Iron Deficiency Anaemia but Why?

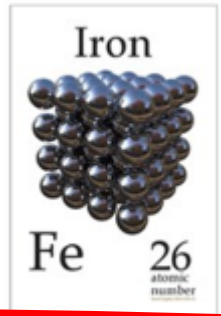
Dr LAU Ching-wa
Specialist in Haematology
Blood Transfusion Service

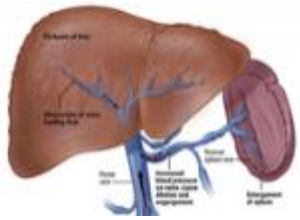
3 Questions

1. **Is anaemia incurable in my patient?**
2. **Is anaemia unavoidable in my bleeding patient?**
3. **Is transfusion improved clinical outcomes in this particular clinical scenario?**

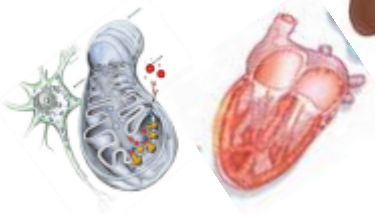
Iron Distribution

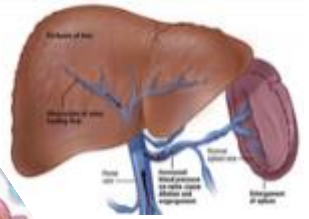
Total Body Iron ~ 50mg/kg BW	Blood Volume ~ 75ml/kg BW	Total Iron in RBC 1ml blood≈ 0.5mg elemental Iron	Myoglobin & Iron – containing Enzymes	Average Store ~10mg/kg
3000~ 4000mg	2200~ 2600mg		300~ 400mg	500~ 1000mg



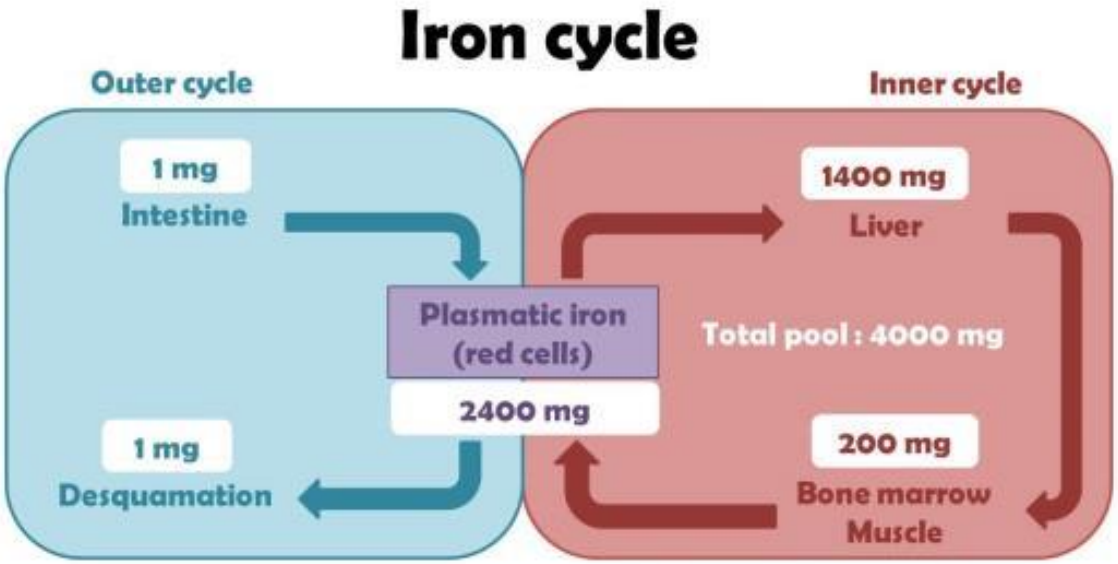


Total Body Iron ~ 40mg/kg BW	Blood Volume ~ 65ml/kg BW			Average Store 5-10mg/kg
2000~ 3000mg	1300~ 1950mg		300~ 400mg	400~ 600mg





Iron Homeostasis



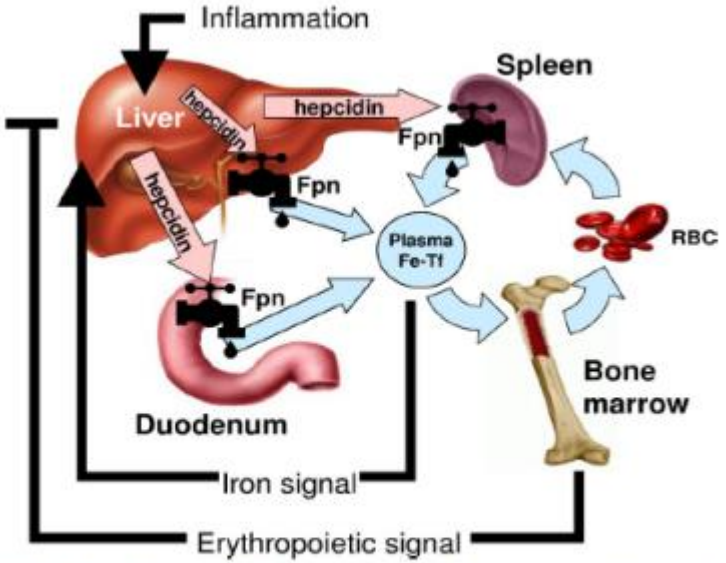


Figure 1. The role of hepcidin in iron metabolism. Hepcidin-ferroportin interaction determines the flow of iron into plasma. Hepcidin concentration is in turn regulated by iron, erythropoietic activity, and inflammation.[6]

Absolute Iron Deficiency

1. Inadequate Iron Absorption
2. Blood Loss

(1ml blood≈0.5mg elemental Iron
↓1g/dl Hb ≈200mg elemental Iron loss)

"Relative" Iron Deficiency

→Fail to Mobilize Iron Store
→ Anaemia of Chronic Illness

Underdiagnosed Anaemia Being Screened During First-time Blood Donation (*Aged 16~65*)

Proportion of Chinese First Time Donor who Failed Pre-donation Hemoglobin Check (2016 & 2017)

	Men (Cut-off Hb < 13.0 g/dL)					Women (Cut-off Hb < 11.5 g/dL)					
Age Group	Total No. of New Donors	Overall Anaemia in Men, n (%)	Mild Anaemia (Hb 11.0-12.9 g/dL)	Moderate Anaemia (Hb 8.0-10.9 g/dL)	Severe Anaemia (Hb < 8.0 g/dL)	Total No. of New Donors	Overall Anaemia in Women, n (%)	Mild Anaemia (Hb 11.0-11.4 g/dL)	Moderate Anaemia (Hb 8.0-10.9 g/dL)	Severe Anaemia (Hb < 8.0 g/dL)	Overall Anaemia in Both Sexes
16-20	20069	1066 (5.3%)	1022 (5.1%)	43 (0.2%)	1 (0.0%)	27568	3379 (12.3%)	1542 (5.6%)	1789 (6.5%)	48 (0.2%)	**4445 (9.3%)**
21-30	10147	533 (5.3%)	515 (5.1%)	18 (0.2%)	0 (0.0%)	11316	1368 (12.1%)	626 (5.5%)	723 (6.4%)	19 (0.2%)	**1901 (8.9%)**
31-40	5309	262 (4.9%)	256 (4.8%)	6 (0.1%)	0 (0.0%)	8640	1199 (13.9%)	501 (5.8%)	675 (7.8%)	23 (0.3%)	**1461 (10.5%)**
41-50	3447	248 (7.2%)	238 (6.9%)	10 (0.3%)	0 (0.0%)	6475	1109 (17.1%)	422 (6.5%)	650 (10.0%)	37 (0.6%)	**1357 (13.7%)**
51-60	1874	158 (8.4%)	150 (8.0%)	8 (0.4%)	0 (0.0%)	3160	284 (9.0%)	155 (4.9%)	124 (3.9%)	5 (0.2%)	**442 (8.8%)**
61-65	93	11 (11.8%)	10 (10.8%)	1 (1.0%)	0 (0.0%)	116	10 (8.6%)	7 (6.0%)	3 (2.6%)	0 (0.0%)	**21 (10.1%)**
Total	40939	2281 (5.6%)	2194 (5.4%)	86 (0.2%)	1 (0.0%)	57312	7352 (12.8%)	3254 (5.7%)	3966 (6.9%)	132 (0.2%)	**9633 (9.8%)**

Another Study of Successful First-time Donors

Female: 32.4% have serum ferritin level below 30ng/ml & 19.6% have serum ferritin level below 15ng/ml (n=102).

Male: 1% have serum ferritin level below 30ng/ml (n=104).

Ferritin 1ng/mL≈8mg Iron Store

Remark:
WHO Definition of Anaemia in Women 12.0g/dL
BTS Blood Donation Cutoff for Women: 11.5g/dL

Projected Overall Underdiagnosed Anaemia in the Society (*Aged 16~65*)

Data projected from Proportion of Low Hb Deferral of New Blood Donors 2016 to 2017 and Population Census data in 2017

	Men					Women					Both Sexes				
Age group	Mild Anaemia (Hb 11-12.9 g/dL)	Moderate Anaemia (Hb 8.0-10.9 g/dL)	Severe Anaemia (Hb<8.0 g/dL)	Overall Anaemia in Men	Overall Anaemia in Men %	Mild Anaemia (Hb 11-11.5 g/dL)	Moderate Anaemia (Hb 8.0-10.9 g/dL)	Severe Anaemia (Hb<8.0 g/dL)	Overall Anaemia in Women	Overall Anaemia in Women %	Mild (Hb 11 to 11.5 for female & 11 to 12.9g/dL for male)	Moderate (Hb 8 to 10.9g/dL)	Severe (Hb<8 g/dL)	Overall Anaemia in both sexes	Overall Anaemia in both sexes %
16-20	8173	344	8	8525	5.3%	8373	9715	261	18349	12.3%	16547	10059	269	**26874**	**8.7%**
21-30	22306	780	0	23086	5.3%	27190	31403	825	59418	12.1%	49496	32182	825	**82504**	**8.9%**
31-40	22292	522	0	22815	4.9%	40306	54305	1850	96461	13.9%	62598	54827	1850	**119276**	**10.3%**
41-50	32797	1378	0	34175	7.2%	43732	67359	3834	114925	17.1%	76528	68737	3834	**149100**	**13.0%**
51-60	47345	2525	0	49870	8.4%	32751	26201	1056	60008	9.0%	80096	28726	1056	**109879**	**8.7%**
61-65	27839	2784	0	30623	11.8%	16016	6864	0	22879	8.6%	43854	9648	0	**53502**	**10.2%**
Total	160752	8333	8	169093	7.1%	168367	195846	7827	372040	12.7%	329120	204179	7835	**541134**	**10.2%**

A portion of the mild anaemia may be related to thalassemia.

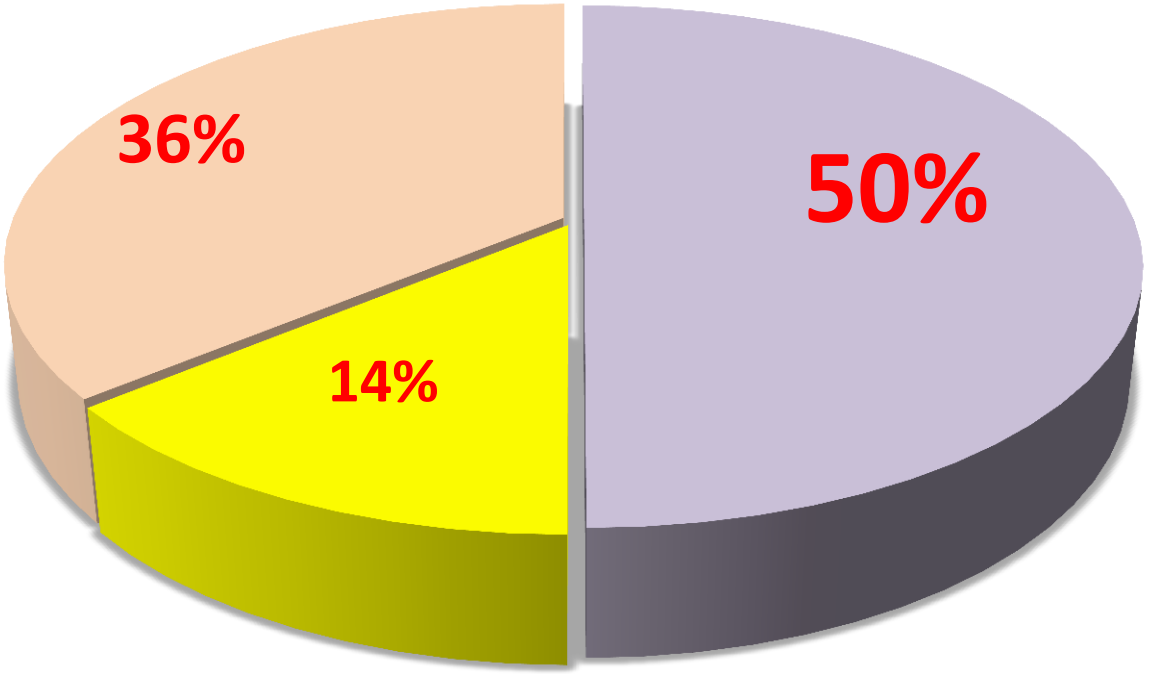
However, moderate and severe anaemia can seldom be explained by thalassemia.

Remark:

WHO Definition of Anaemia in Women 12.0g/dL

BTS Blood Donation Cutoff for Women: 11.5g/dL

Indications of Blood Transfusion in 2016



- Blood Loss (Gynecology 4%, GIB 20%, Elective operations 13%, Emergency operations 8%, Trauma 5%)
- Renal Insufficiency (Hemodialysis 7%, peritoneal dialysis and non-dialysis 7%)
- Marrow Failure 10%, Red Cell Disorders 6%, Hematological Malignancy 10%, some Oncological conditions 10%

Data from CDARDS_2016

Perpetuation of Iron Deficiency

Hospital Settings:

- Blood Transfusion as reflex response to treat Anaemia
- Pathological causes of Blood Loss managed
- Under-diagnosed Iron Deficiency in many chronic illness *e.g.* Chronic Renal Impairment, Chronic Heart Failure, Malignancy, Inflammatory Conditions…
- Blood Loss due to various procedures and blood taking
- Insufficient treatment to minimize Blood Loss
- Underlying Iron Deficiency seldom received adequate treatment

GP/FM/SOPD Settings:

- Pathological causes of Blood Loss diagnosed and treated *or* referred to Hospital
- Underlying Iron Deficiency seldom received adequate treatment
- Insufficient treatment to control chronic Blood Loss (physiological or pathological)
- Anti-platelet or oral anti-coagulation therapy may increase Blood Loss
- Acid suppressants inhibit Iron Absorption

Iron Deficiency related to:

- Inadequate Iron Intake
- Suboptimal Iron Absorption
- Helicobacter Pylori Infection
- Physiological Blood Loss
- Suboptimal Iron Supplement during pregnancy
- Blood Donation
- Poor Compliance to Iron Therapy

1. Inadequate Iron Intake

>80% of the male population &
>90% of the female population below the recommended nutrient intake level for iron for adult

Adobe Acrobat Document

Centre for Food Safety of the Food and Environmental Hygiene Department 2014

The recommended nutrient intakes for iron based on varying dietary iron bio-availabilities

Group	Age (years)	Mean Body weight (kg)	Recommended Nutrient Intake (mg/day)			
			% Dietary Iron Bio-availability			
			15	12	10	5
Children	0.5-1	9	[6.2][b]	[7.7][b]	[9.3][b]	[18.6][b]
	1-3	13.3	3.9	4.8	5.8	11.6
	4-6	19.2	4.2	5.3	6.3	12.6
	7-10	28.1	5.9	7.4	8.9	17.8
Males	11-14	45	9.7	12.2	14.6	29.2
	15-17	64.4	12.5	15.7	18.8	37.6
	18+	75	9.1	11.4	13.7	27.4
Females	11-14[c]	46.1	9.3	11.7	14	28
	11-14	46.1	21.8	27.7	32.7	65.4
	15-17	56.4	20.7	25.8	31	62
	18+	62	19.6	24.5	29.4	58.8
Post-menopausal		62	7.5	9.4	11.3	22.6
Lactating		62	10	12.5	15	30

[a]Based in part on a 1988 report from the FAO/WHO (*8*) and in part on new requirements in menstruating women. Because of the very skewed distribu iron requirements are calculated for four levels of dietary iron bio-availabili
[b]Bio-availability of dietary iron during this period varies greatly.
[c]Non-menstruating.

2. Food Interaction affecting Heme Iron Absorption

1	**Iron status of subject** (The absorption of heme iron can vary from >40% during iron deficiency to about 10% during iron repletion)
2	**Amount of dietary heme iron**
3	**Content of calcium in meal** (e.g., milk, cheese) (Calcium is the only dietary factor that negatively influences the absorption of heme iron and does so to the same extent that it influences non-heme iron)
4	**Food preparation (time, temperature)** (Heme iron can be degraded and converted to non-heme iron if foods are cooked at a high temperature for too long)

3. Food Interaction affecting non-Heme Iron Absorption

Enhancing factors	Inhibiting factors
Ascorbic acid (e.g., certain fruit juices, fruits, potatoes, and certain vegetables)	**Phytates and other inositol phosphates** (e.g., bran products, bread made from high-extraction flour, breakfast cereals, oats, rice [especially unpolished rice], pasta products, cocoa, nuts, soya beans, and peas)
Meat, chicken, fish and other seafood	**Iron-binding phenolic compounds** (e.g., tea, coffee, cocoa, certain spices, certain vegetables, and most red wines)
Fermented vegetables (e.g., sauerkraut), **fermented soy sauces**, etc.	**Calcium** (e.g., milk, cheese, soy proteins)

4. Helicobacter Pylori

- 58.4% population is infected by H. Pylori
- H. Pylori diminishes Iron Absorption from diet
- A number of meta-analyses confirmed the role of H. pylori eradication in improving **Iron Deficiency Anaemia** correction with appropriate Iron therapy

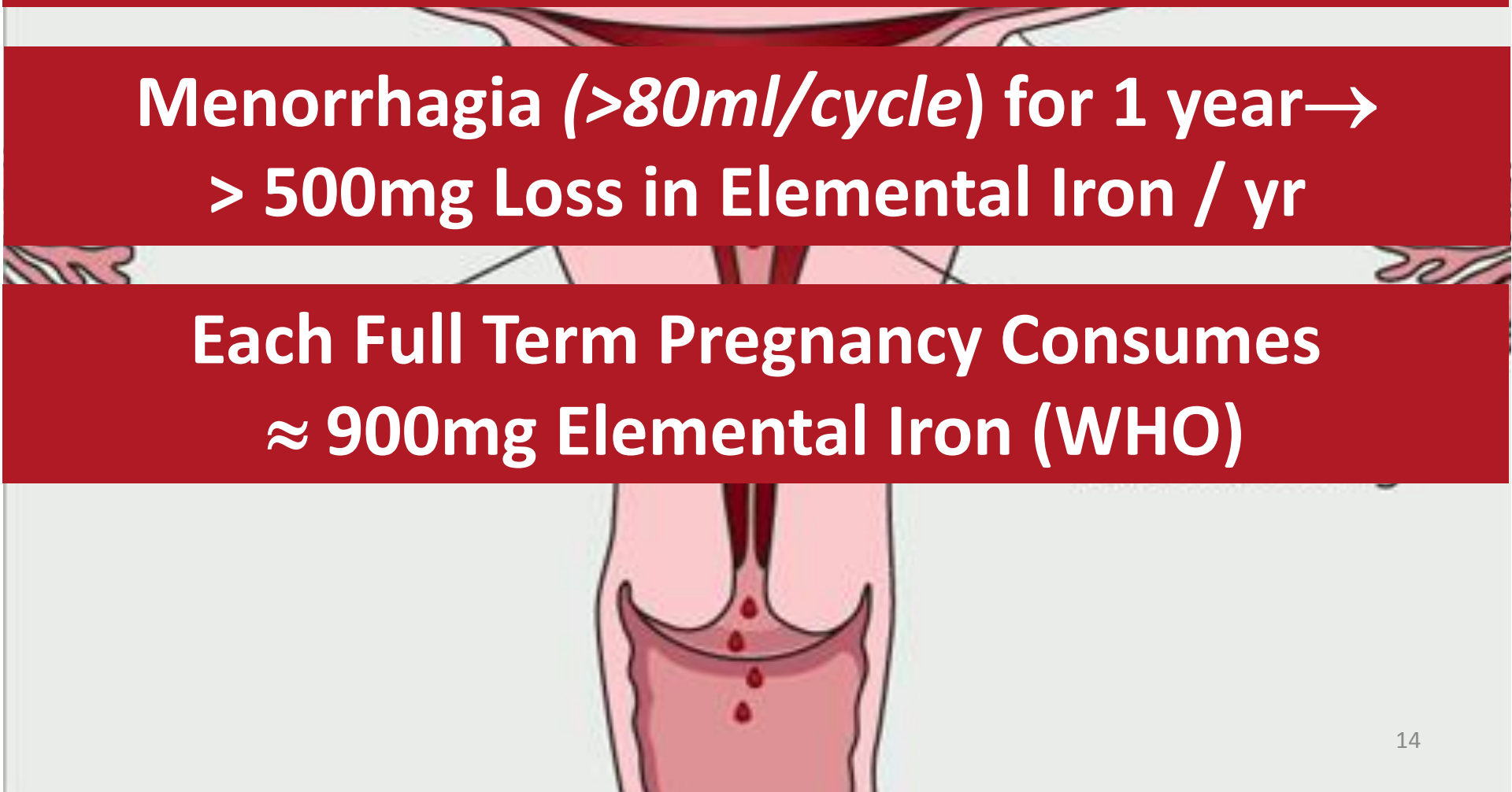
5. Physiological Blood Loss in Women

1 ml Blood= 0.5mg Elemental Iron

↓In 1g/dL Hb ≈200mg Loss in Elemental Iron

Menorrhagia *(>80ml/cycle)* for 1 year→
> 500mg Loss in Elemental Iron / yr

Each Full Term Pregnancy Consumes
≈ 900mg Elemental Iron (WHO)



6. Improper Iron Supplement for Pregnancy

Published in final edited form as:
Am J Med. 2008 November ; 121(11): 943–948. doi:10.1016/j.amjmed.2008.07.012.

Individualized treatment for iron deficiency anemia in adults

Michael Alleyne, MD[a,c], McDonald K. Horne, MD[b], and Jeffery L. Miller, MD[c,*]

Multivitamin preparations should never be recommended as a sole therapy for iron deficient anemia, since the calcium, phosphorus and magnesium salts contained in iron-containing multivitamin pills impair absorption of elemental iron.

MINERALS		
Calcium (calcium carbonate)	250	mg
Magnesium (magnesium oxide)	50	mg
Iodine (potassium iodide)	0.15	mg
Iron (ferrous fumarate)	60	mg
Copper (cupric oxide)	2	mg
Zinc (zinc oxide)	25	mg
Chromium (chromium chloride)	25	mcg
Manganese (manganese sulfate)	5	mg
Molybdenum(sodium molybdte)	25	mcg
Selenium (sodium selenate)	25	mcg
THERAPEUTIC USE ONLY		

7. Repeated Blood Donation

1 ml Blood= 0.5mg Elemental Iron

≈200mg Elemental Iron loss in Each Donation

Perpetuation of Iron Deficiency

Hospital Settings:

- Blood Transfusion as reflex response to treat Anaemia
- Pathological causes of Blood Loss managed
- Under-diagnosed Iron Deficiency in many chronic illness *e.g.* Chronic Renal Impairment, Chronic Heart Failure, Malignancy, Inflammatory Conditions…
- Blood Loss due to various procedures and blood taking
- Insufficient treatment to minimize Blood Loss
- Underlying Iron Deficiency seldom received adequate treatment

GP/FM/SOPD Settings:

- Pathological causes of Blood Loss diagnosed and treated *or* referred to Hospital
- Underlying Iron Deficiency seldom received adequate treatment
- Insufficient treatment to control chronic Blood Loss (physiological or pathological)
- Anti-platelet or oral anti-coagulation therapy may increase Blood Loss
- Acid suppressants inhibit Iron Absorption

Iron Deficiency related to:

- Inadequate Iron Intake
- Suboptimal Iron Absorption
- Helicobacter Pylori Infection
- Physiological Blood Loss
- Suboptimal Iron Supplement during pregnancy
- Blood Donation
- Poor Compliance to Iron Therapy

8. Drug Interaction affecting Iron Absorption

Clinical Data Analysis & Reporting System

Patient-Based Analysis

Data Source in (User Defined Query: **Antacids, H2 Receptor Antagonists or PPIs**

Drug Dispensing Date Between 01/01/2017 and 31/12/2017)

Institution Cluster	No. of Patient Headcount
A	118594
B	81754
C	211878
D	152885
E	199999
F	179179
G	173743
Grand Total :	1,118,032

MEDICATIONS INHIBITING IRON ABSORPTION:

H2 receptor blockers, antacid medications, proton pump inhibitors; tetracyclines, quinolones; ACEI; levothyroxine; levodopa, carbidopa; cholestyramine and colestipol (bile acid sequestrant)

9. Anti-plaletet or oral anticoagulant may increase bleeding

Clinical Data Analysis & Reporting System

Patient-Based Analysis

Data Source in (

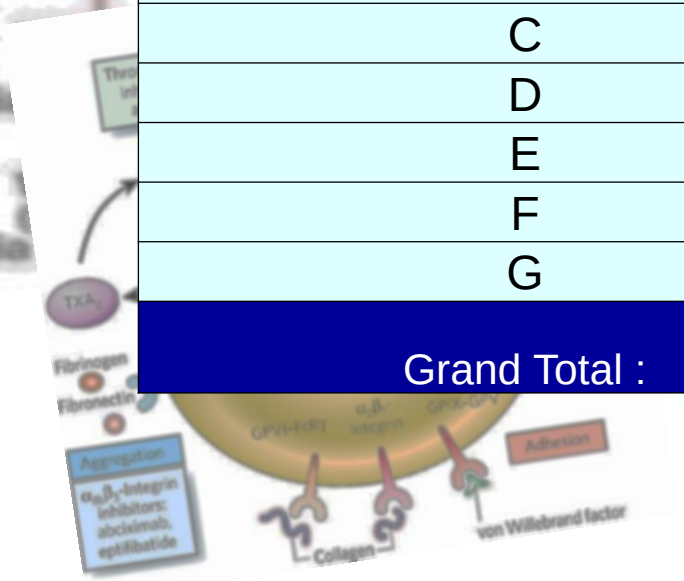
« Drug{Therapeutic Classification (BNF, Principal or Secondary) in (

Drug BNF: **2.9 ANTIPLATELET DRUGS**

Drug BNF: **2.8.2 ORAL ANTICOAGULANTS**)} »

Drug Dispensing Date Between 01/01/2017 and 31/12/2017)

Institution Cluster	No. of Patient Headcount
A	47645
B	36526
C	79987
D	57526
E	74886
F	64914
G	50320
Grand Total :	411,804



Perpetuation of Iron Deficiency

Hospital Settings:

- Blood Transfusion as reflex response to treat Anaemia
- Pathological causes of Blood Loss managed
- Under-diagnosed Iron Deficiency in many chronic illness *e.g.* Chronic Renal Impairment, Chronic Heart Failure, Malignancy, Inflammatory Conditions…
- Blood Loss due to various procedures and blood taking
- Insufficient treatment to minimize Blood Loss
- Underlying Iron Deficiency seldom received adequate treatment

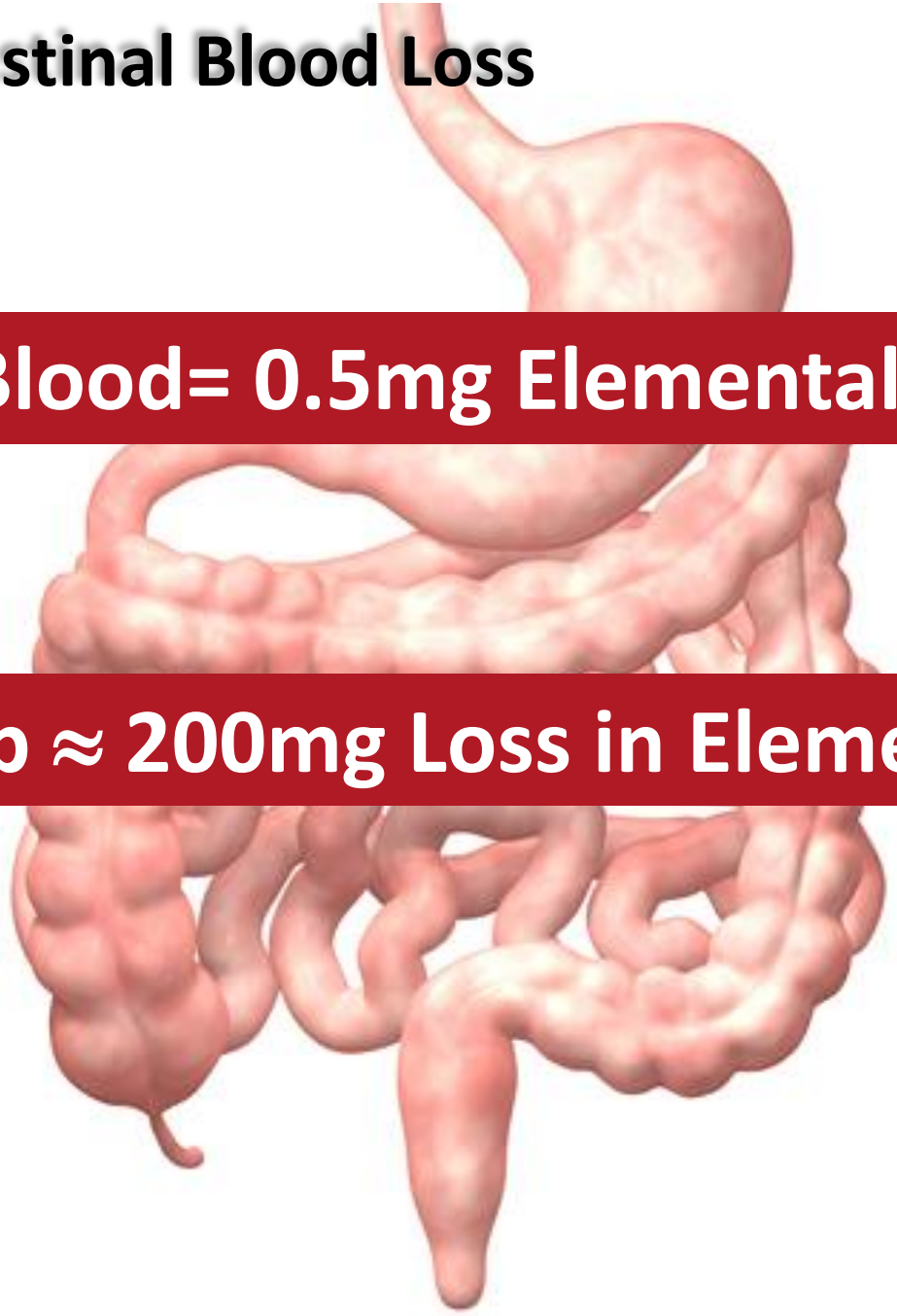
GP/FM/SOPD Settings:

- Pathological causes of Blood Loss diagnosed and treated *or* referred to Hospital
- Underlying Iron Deficiency seldom received adequate treatment
- Insufficient treatment to control chronic Blood Loss (physiological or pathological)
- Anti-platelet or oral anti-coagulation therapy may increase Blood Loss
- Acid suppressants inhibit Iron Absorption

Iron Deficiency related to:

- Inadequate Iron Intake
- Suboptimal Iron Absorption
- Helicobacter Pylori Infection
- Physiological Blood Loss
- Suboptimal Iron Supplement during pregnancy
- Blood Donation
- Poor Compliance to Iron Therapy

10. Gastrointestinal Blood Loss



1 ml Blood= 0.5mg Elemental Iron

↓ 1g/dL Hb ≈ 200mg Loss in Elemental Iron

11. GIB received Blood Transfusion in 2016:
Underlying Iron Deficiency is Insufficiently Treated

	GI neoplasms	Non-malignant Lower GIB	Non-malignant Upper GIB
Number of unique patients	3,604	3,161	5,612
Median age (range)	72 (3~105)	78 (0~106)	75 (0~105)
Number of transfusion episodes	5,377	5,870	9,789
Units of RC transfused	9,179	10,262	16,558
Episodes			
• Pre-transfusion Hb absent	97 (1.8%)	14 (0.2%)	17 (0.2%)
• Post-transfusion Hb absent	909 (16.9%)	305 (5.2%)	497 (5.1%)
• Pre-transfusion Hb ≥8 g/dL	1,423 (26.5%)	1,429 (24.3%)	2,043 (20.9%)
• Post transfusion Hb ≥ 10 g/dL	1,626 (30.2%)	1,602 (27.3%)	2,379 (24.3%)
• Multiple units RC given	3,230 (60.1%)	3,521 (60.0%)	5,510 (56.3%)
Neither parenteral nor oral iron given	2,458 (68.2%)	2,352 (74.4%)	3,863 (68.8%)

1st Pillar

OPTIMIZE HEMATOPOIESIS

Neither parenteral nor oral iron in ~2/3

2nd Pillar

MINIMIZE BLOOD LOSS

3rd Pillar

OPTIMIZE PATIENT-SPECIFIC TOLERANCE TO ANAEMIA

Post transfusion Hb ≥ 10 g/dL in 1/4 ~ 1/3

Multiple units RC given in ~2/3

Data from CDARDS

How often was iron deficiency managed in gastrointestinal bleeding?

Dr Ching-Wa LAU, Dr Jennifer Nga-Sze LEUNG, Dr Cheuk-Kwong LEE
Hong Kong Red Cross Blood Transfusion Service

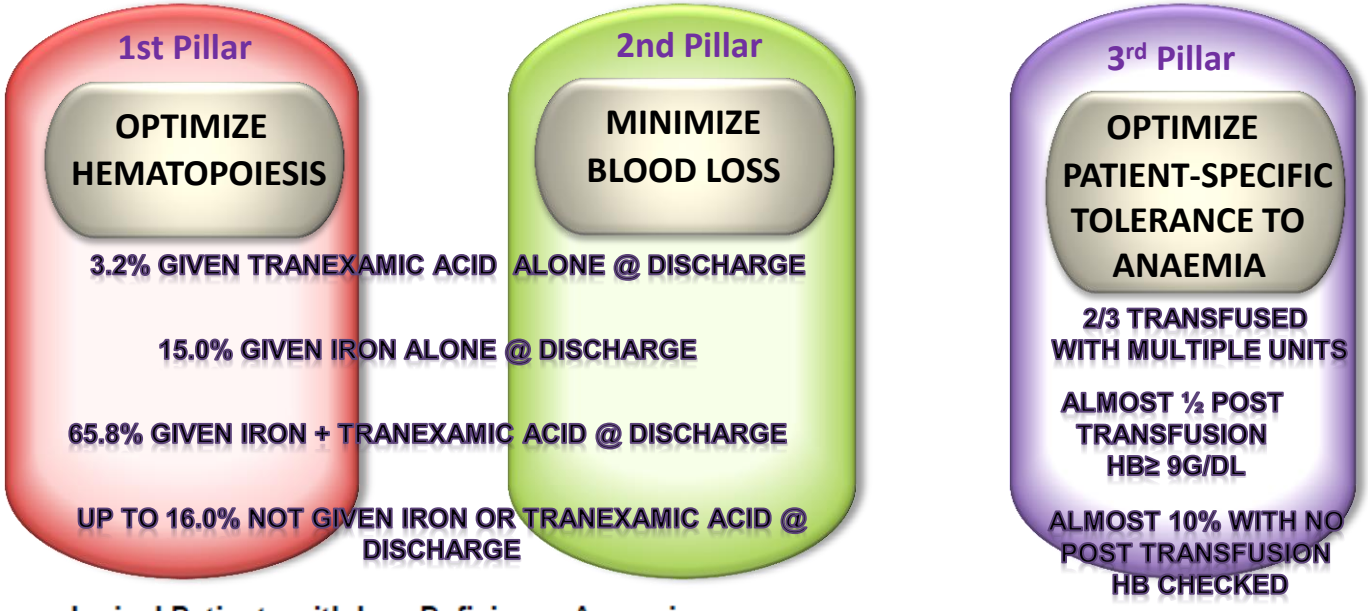
12. Gynecology Patients received Blood Transfusion in 2016: *Underlying Iron Deficiency is Insufficiently Treated Bleeding Condition is Insufficiently Managed*

Study Period between 01/01/2016 and 31/12/2016

Gynecology Patients Age ≤60 (range 11~60), Non-operation related Admission

(2,906 Transfusion Episodes of 5,889 units RC in 2,523 Unique Patients)

Pre-transfusion Hb	Median Age	1 unit RC	2 units RC	3 units RC	4 units RC	5 units RC	>5 units RC	Total Transfusion Episodes	Post-transfusion Hb <7	Post-transfusion Hb 7~8	Post-transfusion Hb 8~9	Post-transfusion Hb 9~10	Post-transfusion Hb >10	Post-transfusion Hb missing
< 7	45	77	777	525	77	3	2	1461	65	208	537	413	136	102
7~8	45	374	656	17	0	0	0	1047	4	52	287	411	179	114
8~9	45	148	117	1	0	0	0	266	3	8	43	76	85	51
9~10	44	23	16	0	0	0	0	39	0	1	4	8	21	5
≥10	36	10	7	0	0	0	0	17	1	1	0	3	12	0
Pre-transfusion Hb missing	46	16	50	10	0	0	0	76	0	7	17	26	15	11
Total	45	648	1623	553	77	3	2	2906	73	277	888	937	448	283



Gaps in Managing Gynaecological Patients with Iron Deficiency Anaemia

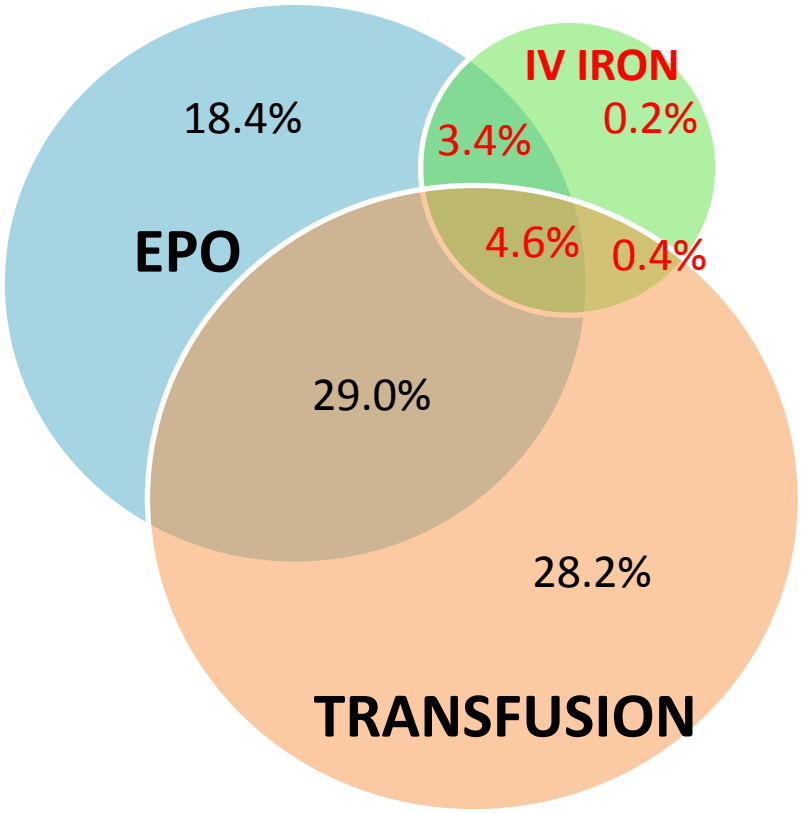
Ching-Wa Lau[1], Wing-Cheong Leung[2], Nga-Sze Leung[1] and **Cheuk-Kwong Lee**[1], (1)Hc
Transfusion Service, Hong Kong, Hong Kong, (2)Kwong Wah Hospital, Hong Kong, Hong

HAA 2017 HSANZ ANZSBT THANZ

Data from CDARDS_2016

13. Anaemia Treatment in Hemodialysis:
Underlying Iron Deficiency is Insufficiently Treated

	Hemodialysis Headcount	Percentage
No Treatment	683	15.9%
Transfusion Alone	1212	28.2%
EPO Alone	792	18.4%
IV Iron Alone	8	0.2%
EPO +IV Iron	147	3.4%
EPO+Transfusion	1248	29.0%
IV Iron+ Transfusion	16	0.4%
EPO+ IV Iron+ Transfusion	199	4.6%



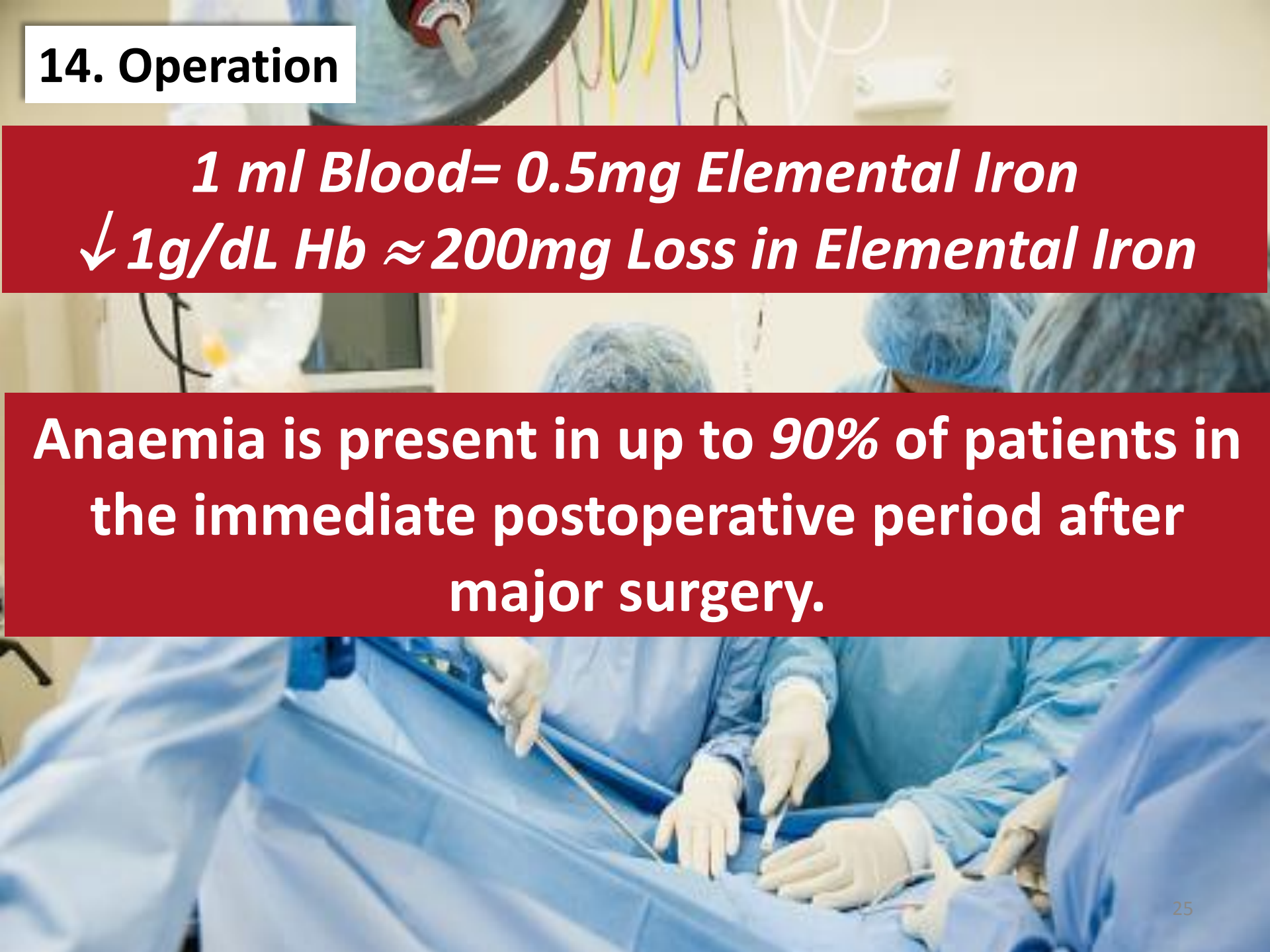
N=4305

No Anaemia Treatment

15.9%

Data from CDARDS_2016

14. Operation



1 ml Blood= 0.5mg Elemental Iron

↓1g/dL Hb ≈200mg Loss in Elemental Iron

Anaemia is present in up to *90%* of patients in the immediate postoperative period after major surgery.

15.Obstetric Patients undergoing Cesarean Section in 2016/17: *Bleeding Condition is Insufficiently Managed*

Hospital Code in (All Hospitals) AND
Discharge Date between 01/10/2016 and 30/09/2017 AND
Diagnosis Code (ICD9) in (74 CESAREAN SECTION AND REMOVAL OF FETUS)

Use of IV Transamin	Yes	No	Row Total
Institution Cluster (Admission Date)	No. of Episodes Headcounts	No. of Episodes Headcounts	No. of Episodes Headcounts
A		872	872
B		966	966
C	19	2310	2329
D	5	903	908
E	43	1660	1703
F	13	1690	1703
G		1637	1637
Grand Total :	80	10038	10118

Data from CDARDS

16. Obstetric Patients with PPH in 2016/17: *Bleeding Condition is Insufficiently Managed*

Hospital Code in (All Hospitals) AND
Discharge Date between 01/10/2016 and 30/09/2017 AND
Diagnosis Code (ICD9) in (666 POSTPARTUM HEMORRHAGE)

Use of IV Transamin	Yes	No	Row Total
Institution Cluster (Admission Date)	No. of Episodes Headcounts	No. of Episodes Headcounts	No. of Episodes Headcounts
A	3	183	185
B	2	232	234
C	51	526	574
D	11	431	442
E	16	499	513
F	5	384	389
G		306	306
Grand Total :	88	2553	2635

Data from CDARDS

Perpetuation of Iron Deficiency

Hospital Settings:

- Blood Transfusion as reflex response to treat Anaemia
- Pathological causes of Blood Loss managed
- Under-diagnosed Iron Deficiency in many chronic illness *e.g.* Chronic Renal Impairment, Chronic Heart Failure, Malignancy, Inflammatory Conditions…
- Blood Loss due to various procedures and blood taking
- Insufficient treatment to minimize Blood Loss
- Underlying Iron Deficiency seldom received adequate treatment

GP/FM/SOPD Settings:

- Pathological causes of Blood Loss diagnosed and treated *or* referred to Hospital
- Underlying Iron Deficiency seldom received adequate treatment
- Insufficient treatment to control chronic Blood Loss (physiological or pathological)
- Anti-platelet or oral anti-coagulation therapy may increase Blood Loss
- Acid suppressants inhibit Iron Absorption

Iron Deficiency related to:

- Inadequate Iron Intake
- Suboptimal Iron Absorption
- Helicobacter Pylori Infection
- Physiological Blood Loss
- Suboptimal Iron Supplement during pregnancy
- Blood Donation
- Poor Compliance to Iron Therapy

Diagnosis

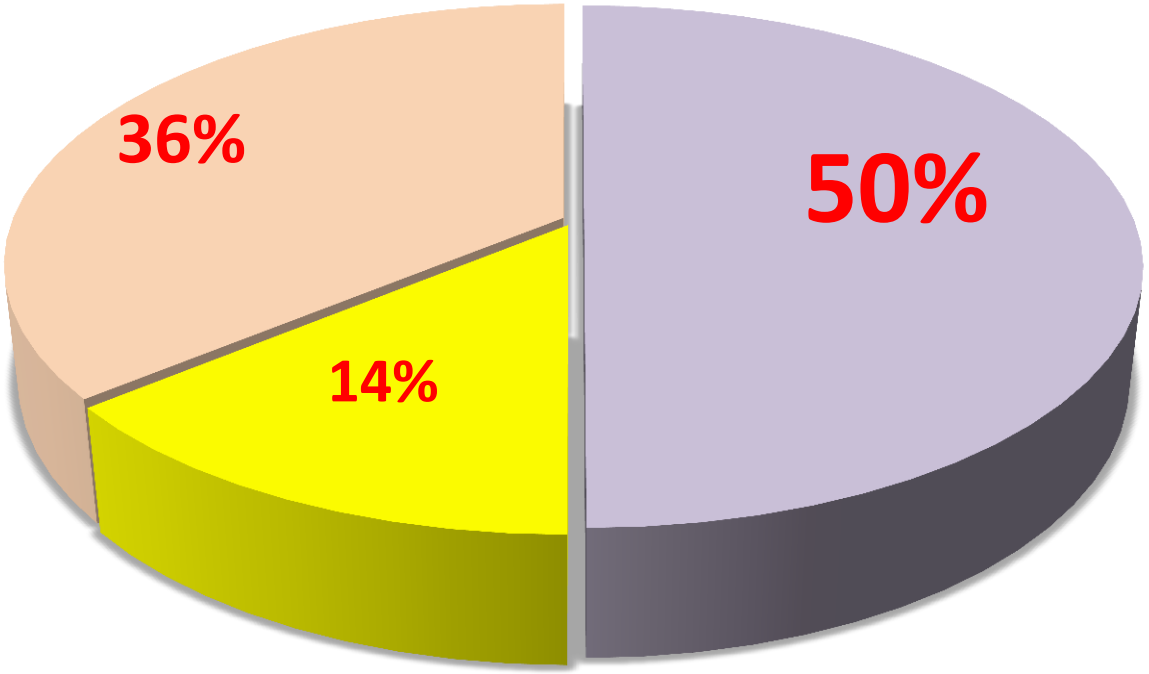
WHO Definitions of Anaemia in Adult			
(gm/dl)	**Mild**	**Moderate**	**Severe**
Pregnant women	10.0-10.9	7.0-9.9	<7
Non-pregnant women	11-11.9	8.0-10.9	<8
Men	11.0-12.9	8.0-10.9	<8

WHO Definitions of Iron Deficiency	Most global experts Definitions of Iron Deficiency
<15 ng/ml	**<30 ng/ml**
	Sensitivity 92%
	Positive predictive value 83%
Ferritin 1ng/ml ≈ 8mg Iron Store	

TRANSFUSION ALTERNATIVES

1. **Maximizing endogenous red cell production by TRANSFUSION ALTERNATIVES**
2. **Minimizing endogenous red cell loss by TRANSFUSION ALTERNATIVES and good surgical and anesthetic techniques**
3. **Safe and appropriate use of ALLOGENEIC BLOOD TRANSFUSION to *improve patient clinical outcomes, not the number***

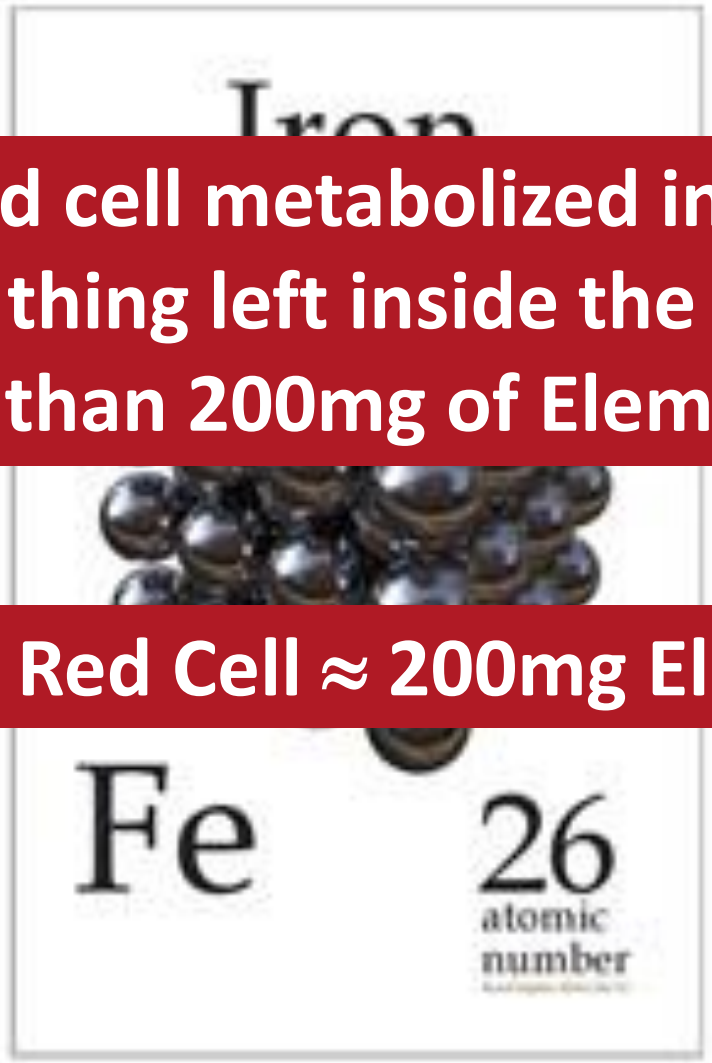
Clinical Scenarios in which Benefits of Transfusion out-weight the Risks



- Blood Loss (Gynecology 4%, GIB 20%, Elective operations 13%, Emergency operations 8%, Trauma 5%)
- Renal Insufficiency (Hemodialysis 7%, peritoneal dialysis and non-dialysis 7%)
- Marrow Failure 10%, Red Cell Disorders 6%, Hematological Malignancy 10%, some Oncological conditions 10%

Data from CDARDS_2016

Allogeneic red cell metabolized in a few weeks, the only thing left inside the patient is no more than 200mg of Elemental Iron



Every Unit of Red Cell ≈ 200mg Elemental Iron

GLOBAL BENCHMARK