraction and iron deficiency</p>

# Sucrosomial® Iron by the European Association for Cardio-Thoracic Surgery as a pre-op solution for anemic patients to avoid RBCT IIa(B) level)



## 2024 EACTS/EACTAIC Guidelines on patient blood management in adult cardiac surgery in collaboration with EBCP

Filip P A Casselman ✉, Marcus D Lance ✉, Aamer Ahmed, Alice Ascari, Juan Blanco-Morillo, Daniel Bolliger, Maroua Eid, Gabor Erdoes, Renard Gerhardus Haumann, Anders Jeppsson ... Show more

Author Notes

European Journal of Cardio-Thoracic Surgery, ezae352,

<https://doi.org/10.1093/ejcts/ezae352>

Published: 10 October 2024 Article history ▼

Recommendation Table 3. Recommendations for preoperative management of patients with anaemia

Recommendations	Class <sup>a</sup>	Level <sup>b</sup>	Ref <sup>c</sup>
It is recommended to investigate newly diagnosed patients with anaemia to determine the aetiology and initiate causal treatment.	I	B	(156, 157, 166)
Oral iron supplementation with a Sucrosomial formulation prior to cardiac surgery should be considered in iron-depleted anaemic patients (females: Hb less than 120 g/L; males: Hb less than 130 g/L) to improve erythropoiesis and reduce postoperative transfusions if the time frame allows it.	IIa	B	(168-170)
Intravenous iron supplementation prior to cardiac surgery should be considered in iron-depleted patients with anaemia (females: Hb less than 120 g/L; males: Hb less than 130 g/L) to improve erythropoiesis and reduce postoperative transfusions when the time frame of the operation does not allow the use of oral iron supplementation.	IIa	A	(171-175)
Erythropoietin supplementation in addition to iron should be considered to improve erythropoiesis and reduce postoperative transfusions in anaemic patients when rapid Hb increase is required.	IIa	A	(173, 175-183)
Preoperative erythrocyte transfusion is not routinely recommended to treat anaemic patients.	III	B	(184)

EPO: erythropoietin; Hb: haemoglobin.

<sup>a</sup> Class of recommendation.

<sup>b</sup> Level of evidence.

<sup>c</sup> References.

# Sucrosomial® Iron PBM Guidance of the World Health Organization as for CHF & Diabetes

Guidance on implementing  
**patient blood management**  
to improve global **blood health**  
status ● ● ●



Anaemia	Global prevalence estimates	Potential and expected benefits for blood health
• Chronic kidney disease (CKD) <sup>a</sup>	Of 700 million patients with CKD, <b>100 million or more are likely to have anaemia</b> (prevalence estimates for anaemia range between 14% and 64%) (315-319).	Anaemia in people with non-dialysis-dependent CKD remains vastly underrecognized. Less than 20% receive anaemia treatment even though anaemia of CKD is highly responsive to iron, ESAs or both, as well as recently introduced hypoxia-inducible factor prolyl hydroxylase (HIF-PH) inhibitors. PBM would significantly improve blood health, productivity and quality of life in this population as well as reducing transfusion dependency (320).
• Cardiovascular disease (CVD) and diabetes	Among the 420 million patients with CVD (321) and the 476 million patients with diabetes (322), anaemia is common. Its prevalence in the subset of CVD patients with chronic heart failure (CHF) is approximately <b>26 million worldwide</b> (323). It occurs in approximately 30% of stable and 50% of hospitalized CHF patients (324). In addition, <b>50% of CHF patients with or without anaemia have ID</b> (325). The overall prevalence of anaemia in people with type 2 diabetes is estimated at 30% (326). <b>Anaemia as a comorbidity of CHF and diabetes affects at least 170 million people.</b>	Anaemia in these populations remains underrecognized and undertreated (317, 327-329). Data from randomized controlled trials show that treatment of ID in CHF patients improves quality of life and exercise capacity, and decreases cardiovascular morbidity and hospitalization (330).  Oral sucrosomial iron may provide a less expensive alternative to intravenous (IV) iron therapy (331). However, more studies are needed to demonstrate that oral sucrosomial iron is an effective alternative to IV iron in patients with non-anaemic ID and CHF.
• Upper digestive system diseases <sup>a</sup>	Anaemia and ID in upper gastrointestinal disease is common but prevalence varies widely depending on the population and the specific condition. Thus, regional epidemiological data are needed to obtain accurate estimates. Anaemia and ID results from bleeding, malabsorption and inflammation. Studies suggest that anaemia in people with upper digestive system disease may be more prevalent than in those with lower digestive disease, suggesting it is a significant contributor to overall prevalence of anaemia (332).  Bariatric surgery for obesity and major oncological surgery on the upper gastrointestinal tract interferes with iron absorption and is a frequent iatrogenic cause of ID involving the upper digestive system.	Gastrointestinal causes should be considered a possibility in any patient with anaemia. The most common cause is ID. Recognition and treatment will decrease the risk that a transfusion will be administered and mitigate the consequences of ID. A structured approach to diagnosis and management often identifies comorbidities such as peptic ulcer disease (particularly detection and eradication of <i>Helicobacter pylori</i> infection), coeliac disease, erosive gastritis, oesophagitis, liver disease, etc., which when identified and treated improve health status beyond blood health alone (333).  A structured approach to managing iron absorption after surgery to the upper gastrointestinal system will reduce the incidence of postoperative anaemia in these patients.
• Inflammatory bowel disease (IBD) <sup>a</sup>	<b>Anaemia and ID is highly prevalent in people with IBD</b> , but the precise figure remains unknown. Estimates vary widely from <b>36–90%</b> (334).	Iron therapy has been associated with significant benefits in patients with IBD and IDA, in terms of both disease progression and health care resource utilization (335).

# Other Next Generation Therapies

- ◆ Hepcidin Modulators-Lexaptepid-hepcidin antagonists to lower hepcidin levels and improve iron availability
- ◆ Anti-hepcidin Monoclonal Antibodies
- ◆ Gene Therapy- Zinteglo-modifies a patient's own blood stem cells to treat thalassemias
- ◆ Erythrocyte maturation agents- Reblozyl



## PATIENT BLOOD MANAGEMENT

### Preoperative anemia management and hemoglobin (Hgb) optimization.

#### AT-RISK PATIENT POPULATIONS:

Hgb < 13 g/dL (male or female), weight < 65kg, female gender, complex or revision surgery, renal disease, anti-platelet and/or anti-coagulant therapy, hematologic conditions (e.g. Thalassemia), "No Blood"/transfusion refusal.

#### IDEAL TIMELINE FOR ASSESSMENT:

Ideally at surgical INTAKE, at time of acceptance for surgery; at least 30 days pre-op.

#### POINTS OF EMPHASIS:

Patient Blood Management strategies (including Anemia Management and Hgb Optimization) should be individualized to patient condition and risks of surgical procedure. Ideal pre-op Hgb targets may need to be adjusted for:

- Renal disease (e.g.: max Hgb 12g/L)
- Patients declining transfusion "No Blood"
- Patients with preexisting arterial-venous thrombotic events should be monitored closely

#### Oral Therapy:

Choice of oral iron agent should consider degree of iron deficiency, drug interactions, likelihood of compliance with therapy, likelihood of iron/Hgb correction by surgery date

#### ESA (erythropoietin-alpha) Therapy:

- Requires iron repletion or concurrent iron therapy
- Requires consideration of risk/benefit balance

#### Standard ESA Dosing:

- 600IU/Kg given SC weekly to target Hgb  
Ex: 20,000-40,000IU SC given on day 21, 14, and day 7 pre-op, and then day of surgery.
- Urgent case: 300 IU/kg pre-op daily x10, day of surgery, then daily x4 post-op
- **CHECK Hgb after every 2 doses** to monitor effect and avoid exceeding safe Hgb targets

#### Hgb LESS THAN 10 g/dL

Consider DELAY of elective procedure. Notify appropriate physician for discussion and investigation.

#### Hgb 10-13 g/dL

**INVESTIGATE CAUSE:** Blood loss (e.g.: GI, menstrual, epistaxis), anti-coagulant status, renal/hepatic failure, poor nutritional status, etc. Refer to appropriate physician for investigation/treatment of underlying cause, if able. Testing: CBC, Retic Count, Ferritin\*, Creatinine, Iron Panel (Serum Iron/TIBC).

\*Consider potential for false elevation with inflammation.

#### Hgb GREATER THAN 13 g/dL

Consider needs of elective procedure. Consider further Hgb optimization and intra-op blood-sparing modalities.

#### MICROCYTIC (MCV <80 fL)

CONSIDER: Iron deficiency, Thalassemia, chronic disease, sideroblastic anemia

**CHECK:** Serum Ferritin<sup>1</sup>, Iron Panel<sup>2</sup> (Serum Iron, TIBC, T-Sat), CRP

1. Consider false elevation with inflammation (e.g.: SLE, RA, sepsis, inflammatory bowel)
2. Test should be performed fasting for accuracy.

✓ Ferritin < 30 mcg/L  
✓ T-Sat < 20%  
✓ TIBC > 72 umol/L  
✓ Retic low

Iron Deficient

✓ Ferritin 30-100 mcg  
✓ T-Sat < 20%  
✓ TIBC 45-72 umol/L  
✓ Retic low

Probable Iron Deficient

#### NORMOCYTIC (MCV 80-100 fL)

CONSIDER: Anemia of chronic disease, cancer, marrow problem, inflammation, hemolysis, bleeding, renal failure/insufficiency

✓ Ferritin > 100 mcg/L  
✓ T-Sat < 20%  
✓ TIBC < 45 umol/L  
✓ Retic low

Anemia of Chronic Disease or combination /w Iron Deficiency

✓ Ferritin > 100 mcg/L  
✓ T-Sat > 20%  
✓ Creatinine > 1.3 mg/dL or eGFR < 60 mL/min

Possible Anemia of Chronic Kidney Disease

#### MACROCYTIC (MCV >105 fL)

CONSIDER: Hepatic disease (fatty liver, cirrhosis), ETOH, thyroid disease, B<sub>12</sub> or folate deficiency, myelodysplasias, drugs: HIV anti-viral, Methotrexate®, Septra®

**CHECK:** TSH, Liver investigations, Serum B<sub>12</sub>, Serum Folate

✓ Serum Folate or Serum B<sub>12</sub> low  
✓ TSH elevated

✓ Abnormal liver investigations

#### Treat Issue or Refer to Specialty:

- Folic Acid 5 mg PO daily
- Vitamin B<sub>12</sub> 1-2 mg PO or SL daily.

#### Or, if absorption problem:

- Vit B<sub>12</sub> 1000 mcg IM q week x4, then 500 mcg q month until normalized
- Thyroid hormone replacement

#### INITIATE IRON THERAPY

1. **Oral:** 150-200 mg elemental iron daily if PO therapy unsuccessful or not tolerated, severe iron deficiency (Ferritin < 15 mcg), short duration to surgery, or on-going blood loss.
2. **Intravenous:** iron sucrose 800-1200 mg total dose\*, given IVPB in divided doses (see product monogram)\*Use iron deficit calculation to confirm total dose required.

#### ESA WITH IRON THERAPY

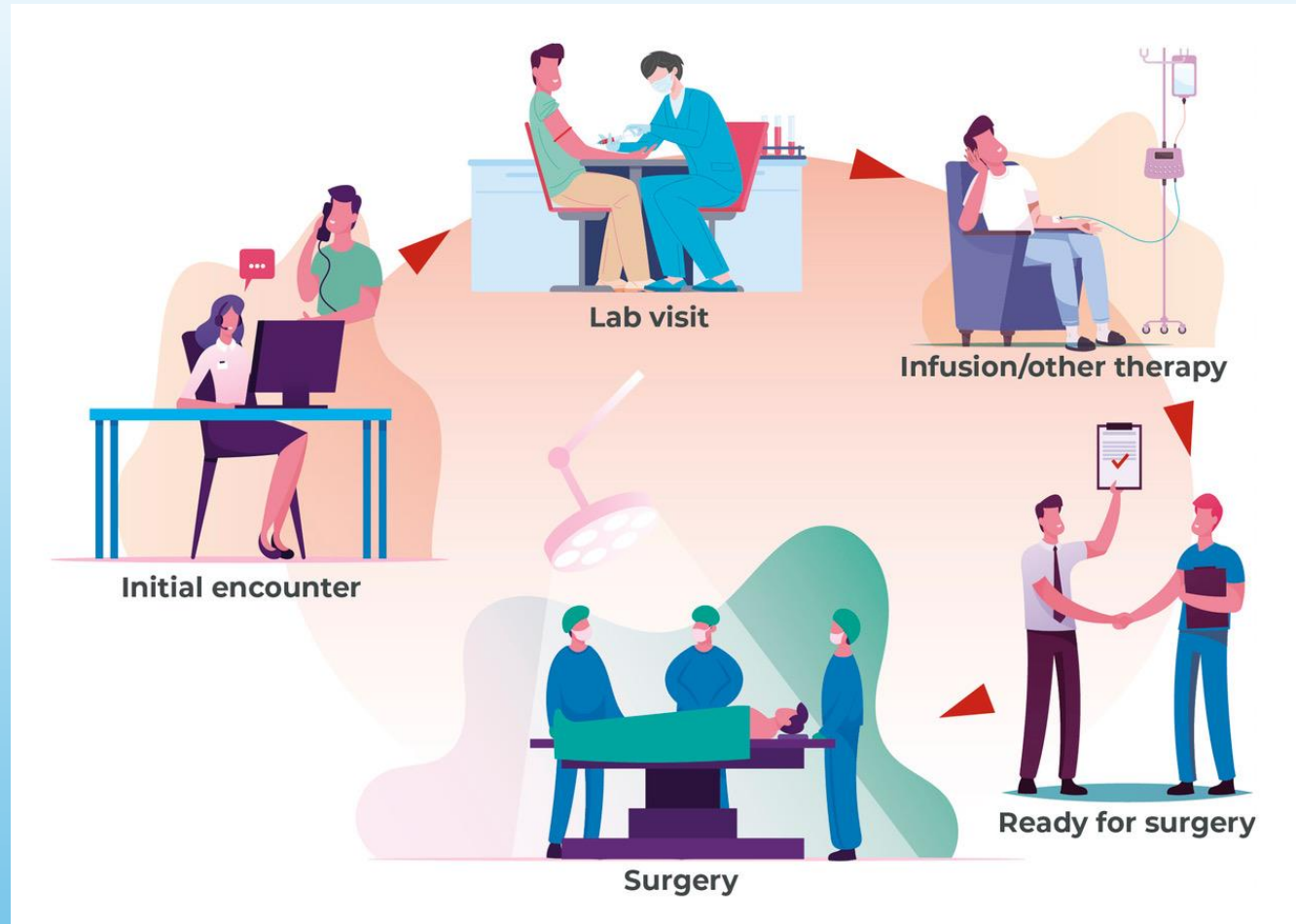
Consider Trial of Erythropoietic-Stimulating Agent (ESA)



**Dignity Health.**

Yavapai Regional Medical Center





**“Virtual” Center with Real Results!**

**Preoperative Virtual Anemia Center**  
Elective patients scheduled for Orthopedic Surgery

**Surgeon's Office**

Surgeon reviews patient's most recent labs to identify current or pre-existing anemia (HGB  $\leq 13$ )  
If evidence of anemia exists, surgeon has phone consult with PBM Department

**PBM Department**

Contacts patient to review benefits of correcting anemia prior to surgery & coordinates with surgeon for lab panel Rx to fully assess anemia

Direct patient to DHYRMC lab for appropriate studies of iron, transferrin, ferritin, retic count etc. (per Algorithm)

Explore methods to correct anemia prior to surgery & determine urgency of surgery in consult with Ortho surgeon

Surgeon prescribes appropriate treatment

PBM to communicate with DH YRMC Infusion Center to confirm necessary documentation received to obtain insurance coverage for recommended treatment \*

\*PBM Assistant will ensure Infusion Center's receipt of: patient's demographics/face sheet, insurance info, labs (CBC, iron saturation, iron level, TIBC and ferritin), Order & MD notes (e.g. regarding prior intolerance of oral iron)

After PBM communicates MD's treatment plan to patient, IVT coordinates appt.w/patient (EX: EPO/IV Iron protocol 3 wks. prior to surgery)

Coordinate surgery date with surgeon based on progress/results

Has/Will patient achieve target HGB? (PBM will maintain record of pre and post-treatment Hgb)

**Evaluation  
for  
Readiness  
Begins with  
Initial  
Consult**

# Multiple Education Strategies Developed

- Presentations targeting high opportunity areas to physician and nursing groups
- Presentations to the community at public libraries, assisted living and retirement facilities explaining patient's role in and benefits of PBM e.g. "Doctors & Donuts"

**A Yavapai Regional Medical Center Presentation**  
**You Are Cordially Invited**

Please be our guest for an exclusive presentation regarding the latest medical research regarding the emerging science of Patient Blood Management and how it's improving outcomes for medical and surgical patients.

**Patient Blood Management: Yesterday, Today and Tomorrow**  
Thursday, October 26th, 2018  
6:00 to 6:00 p.m.  
Yavapai College Performing Arts Center  
100 East Sheldon Street - Prescott, Arizona

The doors open at 5:00 p.m. and heavy hors d'oeuvres and light desserts will be served. The presentation will begin at 6:00 p.m.

Your RSVP is respectfully requested no later than **October 18th**. Please call (928) 771-1100 or e-mail your acceptance to [elizabethblack@yrmc.org](mailto:elizabethblack@yrmc.org). Please indicate the names for those in your party and your phone number. As seating is limited, we will not be able to guarantee seating for responses received after October 18th. Please contact the event organizer at (928) 606-1276 with questions or comments.

**OUR FEATURED PRESENTERS**

**Dale Black, MD, FACC, FSCAI**  
Dr. Black is a past president of the American College of Cardiology and a past president of the American Society of Interventional Cardiology. He is currently the Medical Director of the Yavapai Regional Medical Center, Prescott, Arizona.

**Elizabeth Black, MD, FACC, FSCAI**  
Dr. Black is a past president of the American College of Cardiology and a past president of the American Society of Interventional Cardiology. She is currently the Medical Director of the Yavapai Regional Medical Center, Prescott, Arizona.

**John Amos, BS, MSM**  
Mr. Amos is the President and Chief Executive Officer of Yavapai Regional Medical Center, Prescott, Arizona.

**George Rizk, MD**  
Dr. Rizk is the Medical Director of the Yavapai Regional Medical Center, Prescott, Arizona.

**Nisha Tung-Takher, MD**  
Dr. Tung-Takher is the Medical Director of the Yavapai Regional Medical Center, Prescott, Arizona.

**Soundos Moualla, MD, FACC, FSCAI**  
Dr. Moualla is the Medical Director of the Yavapai Regional Medical Center, Prescott, Arizona.

**Gwen Rhodes, RN**  
Ms. Rhodes is the Nurse Navigator at the Yavapai Regional Medical Center, Prescott, Arizona.

**Pierre Tibi, MD, FACC, FSCAI**  
Dr. Tibi is the Medical Director of the Yavapai Regional Medical Center, Prescott, Arizona.

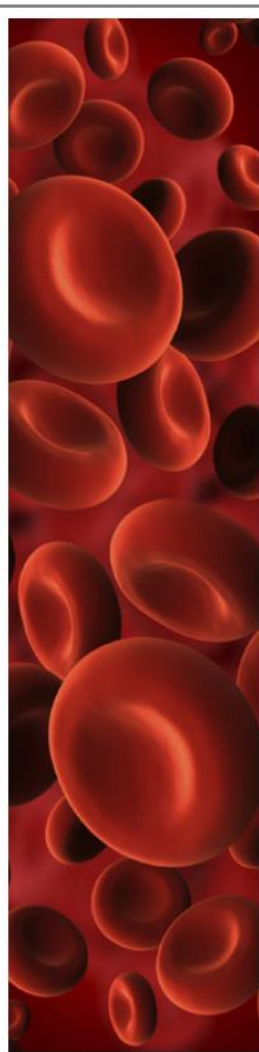
**Anthony V. Torres, MD, FACC**  
Dr. Torres is the Chief Medical Officer of the Yavapai Regional Medical Center, Prescott, Arizona.

**Robert B. Tice, MD, FACC**  
Dr. Tice is the Medical Director of the Yavapai Regional Medical Center, Prescott, Arizona.

**For our out-of-town attendees:**  
Discounted rates for lodging are available for those attending the YRMC Patient Blood Management event October 26th, 2018. The rates are available through the weekend for those wanting to stay in the area and enjoy the beautiful fall weather and activities in Prescott.

**DISCOUNTED RATES BY HOTEL:**  
100 East Sheldon Street, Prescott, AZ 86301  
To receive a discounted rate for the Quality Inn, please call (928) 606-1276 or call the hotel direct to make a reservation.

**QUALITY INN BY HOTEL:**  
100 East Sheldon Street, Prescott, AZ 86301  
To receive a discounted rate for the Quality Inn, please call (928) 606-1276 or call the hotel direct to make a reservation.



## YRMC—Your Destination for Cardiac Care and Blood Management

### PROGRAM SCHEDULE • October 17, 2019

- 5:00 p.m. Heavy hors d'oeuvres and light desserts
- 6:00 p.m. **Welcome and Introduction**  
**Elizabeth Black**, Data Manager, Patient Blood Management, Yavapai Regional Medical Center, Prescott, Arizona
- 6:05 p.m. **YRMC, A Destination for Hearts and Blood Management**  
**John Amos, BS, MSM**, President and Chief Executive Officer, Yavapai Regional Medical Center, Prescott, Arizona
- 6:15 p.m. **Launching YRMC Cardiology – A Journey to Better Outcomes for You**  
**George Rizk, MD**, Invasive Cardiovascular Medicine, YRMC PhysicianCare, Prescott, Arizona
- 6:25 p.m. **The Beat Goes On**  
**Nisha Tung-Takher, MD**, Cardiac Electrophysiologist, YRMC PhysicianCare, Prescott, Arizona
- 6:35 p.m. **Mending Hearts With Less Invasive Interventions**  
**Soundos Moualla, MD, FACC, FSCAI**, Structural and Interventional Cardiologist, YRMC PhysicianCare
- Gwen Rhodes, RN**, Patient Navigator, Yavapai Regional Medical Center, Prescott, Arizona
- 6:50 p.m. **Patient Blood Management at YRMC – Together We Are Doing Great Things**  
**Elizabeth Black**, Data Manager, Patient Blood Management, Yavapai Regional Medical Center, Prescott, Arizona
- 7:00 p.m. **Patient Blood Management – YRMC and Beyond**  
**Pierre Tibi, MD, FACC, FSCAI**, Medical Director, Patient Blood Management and the James Family Heart Center, Yavapai Regional Medical Center, Prescott, Arizona
- 7:15 p.m. **Ask the Experts – Panel Discussion**  
**Pierre Tibi, MD, FACC**  
**Elizabeth Black**  
**Dale Black**  
**Soundos Moualla, MD, FACC, FSCAI**  
**Gwen Rhodes, RN**  
**George Rizk, MD**  
**Nisha Tung-Takher, MD**
- 8:00 p.m. Program adjourns



## A Doctors & Donuts presentation

# Patient Blood Management

Please join us and learn about:

- How you benefit from Patient Blood Management (PBM) in surgery. Presented by Pierre Tibi, MD, Cardiothoracic Surgeon, The James Family Heart Center
- What causes anemia? Are you anemic and why does it matter? Presented by Gwen Rhodes, RN, ICU Registered Nurse Educator
- How to optimize your blood health before surgery and what Enhanced Recovery After Surgery (ERAS) means for you. Presented by Lauren Mills, NP, Pre-admission Testing

Followed by a Q&A with presenters



Thursday, November 9,  
10:30–11:30 a.m.  
The Center on Rosser,  
1280 E. Rosser Street  
Prescott  
Formerly the Adult Center  
of Prescott

Seating is limited.  
Please reserve a seat by  
calling (928) 771-5109  
or email [eblack@yrmc.org](mailto:eblack@yrmc.org)

# SUMMARY

Anemia is a modifiable risk factor

All efforts to address pre-operative anemia and iron deficiency should be made to avoid transfusions (preferably several weeks before surgery, nevertheless, can be instituted 1-2 days prior to surgery)

Even one transfusion may be detrimental in cardiac surgery

Pre-operative anemia can be safely treated with iron +/- ESAs

Algorithms and Virtual Anemia Clinics facilitate treatment of anemia in surgical patients





Thank you