

FLETCHER ALLEN HEALTH CARE
Laboratory Services Directory

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Thyroid Testing Cascade

Mary E. Tang, M.D.

March 1998

Review Date: October 2010

Review By: Greg Sharp, MD

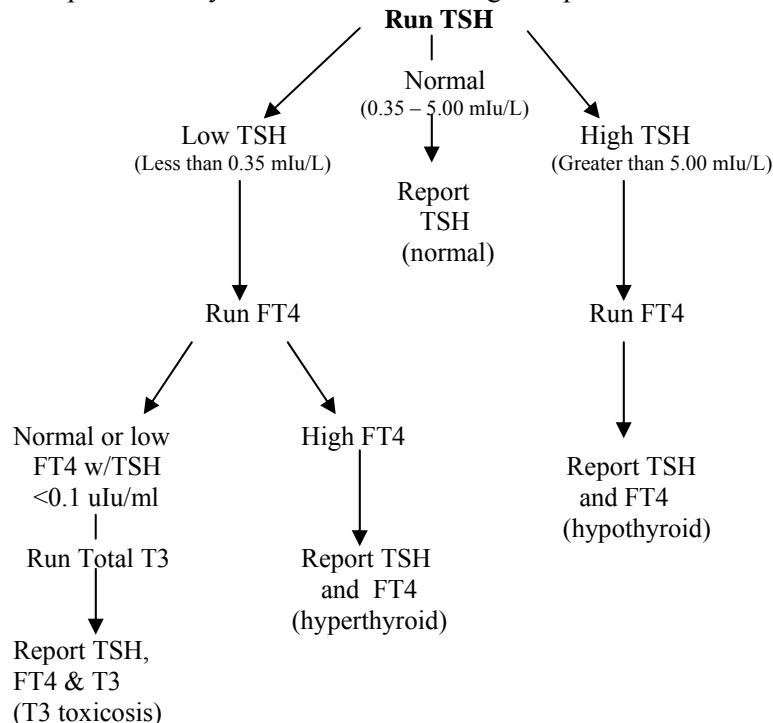
Listed below is a chart for Thyroid Testing Cascade for the evaluation of primary thyroid dysfunction. This test cascade will allow clinicians to use reflex ordering of thyroid function tests in order to provide more timely and cost effective laboratory diagnosis of common thyroid function disorders. This test cascade is only intended for ambulatory patients and is not recommended for inpatients, patients with pituitary or hypothalamic disorders or patients with acute illness or neuropsychiatric disease. The cascade is performed only if the physician specifically orders it. Patients are charged only for the tests that are performed. Monitoring thyroid hormone replacement can be done with TSH alone and does not require the test cascade.

The basis for the cascade is the TSH. Recent improvements in testing have made TSH the most sensitive indicator of primary hyper/hypothyroidism. A normal TSH effectively excludes primary thyroid dysfunction. It is not sensitive for cases in which pituitary or hypothalamic etiologies are suspected. In those cases a TSH and free T4 should be ordered.

The Thyroid Test Cascade starts with a TSH. If the TSH result is abnormal a free T4 is performed. In cases where a TSH is suppressed and the free T4 is low or normal a total T3 is done to test for T3 toxicosis.

When the Thyroid Test Cascade is ordered a report will follow showing the tests performed and the results. There is no accompanying interpretative report. Interpretation is available through your local pathologist.

Questions about this protocol may be directed to Dr. Greg Sharp at 847-5121 or 800-991-2799.



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An Approach to Lipid Testing

Gregory Sharp, M.D.

March 2002 Revision

Review Date: July, 2008

Reviewed By: Greg Sharp, MD

This approach to lipid testing is based on the summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). JAMA, May 16, 2001 – Vol 285, no. 19. Go to <http://www.nhlbi.nih.gov/guidelines/cholesterol/index.htm> for a downloadable version of the NCEP report and summary. There is an easy-to-use cholesterol risk calculator at the NIH site - <http://hin.nhlbi.nih.gov/atpiii/riskcalc.htm>

The primary target for therapy under this protocol is LDL cholesterol. As a consequence, the goals for therapy and the cutpoints for initiating treatment are stated in terms of LDL. In addition, the goals and cutpoints are based on an assessment of risk, with the most aggressive therapy being directed at those persons judged to be at highest risk.

It is recommended that adults aged 20 years or older should obtain a fasting lipid profile consisting of total cholesterol, LDL cholesterol, high-density lipoprotein (HDL) cholesterol, and triglyceride at least once every 5 years. The classification for the lipoprotein levels is shown in Table 1.

<u>LDL Cholesterol</u>	
< 100	Optimal
100 – 129	Near or above optimal
130 – 159	Borderline high
160 – 189	High
≥ 190	Very High
<u>Total Cholesterol</u>	
<200	Desirable
200 – 239	Borderline High
≥ 240	High
<u>HDL Cholesterol</u>	
< 40	Low
≥ 60	High (Desirable)

TABLE 1
Classification of LDL, Total Cholesterol and HDL Cholesterol (mg/dl).

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Footnote to the NCEP Guidelines

As a result of 5 major clinical studies of statin therapy, the National Cholesterol Education Panel has issued further guidelines.

Grundy et al. Implications of Recent Clinical Trials for the National Cholesterol Education Program Adult Treatment Panel III Guidelines. *Circulation*. 2004; 110:227-239.

- 1) The recommended LDL-cholesterol target remains <100 mg/dL for most high risk patients.
- 2) A new optional target of <70 mg/dL has been recommended for patients at “very high risk” (patients with CHD who also have multiple or poorly controlled risk factors or a recent coronary event)
- 3) Pharmacologic therapy is now recommended for high risk and very high risk patients whose LDL levels are \geq 100 mg/dL, along with lifestyle changes.
- 4) For moderate risk individuals (10 year CHD risk of 10-20%) the LDL target remains <130mg/dL. However, a target of <100 mg/dL is a therapeutic option. Pharmacologic therapy is recommended for all eligible moderate risk patients with an LDL level >130 mg/dL.
- 5) The importance of control for those aged 65 to 80 continues to be emphasized. For those over 80, evidence is scant and physician discretion is advised.
- 6) The importance of raising HDL levels is discussed, but no specific targets are recommended

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Risk Factors: Once the lipid profile is obtained, an individual can be classified into one of three categories of risk, that modify the LDL cholesterol goal. Those individuals that are in the highest category of risk have the most stringent LDL goals, while those in the lowest risk category have the least stringent LDL goals. The categories and the LDL goals are shown in Table 3.

The highest risk category consists of CHD and CHD equivalents. CHD equivalents are those processes that carry a risk for a major coronary event equal to that of established CHD (> 20% per 10 years). Risk equivalents include:

1. Other clinical forms of atherosclerotic disease such as abdominal aortic aneurysm or symptomatic carotid disease.
 2. Diabetes
 3. Multiple risk factors that confer a ten year risk for CHD > 20%. (This can be assessed using Table 4)
- Their LDL goal is < 100 mg/dL

The second risk level consists of those individuals who have two or more of the major risk factors shown in Table 2, **and** in whom the 10 year risk for CHD is ≤ 20%. The 10 year assessment of risk is made in Table 4 and is based on the Framingham study. Their LDL goal is < 130 mg/dL.

<u>Major Risk Factors</u>
+ Cigarette smoking
+ Hypertension (blood pressure ≥ 140/90 mm Hg or on antihypertensive medication)
+ Low HDL cholesterol (<40 mg/dl)
+ Family history of premature CHD (CHD in male first-degree relative < 55 years; CHD in female first-degree relative < 65 years)
+ Age (men ≥ 45 years; women ≥ 55 years)
- HDL cholesterol ≥ 60 mg/dL counts as “negative” risk; remove 1 risk factor from total count.

TABLE 2.
Risk Factors that can modify LDL goals.

The third category consists of individuals with 0 – 1 risk factors (and almost certainly a 10 year risk < 10%). Their LDL cholesterol goal is < 160 mg/dL.

<u>Risk Category</u>	<u>LDL Goal (mg/dL)</u>	<u>LDL Level at which to initiate Therapeutic Lifestyle Changes (mg/dL)</u>	<u>LDL Level at which to Consider Drug Therapy (mg/dL)</u>
CHD and CHD risk equivalents	<100	≥ 100	≥ 130 (100-129 drug optional)
Multiple (2+) risk factors and (10 year CHD risk < 20%)	<130	≥ 130	10yr risk 10-20%: ≥ 130 10yr risk < 10%: ≥ 160
0 – 1 risk factor	<160	≥ 160	≥ 190 (160-189 LDL-lowering drug optional)

TABLE 3.
LDL goals and treatment levels modified by risk category.

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Recommendations: Once the LDL goals are set (and these are just general guidelines – they may be individualized to each unique clinical situation), the ATP III recommends a multifaceted lifestyle approach to reduction in LDL designated as therapeutic lifestyle changes (TLC). The major features are detailed in Table 5. These steps could be monitored for effectiveness every 6 weeks, with increasingly active steps being taken until the LDL level is achieved. If necessary, drugs could be added to the regime. They could be considered immediately in those with CHD and CHD equivalents, or after 3 months for other risk categories. Some possible drug categories are listed in Table 6

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Estimate of 10 Year Risk for Men

(Framingham Point Scores)

Add up points for 5 tables, and get risk from last table.

Age, years	Points
20-34	-9
35-39	-4
40-44	0
45-49	3
50-54	6
55-59	8
60-64	10
65-69	11
70-74	12
75-79	13

Estimate of 10 Year Risk for Women

(Framingham Point Scores)

Add up points for 5 tables, and get risk from last table.

Age, years	Points
20-34	-7
35-39	-3
40-44	0
45-49	3
50-54	6
55-59	8
60-64	10
65-69	12
70-74	14
75-79	16

|---POINTS-----|

Total Cholesterol mg/dL	Age 20-39 years	Age 40-49 years	Age 50-59 years	Age 60-69 years	Age 70-79 years
< 160	0	0	0	0	0
160-199	4	3	2	1	0
200-239	7	5	3	1	0
240-279	9	6	4	2	1
? 280	11	8	5	3	1

|---POINTS-----|

Total Cholesterol mg/dL	Age 20-39 years	Age 40-49 years	Age 50-59 years	Age 60-69 years	Age 70-79 years
< 160	0	0	0	0	0
160-199	4	3	2	1	1
200-239	8	6	4	2	1
240-279	11	8	5	3	2
? 280	13	10	7	4	2

	Age 20-39 years	Age 40-49 years	Age 50-59 years	Age 60-69 years	Age 70-79 years
Nonsmoker	0	0	0	0	0
Smoker	8	5	3	1	1

	Age 20-39 years	Age 40-49 years	Age 50-59 years	Age 60-69 years	Age 70-79 years
Nonsmoker	0	0	0	0	0
Smoker	9	7	4	2	1

HDL, mg/dL	Points
? 60	-1
50-59	0
40-49	1
< 40	2

HDL, mg/dL	Points
? 60	-1
50-59	0
40-49	1
< 40	2

Systolic BP, mm HG	If Untreated	If Treated
< 120	0	0
120-129	0	1
130-139	1	2
140-159	1	2
> 160	2	3

Systolic BP, mm HG	If Untreated	If Treated
< 120	0	0
120-129	1	3
130-139	2	4
140-159	3	5
> 160	4	6

Point Total	10-Year Risk, %
< 0	< 1
0	1
2	1
3	1
4	1
5	2
6	2
7	3
8	4
9	5
10	6
11	8
12	10
13	12
14	16
15	20
16	25
> =17	> 30

Point Total	10-Year Risk, %
< 9	< 1
9	1
10	1
11	1
12	1
13	2
14	2
15	3
16	4
17	5
18	6
19	8
20	11
21	14
22	17
23	22
24	27
> =25	> 30

TABLE 4
Estimated 10 Year Risk for Men and Women

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TLC Diet (perhaps in consultation with a dietician)
---Saturated fat < 7 % of calories
---cholesterol < 200 mg/day
---consider viscous (soluble) fiber(10-25 g/day) and plant stanols/sterols (2 g/day) as therapeutic options to enhance LDL lowering
Weight management
Increased physical activity

TABLE 5
Therapeutic lifestyle changes to lower LDL.

Drug Class	Lipid/Lipoprotein Effects	Side Effects	Contraindications
HMG-CoA reductase inhibitors (statins)	LDL ↓ 18-55% HDL ↑5-15% TG ↓7-30%	Myopathy Liver enzyme increase	Absolute: active or chronic liver disease Relative: concomitant use of other drugs
Bile acid sequestrants	LDL ↓ 15-30% HDL ↑3-5% TG no change or increase	GI distress Constipation Decreased absorption of other drugs	Absolute: dysbetalipoproteinemia; TG > 400 mg/dL Relative: TG>200mg/dL
Nicotinic acid	LDL ↓ 5-25% HDL ↑15-35% TG ↓20-50%	Flushing Hyperglycemia Hyperuricemia Upper GI distress Hepatotoxicity	Absolute: chronic liver disease, severe gout Relative: diabetes, hyperuricemia, peptic ulcer disease
Fibric acids	LDL ↓ 5-20%(may be increased in high TG) HDL ↑10-20% TG ↓20-50%	Dyspepsia Gallstones Unexplained non-CHD deaths in WHO study	Absolute: severe renal disease, severe hepatic disease

TABLE 6
Pharmacologic agents affecting lipid metabolism.

Metabolic Syndrome:

Evidence has been suggestive that risk for CHD can be lowered by modifying other risk factors than LDL. One particular target is the “metabolic syndrome” which seems linked to a generalized metabolic disorder called *insulin resistance* in which the normal actions of insulin are impaired. Abdominal obesity and physical inactivity or genetic predisposition seem to be particularly associated with the development of insulin resistance. The diagnosis of metabolic syndrome is made by any 3 of the conditions described in Table 7.

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Risk Factor	Defining Level
Abdominal obesity (waist circumference)	
Men	> 40 in
Women	> 35 in
Triglycerides	≥ 150 mg/dL
HDL Cholesterol	
Men	< 40 mg/dL
Women	< 50 mg/dL
Blood Pressure	≥ 130/≥ 85 mm Hg
Fasting Glucose	≥ 110 mg/dL

TABLE 7
Clinical Signs of the Metabolic Syndrome

Treatment of the metabolic syndrome is directed at the underlying causes of obesity and physical inactivity. In addition, hypertension may be treated and elevated triglyceride and low HDL may be treated as described below.

Recent data has suggested that elevated triglycerides may be an independent risk factor for CHD. Triglycerides are evaluated as shown in Table 8.

Normal	< 150
Borderline high	150 – 199
High	200 – 499
Very High	≥ 500

TABLE 8
Evaluation of Triglycerides (mg/dL)

The primary aim of therapy is to achieve the LDL goal. If this is achieved, therapy is further aimed at lowering triglycerides below 200 mg/dL. This goal is set as a secondary goal of achieving a non-HDL cholesterol (that is Total – HDL) 30 mg/dL higher than the LDL goal. For those with triglycerides between 200 – 499 mg/dL consideration could be giving to intensifying therapy with a LDL lowering drug, or adding nicotinic acid or fibrate to further lower VLDL. For triglycerides > 500 mg/dL, it is important to lower them to prevent pancreatitis. Consideration should be given to a very low fat diet, weight management, increasing physical activity, adding fibrate or nicotinic acid. When the triglycerides are lower than 500 mg/dL, attention can return to lowering LDL.

If the HDL is low (< 40 mg/dL) attention should first be directed to the LDL goal. If this is achieved, emphasis can be placed on weight management and increased physical activity. If triglycerides are 200 – 499, emphasis could be placed on achieving the non-HDL cholesterol goal. If the triglycerides are < 200 mg/dL (isolated low HDL) in CHD or CHD equivalent, nicotinic acid or fibrate could be considered.

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The Vermont Transfusion Project
NECLA Communiqué
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Review By : Mark Fung, MD

In 1998 the hospitals in the State of Vermont joined in a statewide contract for the provision of blood products with the New England region of the American Red Cross Blood Services. Included in this contract was an agreement to launch a cooperative effort, the Vermont Transfusion Project, designed to educate physicians throughout the state about the appropriate use of blood products and their risks. As part of this project the following article was written by Dr. Robert Westphal, the former Medical Director of the Vermont-New Hampshire region of the American Red Cross (ARC), in collaboration with Drs. Mark Popovsky and Mary O'Neill from the ARC and Dr. Bruce MacPherson, Medical Director of the FAHC Blood Bank. The transfusion guidelines described in this article have been presented to medical staffs throughout the state for their consideration and appear on the Blood Component Order Sheet.

Red Cell Transfusion in the 1990's:
A Reassessment of the Transfusion Trigger

The use of red blood cell (RBC) transfusions remains an important part of medical and surgical practice. However, the AIDS epidemic of the 1980's, increased awareness of transfusion-transmitted hepatitis and a better understanding of red cell physiology have resulted in closer attention to the indications for RBC transfusion. Evidence exists that a significant proportion of RBC transfusions are not clinically indicated, and place the patient at unnecessary risk of adverse effects. A 1988 National Institutes of Health (NIH) consensus conference shattered the 10 g/dL (hematocrit = 30%) transfusion "trigger" that had been used for many years⁽¹⁾. Since then, other studies have shown that the transfusion trigger must be reassessed. The decline of the HCT = 30% threshold: Tissue oxygenation often does not improve as the hematocrit increases beyond 30%⁽²⁾. A common misconception is that the delivery of oxygen to tissues increases linearly as the hematocrit rises. Studies reveal that the resistance to flow increases as the hematocrit increases; the presence of more red cells increases the viscosity of blood, and may hamper its passage through smaller vessels⁽³⁾. Thus, for some patients, particularly those with arteriosclerosis, blood flow and tissue oxygenation may not rise, and could even be reduced as hematocrits increase beyond 30%.

Patients Often Tolerate Low Hematocrits

Studies of hemodilution of healthy humans suggest that cardiac output does not begin to increase until the hematocrit falls to about 27% ⁽⁴⁾. A recent study of acute reduction in hemoglobin to 5 g/dL (with insolemic non-RBC fluid replacement) in 32 healthy individuals demonstrated that systemic oxygen delivery was sufficient to maintain normal end-organ function ⁽⁵⁾. These studies underscore the point that as long as insolemia is maintained, even severe anemia may be tolerated, at least acutely. It must be noted that the data for transfusion guidelines in patients with preexisting myocardial or severe pulmonary disease are less substantial than the data for other types of anemic patients. However, a recent study comparing "conservative" and "liberal" transfusion strategies in critically ill patients found that transfusions given to maintain the hemoglobin level between 8-10 g/dL were at least as safe, and possibly safer than transfusions given to maintain the hemoglobin level above 10 g/dL ⁽⁶⁾.

The experience of surgery on Jehovah Witnesses, who choose not to accept blood transfusion, indicates that complex surgery can be performed at hematocrits much lower than conventionally considered "necessary". A recent study of almost 20,000 Jehovah's Witnesses undergoing surgery for many types of procedures found that the risk of mortality increased significantly only when hemoglobin fell below 7 g/dL. In that study, underlying cardiovascular disease was an additional risk factor for increased morbidity (7).

**Maintaining Adequate Tissue Perfusion May Be More Important
Than High Hematocrit**

The maintenance of adequate tissue perfusion is more important than a high hematocrit in delivering oxygen to such critical vascular beds of the heart and kidneys. This can often be accomplished by adequate maintenance of intravascular volume with crystalloids or colloids (e.g. albumin, hetastarch).

What's in a Unit of Red Blood Cells?

A unit of RBC is anticoagulated with citrate and preserved with a saline solution containing dextrose and adenine. The hematocrit is approximately 55% and the volume is approximately 200 ml. There is less than 60 ml of plasma. Unless modified by special means, the typical unit contains approximately 2 billion white blood cells.

Why Transfuse Red Blood Cells?

Red blood cells are needed to improve O₂-carrying capacity in the treatment of signs and symptoms of anemia. Those signs and symptoms may include syncope, dyspnea, cyanosis, tachycardia, angina, pallor, and decreased exercise tolerance. A drop in blood pressure and rapidly dropping hemoglobin and hematocrit associated with acute blood loss may also merit consideration for transfusion. Because all these signs and symptoms are nonspecific, they may be due to other causes.

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Non-indications and Special Considerations

Age: Age alone is not an indication for transfusion.

Wound Healing: Transfusing post-operative patients to a higher hematocrit is not associated with improvement in wound healing. Healing is normal at a hemoglobin of 7 g/dL.

Cerebrovascular Disease: It is not known whether the criteria for transfusion should be either more liberal or conservative in patients with cerebral vascular disease.

Myocardial Disease: A remote history of cardiac disease, without evidence of recent injury, is not itself an indication for transfusion. Recent myocardial injury favors more liberal use of RBC.

Complications of Red Blood Cell Transfusion

Hepatitis: Due to the sensitivity of current blood donor screening tests, the risks of hepatitis B and hepatitis C are very low (1 in 205,000 and 1 in 1,935,000 per unit transfused, respectively). However, evidence suggests that other hepatitis viruses, yet unidentified, will be found that are associated with transfusion.

HIV/AIDS: With current tests, the risk of HIV from a unit of blood is about 1 in 2,135,000.

Hemolytic Reaction: Immediate hemolytic transfusion reactions generally result from in-hospital identification or clerical errors involving the ABO system. The risk is approximately 1 in 30,000 and the risk of death is approximately 1 in 250,000 transfusions. Delayed hemolytic reactions are much more common, occurring in about 1 in 1000 transfusions.

Circulatory Overload: This is congestive heart failure due to hypervolemia, usually seen in very young or elderly patients. Until recently, this risk has been much underrecognized. A recent study suggests that 1% of orthopedic surgery patients may develop circulatory overload, a potentially life-threatening complication⁷.

Acute Lung Injury: This is adult respiratory distress syndrome due to transfusion. Antileukocyte antibodies in donor plasma reactive against recipient leukocytes are frequently associated with this life-threatening complication. The risk is approximately 1 in 1,000 to 200,000. The mortality is approximately 10%.

Bacterial Contamination: Despite the use of aseptic venipuncture and sterile needles and equipment, bacteria can enter the collection system for blood. This is among the most frequent causes of death from transfusion. Gram-negative or gram-positive organisms may be implicated.

Bacterial infection with platelets is 1 in 33,000 to 75,000.

Bacterial infection with RBCs is 1 in 30,000 to 5,000,000.

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Guidelines for Red Blood Cell Use

Accepted guidelines for RBC Transfusion include the following:

Signs and/or symptoms of anemia

Acute blood loss of ≥ 15 -30% blood volume (750-1000 mL)

Symptomatic anemia when hemoglobin is ≤ 7 g/dL (Hematocrit $\leq 21\%$)

Re-evaluate the patient between units.

Much unnecessary RBC use results from orders of multiple units when a smaller number would have been adequate. Unless patients are profoundly anemic or bleeding actively, the hemoglobin/hematocrit should be checked between units.

Autologous Transfusions: Autologous blood has many advantages. However, with increasing safety, some studies suggest that its cost-benefit has decreased markedly⁸. Nevertheless, preoperative autologous donation or intraoperative blood salvage may be considered for some surgical patients.

Leukocyte-reduced RBC: For selected patients, leukocyte reduction is considered desirable. Currently, the accepted indications include:

1. Prevention of recurrent febrile reactions
2. Prevention of HLA alloimmunization
3. Prevention of CMV infection.

These guidelines are not a substitute for medical judgment for individual patients.

Risks of Adverse Consequences Resulting From Blood Transfusions

<u>Immune-mediated Adverse Effects</u>	<u>Frequency/Unit</u>
Acute hemolytic transfusion reactions	1:30,000
Febrile transfusion reactions	1:200
Allergic reactions	1:333
Acute lung injury (TRALI)	1:1,000 to 200,000
Acute anaphylaxis	1:2,000 to 30,000
Delayed hemolytic transfusion reactions	1:5,000 to 110,000
Transfusion-associated GVH	Unknown
<u>Non-immune Adverse Effects</u>	
Bacterial Contamination	
Red Blood Cells	1:30,000 to 5,000,000
Platelets	1:33,000 to 75,000
Hepatitis B virus	1:205,000
Hepatitis C virus	1:1,935,000
HTLV I/II	1:2,993,000
HIV I/II	1:2,135,000
Aggregate risk of these viruses	1:30,000
Circulatory overload	1:2,000 to 6,000

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BLOOD BANK/TRANSFUSION MEDICINE INFORMATION

Reviewed July, 2008

RISKS COMMON TO ALL BLOOD COMPONENTS

Infection and alloimmunization are the major complications associated with transfusion of blood components. There is a relationship between these risks and the number of donor exposures. The risk of infection is geographically variable. The current estimated risks per unit transfused are:

CURRENT ESTIMATED TRANSFUSION RISKS

<u>Complication</u>	<u>Risk/Unit Transfused</u>
Transfusion related acute lung injury	1 in 1,000 to 200,000
Circulatory overload	1 in 2,000 to 6,000
Severe allergic/anaphylaxis	1 in 2,000 to 30,000
Delayed hemolytic reaction	1 in 5,000 to 110,000
ABO incompatible hemolysis*	1 in 13,000 to 200,000
Bacterial infection with platelets	1 in 33,000 to 75,000
Bacterial infection with RBC	1 in 30,000 to 5,000,000
Hepatitis B	1 in 205,000
Hepatitis C	<1 in 1,935,000
HIV	1 in 2,135,000
HTLV	1 in 2,993,000

*Preventable fatal transfusion reactions are almost always caused by errors in labeling or patient identification.

Additional Risks:

- Allergic reactions and febrile reactions may also occur.
- Other infections diseases (e.g. cytomegalovirus, malaria, West Nile virus, SARS—for the last three diseases the risk is extremely low but undefined).

URGENT TRANSFUSIONS

While the standard of care is to give a patient crossmatch compatible blood that has passed all required testing procedures, if the risk of death or severe morbidity from acute anemia is greater than the risk of transfusing incompletely tested and possibly incompatible blood, a request for emergency release of blood should be given to the Blood Bank. An attending or housestaff physician must sign the emergency release form entitled “Emergency Transfusion of Blood Components Prior to Completion of Testing”.

TRANSFUSION REACTIONS

If an acute transfusion reaction occurs (fever, chills, hypotension, shortness of breath, nausea/vomiting):

1. Stop blood component transfusion immediately
2. Maintain IV access and ensure adequate urine output with appropriate crystalloid or colloid solution
3. Notify attending physician and Blood Bank
4. Verify the correct unit was given to the correct patient
5. Maintain blood pressure and pulse
6. Maintain adequate ventilation
7. Document reaction in patient chart and Blood Bank copy of transfusion slip
8. Send blood bag, administration set, and copy of transfusion slip to Blood Bank (except for isolated urticaria and circulatory overload)
9. If required, the Blood Bank will request blood/urine for transfusion reaction workup
10. Blood Bank will perform workup of suspected transfusion reaction to rule out a hemolytic reaction.
11. If intravascular hemolytic reaction is confirmed, consult Blood Bank physician.
12. If bacterial contamination is suspected, obtain blood culture of patient.

For isolated urticarial reactions only, the transfusion may be continued once urticaria has subsided with medication.

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INFORMED CONSENT

All patients (or their appropriate family members) who receive non-emergent transfusions must be informed of the risks and benefits of blood and blood components and consent to their use.

The elements of informed consent should include:

- An understanding of why transfusion therapy is recommended
- Its associated risks and benefits
- Alternative methods of therapy available and their attendant risks including the possible consequences of not receiving recommended transfusion therapy
- An opportunity to ask questions; and
- Consent to transfusion.

Once consent has been obtained, this should be documented in the medical record (chart) and also by marking the check box on the top of the blood component order sheet.

Fletcher Allen Health Care specific blood bank points:

Drawing of blood samples for the Blood Bank: Only authorized staff and the phlebotomy team, properly trained in patient identification and sample tube labeling, are allowed to draw blood samples for the Blood Bank for a Type and Crossmatch. This longstanding policy has helped prevent the most common cause of fatal blood transfusion reactions – ABO incompatible blood transfusion due to misidentification of patient or mislabeling of a blood sample.

Universal leukoreduction of blood: The FAHC Blood Bank has dual blood inventories, blood that is leukoreduced, and blood that is not. If you believe your patient needs leukoreduced blood, please indicate this on the blood component order sheet. If uncertain call the blood bank for assistance in the determination.

Ordering of blood for surgical procedures: The Blood Bank maintains a Maximum Surgical Blood Order Schedule (MSBOS) for the various surgical services, with an agreed upon standard amount of blood that is set up for a patient when they are scheduled for surgery. The Blood Bank will assign the appropriate number of required units for the given procedure. Physicians may specifically order more units if they expect a greater than usual amount of bleeding. When uncertain of the number of units required, please consult the MSBOS or ask the staff in the Blood Bank.

ADDITIONAL QUESTIONS or REQUESTS FOR CLINICAL CONSULTATIONS??

Please call the Blood Bank, (802) 847-3569. A pathology resident and attending physician are always available (in the hospital or by phone) 24 hours a day/ 7 days a week. ACC, East Pavillion, Level 1, 233MP1

The information provided is for educational purposes only and does not supersede existing FAHC policies, procedures, or clinical judgment.

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	RED BLOOD CELL	PLATELET	FROZEN PLASMA
INDICATION	<ul style="list-style-type: none"> ◆To increase oxygen-carrying capacity in anemic patients. 	<ul style="list-style-type: none"> ◆To control or prevent bleeding associated with deficiencies in platelet number or function. 	<ul style="list-style-type: none"> ◆To increase the level of clotting factors in patients with demonstrated deficiency.
DOSAGE	<ul style="list-style-type: none"> ◆1 Unit of RBC will usually increase the hemoglobin by 1 g/dL and the hematocrit by 2-3 percent in the average 70 kg adult. ◆Adequate oxygen-carrying capacity can be met by a hemoglobin of 7g/dL (hematocrit of approximately 21 percent) or even less when the intravascular volume is adequate for perfusion. 	<ul style="list-style-type: none"> ◆One apheresis unit of platelets should increase the platelet count in the average adult recipient by at least 30,000 to 60,000 platelets/μL. 	<ul style="list-style-type: none"> ◆Usual starting dose is 10-15 mL/kg (i.e. 3-4 units for a 70-kg patient). Assessment of effect of transfusion should be made before continuing therapy. ◆If prothrombin time (PT) and partial thromboplastin time (PTT) are <1.5 times normal, FP transfusion is rarely indicated and unlikely to improve coagulation values. Patients who have been given the anticoagulant warfarin sodium become deficient in coagulation factors II, VII, IX, and X. If these patients are bleeding or require emergency surgery, they may be candidates for FP transfusion to achieve immediate hemostasis when time does not permit warfarin reversal by stopping the drug or administering vitamin K.
OTHER FACTORS THAT INFLUENCE REQUIREMENTS	<ul style="list-style-type: none"> ◆Person's age, etiology and degree of anemia, hemodynamic stability, and presence of coexisting cardiac, pulmonary or vascular conditions, increased oxygen consumption (seizure, fever). ◆When a treatable cause of anemia can be identified, specific replacement therapy (e.g., vitamin B12, iron, folate) should always be used before transfusion is considered. 	<ul style="list-style-type: none"> ◆For the clinically stable patient with an intact vascular system and normal platelet function, prophylactic platelet transfusions may be indicated for platelet counts of <10,000/μL ◆A patient undergoing an operation or other invasive procedure is unlikely to benefit from prophylactic platelet transfusions if the platelet count is at least 50,000/mL and thrombocytopenia is the sole abnormality. ◆Platelet transfusions at higher platelet counts may may be required for patients with systemic bleeding and for patients at higher risk of bleeding because of additional coagulation defects, sepsis, or platelet dysfunction related to medication or disease. 	
DO NOT TRANSFUSE:	<ul style="list-style-type: none"> ◆For volume expansion (use colloids or crystalloids instead) ◆To enhance wound healing ◆To improve general "well-being" 	<ul style="list-style-type: none"> ◆To patients with immune thrombocytopenic purpura or thrombotic thrombocytopenic purpura (unless there is life-threatening bleeding) ◆Prophylactically with massive blood transfusion ◆Prophylactically following cardiopulmonary bypass 	<ul style="list-style-type: none"> ◆For volume expansion ◆As a nutritional supplement ◆Prophylactically with massive blood transfusion ◆Prophylactically following cardiopulmonary bypass

The information provided is for educational purposes only and does not supersede existing FAHC policies, procedures, or clinical judgment.

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**General Indications for Special Attributes
for FAHC Blood Bank Orders**

Indications for CMV seronegative units

- Premature infants and infants less than 6 months old in the NICU
- CMV seronegative patients undergoing stem cell or solid organ transplantation (or candidates for transplantation)
 - If uncertain of CMV status, order CMV negative blood and order a CMV IgG test on patient

Indications for irradiation of cellular blood products

- Premature infants and infants less than 6 months old
- Infants with congenital heart defects where thymic aplasia has not been ruled out (DiGeorge syndrome)
- Patients with congenital immunodeficiencies
- Patients with leukemia, lymphoma, or myelodysplasia(MDS) or multiple myeloma
- Patients undergoing stem cell transplantation
- Patients undergoing myeloablative chemotherapy
- Patients who have received fludarabine (Fludara), cladribine (Leustatin), or multiple doses of alemtuzamab (Campath) in the past 12 months
- Patients receiving blood components from a blood relative
- Patients receiving HLA-matched platelets

Indications for leukoreduced/leukodepleted blood

- Patients who require CMV negative blood when no CMV seronegative blood is available
- Patients with recurrent febrile nonhemolytic transfusion reactions
- Patients who will receive multiple platelet transfusions (usually heme/onc patients) and are at risk for becoming platelet refractory (i.e. will not respond to platelet transfusions due to development of HLA antibodies)
- Patients who are transplant recipients (stem cell or solid organ transplants) or are likely to receive a transplant

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The Evaluation of Anemia

March, 2009

Reviewed By: John Lunde, MD

People both inside and outside of health care have at least a rudimentary understanding of the term “anemia,” but finding a simple approach to the evaluation of anemia presents some challenges. The proposed guideline is an attempt to offer a basic approach in a one-page scheme. Part of the algorithm indicates what tests to perform, and part indicates what disease(s) to consider. When a specific anemia type is being considered, an approach to appropriate testing can be gleaned from standard hematology and clinical pathology texts. This scheme is not all-inclusive, but should serve as at least a starting point for the evaluation of anemia.

Some caveats are offered as follows:

- The red cell parameters in a CBC should always be interpreted in conjunction with the WBC count and platelet count. Abnormalities of several cell lines may imply an etiology that is different than that for isolated anemia. For the purposes of this guide, the following discussion is to be used in the context of an isolated anemia.
- A CBC should initiate the evaluation. Since RBC parameters may change with time, the CBC should be repeated if subsequent additional testing is to be done after the passage of considerable time since the initial CBC.
- Clinical information is essential in order to plan for complete/appropriate testing.

Microcytic-Hypochromic Anemia:

- Serum ferritin is a more sensitive indicator than are serum iron and iron binding capacity. Therefore, it is recommended that serum ferritin be performed first in the evaluation of microcytic-hypochromic anemia. Serum ferritin values, however, may not accurately reflect the true value since serum ferritin is affected in the presence of liver disease, inflammation, and bone marrow damage.
- The red blood cell count may be normal or elevated in the presence of heterozygous thalassemia and other hemoglobinopathies, despite borderline or mild anemia.
- In the consideration of beta thalassemia, hemoglobin electrophoresis (HGBELE) is usually recommended as the test to order. Hemoglobin A2 (HGBA2) may be ordered together with HGBELE, or may be recommended in the event that the HGBELE is unclear.
- HGBA2 is elevated in thalassemia trait; but may be in the normal range if there is concomitant severe iron deficiency anemia.

Normocytic-Normochromic Anemia:

- Serum ferritin (low) will be helpful in ruling in early iron deficiency anemia when the HGB is low but the MCV is normal.
- Anemia of chronic disease (early) may be associated with normocytic-normochromic indices together with elevated serum ferritin, low serum iron, and low iron binding capacity.

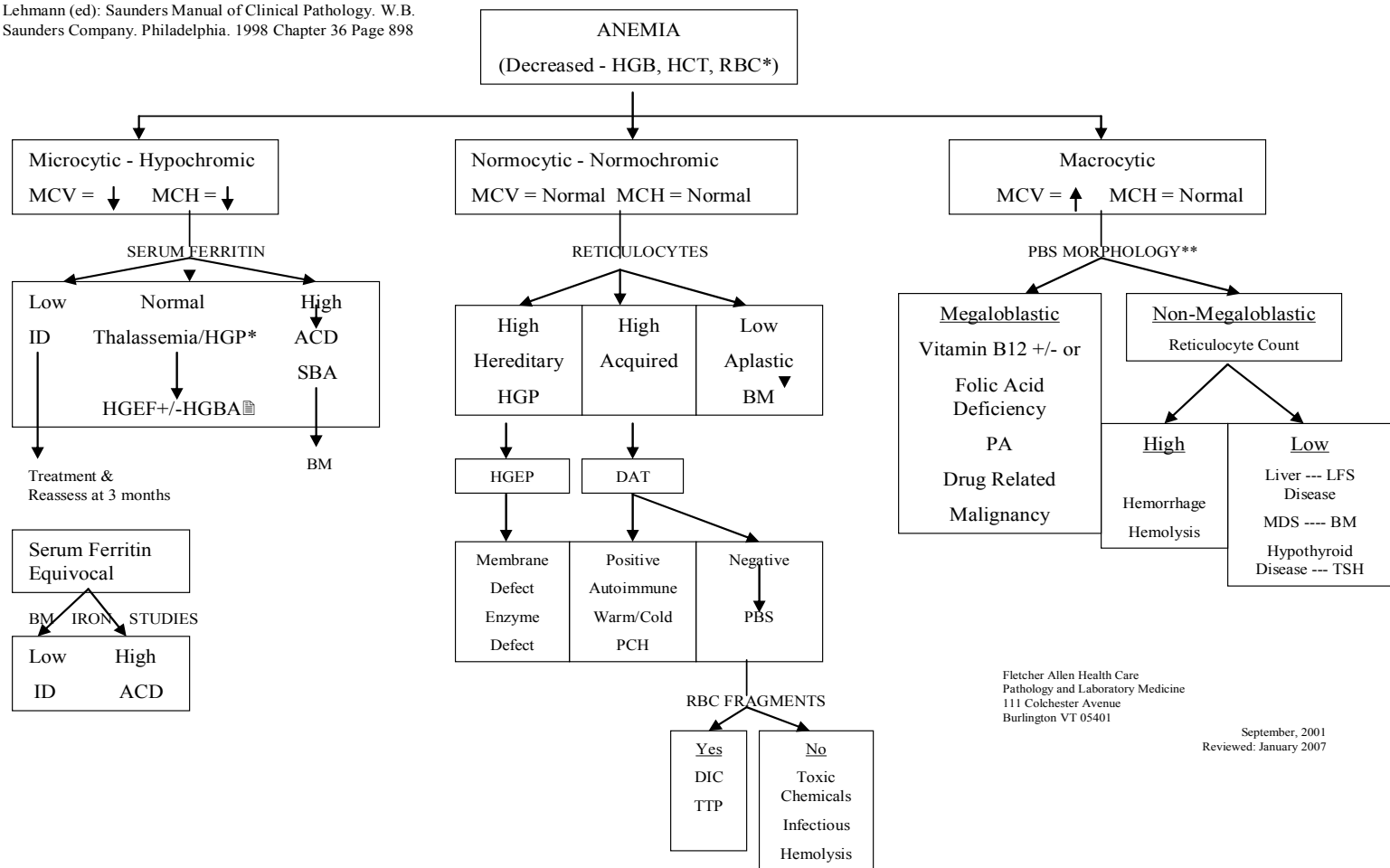
Macrocytic Anemia:

- Serum folate and Vitamin B12 should be performed to evaluate for megaloblastic anemia from deficiency of one or both vitamins. When these results are borderline or unclear and if the evaluation of the patient suggests vitamin B12 deficiency, measurement of homocysteine and methylmalonic acid should be considered
- Liver disease and many medications are associated with macrocytic RBC's, both in anemic and non-anemic patients.

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Modified from: Kube & Finnegan: Erythrocyte Disorders in Lehmann (ed): Saunders Manual of Clinical Pathology. W.B. Saunders Company. Philadelphia. 1998 Chapter 36 Page 898



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* RBC may be elevated or normal BM=bone marrow HGP=hemoglobinopathy MDS=myelodysplastic syndrome SBA=sideroblastic anemia
 **Megaloblastic=Larger ovalocytes DAT=direct antiglobulin test HGEF=hemoglobin electrophoresis PA=pernicious anemia TSH=thyroid stimulation hormone
 **Non-megaloblastic=large round cells DIC=disseminated intravascular coagulation ID=iron deficiency PBS=peripheral blood smear TTP=thrombotic thrombocytopenia purpura
 ACD=anemia of chronic disease LFS=liver function states PCH=paroxysmal cold hemoglobinuria

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