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Computer Programs and Access

iNyp
Contains all relevant inpatient information, including anesthesia record
Access using NYP-CWID and password
Can access from home using internet (no VPN needed): inyp.nyp.org

CROWN
Contains all relevant outpatient information
Access using NYP-CWID and password
Can access from home using internet (no VPN needed): ita.nyp.org

Allscripts
System for placing and reviewing orders for both inpatient and outpatient settings
Access using NYP-CWID and password
Can access from home using internet (no VPN needed): ita.nyp.org

CoPath
System where all pathology specimens are accessioned, tracked, and signed out
Access using CUMC UNI and password specific for CoPath
Can access from home via remote desktop (see directions below)

TeleResults
Contains Immunogenetics information on transplant patients
Email to Teleresultshelp@nyp.org to get access
Can access from home using internet (no VPN needed)

Directions: Go to http://teleresults.nyp.org. Log in using your CWID (the nyp login) and CWID password. Click Patient --> Patient Info. Enter MRN and “Find”. Click the selected patient. Look underneath the basic info to see the Documents tab—click it. See the list of folder icons with “+” signs—click Suciu-Foca Lab. Click the document with the date that is most recent (titled in the format YYYYMMDD). Click the PDF/Click to Open on the top right side and PDF of the report with DSA, PRA etc will appear.

WYNDGATE
Contains information on blood products administered to patients and for inventory tally
Access via CWID and password specific for Wyndgate. To set up system preferences or to reset your password, email or see Sylvia Parker-Jones (syp9002@nyp.org)
Access through “NYP apps” at the following website:
ita.nyp.org

Directions: Log in using your CWID (NYP login) and Wyndgate password.
1. Click “Patient Order”
3. Enter MRN where it says “MR No” and hit enter. When highlighted name comes up, click OK.
4. To find out products given, click the red “I” button and a new window with the product list will come up. Use the excel sheets in \Archive\bloodbank\Components\Wyndgate Product Codes to determine which products were given.

Check status:
“issued” – means released only—check transfusion note if transfused (or if issued to OR, no way to check)
“transfused” – means the unit was transfused. This status is obtained either by the nurse/anesthesia marking the unit as being transfused OR when the unit has not been returned 72 hours after issue (the computer automatically switches the status).

Setting up VPN on home computer, iPad, or iPhone:
Go to: https://secure.cumc.columbia.edu/cumcit/secure/howto/vpn/index.html

Setting up remote desktop for home PC:
1. Log into VPN
2. Start → Run → Type in “mstsc” → Type in “ts-server.pathology.columbia.edu” → Log in with your CUMC UNI username and password → now you are in the pathology virtual network so you can access the shared folders (e.g. Resident Library, Bloodbank, etc), as well as CoPath.

Connecting to Athens wireless network on campus:
3. Go to: http://www.cumc.columbia.edu/it/howto/wireless/ and select desired device on left side
When to Contact an Attending

**Contact Transfusion Medicine attending:**

1. New apheresis patient
2. Apheresis patients experience non-urticarial adverse reactions
3. Transfusion reaction due to acute/delayed hemolytic reaction, sepsis, suspected TRALI, or unclear etiology
4. When culturing a unit may be indicated
5. Massive transfusion protocols where recipient has antibodies against red cell antigens
6. Conversion of patients from one blood group to another (Rh negative to Rh positive, AB to A, etc.)
7. Change in transfusion criteria for a particular patient (e.g. change in platelet transfusion cutoff for BMT patient or clinician’s request to exempt patient from blood bank guidelines/policy)
8. Requests for product “drips” (platelet or plasma)
9. Novoseven release not meeting criteria listed in The Official Call Guide to Laboratory Medicine
10. Granulocyte transfusion request
11. Platelet refractoriness workup request
12. Transfusion Service resident will be notified immediately by the BB if there are any abnormal results of post issue testing emergency release of pRBC. The resident must notify the Transfusion Medicine attending and the treating physician if any incompatible units were transfused and discuss the potential implications.
13. Any transfusion medicine issue when you feel uncomfortable and/or don’t know what to do

**Contact Microbiology attending by email at any time:**

1. Peripheral smear with ring forms
2. Susan Whittier (sw189@columbia.edu)

**Contact Hemepath fellow:**

1. Peripheral smear concerning for new or relapsed leukemia/lymphoma where immediate medical intervention may be required

**Contact Core lab/Chemistry attending:**

1. Stat metabolic send out testing
Transfusion Medicine Rotation Guidelines

Blood Bank & Apheresis Rotation:

Rotation Schedule

Schedule
- The components resident and apheresis resident will divide the service, such that one is covering transfusion medicine calls (pager: 85838), immunohematology, and transfusion reactions, while the other is covering therapeutic apheresis and cellular therapy (pager: 82754). The NYBC fellow (when rotating at CUMC) will assume a graded responsibility throughout their 3 months of service. They will function mainly in a teaching and supervisory role (i.e. pre-tending).

- Daily resident coverage hours: 8:00AM – 5:00PM
- Overnight resident coverage hours: 5:00PM – 8:00AM
- Sign out occurs daily with the attending on service and on-call resident, typically at 10:00AM and 4:30PM in HP4-415
  - Attendings are on service on a weekly basis from Tuesday to Monday
- Additional conferences occur at the following times, but are subject to change. Please see the weekly schedule for final conference schedule.
  - Tuesday, 12:30-1:30: CP Journal Club/Special Topics Conference (PH3-329)
  - Thursday, 3:30-4:30: CP Case of the Week (HP4-415)
  - Friday, 12:30-1:30: CP Didactic Conference (PH3-329)
Blood Bank Rotation
Components Resident Responsibilities

Main Drive: \Archive\bloodbank\components (IP Address: 10.115.120.34)

Team:
- Joseph (Yossi) Schwartz, Director of Transfusion Medicine, js2745@columbia.edu
- Yvette Tanhehco, Assistant Director of Transfusion Medicine, yct2103@columbia.edu
- Robin Hussey, Blood Bank Manager, husseyr@nyp.org
- Sylvia Parker-Jones, Quality Assurance Manager, syp9002@nyp.org
- Supervisors: Carin Campbell (cac9132@nyp.org), Linda/Martine (night)
- Technologists
- Dawn Lewis-Roberts, Assistant to Dr. Schwartz, dml9005@nyp.org

Logs
- Call Log – daily [pp. 10]
  - Enter ALL component calls in the call log “Components Call Log” in the Components folder in the Archive drive
  - Enter logs with information template “Component Call log TEMPLATE”
  - Note that this is a legal document of the calls received. All calls made to you should be entered in this database. Often, this is the only documentation of the process behind our decisions
- Novoseven Log – daily [pp. 24]
  - Log all release of rFVIIa in the Novo7 tab of “Current Logs F7, MTP, PCC” in the Components folder in the Archive drive
- MTP Log – daily [pp. 43]
  - Log all MTPs in the MTP tab of “Current Logs F7, MTP, PCC” in the Components folder in the Archive drive

Transfusion Reactions – as needed [pp. 34]
- Workup possible transfusion reactions when notified by the Blood Bank according to the SOP TS141.2 “Transfusion Reaction Investigation”
- Present these findings together with a copy of the “Transfusion Reaction Preliminary Report Form” and “Transfusion Reaction Worksheet” to the attending as soon as the appropriate information has been gathered.
- Communicate the need for any further workup to the blood bank technologist after consulting with the attending.
- Fill out “Transfusion Reaction Preliminary Report Form” to submit to the BB Supervisor within 1 business day
- Give the “Transfusion Reaction Worksheet” to Dawn to accession the case in CoPath. Enter CoPath note for each reaction within 1 business day.

Immunohematology/Antibody Panels – daily [pp. 38]
- Review and sign-out the accessioned immunohematology cases located in \Archive\BBAccd
- Necessary information to gather can be found on “Antibody Signout Form”
- These should be presented to the Attending daily at PM rounds
- CoPath note for each titer should be entered within the week

Retrospective Red Cell Audit – every Friday
- Complete and review with the attending at Friday PM rounds. Typically the anesthesia resident takes the lead in completing the audit with your guidance.
- Once signed by the attending on service, scan and email the form to Sylvia Parker-Jones (syp9002@nyp.org)

Emergency Component Release – daily
- Check the folder in the overnight supervisor office for Emergency Component Release forms daily
- Bring the week’s release forms to Friday afternoon signout

Antibody Titers – as needed
- Investigate requests for antibody titers
- Present these daily to the Attending at PM rounds

Signout – daily
- Inventory (PM signout only)
  - Review and record the daily inventory (pRBCs & platelets) in the afternoon in preparation for daily sign-out at 16:30PM.
- Patient List (AM, PM signout)
  - Patient list with current patients with recurring issues on component call or apheresis
  - Cases of interest (i.e. pay attention to the high volume component users: LVAD, open heart surgery, liver and heart transplants. Also be aware of patients with complicated/rare antibodies, transplant cases)

Allen Hospital
Occasionally, the resident will get product requests and calls from the Allen Hospital (212) 932-4235 or extension 4-4235. These must be treated as if they were calls from CUMC—ie, investigated, logged, placed on the signout, etc
Blood Bank Rotation:
Apheresis Resident Responsibilities

Main Drive: \Archive\bloodbank\Apheresis  (IP Address: 10.115.120.34)
Team:
- Apheresis Manager: Ronald Villota
- Nurses: Cookie, Giselle, Nilda, Debbie, Patricia,

- Signout – daily
  - Maintain the apheresis list
  - AM list should have the patients scheduled for that day
  - PM list should have any patients still on the machine after 16:30 and the patients scheduled for the next day
  - Friday signout should have the patients scheduled for Saturday and Sunday

- Patient care – daily
  - Ensure that patient labs have been drawn, resulted, and reviewed, and that the patient has been examined prior to apheresis
  - Inform your TM attending when the procedure has begun so that the patient can be seen during the procedure
  - CoPath note should be entered within 24 hours of the procedure

- Policy on Patient Notes
  - First treatment note will include a complete history of the present illness, Past Medical History, Past Surgical History, current medications, allergies.
  - Subsequent notes are shorter with a brief interval history, pre/post procedure vitals, labs and the plan.
  - Scheduled patient’s notes will be written by the day resident even when the procedure is performed after 5PM.
  - If the patient referral comes in before 5PM, the note will be written by the day resident.
  - If the patient’s referral comes after 5PM, the note will be written by the on-call resident.
On-Call Responsibilities

Clinical Pathology Services & Pagers
- Hematology (87054)
- Clinical Chemistry (87055)
- Components (85838)
- Apheresis (82754)

Weekday Call:
- Hours: 5:00PM – 12:00AM (PGY1) or 5:00PM - 8:00AM (PGY2+)
  - The on call resident should sign the pager over at 5:00PM and the daily resident should sign the pager over by 8:00AM.
  - The resident on call covers all Clinical Pathology pagers during these hours
  - The resident on call should attend PM sign out the night of their call and AM sign out the day after their call to report/sign out overnight cases/activities
    - Always check with the attending on service if you cannot attend either sign out and notify the residents on service
    - Attendance by the covering night senior resident is at the discretion of the senior resident
    - Always make sure you have at least two ways to reach the attending on call (e.g. pager, cell)

Weekend Call:
- Hours:
  - for PGY1: Friday 5:00PM – 12:00AM, Saturday 8:00AM – 12:00AM, Sunday 8:00AM – 12:00AM (coverage by PGY2 or higher from 12:00AM – 8:00AM)
  - for PGY2+: Friday 5:00PM to Monday 8:00AM
- The resident on call covers all Clinical Pathology pagers during these hours
- The resident on call should attend PM sign out on Friday and AM sign out on Monday to report/sign out overnight cases/activities
  - Always check with the attending on service if you cannot attend either sign out and notify the residents on service
  - Attendance by the covering night senior resident is at the discretion of the senior resident
  - Always make sure you have at least two ways to reach the attending on call (pager, cell)

Service Responsibilities While on Call
- Components
- Routine Blood Bank audit calls end at 11:00PM. However, you will be called after 11:00PM for the other blood bank issues at the discretion of the blood bank technologist according to their protocols (e.g., transfusion reactions, request for washed cells, emergent apheresis, blood type switching and other consultation)
- Apheresis
  - A resident must always be present in house when a patient is on a machine
  - All pages for apheresis requests must be evaluated by the resident and attending on call. If accepted, NYBC must be called for ALL Saturday cases or for Sunday cases if there are more than 2 patients scheduled
- Hematology
  - Please see pp. 70 for call description
- Chemistry
  - Routine chemistry requests are not processed during the weekend
  - Emergent metabolic test requests are processed during the weekend
  - Previously residents were called when lab staff failed to contact the clinical team about a critical value. Currently residents should not be called about routine critical values problems. The administrator on duty is responsible for critical values calls. However, you should use your judgement. In an extraordinary circumstance please do your best to help.
Blood Bank:
Miscellaneous

Answer all of the Blood Bank pages within ten minutes of receiving the page. All decisions should be made and conveyed to the laboratory within twenty minutes.

- If a decision or action will be delayed for longer than twenty minutes, it may be useful to call the Blood Bank and inform them of your plan and approximately when you will finalize a decision. This step in communication will help the laboratory staff to communicate with the nurses and physicians who are often requesting the blood multiple times while the resident investigates the appropriateness of the request. The product will not be released without the resident’s approval.

The “Ten minute rule”
If you are traveling, can’t get to a phone (e.g. subway), or if you are too busy to answer the call, the blood bank will release the product according to the “ten minute rule.”

If the blood bank does not hear from you within ten minutes, they will release the components

- If you are traveling from CPMC to home, the following is recommended:
  - Call the Blood Bank Front Desk and let them know you will be traveling home.
  - Keep your pager on so that you are aware of any Blood Bank activity.
  - Call the blood bank front desk when you get home to learn of any pending problems and to check whether components were released according to the “ten-minute” rule. A retrospective review of the released components should be made if components were released.

- If you are sick or unable to cover the service that you are expected to cover, first make an effort to approach another resident to arrange coverage for the time that you will not be available. If this period of time is going to be lengthy, please contact the Chief Resident in Clinical Pathology or the attending in charge of your rotation. It is irresponsible and inexcusable to leave a service uncovered by a resident physician without properly arranging coverage or notifying the attending of the service.

A Communication log book (black & white marble notebook) is also kept at the front desk. You can write a telephone number where you can be reached, log in requests to the New York Blood Center, and write standing orders.
Blood Bank Resident/Fellow Documentation for Component Calls

- The majority of calls you will receive will be from the blood bank front desk concerning the requests by physicians for platelets or plasma products (plasma, cryoprecipitate or coagulation factor concentrates) if these requests do not meet audit criteria (See pages 14-17 for product-specific audit criteria).

From the tech at the blood bank front desk, you will need to obtain the following information:
- Patient Name, MRN, and location
- Name and beeper/phone number of the requesting physician
- Type and amount of product requested
- Indication for the product that was entered with the order (e.g., bleeding, ECMO, etc...)

- The patient’s history and other clinical/laboratory information can be obtained from INYP, Allscripts and/or by calling the physician requesting the product.
  - Relevant lab values, blood type and weight
  - Presence or absence of bleeding (the source of the bleeding, if patient is bleeding)
  - If and when the patient is scheduled for surgery or an invasive procedure.
  - It may be useful to find out what medications the patient is taking (e.g. effect on platelet function), if the patient is on antiplatelet agents (aspirin, Reopro), if the patient had received vitamin K yet, or if the patient is receiving UFH or LMH.

- Blood type, antibody workups and transfusion history can be obtained online through CoPath, Wyndgate, and INYP.

- A decision should then be made as to the appropriateness of the product requested.
  - If you agree with the request, APPROVE the products by calling the lab back and letting them know. Document this in the on call laptop.
  - If you disagree with the indication for the components, then discuss with the requesting physician and explain why.
    ▪ If you can convince them of your plan for transfusion, then call the desk and tell them that the products are NOT APPROVED. Often, we make alternative products or amounts available.

If you are not sure of the appropriateness or if the requesting physician does not agree with your plan for transfusion, then involve the attending on call.

You are encouraged to request or even add on additional tests to clarify the clinical situation. A fibrinogen level, D-dimer assay, or a mixing study can go a long way in choosing the correct products. You can add on tests by calling the Core Lab at 5-2732 or paging the shift supervisor at #86859.

You are also encouraged to see the patient at the bedside and review the chart. Assessing bleeding yourself can give you a good feel for the clinical situation and communicates to the clinician that you are interested and willing to invest time into the case.

- If you disagree with the indication for the components, then there are a few options:
  1. Call the attending on-call and discuss the case with them. If the attending refuses to release the product, notify the requesting physician and explain the reasoning and let them know that your attending is willing to speak with them about the case. Notify the front desk that the product is NOT APPROVED.
  2. Alternatively, if the attending decides to release the product, you should tell the blood bank to release the product with or without our approval.
    a. If you release without approval (when the clinician really insists on having the product against the blood bank recommendations), subsequent review by the hospital’s transfusion committee will take place (this is the so-called “level 3 review”).
Format for Resident Blood Bank Component Call Entry

1. Date and Time of Page
2. Date and Time of Event Occurrence (if applicable)
3. Name and Medical Record Number of Patient
4. Patient Location
5. Name and contact number/pager of treating physician
6. Brief Clinical History
7. Statement of Problem
   a. Request for products not meeting audit criteria
   b. Request for special products or procedures
   c. Difficult crossmatch or irregular antibodies
   d. Authorization for deviation from normal procedure (e.g. Rh conversion)
8. Pertinent laboratory and other ancillary data
9. Documentation of Discussion with treating physician
10. Recommendations made and plans for additional investigation
11. Final action taken with your initials
12. Follow-up information on additional investigations or clinical outcome.
13. Indicate whether the case was discussed with a particular attending and record their name.

Example:

As an example of an appropriate clinical history, see below:

40 year old woman with Hepatitis C cirrhosis admitted today for abdominal pain and ascites. A request for 4 units plasma was made with a PT 16.4. The patient is not bleeding and is scheduled to have paracentesis today. Other relevant data include Hgb 10, Plts 80,000, aPTT 32, fibrinogen 220. I spoke with Dr. Smith who says that he would feel more comfortable with a PT in the normal range. I explained that a PT corresponded to adequate levels of coagulation factors. In addition, the patient would be given approximately a liter of fluid, addition a risk of volume overload. However, he insisted on the product. After discussing the case with BB attending (Dr. XYZ), I emphasized the blood bank position and Dr. Smith agreed to proceed without the products, but will call immediately if the patient runs into any bleeding problems. The 4 units plasma were NOT APPROVED.
### Components Therapy:

#### Blood Components

**General Component Information**

<table>
<thead>
<tr>
<th>Component</th>
<th>Volume</th>
<th>Composition</th>
<th>ABO compatibility required</th>
<th>Storage condition</th>
<th>Expiration</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBCs</td>
<td>250 mL</td>
<td>RBCs (Hct ~60% for AS RBCs -&gt; total volume = 350mL)</td>
<td>Yes</td>
<td>1-6 °C</td>
<td>* 42 days (for AS RBCs)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*28 days for irradiated RBCs or original date of expiration, whichever is sooner</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*24 hours for open system (i.e washed RBCs)</td>
</tr>
<tr>
<td>Plasma</td>
<td>250 mL</td>
<td>All coagulation factors</td>
<td>Yes</td>
<td>1-6 °C (after thawing)</td>
<td>5 days after thawing (labeled as thawed plasma)</td>
</tr>
<tr>
<td>Apheresis Platelets</td>
<td>300 mL</td>
<td>Platelets (irradiated)</td>
<td>No (however, in small baby, try to match ABO because of reverse hemolysis)</td>
<td>20-24 °C with continuous gentle agitation</td>
<td>*5 days</td>
</tr>
<tr>
<td>(1 dose apheresis platelet = ~6 units)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*4 hours for open system (i.e. washed platelets)</td>
</tr>
<tr>
<td>Cryoprecipitate (1 dose)</td>
<td>80-120mL (<strong>1U = 15mL</strong>)</td>
<td>Fibrinogen, Factor VIII, vWF, factor XIII, fibronectin</td>
<td>No</td>
<td>20-24 °C (after thawing)</td>
<td>*6 hours after thawing if not pooled</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*4 hours if pooled</td>
</tr>
<tr>
<td>Granulocytes</td>
<td>250 mL</td>
<td>Granulocytes, platelets, RBCs</td>
<td>Yes</td>
<td>20-24 °C</td>
<td>24 hours</td>
</tr>
</tbody>
</table>

**1 Unit of cryoprecipitate is 15mL in volume, but the pooled dose has more volume than 5 individual units of cryoprecipitate added together. This is indeed the correct volume.**
Prior to blood issue, the blood bank performs a serological work-up (see Chapter 15 of the Technical Manual 16th ed). This work-up can be relatively quick (15-30 minutes) or can take much longer. The table below is meant to be used as a general guide on the minimum time requirement for testing/procuring blood.

<table>
<thead>
<tr>
<th>Time</th>
<th>pRBC product Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5 minutes</td>
<td>Group O, Uncrossmatched</td>
</tr>
<tr>
<td>15 min after the sample arrives in BB</td>
<td>ABO-group specific, Uncrossmatched</td>
</tr>
<tr>
<td>1 hr (Stat) or 4 hrs (Routine) after blood arrives in BB</td>
<td>ABO-group specific, Crossmatched (Neg Antibody screen)</td>
</tr>
<tr>
<td>Several hours</td>
<td>ABO group-specific, antigen-negative, crossmatched in a patient with antibodies</td>
</tr>
</tbody>
</table>

**Other Blood Products:**

<table>
<thead>
<tr>
<th>Time</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 min</td>
<td>10 units <strong>Cryoprecipitate</strong></td>
</tr>
<tr>
<td>10 min (if previously thawed); 30 min to thaw</td>
<td>4-6 units <strong>FFP</strong></td>
</tr>
<tr>
<td>10 min (non-aliquoted) 30 min (aliquoted)</td>
<td>1 dose apheresis <strong>Platelets</strong></td>
</tr>
</tbody>
</table>

In cases of emergency requests (for uncrossmatched blood), the requesting MD will have to sign the emergency blood release form at the BB front desk.
Transfusion Guidelines:

Infonet (home) under ‘Departments’ → ‘Lab and X-Ray’ → ‘Transfusion Medicine and Cellular Therapy’ (left hand side) → ‘Columbia University Transfusion Medicine and Cellular Therapy’

SoftTech Search ‘TS013’ or ‘Guidelines For RBCs PLTs Plasma and Cryo’

RBCs

(not prospectively audited)

A. Transfusion without reference to Hgb/Hct
   • Massive transfusion (> 15% blood volume loss)
   • Exchange transfusion
   • Symptomatic anemia

B. Hgb < 11.5:
   • Neonate requiring mechanical ventilation

C. Hgb < 9.5:
   • Neonate requiring CPAP or supplemental oxygen

D. Hgb < 8:
   • Patients with history or risk factors for cardiovascular disease

E. Hgb < 7:
   • All other patients not mentioned above
Platelets

A. Transfusion without reference to platelet count
   - Bleeding with loss of one blood volume and no labs available
   - Bleeding with qualitative platelet defect (e.g., aspirin, bypass)

B. Platelet count < 100 x10^9 and:
   - Patients on ECMO
   - Imminent invasive procedure (< 4 hours)
   - Neurosurgery
   - Intracranial hemorrhage
   - Pulmonary hemorrhage
   - Neonate (0-28 days) with major surgery or major bleeding

C. Platelet count < 50 x10^9 and:
   - Active minor bleeding (adults and children)
   - Minor invasive procedure
   - Neonate (0-28 days) on ventilator support
   - Neonates (0-28 days) at risk for intracranial hemorrhage

D. Platelet count < 25 x10^9 and:
   - Any neonate (0-28 days)

E. Platelet count < 10 x10^9:
   - All patients (not mentioned above)
   - Exceptions: Patients with:
     - **Thrombotic thrombocytopenic purpura/hemolytic uremic syndrome (TTP/HUS)**
     - **Heparin-induced thrombocytopenia (HIT)**
     - **Immune thrombocytopenic purpura (ITP)**

   **Transfusion of platelets in these settings are generally CONTRAINDIQUEATED, but in emergency settings with active bleeding, platelet transfusion may be indicated.**

   **Contact an attending on service if these patients require platelets (e.g., active bleeding)**

Facts about platelets:
- One dose of apheresis platelets (~6 units) has ≥ 3 x 10e11 platelets – expect bump of ≥30K in plt count.
- The few RBCs contaminating platelet units have ABO and Rh antigens
  - The Blood Bank must issue Rh-matched platelets, but they need not be ABO-matched.
- Platelets have ABO antigens, but NOT Rh antigens.
  - ABO matched platelets may be offered to adult patients with platelet refractoriness to improve post-transfusion platelet survival
- Each dose contains ~200-250 cc’s of plasma with anti-A and / or B red cell antibodies.
  - Platelets are ABO matched for infants less than 4 months old to prevent ‘reverse hemolysis’ from incompatible plasma.

Platelets can be VOLUME REDUCED for babies, however, the platelets can get activated and degranulate during the centrifugation process, causing them to become less effective. Discuss requests for volume reduction with your attending.

Platelets can be ordered in doses or mLs.
Plasma

A. Transfusion without reference to laboratory tests
   - Thrombotic thrombocytopenic purpura/Hemolytic uremic syndrome
   - Bleeding with loss of one blood volume and no labs available
   - Patients receiving plasma exchange with coagulopathy or imminent surgery
   - Patients treated with L-asparaginase

B. Prolonged INR (> 1.6):
   - Patients with bleeding and/or surgery

C. Prolonged PTT (>55 sec):
   - Factor deficiency and bleeding and/or surgery

D. PT or PTT > 1.5 x the upper limit of reference range for age:
   - Infants with active bleeding or undergoing surgery

Coagulation Screening Tests: Results and Factor Levels

<table>
<thead>
<tr>
<th>Activity (%)</th>
<th>PT</th>
<th>INR</th>
<th>aPTT</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>13.0</td>
<td>0.95</td>
<td>29.0</td>
</tr>
<tr>
<td>50</td>
<td>16.5</td>
<td>1.28</td>
<td>44.2</td>
</tr>
<tr>
<td>40</td>
<td>18.8</td>
<td>1.52</td>
<td>54.2</td>
</tr>
<tr>
<td>30</td>
<td>21.6</td>
<td>1.82</td>
<td>74.2</td>
</tr>
<tr>
<td>20</td>
<td>28.6</td>
<td>2.63</td>
<td>117.3</td>
</tr>
<tr>
<td>10</td>
<td>&gt;50</td>
<td>&gt;180</td>
<td></td>
</tr>
</tbody>
</table>

1 unit of plasma contains approximately 220U of coagulation factors.
1 unit of plasma contains approximately 400 mg of fibrinogen
Factors V and VIII are extremely labile, and will decrease in concentration after thawing.

The range of INR of plasma units taken from the shelf is approximately 0.9 to 1.5.
Keep this in mind when clinicians claim that they want to “lower” a marginally high INR.
Using the above table, INR can be used to estimate the %coagulation factor activity. Final %coagulation factor activity after transfusion of plasma can be estimated using the following equation:

\[%\text{coagulation activity}_{\text{final}} = \frac{\text{TBV}[1-\text{Hct}]\times[\%\text{coagulation activity}_{\text{initial}} + V_{\text{plasma}}]}{\text{TBV} + V_{\text{plasma}}}\]
Transfusion Audit Criteria:

Cryoprecipitate

A. Transfusion without reference to laboratory tests
   - Abnormal fibrinogen (dysfibrinogenemia)
   - Uremic bleeding refractory to DDAVP and dialysis
   - Disseminated Intravascular Coagulation (DIC)
   - Known factor XIII deficiency with active bleeding or scheduled surgical/invasive procedure and factor XIII concentrate not available

B. Hypofibrinogenemia (fibrinogen < 150 mg/dl) and:
   - Active bleeding and/or procedure

C. Fibrinogen < 60 mg/dl
   - All patients

Facts about cryoprecipitate:
- Cryoprecipitate is enriched for fibrinogen, vWF, factor VIII, factor XIII, and fibronectin.
- In the absence of any other components, 1 unit of cryoprecipitate should increase fibrinogen by 7-8 mg/dL in a 70 kg adult. Subsequently, 1 dose of cryoprecipitate should increase fibrinogen by 35-40 mg/dL in a 70 kg adult.
- 1 dose = 5 units of cryoprecipitate
- 1 unit of cryoprecipitate contains 150-250 mg of fibrinogen.
- AABB standards state that each unit of cryoprecipitate has to contain at least 150 mg of fibrinogen and 80 IU of factor VIII.

The Blood Bank stocks pre-pooled units (5 units) of cryoprecipitate (100-135 mls). Cryoprecipitate can be ordered in doses or mLs.
Recommended pediatric dosing

**Pediatric Hemotherapy Data Card**

<table>
<thead>
<tr>
<th>Component</th>
<th>Attributes</th>
<th>Indication</th>
<th>Dosage</th>
<th>Expected Increment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Blood Cells</td>
<td>See anticoagulant-preservative solutions table below</td>
<td>Increase oxygen-carrying capacity</td>
<td>10-15 mL/kg</td>
<td>2-3 g/dL rise in Hb (depends on anticoagulant-preservative)</td>
</tr>
<tr>
<td>Washed RBCs</td>
<td>70-80% Hct, suspended in normal saline</td>
<td>Recurrent severe allergic reactions</td>
<td>10-15 mL/kg</td>
<td>3 g/dL rise in Hb</td>
</tr>
<tr>
<td>Fresh Frozen Plasma (FFP)</td>
<td>(Note thawed plasma can be used in lieu of FFP)</td>
<td>Factor deficiency</td>
<td>10-15 mL/kg</td>
<td>15-20% rise in factor level (assume ideal recovery)</td>
</tr>
<tr>
<td>Platelets</td>
<td>Whole-blood-derived platelets: ≥5.5 x 10^10 platelets suspended in 50 mL of plasma</td>
<td>Correct/prevent bleeding due to thrombocytopenia or platelet function defect</td>
<td>5-10 mL/kg</td>
<td>50,000-100,000/μL rise in platelet count (assume ideal recovery)</td>
</tr>
<tr>
<td></td>
<td>Apheresis platelets: ≥3.9 x 10^11 platelets in 250-300 mL plasma, equivalent to approx. 4-6 units whole-blood-derived platelets</td>
<td>Same as above</td>
<td>Same as above</td>
<td>Same as above (assume ideal recovery)</td>
</tr>
<tr>
<td>Cryoprecipitated AHF</td>
<td>≥150 mg fibrinogen/ unit; ≥80 units Factor VIII/unit; von Willebrand factor (vWf): Factor XIII</td>
<td>Deficiency of fibrinogen (hypofibrinogenemia &lt;100 mg/dL; hemophilia A and vWD only when concentrate not available; deficiency of Factor XIII)</td>
<td>1-2 units/10 kg (volume of a unit will vary, maximum to 15 mL)</td>
<td>60-100 mg/dL rise in fibrinogen</td>
</tr>
</tbody>
</table>

**Anticoagulant-Preservative Solutions for Red Blood Cells**

<table>
<thead>
<tr>
<th></th>
<th>CPD, CPDA-1</th>
<th>AS-1, AS-3, AS-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematocrit</td>
<td>66-80%</td>
<td>55-65%</td>
</tr>
<tr>
<td>Expected Hb rise after transfusion of 10-15 mL/kg</td>
<td>3 g/dL</td>
<td>2 g/dL</td>
</tr>
<tr>
<td>Glucose</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Mannitol</td>
<td>0</td>
<td>AS-1, AS-5</td>
</tr>
<tr>
<td>Sodium</td>
<td>Minimal</td>
<td>++</td>
</tr>
<tr>
<td>Adenine</td>
<td>CPDA only</td>
<td>Yes</td>
</tr>
<tr>
<td>Shelf-life</td>
<td>21-35 days</td>
<td>42 days</td>
</tr>
</tbody>
</table>
Formulae for pediatric dosing of components

Formulae/Calculations

Blood volume (BV): Preterm neonate = 100 mL/kg; term neonate = 85 mL/kg; >1 month = 75 mL/kg
Plasma volume (PV): BV × (1 – Hct)

RBC replacement: Volume required = BV × desired Hct increase – Hct of RBC product
Exchange transfusion: Double volume to remove plasma bound substances: preterm = 2 × 100 mL/kg; full term = 2 × 85 mL/kg
Single volume for correction of coagulopathies or anemia: preterm = 100 mL/kg; full term = 85 mL/kg
Partial volume to change hematocrit level in polycythemia:
Volume replaced (mL)** = BV × (Hct observed – Hct desired)
Hct observed
Partial volume to change hemoglobin level in anemia:
Volume RBC exchanged (mL) = BV × (Hb desired – Hb initial)
Hb RBC (approximately 22 g/dL) – Hb initial

*Replacement fluid will vary depending on the clinical situation.

Number of units cryoprecipitate needed for fibrinogen replacement:

250 mg fibrinogen/unit (content of 75% of units)

Example: initial fibrinogen is 20 mg/dL, desired fibrinogen is 200 mg/dL, weight 2.5 kg, Hct 50, DL = 100 mL
PV = BV × (1 – Hct) = (100 mL/kg × 2.5 kg) × (1 – 0.5) = 125 mL

(200 mg/dL – 20 mg/dL) × 125 mL = 180 mg/100 mL × 125 mL = 225 mg = 1 unit
250 mg fibrinogen/unit

Factor VIII dosing**: Each unit of either plasma-derived or recombinant Factor VIII infused per kilogram raises the Factor VIII level by 2% (0.02 IU/kg x 1 unit). Dose (IU) = weight (kg) x desired increment

Factor IX dosing: Each unit of plasma-derived Factor IX infused per kilogram raises the Factor IX level by 1% (0.01 IU/kg); Dose (IU) = weight (kg) x desired increment

Due to lower recovery of recombinant Factor IX, most practitioners increase the dose by 1.3.

Dose (IU) = weight (kg) x desired increment x 1.3

*In newly diagnosed patients the preferred product is recombinant Factor (VIII or IX, respectively). Because kinetic studies with recombinant factor may vary, obtaining factor levels to evaluate status is important.

Adverse effects of transfusion to discuss during consent

Adverse Effects of Blood Component Transfusion

General infectious risks per unit in the United States
Infectious Risks:
- Human immunodeficiency virus—approximately 1 in 2 million
- Hepatitis C virus—approximately 1 in 2 million
- Hepatitis B virus—1:205,000 (Ref. 5)
- Other infectious agents tested: Human T-cell lymphotropic virus type VII, West Nile virus, Treponema pallidum (syphilis), bacteria (platelets only)

Noninfectious Risks (major):
- Febrile nonhemolytic—0.25 to 1.0%
- Allergic—1 to 6%
- Hemolytic—approximately 1 in 78,000 to 1 in 38,000

Special considerations in pediatric transfusions: (for more detail see Ref. 6)
- Volume overload/transfusion—infusion rate determined according to patient size and medical condition
- Hyperkalemia, hypoglycemia, and other metabolic derangements—affected by anticoagulant-preservative, age of blood, rate of transfusion, renal/hepatic function
- Hypothermia—associated with rapid infusion, particularly through central line
- ABO hemolysis associated with ABO-incompatible platelet transfusion—passive transfer of antibody
- Transfusion-related acute lung injury—acute respiratory deterioration following transfusion of components containing plasma
- RBC or HLA alloimmunization—patients requiring multiple RBC or platelet transfusions
- Cytomegalovirus (CMV) transmission in seronegative infants <1200 g—risk reduced by using CMV-reduced-risk blood components (seronegative or leukocyte-reduced)
- Transfusion-associated graft-vs-host disease—risk in susceptible patients reduced by irradiation of blood components (minimum 25 Gy)
Special Products Transfusion Criteria:

Infonet (home) under ‘Departments’ → ‘Lab and X-Ray’ → ‘Transfusion Medicine and Cellular Therapy’ (left hand side) → ‘Columbia University Transfusion Medicine and Cellular Therapy’

SoftTech Search ‘TS016’ or ‘Guidelines For Special Needs and Products’

CMV-Negative Blood Products

(NOTE: ALL BLOOD PRODUCTS ISSUED FOR ROUTINE REQUESTS ARE CMV SAFE: LEUKOCYTE-REDUCED)

**Step 1: Are CMV-negative blood products indicated?**

**Our Indications:**
- All Infants <4 mo of age.
- All Intrauterine Transfusions
- Autologous BMT/PBSCT when the patient is CMV negative.
- Allogeneic BMT/PBSCT when both patient and donor are CMV negative
- Lung Transplant when both patient and donor are CMV negative
- Cardiac patients with DiGeorge syndrome
- Other transplant settings are NOT approved indications and CMV negative products are unlikely to improve outcomes compared to our standard leukoreduced / ‘CMV safe’

**Step 2: Looking up CMV status in iNYP**

Click on “Laboratory”
On the left in the grey bar just above the menu of patient labs there is a field called “Filter”
Just type in “CMV”
Look for CMV IgG and IgM. These serologies tell you the CMV status. CMV PCR results may show up but these are only positive during active viremia.

If there are no CMV serologies in iNYP, and the patient is known to the Stem cell laboratory, call them to find out if they have performed CMV serologies on the patient (Stem cell lab sends out sample to the NYBC). The stem cell laboratory can be reached at 5-4446 (Mon-Fri 8AM-5PM).

**Step 3: Obtain donor status, if relevant from clinical team or iNYP notes.** If patient is CMV negative and donor’s CMV status is unknown, CMV negative products are approved until such time that donor CMV status can be accurately ascertained.

**What if there are no CMV titers in iNYP?**

If there are no patient CMV titers, ask requesting MD to send out CMV antibody titers ASAP. Inform Blood Bank tech that CMV-negative blood products are approved for 3 days. At the end of this 3-day period, if any further blood products are requested for the patient, the BB resident will be paged by techs. CMV titers should be back at this point and should aid in making a final decision. Communicate decision to BB tech so that they can input this information in Wyndgate. If MD states that he/she does not know donor CMV status in lung transplant cases, call lung transplant coordinator 47771 (87600) or 917-407-5522 for CMV status.

**CMV Negativity/Positivity:**

“CMV negative” patient status is defined as negative CMV IgM AND negative CMV IgG. Note: positive IgM indicates acute infection.

Most commonly, the “CMV positive” patient has negative IgM but positive IgG titers

**Testing Information:**

- Site: Specialty Laboratory
- Location: CHC-02
- Phone (212) 305-9116
- Availability Mon-Fri, 8 AM - 4 PM
- CMV IgG is performed 3 times per week; CMV-IgM is performed 2 times per week
- Volume & Container: Send 2ml blood in Gold Top Tube

**Reference Ranges**

**CMV IgG:**
- No antibody detected: <4
- Equivocal: ≥4 to <6
- Antibody detected: >6

**CMV IgM:**
- No antibody detected: <0.70
- Equivocal: >0.70 to <0.90
- Antibody detected: ≥0.90
Special Products Transfusion Criteria:

Irradiated Blood Products

Whole blood, RBCs, platelets, and granulocytes are irradiated to decrease the risk of Graft-Versus-Host disease. Irradiation damages the DNA of lymphocytes thus making them unable to proliferate.

Indications for irradiated blood products:

- Congenital immunodeficiency syndromes
- Intrauterine transfusions
- Neonatal exchange transfusion
- All pediatric patients (CHONY, Pediatric Infusion Center – IP7)
- Patients with congenital heart disease/Di George syndrome
- All oncology patients
- Directed donor blood products
- HLA-matched products
- Granulocyte products
- Patients treated with purine analogues (e.g. fludarabine, cladribine and deoxycoformycin), purine antagonists (e.g. bendamustine), alemtuzumab (Campath, anti-CD52), anti-thymocyte globulin, or other medications that affect T-cell function/number
- All VAD/ECMO patients
- All platelets

Adverse effects of irradiation:

RBCs: increase in extracellular potassium, decrease in post-transfusion RBC survival (10% decrease in viability at 24 hours).

Sickle Negative (HgbS -) Blood Products

- For hypoxic or acidic neonatal recipients of massive transfusion or exchange transfusion.
- For patients with known Hemoglobin S Disease for routine or exchange transfusions
- For patients on ECMO
- For infants < 4 months

Washed Red Blood Cells

- Fax request form to the blood bank (on Infonet search ‘washed rbc’ or ‘NYPH-465-76’)
- Multiple, increasingly severe allergic reactions or prior anaphylactic reaction to the transfusion of RBCs.
- IgA deficiency with antibodies against IgA, when IgA deficient RBCs are not available
  - Note: For patients who report a history of IgA deficiency you should request IgA levels and anti-IgA antibody titers to better guide their transfusion therapy
Granulocyte Transfusions

(Fax request form to blood bank, on Infonet search ‘granulocyte product’ or ‘NYPH-465-75’)

General guidelines for use of Granulocytes:
1. Pediatric or adult patient with severe neutropenia (ANC ≤ 500/μL)
2. Fever for 24 to 48 hours with persistent morbidity
3. Documented bacterial or fungal infection
4. Unresponsive to appropriate antibiotics for 48 hours
5. Reasonable hope of marrow recovery

Instructions and Information:
1. Administration
   a. There MUST be an Allscripts order placed to the Blood Bank prior each day of granulocyte transfusion. One order for 3 granulocytes transfusions is NOT acceptable.
   b. Appropriate orders should be written in the patient’s chart in advance so that nursing and house staff are aware of the transfusion.
   c. Granulocytes will be:
      i. ABO/Rh specific and fully crossmatch compatible (high red cell content); there MUST be an active type and crossmatch sample in the Blood Bank;
      ii. Irradiated to prevent transfusion associated graft-versus-host disease
      iii. Regardless of CMV status of donor and/or recipient, the Blood Bank always obtains CMV negative granulocytes. The products will not be labeled as “CMV negative” due to testing not being complete at the time of issue (see #4)
   d. Premedicate 1 hour prior to granulocytes with diphenhydramine 1 mg/kg (max 50 mg) and hydrocortisone 1 mg/kg (max 50 mg)
   e. give through a standard blood filter (170 μm) over 1-2 hours
2. Dosage:
   Note that granulocytes are collected at NYBC from a stimulated donor (with steroids). In general, the product has a low yield of granulocytes (usually less than 1 x 10^11 PMN)
   Each unit is ~250-300 mL, is irradiated, and contains plasma and platelets, therefore it must be ABO and Rh compatible.
3. Storage and Timing
   a. Products are stored at room temperature and expire 24 hours after collection
   b. Optimal administration is within 6 hours of collection to minimize loss of chemotaxis
   c. Granulocytes MUST be picked up and transfused as soon as possible after arrival. The Blood Bank will not send them through the pneumatic tube system.
4. Urgent Medical Need
   a. The risk of infectious disease transmission is essentially similar to any other blood product except that donors are only tested for infectious disease markers on the day of collection. Thus, due to the expiration time of the product, the products are issued prior to the release of infectious disease marker testing results under urgent medical need. Please note that granulocyte donors have been tested for infectious disease markers and found negative/non-reactive within the last ten days.
5. Adverse Reactions
   a. Granulocyte transfusions have the same risk of adverse reactions as any other blood product and should be monitored closely; systemic reactions or fever may be treated with acetaminophen 10 mg/kg (max 650 mg), meperidine 1 mg/kg and additional diphenhydramine and hydrocortisone as necessary
6. Continuation (based on clinical judgment and the patient’s response)
   a. Reasons for discontinuing granulocytes include:
      i. Neutrophil recovery (ANC > 500 for two days)/ clinical response
      ii. Exhaustion of available donors
      iii. Severe transfusion reactions
      iv. Futility deterioration of patient’s condition
   b. Granulocyte donors undergo a procedure with moderate risk for complications. In order to prevent exposing healthy donors to unnecessary risk, Ped Hem/Onc fellows and/or Ped Hem/Onc/BMT attending must let the Blood Bank know as soon as possible if granulocytes are no longer indicated.
Transfusing Rh-D+ pRBCs in Rh-D- patients

You will be paged by the blood bank when a Rh(D)-Neg patient needs blood at a time of limited Rh(D)-Neg inventory. Consider: patient’s age, sex, condition, anticipated future transfusion needs. Discuss the case with your TM attending and the patient’s physician.

Derivatives:

**Factor VIII, IX, Humate P**

You will be paged for factor concentrate dosing. These patients should also have a hematology consult. Look up our special heme/coag lab work-up for factor and inhibitor levels, if any. It is also important to discuss factor inventory with the blood bank supervisor/manager.

The CUMC nursing manual discusses how coagulation factor concentrates/blood derivatives should be administered (essentially, it directs the nurse to follow directions from the package insert). A copy of this nursing manual can be found on infonet (http://infonet.nyp.org/Nursing/Standards/Blood%20and%20Blood%20Components%20Derivatives,%20Administration%20Procedure.pdf). Syringe pumps are not readily available. If they ask if it is OK to dilute the factor further into saline so as to infuse using a regular IV set, the answer is always NO. They should use a syringe pump or manually infuse the concentrate at the recommended rate. You can reassure them it usually only takes 10-20 minutes.

a) **Factor VIII (half-life = 8-12 hours):**

In the absence of an inhibitor, an easy to remember rule of thumb: Factor VIII levels will increase 2% for every 1 unit/kg infused. Assuming a starting plasma level of 0%, a 100% factor VIII level can be achieved by giving a 50 IU/kg IV bolus. The maintenance dose is half the loading dose and is dosed q12 hours. The severity of bleeding/ invasive procedure will determine the target levels to be achieved. Typically, targets for mild, moderate and severe hemorrhage are 30%, 50-70% and 80-100% respectively. The blood bank stocks both recombinant and plasma-derived factor VIII. Patients should stay on the same formulation. See Mannucci M et al. Blood, 3 May 2012; 119 (18): 4108-4114, for risks and benefits.

b) **Factor IX (half-life = 20-24 hours):**

In the absence of an inhibitor, an easy to remember rule of thumb: Factor IX levels will increase 1% for every 1 unit/kg infused. Assuming a starting plasma level of 0%, a 100% factor IX level can be achieved by giving a 100 IU/kg IV bolus. The maintenance dose is half the loading dose and is dosed q24 hours. Target factor percentages for mild, moderate and severe hemorrhage are similar to those for Factor VIII.

c) **Von Willebrand factor/Antihemophilic Factor complex:**

Humate P is used for the treatment of von willebrand disease. Note that Humate P vials are actually labeled with both von Willebrand Factor units and Factor VIII units (~ 2:1 vWF: FVIII; exact levels vary by lot). Loading dose is typically 40-60 units/kg and Humate P is dosed q8-12 hours.

Table 1. Classification of vWF

<table>
<thead>
<tr>
<th>Subtype</th>
<th>Description</th>
<th>Inheritance</th>
<th>Lab Findings</th>
<th>Multimer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>Quantitative deficiency of vWF</td>
<td>Autosomal dominant</td>
<td>Parallel reductions in vWF antigen, activity, and Factor VIII</td>
<td>Normal Distribution</td>
</tr>
<tr>
<td>Type 2A</td>
<td>Abnormal platelet-dependent function of vWF, loss of large multimers</td>
<td>Autosomal dominant</td>
<td>Reduced vWF activity-to-antigen ratio (&lt; 0.6)</td>
<td>Loss of mid-sized and highest molecular weight multimers</td>
</tr>
<tr>
<td>Type 2B</td>
<td>Increased platelet-dependent function of vWF, loss of large multimers</td>
<td>Autosomal dominant</td>
<td>Reduced vWF activity-to-antigen ratio (&lt; 0.6)</td>
<td>Abnormal Ristocetin-induced platelet aggregation</td>
</tr>
<tr>
<td>Type 2M</td>
<td>Abnormal platelet-dependent function of vWF</td>
<td>Autosomal dominant</td>
<td>Reduced vWF activity-to-antigen ratio (&lt; 0.6)</td>
<td>Normal distribution</td>
</tr>
<tr>
<td>Type 2N</td>
<td>Decreased affinity of vWF for Factor VIII</td>
<td>Autosomal dominant</td>
<td>Reduced Factor VIII level (2-10%)</td>
<td>Normal distribution</td>
</tr>
<tr>
<td>Type 3</td>
<td>Near complete deficiency of vWF</td>
<td>Autosomal recessive</td>
<td>Marked reductions or absence in vWF levels</td>
<td>Low Factor VIII levels (5-10%)</td>
</tr>
</tbody>
</table>

**d) Patients with inhibitors:**

Very infrequently you may encounter a patient with factor inhibitors. Most of these patients have inhibitors to factor VIII. At CUMC, we use recombinant activated Factor VII (Novoseven) for these patients. Use of these drugs occurs typically with the level of inhibitors >5-10 Bethesda Units. Discuss dosing with the TM attending and hematology fellow/attending (see below for more information on activated Factor VII).
Activated Factor VII (Novoseven)

- Indication: Severe uncontrolled bleeding despite transfusion of 2 rounds of routine components (1 dose plts, 6U FFP, 2 bags of pooled Cryo and pRBCs). Note that Novoseven will not help arrest a purely surgical bleed.
- A hematology consult is required in non-emergent situations.
- Discuss prothrombotic risks of Novoseven. Make sure that the requesting MD understands and accepts these risks and document this in the on call log.
- Recommend correction of acidosis if pH<7.2.
- Encourage continued transfusion of blood products so that there is enough substrate to form a clot (usually the platelet count should be above 50000 and fibrinogen should be above 100). Also ask the team to send labs (CBC, coags, fibrinogen) often to monitor the patient’s status.
- Follow up on patient status after Novoseven administration. Evaluate bleeding/number of blood products used. PT should correct with FVIIa.
- Notification of an attending is necessary if the approval resident is a PGY-1
- A second dose of Novoseven is rarely required. If the second dose is requested, please get TM attending approval.

- **General Dosing Guidelines (Refer to Flowchart below for more details, 1000 mcg = 1 mg)**
  - SEVERE UNCONTROLLED BLEEDING:
    - 35-90 mcg/kg
  - CONGENITAL FACTOR VII DEFICIENCY:
    - 15-30 mcg/kg
  - BLEEDING IN A PATIENT WITH FACTOR VIII OR IX INHIBITOR:
    - 90 mcg/kg q2 hours until hemostasis is achieved

Novoseven has an in vivo half life of 2-3 hours. Bloodbank supplies vials of 1, 2 and 5 mg.

**Don’t forget to:**

- Discuss prothrombotic risks of Novoseven with clinicians. Make sure that the requesting MD understands and accepts these risks and document this in the on call computer.
- Fill out the NOVOSEVEN LOG, located in the blood bank components folder each time you issue Factor VII. These are used for quality control purposes and are required by law.
Treatment Guidelines For The Use of Recombinant Factor VIIa

**NOTE: FACTOR VIIa SHOULD BE USED WITH CAUTION IN PATIENTS WITH ANY OF THE FOLLOWING:***
1. CAD
2. DIC
3. RECENT CARDIAC SURGERY
4. H/O ARTERIAL or VENOUS THROMBOSIS
5. CEREBRAL VASCULAR DISEASE
6. CURRENT ECMO or VAD USE.
## Reversal Guidelines for Anti-Coagulants

**Current Hospital Policy:**

- **Infonet**
- **Current Hospital Policy:**

### Reversal Guidelines for Life-Threatening Bleeding Caused by Antithrombotics or Emergent Surgery

1. Discontinue offending antithrombotic agent
2. Evaluate source of bleeding
3. Supportive Therapy – volume resuscitation, inotropes as needed
4. Transfusion of red cells, platelets and FFP as indicated
5. Baseline Labs – CBC, Platelets, Basic Metabolic Panel, aPTT, PT/ INR, Fibrinogen
6. For perioperative and postoperative management of antithrombotic therapy refer to: [Perioperative Management Of Antithrombotic Therapy: Guidelines For Adult Inpatients](#)
7. For **refractory bleeding** consider an anti-fibrinolytic (ex: aminocaproic acid) to help promote hemostasis

<table>
<thead>
<tr>
<th>Medication</th>
<th>Mechanism of Action</th>
<th>Half-life</th>
<th>Renal Elimination</th>
<th>Laboratory Monitoring</th>
<th>Treatment</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warfarin (Coumadin&lt;sup&gt;®&lt;/sup&gt;)</td>
<td>Vitamin K antagonist</td>
<td>1-8 days</td>
<td>No</td>
<td></td>
<td>Vitamin K AND factors (either 4F-PCC OR Plasma [FFP])</td>
<td>1. No Plasma with 4F-PCC</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>1. Vitamin K 10 mg IPB AND</td>
<td>2. If INR &gt;1.5: 4F-PCC (Kcentra&lt;sup&gt;®&lt;/sup&gt;) X 1 dose only</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1. No Plasma with 4F-PCC</td>
<td>For patients with HIT/HITTS or Heparin Allergy:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. If INR &lt;1.5 (or if no PCC administered), Plasma 15 mL/kg</td>
<td>- 4F-PCC is contraindicated in HIT/HITTS (as it contains heparin)</td>
</tr>
<tr>
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<td>- Obtain stat Heme consult</td>
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<td>- Consider the following alternatives:</td>
</tr>
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<td></td>
<td>o 3F-PCC (Protiline&lt;sup&gt;®&lt;/sup&gt;) 25 – 50 units/kg, total body weight, use Kcentra table for dose + 1-2 units Plasma</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Body weight (kg)</th>
<th>Pre-dose INR</th>
<th>Blood Products</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.5-3.9</td>
<td>4-6</td>
</tr>
<tr>
<td></td>
<td>25 IU/kg</td>
<td>50 IU/kg</td>
</tr>
</tbody>
</table>

|                  | 1000        | 1500           |
|                  | 2000        | 3000           |

*Vitamin K onset: 6 hours (IV) and 24 hours (PO)*
<table>
<thead>
<tr>
<th>Medication</th>
<th>Mechanism of Action</th>
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<th>Renal Elimination</th>
<th>Laboratory Monitoring</th>
<th>Treatment</th>
<th>Blood Products</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dabigatran (Pradaxa®)</td>
<td>Direct thrombin inhibitor</td>
<td>12-18 hrs</td>
<td>Yes, 80% renal</td>
<td>TT* (thrombin time), aPTT*, *qualitative</td>
<td>There is no reversal agent for dabigatran</td>
<td>NO Plasma</td>
<td>For Additional Information: Refer to Dabigatran Dosing And Monitoring Policy For Adult Patients</td>
</tr>
<tr>
<td>Rivaroxaban (Xarelto®)</td>
<td>Factor Xa inhibitor</td>
<td>5-9 hrs</td>
<td>Yes, 33-66%</td>
<td>PT* (*qualitative)</td>
<td>There is no reversal agent for rivaroxaban</td>
<td>NO Plasma</td>
<td>For Additional Information: Refer to Rivaroxaban Dosing And Monitoring Policy In Adult Patients</td>
</tr>
<tr>
<td>Apixaban (ELIXA®)</td>
<td>Factor Xa inhibitor</td>
<td>8-15 hrs</td>
<td>Yes, 25%</td>
<td>PT* (*qualitative)</td>
<td>There is no reversal agent for apixaban</td>
<td>NO Plasma</td>
<td>For Additional Information: Refer to Apixaban Dosing And Monitoring Policy In Adult Patients</td>
</tr>
<tr>
<td>Unfractionated heparin (UFH)</td>
<td>Potentiates the action of antithrombin and thereby inactivates thrombin</td>
<td>1.5 hrs</td>
<td>No</td>
<td>aPTT</td>
<td>Protamine</td>
<td>NO Plasma</td>
<td>Protamine works by binding to UFH and removing it from circulation. Unbound protamine can cause paradoxical bleeding, thus it is crucial to know the amount of heparin exposure to ensure appropriate protamine dosing. * For Additional Information Refer to: Heparin (Unfractionated) UFH Dosing And Monitoring Policy For Adult Patients</td>
</tr>
<tr>
<td>Low-molecular weight heparin (LMWH)</td>
<td>Inhibits Factor Xa and thrombin (via antithrombin). (LMWH have higher ratio of anti-Xa to Hla activity than UFH)</td>
<td>3-5 hrs</td>
<td>Yes</td>
<td>Xa level*</td>
<td>Protamine does not completely neutralize anti-factor Xa activity and therefore has controversial efficacy for reversing LMWH</td>
<td>NO Plasma</td>
<td>The anti-factor Xa activity is not completely neutralized by protamine (&lt;40%). Protamine is derived from fish, thus a fish allergy or hypersensitivity is considered a relative contraindication to protamine and is a risk factor for cardiovascular collapse, pulmonary edema, and pulmonary hypertension that may be seen with protamine. * For Additional Information Refer to: Low Molecular Weight Heparin (LMWH) Treatment Dosing And Monitoring Policy For Adult Patients</td>
</tr>
</tbody>
</table>

* Denotes a qualitative measurement.

TT = thrombin time, aPTT = activated partial thromboplastin time, PT = prothrombin time.
<table>
<thead>
<tr>
<th>Medication</th>
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<th>Half-life</th>
<th>Renal Elimination</th>
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<th>Treatment</th>
<th>Blood Products</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argatroban</td>
<td>Direct thrombin inhibitor (intravenous)</td>
<td>40-50 min</td>
<td>Hepatic impair ent ≤1 hr</td>
<td>No aPTT</td>
<td>There is no reversal agent for argatroban. Given its short half-life, supportive care alone is recommended. 1. Discontinue infusion 2. Consider FEIBA 25 units/kg for life-threatening bleeds “Do NOT use 4F-PCC (Kcentra)”, which contains heparin</td>
<td>NO Plasma  *Plasma does not reverse argatroban, thus is not recommended</td>
<td>For Additional Information: Refer to: Argatroban IV Dosing And Monitoring Policy For Adult Inpatients</td>
</tr>
<tr>
<td>Bivalirudin (Angiomax®)</td>
<td>Direct thrombin inhibitor (intravenous)</td>
<td>25 mins Up to 1 hr – Severe Renal impair ent</td>
<td>Yes aPTT</td>
<td>There is no reversal agent for bivalirudin. Given its short half-life, supportive care alone is recommended. 1. Discontinue infusion 2. Consider FEIBA 25 units/kg for life-threatening bleeds “Do NOT use 4F-PCC (Kcentra)”, which contains heparin</td>
<td>NO Plasma  *Plasma does not reverse bivalirudin, thus not recommended</td>
<td>For Additional Information: Refer to: Desirudin Dosing And Monitoring Policy for Adult Inpatients</td>
<td></td>
</tr>
<tr>
<td>Desirudin (Praxxa®)</td>
<td>Direct thrombin inhibitor (SubQ)</td>
<td>2-3 hrs</td>
<td>Yes aPTT</td>
<td>There is no reversal agent for desirudin. 1. Discontinue medication 2. Consider FEIBA 25 units/kg for life-threatening bleeds “Do NOT use 4F-PCC (Kcentra)”, which contains heparin</td>
<td>NO Plasma  *Plasma does not reverse desirudin, thus not recommended</td>
<td>For Additional Information: Refer to: Fondaparinux Dosing And Monitoring Policy For Adult Inpatients</td>
<td></td>
</tr>
<tr>
<td>Fondaparinux (Arixtra®)</td>
<td>Factor Xa inhibitor</td>
<td>17-21 hrs</td>
<td>Yes aPTT</td>
<td>There is no reversal agent for fondaparinux. 1. Consider /FVIIa 14-28 mcg/kg for life-threatening bleeds (round to the nearest vial size)</td>
<td>NO Plasma  *Plasma does not reverse fondaparinux, thus not recommended</td>
<td>For Additional Information: Refer to: Fondaparinux Dosing And Monitoring Policy For Adult Inpatients</td>
<td></td>
</tr>
<tr>
<td>Aspirin®</td>
<td>Aspirin/Dipyrid amide (Aggrenox®)</td>
<td>Cyclooxygenase inhibitor - Inhibition of platelet aggregation</td>
<td>A1:15-30 min</td>
<td>No Aspirin level</td>
<td>There is no reversal agent for antiplatelet medications. 1. Administer Activated charcoal (25 g) if ingestion was within 2 hours and repeat as needed 2. Consider desmopressin 0.3 mcg/kg X 1 dose over 15 mins</td>
<td>Consider platelet infusion (1 single donor/apheresis unit)</td>
<td>• Multiple doses of DDAVP can cause tachyphylaxis, hyponatremia and seizures  • Aspirin inhibits platelet function for the life-span of the platelets  • Hemodialysis can be used to enhance the removal of salsalate from the blood in aspirin overdoses</td>
</tr>
<tr>
<td>Clopidogrel (Plavix®)</td>
<td>Prasugrel (Effient®) Ticagrelor (Brilinta®)</td>
<td>ADP receptor inhibitor - Inhibition of platelet aggregation</td>
<td>C: 6 hrs P: 7 hrs T: 7 hrs</td>
<td>No Platelets</td>
<td>There is no reversal agent for antiplatelet medications. 1. Administer Activated charcoal (25 g) if ingestion was within 2 hours and repeat as needed 2. Consider desmopressin 0.3 mcg/kg X 1 dose over 15 mins</td>
<td>*Consider platelet infusion (1 single donor/apheresis unit)</td>
<td>• Multiple doses of DDAVP can cause tachyphylaxis, hyponatremia and seizures  • Clopidogrel and prasugrel inhibit platelet function for the life-span of the platelets  • Ticagrelor is a reversible inhibitor, therefore, platelet function normalizes when drug is cleared.</td>
</tr>
<tr>
<td>Glycoprotein Ib/IIa inhibitors</td>
<td>Eptifibatide (Integrilin®) Abciximab (ReoPro®) Tirofiban (Aggrastat®)</td>
<td>Binds to platelet Ib/IIa receptors, resulting in inhibiting platelet aggregation</td>
<td>E: 2.5 hrs A: 4 hrs T: 2 hrs</td>
<td>No Platelets</td>
<td>There is no reversal agent for glycoprotein Ib/IIa inhibitors. Given their short half-life, supportive care alone is recommended. 1. Discontinue the infusion 2. Consider DDAVP – 0.3 mcg/kg IV X 1 dose over 15 mins</td>
<td>*Consider platelet infusion (1 single donor/apheresis unit)</td>
<td>• Multiple dose of DDAVP can cause tachyphylaxis, hyponatremia and seizures</td>
</tr>
<tr>
<td>Medication</td>
<td>Mechanism of Action</td>
<td>Half-life</td>
<td>Reversal Agents</td>
<td>Laboratory Monitoring</td>
<td>Treatment</td>
<td></td>
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</tr>
<tr>
<td>Thrombin &amp; Fibrinolytic Inhibitors</td>
<td>Binding to plasminogen to inhibit fibrinolysis and inhibition of thrombin</td>
<td>45-90 minutes</td>
<td>Activated Protein C (APC) &amp; Protamine Sulfate</td>
<td>-</td>
<td>-</td>
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<td></td>
</tr>
<tr>
<td>3F-PC + 3 factor prothrombin complex concentrate (factor II, IX, and X)</td>
<td>4-10 hours</td>
<td>Activated Protein C (APC) &amp; Protamine Sulfate</td>
<td>-</td>
<td>-</td>
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</tbody>
</table>

**Reversal Agents**

- APC
- Protamine Sulfate

**Laboratory Monitoring**

- Activated clotting time
- Prothrombin time

**Treatment**

- Supportive care alone is recommended
- For life-threatening bleeds, 4F-PC + 4 factor prothrombin complex concentrate (factors II, V, VII, and X)
- APC + Protamine Sulfate

**Comments**

- Hemorrhagic complications have been reported with the use of APC/GPIb agonists. Some animal studies show that APC may prolong bleeding in patients on antiplatelet agents.
- Antifibrinolytic effects may last for 4-10 days depending on the agent used.
- Contact Hematology for additional guidance.

*Note: All treatments should be administered by trained medical professionals.*
## USE OF CONCENTRATED FACTORS IN THE OPERATING ROOM AND IN MASSIVE TRANSFUSION PROTOCOLS (MTP)

<table>
<thead>
<tr>
<th>Trauma MTP</th>
<th>Operating Room</th>
<th>Massive Bleeding:</th>
<th>Non-Trauma MTP</th>
<th>Operating Room</th>
<th>Patient on therapeutic Coumadin requiring emergency surgery:</th>
<th>Coagulopathy associated with significant blood loss/PRBC transfusion (&gt;6 units PRBC):</th>
<th>Coagulopathy associated with cardiac surgery:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1) PRBC, plasma and platelets should be administered in approximately 1:1:1 proportion during massive hemorrhage/transfusion per the trauma MTP protocol.</td>
<td>1) For patients on VKA, Xa inhibitors, or Direct Thrombin inhibitors with “major bleeding” Refer Perioperative Management Of Antithrombotic Therapy: Guidelines For Adult Inpatients.</td>
<td>1) If possible, ROTEM guided administration of blood products</td>
<td>1) ROTEM guided administration of blood products whenever possible</td>
<td>1) RRT.</td>
<td>1) RRT.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) Once surgical bleeding is under control ROTEM performed or if not available send PT/PTT/Fibrinogen/CBC to lab.</td>
<td>2) Anesthesiology team will ensure that reversal has been initiated prior to surgery when indicated.</td>
<td>2) After 6 Units FFP/3 Plt/10 Cryo Consider 4F-PCC* (Kcentra®) 25 units/kg</td>
<td>2) Persistent microvascular bleeding after 6 Units FFP/3 Plt/10 Cryo or inability to tolerate that much fluid Consider 4F-PCC* (Kcentra®) 25 units/kg</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>3) If hemodynamically unable to tolerate additional plasma administration Consider 4F-PCC* (Kcentra®) 25 units/kg</td>
<td>3) Anesthesiology team will ensure that reversal has been initiated prior to surgery when indicated.</td>
<td>3) After 6 Units FFP/3 Plt/10 Cryo Consider 4F-PCC* (Kcentra®) 25 units/kg</td>
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</tr>
</tbody>
</table>

- 4-F PCC is contraindicated in HIT/HTTS (as it contains heparin)
- Consider the following alternatives:
  - 3F-PCC (Profilnine®) 25 units/kg
Prothrombin Complex Concentrate (PCC-Profilnine), Kcentra

- Both 3-factor and 4-factor PCC are orderable through pharmacy starting from 2014.

**PCC is no longer available through the blood bank**

The following guidelines are for reference information only, please refer clinicians to Pharmacy (305-2777) for PCC requests.

**Indications**
- For warfarin reversal in patients with supratherapeutic INR and a life-threatening bleed (e.g., intracranial hemorrhage) or who require emergent surgery.

**Dosing**
- 25 units/kg dosed on total body weight (but capped at 100 kg)
- Maximum dose is 2500 units (for all patients >100 kg)
- Round to nearest vial size
- If repeat INR within 2 hours is >2, may re-dose with 25 unit/kg
- Consider administering ~2 units of plasma in addition to PCC

**Adjunctive Therapy**
1. Vitamin K: Patients with life-threatening bleed due to warfarin-induced supratherapeutic INR should receive Vitamin K 10 mg IVPB over 30 min
2. Plasma: Patients receiving PCC for life-threatening bleed should receive lower doses of plasma than when used alone. Consider 1-2 units of plasma as an adjunct to PCC
3. *DO NOT* use Factor VIIa in addition to PCC. 3-factor PCC results in significant reductions in INR. If adjunctive therapy is indicated (due to lack of factor VII in 3-factor PCC), supplement with the administration of FFP as described above.
Rh Immunoglobulin (WinRho & RhoGAM): ITP & Obstetrics

A. Idiopathic Thrombocytopenic Purpura:

A hematology consult is required.

We use WinRho SDF to treat ITP patients (IV administration).

**Adult ITP dosage:**
- 50-75 mcg/kg (250 – 375 IU/kg) for acute (i.e. 1st dose – can be split over 2 days)
- 25-60 mcg/kg (125 – 300 IU/kg) for subsequent doses

**Pediatric ITP dosage:**
- Same as in adults. However subsequent doses are not usually needed.

If hemoglobin is <10g/dL, use 25-40 mcg/kg (125 – 200 IU/kg).

**Important Notes:**
- Every WinRho request needs approval by the resident.
- Patient should be Rh positive (D+) and non-splenectomized in order to be qualify for WinRho.
- The blood bank has 1,500 IU (=300mcg) and vials of 5,000 IU (=1000mcg) in stock.
- Upon approving the request, the resident should tell the blood bank technologist the approved dose, BOTH in micrograms and in international units in order to prevent any confusion. Ask the technologist to read back your dose.

B: Suppression of Rh isoinmunization:

1. Obstetric patients:

We use RhoGAM to treat obstetrical patients (IM administration).

1 vial of RhoGAM= 300ug = enough RhIg to neutralize 15mL of red cells (or 30cc of whole blood).

Our RhoGAM protocol:

The Kleihauer-Betke (K-B) test can be used to quantitate the amount of fetal-maternal bleeding. This test is based on the principle that in the presence of acid, fetal red cells will maintain normal staining characteristics whereas adult red cells will appear as "ghosts." The number of fetal red cells present in the sample is determined by manual counting and is expressed as a percentage of the total red cells.

To calculate the number of vials of Rhogam required, the following rule-of-thumb is used:

\[
\text{# Vials Rhlg required} = \left( \frac{\text{Maternal blood volume (in cc)} \times \text{K-B}\%}{3000} \right) + 1
\]

Example: 70 Kg female; Fetal screen: Pos; K-B=0.4%

\[
\text{# Vials Rhlg required} = \left( \frac{4900\text{cc} \times 0.4\%}{3000} \right) + 1 = 0.65. \text{ Round-off to 1.0 } +1= 2 \text{ vials issued}
\]

The table provided below can also be used for Rhlg dosing.
### 1. Based on maternal blood volume of 5000 cc

2. 1 vial of 300 μg is needed for each 15 cc of fetal red cells or 30 cc of fetal whole blood

From *Technical Manual*, 16th Ed. Roback, JD et al.

### 2. Rh- female patients > 4 months of age through childbearing years exposed to Rh+ platelets:

We use RhIG to treat Rh- patients exposed to Rh+ platelet products to suppress Rh isoimmunization. RhIG is recommended for the suppression of Rh isoimmunization in Rh(D) negative female children and female adults in their childbearing years transfused with Rh(D)+ platelets. A 300 μg (1500 IU) dose will suppress the immunizing potential of approximately 15 mL of Rh(D)+ RBCs.

**Approximate number of RBCs in platelet products:**
- Single Donor Platelet Unit ~ 0.5mL RBCs
- Apheresis Platelets (6 unit dose) ~2-3mL RBCs

**Dosage:**
Administer 1 vial (300 μg) of rhogam within 72 hours after exposure to Rh(D)+ platelets.

### 3. Obstetric patients after miscarriage:

If a miscarriage occurs at 12 weeks or less, a 50 mcg dose of Rhogam is sufficient and a fetal screen is not necessary. However, if IUFD occurs in the second or third trimester, a 300 mcg dose (one vial) of Rhogam should be given AND a fetal screen should be done to determine need for further Rhogam. If the fetal blood type is not known and cord blood is not available, assume that it was Rh positive.

**References:**
Transfusion Reaction Workup

***FILL OUT THE PRELIMINARY TRANSFUSION REACTION FORM AND GIVE IT TO A BB SUPERVISOR WITHIN 1 BUSINESS DAY***

***TRANSFUSION REACTION NOTE SHOULD BE IN COPATH WITHIN 1 BUSINESS DAY OF RESIDENT BEING PAGED ABOUT THE REACTION***

***TRANSFUSION REACTION PAPERWORK CANNOT BE TAKEN OUT OF THE TM OFFICE (MAKE PHOTOCOPIES IF NEEDED)***

- The blood bank front desk will notify you of reported transfusion reactions after the initial workup has been completed (i.e. DAT, clerical check, and visual check for hemolysis) according to the SOP TS141.2 “Transfusion Reaction Investigation”.

- Document the following information in the call log when you receive the call:
  - Patient Name
  - Medical record number
  - Blood type
  - Type of product that was transfused (e.g. Leukoreduced, packed red cells)
  - Amount transfused
  - Patient’s symptoms
  - Timing of symptoms with transfusion
  - Pre and Post vital signs
  - Results of our laboratory workup
  - Clerical check
  - Visual check
  - DAT from pre- and post-transfusion patient blood samples, Hemoglobinemia on pre and post-transfusion blood samples, Urine Sample for hemoglobinuria, LFT’s, LDH, Haptoglobin
  - Premedication given
  - Therapy initiated after the reaction and the follow-up information about the effect of the therapy

- Call the floor and speak with the nurse or doctor reporting the reaction. Obtain a medical history, transfusion history (prior pregnancy and transfusions, irregular antibodies), and the events leading to the suspected transfusion reaction. A template for this purpose can be found on the Transfusion Medicine section of our CP website. Make sure they send the component bags even if empty and any other attached tubings/bags, compatibility slips with transfusion reaction information completed (paper attached to the component bags), and a post-transfusion blood sample to the blood bank for work up, if they have not already done so. Ask them to order and draw relevant labs: CBC, LFTs, LDH, haptoglobin, urinalysis and a CXR if needed. You are also encouraged to see the patient at the bedside and review the chart.

- Try to come up with a diagnosis based on the information you have gathered, and use your clinical judgment. The most important thing is to rule out an acute hemolytic transfusion reaction. Decide if it is worthwhile to culture the units. If you believe that there may have been an acute hemolytic transfusion reaction (e.g. transfusion of ABO-incompatible RBC), contact your attending.

- Interpretation and recommendations can be reserved until all laboratory testing is complete and the case has been review with an attending. In general, an extensive recommendation on treatment is not warranted at the time of the workup. Eventually, the Blood Bank and clinician will want to know whether the additional units of red cells or other component can be transfused.

- Fill out the Preliminary Transfusion Reaction form and give it to the Blood Bank supervisor. The transfusion reaction documentation should be put in the CP Call Log and printed for the following morning’s conference with all the required information. At the conference, the case can be discussed and reviewed. After presenting the transfusion reaction, give Dawn the “Transfusion Reaction Worksheet” so she can accession the case in CoPath. Once the case is in CoPath, enter the interpretation of the case in CoPath.
Transfusion Reaction Flowchart
Transfusion Reactions

Categories: Immunologic (Acute and Delayed), Non-immunologic (Acute and Delayed)

Acute (<24 hours) Immunologic Transfusion Reactions:

1) Hemolytic:
- Red cell antigen-antibody reaction (e.g. ABO incompatibility), may activate complement
- Sx: Chills, fever, hemoglobinemia, hemoglobinuria, hypotension, renal failure with oliguria, DIC, back pain, pain along infusion vein, anxiety, chest pain.
- Note: fever may be the only presenting sign of an acute hemolytic transfusion rxn.
- Clinician must stop transfusion immediately, and provide supportive care.

2) Febrile Nonhemolytic:
- Temperature increase more than 1C (1.8F).
- Leukocyte antigen-antibody reaction or infusion of cytokines that accumulate in bag during storage.
- Sx: Fever, chills/rigors, headache, vomiting, anxiety, mild dyspnea.
- Tx: Acetaminophen.

3) Allergic (mild):
- Antibody to soluble plasma proteins in donor plasma
- Sx: Hives, itching.
- Tx: Antihistamines

4) Allergic (severe):
- Antibody to soluble plasma proteins in donor plasma
- Sx: Hives, Dyspnea, Wheezing, local edema, abdominal pain, hypotension, nausea, anaphylaxis
- Tx: Epinephrine, corticosteroids, antihistamines, vasopressors, supportive care.
- Consider a diagnosis of IgA deficiency if recurrent anaphylaxis.

5) TRALI (Transfusion-related acute lung injury):
- Neutrophil-mediated endothelial damage, initiated by antibodies activating neutrophils directly or via activation of monocytes, pulmonary macrophages, and/or endothelial cells
- Sx: acute respiratory insufficiency, fever, chills, X-ray: bilateral pulmonary infiltrates.
- Tx: supportive care, patient and donor testing

Acute (<24 hours) Non-immunologic Transfusion Reactions:

1) Sepsis:
- Bacterial contamination of blood products (most frequently platelets).
- Sx: Sudden shock, fever, hypotension, tachycardia, N/V, dyspnea, DIC.
- Tx: Supportive therapy, blood cultures, antibiotics. Bag can be cultured.

2) Hypotension associated with ACE inhibition:
- Inhibited metabolism of bradykinin (ACE inhibitors, genetic polymorphisms), with infusion of bradykinin (negatively charged filters) or activators of prekallikerin. Most commonly occurs with platelet transfusions
- Sx: Flushing, hypotension, dyspnea, urticarial, N/V.
- Tx: Supportive care, IV fluids.

3) Circulatory Overload (TACO):
- Due to rapid increase in blood volume in patients with decreased cardiac/pulmonary function or euvolemic anemia.
- Sx: Dyspnea, orthopnea, cyanosis, tachycardia, increased venous pressure, hypertension, headache.
- Tx: Oxygen and diuretics. Reduce rate of transfusion.

4) Nonimmune Hemolysis:
- Physical or chemical destruction of blood; hypotonic IV solutions, overheating, freezing…
- Sx: Hemoglobinuria, hemoglobinemia, if severe- renal failure.

Other: Air embolus, Hypocalcemia, Hypothermia.

Delayed (>24 hours) Immunologic Transfusion Reactions:

1) Delayed Hemolytic:
- Amnestic antibody response to transfused red cells with hemolysis 3-14 days after transfusion (most common antigens: E, Jka, c, Fya, K).
- Sx: Fever, anemia, new positive antibody screen test, and mild jaundice.
- Tx: Transfuse compatible blood (antigen negative).

2) Graft vs. Host Disease:
- Donor lymphocytes engraft in recipient and mount attack on host tissues.
- Sx (1-2 weeks after transfusion): Erythrodema, maculopapular rash, fever, liver dysfunction, anorexia, nausea, vomiting, diarrhea, hepatitis, pancytopenia.

3) Posttransfusion Purpura:
- Recipient platelet antibodies destroy autologous platelets.
- Sx (8-10 days after transfusion): thrombocytopenic purpura, bleeding. Transfusions frequently associated with fever, chills, rigors, bronchospasm.
- Tx: IVIG. Test for platelet-specific antibodies.

Delayed (>24 hours) Non-Immunologic Transfusion Reactions:

1) Iron Overload:
   - Typically seen after greater than 100 red cell transfusions in transfusion dependent patients.
   - Sx: Diabetes, cirrhosis, cardiomyopathy.
   - Tx: Iron chelation therapy.
Antibody Panel Basics

One of the duties of the Components resident is to give a preliminary interpretation of antibody panels, which are ultimately signed out by the attending on service. Once a day, the Components resident should check: `\Archive\BBAccd`. This folder contains all of the accessioned antibody panels by Dawn Lewis-Roberts. The resident should determine the last panel to be signed out, and print out the panels succeeding that panel. Although every institution has its own rules for antibody panel interpretation and rule-out, useful guidelines/instructions can be found on pg 52, “Appendix 3-1. Method for Reagent RBC Panel Interpretation” in Practical Guide to Transfusion Medicine by Petrides et al.

Helpful Data to Gather Before Starting a Panel:
- History (one-liner) – Tells you why the patient was admitted.
- Type & Screen historically - Tells you when the patient became “antibody positive”
- Prior antibody panels under “Pathology” tab - Tells you if we have a history of antibodies. If there is a history of antibodies, the tech will use antigen-negative (for the antibody present) cells for testing
- Transfusions (check transfusion notes and OR report to see if got blood in OR) - Tells you source of new alloantibody and can explain if/why the tech did not phenotype the patient

How to Check Antibody & Phenotype in Wyndgate
Sometimes it can be useful to check antibody & phenotyping interpretation by the tech in Wyndgate after completing a panel rule-out.

Click Patient order
File ➔ Open ➔ Patient
Enter MRN ➔ click OK
Click on appropriate most recent Admission if this is the next option
Once inside specific patient file, click ABY
Under tab “Extended Typings”, this will give you the alloantibodies discovered and the phenotyping

How to Check Recent Transfusions in Wyndgate
In addition to checking transfusion notes and OR reports, another useful place is Wyndgate. Here, you will see what components were recently transfused.

Click Patient order
File ➔ Open ➔ Patient
Enter MRN ➔ click OK
Click on appropriate most recent Admission if this is the next option
Once inside specific patient file, click “I”
Look for Issued or Transfused units by code using the excel sheets in `\Archive\bloodbank\Components\Wyndgate Product Codes to determine which products were given.

Rule out/Rule in Rules
Normally, you can rule out an antibody when there is no reaction with one homozygous antigen-positive cell and can rule in antibody when there is a reaction on three antigen-positive cells and no reaction on three antigen-negative cells.

Examples of homozygous and heterozygous antigens:

<table>
<thead>
<tr>
<th></th>
<th>E</th>
<th>e</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heterozygous</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Homozygous</td>
<td>+</td>
<td>0</td>
</tr>
</tbody>
</table>

You CAN rule out Kell, C and E on heterozygous cells (C and E only if the patient has anti-D antibodies), but you must rule out Rh, Duffy, MNS, and Kidd on homozygous cells.

Ficin Treatment
Ficin treatment enhances the following antigens: Lewis, i, i, ABO, Rh, P and Jka, Jkb.
Ficin treatment decreases the following antigens: Duffy, MNS, Lutheran, Chido.

New Antibody
For every new antibody, the tech should phenotype the patient (if not transfused in the last 3 months) for that antigen to confirm that the patient is negative for the antigen and that it is not an auto-antibody.
The patient will get antigen-negative blood once an antibody is found IF the antibody reacts at 37 degrees and/or if the antibody reacts at AHG phase (this means it’s clinically significant).

Historical Antibody
When patients have a hx of antibodies, the techs will test on cells that are negative for those antigens (ie, they do a selected panel)

Antigen Phenotyping
For every new antibody, the tech should phenotype the patient for that antigen to confirm that the patient is negative for the antigen and that you are not dealing with an auto-antibody.
The exception to this rule is if the patient has been recently transfused (last 3 months)—the tech will not phenotype for risk of phenotyping transfused cells. A sample can be sent to the NYBC for molecular phenotyping.

+AC, - DAT
If the antibody panel shows a positive autocontrol with a negative DAT, this suggests that the agglutination of the autocontrol was not immunogenic in origin. It is not significant, so do not report it.

+DAT, - Eluate
Causes of a positive DAT and a negative Eluate are reviewed in the Hemolysis Algorithms on pp. 81 and are summarized here:
1. Drug induced: Drug binds to RBC → causes neoantigen formation & antibody formation → RBC binds antibody → do eluate on RBCs but test RBCs don’t have neoantigen so eluate is negative
2. Paroxysmal cold hemoglobinuria: IgG that binds at periphery where cold, binds complement and when central, loses IgG
3. Anti A, or Anti B: If a patient (eg, type A) is given ABO incompatible platelets (eg, type B), the little anti-A antibodies in the plasma of the platelets can bind to the type A RBCs, creating DAT+

Fisher-Race & Wiener Haplotypes

<table>
<thead>
<tr>
<th>Fisher-Race Haplotype</th>
<th>Wiener Haplotype</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dde</td>
<td>R1e</td>
<td>44/26/11</td>
</tr>
<tr>
<td>DDe</td>
<td>R1e</td>
<td>42/37/31</td>
</tr>
<tr>
<td>DDe</td>
<td>r'</td>
<td>42/37/26</td>
</tr>
<tr>
<td>DCe</td>
<td>r'</td>
<td>42/37/26</td>
</tr>
<tr>
<td>Ce</td>
<td>r'</td>
<td>42/37/26</td>
</tr>
<tr>
<td>Cc</td>
<td>r'</td>
<td>42/37/26</td>
</tr>
</tbody>
</table>

Ex: if patient is B+ and has allo c, E, then the possible genotypes are:
R1: DCe and R1: DCe => DCe
R1: DCe and r: dCe => DCe
To determine the percentage of random donor units that are compatible with a patient's blood type and screen, use the below table. For example, for a patient who is Rh+ and has an Anti-E, 69% of random donor units would be crossmatch compatible. If this same patient also had an Anti-K, use the Ortho Antibody Index Chart to calculate the percentage of random donor units that would be crossmatch compatible by looking up the percent Blood Compatibility for Whites. Multiply the percentage of one antibody by the other, for example: 0.69 [for Anti E] x 0.90 [for Anti K] = 0.62 → 62%.
## ORTHO* ANTIBODY INDEX CHART

<table>
<thead>
<tr>
<th>Blood Group System</th>
<th>Antibody</th>
<th>Common Reaction Mode</th>
<th>Transfusion Reaction</th>
<th>HDN</th>
<th>Reactivity With Enzyme Treated RBC</th>
<th>% Blood Compatibility Whites</th>
<th>Blacks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rh-hr</td>
<td>D</td>
<td>Probable</td>
<td>Probable</td>
<td>Probable</td>
<td>Common</td>
<td>Increased</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>Probable</td>
<td>Probable</td>
<td>Probable</td>
<td>Made</td>
<td>Increased</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>Probable</td>
<td>Probable</td>
<td>Probable</td>
<td>Common</td>
<td>Increased</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>V</td>
<td>Probable</td>
<td>Probable</td>
<td>Probable</td>
<td>May</td>
<td>Increased</td>
<td>100</td>
</tr>
<tr>
<td>Kell</td>
<td>K</td>
<td>Probable</td>
<td>Probable</td>
<td>Probable</td>
<td>May</td>
<td>Same</td>
<td>90</td>
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<tr>
<td></td>
<td>k</td>
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<td>Probable</td>
<td>Probable</td>
<td>May</td>
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<td>0.2</td>
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<td>Probable</td>
<td>Probable</td>
<td>May</td>
<td>Same</td>
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</tr>
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<td></td>
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<td>Probable</td>
<td>Probable</td>
<td>May</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td></td>
<td>Js</td>
<td>Probable</td>
<td>Probable</td>
<td>Probable</td>
<td>May</td>
<td>&gt;99</td>
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<td>Fya</td>
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<td>Probable</td>
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<td>May</td>
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<td>Probable</td>
<td>Probable</td>
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<td>Increased</td>
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<td>Lea</td>
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<td>Not usually</td>
<td>Not usually</td>
<td>Increased</td>
<td>78</td>
<td>82</td>
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<td></td>
<td>Leb</td>
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<td>Not usually</td>
<td>Not usually</td>
<td>Increased</td>
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<td>40</td>
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<tr>
<td>MNS</td>
<td>S</td>
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<td>Probable</td>
<td>May</td>
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<tr>
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<td>s</td>
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<td>Probable</td>
<td>Probable</td>
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<td>Variable</td>
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<td>Not usually</td>
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<td>22</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>N</td>
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<td>Not usually</td>
<td>Not usually</td>
<td>Decreased</td>
<td>28</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>U</td>
<td>Probable</td>
<td>Probable</td>
<td>Probable</td>
<td>May</td>
<td>Variable</td>
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<td>Not usually</td>
<td>Not usually</td>
<td>Increased</td>
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<td>Not usually</td>
<td>Not usually</td>
<td>Increased</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
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<tr>
<td></td>
<td>P+k</td>
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<td>Probable</td>
<td>Probable</td>
<td>May</td>
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<td>8</td>
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<td>Not usually</td>
<td>Probable</td>
<td>May</td>
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<td>HTLA</td>
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<td>Not usually</td>
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</tr>
<tr>
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<td>Kn</td>
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<td>Not usually</td>
<td>Probable</td>
<td>May</td>
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<td>Cs</td>
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<td>Not usually</td>
<td>Probable</td>
<td>May</td>
<td>Same</td>
<td>2</td>
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<td>Not usually</td>
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<td>May</td>
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<td>May</td>
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<td>Probable</td>
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<td>2</td>
</tr>
<tr>
<td></td>
<td>McC</td>
<td>Unlikely</td>
<td>Not usually</td>
<td>Probable</td>
<td>May</td>
<td>Same</td>
<td>7</td>
</tr>
</tbody>
</table>
Platelet Refractoriness Work Up Information/Consultation

General Indication for Platelet Refractoriness Work-up:
1. A patient is regarded as refractory to platelets if he/she fails to show an acceptable increment in platelet count 1 hour after transfusion on at least two separate occasions.
2. Increment is normalized by calculating the Correct Count Increment (CCI):

\[
CCI = (\text{Posttransfusion } [15-60\text{min}] \text{ PLT count} - \text{Pretransfusion PLT count}) \times BSA (m^2)
\]

An apheresis platelet bag has approximately 4x10^{11} platelets; BSA in a 70kg male is \sim 2m^2

CCI can be calculated on the CCI excel sheet in our bloodbank shared folder.

Severe refractoriness is defined as a CCI <5,000; Moderate refractoriness as CCI <7,500, and mild refractoriness as CCI <10,000.

3. All non-immune causes of refractory thrombocytopenia including consumption, drug-related and sequestration by the spleen should be considered in the differential diagnosis.

Instructions and Information:
A request for anti-HLA/anti-PLT antibody testing must be ordered on Allscripts. Then:

1. Fax the ordering clinician the “Platelet Refractoriness Work-Up” form (on Infonet search ‘platelet refractoriness’ or NYPH-465-27). All appropriate information must be completed and faxed back to the blood bank.

2. Utilizing the information provided on the form, calculate the one-hour post-transfusion CCI for the two trials provided.

3. If >7,500 STOP here.

4. If <7,500, examine the clinical history provided on form for other, non-immune causes of thrombocytopenia.

5. If no other clinical causes can be determined, ask the following questions:
   - Were “fresh” platelets used in transfusion? By fresh, we mean platelets that are about 3 days old. This may not always be possible.
   - Were ABO-matched platelets transfused? When assigning platelets to a patient, we prioritize release of those that are about to expire, with ABO-matching as a secondary concern. Matching for ABO may increase platelet circulation time.
   - This information is available in Wyndgate.

6. If the two alternatives in (5) have not already been tried, or you/your attending don’t believe this is practical based on inventory, approve testing to be sent out to the NYBC. The test requires 2 red top tubes of blood.

7. Results of testing will tell us if an immune mechanism is responsible for platelet refractoriness. The immune nature of the reaction will be further classified as mediated by anti-HLA or anti-PLT antibodies.

8. For either anti-HLA or anti-PLT antibodies, platelet crossmatch may be performed on units to help identify cross-match compatible units.

9. If anti-HLA antibodies are present in the patient, you may consider using HLA-matched platelet transfusions. This requires an HLA-type from the patient (if available, the results will be in the Suciu-Foca lab-56941).
Massive Transfusion Protocol (MTP): Adults

Massive transfusion is defined as a one blood volume transfusion over 24 hours and is most often associated with trauma, solid organ transplant, obstetrical emergencies, and surgical complications. Timely replacement of volume and oxygen carrying capacity in these situations is critical. However, due to the unexpected nature of these bleeds, providing blood products quickly without sacrificing patient safety is often a challenge. Furthermore, emerging evidence suggests volume resuscitation using a 1:1:1 ratio of pRBCs, FFP, and platelets improves patient survival (Shaz et al., 2009). For these reasons, the blood bank has a Massive Transfusion Protocol (MTP) in place.

The criteria that must be met to activate the MTP are:

- The patient must be currently exsanguinating and
- one blood volume transfusion over 24 hours, or
- 50% blood volume in 3 hours, or
- ongoing blood loss >150 ml/min, or
- >10 pRBC units in 24 hours must be anticipated or met
- As per SOP TS029

After the Massive Transfusion Protocol has been activated by the clinical team, the on-call CP resident will be notified by the blood bank staff. It is your responsibility to immediately call the clinical team and confirm:

- Patient MRN, location, clinical diagnosis and status.
- Name of MD ordering MTP to be documented as “Initiating Physician”.
- Provide your contact information and obtain contact information for clinical team to facilitate ongoing communication.
- Provide the physician with an overview of the protocol:
  - 6 units of blood, 1 dose of platelets, 6 units of FFP, 1 dose (5 pre-pooled units) of Cryo will be available in the blood bank at all times
  - Do not call when more products are desired, just send transport
  - FFP and cryo takes 30 minutes to thaw, so may be delayed at times, just keep sending transport to pick up products
  - Every 30-minutes follow up will be made between the on-call blood bank physician and the “Initiating Physician” to determine the efficacy of the released products and the need for additional products.
  - Any questions or problems, call on-call blood bank resident or attending.
  - Note: the blood bank front desk is going to be busy preparing products as fast as they can, so calls to them will slow down product release

The blood bank technologist will have begun preparing the following products:

- 6 unit ABO and Rh compatible pRBC
- 6 units ABO compatible FFP
- 1 dose of ABO compatible platelets (if available. If not see table 1 below).
- 1 dose (5 units prepoold) cryoprecipitate

The clinical team can either send a transport agent to pick up the products or can opt to use the pneumatic tubing system (2 units at a time). Only one call will be made to inform the team that the MTP-package is ready. No calls will be made for additional packages prepared. A pickup slip (tubed, faxed, or generated electronically) is still needed.

If a valid ABO is not available, the same amount of products will be released based on emergency release protocol

- 6 unit O-negative pRBC for young females and O-positive pRBCs for males and older (post-menopausal) women.
- 6 units AB FFP
- 1 dose of platelets
  - The first choice for platelets should be RH negative for females and RH positive for males. If inventory does not permit – RH positive platelets will be issued.

Table 1. Choice of Platelets

<table>
<thead>
<tr>
<th>First choice</th>
<th>Second choice</th>
<th>Third choice</th>
<th>Fourth choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB</td>
<td>A</td>
<td>B</td>
<td>O</td>
</tr>
</tbody>
</table>

1 dose of cryo (5 pre-pooled units)

If the patient has a history of allo-antibodies and there is not enough blood for appropriate cross-matching

- Ask the clinical team for 2 additional pink top tubes to blood bank
- Choose the appropriate red cell phenotype for the patient after discussion with you attending.
The blood bank will then prepare pre-designated packages of components with a 1:1:1 ratio of pRBCs:FFP:platelets without additional requests from the clinical team or from you:

- At least 6 units of pRBC, 6 units of compatible FFP, and 1 dose of platelets shall be available at all times for pick up until the MTP has been terminated.
- No call will be made to the clinical team when these additional packages are ready.
- NovoSeven®RT usage requires a specific request from the clinical team with consult and approval from the blood bank resident or attending.

**Terminating the MTP**

- If no blood products are picked up in a 4 hour period, MTP will automatically be terminated.
- Ask the clinical team to draw appropriate labs (CBC, PT/PTT/Fibrinogen, iCal, D-Dimer, pH) after infusion of every other transfusion package to appropriately monitor progress.
- The on-call blood bank physician will follow up with the clinical team q30 minutes to determine the efficacy of the released products and the need for additional products. You can make appropriate recommendations/modifications to the protocol based on recent lab values.
- The designated “Initiating Physician” or the on-call blood bank physician will notify the blood bank when the MTP is terminated.

Don’t forget to:

- Log in all MTP requests in the MTP LOG
- DOCUMENT the name of the physician deactivating the MTP.
Massive Transfusion:
Pediatric Patients

This is not a formal protocol. Rather it is a guideline.

<table>
<thead>
<tr>
<th>Weight (kg)</th>
<th>RBC</th>
<th>Plasma</th>
<th>Platelets</th>
<th>Cryo</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–10</td>
<td>1–2 units</td>
<td>1–2 units</td>
<td>50–100 ml</td>
<td>15–30 ml</td>
</tr>
<tr>
<td>11–25</td>
<td>2–3 units</td>
<td>2–3 units</td>
<td>100 ml</td>
<td>30–50 ml</td>
</tr>
<tr>
<td>≥26</td>
<td>5 units</td>
<td>5 units</td>
<td>1 dose</td>
<td>1 predosed dose</td>
</tr>
</tbody>
</table>

Rather than sending a courier to retrieve products, the Blood Bank will tube products to CHONY. A pickup slip (tubed, faxed, or generated electronically) is still needed.

Massive Transfusion:
AB Patients

Non-transplantation:

For a massively bleeding patient who is blood group AB, you might be paged to switch the patient from AB FFP to A FFP after s/he has received at least 6 units of A RBCs. Discuss with the team and consult with TM attending as deemed necessary.

Transplantation:

These transplants typically do not come to the attention of the BB resident/fellow, unless some sort of ABO switching is being contemplated. For example in a massively bleeding AB heart transplant recipient, the decision may be made to transfuse ≥10 A-type pRBCs followed by A-type FFP, because of low AB FFP inventory. However this may be a problem if the heart is from a B-type donor. In the specific example presented, it may be a better choice to transfuse B type pRBCs and follow with B type FFP in order not to increase the risk of AMR in the donor heart due to passively transfused isohemagglutinins in FFP. Therefore, before switching the ABO type for transfusion, the resident/fellow should ascertain ABO type of the donor and only then decide on the future course of action. Consult with TM attending as deemed necessary.
### Transfusion of products based on ABO status of recipient and donor in BMT

<table>
<thead>
<tr>
<th>Recipient</th>
<th>Donor</th>
<th>Phase I</th>
<th>Phase II</th>
<th>Phase III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>All Components</td>
<td>pRBC</td>
<td>1st choice Platelets</td>
</tr>
<tr>
<td>O</td>
<td>A</td>
<td>RECIPIENT</td>
<td>O</td>
<td>A</td>
</tr>
<tr>
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<tr>
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<td>AB</td>
</tr>
<tr>
<td>A</td>
<td>O</td>
<td>RECIPIENT</td>
<td>O</td>
<td>A</td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>RECIPIENT</td>
<td>O</td>
<td>AB</td>
</tr>
<tr>
<td>A</td>
<td>AB</td>
<td>RECIPIENT</td>
<td>A</td>
<td>AB</td>
</tr>
<tr>
<td>B</td>
<td>O</td>
<td>RECIPIENT</td>
<td>O</td>
<td>B</td>
</tr>
<tr>
<td>B</td>
<td>A</td>
<td>RECIPIENT</td>
<td>O</td>
<td>AB</td>
</tr>
<tr>
<td>B</td>
<td>AB</td>
<td>RECIPIENT</td>
<td>B</td>
<td>AB</td>
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<tr>
<td>AB</td>
<td>O</td>
<td>RECIPIENT</td>
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<td>AB</td>
</tr>
<tr>
<td>AB</td>
<td>A</td>
<td>RECIPIENT</td>
<td>A</td>
<td>AB</td>
</tr>
<tr>
<td>AB</td>
<td>B</td>
<td>RECIPIENT</td>
<td>B</td>
<td>AB</td>
</tr>
</tbody>
</table>

Platelet products should be selected in the order presented. Phase 1= Prior to bone marrow/hematopoietic stem cell transplantation; Phase II= from the time of BMT/HSCT until (1) for pRBCs, DAT is Neg and antidonor isohemagglutinin is no longer detectable (ie. Back type is donor type) or (2) for FFP, recipient’s erythrocytes are no longer detectable (ie. The front type is consistent with donor’s ABO type); Phase III= after the front and back type of the patient are consistent with donor’s ABO type. (Modified from *Technical Manual*, 16th Ed, Roback, JD et al.).
### ABO Non-Identical BMT/HCST: Blood Transfusion Guidelines

Transfusion of red cell containing products based on Rh (D) status of recipient and donor:

<table>
<thead>
<tr>
<th>RECIPIENT</th>
<th>DONOR</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rh (D)-POS</td>
<td>Rh (D)-NEG</td>
</tr>
<tr>
<td>Rh (D)-POS</td>
<td>Select Rh (D) pos pRBC, platelets</td>
<td>Select Rh (D) neg pRBC, platelets</td>
</tr>
<tr>
<td>Rh (D)-NEG</td>
<td>Select Rh (D) neg pRBC, platelets**</td>
<td>Select Rh (D) neg pRBC, platelets</td>
</tr>
</tbody>
</table>

** After the patient has engrafted and front types as Rh (D)-positive, Rh (D)-positive red cell containing products may be issued.

Anti-A/B Titration & Blood Transfusion (ABO-incompatible Transplant Protocols):

**ABO-Incompatible Kidney Transplant Protocol**

- Pink Top tube (≥3cc of blood) with signature, ≥ 2 patient identifiers & test requisition are required for ABO testing/titration.
- Page Transfusion medicine resident/fellow at 85838 when ABOi transplant is being considered. Provide donor ABO type (including A subtype, if known).
- Transfusion medicine resident/fellow will communicate information to BB staff in order to prepare appropriate blood products.

**Procedure:**

1. As soon as it is determined that a patient is a candidate for an ABOi kidney transplant, the transplant service will fill out the “Anti A/B titer Request” form (on Infonet search ‘A-B titer’ or ‘NYPH-465-12’) and fax it to the Blood bank.

2. The following testing will be performed.

**Table 1. Testing**

<table>
<thead>
<tr>
<th>Recipient</th>
<th>Donor</th>
<th>Testing Performed (IgM and IgG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>AB</td>
<td>Anti-A and Anti-B</td>
</tr>
<tr>
<td>O</td>
<td>B</td>
<td>Anti-B</td>
</tr>
<tr>
<td>O</td>
<td>A</td>
<td>Anti-A</td>
</tr>
<tr>
<td>B</td>
<td>AB</td>
<td>Anti-A</td>
</tr>
<tr>
<td>B</td>
<td>A</td>
<td>Anti-A</td>
</tr>
<tr>
<td>A</td>
<td>AB</td>
<td>Anti-B</td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>Anti-B</td>
</tr>
</tbody>
</table>

3. Titer testing schedule (Table 2)

Routine titration will be performed during the day shift on Tuesday & Thursday. After baseline titering results are available, the nephrology/transplant service and the Blood bank will finalize plasmapheresis schedule for the patient.

4. Testing post-transplant will require a new “Anti A/B titer Request” form and Transfusion Medicine approval (check “post-transplant” on titer request form)
### Table 2: ABO-incompatible Kidney transplant titration protocol

<table>
<thead>
<tr>
<th>Testing</th>
<th>Timing (Frequency)</th>
<th>Technique</th>
<th>Result Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline (pre-plasma-pheresis)</td>
<td>ROUTINE</td>
<td>Dilutions (maximal dilution if indicated, 1:512)</td>
<td>Titration result</td>
</tr>
<tr>
<td>Plasma-pheresis Midpoint</td>
<td>ROUTINE</td>
<td>Dilutions (maximal dilution if indicated, 1:128)</td>
<td>Titration result</td>
</tr>
<tr>
<td>Immediate Pre-transplant (post-</td>
<td>STAT</td>
<td>Limited Titration (1:16)</td>
<td>POS/NEG at 1:16</td>
</tr>
<tr>
<td>plasmapheresis treatment)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-Operative*</td>
<td>ROUTINE</td>
<td>Limited Titration (1:128)</td>
<td>POS/NEG at 1:128</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Most frequent schedule: NO more than once per week (with persistent AMR)
Table 3: Recommended Intra and post-operative blood product use for ABOi Kidney Transplant:

<table>
<thead>
<tr>
<th>Recipient</th>
<th>Donor</th>
<th>pRBC</th>
<th>FFP First Choice</th>
<th>FFP Second Choice</th>
<th>Platelets** First Choice</th>
<th>Platelets** Second Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>A</td>
<td>O</td>
<td>AB</td>
<td>A</td>
<td>A</td>
<td>AB</td>
</tr>
<tr>
<td>O</td>
<td>B</td>
<td>O</td>
<td>AB</td>
<td>B</td>
<td>B</td>
<td>AB</td>
</tr>
<tr>
<td>O</td>
<td>AB</td>
<td>O</td>
<td>AB</td>
<td>A</td>
<td>AB</td>
<td>A</td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>A or O</td>
<td>AB</td>
<td>A</td>
<td>AB</td>
<td>B</td>
</tr>
<tr>
<td>A</td>
<td>AB</td>
<td>A or O</td>
<td>AB</td>
<td>A</td>
<td>AB</td>
<td>A</td>
</tr>
<tr>
<td>B</td>
<td>A</td>
<td>B or O</td>
<td>AB</td>
<td>B</td>
<td>AB</td>
<td>A</td>
</tr>
<tr>
<td>B</td>
<td>AB</td>
<td>B or O</td>
<td>AB</td>
<td>B</td>
<td>AB</td>
<td>B</td>
</tr>
</tbody>
</table>

**Platelets will be provided primarily based on inventory. When available, type specific platelets will be supplied.
Anti-A/B Titration & Blood Transfusion: ABO-Incompatible Heart Transplant Protocol

- Pink Top tube (>3cc of blood) with signature, > 2 patient identifiers & test requisition are required for ABO testing/titration.
- Page Transfusion medicine resident/fellow at 85838 at the time of listing.
- Page Transfusion medicine resident/fellow at 85838 as soon as donor ABO type is known (including A subtype if available).
- Transfusion medicine resident/fellow will communicate information to BB staff in order to prepare/order appropriate blood products and titers.

Procedure:
1. As soon as it is determined that a patient is a candidate for an ABOi heart transplant, the transplant/pediatric cardiology service will fill out the "Anti A/B titer Request" form (on Infonet search 'A-B titer' or 'NYPH-465-12') and fax it to the Blood bank.
2. The following testing will be performed during the pre-transplant period.

Table 1A: Pre-transplant testing

<table>
<thead>
<tr>
<th>Patient</th>
<th>Testing Performed (IgM) - Immediate Spin</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>Anti-A and Anti-B</td>
</tr>
<tr>
<td>A</td>
<td>Anti-B</td>
</tr>
<tr>
<td>B</td>
<td>Anti-A</td>
</tr>
</tbody>
</table>

Table 1B: Immediate pre-op, Intra-op and Post-transplant testing

<table>
<thead>
<tr>
<th>Recipient</th>
<th>Donor</th>
<th>Testing Performed (IgM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>AB</td>
<td>Anti-A and Anti-B</td>
</tr>
<tr>
<td>O</td>
<td>B</td>
<td>Anti-B</td>
</tr>
<tr>
<td>O</td>
<td>A</td>
<td>Anti-A</td>
</tr>
<tr>
<td>B</td>
<td>AB</td>
<td>Anti-A</td>
</tr>
<tr>
<td>B</td>
<td>A</td>
<td>Anti-A</td>
</tr>
<tr>
<td>A</td>
<td>AB</td>
<td>Anti-B</td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>Anti-B</td>
</tr>
</tbody>
</table>

3. Titer testing schedule (Table 2)
   - Routine titration will be performed during the day shift on Tuesday & Thursday.
   - All preop titration (except baseline) will report titer as POS or NEG at 1:32 dilution.
   - Listing titer will be done stat only if testing cannot be delayed for next routine titration day (e.g. need to list on weekend)
   - All intra-operative and post-transplant testing will be performed by back typing immediate spin. On post-op samples which are positive, full titers will be performed on Tue/Thur, while rest of the week, limited titration at 1:32 dilution will be performed.

4. Testing >14 days post-transplant: will require a new "Anti A/B titer Request" form and Transfusion Medicine approval (check "post-transplant" on titer request form). After test approval, Routine full titer will be done once a week for 4 consecutive weeks (Tuesday or Thursday) and then monthly if necessary.
## Table 2: ABO-incompatible heart transplant titration protocol

<table>
<thead>
<tr>
<th>Testing</th>
<th>Timing (Frequency)</th>
<th>Technique</th>
<th>Result Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>At listing</td>
<td>STAT (if cannot be delayed for routine testing)</td>
<td>Limited Titration (1:32)</td>
<td>POS/NEG at 1:32</td>
</tr>
<tr>
<td>Baseline</td>
<td>ROUTINE</td>
<td>Dilutions (maximum dilution if indicated, 1:512)</td>
<td>Titration result</td>
</tr>
<tr>
<td>Pre-transplant (while on organ waitlist)</td>
<td>ROUTINE (q month until transplant)</td>
<td>Limited Titration (1:32)</td>
<td>POS/NEG at 1:32</td>
</tr>
<tr>
<td>Immediate Pre-transplant</td>
<td>ROUTINE</td>
<td>Limited Titration (1:32)</td>
<td>POS/NEG at 1:32</td>
</tr>
<tr>
<td>Intra-operative</td>
<td>STAT (Turn around time 20 min)</td>
<td>Back Type Immediate Spin</td>
<td>POS/NEG <strong>Call OR with results</strong></td>
</tr>
<tr>
<td>Post-operative</td>
<td>ROUTINE</td>
<td>Back Type Immediate Spin</td>
<td>POS*/NEG Titration result</td>
</tr>
<tr>
<td>1) 6 hours</td>
<td>Tues and Thurs</td>
<td>Full titer</td>
<td>POS*/NEG *Limited titration (1:32)</td>
</tr>
<tr>
<td>2) 2-14 days</td>
<td>Daily: Rest of the week</td>
<td>Back Type Immediate Spin</td>
<td>POS*/NEG *Limited titration (1:32)</td>
</tr>
</tbody>
</table>
Table 3: Recommended Intra and post-operative blood product use

*Platelets will be provided primarily based on inventory. BB physician will have to make a decision based on transfusion needs of the recipient, supply etc

<table>
<thead>
<tr>
<th>Donor</th>
<th>Recipient</th>
<th>Plasma</th>
<th>RBCs</th>
<th>Platelets</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB</td>
<td>O</td>
<td>AB</td>
<td>O</td>
<td>AB</td>
</tr>
<tr>
<td>B</td>
<td>O</td>
<td>AB or B</td>
<td>O</td>
<td>AB or B</td>
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<tr>
<td>A</td>
<td>O</td>
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<td>O</td>
<td>AB or A</td>
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<td>AB</td>
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<td>AB</td>
<td>O or B</td>
<td>AB</td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>AB</td>
<td>O or B</td>
<td>AB</td>
</tr>
<tr>
<td>AB</td>
<td>A</td>
<td>AB</td>
<td>O or A</td>
<td>AB</td>
</tr>
<tr>
<td>B</td>
<td>A</td>
<td>AB</td>
<td>O or A</td>
<td>AB</td>
</tr>
</tbody>
</table>
Anti-A/B Titration & Blood Transfusion: ABO-Incompatible Liver Transplant Protocol

- Pink Top tube (>3cc of blood) with signature, ≥ 2 patient identifiers & test requisition are required for ABÒ testing/titration.
- Page Transfusion medicine resident/fellow at 85838 at the time of listing.
- Page Transfusion medicine resident/fellow at 85938 as soon as donor ABO type is known (including A subtype, if known).
- Transfusion medicine resident/fellow will communicate information to BB staff in order to prepare/order appropriate blood products and titers.

Procedure:

1. As soon as it is determined that a patient is a candidate for an ABOi liver transplant, the transplant service will fill out the “Anti A/B titer Request” form (on Infonet search ‘A-B titer’ or ‘NYPH-465-12’) and fax it to the Blood bank.

2. The following testing will be performed during the pre-transplant period.

Table 1A: Pretransplant testing

<table>
<thead>
<tr>
<th>Patient</th>
<th>Testing Performed (IgM and IgG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>Anti-A and Anti-B</td>
</tr>
<tr>
<td>A</td>
<td>Anti-B</td>
</tr>
<tr>
<td>B</td>
<td>Anti-A</td>
</tr>
</tbody>
</table>

Table 1B: Immediate preoperative & post-transplant testing

<table>
<thead>
<tr>
<th>Recipient</th>
<th>Donor</th>
<th>Testing Performed (IgM and IgG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>AB</td>
<td>Anti-A and Anti-B</td>
</tr>
<tr>
<td>O</td>
<td>B</td>
<td>Anti-B</td>
</tr>
<tr>
<td>O</td>
<td>A</td>
<td>Anti-A</td>
</tr>
<tr>
<td>B</td>
<td>AB</td>
<td>Anti-A</td>
</tr>
<tr>
<td>B</td>
<td>A</td>
<td>Anti-A</td>
</tr>
<tr>
<td>A</td>
<td>AB</td>
<td>Anti-B</td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>Anti-B</td>
</tr>
</tbody>
</table>

3. Titer testing schedule (Table 2)

Routine titration will be performed during the day shift on Tuesday & Thursday. Immediate preoperation titration will be performed retrospectively on the next available day shift.

4. Testing post-transplant will require a new “Anti A/B titer Request” form and Transfusion Medicine approval (check "post-transplant" on titer request form)
Table 2: ABO-incompatible liver transplant titration protocol

<table>
<thead>
<tr>
<th>Testing</th>
<th>Timing (Frequency)</th>
<th>Technique</th>
<th>Result Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>ROUTINE</td>
<td>Dilutions (maximal dilution if indicated, 1:512)</td>
<td>Titration result</td>
</tr>
<tr>
<td>Pre-transplant (while on organ waitlist)</td>
<td>ROUTINE (q monthly until transplant)</td>
<td>Limited Titration (1:128)</td>
<td>POS/NEG at 1:128</td>
</tr>
<tr>
<td>Immediate Pre-transplant</td>
<td>ROUTINE</td>
<td>Limited Titration (1:128)</td>
<td>POS/NEG at 1:128</td>
</tr>
<tr>
<td>Post-Operative* Only if there is evidence for graft dysfunction and evidence of antibody mediated rejection/pending pathology</td>
<td>ROUTINE</td>
<td>Limited Titration (1:128)</td>
<td>POS/NEG at 1:128</td>
</tr>
</tbody>
</table>

*Most frequent schedule NO more than once per week (with persistent AMR)
Table 3: Recommended Intra and post-operative blood product use for ABOi liver:

<table>
<thead>
<tr>
<th>Recipient</th>
<th>Donor</th>
<th>pRBC</th>
<th>FFP First Dose*</th>
<th>FFP Second Dose</th>
<th>Platelets** First Dose</th>
<th>Platelets** Second Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>A</td>
<td>O</td>
<td>AB</td>
<td>A</td>
<td>A</td>
<td>AB</td>
</tr>
<tr>
<td>O</td>
<td>B</td>
<td>O</td>
<td>AB</td>
<td>B</td>
<td>B</td>
<td>AB</td>
</tr>
<tr>
<td>O</td>
<td>AB</td>
<td>O</td>
<td>AB</td>
<td>A or B</td>
<td>AB</td>
<td>A or B</td>
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<tr>
<td>A</td>
<td>B</td>
<td>A or O</td>
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<td>A</td>
<td>AB</td>
<td>A or O</td>
<td>AB</td>
<td>A</td>
<td>AB</td>
<td>A</td>
</tr>
<tr>
<td>B</td>
<td>A</td>
<td>B or O</td>
<td>AB</td>
<td>B</td>
<td>AB</td>
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<td>AB</td>
<td>B or O</td>
<td>AB</td>
<td>B</td>
<td>AB</td>
<td>B</td>
</tr>
</tbody>
</table>

*First dose refers to the first 10 units set up for the surgery.
**Platelets will be provided primarily based on inventory. When available, type specific platelets will be supplied.
# Apheresis

## ASFA Guidelines 2013 Summary

<table>
<thead>
<tr>
<th>Disease name</th>
<th>TA Modality</th>
<th>Disease condition</th>
<th>Category</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute disseminated encephalomyelitis</td>
<td>TPE</td>
<td></td>
<td>II</td>
<td>2C</td>
</tr>
<tr>
<td>Acute inflammatory demyelinating polyneuropathy (Guillain-Barre Syndrome)</td>
<td>TPE</td>
<td>Post IVIG</td>
<td>I</td>
<td>1A</td>
</tr>
<tr>
<td>Acute liver failure</td>
<td>TPE</td>
<td></td>
<td>III</td>
<td>2B</td>
</tr>
<tr>
<td>Age related macular degeneration, dry</td>
<td>Rhoopheresis</td>
<td></td>
<td>I</td>
<td>1B</td>
</tr>
<tr>
<td>Amyloidosis, systemic</td>
<td>TPE</td>
<td></td>
<td>IV</td>
<td>2C</td>
</tr>
<tr>
<td>Amyotrophic lateral sclerosis</td>
<td>TPE</td>
<td></td>
<td>IV</td>
<td>1C</td>
</tr>
<tr>
<td>ANCA-associated rapidly progressive glomerulonephritis (Granulomatosis with polyangiitis; Wegener’s Granulomatosis)</td>
<td>TPE</td>
<td>Dialysis dependence</td>
<td>I</td>
<td>1A</td>
</tr>
<tr>
<td>TPE</td>
<td>DAH</td>
<td>I</td>
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<td></td>
</tr>
<tr>
<td>TPE</td>
<td>Dialysis independence</td>
<td>III</td>
<td>2C</td>
<td></td>
</tr>
<tr>
<td>Anti-glomerular basement membrane disease (Goodpasture’s syndrome)</td>
<td>TPE</td>
<td>Dialysis dependent and no DAH</td>
<td>II</td>
<td>2B</td>
</tr>
<tr>
<td>TPE</td>
<td>DAH</td>
<td>I</td>
<td>1C</td>
<td></td>
</tr>
<tr>
<td>TPE</td>
<td>Dialysis independence</td>
<td>I</td>
<td>1B</td>
<td></td>
</tr>
<tr>
<td>Aplastic anemia; pure red cell aplasia</td>
<td>TPE</td>
<td>Aplastic anemia</td>
<td>III</td>
<td>2C</td>
</tr>
<tr>
<td>TPE</td>
<td>Pure red cell aplasia</td>
<td>III</td>
<td>2C</td>
<td></td>
</tr>
<tr>
<td>Autoimmune hemolytic anemia: WAHA; cold agglutinin disease</td>
<td>TPE</td>
<td>Severe WAHA</td>
<td>III</td>
<td>2C</td>
</tr>
<tr>
<td>TPE</td>
<td>Severe cold agglutinin disease</td>
<td>II</td>
<td>2C</td>
<td></td>
</tr>
<tr>
<td>Babesia</td>
<td>RBC exchange</td>
<td>Severe</td>
<td>I</td>
<td>1C</td>
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**Nursing Schedule**

**NYP-CUMC Apheresis Nursing Schedule:**
Monday - Friday: 8:00AM – 9:30PM; Sunday: 9:00AM – 4:00PM
Saturday and off-hours → Must call NYBC (previously Coral) Blood Services: 800-483-4888

Call attending to confirm that this is an emergency and cannot be scheduled during regular hours.

**Evaluation:**

**What do I do when I get a call requesting Apheresis treatment?**

Elicit a detailed history from the requesting MD and assess if apheresis is the appropriate modality of treatment for the patient. The American Society for Apheresis (ASFA) has published guidelines reflecting the current thinking regarding the efficacy of apheresis for various clinical entities. Diseases are assigned to one of four categories based on available studies in the literature (ASFA 2013 guidelines):

- **Category I:** Standard acceptable therapy
- **Category II:** Sufficient evidence to suggest efficacy usually as adjunctive therapy
- **Category III:** Inconclusive evidence of efficacy or uncertain risk/benefit ratio
- **Category IV:** Lack of efficacy in controlled trials

Discuss the case with your TM attending, and if the decision is made to go ahead with apheresis, discuss the following with requesting MD.

1) **Referral form/Consent/Orders:** Ask referring MD to fill out the Apheresis referral form (on Infnonet search 'hemotherapy' or 'NYPH-465-14'). The apheresis resident should obtain an Apheresis Consent prior to initiating the procedure. See apheresis section below for complications to mention and discuss when obtaining consent. The resident consenting the patient should sign the form next to the patient signature where it says ‘witness.’ Use NYP Translator Services (305-9607) or a telephone translator (800-876-3059, access code 836135) if needed; document their use on the consent form with their name and translator number. If obtaining telephone consent, you must have another physician witness the conversation. Modify the consent as necessary if clinically indicated. For example, if the patient is unstable and requires emergency apheresis, add in a sentence saying, “although rare, death is a possible complication of the apheresis procedure.” Also, include a blood product consent form if plasma or RBCs are to be used as prime or replacement fluid. You will need to order the blood product from BB. You will also need to write apheresis orders calculating exchange volumes using the Plasma Exchange or RBC Exchange excel files, which are located in the Bloodbank\Apheresis shared folder. Any errors or changes on consents or order forms need to be crossed out with a single line, initialed and dated.

**TABLE IV, Continued**

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<td>Systemic lupus erythematosus</td>
<td>TPE</td>
<td>Severe</td>
<td>II</td>
<td>2C</td>
</tr>
<tr>
<td></td>
<td>TPE</td>
<td>Nephritis</td>
<td>IV</td>
<td>1B</td>
</tr>
<tr>
<td>Thrombocytosis</td>
<td>Thrombocytapheresis</td>
<td>Symptomatic</td>
<td>II</td>
<td>2C</td>
</tr>
<tr>
<td></td>
<td>Thrombocytapheresis</td>
<td>Prophylactic or secondary</td>
<td>II</td>
<td>2C</td>
</tr>
<tr>
<td>Thrombotic microangiopathy, drug associated</td>
<td>TPE</td>
<td>Ticlopidine</td>
<td>I</td>
<td>1B</td>
</tr>
<tr>
<td></td>
<td>TPE</td>
<td>Clopidogrel</td>
<td>III</td>
<td>2B</td>
</tr>
<tr>
<td></td>
<td>TPE</td>
<td>Cyclosporine/ Tacrolimus</td>
<td>III</td>
<td>2C</td>
</tr>
<tr>
<td></td>
<td>TPE</td>
<td>Granulocyte recovery</td>
<td>IV</td>
<td>2C</td>
</tr>
<tr>
<td></td>
<td>TPE</td>
<td>Quinine</td>
<td>IV</td>
<td>2C</td>
</tr>
<tr>
<td>Thrombotic microangiopathy, HSCT associated</td>
<td>TPE</td>
<td>Refractory</td>
<td>III</td>
<td>2C</td>
</tr>
<tr>
<td>Thrombotic thrombocytopenic purpura</td>
<td>TPE</td>
<td></td>
<td>I</td>
<td>1A</td>
</tr>
<tr>
<td>Thyroid storm</td>
<td>TPE</td>
<td></td>
<td>III</td>
<td>2C</td>
</tr>
<tr>
<td>Toxic epidermal necrolysis</td>
<td>TPE</td>
<td>Refractory</td>
<td>III</td>
<td>2B</td>
</tr>
<tr>
<td>Voltage-gated potassium channel antibodies</td>
<td>TPE</td>
<td></td>
<td>II</td>
<td>1C</td>
</tr>
<tr>
<td>Wilson disease</td>
<td>TPE</td>
<td>Fulminant</td>
<td>I</td>
<td>1C</td>
</tr>
</tbody>
</table>

DAAH — diffuse alveolar hemorrhage; HSCT — hematopoietic stem cell transplant; PANDAS — pediatric autoimmune neuropsychiatric disorders associated with streptococcal infections; POEMS — polyneuropathy, organomegaly, endocrinopathy, M protein, and skin changes; PML — progressive multifocal leukoencephalopathy; WAHA — warm autoimmune hemolytic anemia.
2) **Patient location:** Patients need a hospital bed in order to undergo therapeutic apheresis. Patients with AMR of Heart transplants should be on cardiac monitor or in an ICU. In instances where patients with AMR heart get transferred to the floor you need to request that they remain on cardiac monitor hooked up in the room.

3) **Vascular Access:** If the patient has a functional graft/fistula (used for dialysis), it may also be used for apheresis. In patients without a graft/fistula, a Vascath needs to be placed to support the high flow rates (60-110 cc/min) used in automated apheresis procedures. It is important to inform the contracted apheresis nursing service on the type of access. If an internal jugular or subclavian line is placed (by a service other than IR), it needs to be **radiographed** prior to the procedure and a General Nursing Order indicating that it is OK to use for apheresis should be placed in the patient chart. In emergency cases, especially with RBC exchange or leukopheresis, a femoral line is recommended (no need for X-ray confirmation).

<table>
<thead>
<tr>
<th>Weight (Kg)</th>
<th>Catheter Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>7 FR MedComp</td>
</tr>
<tr>
<td>10-20</td>
<td>8 FR MedComp or 8 FR Mahurkar</td>
</tr>
<tr>
<td>20-50</td>
<td>9 FR MedComp or 10 FR Mahurkar</td>
</tr>
<tr>
<td>&gt;50</td>
<td>9 FR MedComp or 11.5 FR Mahurkar</td>
</tr>
<tr>
<td>Adult</td>
<td>13.5 FR Mahurkar, Adult PermCath, Adult VasCath</td>
</tr>
</tbody>
</table>

**Transfusion Needles**

- **Pediatrics**: 22 gauge for kids
  - 24 gauge for neonates/preemies
- **Adults**: 16/18 gauge for high risk ante/post partum
  - 18/20 gauge for adults (19 gauge Huber (non-coring) needle for ports)

4. **Request appropriate laboratory testing:** The typical apheresis patient must have CBC and BMP. Depending on the clinical situation RBCs, plt or electrolytes may need to be repleted. Many attendings also prefer to know the ionized calcium (>1.1, if lower, then replete), and coags, in particular the Fibrinogen should be >100 prior to any plasma exchange with albumin replacement. Request additional testing when appropriate (e.g. LDH, smear review in TTP). Patients scheduled for ECP should have a lipid profile.

5. **Medical Evaluation:** A physical exam must be done during the initial consultation after receiving the appropriate referral form. Ask the patient if they have had enough to eat and drink before the procedure. If they haven’t been able to eat and/or drink, then offer snacks from the unit and at least rehydrate with juice or water. Dehydration and hunger puts them at risk for hypotensive and hypoglycemic episodes on the machine. Correction of abnormal electrolytes (e.g. calcium), abnormal blood cell indices (e.g. Hct<25, Plt<50, Fibr<100), should be done prior to initiating apheresis. Patients who develop symptoms of citrate toxicity should be treated with PO or IV calcium supplements until symptoms resolve. Patients who are unable to communicate should be given 1-2 g Calcium Gluconate during the procedure to prevent citrate toxicity. An interim history and physical should also be obtained prior to each therapy thereafter.

In the situation where a patient is scheduled for an apheresis procedure, however, upon being evaluated appears too unstable for the procedure and the procedure is not started, this incident should be documented in an ‘event note’ in Allscripts.

Instructions for how to create an event note: 1) log in to Allscripts and open patient’s chart; 2) in top bar, click on "enter document"; 3) in pop-up box, in the search bar, type in "event note"; 4) click on "event note", a pop-up will appear; 5) write your note in the text box; 6) above the text box there is an option to add a co-signer; 7) add your attending as co-signer (you may search using his/her last name); 8) submit your completed note. Be sure to remind your attending to log-in to Allscripts so they can sign your note.

What to write in your note (this note is meant to be brief): 1) state that the patient was evaluated; 2) state why the procedure could not be started (for example- patient was in severe respiratory distress); 3) state that notification was given and to whom it was given (including their name and title).
6. **Medications:** There is a higher incidence of hypotensive events associated with use of ACE inhibitors. Ideally, the patient should be off of ACE inhibitors for 24hrs prior to apheresis. In addition, there is very limited data on drug removal by apheresis. Recommend to the requesting MD that whenever possible medications (esp. once daily meds) be administered post-plasmapheresis. IVlg and rituximab should always be administered post-plasmapheresis.

7. **Body Weight/Blood Priming:** Patients typically need to be >10 kg for all procedures, and preferably >15 kg for RBC exchange and plasmapheresis. In pediatric patients undergoing all apheresis procedures except for RBC exchange, priming the apheresis set with a 1:1 pRBC-5% albumin mix should be considered when the extracorporeal volume (ECV) exceeds 15% of the Total Body Volume. The maximum ECV for the COBE Spectra is <300cc (see table below for specific volumes). The resident should order 150cc of packed RBCs for a 1:1 mix with 5% albumin. For RBC exchange procedure, albumin should be used to prime the machine instead of RBCs. Apheresis disposable set volumes are provided below:

<table>
<thead>
<tr>
<th>COBE Spectra Disposable Set</th>
<th>Set Volume (cc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platelepheresis</td>
<td>131 cc</td>
</tr>
<tr>
<td>Plasmapheresis</td>
<td>170 cc</td>
</tr>
<tr>
<td>RBC exchange</td>
<td>170 cc</td>
</tr>
<tr>
<td>Leukapheresis set</td>
<td>284 cc</td>
</tr>
</tbody>
</table>

ECV should be less than 15% of TBV of a patient. This is especially important in pediatric patients [Kim *Journal Clin Apher* 2000;15:129-157]

Maximum ECV for Spectra Optia is 191 cc.

Estimated TBV calculation (to determine whether a blood prime is required):

- Adults = 70cc/kg
- Children = 80cc/kg
- Neonates = 100cc/kg

8. **Attending Physician Evaluation:** Review patient history, physical exam, lab values, medications and treatment plan with TM on-call attending.

9. **Procedure:** The resident/fellow must be present in the medical center, accessible by pager, and able to return immediately to the procedure location if requested (within 5-15 minute response time) when the procedure is taking place.

10. **Write consult note in CoPath:** If you are on-call for the weekend and the case has not been accessioned, then write the note as a Microsoft Word document that can then be put in CoPath on the following workday.

**Note on electrolyte changes with plasmapheresis:** Plasmapheresis is not expected to significantly change plasma concentrations of sodium, potassium, bicarbonate, chloride or glucose. Levels of ionized calcium and magnesium are decreased during plasmapheresis.
Quick Reference Guide for Apheresis Procedures (Including manual RBC exchange)

Therapeutic Phlebotomy
- Common Indications:
  - Hereditary Hemochromatosis
  - Primary or Secondary Polycythemia (The viscosity of blood increases exponentially >10gm/dl)
  - Stroke or Symptomatic consequences of increased hematocrit
- Pre-procedure evaluation:
  - Hemocue- point of care testing (HbPOC)
  - Labs: CBC
- Orders:
  - You will typically phlebotomize 450-500cc on each occasion to achieve a target hematocrit requested by the patient’s physician (usually 45-47%) with at least 5-7 days in between each procedure for best tolerance.
  - Note: Patients with cyanotic heart disease only tolerate removal of 200-250 cc
  - These patients require an increased RBC mass. Target Hct should be 52-57%
  - They may need fluid replacement
  - Syncopal episodes occur if too aggressive

Red Blood Cell Exchange
- Common Indications:
  - Acute Chest/CNS ischemia/Priapism/Multi-organ failure secondary to Sickle cell disease
- Pre-procedure evaluation:
  - Apheresis consent
  - Blood product consent
  - ABO type and history/current antibodies **Check history of antibodies against red cell antigens
  - Order antigen-negative/HbS -negative pRBC units for all adult and pediatric inpatients and outpatients
  - Labs: CBC (required), BMP (required), HbS % pre and post (required), ionized Ca (optional), Coag (usually not needed), Fibrinogen (usually not needed)
- Order sheet:
  - Type of replacement fluids: pRBCs (Hgb S +/- antigen negative)
  - Replacement volume, TBV, RCV: According to equation (REX excel file)
  - No rinse back: You do not want to give the patient the Hgb S in the machine back to them and you want to maintain isovolemia.
  - The referral will indicate the target end Hct level, typically 27-30%
  - Fraction Cells Remaining: The referral will indicate the maximum desired target %HgbS.
  - Ideally a %HgbS will be drawn in the days immediately prior to the red cell exchange. Based on the starting %HgbS, set the FCR to a value that will safely fall below the %HgbS target. A patient on regular exchange/transfusion therapy may start their procedure at just 50% HgbS so an FCR of 0.4 – 0.5 may suffice. In a patient where %HgbS is unknown or presumed to be 100% an FCR of 0.25 – 0.3 typically will provide an adequate exchange.
- Note: If you need to prime the apheresis machine for RBC exchange procedure, then albumin should be used instead of RBCs.
Manual Red Blood Cell Exchange:
- Always clarify with clinical team whether units need to be reconstituted (i.e. plasma and pRBC mixed together) or not.
- **FOR PATIENTS WITH SICKLE CELL ANEMIA/HYPERBILIRUBINEMIA:** (Necessary for children weighing less than 15kg). They should be manually exchanged with reconstituted whole blood (pRBC and plasma that is ABO compatible). The hematologist must specify the desired reconstituted hematocrit and exchange volume (typically, a 2-blood volume exchange calculated based on 80cc/kg blood volume for children and 100 cc/kg for neonates) when placing orders for reconstituted blood. You might be asked to confirm the volume of plasma used to reconstitute the pRBCs. Do so with the following formulas:
  - Volume of RBC product = (Exchange volume x reconstituted Hct)/Hct of RBC product
  - Volume of FFP = Exchange volume - volume of RBC product
  - **Where hct of RBC product = 80%**
- Note: Reconstituted blood should be used within 24 hours of preparation, after which it will be discarded by the blood bank.
- **TO ORDER RECONSTITUTED WHOLE BLOOD:** Sylvia is in the process of getting a ‘Whole Blood, reconstituted’ order entered into Allscripts (currently it exists as a test). Until that time instruct the clinical team to order a unit of pRBCs and specify in special comments ‘RECONSTITUTED WHOLE BLOOD HEMATOCRIT OF xx%’ Then you, the transfusion resident, need to CALL THE BLOOD BANK AND CONFIRM THEY UNDERSTAND THE ORDER.
- **FOR PATIENTS IN THE OPERATING ROOM:** Pediatric patients undergoing ABO or HLA incompatible transplants may receive an exchange transfusion in the operating room simultaneously with the transplant. These units do not need to be reconstituted. The clinical team will calculate the volume of pRBC and FFP needed.

Plasma exchange:
- Pre-procedure evaluation:
  - Apheresis consent form
  - Blood product consent form, if applicable
  - Labs: CBC (required), BMP (required), Fibrinogen (optional), ionized Ca (optional), PT / PTT (usually not needed)
  - In certain patients with susceptibility to hypofibrinogenemia (eg. cardiac patients, liver patients with impaired synthetic function) pre-procedure plasma fibrinogen levels should be followed closely. It should be greater than 100 mg/dL prior to starting a procedure because during the procedure approximately 2/3 will be removed and recovery takes longer than for the other factors. Replete with cryo as needed.
  - Routine coags should not be checked immediately after a procedure unless clinically indicated. After plasmapheresis patients getting albumin replacement are transiently coagulopathic and most coagulation factor levels except fibrinogen return to normal within 24 hours.

- Orders:
  - Replace with 5% albumin (500 cc bottles) except in TTP (see below), and in special circumstances (with coagulopathy/low serum albumin and protein/anasarca)
  - **Thrombotic Thrombocytopenic Purpura:**
    - Replace all plasma volume with FFP.
    - Ask clinician to always order “CBC+Retic” instead of CBC so that platelets are counted in the more accurate optical light scatter method. Schistocytes can be mistaken as platelets in the standard impedance method of detection and may result in a spuriously high platelet count.
  - **Renal Transplant Rejection:**
    - Typical schedule is 5 treatments (albumin replacement) qod followed by reevaluation (repeat antibody titer/biopsy/monitoring serum creatinine)
    - Prior to commencing treatment, request HLA/ABO antibody titer tests, as appropriate. HLA titer results are available in TeleResults
    - IVlg should be administered AFTER plasmapheresis
  - **All apheresis procedures:**
    - Refer to the ASFA 2013 guidelines for evidence based treatment recommendations
    - Make a vigorous effort to consult the ASFA guidelines before discussing a case with your attending
Leukapheresis

- **Common Indications:**
  - AML: WBC > 100,000, with myeloblasts without symptoms of hyperviscosity
  - Symptomatic Hyperviscosity with high WBC

- **Pre-procedure evaluation:**
  - Apheresis consent form
  - Calculate blood volume based on sex, height and weight
  - Labs: CBC (required), BMP (required), ionized Ca (optional), PT/PTT (usually not needed)

- **Orders:**
  - Process 1.5-2 total blood volumes (usually 2 BV)
  - Pre-procedure almost always will require IV Calcium supplementation
  - In pediatric patient, be aware of the volume you remove. Replacement fluid with albumin might be indicated

Platelet Depletion

- **Indication:** Platelet count > 1,000,000

- **Pre-procedure evaluation:**
  - Apheresis consent form
  - Labs: CBC (required), BMP (required), ionized Ca (optional), PT/PTT (usually not needed)

- **Orders:**
  - Process 1.5-2 total blood volumes
  - This procedure almost always will require IV Calcium supplementation
  - Get post-procedure CBC to determine plt count and transfuse pRBCs if hematocrit is low

Peripheral Blood Stem Cell Harvest (PBSCH)

- **Pre-procedure evaluation:**
  - Apheresis consent form
  - Labs: CBC (required), BMP (required), pre-harvest CD34 count (required, goal: 20 CD34+ cells/μL or more), ionized Ca (optional), PT/PTT (usually not needed)
  - Specifically look for evidence of infection/sepsis (fever/sinus pain/ headaches/ diarrhea/URI etc) and ask about abdominal pain (splenic rupture).
  - In addition to blood sent to core lab, immediately pre-harvest: stem cell lab needs three tubes of blood 1) ABO T&S long pink top, 2) CBC lav top 3) translucent green top (pediatric Na Heparin tube without gel) for CD34 enumeration
  - Regardless of starting iCal level almost all patients will need IV calcium gluconate. Typically it is ordered up front (2g IV calcium gluconate) and run slowly during the procedure.

- **Orders:**
  - Process 20 L in adults qday to target (usually 2.5 - 5 X 10^6 CD34/kg based on wt of pt)
  - Process 4 BV for pediatric cases qd to target dose (5 - 10 x 10^5 CD34/kg based on wt of pt)
  - Replacement fluid is normal saline pm
  - Pediatric primer: If indicated, reconstitute 150cc of pRBCs (irradiated, leukocyte reduced) in 150cc of Albumin to obtain a Hct of 30%.
  - At 15L or ½ of the way through the procedure the product is sampled, 1mL into a peds CBC tube and 1mL into a translucent green top for product CD34 enumeration
  - Get post CBC and transfuse platelets, if necessary
  - Add 10% ACDA by volume to product (nurses typically do this automatically) and deliver product to stem cell processing lab
Extracorporeal Photopheresis (ECP)

- **Common Indications:**
  - Cardiac Transplantation (Humoral/Cellular Rejection; ABO-compatible): one cycle every 1-8 weeks for several months; MNC product from processing 1.5 L blood
    i) Rejection prophylaxis: Category II
    ii) Cellular/recurrent rejection: Category II
  - Cutaneous T Cell Lymphoma/Mycosis Fungoides/Sezary Syndrome: one cycle every 2-4 weeks; MNC product of 200-270 mL treated
    i) Erythrodermic MF + SS: Category I
    ii) Nonerythrodermic MF: Category III
  - Graft-Versus-Host-Disease: one cycle every 1-2 weeks; MNC product of 200-270 mL
    i) Skin (chronic): Category II
    ii) Skin (acute): Category II
    iii) Nonskin: Category III
  - Inflammatory Bowel Disease: once per week or more intensive therapy of daily to two times per week;
    i) Crohn’s disease: Category III
  - Lung Allograft Rejection: 24 treatments in 6 months (10 treatments in the first month, biweekly for 2 months (6 treatments), monthly for 3 months (6 treatments)); MNC product of 200-270 mL
    i) Bronchiolitis Obliterans Syndrome: Category II
  - Psoriasis: once to twice a week: 1,000-3,000 mL volume treated depending on method
    i) Category III

- **Pre-procedure evaluation:**
  - **Apheresis consent form**
  - **Labs:** CBC (required), BMP (required), PT / PTT (required), lipid profile (required)

- **Orders:**
  - One cycle: 2 consecutive treatment days
  - **Volume processed:**
    i) 1,500mL if no blood prime needed.
    ii) A blood prime is needed if the extracorporeal volume calculated for a SINGLE NEEDLE procedure ≥ 15% of the patient’s total blood volume.
    iii) Refer to Table 12 (Section 10-3) in the CELLEX® Operator’s manual to estimate the ECV.
  - **Catheter care:** Flush w/ 10cc normal saline (NS) both parts, lock with 1000U/cc heparin
  - **Heparin:** 10,000 units in 500mL NS if >40kg; 150 units/kg in 500mL NS if <40kg. When working with the computerized orders it helps to delete the infusion rate. Heparin is contraindicated in patients with heparin allergy or history of HIT.
  - **Uvadex 20 mcg/mL:** 10mL vial in light protected bag. Add as per Cellex calculation. Infuse via photopheresis circuit (you may need to add this route to the computerized order).
  - **A/C ratio:** The blood to anti-coagulant ratio is 10:1 (default). Use 8:1 if the patient’s platelet count is >415,000/ul. Use 12:1 if platelet count <165,000/ul or if the patient is taking blood thinners; 25:1 should be considered if the patient is already heparinized.
  - **Single or double needle mode:** Double needle mode is preferred for all patients and especially those with CHF/Cardiomyopathy, less than 4ft 8in in height and/or less than 55kg or with Hct <28%. Single needle mode is used in the event that a lumen of the patient’s line malfunctions mid-procedure.
  - **Often paper orders are needed to complement the electronic orders for ECP procedures.** When writing these orders please:
    i) Specify the procedure type is ECP
    ii) Note that the paper order accompanies an electronic order
**Additional Photopheresis Information**
*(Complications and Requirements)*

**Pre-procedure Requirements:**
- **CBC:** WBC \( \geq 1000/\mu L \), Hematocrit \( \geq 27\% \), platelet \( \geq 50,000/\mu L \), nl PT/PTT
- **Lipids:** Triglycerides \( \leq 300 \text{ mg/dL} \) (fasting). If on TPN, hold intralipids for 24 hours.
- **Anti-hypertensive medications:** Hold anti-hypertensive medications, beta blockers or diuretics on the mornings prior to treatment.
- **Diet:** Low-fat and low-cholesterol diet especially on days just prior to ECP and on the day of ECP.
- **Hydration:** Drink plenty of water and non-caffeinated fluids on the days prior to ECP.
- **Access:** Peripheral vein with 16 gauge needle or central line (non-tunneled or tunneled apheresis catheter or Hickman catheter; minimum 7Fr internal diameter, maximum 36cm in length); no picc lines or ports.
- **No history of:** Heparin or 8-MOP/psoralen compound allergy, HIT, Light sensitive disease state
- **No aphakia (no lens)**
- **Must not be currently pregnant**

**Adverse Events**
- **Photosensitivity:** UV shielding/absorbing wrap-around glasses needed for 24 hours
- **Nausea and vomiting** due to psoralen
- **Hypotension** (from change in extracorporeal volume), hypovolemia, light-headedness, dizziness
- **Complaints of feeling hot or excessive yawning** may accompany fluid changes and precede a hypovolemic reaction
- **Vagal response** may result from anxiety regarding the procedure especially if there are access problems.
- **Plastic or metallic taste** during reinfusion likely due to heparin
- **Fever** (37.7-38.9) and redness within 6-8 hours of reinfusion of photoactivated leukocyte-enriched blood.
- **Venous access infection and pain**

**Patient Counseling**
- **Leave dressing intact for 4-6 hours and avoid heavy lifting.**
- **Biopsies and other invasive procedures should be avoided until heparin clears (about 6 hours).**
- **May have increased redness, itching and scaling following ECP.**
- **Temperature elevation may occur 4-6 hours after reinfusion.** Indicates presence of immunological reaction to the reinfusion of treated cells.
- **Patients should report any fever or chills.** CTCL patients are predisposed to staphylococcus sepsis and may need to be evaluated by blood cultures.
- **Patients should avoid sun exposure for 24 hours following photopheresis.** They should wear UV blocking glasses until the sun sets and cover exposed skin from sunlight or use a sunblock (SPF15 or greater).

**Additional information:** //Archive/Bloodbank/Apheresis**
Complications of Apheresis

Complications of Apheresis to discuss when obtaining informed consent

1) Citrate-induced hypocalcemia
   - Always measure ionized calcium prior to procedure because albumin-calcium complexes may falsely elevate the total calcium level.
   - Mild (tingling/numbness at lips/fingertips)
     - Decrease flow rate to 50-60 cc/min
     - Calcium carbonate (500mg tab): 4-6 tabs PO
   - Moderate (diffuse numbness/tingling, +Chvostek’s)
     - Decrease flow rate to 50-60 cc/min
     - Stop procedure, if necessary
     - Calcium gluconate (1g/10ml): 1-2g in NS
   - Severe (irregular pulse, hypotension, seizures)
     - Stop procedure
     - CALL FOR HELP (5-3333)
     - Call attending
     - Calcium gluconate IVP
     - Saline to KVO

2) Depletion of coagulation factors
   - Fibrinogen acts as an ideal solute and two-thirds of it is removed by 1 plasma volume exchange. Consider cryoprecipitate transfusion when fibrinogen levels are <100.

3) Allergic reaction
   - Mild (localized itching, rash): 25mg IV Diphenhydramine
   - Moderate (diffuse itching, rash, swelling of the face, mild congestion): 50mg IV Diphenhydramine
   - Moderate persistent: 50mg IV Diphenhydramine + 125mg IV Methylprednisolone in NS
   - Discontinue blood component and order transfusion reaction work-up

4) Anaphylaxis (rash with hypotension, stridor, wheezing, acute respiratory distress)
   - Epinephrine 1:1000 in 0.5cc subcutaneous, may repeat in 10-15 min
   - CALL FOR HELP (5-3333)

5) Hypotension/dizziness due to fluid imbalance
   - 15% of TBV should not be exceeded in extracorporeal circulation
   - Ensure the patient is well hydrated prior to beginning the procedure
   - Other causes of hypotension must be excluded eg. Anaphylaxis, MI, sepsis, arrhythmia
   - Treatment
     - Expand volume with NS bolus, 200-500 cc
     - Call attending
     - If hypotension is unresponsive to fluids, CALL FOR HELP (5-3333)

6) Problems with vascular access
   - Call IR or the service that originally placed the line
   - Placement associated issues- pneumothorax
   - Infection- culture access site if there is fever or purulent discharge
   - Clotting – our nursing staff is in the process of learning how to do line clearance with tPA, contact Ronald if a line requires clearance
   - Extravasation/hemorrhage
   - Cardiac arrhythmias

7) Hyperventilation/Anxiety
   - Offer cold compress, encourage deep slow breathing

8) Back Pain / Bone Pain / Abdominal Pain / Fever
   - G-CSF can cause all of the above symptoms. Abdominal pain may be secondary to splenic rupture, a potentially serious complication.
   - For pain we can give Acetaminophen (325mg tab): 1-2 tab PO
   - For patients with pain refractory to Tylenol call the attending

9) Calling for help
   - Call security (5-2222)
   - Cardiac arrest/trauma (5-3333)
   - Fire (5-4444), as appropriate.
Commonly Used Medication Orders for Apheresis

- Tylenol 650 mg PO PRN for fever (325 mg PO for kids)
- Calcium carbonate 650 mg PO, 1-2 tablets every 15 minutes X 4 PRN for citrate toxicity
- 10% Calcium Gluconate (1 amp = 10mL) – 1-2g IVPB Calcium Gluconate
  - Only MD’s can give IV push
  - Otherwise, hang 1 amp of 10% calcium gluconate diluted in (at least) 50cc of 0.9% NS.
  - Note: Occasionally, only Calcium Chloride is available. This must be run in a central line other than apheresis line
- Benadryl 25 or 50 mg PO; Benadryl 25-50 mg in 50cc NS IVSS over 15-30 min
- Solumedrol 125 mg in 100cc NS IVSS if hives not improved with IV Benadryl
Core Lab, Hematology, Other Lab Services

**CORE LAB**

- The 5% of calls you get that aren’t related to transfusion medicine are mostly from the Core Lab, where the supervisor may call you to look at a peripheral blood smear with blasts/malaria or a body fluid (CSF, pleural fluid, ascetic fluid) with unidentifiable cells (malignant).

- The hematology supervisor should only call you for patients with first-time blasts and atypical lymphocytosis. You should not be paged for patients with a known diagnosis of leukemia and recent confirmed blasts. Check INYP/CROWN to make sure this is the case. If a patient has a known diagnosis of leukemia or lymphoma, make certain that they are not supposed to be in remission. We cannot miss instances of primary leukemia/lymphoma in a new patient or relapse in a patient thought to be in remission. For suspected new or relapsed cases of leukemia it is important that you look at the slide in a timely manner and inform the clinician. It is important to inform them as soon as possible about blasts so that the patient is admitted and not sent home. Although hematopathology and flow cytometry may not be available on the weekend or off-hours, you can at least tell the clinician to send the patient’s peripheral blood to hematopathology for evaluation and flow cytometry on the next working day.

- The following requires the CP On-Call Resident to come in for immediate review:
  - Intraerythrocytic parasites on peripheral blood smear (Malaria/Babesia)
  - Peripheral blast if an immediate read is clinically indicated. (Unless the patient has a known diagnosis of leukemia, contact the clinical team for pertinent history. If warranted, come in to review smear.)

- The hematopathology fellow carries a pager (8-3845) on the weekends. He/she can be called in emergency situations to review slide and/or discuss the case.

- **Critical values:** In days past the core lab would page the resident covering chemistry when there was difficulty in reporting a critical value. However residents are no longer involved in critical value reporting. If called, the resident should remind the core lab tech or supervisor that the core lab SOP is as follows: technologists report to a core lab supervisor, if the supervisor is not successful in reporting the critical value, then the supervisor must call the administrator on duty (not the resident on call).
## Blood Collections Tubes

<table>
<thead>
<tr>
<th>Color of tube top</th>
<th>Additive</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold (or Red-gray tiger*)</td>
<td>Gel for serum separation</td>
<td>Serum tests: chemistry, serology</td>
</tr>
<tr>
<td>Light green (or Green-gray tiger*)</td>
<td>Lithium heparin and gel for plasma separation</td>
<td>Plasma: chemistry</td>
</tr>
<tr>
<td>Red</td>
<td>None</td>
<td>Serum: chemistry (also used as discard tube)</td>
</tr>
<tr>
<td>Orange*</td>
<td>Thrombin based clot activator +/- gel for serum separation</td>
<td>Stat tests, chemistry</td>
</tr>
<tr>
<td>Royal blue</td>
<td>None (red label), EDTA (purple label) or Heparin (green label)</td>
<td>Trace-element, toxicology, etc.</td>
</tr>
<tr>
<td>Dark green</td>
<td>Sodium heparin</td>
<td>Plasma: chemistry</td>
</tr>
<tr>
<td>Gray</td>
<td>Potassium oxalate, sodium fluoride</td>
<td>Glucose, alcohol</td>
</tr>
<tr>
<td>Tan</td>
<td>EDTA</td>
<td>Lead</td>
</tr>
<tr>
<td>Light Yellow</td>
<td>Sodium polyanethol sulfonate (SPS)</td>
<td>Blood culture</td>
</tr>
<tr>
<td></td>
<td>ACD</td>
<td>HLA, DNA</td>
</tr>
<tr>
<td>Lavender</td>
<td>EDTA</td>
<td>Hematology, Immunohematology, Viral Load</td>
</tr>
<tr>
<td>Pink</td>
<td>EDTA</td>
<td>Hematology, Immunohematology</td>
</tr>
<tr>
<td>White*</td>
<td>EDTA and gel for plasma separation</td>
<td>Molecular tests</td>
</tr>
<tr>
<td>Light blue</td>
<td>Buffered sodium citrate</td>
<td>Coagulations studies</td>
</tr>
<tr>
<td></td>
<td>CTAD</td>
<td>Platelet function assays, coagulation</td>
</tr>
<tr>
<td>Red-light gray tiger*</td>
<td>None</td>
<td>Discard tube, secondary specimen</td>
</tr>
</tbody>
</table>

*Not available at NYPH-CUMC

**Order of blood draws:**
1. Blood cultures (light yellow top-SPS or bottles)
2. Light blue (need discard tube prior if nothing drawn first)
3. Gold/Red/Red-gray tiger
4. Light green/Green-gray tiger/Dark green
5. Lavender/White/Pink/Tan
6. Gray
7. Light yellow –ACD

Note: Royal Blue tubes can contain no additive, EDTA or Heparin. Draw at same time as tubes with same additive.

**List of Lab Tests: Columbia:** [https://www.testmenu.com/nymphcolumbia](https://www.testmenu.com/nymphcolumbia)
Manual Differential, Triage & Review by Hematology Resident

**Policy:** There are various situations when the Core Laboratory technologist must perform a manual differential using a smear of the patient’s peripheral blood sample. When certain criteria are met or whenever the technologist has a question about a smear, the Core Lab Hematology Supervisor will review the smear and determine whether the differential can be released or whether the Hematology resident on call should be paged.

**Procedure:**

**Daytime, Weekday - During the day shift of week**

1) The Hematology resident will obtain the following information (parentheses indicate source of information):
   a. The age, name & MRN of the patient.
   b. The audit criteria that were met and for which the resident was paged (technologist)
   c. The white count, hemoglobin, hematocrit and platelet count of the CBC (technologist or iNYP)
   d. The differential obtained by the technologist (technologist)
   e. The location of the patient (technologist or iNYP)
   f. Current reason for admission (iNYP)
   g. Findings/patient history relevant to any hematologic malignancy, e.g., recent fevers, lymphadenopathy, fatigue, weight loss (iNYP)

2) Review the smear first, and gather relevant past medical history, especially previous hematopathology workup (if any).

3) Coverslip the smear and render a preliminary differential, diagnosis, and comment for the smear.
   a. The resident will review the smear with the Hematopathology fellow on service first (if available) and with the Hematopathology attending on service

4) Results will be verbally communicated to the clinician caring for the patient immediately
   a. Flow cytometry will be submitted as needed on the Core Lab CBC sample immediately
   b. **You must notify the ordering physician of the CBC test prior to sending it for flow cytometry, as some clinicians may deem additional testing unnecessary.**

5) The comment must address the nature of any cells recorded as “Other”
   a. The slides, relevant forms and tube of blood (if not sent for flow cytometry) will be returned to the Core Lab
   b. The form will be submitted to the Technologist to enter the differential (if before 4pm)
   c. The forms will be submitted to the Hematology Supervisor to enter the differential (if after 4pm)
   d. The slide will be filed in the slide box.
   e. The tube will be returned to the tube tracker system or cooled storage room (if not sent for flow cytometry).

6) The resident will log all cases for which s/he was paged in the smear log:
   a. `\Archive\resident library\CP\Hematology & Coag\Smear Log`
   b. The resident who completes the differential (daytime or covering) will complete the log.
1) If the Core Lab technologist sees **blasts** not previously reported or bizarre cells not previously reported, the Hematology Resident will be paged to review the slide.
   a. The resident will contact the resident/attending caring for the patient to determine if the findings in the smear of the differential will alter treatment or care of that patient, based on that clinician’s assessment
   b. If the immediate treatment or care of the patient **will not** be altered based on the smear findings or differential, then the review will occur by Hematology Supervisor during day shift of next business day.
      i. Upon review by the Hematology Supervisor, s/he will determine whether the differential can be released whether the Hematology resident should be called.
   c. If the immediate treatment or care of the patient **will** be altered based on the smear findings or differential, or if a Hematopathology consultation is requested:
      i. The resident will examine and evaluate the smear with specific attention to the audit criteria in question
         1. Obvious cases with numerous blasts can be signed out as such.
         2. Difficult cases can be reported as “Suspicious for blasts (to be confirmed the next morning by Hematopathology)”. The resident can page the Hematopathology Fellow in the evening (i.e., before midnight) to discuss the case if the resident is unsure of the findings.
         3. Results will be verbally communicated to the clinician caring for the patient
         4. The tube will be returned to the tube tracker system or cooled storage room
         5. The resident should sign out the case to the daytime Hematology resident and Hematopathology fellow at 8am the next day, and bring the slides to him/her

2) If the smear meets any of the other audit criteria (based on outlined in HEM-22, point #6 and Appendix A) during a weekday night (Mon-Thurs and Sun night), the smear will be left for the Hematology Supervisor to review the next business morning and s/he will determine whether the differential can be released or whether the Hematology resident should be called.

3) If the smear meets any of the other audit criteria during a weekend night (Fri and Sat night) the Hematology Resident will be paged to review the slide **during the next day shift** (business or non-business day).
   a. See “Daytime –Weekends” section below
Daytime –Weekends

1) The Hematology Supervisor will be called by the Core Lab technologist based on the criteria outlined in HEM-22, point #6 and Appendix A, the Hematology Resident will be paged to review the slide.

2) The resident will contact the resident/attending caring for the patient to determine if the findings in the smear of the differential will alter treatment or care of that patient, based on that clinician’s assessment:
   a. If the immediate treatment or care of the patient will not be altered based on the smear findings or differential, then the review will occur by Hematology Supervisor during day shift of next business day.
      i. Upon review by the Hematology Supervisor, s/he will determine if the differential can be released or whether the Hematology resident should be called.
   b. If the immediate treatment or care of the patient will be altered based on the smear findings or differential, or if a Hematopathology consultation is requested:
      i. The resident will examine and evaluate the smear with specific attention to the audit criteria in question
         1. Obvious cases with numerous blasts can be signed out as such.
         2. Difficult cases can be reported as “Suspicious for blasts (to be confirmed the next business day by Hematopathology)”. The resident can page the Hematopathology Fellow to discuss the case if the resident is unsure of the findings.
      ii. Results will be verbally communicated to the clinician caring for the patient
      iii. The tube will be returned to the tube tracker system or cooled storage room
      iv. The resident should sign out the case to the Hematopathology fellow as soon as possible and leave the slide and paperwork for him/her to review

3) On all pages received by the covering or daytime Hematology resident, the resident will log all cases for which s/he was paged in the smear log:
   b. \Archive\resident library\CP\Hematology & Coag\Smear Log
   c. The resident who completes the differential (daytime or covering) will complete the log.

4) Should the resident have any questions, the following physicians can be contacted:
   a. Core Laboratory:
      i. Attendings: Alexander Kratz (ak2651@columbia.edu), Eldad Hod (eh2217@columbia.edu)
      ii. Supervisors: Giselle Reynafarje (gmr9001@nyp.org), Carlito Rubino (crubino@nyp.org)
   b. Hematopathology: Govind Bhagat (gb96@columbia.edu), Bachir Alobeid (ba2024@columbia.edu), Daniela Hoehn (dh2315@columbia.edu)
   c. Hematology: Richard Francis (rof3@columbia.edu)
CSF and Body Fluids

While on hematology rotation and on-call, you may get called by the core lab to review a body fluid. These can be reviewed with Cytology attending during normal business hours (M-F 8-5). After hours or on weekends, notify the patient’s clinician that the slide will be reviewed the next working day.

Procedure for body fluid review:
Gather relevant clinical information and laboratory data, including the fluid and peripheral blood glucose, total protein, triglycerides, LDH, and cell count and differential.

Review the smear. After you have assessed the slide, show it to the cytopathologist on the non-gynecology cytology service. The Cytology attending will help to describe what should be written on the comment section of the Core Lab sheet and let you know if further workup is required. Speak with the Supervisor in core lab to have the interpretation added as comment to the specimen in Cerner. The technicians in the Core Lab should have also made two unstained slides. If the attending Cytologists would like to work up the case further, write up a requisition form and a “Fluids from Core laboratory” form. Please include the comment placed in Cerner in the “additional comments” section at the bottom of the latter. Send both forms along with the specimen and the two unstained slides to Cytology.

RBC morphology and Blood Parasites for Review

- If you are called by a clinical team to assess RBC morphology (eg. presence of schistocytes), remind them that can also order a ‘Morphology Scan’ in Allscripts. The Morphology Scan provides a semi-quantitative measure of the abnormal RBCs which may be helpful in tracking response to therapy. DO NOT use the morphology scan as a way of avoiding taking a look at their smear. If they want your help then help them.
- If you are called by a clinical team to look at a smear and assess for the presence of RBC parasites (eg. babesia) remind them that they can order a ‘Blood Parasite Exam’ in Allscripts
- If parasites are found on a smear, you will be called by a lab technician to identify blood parasites on holidays, weekends or evenings/night.
- During off-hours, the blood smears are prepared and stained by Hematology.
- You need to identify whether Plasmodium species are present and differentiate them from Babesia. A travel history is helpful in obtaining a differential.
- In addition, it is required that the rapid antigen detection assay (BINAX NOW malaria kit) be performed. This kit is located at the Parasitology bench or in the refrigerator on the left hand side as you head towards the Parasitology bench.
- A preliminary level of parasitemia can be calculated but needs to be confirmed by a parasitologist in the Clinical Microbiology Service.
  - The percent of infected RBCs is determined by enumerating the number of infected RBCs in relation to the number of uninfected RBCs. A minimum of 500 RBCs total should be counted. Multiply-infected RBCs are counted as one. Gametocytes are not counted.
  - Percent Infected RBCs = (No. infected RBCs ÷ Total No. RBCs counted) × 100
- The comment on the Core Lab Pathology Review Sheet should read:
  - “Intraerythrocytic ring forms are/are not identified. Approximate percent parasitemia is X%. BinaxNow testing is positive/negative for P.falciparum/P.ovale/etc. Results communicated to [[MD name at “time” on “date”]]”
- After examination, the original slides, blood tubes and BinaxNow test should be placed in the Blue drop box (“Off Hours Microbiology”) in the Core Lab Hematology bench to be delivered to parasitology for confirmation.
- Additional lavender top tubes MUST be collected every six hours, but need not be examined by a resident.
- The Microbiology attending (Dr.Whittier) must be notified by e mail of all r/o malaria blood smear reviews, whether positive or negative.
- On the next working day, follow-up with Dr.Whittier about blood parasite case.
Approval of Duplicate *Clostridium difficile* Toxin PCR

**Principle:**

The Clinical Microbiology Service now performs a PCR assay for *Clostridium difficile* Toxin B. Unlike prior *C. difficile* tests, PCR has very high sensitivity, greatly reducing the need for repeat testing after a negative result, especially within the first 5 days of a negative result. Only about 1% of repeat tests will be positive. However, physicians continue to order tests on patients with a recent negative result.

**Procedure:**

If a test is ordered within 5 days of a negative result, that specimen will be rejected as a duplicate and the test will be cancelled in the EMR. Physicians will sometimes call the microbiology laboratory to ask if we can run the test anyway. This request requires approval by either the micro lab director (8am – 5pm, Mon-Fri) or the resident on call (5pm-11pm, Mon-Fri, plus weekends/holidays).

If you receive a page from the microbiology technologist while on call, use the criteria below to determine if the request is appropriate.

- If it is appropriate, call the microbiology lab (305-6276) and inform the technologist that the test is approved. Instruct the physician to place a new order in Allscripts and submit another stool specimen.
- If it is not appropriate, call the microbiology lab and ask the technologist to hold on to the specimen but not run it. Send an email to Dr. Whittier (sw189@cumc.columbia.edu) with the patient’s name, MRN, and relevant information.

**Criteria:**

Approve the test if patient has:
- History of prior *C. difficile* infection
- Recurrent or worsening diarrhea
- Rising WBC count with diarrhea

Do not approve if:
- Patient needs two negative tests for discharge
- Diarrhea is unchanged
- Testing seems arbitrary

The majority (~90%) of requests will be approved, but it is important to educate ordering physician on the low yield of repeat testing and inappropriate test ordering.
Respiratory Pathogen Panel (RPP) Repeat Test Request Guideline

Principle:
The respiratory pathogen panel (RPP) is a multiplex PCR assay for the 20 most common viral and atypical respiratory pathogens. Only 1 test is allowed per patient per 24 hours. Sometimes physicians will order more than 1 per day, especially if first sample was collected in the ED (presumably due to concern that the specimen was not collected properly in the ED).

Procedure:
If the first sample was collected in the ED and the patient is then admitted to the ICU, the second test will be automatically approved.

If the patient is admitted to the floors, the sample will be rejected as a duplicate and the test cancelled in the EMR. Sometimes physicians will call the lab to ask that the second sample be run anyway, which requires the approval of either the microbiology lab director (8am-5pm, Mon-Fri) or the resident on call (5pm-11pm, Mon-Fri, plus weekends/holidays).

If you receive a while on call, call the microbiology lab (305-6276) and approve the test. Send an email to Dr. Whittier (sw189@cumc.columbia.edu) with the patient's name, MRN, and relevant information.

Criteria:
Approve all requests. The roadblocks in place prevent most repeat tests from being performed, and therefore we do not get many requests.
STAT Metabolic Send-outs

SEND-OUT PROTOCOL

Principle:
When a child presents to NYPH/CHONY and there is high clinical and laboratory suspicion of an inborn error of intermediary metabolism, it may be necessary to obtain STAT metabolic testing from ARUP laboratories. This SOP describes the mechanism for obtaining STAT metabolic testing in these rare scenarios.

Appropriate use of STAT testing:
This protocol shall be followed only when the diagnosis of an inborn error of metabolism is highly suspected and when the STAT diagnosis is necessary to correctly guide therapy. This test should not be used for routine monitoring or for clinically stable referrals sent to CUMC for confirmation of a NYS NBS result. The relevant test codes at ARUP are as follows:

- Urine Organic Acids (0098389)
- Plasma Amino Acid (0080710)*
  *(if Argininosuccinic acid is desired, this must be specified)

Relevant Individuals:
- Treating Metabolism attending
- Clinical Pathology resident on call
- Clinical Pathology attending on call
- Core-lab supervisor

Protocol:
- The treating physician will page the CP resident covering send-outs with the request for STAT metabolic testing (87055). After 5pm and on weekends, this pager is covered by the CP resident on-call. An appropriate indication must be provided. This should be discussed with the Core Lab Attending On Call prior to approval.
- If the request comes after hours or on weekends, the CP resident will contact the ARUP courier to arrange for a special pick-up time (Rohan 718-207-2204). Routine pickup on weekdays and Saturday is at 5pm.
- Regardless of the timing of the specimen (on or off hours) the CP resident will contact a supervisor in the core-lab (pager 86859) to notify them of the sample.
- Based on the established pick-up time, the CP resident should advise the clinical team of a deadline by which time the samples should be received in the lab. Keep in mind that samples must be processed. Therefore, for a pickup time of 5pm, advise a drop-off deadline of 3pm.
- The treating physician will order the appropriate testing in Allscripts, bring the samples (on ice) down to the core-lab and hand to a supervisor.
- If off hours, the supervisor will fill out a paper requisition for ARUP and will not transmit the order to ARUP. He/she will leave a copy on the send-out supervisor’s desk for documentation and proper ordering on the next business day.
- The supervisor will then process, freeze and package the sample for the STAT pickup.
- The CP resident should call a genetic counselor at ARUP as soon as possible (in the AM if off hours) to alert them to the STAT nature of the sample (800-242-2787x3921). The CP resident should provide the ARUP counselor with a call-back number for the metabolic team. Our ARUP Client Number is: 13352.
- Once the sample is picked up, there are at least three flights to ARUP daily, one at 8am, one at 3:30pm and one at 7pm. This will allow for a turnaround time of approximately 24-30 hours.
- The send-out supervisor will appropriately order the testing in CERNER the next business day.
### Coagulation Basics

- **Coagulation Testing** (Light blue, 3.2 % Sodium Citrate Tube)
  - PT, PTT, INR
  - Thrombin Time
    - Measures conversion of fibrinogen to fibrin by thrombin
    - Prolonged with: low fibrinogen, dysfibrinogenemia, thrombin inhibitors (ie, heparin)
  - Reptilase Time
    - Measures conversion of fibrinogen to fibrin by thrombin-inhibitor-resistant form of thrombin (ie, reptilase)
    - Used to differentiate heparin from hypofibrinogenemia or dysfibrinogenemia
  - Dilute Russell Viper Venom Time (DRVVT)
    - Used to differentiate factor inhibitor from lupus anticoagulant in the presence of prolonged PT or PTT
Useful resources

- http://practical-haemostasis.com
Hemolysis Algorithms

Hemolysis Algorithm

DAT + Immune Mediated
- Eluate +
  - ANTR/DHTR
  - AIHA
  - HDN
  - IVIG
- Eluate -
  - Drug
  - PCH
  - Anti A, B

DAT - Non-immune Mediated
- Structural
  - HS
  - HE
- Enzymatic
  - G6PD
- Mechanical
  - Valve
  - TMA (TTP, HUS)
- Hemoglobinopathy
  - HBO2, HbA
- Infectious Disease
  - Malaria
  - Babesia

Signs of hemolysis?
- Increased reticulocytes
- Increased LDH
- Increased bilirubin
- Increased ferritin
- Uric acid
- Decreased haptoglobin

Evaluate peripheral blood smear

Sickle cell disease (and variants)

Hemolytic anemia

Hb electrophoresis

Erythrocyte morphology

Deferoxamine treatment

Hemoglobin electrophoresis

HCQ therapy

Paroxysmal nocturnal hemoglobinuria

Hemolytic uremic syndrome

Thrombotic thrombocytopenic purpura

Ectopic hemolysis

Decreased haptoglobin

Decreased G6PD

Increased D-Dimer

Increased bilirubin

Increased LDH

Increased ferritin

Increased uric acid

Increased reticulocytes

Increased platelet count

Positive

Negative

Yes

No

No

Repeat G6PD screen

Positive

Negative

Positive

Negative

Administered oxidant substances, other rare RBC enzyme deficiencies, unstable hemoglobin
Forms and Miscellaneous Information:

Infonet (home) under 'Departments' → 'Lab and X-Ray' → 'Transfusion Medicine and Cellular Therapy' (left hand side) → 'Columbia University Transfusion Medicine and Cellular Therapy'

Hemotherapy Referral Form

Search 'hemotherapy' or 'NYPH-465-14'
http://infonet.nyp.org/Lab/Shared%20Documents/Hemotherapy%20Referral.pdf

Anti A/B Titer Request

Search 'A-B titer' or 'NYPH-465-12'
http://infonet.nyp.org/Lab/Shared%20Documents/Anti_A_B_Titer_Request.pdf

Granulocyte Product Request

Search 'granulocyte product' or 'NYPH-465-75'
http://infonet.nyp.org/Lab/Shared%20Documents/GranulocyteProductRequest.pdf

Request for Platelet Refractoriness Work-up

Search 'platelet refractoriness' or 'NYPH-465-27'
http://infonet.nyp.org/Lab/Shared%20Documents/Platelet-Refractoriness-Work-Up-Request.pdf

Washed Red Blood Cell (RBC) Product Request

Search 'washed RBC' or 'NYPH-465-76'
http://infonet.nyp.org/Lab/Shared%20Documents/WashedRBCProductRequest.pdf

Transfusion Reaction Preliminary Report Form

Manilla folders at entrance to blood bank
Resources & Contacts

Computer Resources
On line SOPs
Soft Tech: http://50.56.64.115/
Username: your cwid, Password: welcome1

New York Blood Center Lecture Series:
\Archive\bloodbank\New York Blood Center Lecture Series 2013

CP Friday Lectures:
\Archive\bloodbank\CP Friday lectures

TM Curriculum Documents:
\Archive\bloodbank\Curriculum Documents

E Books:
\Archive\bloodbank\E-books
\Archive\resident library\eBooks

Reference Papers:
\Archive\bloodbank\Papers

CP Orientation Lectures:
\Archive\bloodbank\CP orientation

NYP Tech Guide for Pathology:
\Archive\resident library\ NYP Columbia Tech Guide for Pathology

Pathology Resource List:
\Archive\resident library\ Pathology Resource List_2013-2014

CP Practice Board Questions:
\Archive\resident library\CP Questions

BLOOD BANKING

Component Resident Sign out Checklist:
\Archive\bloodbank\Components\Old Logs, Data, sign outs\ Component log_paperform

Retrospective Red Cell Audit Information (Instructions, Form etc):
\Archive\bloodbank\Components\Red cell audit

Blood Derivatives Administration: CUMC Nursing Manual:

Package inserts (NovoSeven, Profilnine, Rhogam, WinRho):
\Archive\bloodbank\Components\Package Inserts

Platelet refractoriness Work-Up forms:
\Archive\bloodbank\Components\Forms\Plateletreq_form

CCI Calculation (excel spreadsheet):
\Archive\bloodbank\Components\CCI calculator

RBC antibodies- clinical significance and frequency:
http://nybloodcenter.org/media/filer_public/2013/06/10/blood_group_systems.pdf

Transfusion Reaction SOP:
\Archive\bloodbank\Components\Transfusion Reaction Docs\ Transfusion Reaction Investigation SOP - TS141_2

Transfusion Reaction Work-up Checklist:
\Archive\bloodbank\Components\Transfusion Reaction Docs\Transfusion Reaction Workup Form

Sample Transfusion Reaction Write-Ups:
\Archive\bloodbank\Components\Transfusion Reaction Docs\ Transfusion Reactions
Anti-A/B titration request form:
\Archive\bloodbank\Components\Forms\AB_titer_form

Sample TM Case of the Week Presentations:
\Archive\bloodbank\Case of the Week Presentations

Anesthesia Resident Documents:
\Archive\bloodbank\Anesthesia Resident

Wyndgate Product Codes:
\Archive\bloodbank\Components\Wyndgate Product Codes

Maximum Surgical Blood Order Schedule (MSBOS):
\Archive\bloodbank\Components\MSBOS

**APHERESIS**

Plasma exchange calculator/excel worksheet:
\Archive\bloodbank\Apheresis\PEX

Red cell exchange calculator/excel worksheets:
\Archive\bloodbank\Apheresis\rbcexchange

Translations for Common Apheresis Complaints (Spanish):
\Archive\bloodbank\Apheresis\Spanish_Translations_Apheresis

ASFA Guidelines
\Archive\bloodbank\Apheresis\Apheresis guidelines 2013
Phone Numbers of Patient Floors

**Calling from Outside**

5-xxxx  212-305-xxxx
2-xxxx  212-342-xxxx
7-xxxx  646-317-xxxx
4-xxxx  212-932-xxxx
6-xxxx  646-426-xxxx

**Paging**

212-305-5880

**Operator**

212-305-2328

**Mistletoe Operator** 212-305-2500

**Allen Operator** 212-932-4240

**Mistletoe**

CTICU (4HN)  52662
SICU (4HS)  56382
MICU-A (4HS)  56345
MICU-B (4HS)  54141
5HN (cardiac step-down)  54171
5CCU (5HS)  58970
5GN (CHF/chest pain)  56705
5GS (CHF/chest pain)  52825
6HN (oncology)  56535
6HS  52331
6GN (medicine)  55691
6GS (medicine)  57100
7HN (on call surgical)  58078
7HS (transplant)  52332
7GN (ortho)  54585
7GS (hospitalist)  52738
8HN (neurosurg)  54957
8HS (neurology)  54686
8GN (rehab)  54559
8GS (neuroCU)  54550
8MA (annex)  54701
9HN (McKeen)  52332
9HS (med/surg/gyn)  52831
9GS (ID)  52449
Onc clinic  58225
Renal Tx Coordinator  56469
Liver Coordinator  51325
IR  55123

**Heart Center**

CCU (HC5)  74270
CTICU (HC5)  74570

**PACU**

Mistletoe 3  55790/56774
Mistletoe 4  52573

**Harkness**

BMT unit 11th FL  76200

**CHONY/Babies Hospital**

Tower 4  28500
Babies PACU  52573
Tower 5  28530
Babies S5 (stork club)  56730
Tower 6  28560
Tower 7 (NICU)  28600
Tower S5  55919
8 Central  56866
Tower 9 (PICU)  28630
Tower 9N (PICU)  53281
Tower 9S (PICU)  56591
Tower 10 (L&D)  21760
10L&D  21760
Peds IR  28670

**Allen Pavilion**

1RW (L&D)  44142
1RW (post partum)  44143/44144
1RW (Nursery)  44147/44148
1RW (NICU)  45298
2FE  44129
2FW  44128
2RE (stepdown)  44125
2RW  44120
2RW ICU  44124
3RE  44131
3RW  44143

**Emergency Rooms**

Area A  56204
Area B  58072
Area C  58634
Area D  51600
Area E  58072
Peds ER  56628
Allen ER  44245

**Outpatient areas**

Mammo (HIP10)  57426
Peds Onc (HIP7)  55696
Peds Onc (HIP7)  55640

**ORs**

Nurse/Anesth

Mistletoe 3 OR Desk  52270
Mistletoe 4 OR Desk  52565
Heart Center OR Desk  74350
Babies OR Desk  52415
Allen OR Desk  44140
Eye Institute OR  52805
OR 1  52336/52337
OR 2  52342/52356
OR 3  52357/52364
OR 4  52365/52369
OR 5  52396/52397
OR 6  52401/52400
OR 7  52409/52411
OR 8  52402/52408
OR 9  52421/52419
OR 10  52429/52428
OR 11  52452/52450
OR 12  52475/52472
OR 13 (12A)  25648/25649
OR 14  54389/54922
OR 15  54387/54925
OR 16  54388/54926
OR 17  54224/54877
OR 18  54632/54633
OR 19  54232/54927
OR 20  58365/54384
OR 21  54410/54411
OR 22  54412/54836
OR 23  54413/54414
OR 41 (24)  25546/25547
OR 25 / H1  74352/74860
OR 26 / H2  74353/74777
OR 27 / H5  74355/74638
OR 28 / H4  74357/74378
OR 29 / H5  74359/74348
OR 30 / H6  74360/74582
OR 312 / H7  74361/74363
OR 322 / H8  74364/74693

 Babies 1  20672/20673
 Babies 2  20674/20675
 Babies 3  59900/57982
 Babies 4  56477/57999
 Babies 5  56476/57998
 Babies 6  56475/57788
 Babies 7  56473/57785
 Babies 8  56471/57780

 Allen 1  45054
 Allen 2  45055
 Allen 3  45057
 Allen 4  45056
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<tbody>
<tr>
<td>Casey Schadie</td>
<td>55697</td>
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<tr>
<td>Pathology IT</td>
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<tr>
<td>Doreen Hebert</td>
<td>506178730</td>
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<tr>
<td>Dr. Michael Shelanski's Office (Salome)</td>
<td>53300</td>
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<tr>
<td>Tony Barrecco</td>
<td>5723007922</td>
</tr>
<tr>
<td>Joann Herzfeld</td>
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<td>Emily Herzfeld</td>
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<tr>
<td>Pat Pringle</td>
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<tr>
<td>Steve Russo (Notary)</td>
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<tr>
<td>MD/PhD Program (Dr. Patrice Spitalnik)</td>
<td>22911</td>
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<tr>
<td>Allen Transport (Surg path bx's)</td>
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<tr>
<td>CUMC Gym</td>
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<tr>
<td>Edward Kritchevski</td>
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<tr>
<td>Evelyn Thompson</td>
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<td>Mayra Viera</td>
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<tr>
<td>Allen FS Room / Telepathology</td>
<td>4516844675</td>
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<tr>
<td>Autopsy/Fax</td>
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<td>Cytology</td>
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<td>Dermatopathology</td>
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<td>Flow Cytometry (Dr. Adriana Coloval)</td>
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<td>Hemepath Fellow Area</td>
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<td>Histology (Sunn)</td>
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<td>Immunohistochemistry Lab</td>
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<td>Immunogenetics (Dr. Suci-Foca)</td>
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<td>Neuropathology Fellow</td>
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<td>OB/GYN Pathology</td>
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<td>Oral Pathology (Judith Burren)</td>
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<td>Renal Pathology Laboratory</td>
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<td>Surgical Pathology/Fax</td>
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<td>Fennoglo Library</td>
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<td>Frozen Section Room</td>
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<td>Gross Room</td>
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<td>Microscope Room (PH-1568)</td>
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<td>Resident’s Room Fax</td>
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<td>Allen Shuttle</td>
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<td>Surgpath</td>
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<td>Autopsy</td>
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<td>Neuropath Attending</td>
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<td>Allen Admitting/ David Francis</td>
<td>4507944389</td>
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<td>Allen Security</td>
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<td>Babies Admitting/Brian Goldstein</td>
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<td>Graduate Medical Education Office</td>
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<td>Hospital Security</td>
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<td>Milstein Admitting/Steve Estevez</td>
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| Occupational Health                  | 57590                 |
| Payroll Office                       | 5271152744            |
| Patient Relations                    | 55934                 |
| Risk Management                      | 51919                 |
| Scrubs/ Laundry                      | 52841                 |
| Faculty Club                         | 62582                 |
| Telecommunications                   | 57740                 |

<table>
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<tr>
<th>Attendings</th>
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<tbody>
<tr>
<td>Dr. Rosanna Abellair</td>
<td>5117481044</td>
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<tr>
<td>Dr. Bachir Aloeide</td>
<td>2054589471</td>
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<tr>
<td>Dr. Govndh Bhagai</td>
<td>2123584308</td>
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<tr>
<td>Dr. Alain Borczuk</td>
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<tr>
<td>Dr. Peter Canoll</td>
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<tr>
<td>Dr. Xiaowei Chen</td>
<td>5887585251</td>
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<tr>
<td>Dr. John Crapanzano</td>
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<tr>
<td>Dr. John Crary</td>
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<tr>
<td>Dr. Vivette D’Agati</td>
<td>56269</td>
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<tr>
<td>Dr. Phyllis Faust</td>
<td>5734584217</td>
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<tr>
<td>Dr. James Goldman</td>
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<td>Dr. Abel Gonzalez</td>
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<tr>
<td>Dr. Mehrvash Haghighi</td>
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<td>Dr. Diane Hamele-Bena</td>
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<td>Dr. Lara Harki</td>
<td>2478398149</td>
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<td>Dr. Hamina Hibshoosh</td>
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<tr>
<td>Dr. Daniela Hoehn</td>
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<tr>
<td>Dr. Alina Iuga</td>
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<td>Dr. Steven Lapana</td>
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<td>Dr. Jay Leikowitch</td>
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<td>Dr. Xiaolin Liu-Jarin</td>
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<td>Dr. Mahesh Mansukhani</td>
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<td>Dr. Glen Markowitz</td>
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<td>Dr. Kathleen O'Toole</td>
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<td>Dr. Karl Perzin</td>
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<tr>
<td>Dr. Elizabeth Philippine (Oral Pathology)</td>
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<tr>
<td>Dr. Fabrizio Remotti</td>
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<td>Dr. Helen Remotti</td>
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<td>Dr. Marcela Salomao</td>
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<td>Dr. Anjali Saq</td>
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<td>Dr. Hermann Schubert</td>
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<tr>
<td>Dr. Antonia Sepulveda</td>
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<td>Dr. Jorge Sepulveda</td>
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<tr>
<td>Dr. Markus Siegelin</td>
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<td>Dr. Barry Stokes</td>
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<td>Dr. Matthias Szabolcs</td>
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<tr>
<td>Dr. Kurenal Tanji</td>
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<td>Dr. Andrew Teich</td>
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<td>Dr. Benjamin Tycko</td>
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<td>Dr. Jean Paul Vonsattel</td>
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<td>Dr. Patricia Wasserman</td>
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<td>Dr. Thomas Wright</td>
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<td>Dr. Hui-Min Yang</td>
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<tr>
<td>Dr. Angela Yoon (Oral Pathology)</td>
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</tbody>
</table>
Clinical Pathology Numbers

Clinical Laboratory Services (PH3-303)
Director: Dr. Steven Spitalnik 52204/85038
646-267-3800 25648 (lab)
Irina Lutinger 58836
Ivy (Amy) Cahill 51790/52204
Office Assistant: Elizabeth Rodriguez 55159/55602

Core Laboratory (PH3W)
Director: Dr. Alexander Kratz 52654/83518
Assistant Director: Dr. Eldad Hod 25648
Manager: Donald Giacomo 55013
Client Service: Joan Todor 50697
Shift Supervisor 52732/86859
General Client Service 58000
Central Processing (Irene Perez) 59575
Hematology area 53114/59137
Herbert Irving Hematology 58227
Referral Testing (Elenor Pikus) 56245/1.23544

Specialty Laboratory (CHONY2Central)
Jocelyn Valenzuela 50800/88521
Special Chemistry 59383, 57816
Dr. Alex Ral 56849
Dr. Serge Cremers 59287/86763
Serology 59116, 59117
Point of Care (Cheryl McKenzie-Mckie) 26889/85573
Point-of-Care Lab 59291
Dr. Tilla Worgall 53961/88761
Immunohematology (Tilla’s Lab) 59522

Transfusion Medicine (HP4)
Dr. Joseph Schwartz 52677/86733
Dr. Yvette Tanheco 74618/87404
Dr. Brie Stoller 50946/85546
Manager: Robin Hussey 56183
Pheresis Unit (Ronald Villota) 54690/82653
Blood Bank Front Desk 52679/52673
Stem Cell Lab 54448
Blood Bank Supervisor (On Call) 82833
CALM Lab 54837
Stem Cell Lab, Nita (cell) 347-867-5302

Microbiology Lab (CHONY3Central)
Dr. Susan Whittier 56237/87766
Bacteriology: Renu Acharya 56276
Lab Manager: To Be Announced 56281
Bacteriology: Sebastian Gregory 56276
Virology: Shailesh Desai 59118
Mycobacteria: Maria Saragias 58995
Mycology: Edwin Miranda 59777 or 59122
Parasitology: Miguel Gelpi 59128
Molecular Epi: Dr. Fan Wu 56703

Cytogenetics Lab (CHONY4Central)
Director: Dr. Dorothy Warburton 57143
Director: Dr. Brynn Levy 58049
Manager: Antonio Sobrino 55840
Cancer Cytogenetics (Dr. Murty) 59341 / 851-4621
Dr. Vaidheji Jobanputra 57373

Special Hematology (CHONY2Central)
Director: Dr. Richard Francis 24569/86092
Jorge Sepulveda 56360
Special Heme/Coag 56079

Molecular Lab
Molecular Lab 59706
Dr. Mahesh Mansukhani 52646/80511
Dr. Peter Nagy 54617
Molecular Fellow 24467

Other Important Phone Numbers
Allen Lab, Director: Dr. Brie Stoller 50948
Allen Blood Bank/Allen Lab 44235/44234
Allen Lab Manager, Charlotte WuGall 44233
Special Collections NYBC 1-800-439-6876
New York Blood Center 1-800-483-4888

Service extensions/pagers
Apheresis 58982/82754
Chemistry 87055
Components 53220/85836
Hematology 87054