INTRAVENOUS IRON ORDER SET OPTIMIZATION AT A LARGE ACADEMIC MEDICAL CENTER

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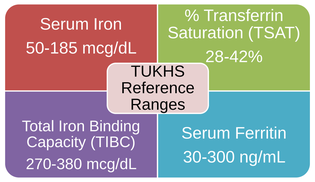
THE UNIVERSITY OF KANSAS HEALTH SYSTEM

BACKGROUND

- Iron products are FDA approved and guideline directed for iron deficiency anemia (IDA)[1-6]
- Lab tests used to diagnose iron deficiency anemia include low hemoglobin (Hgb) and low serum ferritin OR low TSAT with high TIBC



- The adult IV iron order set at The University of Kansas Health System (TUKHS) includes iron sucrose or ferric gluconate (can be ordered outside of order set), nursing vital checks during administration, and pre/peri-infusion reaction medications (diphenhydramine and epinephrine)
- Drug utilization evaluation of 255 adult patients receiving IV iron products at TUKHS from May to July 2019 found differences in prescribing patterns among services and indications
- The order set was not utilized in 71% of patients, 27% did not have iron studies within 14 days, and 23% received more than 1000 mg in 14 days[7]
- An outpatient anemia clinic through TUKHS exists to refer clinically-stable patients for outpatient management providing the opportunity for outpatient use of IV iron

METHODS

- Single site, quasi-experimental chart review
- Inclusion criteria: adult patients who received IV iron while inpatient at TUKHS on or after December 4th, 2020
- Exclusion criteria: patients <18 years of age, pregnant

Interventions Implemented:

1) Iron sucrose and ferric gluconate restricted to order through the order set
2) Iron studies (iron, TSAT, TIBC, and ferritin) collected within 14 days populate into the order set for ease of assessment
3) Inclusion of indication-specific guideline recommendations for appropriate utilization of IV iron (**Table 1**)
4) Indication selection upon ordering: IDA, CKD, heart failure (HF), Chronic GI losses +/- IBD, Cancer/chemo-associated anemia, Other (write in comment)
5) Statement added to order set: "If patient has received IV iron or a blood transfusion in the last 14 days: Maximum recommended IV iron is 1000 mg in 14 days; each unit of blood contains around 125-250mg elemental iron"[7]
6) Ferrous sulfate and ascorbic acid available to order through order set to promote use of oral iron products when appropriate
7) Electronic referral method for outpatient anemia clinic created
8) Education provided to multidisciplinary acute care providers and internal medicine providers/pharmacists on clinic referral process

Table 1. Guideline Recommendations for Iron Use Based on Indication

Indication	Hgb (g/dL)	Ferritin (ng/mL)	TSAT (%)
CKD	<13 (M), < 12 (F)	<500	≤30% (<40% in HD)
IDA +/- chronic GI losses or IBD	<13 (M), <12 (F), <11 (pregnant)	<30 (<100 with GI losses or IBD)	<20%
HF	<15	<100	<20% (+ ferritin 100-299 ng/dL)
Cancer/chemo-associated anemia	≤11 or ≥2 below baseline	<30 (30-500 with ESA use)	<20% (<50% with ESA use)

ENDPOINTS

Primary endpoints
- Appropriate IV iron use based on selected indication
- Appropriate IV iron use based on total iron received over a 14-day period

Safety endpoints
- Decrease in patients receiving >1000mg of IV iron post-intervention
- Increase in availability of pre/peri-infusion reaction medications post-intervention

Secondary endpoints
- Cost savings based on average total dose received post-intervention
- Number of referrals made to the outpatient anemia clinic

RESULTS

Statistics
- Descriptive statistics used to assess post-interventional data independently
- Chi-square and t-test analysis to compare pre/post-interventional data

Figure 1. Patient Inclusion

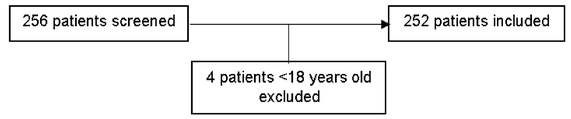


Table 2. Patient Demographics

Characteristic	Pre-intervention (n=255)	Post-intervention (n=252)	P-value
Age, years (mean ± SD)	55.5 ± 18.6	56.2 ± 21.3	0.694
Weight, kg (mean ± SD)	84.5 ± 27.0	85.4 ± 28.5	0.715
Male, n (%)	100 (39.2)	98 (39)	0.940
Hgb, g/dl (mean ± SD)	8.9 ± 1.7	9.1 ± 1.7	0.186
Serum iron, mcg/dL (mean ± SD)	36.1 ± 27.7	34.5 ± 27.6	0.515
TSAT, % (mean ± SD)	10.3 ± 8.2	10.8 ± 8.1	0.490
TIBC, mcg/dL (mean ± SD)	379.8 ± 108.8	355.7 ± 125.3	0.021
Ferritin, ng/mL (mean ± SD)	154.6 ± 571.6	156.1 ± 277.2	0.970

Table 3. Pre/post intervention IV iron dose comparison

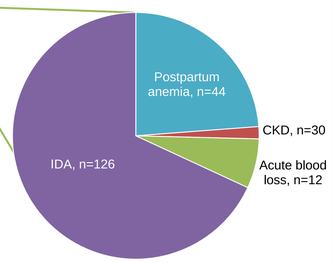
Data point	Pre-intervention (n=255)	Post-intervention (n=252)	P-value
Dose, mg (mean ± SD)	279.6 ± 76.4	288.8 ± 48.4	0.106
Number of doses (mean ± SD)	2.3 ± 1.1	2 ± 0.9	0.001
Total dose*, mg (mean ± SD)	NA	587.7 ± 273.7	NA

*Includes all Iv iron (while admitted and prior to admission) + blood products (250mg per unit)

Table 4. Indication selected

Indication (n=252)	n (%)
IDA	185 (73.4)
CKD	30 (11.9)
HF	59 (11.5)
Chronic GI losses +/- IBD	4 (1.6)
Cancer/chemo-associated	2 (0.8)
Other	2 (0.8)

Figure 1. True diagnosis when "IDA" indication selected (n=185)



RESULTS (cont.)

Table 5. Primary endpoints: appropriateness of indication and dose

Appropriate indication	n=190
Appropriate lab values for indication, n (%)	107 (56.3)
Appropriate dose of total iron received in 14-day period	**n=252**
Received >1g IV iron including doses prior to admission*, n (%)	6 (2.4)
Received >1g IV iron including doses prior to admission + blood products, n (%)	30 (11.9)
Appropriate doses received (<1g IV iron total), n (%)	222 (88)

*Prior to admission includes doses received outpatient or from an outside facility prior to transfer within 14 days

Table 6. Safety endpoints: pre/post-intervention data comparison

Data point	Pre-intervention (n=255)	Post-intervention (n=252)	P value
Received IV iron in past 14 days*, n (%)	7 (2.7)	6 (2.4)	0.795
Received >1g of IV iron in past 14 days, n (%)	1 (0.4)	6 (2.4)	0.067
Diphenhydramine pre-medication, n (%)	6 (2.3)	4 (1.6)	0.535
Diphenhydramine within 1 hour, n (%)	5 (2)	2 (0.8)	0.450
Epinephrine within 1 hour, n (%)	0 (0)	0 (0)	NA
Order set used, n (%)	74 (29)	244 (96.8)	0.001
Iron studies within 14 days, n (%)	186 (72.9)	191 (75.8)	0.462
Blood transfusion in past 14 days, n (%)	57 (22.3)	56 (22.2)	0.972
Cumulative IV iron dose (with previous doses + blood transfusions) >1000 mg, n (%)	59 (23.1)	30 (11.9)	0.001

*Includes all Iv iron (while admitted and prior to admission) + blood products (250mg per unit)

- Due to routing error in electronic referral for outpatient anemia clinic, unable to collect number of patients referred for analysis

DISCUSSION

- Ferritin, an acute phase reactant, can be elevated in several acute disease states, confounding assessment of lab values for appropriate iron use
- Inappropriate selection of "IDA" indication (**Figure 1**) potentially due to being at top of drop-down list in order set
- 62 patients did not have recent iron studies to assess appropriateness
- Unable to assess appropriateness in 56 patients having indications without guideline recommendations (postpartum anemia, acute blood loss
- Significant reduction in cumulative iron dose conceivably secondary to inclusion of blood product statement and educating providers/pharmacists
- Improved patient safety from increased availability of pre/peri-infusion medications through increased order set utilization

Limitations
- Inability to capture all IV iron (doses/blood from other health systems)
- Technical issues with outpatient anemia clinic referral
- Delays in implementation secondary to COVID-19 pandemic

Future Directions
- IV iron protocols for indications without guidelines (postpartum anemia)
- Track impact of clinic referrals through a working electronic referral process
- Subgroup analysis of IV iron dosing based on indication

REFERENCES

1) Kidney Disease: Improving Global Outcomes (KDIGO) Anemia Work Group. KDIGO Clinical Practice Guideline for Anemia in Chronic *Kidney Disease. Kidney inter.*, Suppl. 2012; 2: 279–335.
2) Anand IS, et al. Anemia and Iron Deficiency in Heart Failure: Current Concepts and Emerging Therapies. *Circulation*. 2018;138(1):80-98.
3) Rodgers GM, et al. Cancer- and chemotherapy-induced anemia. *J Natl Compr Canc Netw.* 2012;10(5):628-653.
4) Bohlius J, et al. Management of Cancer-Associated Anemia With Erythropoiesis-Stimulating Agents: ASCO/ASH Clinical Practice Guideline Update. *J Clin Oncol.* 2019;37(15):1336-1351.
5) Jimenez K, et al. Management of Iron Deficiency Anemia. *Gastroenterol Hepatol*. 2015;11(4):241-250.
6) Bayraktar UD, Bayraktar S. Treatment of iron deficiency anemia associated with gastrointestinal tract diseases. *World J Gastroenterol*. 2010;16(22):2720-2725
7) Ning Remacha A, et al. Guidelines on haemovigilance of post-transfusional iron overload. *Blood Transfus*. 2013;11(1):128-139.

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