

## Hematology-Oncology

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### I. Inpatient Team Resources –

The intern is responsible for the daily patient management, EXCEPT for ordering chemotherapy. For oncology patients on a complex protocol/regimen, it is most important to learn the common side effects of each chemotherapeutic agent in the regimen and measures to minimize the risk. The intern's principle responsibility is managing immediate complications of chemotherapy or of the primary cancer.

Clinical Nurse Specialist (CNS) and Nurse Practitioner (NP) - The Advanced Practice Nurses (APNs) serve as a resource of information regarding the case management of patients, particularly regarding issues of patient education, discharge planning, coordinating multidisciplinary evaluation, and supportive care.		
Cory Hoepfner, ARNP	469-6766	CNS tumors
Laura Eisenberg, ARNP	469-6663	ALL, Hodgkin's Disease
Ji Lee, ARNP	469-6625	ALL, Non-Hodgkin's Lymphoma, Wilms', Liver tumors, neuroblastomas
Kristin Gard, ARNP & Sue Ehling, ARNP	469-6656	Bone tumors, Sarcomas
Karyn Brundige, ARNP	469-6464	ALL, CML, Aplastic Anemia, Hematology
Dahlia Hanna, ARNP	469-1503	Inpatient APN, AML, Histiocytosis, Retinoblastoma
Ruth White, ARNP	469-6642	Sickle Cell
Laura Winter, PharmD.	469-5528	Pharmacist. Resource for chemotherapy regimens, chemotherapy ordering process, TPN, antibiotics, anti-emetics.
Kathy Hunt, R.D.	469-6474	Will help with ordering and monitoring TPN, enteral supplements, and nutritional assessments.
Mary Jeanne Phipps, MSW	469-6360	Social Worker for Neuro-oncology, Sarcoma
Tanya Ranchigoda, MSW	469-6477	Social Worker for AML, CML, infant ALL, Neuroblastoma, Wilms Tumor, Retinoblastoma, Miscellaneous solid tumors, inpatient SCCA bone marrow transplant.
Fred Wilkinson, MSW	469-0379	Social Worker for ALL, Hodgkins Disease, Non-Hodgkin's Lymphoma, Histiocytosis, Hematology diagnoses and Long Term Follow-up clinic
PCCs (Patient Care Coordinators)	Phone: Ext. 7-4366	Located in the 6 <sup>th</sup> floor Balloon zone, office B6556. PCCs coordinate complex scheduling for our patients.
Pain Service		Patients who receive a patient controlled analgesia (PCA) pump or who have particularly complicated pain management problems are followed by the Pain Service.
Sickle Cell Team • Bender, MD • Ruth White, ARNP • Seema Mhatre, MPh, MSW	469-1661 469-6642 469-3974	Several days a week, Bender and/or Ruth will attend the beginning of rounds to discuss patients with sickle cell disease. Because they follow patients with sickle cell disease over many years, they provide useful information regarding previously successful management strategies.
Hemophilia Team • Dana Matthews, MD • Cheryl Brower, RN, PSBC	469-5126 ph: 292-6573	Cheryl Brower functions as clinical nurse specialist for the hemophilia patients through the Puget Sound Blood Center. She is very familiar with the patients, disease, and anti-hemophilic factor concentrates. Dana oversees the treatment.
Children's Hospital Home Care Services (CHHCS)	(425) 482-4207 (425) 482-4200	CHHCS is the home care agency that follows ~80% of patients. Verify that this is the appropriate home care agency. They provide teaching for TPN and home antibiotics with the families (allow 2-3 days for adequate first-time teaching). When discharging a patient home with antibiotics, the intern can order them through CHHCS. Home TPN will be arranged by the dietitian and pharmacist.
Children's Oncology Group (COG)		COG in a national organization of greater than 200 pediatric cancer centers across the country and around the world. Over the past 40 years, it has organized randomized therapeutic studies that have led to dramatic improvements in the survival of children with cancer. Most of the children treated on the Hem-Onc service will be enrolled on one or more COG studies. Each study has a strict set of requirements, including laboratory tests, scans, and other documentation. Patients not enrolled on a COG study are often treated with a study protocol developed at CHRMC.

## II. RESOURCES

- A. **Hem-Onc Division Policies** –Some problems encountered on this service, (e.g. fever and neutropenia and other infectious issues, varicella exposure, methotrexate clearance, extravasation management) are addressed by specific policies agreed upon uniformly by the division. These are located in the SCCA conference room in the 3-ring binder labeled **CLINICAL GUIDELINES**.
- B. **Patient's old charts** - these come with the patient to the floor and are kept in a file cabinet in the conference room. **All medical evaluations on all established HemOnc patients are performed in CIS.** Outpatient documents include a Summary Medical History that provides pertinent information on diagnosis and treatment. To access outpatient documents go into CIS under Documents/Outpatient/HemOnc Interval Note. **Additional important information to obtain from the chart:**  
The roadmap - this is a plan for the patient's chemotherapy, including what the patient has received, is currently receiving, and/or is due for. It is located on the left side of the chart.  
Blood product status – This information will be included in the patient's outpatient Interval Note on CIS. Information may also be included on CIS Blood Transfusion Profile under Ad Hoc Charting. You need to know whether the patient requires leuko-reduced, volume-reduced, or CMV- blood products.  
Immune titers – Serum for CMV, HSV, VZV titers are usually obtained at the time of initial diagnosis prior to blood transfusion. Because blood transfusion may transfer passive immunity, titers obtained following transfusion are not a reliable indicator of viral immune status unless negative. If not located in hard chart, refer to electronic medical record.
- C. **Principles and Practice of Pediatric Oncology (Pizzo and Poplack) and Hematology of Infancy and Childhood (Nathan and Orkin)** - both excellent detailed textbooks kept in the SCCA conference room. They provide specific information regarding the diseases seen on the Hem-Onc service.
- D. **Supportive Care for Children with Cancer** - an aqua colored book; should be a copy for each intern, in the SCCA conference room. Has general chapters on fever and neutropenia, side effects of chemotherapy, etc. ***Good to read through in the first few days of the rotation.***

## III. The PATIENTS. There are general groups of patients.

- A. **Admit from clinic for routine chemotherapy** - These patients have a known cancer and are being admitted for routine, pre-scheduled chemotherapy. They are almost always admitted on a weekday from Hem-Onc clinic in the afternoon. They arrive with a completed history, physical, and orders. On the day of admit, the intern's job is to become familiar with the case, meet the family, do brief exam, and add any orders that may have been forgotten (such as home medications). While the patient is inpatient, the intern manages the side effects of the chemotherapy (nausea and vomiting, etc). It is important to know the major side effects of their regimen, so they can be accounted for on rounds (e.g., hematuria, nausea, vomiting, fever, hypotension).
- B. **New Diagnosis** - The fellow and attending will be *very involved* in these cases; organizing diagnostic evaluations and procedures and communicating information/diagnosis and prognosis to the patient and family. During the inpatient stay, the patient will have a complex workup for their diagnosis, including pre-chemotherapy baseline studies (e.g., radiographic scans, biopsies, ECHO, iothalamate clearance or GFR, lab studies), and usually start chemotherapy within 1-3 days. These plans will be outlined in team rounds. These patients represent great learning opportunities for interns by having the fellow or attending review the scans, marrows, etc. Residents are strongly encouraged to participate in family conferences and family teaching sessions.
- C. **Fever and Neutropenia (F&N)** – Typically these patients recently received myelosuppressive chemotherapy 7-10 days prior, so their absolute neutrophil count (ANC) is now < 200/ $\mu$ l (or have a falling ANC soon to be < 200/ $\mu$ l), and they have a fever. Source of fever can be very difficult to ascertain when the patient's ANC is low. The medical providers must be very careful about looking for occult infections (e.g. typhlitis, mucositis, cellulites, etc).
- D. **Seriously Ill or Unstable Patients** - These patients have developed more serious complications of their disease or the therapy. Many have received intensive chemotherapy, either for AML, neuroblastoma, or sarcomas. They may be on the service for a long time, require multiple scans, different antibiotics, consults, etc., and frequent transfer to the PICU during part of their care.
- E. **Hematology patients** - Includes sickle cell pain crises, fever in asplenic hosts, severe anemia, ITP, and hemophilia. The majority of patients with sickle cell have a pre-designed plan for pain management that is documented under Care Plan / Coordination Plan on CIS. A Vaso-Occlusive Crisis order set exists on CIS for admissions. Other patients with benign hematologic conditions are an excellent way to learn about general hematology, including the evaluation for anemia and coagulation.

#### IV. DAILY RESPONSIBILITIES

##### A. Rounds/Sign Out

- 1) Morning: Team rounds are in the SCCA conference room. The purpose of morning rounds is to synthesize data about a patient's course and decide upon a plan for the day. The bedside nurse is present for this. Because patients usually have multiple active issues, several topics may require discussion and decisions.

Present by systems:

Principle diagnosis, reason for admission and events overnight (especially fever spikes)

Fluids, Electrolytes, Nutrition

Heme - counts, transfusions, ANC

Oncology / Chemotherapy – specific agents received or planned

ID - fevers, antibiotics

Gastrointestinal

Pain

Psychosocial / Quality of Life

Other issues as necessary (e.g., respiratory, endocrine, nervous system, skin)

- 2) Immediately after team rounds: Each intern will individually walk around with the fellow & attending to see their patients. If morning rounds have extended past noon then only the on-call resident will see patients with the fellow and attending to allow other residents to sign-out (if post-call or have continuity clinic) or to go to resident noon conference.

- 3) Sign-out: The interns sign out to fellow on service or to the on call intern before they leave for the day. The fellow on service signs out to the on call intern and the on call fellow before they leave for the day (usually, around 5 pm)

Key issues to include on sign-out:

- 1) Is the patient neutropenic or likely to become neutropenic soon?
- 2) What to do in response to fever, (e.g., obtain Bld Cx, start ceftazidime, CXR, examine the patient, etc.)
- 3) Define baseline status, including respiratory, neurologic, and hemodynamic.

Following sign-out rounds, the on-call intern and the on-call fellow meet with the PICU resident and fellow to discuss any unstable patients before the Hem-Onc fellow goes home at night. The on-call intern and fellow should meet the PICU resident and fellow even if there are no unstable patients.

- 4) On-call: There are several resources while on-call. The primary resource is the on-call fellow. They expect the intern to call regarding any issue about which the intern is uncertain, including the addition of new antibiotics, the treatment of persistent emesis or bleeding, or complex fluid and electrolyte problems. The on-call fellow is expected to return to the hospital to evaluate all newly diagnosed patients, any patient who is being considered for transfer to the PICU, or to assist in any issue that the intern feels requires direct examination by the fellow. The intern should not be reluctant to call the fellow or request that the fellow return to the hospital. For more minor issues, the intern should talk with the PICU resident or fellow, including asking them to examine a patient, review an x-ray, or discuss laboratory abnormalities. The attending expects to be called by the fellow regarding all admissions or any significant change in a patient's status, such as transfer to the PICU. The intern can contact the attending directly regarding any patient care matter as an additional resource.

**B. Parenteral Nutrition (PN)** - PN orders are written by the Hem/Onc pharmacist and the Hem/Onc dietitian in collaboration with the Hem/Onc team (intern, inpatient fellow and attending). To initiate a patient on PN, enter the "New PN per pharmacy protocol" orderable in CIS. The Hem/Onc dietitian will perform a nutrition assessment and make recommendations regarding the PN therapy in the patient's medical record. The Hem/Onc pharmacist will prescribe PN based on the dietitian's recommendations once they have been discussed with the Hem/Onc team. The dietitian / pharmacist will document the plan for PN, including electrolyte therapy, in the medical record. PN therapy will be evaluated daily during rounds and changes will be made as necessary based on fluid status, oral intake and electrolyte values after discussion with the Hem/Onc team.

**C. K<sup>+</sup>** - Occasionally, a patient may require intravenous infusions of potassium. If the IVF contains > 100 mEq/l K<sup>+</sup> or a rate > 0.3 mEq/kg/hour K<sup>+</sup>, or the patient is on a K<sup>+</sup> drip, the CHRMC Potassium Guidelines take effect (see the on-line Potassium or Phosphate Repletion, Intravenous Policy & Procedure for details. Patients must be on a CR monitor and have K<sup>+</sup> checks q2hrs until stable. Potassium drips may be written in CIS via the HemOnc Potassium Drip Order set. The fellow or attending must co-sign the order for a potassium drip. Alternatively, the fellow or attending may write the order in CIS themselves without co-signature.

**D. Examining the patients** – Each patient must be examined every day and a note written summarizing findings and pertinent laboratory data. **The intern should review each patient's medication record (MAR) on CIS and chemotherapy MAR at bedside (if applicable).** Make specific reference in the note to having discussed the patient with the Hem-Onc attending. Stable patients receiving routine chemotherapy without complications may have only one note over the weekend but still need to be examined and have their flowsheets and laboratory data reviewed daily.

**E. Procedures** – Oncology patients have multiple procedures performed during their therapy, particularly lumbar punctures and bone marrow aspirations/biopsies for patients with leukemia. Many of these procedures are done under anesthesia in the Hem-onc Clinic. This is an ideal opportunity to learn these skills. Whenever possible, interns should perform these procedures on their patients.

## V. COMMON HEM-ONC PROBLEMS

**A. Fever and Neutropenia** – Because of risk of rapid clinical deterioration in neutropenic patients, any sign of infection is a medical emergency.

**Definition:** Any single temperature  $\geq 38.3^{\circ}\text{C}$  and ANC  $< 200/\mu\text{l}$  ---or--- Fever and ANC predicted to fall  $< 200/\mu\text{l}$  in next 24 hours ---or--- Ill-appearing patient regardless of temperature or ANC

**History:** diagnosis, date and agents used in most recent chemotherapy, previous infectious complications, respiratory/urinary/enteric symptoms, chills or rigors, mouth or throat pain, most recent blood counts, HSV/VZV/CMV serology status, antibiotic prophylaxis (PCP, HSV, fungal), other medications.

**Examination:** vital signs, mouth for mucositis/thrush, line site for redness/tenderness/discharge, chest, abdomen for tenderness, perianal area for erythema, skin for erythema/tenderness.

**Laboratory:** CBC with ANC, blood cultures (anaerobic, aerobic and fungal bottles from each lumen), UA and urine culture (but DO NOT withhold antibiotics waiting for urine specimen), CXR and nasal wash for respiratory virus FA and culture if respiratory symptoms, gram stain and culture of line site if suspicious, stool for *C. difficile* toxin if diarrhea, LP only if significant CNS symptoms or infant.

**Treatment:** (CPOE order set is available on CIS, also see [Infectious Disease Management Guidelines in HemOnc Clinical Guidelines Binder](#))

- 1) Fluids if tachycardic, hypotensive, or clinically dehydrated
- 2) Start empiric antibiotics within 1 hour of fever or new symptoms

All patients:	<b>Ceftazidime</b> 150 mg/kg/day $\div$ Q 8 hours; 2000 mg max. dose
Cellulitis:	<b>ADD Nafcillin</b> 100-200 mg/kg/day $\div$ Q 6 hours, 2000 mg max. dose
Septic appearing or hypotension:	<b>ADD Gentamicin</b> 7.5 mg/kg/day $\div$ Q 8 hours, check levels @ 3rd dose. Be sure renal function is normal. Consider Vancomycin 45 mg/kg/day IV $\div$ q8h for additional coverage of gram positive organisms.
Abdominal or perirectal pain:	<b>Gentamicin</b> (see dose above) and <b>Clindamycin</b> 30 mg/kg/day $\div$ Q 8 hours, 900 mg max. dose.
Severe mucositis with potential concerns for $\alpha$ -Strep	<b>Clindamycin</b> 30 mg/kg/day $\div$ Q 8 hours, max dose 900 mg - or - <b>Cefazolin</b> 50-100 mg/kg/day $\div$ Q 8 hours, max dose 2000 mg.
(+) Bld Cx: Gram Neg Rod	<b>ADD Gentamicin</b> (see dose above) to <b>ceftazidime</b> until cultures and sensitivities are reported.
(+) Bld Cx: Gram Pos Cocci	<b>ADD Vancomycin</b> 45 mg/kg/day IV $\div$ q8h (in patients with nl renal function). Check levels around 5 <sup>th</sup> dose. Continue until Cx & sens are reported.

**Management in hospital:** Culture daily for fever, especially if rigor, repeat examination at least daily to detect new focus of infection. **Modifications in antibiotics are made only in response to new clinically or microbiologically defined sources of infection, not because of persistent fever.** The only exception to this rule is the empiric use of amphotericin. Amphotericin is added because of persistence or re-emergence of fever after 7 days of empiric antibacterial antibiotics.

**Amphotericin** 0.5 mg/kg/dose IV daily over 2 hours (if central line present); give with acetaminophen and diphenhydramine pre-medication and provide saline loading with 10 cc/kg of NS IV before infusion. Patients may require meperidine 1 mg/kg IV for chills or rigors caused by amphotericin. CPOE order set is available on CIS. Consider use of liposomal amphotericin (Ambisone®) 3 mg/kg/dose IV daily if patient's serum creatinine doubles on conventional amphotericin or if the patient is receiving or scheduled to receive nephrotoxic chemotherapy, is receiving other nephrotoxic medications or has history of renal insufficiency. See Hem/Onc Fungal Guidelines located in the HemOnc Clinical Guidelines Binder in SCCA conference room for specific details.

### B. Prophylactic antibiotics

- 1) **Bactrim** - patients at high risk for PCP (lymphoma, leukemia,  $< 2$  yo receiving aggressive chemotherapy, transplant) receive Bactrim prophylaxis. It will be held during unexpected neutropenia, as it has potential to suppress bone marrow, and during high dose methotrexate infusion (drug interaction). **Dosing** - based on TMP – 5 mg/kg/day divided BID Q Mon/Tues.

- 2) **Dapsone** – In patients intolerant of Bactrim for PCP prophylaxis, dapsone 1 mg/kg/day (max 100 mg/day) PO daily is an option. In patients who experience anemia, the dose may be given divided BID.
- 3) **Fluconazole** – Patients with AML, relapsed ALL during induction therapy, or patients receiving high dose chemotherapy requiring PBSC rescue (i.e. VACIME) receive prophylactic fluconazole. It is started on the day of discharge from chemotherapy, continued throughout neutropenia, and stopped when the patient is off of broad spectrum antibiotics and the ANC >200/ $\mu$ l after the neutrophil nadir. **Dosing** - 5 mg/kg/day (max 200mg) daily, rounded to the nearest 50 mg (PO is preferred!).
- 4) **Acyclovir** - If a patient is HSV+ by serology and will likely develop mucositis, start prophylactic acyclovir on the day of discharge from chemotherapy, continue throughout neutropenia, and stop when the ANC >200/ $\mu$ l after the neutrophil nadir. **Dosing** - 15 mg/kg/day PO divided BID, rounded to the nearest 100 mg. If **treating** suspected or confirmed mucocutaneous HSV in a neutropenic patient: 250 mg/m<sup>2</sup>/dose IV q8h or 600 mg/m<sup>2</sup> PO q 6h.

**C. Newly diagnosed oncology patients** – It is the fellow's and attending's responsibility to arrange the initial diagnostic evaluation, discuss the results with the patient and family, and order chemotherapy. It is very instructive for the intern to attend the family conferences when newly diagnosed patients are told about the disease and the proposed therapy.

**History:** Initial time of symptoms, including pain, fever, pallor, bleeding, swelling, decreased energy, reduced appetite, headaches, vomiting, prior medical history or constitutional syndrome, current medications, history of varicella, prior immunizations, family history (including parents, siblings, grandparents, aunts, uncles, cousins) of malignancy or other significant illnesses.

**Examination:** Vital signs, mouth for mucositis/thrush, chest, abdomen for tenderness, perianal area for erythema, skin for erythema/tenderness, testicles in boys (particularly with leukemia), cranial nerve exam (especially for leukemia, brain tumors), measurement of all palpable masses and lymph nodes.

**Laboratory:** CBC with differential, lytes, BUN, Cr, AST, Bili, Alk Phos, Ca, Phos, Mg, Uric acid (if leukemia or lymphoma), PT/PTT/TT/Fibrinogen (if leukemia or history of bleeding), HSV/VZV/CMV immune status by antibody serology (preferably prior to blood transfusion), type and cross for CMV- irradiated PRBC if anticipate transfusion, blood cultures if febrile, UA and urine culture if urinary symptoms, CXR if respiratory symptoms and for all leukemia patients, gram stain and culture of suspicious skin lesions.

**Other tests:** Specific studies depend upon the suspected diagnosis and therapy.

Bone marrow aspiration/biopsy: leukemia, neuroblastoma, lymphoma, Ewing's sarcoma, rhabdomyosarcoma.

Lumbar puncture: leukemia, lymphoma, parameningeal rhabdomyosarcoma, brain tumor.

Chest CT: kidney and liver tumors, sarcoma, lymphoma.

CT/MRI: primary lesion of any solid tumor.

Bone scan: neuroblastoma, sarcoma.

MIBG: neuroblastoma / Gallium scan: Hodgkins and Non-Hodgkin's lymphoma

Cardiac echo: any patient who will receive anthracyclines, such as doxorubicin or daunorubicin.

Iothalamate or urine creatinine clearance: any patient who will receive cisplatin, carboplatin, or ifosfamide.

Audiogram: any patient who will receive cisplatin or carboplatin.

**D. Tumor lysis syndrome** – Patients with rapidly dividing tumors, exquisitely chemotherapy sensitive tumors, and large tumor burdens, are susceptible to multiple metabolic complications following the start of chemotherapy. These malignancies include T-cell ALL or lymphoma, Burkitt's lymphoma, and leukemia patients with initial WBC counts >200,000/ $\mu$ l. All patients with leukemia and non-Hodgkin's lymphoma are treated preventively for tumor lysis syndrome.

**Metabolic effects:**

- 1) Increased uric acid, potassium, and phosphorus, secondary to release from tumor cells.
- 2) Decreased calcium, secondary to binding and precipitation by phosphorus.
- 3) Renal insufficiency, secondary to precipitation of uric acid and calcium-phosphate crystals in the kidney. Renal insufficiency worsens all of the above abnormalities.

**Management:**

- 1) Vigorous hydration with 1.5-2 x maintenance IVF to keep urine output >2-3 cc/kg/hour. Uric acid is poorly soluble in urine, so keeping the urine dilute will reduce precipitation. If urine output is inadequate, confirm adequate hydration and consider a diuretic, such as furosemide or mannitol.
- 2) Alkalinization with D<sub>5</sub>0.2NS with NaHCO<sub>3</sub>. 40 mEq/L. Uric acid is more soluble in alkaline urine.
- 3) Do not include KCl in the IVF initially.
- 4) Allopurinol inhibits the production of uric acid from xanthine. Dose of Allopurinol 10 mg/kg/day *or roughly*:
 

< 20 kg	50 mg po TID
20-40 kg	100 mg po TID
>40 kg	200 mg po TID

- 5) For patients with elevated uric acid at presentation, uric oxidase may be used to immediately metabolize existing uric acid.
- 6) Monitor lytes, BUN, Cr, uric acid, Ca, Phos, and I&O carefully (q4-6 hours for high risk patients, q12 hours for low risk patients).
- 7) Dialysis may be necessary for hyperkalemia, hyperuricemia, hyperphosphotemia, volume overload unresponsive to medical measures and/or worsening renal insufficiency.

### Common Pediatric Malignancies

Diagnosis	Incidence (0-14 years)	Peak age, years	Presenting symptoms	Poor risk features	Treatment	Prognosis
<b>Acute lymphoblastic leukemia (ALL)</b>	25/10 <sup>6</sup>	1-5	Fever, bleeding, pallor, lymphadenopathy, bone/joint pain, organomegaly	WBC >50k, Age <1 or >10, t(4;11), t(9;22)	Multiagent chemo Boys: 38 months Girls: 26 months	70-80%
<b>Acute myelogenous leukemia (AML)</b>	5/10 <sup>6</sup>	None	Fever, bleeding, pallor, lymphadenopathy, bone/joint pain, organomegaly	WBC > 100k, Monosomy 7, 2° prior chemo	Very intense chemo Marrow transplant if HLA-matched sib	45-55%
<b>Brain tumors:</b> Astrocytoma Medulloblastoma Ependymoma	24/10 <sup>6</sup> 11/10 <sup>6</sup> 5/10 <sup>6</sup> 3/10 <sup>6</sup>	None	Nausea, vomiting, cranial nerve palsy, focal weakness, seizures	Incomplete rxn, mets. to spine or intracranial, < 3years old	Surgery/±XRT/±chemo Surgery/XRT/chemo Surgery/XRT/?chemo	45-90% 30-70% 30-60%
<b>Lymphoma:</b> Hodgkin's Burkitt's Lymphoblastic	13/10 <sup>6</sup> 6/10 <sup>6</sup> 2/10 <sup>6</sup> 2/10 <sup>6</sup>	>12 >3 >3	Cervical/mediastinal LN Abdominal mass Mediastinal mass	BM+, bulky LN CNS+ CNS/BM+	Outpt. chemo 4-6mth/XRT Intense chemo 2-6 mth Multiagent chemo 24 mth	>90% 80-90% 70%
<b>Neuroblastoma</b>	12/10 <sup>6</sup>	0-4	Abd. mass, posterior mediastinal mass, ptosis, bone pain, limp, ataxia	Age >1 year, BM/bone mets, N-myc ↑	Low risk: surgery Inter. risk: surgery/chemo High risk: intense chemo/ Surgery /transplant/XRT	>95% >90% 10-30%
<b>Wilms' tumor</b>	10/10 <sup>6</sup>	0-6	Flank mass, hematuria, hypertension	Pulm. mets, anaplastic histology	Surgery Outpt. chemo 6 mth ±XRT	75-95%
<b>Rhabdomyosarcoma</b>	4/10 <sup>6</sup>	1-10	Muscle mass, esp. face, testicle, bladder, extremity	Pulm/BM/bone/ LN mets	Intense chemo/surgery/XRT	80% 20%(mets)
<b>Osteosarcoma</b>	3/10 <sup>6</sup>	>10	Bone lesion, pain, swelling, usually knee	Pulm. mets.	Intense chemo/surgery	60-70% 15%(mets)
<b>Ewing's sarcoma</b>	2/10 <sup>6</sup>	>10	Bone lesion, pain, swelling	Pulm/BM/bone mets, >18 years	Intense chemo/surgery/±XRT	65% 20%(mets)
<b>Hepatoblastoma</b>	1/10 <sup>6</sup>	0-3	RUQ mass	Pulm. mets	Surgery/chemo	70-95% 20%(mets)

## E. Nausea and Vomiting –

### General Principles

- Chemotherapy-induced emesis usually resolves within 24 hours following administration. Exceptions: cisplatin (can last up to 5 days after); cyclophosphamide, ifosfamide, carboplatin, and idarubicin (can last 1-2 days after dose).
- Understand the emetogenic potential of each drug in the regimen.
- Consider the patient history: what has worked, what has not worked previously.
- Use scheduled anti-emetics rather than PRN.
- Although complete control of nausea and emesis is the goal, this may not always be possible.
- Various dosing ranges of anti-emetics are published. The dosing recommendations provided below are preferred for our patient population.

Emetogenic Potential of Chemotherapy Agents Used at CHRMC (modified from Craig *et al. Am J Med Sci* 1987):

<b>HIGH</b>	cisplatin, high dose cytarabine (Ara-C)
<b>MOD HIGH</b>	cyclophosphamide, ifosfamide, carboplatin, oral procarbazine, oral lomustine, methotrexate (doses > 200mg/m <sup>2</sup> ), idarubicin, dactinomycin
<b>MODERATE</b>	doxorubicin (Adriamycin), daunorubicin, IT cytarabine
<b>MOD – LOW</b>	etoposide, bleomycin, oral hydroxyurea, lower dose cytarabine, vinblastine, fludarabine, low dose methotrexate (doses < 200mg/m <sup>2</sup> )
<b>LOW</b>	vincristine, oral thioguanine, oral mercaptopurine, corticosteroids

### Pharmacologic Agents

- **Ondansetron (Zofran)**, 5HT<sub>3</sub> antagonist. Extremely effective for chemotherapy-induced emesis. Duration of action of the big dose is 18-24 hours. Daily dosing may be adequate for some regimens, however many patients will require a "breakthrough" dose approximately 18 hours after the initial dose. Also very effective for radiation-induced emesis. Ineffective for the DELAYED phase of cisplatin-induced N/V.

<b>Fractionated Chemotherapy == Highly emetogenic regimens (i.e., 5 day admissions)</b>	
0.45 mg/kg (max 24 mg) IV q 24h during chemo. May give 1 breakthrough dose of 0.15 mg/kg (max 8 mg) in a 24 hour period. Do NOT change the time of the "Big Dose," as it is usually timed just before chemotherapy each day. -or- 0.15 mg/kg (max 8 mg) IV q8h around the clock during chemotherapy.	
<b>Mild to moderate chemotherapy</b>	
0.15 mg/kg/ (max 8 mg) IV or PO x 1 dose pre chemo -or- 0.45 mg/kg (max 24 mg) IV or PO x 1 dose pre-chemo.	
<b>Discharge Prescriptions (usually after cyclophosphamide, carboplatin, ifosfamide, or idarubicin regimens)</b>	
>30 kg pt: 4 mg PO BID x 2 days (Not PRN); Disp #4; <30kg pt: 2mg PO BID x 2 days (Not PRN) Disp #4	
<b>Patients with F&amp; N receiving opiates (not chemotherapy induced emesis). Doses in this setting are lower.</b>	
>50 kg patient: 4 mg IV or PO q8h PRN	35-50 kg patient: 3 mg IV or PO q8h PRN
20-35 kg patient: 2 mg IV or PO q8h PRN	10-20kg patient: 1 mg IV or PO q8h PRN

- **Metoclopramide (Reglan)** - Higher doses than those used for gastroparesis are used for the anti-emetic benefit. Must use an anti-cholinergic agent (typically diphenhydramine) to minimize EPS. Good efficacy and limited EPS with the 0.5 mg/kg/dose IV q4-6 hours.
- **Diphenhydramine (Benadryl)** - Not a true anti-emetic (effect is sedation), though frequently used as one. Dosing: 1 mg/kg (max: 50 mg) IV q4-6 hours.
- **Lorazepam (Ativan)** - Benzodiazapine - amnestic and anxiolytic properties. Middle to lower range dosing reduces risk of hallucinations. Dosing: 0.03 mg/kg/dose IV q4-6h. Has been shown to worsen N/V and increase adverse effects in children under 6 years of age, however has good success in adolescents.
- **Dexamethasone (Decadron)** - Synergistic with ondansetron. Highly effective for cisplatin delayed N/V. Dosing: 0.3 mg/kg/dose PO QD while receiving chemotherapy. For cisplatin-induced delayed N/V discharge Rx: 0.05 mg/kg/dose PO TID x 3-5 days.
- **Dronabinol (Marinol)** THC derivative - Doses to produce "high" must be used in order to achieve anti-emetic benefit. The starting dose is 5 mg/m<sup>2</sup>/dose PO q4-6h but may need to be escalated up to 10 mg/m<sup>2</sup>/dose. Available only as oral.

(Hematology/Oncology –Drs. Bender, Geyer, Hawkins, Matthews, Park & Winter, PharmD– Rev. 4/05)

## F. Antineoplastic Agent Toxicities – Commonly used anti-neoplastic agents, toxicities & related agents.

### Asparaginase and Pegaspargase (IM administration)

- Hypersensitivity reactions are common. Usually mild, however can be life threatening
- Hyperglycemia
- Hepatic protein synthesis depression, resulting in hypoalbuminemia, coagulopathies
- Pancreatitis with or without increased amylase, lipase
- ↑ BUN (common after the first dose)
- Stroke, thrombosis
- Fatty infiltration in the liver (rare)

### Bleomycin

- Anaphylactoid reaction - most commonly seen in lymphoma patients
- High incidence of fever with or without chills
- Hyperpigmentation
- Pulmonary fibrosis presenting as dry cough, dyspnea, rales, and infiltrates. Cumulative dose phenomenon. (PFT's monitored)

### Carboplatin

- Myelosuppression, particularly thrombocytopenia
- N/V, ototoxicity, nephrotoxicity, & neurotoxicity, but less severe than with cisplatin

### Cisplatin

- Delayed N/V - severe and can be delayed for 4-5 days after the dose - dexamethasone is particularly useful for delayed N/V. Also severe acute N/V is common.
- Nephrotoxicity -renal tubular damage, electrolyte wasting (particularly magnesium). Forced diuresis with mannitol and hydration with monitoring urine output is required.
- Ototoxicity, high frequency loss common (monitored with BAER or audiogram)
- Peripheral neuropathy
- Hypersensitivity reactions - rare
- Myelosuppression is minimal - except when in combination with other myelosuppressive agents

### Cyclophosphamide (Cytosan)

- Myelosuppression
- N/V - dose related, but can persist for 1-2 days after cyclophosphamide given
- Hemorrhagic cystitis - MESNA (a uroprotector that binds the toxic metabolite) and aggressive IVF for doses greater than  $1\text{gm/m}^2$ . Dehydrated patients and patients with compromised renal function are at higher risk.
- SIADH (high dose). Use diuretic to eliminate free water after infusion
- Late effect: infertility

### Cytarabine (Ara-C, cytosine arabinoside)

- Myelosuppression
- Mild to moderate mucositis
- N/V - severe with high dose; moderate with lower doses and IT administration
- Fever with or without flu-like syndrome
- Associated with increased frequency of alpha Strep bacteremia; increased frequency of typhlitis
- Hepatic dysfunction and acute pancreatitis (rare)
- Other high dose toxicities (doses  $>1\text{gm/m}^2$ ): conjunctivitis (administer with prophylactic artificial tears or steroid eye drops), cerebellar dysfunction, and dermatologic reactions

### Corticosteroids

- Conversion from prednisone (tabs) to prednisolone (liquid) = 1:1
- Conversion from prednisone to methylpred (IV) = 1: 0.8

### Dactinomycin (Actinomycin D, Cosmegen)

- N/V - moderate
- VESICANT - if extravasated, refer to the Clinical Services Policies and Procedures on Children's website
- Myelosuppression
- Radiation recall

- Mucositis

#### **Daunorubicin (daunomycin), Doxorubicin (Adriamycin), and Idarubicin (Idamycin)**

- Myelosuppression
- Mucositis
- N/V - moderate
- VESICANT - if extravasated, refer to the Clinical Services Policies and Procedures on Children's website
- Cardiomyopathy - cumulative dose effect (monitor with ECHO or MUGA)
- Red to orange color in urine from excretion, not hematuria

#### **Etoposide (VP-16, Vepesid)**

- Hypotension during the infusion (especially if infused over 30 minutes or less). The hypotension is related to the organic solvent vehicle and can be ameliorated by prolonging the etoposide infusion
- Myelosuppression
- N/V- moderate
- Mucositis
- Secondary AML

#### **Filgrastim (G-CSF, Neupogen)**

- Shortens the period of neutropenia following chemotherapy
- Post chemotherapy dosing is typically 5 mcg/kg/dose SQ daily until the post-nadir ANC > 2000/ $\mu$ l. Variations on this dosing exist, particularly if the patient will be stem cell harvested, or has chronic neutropenia
- Toxicities are minor, but include pain at the injection site and bone pain

#### **Ifosfamide**

- Hemorrhagic cystitis - MESNA must always be administered to detoxify the urine as a preventative measure. IVF are run at a minimum of twice maintenance ( $125 \text{ mL/m}^2/\text{hr} = 2x \text{ maintenance}$ )
- Myelosuppression
- Neurologic: lethargy, confusion, and seizures
- Renal toxicity - renal tubular damage with electrolyte wasting
- Late effects: infertility

#### **Leucovorin**

- A reduced folate (not a chemotherapeutic agent) used as a rescue following high dose methotrexate (doses >1  $\text{gm/m}^2$ )
- It is IMPERATIVE that patients on high dose methotrexate have appropriate monitoring of their urine output, Cr, and methotrexate serum concentrations vs. time. Refer to the methotrexate section in the SCCA conference room. Policies to determine if leucovorin doses need adjustment after methotrexate levels have been reported by the lab

#### **MESNA**

- A urinary detoxifying agent used in conjunction with higher doses of cyclophosphamide and all doses of ifosfamide to prevent hemorrhagic cystitis. Binds to acrolein, the metabolite responsible for bladder wall damage
- False positive ketones on urine dipstick

#### **Methotrexate**

- Mild myelosuppression
- Mucositis
- Hepatotoxicity
- CNS toxicity, particularly with IT administration or high dose IV infusions
- Renal failure with high doses (doses >1 $\text{gm/m}^2$ ) secondary to poor urine solubility. Requires alkalization to prevent precipitation of methotrexate in urine. Renal impairment can alter methotrexate clearance resulting in severe myelosuppression and mucositis. Altered methotrexate clearance requires leucovorin dosing adjustment. Refer to leucovorin (see above) and the policies in the SCCA conference room for more information about high dose methotrexate

#### **Mercaptopurine (6-MP)**

- Mild myelosuppression
- Hepatotoxicity

**Procarbazine (Matulane)**

- Myelosuppression
- Flu-like syndrome seen occasionally, but usually only with initiating therapy
- DRUG / FOOD INTERACTIONS - Procarbazine is a MAO inhibitor - tyramine containing foods (wines, cheeses, bananas), tricyclic anti-depressants, meperidine are contraindicated

**Thioguanine (6-TG)**

- Mild myelosuppression
- Hepatotoxicity

**Vinblastine (Velban)**

- Neurologic toxicities, though less frequently than with vincristine
- VESICANT - if extravasated, refer to the Clinical Services Policies and Procedures on Children's website
- SIADH
- Myelosuppression

**Vincristine (Oncovin)**

- Neurologic: seizures peripheral neuropathy, absent DTRs, leg weakness, foot drop, jaw soreness, constipation (especially when given weekly for 4 or more weeks, use prophylactic stool softeners)
- VESICANT - if extravasated, refer to the Clinical Services Policies and Procedures on Children's website
- SIADH

**G. Vaso-Occlusive Pain in Child with Sickle Cell Disease**

History: Prior history of pain crises/acute chest syndrome, onset and sites of pain (including chest, abdomen, extremities), pain medication use prior to admission, fluid intake, fever, URI symptoms, ill contacts, prophylactic antibiotics. Any history of potential triggers e.g dehydration, cold, over-exertion or trauma.

Examination: Vital signs, chest, abdomen (including spleen size), bone and joint tenderness, hydration status.

Monitoring/Laboratory:

- 1) Continuous pulse oximetry: If any respiratory symptoms present or if on parenteral narcotics.
- 2) CBC with differential and reticulocyte count on admission.
- 3) CXR if cough, chest pain, hypoxia, or any respiratory symptoms present or develop after admission.
- 4) Blood culture, urinalysis/urine culture if febrile; other cultures as indicated.
- 5) Consider renal (BUN, Cr) and liver (T/D bili, ALT) function tests for very severe pain or any evidence of encephalopathy (R/O acute multi-organ failure syndrome).
- 6) Consider abdominal ultrasound and liver function tests for RUQ pain (R/O cholelithiasis, cholecystitis).
- 7) Type and cross match for RBC (extended phenotype, leukocyte depleted, sickle-negative) if Hgb is 1-2 gm/dL or more below baseline, evidence of acute chest syndrome, or cardiovascular compromise.

Treatment:

- 1) Do not bolus with IVF unless dehydrated if patient has a history of fluid intolerance or acute chest syndrome. Maintain "euvolemia." IV + PO 1-1.25 x maintenance. More fluids are appropriate only if patient is dehydrated and/or insensible losses are increased (e.g. persistent fever). Avoid excessive fluids, which may precipitate or exacerbate acute chest syndrome.
- 2) Incentive spirometry – 10 breaths q 2hr when awake if the patient is > 5 years old.
- 3) Encourage ambulation and activity.
- 4) Obtain a Pain Team Consult. Refer to the patient's pain plan under the Care Plan / Coordination Plan on CIS. If plan not available, start with morphine boluses 0.05-0.1 mg/kg IV q 2 hr or continuous infusion (10 mcg/kg/hr starting dose or higher) or PCA. Also add ketorolac 0.5 mg/kg/dose (max 30 mg) IV q6h x 3 days.
- 5) Continue folic acid, and prophylactic antibiotics if applicable.
- 6) O<sub>2</sub> by nasal cannula as needed to keep pulse oxymetry  $\geq 92\%$  or  $\geq$  patients baseline value. Avoid excessive or unnecessary O<sub>2</sub>, which may suppress the reticulocyte count and exacerbate anemia.
- 7) Offer heating pads or other comfort measures previously used by patient.
- 8) Add prophylactic stool softener or other laxative for narcotic-induced constipation.

- 9) Reassess pain control at least twice daily. Analgesics may be weaned as tolerated by decreasing dose, not by prolonging interval between doses. Discuss analgesic changes with patient/family. As soon as patient is tolerating PO's discuss initiation of oral pain meds.

#### H. Fever and Sickle Cell Disease

History: Temp  $\geq 38.3$  C, poor appetite, irritability, lethargy, respiratory symptoms, pain (including chest, abdomen, extremities), ill contacts, prophylactic antibiotics, hydroxyurea use and fluid intake.

Examination: Vital signs, evidence of systems or localized infection, cardiopulmonary assessment, spleen size, hydration status, and neurologic exam.

Monitoring/Laboratory:

- 1) Continuous pulse oximetry: If any respiratory symptoms present or if on parenteral narcotics.
- 2) CBC with differential and reticulocyte count on admission.
- 3) CXR if cough, chest pain, hypoxia, or any respiratory symptoms present or develop after admission.
- 4) Blood culture, urinalysis/urine culture; other cultures as indicated.

Treatment:

1. Initial dose of IV ceftriaxone 50mg/kg (2000 mg maximum) within 20min.
2. Hospitalization for IV ceftriaxone 50mg/kg (2000 mg maximum) or IV cefuroxime 50mg/kg q8hrs (2000 mg maximum) if the patient has any of the following:
  - Has clinical infection, such as cellulitis or pneumonia; *or*
  - Is ill-appearing; *or*
  - Has WBC  $>30,000/\mu\text{l}$  or  $< 5,000/\mu\text{l}$ , *or*
  - $T > 39$  C, *or*
  - Age  $< 6$  mos with Hgb SS or  $\text{S}\beta^0$ -Thalassemia, *or*
  - Concerns about compliance
  - Note: cefuroxime plus a macrolide is preferred if pneumonia is present
 Treat 48-72 hours pending (-) culture, or if culture (+), treat as per organism
2. **If none of the features in #1:** Repeat vital signs and assessment 2 hrs after parenteral ceftriaxone. If stable, discharge to home: follow-up in 24hrs for second dose ceftriaxone, repeat clinical evaluation, a review of blood culture result. A specific followup plan must be discussed with the family (i.e where and when)
  - If culture (+) or clinically worse at 24 hours, consider hospitalization and complete course of antibiotic.
  - If culture (-) and clinically stable or improved, discontinue ceftriaxone after second dose. Resume PCN

#### I. Acute Chest Syndrome (Any new infiltrate on CXR in a patient with a sickle hemoglobinopathy. Patients may appear clinically well with a normal PE)

History: Prior history of pain crises, acute chest syndrome, pneumonias or pulmonary disease; onset and sites of pain (including chest, abdomen, extremities), pain medication use prior to admission, fluid intake, fever, URI symptoms, ill contacts, prophylactic antibiotics, hydroxyurea use, albuterol use.

Examination: Vital signs, chest (retractions, grunting, nasal flaring, air exchange), hydration status.

Monitoring/Laboratory:

- 1) Continuous pulse oximetry.
- 2) CBC with differential and reticulocyte count on admission and daily until improvement.
- 3) CXR on admission, repeat for clinical deterioration.
- 4) Blood culture if febrile.
- 5) Consider renal (BUN, Cr) and liver (T/D bili, ALT) function tests for very severe pain or any evidence of encephalopathy (R/O acute multi-organ failure syndrome).
- 6) ABG for severe illness.
- 8) Type and cross match for RBC (minor-antigen-matched if available, leukocyte depleted, sickle-negative).

Treatment

- 1) Do not bolus with IVF unless dehydrated if patient has a history of fluid intolerance or acute chest syndrome. Maintain "euvoolemia." IV + PO 1-1.25 x maintenance. More fluids are appropriate only if patient is dehydrated and/or insensible losses are increased (e.g. persistent fever).
- 2) Incentive spirometry – 10 breaths q 2hr when awake if the patient is  $> 5$  years old.
- 3) Encourage ambulation and activity.
- 4) Oxygen to maintain  $\text{O}_2$  saturation  $\geq 94\%$  or  $\geq$  baseline value.
- 5) Obtain a Pain Team Consult. Refer to the patient's pain plan in the documents section on CIS. If plan not available, start with morphine boluses 0.05-0.1 mg/kg IV q 2 hr or continuous infusion (10 mcg/kg/hr starting dose or higher) or PCA. Also add ketorolac 0.5 mg/kg/dose (max 30 mg) IV q6h x 3 days.

- 6) Cefuroxime 50 mg/kg/dose IV q 8 hr (Prophylactic penicillin may be discontinued while on IV antibiotics).
- 7) Erythromycin 10 mg/kg/dose PO q 6 hr or other macrolide antibiotic.

- 8) Continue prophylactic folic acid.
- 9) Consider bronchodilators, especially if patient has history of restrictive airway disease.
- 10) Add prophylactic stool softener or other laxative for narcotic-induced constipation.
- 11) Consider red cell transfusion:
  - a) Simple transfusion for moderately severe illness, especially if Hgb > 1 gm/dl below baseline (do not transfuse acutely to Hgb > 10 gm/dl or Hct > 30%, which would increase the risk for vaso-occlusion and thrombosis including stroke).
  - b) Partial exchange transfusion to Hgb 10 gm/dl and Hgb S < 30% for severe or rapidly progressive disease. May require transfer to ICU for erythrocytapheresis). This can be done with peripheral access, but usually not a portacath. If needed, remove femoral or central venous catheters as soon as possible after exchange transfusion to reduce risk of thrombosis.

**J. Idiopathic thrombocytopenia purpura (ITP)**

History: Bruising, petechiae, or epistaxis in a previously healthy child, usually presenting abruptly. Peak age is 2-4 years, often preceded by viral infection or immunization 1-3 weeks earlier.

Examination: Vital signs, signs of infection, mouth for oral bleeding, examination of all lymph node groups, liver, and spleen (which should be normal).

Laboratory: CBC with differential and careful review of smear (thrombocytopenia should be isolated without other abnormalities, platelets may be large)

Treatment: If platelets  $\leq 10,000/\mu\text{l}$  or if there is significant bleeding, particularly in the mouth, give IVIgG 800 mg/kg/dose. May repeat IVIgG in 24 hours if follow-up platelet count not  $> 20,000/\mu\text{l}$ . An alternative is prednisone 2 mg/kg/day  $\div$  TID for 14 days then tapered, although this requires a bone marrow aspiration to exclude leukemia. Another alternative is WinRho 50 mcg/kg IV push over 3-5 minutes in Rh positive patients. Recurrent or refractory patients may require splenectomy.

BLOOD COMPONENT TRANSFUSION

Dana Matthews, MD and Dee Townsend-McCall, BSN, RN

Memorize this phone number to the **Puget Sound Blood Center--University District Lab** (a.k.a. the “Blood Center” or “PSBC--UDL”): **522-2462**.

The Children’s Hospital Laboratory **Transfusion Support**, which stores and issues ordered blood components, can be reached at **x7-5151** within the hospital (and at 987--5151 outside of the hospital).

Dee Townsend-McCall, the Children’s **Transfusion Nurse Specialist** is available to coordinate emergency blood component delivery and to answer questions regarding blood component ordering and may be contacted through Children’s Transfusion Support.

**Red Cell Orders** (Packed Red Cells, Whole Blood, Pedi-packs/Divided units, and Assigned Pediatric Aliquots)

1. Require a specimen for compatibility testing (which stays active until **11:59pm on the third day after collection**)
2. Call the Blood Center personally to place a phone order if an active specimen is available at PSBC.

**Platelet, Fresh Frozen Plasma, and Cryoprecipitate Orders**

1. Requires that the Blood Center has the patient’s ABO type on file
2. Call the Blood Center personally to place these orders at 522-2462

**Phone Orders placed to Puget Sound Blood Center –University District Lab**

You will need:

1. Patient’s name (as registered in Cerner, INCLUDING MIDDLE INITIAL)
2. Patient’s medical record number
3. The blood component requested (e.g., FFP, random standard apheresis platelets, cryoprecipitate.)
4. The number of units requested
5. Attributes or special processing required (e.g., irradiation, CMV negative, volume reduction)

Attributes and Special Processing**CMV Negative**

- **Indications**

If the **patient is CMV seronegative** (or their CMV status is **unknown** because serology is pending) **and**:

- Hematopoietic stem cell (HSC) transplant candidate (e.g. has leukemia or aplastic anemia)
- Transplant recipient (HSCs or solid organ) or candidate
- Receiving intensive chemotherapy
- HIV disease
- Neonate regardless of serology (defined by PSBC as < 4 months of age)

- **Alternative**

If CMV negative blood components are not available, **leukocyte-reduced** (considered equivalent to CMV negative) blood components can be substituted.

- **Special Considerations**

- If you are ordering a leukoreduced blood component, do not also request “CMV negative”.
- All pedi-packs, assigned aliquots, and Whole Blood are leukoreduced (considered equivalent to “CMV negative”).

**Irradiation**

--Inactivates donor lymphocytes to prevent Transfusion-associated Graft Versus Host Disease

- **Indications**

- All patients with primary or secondary immunodeficiencies (including an absolute lymphocyte count (ALC) < 500/ $\mu$ L secondary to chemotherapy)
- This essentially means that all Oncology patients receive irradiated blood components.**
- HSC transplant recipients
- HSC transplant donors *before* harvest
- Neonates (defined by PSBC as <4 months old)
- Transfusions from family members (Directed Donor units)
- Transfusion of HLA-matched platelets
- Transfusion of granulocytes

**NOTE:** Irradiation of red cell components causes a disruption of the sodium-potassium ATP pump in the cell wall of RBCs, resulting in increased extracellular potassium concentrations.

### **Leukocytes Reduced (Leukoreduction)**

--Reduces WBCs down to **less than  $5 \times 10^6$  leukocytes** in the component unit

- **Indications**
  - Patients with a history of severe febrile non-hemolytic transfusion reactions (FNHTR)
  - When CMV negative components are indicated, but not available
  - Prevention of HLA sensitization
    - HSC transplant candidates (some Hematology/Oncology patients, particularly patients with Aplastic Anemia or AML – ask your Hematology/Oncology Attending)
    - Heart, lung or kidney transplant candidate (ask your Attending)
- **Special Considerations**
  - Leukoreduced PRBC units ordered from the Blood Center are usually leukofiltered before storage.
  - Leukoreduction of blood components at the time of order requires additional processing time at the Blood Center.
  - Leukoreduced single donor apheresis platelets are collected leukopoor by the apheresis machine at the time of collection (no additional processing required at the time of order).
  - All pedi-packs, assigned aliquots and Whole Blood units are all processed and stored as leukoreduced (considered equivalent to “CMV negative”) components.

### **Volume Reduction**

--Removes excess donor plasma from platelets

- **Indications**
  - Volume sensitive or volume overload patients
  - For some ABO incompatible platelets
    - Check ABO compatibility chart on the reverse side of the red bordered “Blood Component Administration Record”
    - PSBC will alert transfusionist with a Blood Group Substitution comment on the Transfusion Report attached to the unit.
  - Febrile transfusion reactions, which persist after leukoreduction (unlikely to help).

### **Cell Washing**

--Used rarely for patients with plasma protein allergies (IgA hypersensitivity), Paroxysmal Nocturnal Hemoglobinuria or RBC T-Activation. Requires prior approval from Puget Sound Blood Center physician on-call.

### **Emergency Blood Components**

#### **Emergency Stock Uncrossmatched O NEG PRBCs**

- **Available for transfusion in bleeding emergencies**
- **Six (6) units** of leukoreduced (considered equivalent to CMV negative), uncrossmatched Type O NEG Packed Red Blood Cells are maintained in the hospital at all times
  - **All 6 units are non-irradiated**  
--**IMPORTANT--NOT appropriate for transfusion to HSC transplant patients**
- **For HSC Transplant patients**
  - **Phone order “Emergency Release” of IRRADIATED, Leukocyte reduced stock uncrossmatched O NEG Packed Red Blood Cells to PSBC at (206) 522-2462**
- **BEFORE TRANSFUSING UNCROSSMATCHED BLOOD:**
  - **Collect compatibility testing specimen (purple top EDTA tubes), if possible**
  - Send specimen(s) with completed standard “Request for Blood” form to hospital Laboratory immediately
- **In emergent, but not life-threatening situations:**
  - Order “Emergency Uncrossmatched” or “Emergency Crossmatched” PRBCs (see explanation in Red Cell section below)
- **Special Considerations**
  - **THE FDA REQUIRES JUSTIFICATION FOR TRANSFUSION OF ALL UNCROSSMATCHED BLOOD ORDERS**
    - Ordering physician **MUST** complete and sign the accompanying “*Uncrossmatched Blood Justification*” form
      - attached to each uncrossmatched unit
      - return completed form to Laboratory Transfusion Support

**Emergency Platelets, Fresh Frozen Plasma (FFP) and Cryoprecipitate (Cryo)**

- Place a phone order for these emergency blood components.
- PSBC can fill the order with ABO/Rh compatible blood components, even when the patient's blood type is not known.

**Blood Components**

In-hospital blood component storage and issue occurs in Laboratory Transfusion Support (x7-5151). Blood Component Inventory can be checked for individual patients on "Results" screen in CIS.

**Red Cell components**

--Compatibility testing routinely required unless:

- > A compatibility sample has been submitted within the past 3 days
- > Patient <4 months of age has been enrolled on Infant Blood Protocol (See separate section on Infant Blood Protocol)

--Order as:

- > Type and Screen (i.e. ABO/Rh performed and specimen screened for red cell antibodies. Sample held for three days in case units are required )
- > Type and Crossmatch
- > Valid until **11:59pm on the third day after specimen is collected**

**Ordering Options (VERY IMPORTANT)**

--MUST use terminology noted below with all written and phone orders

--DO NOT use terms such as "STAT", "As soon as possible", etc. when ordering red cell components

--Emergency—use ONLY for patients who are, or have a potential for, bleeding

- > **"Emergency UNcrossmatched"**
  - Released to patient ABO specific, but **before antibody screen is completed**
  - Blood Center will call patient care area (to prevent transfusion) if antibody screen indicates incompatibility
  - Issued within **45 minutes** from the time the Blood Center receives order
  - **Becomes crossmatched:** Antibody screen completed by time specified on accompanying --"**Uncrossmatched Blood Justification**" form (a.k.a. "UBJ" or "Justification form")
  - **Justification form** (must be signed by ordering physician)  
--Completion **required** by FDA
- > **"Emergency Crossmatched"**
  - **Arrives fully crossmatched**
  - Issued from PSBC within **60 minutes** from the time the order is received
- > **"Routine—Planned Transfusion--Patient Waiting"**
  - When a **non-bleeding outpatient** is waiting in clinic for transfusion
  - Under "Planned Transfusion" record:
    - Current date and time for transfusion (minimum of 90 minutes)
    - Document: "Patient is waiting"
    - Usually available **within 1.5 - 2 hours** from time the Blood Center receives order
- > **"Routine"**
  - Available within **4 hours** from the time the Blood Center receives order

**Whole Blood**

- **Indication**
  - > **ONLY available for patients under 2 years old on cardiac bypass during open heart surgery**
  - > Replacement of O<sub>2</sub> binding capacity, volume, coagulation factors and proteins

**Packed Red Blood Cells (PRBCs)**

- **Indications**
  - > Symptomatic anemia not treatable with iron, vitamin B<sup>12</sup>, or folic acid therapy.
- **Dosage**
  - > Transfuse to keep Hct > **20%** (or to other clinically indicated criteria)
  - > **10-15 mL/kg; up to 20 mL/kg may be tolerated in some patient and reduce donor exposure** (OK to round off to nearest number of units)  
--Each **1 mL/kg** of PRBCs transfused will raise the patient's Hct by **0.5- 0.7%** (for Optisol)

**NOTE:** Smaller increase in Hct for Optisol (AS-5) preserved units than for CPD-preserved units

*(Blood Component Transfusion – Rev. 5/05)*

- **Rate**
  - **10 - 15mL/kg over 3-4 hours** (can consider **up to 20mL/kg**, to a maximum rate of **5mL/kg/hr**)
    1. Unless patient has chronic, long-standing anemia or congestive heart failure
      - in which case, smaller volume should be given over 4 hours (slower rate)
      - slower rate = 2 mL/kg/hr**
    2. If **Hgb < 5.0g/dL**
      - transfuse:  $\text{Hgb (g/dL)} \times \text{weight (kg)} = \# \text{ mL over 4 hours}$
      - (e.g. if Hgb = 3.0g/dL, and child weighs 20kg, then transfuse (3) x (20) = 60mL PRBCs over 4 hours).
- **Optisol-preserved (AS-5) adult units**
  - For most routine PRBC transfusions
  - **Not appropriate for large volume transfusions to neonates (defined by PSBC as <4 months of age)**
  - Volume = approximately **350 - 450mL**, average Hct = approximately **57%**
- **CPD-preserved (Citrate/Phosphate/Dextrose) adult units**
  - For large volume transfusions (e.g. ECMO, etc.) to infants  $\leq 4$  months old.
  - For infants < 2 years of age scheduled for surgery using cardiopulmonary bypass.
  - All CPD units are automatically leukoreduced (considered equivalent to “CMV negative”)
  - Issued 7 days or less old (for cardiopulmonary bypass issued 5 days or less old)
  - Volume = approximately **250-350mL**, average Hct = approximately **72%**

### Pedi-packs

- **Indications**
  - Single or limited small volume PRBCs transfusions
  - **Usually not appropriate for perioperative transfusion (order adult-sized PRBCs)**
    - wasted if ordered for perioperative transfusion and not administered prior to expiration of crossmatch
- **Attributes**
  - Volume = **50 - 80mL**
    - one-fourth of an adult **CPD-preserved** PRBC unit
    - Avg. Hct=**72%**
  - All leukoreduced (CMV safe), Hemoglobin S screened, and 7 days old or less
  - Note: Irradiation of Pedi-packs must be ordered if needed (no longer automatically included)
- **Special Considerations**
  - Up to **4** pedi-pack units can be issued **from the same donor**
  - If multiple pedi-packs are ordered for a patient at one time, the Blood Center should issue up to four pedi-packs from the same donor--**to minimize donor exposure**
  - Pedi-pack units **cannot be returned** to the Blood Center for credit.
    - wastage (ordering excessively or for perioperative transfusion ) can be costly to the hospital (patient not charged)

### Assigned Pediatric Aliquots

- **Indications**
  - **Multiple** small volume transfusions possible
  - **Intended to limit donor exposure**
  - **Usually not appropriate for perioperative transfusion (order adult-sized PRBCs)**
    - Wasted if ordered for perioperative transfusion and not administered prior to expiration of crossmatch
- **Attributes**
  - Volume = **30 - 43mL**
    - one-eighth of an adult **AS-5-preserved** PRBC unit
    - Avg. Hct=**57%**
    - “mother bag” split into eight smaller units at time of order (allows selection of freshest PRBC unit) and are set aside for the infant
    - preparation of Aliquots **not available emergently** (takes about **4 hours** to create set)
  - Shelf life **~40-42 days**
    - IMPORTANT: unit expires **3 days** after issue from PSBC
    - therefore, request **only the number of units to be transfused** (leave balance at Blood Center)
  - All leukoreduced (considered equivalent to “CMV negative”), Hemoglobin S screened
  - Note: Irradiation of aliquots must be ordered if needed (no longer automatically included)

- **Special Considerations**

- Typically, no more than 2 aliquots requested for issue at one time
- Aliquots are irradiated **at time of issue** (just before release to hospital) (limits potassium load in unit)
- Assigned Pediatric Aliquot units **cannot be returned** to the Blood Center for credit.
  - Wastage (ordering excessively or for perioperative transfusion) can be costly to the hospital.

### Platelets

--Platelets are derived from whole blood donation or collected by apheresis technology.

- **Pooled Platelets:** up to six individual platelet units pooled into a single bag to provide a transfusion dose.
- **Random Apheresis Platelets:** collected from a single donor using apheresis technology
  - “Standard (STD)” equivalent to approximately **4 units**, usually for children > 15 – 20 kg
  - “Large (LRG)” equivalent to approximately **6 units** (Due to cost, reserve ordering Large Apheresis Platelets for children > 20 – 30 kg with poor responses to platelet transfusion.)

- **Indications**

- Thrombocytopenia or platelet dysfunction

- **General transfusion triggers**

- **Prophylactic** (no bleeding) keep platelet count > **10,000/mm<sup>3</sup>**
- **IM injection** (L-asp) keep platelet count > **20,000/mm<sup>3</sup>**
- **Lumbar puncture** keep platelet count > **20,000/mm<sup>3</sup>**
- **Neonatal prophylactic trigger** keep platelet count > **20,000/mm<sup>3</sup> - 25,000/mm<sup>3</sup>**
- **CNS tumor patients** keep platelet count > **30,000/mm<sup>3</sup>**
- **Pre-operative** keep platelet count > **50,000/mm<sup>3</sup>**
- **Post-operative** keep platelet count > **50,000/mm<sup>3</sup>** (until primary healing has taken place)
- **Neonates at increased risk for intraventricular hemorrhage (<35 weeks post-menstrual age)** keep platelet count > **50,000/mm<sup>3</sup>**
- **Post-operative coronary bypass** keep platelet count > **80,000/mm<sup>3</sup> – 100,000/mm<sup>3</sup>**
- **ECMO** keep platelet count > **80,000/mm<sup>3</sup> – 100,000/mm<sup>3</sup>**

- **General Platelet Dosing Guidelines by Weight (assuming ideal recovery of transfused platelets)**

- 1 unit (or equivalent) for every 10 kg patient’s body weight will increase patient’s platelet count by 50,000/mm<sup>3</sup>
- 5 – 10 mL/kg of full volume platelets should raise platelet count by >50,000/mm<sup>3</sup>
- 10 – 15 mL/kg of full volume platelets should raise platelet count by >100,000/mm<sup>3</sup>

Weight	Full Volume Dose
<2kg	0.5 single unit/kg
2 – 4kg	1 unit
4 – 10kg	2 units
10 – 20kg	2 – 3 units or one standard apheresis unit
20 – 30kg	4 – 5 units or one standard apheresis unit
>30kg	4 – 5 units or one standard apheresis unit

- **General Platelet Dosage Guidelines by Type of Component**

Component	Full Volume Dose	Expected Increment
Pooled Platelets (~60 mL per unit)	0.1 units/kg 5 – 10 mL/kg	≥50,000/mm <sup>3</sup>
	0.2 units/kg 10 – 15 mL/kg	≥100,000/mm <sup>3</sup>
	4 – 5 units if 20 - 30 kg 4 – 6 units if ≥ 30 kg	≥50,000/mm <sup>3</sup>

Component	Full Volume Dose	Expected Increment
Standard Apheresis	Usually for children greater than 15 – 20 kg requiring the equivalent of approximately 4 units of pooled platelets	$\geq 50,000/\text{mm}^3$
Large Apheresis	Due to cost, reserve for children > 20 - 30 kg with poor responses to platelet transfusions	$\geq 50,000/\text{mm}^3$

- **Rate**
  - For non-emergent transfusions, give total dose over 30 minutes – 2 hours, depending on fluid status and weight of patient. If volume is a problem, administer total dose over 1 – 4 hours via pump and/or consider volume reduced platelets.
- **Ordering Options**
  - “Emergency”—actively bleeding or high risk for active bleeding only
  - “Routine”—within 2 hours or for planned transfusion or procedure
- **Special Considerations**
  - Single unit volume = approximately **60mL**
  - **Reduced volume platelets**
    - **Indication**—for patients who can not hemodynamically tolerate full volume
    - Volume reduction **removes plasma**
      - Therefore, **DO NOT order reduced volume platelets if FFP is also needed**
    - Volume reduction results in:
      - Loss of some platelets
      - Less effective increase in post-transfusion platelet count
      - Possible platelet activation
      - Delay in receiving platelets by up to 1 hour
    - Standard Volume reduction of 4 – 6 units of pooled platelets is 100mL.
      - In general, standard volume reduction results in ½ of the original volume.
      - Minimum volumes** are as follows:
        - 1 unit platelet concentrate      20 mL
        - 2 – 3 units pooled platelets      20 mL
        - 4 units pooled platelets      40 mL
        - 5 – 6 units pooled platelets      50 mL
        - Standard Apheresis Platelets      50 mL
        - Large Apheresis Platelets      50 mL
- For infants less than 10 kg body weight who cannot tolerate volume, consider ordering volume reduced platelets as follows:
  - Infants < 2 kg
    - Order 1 unit volume reduced platelet concentrate
    - Reduce volume to 20 mL from a starting volume of 60 mL
    - Administer 10 mL/kg
  - Infants 2 – 4 kg
    - Order 1 unit volume reduced platelet concentrate
    - Reduce volume to 20 mL from a starting volume of 60 mL
    - Administer the entire unit
  - Infants 4 – 10 kg (or 3 – 8 kg if rapidly consuming platelets)
    - Order 2 units pooled, volume reduced platelet concentrates
    - Reduce volume to 40 mL from a starting volume of 120 mL
    - Administer the entire pool of 2 units

### Fresh Frozen Plasma (FFP)

- **Indications**

- Patient with documented multiple coagulation factor deficiencies who are actively bleeding
  - DIC
  - Liver failure
  - Dilutional Coagulopathy
- Patients with coagulation factor deficiencies for which there are no factor concentrates
  - V (Factor Five)
  - XI (Factor Eleven)
  - XIII (Factor Thirteen)
- Patient with documented coagulation factor deficiency about to undergo an invasive procedure
  - to reduce risk of bleeding
- Treatment of Thrombotic Thrombocytopenia Purpura (TTP)
- Prolonged coagulation tests (PT INR  $\geq$  1.6 or PTT > 45 seconds)
- **NOT for use as a volume expander**

- **Dosage**

- **Clotting deficiency: 10 - 15mL/kg (may need more in certain situations)**
- **Acute hemorrhage: 15 - 30mL/kg**
- 1mL/kg will raise most coagulation factors by 1%

- **Rate**

- Clotting deficiency: **over 1 - 4 hours**
- Acute hemorrhage: **as indicated by patient's condition**

- **Ordering**

- Must be issued ABO specific (antibodies in plasma must be compatible with ABO antigens on patient's red blood cells)
  - patient's blood type must be on record at the Blood Center
    - if not, specimen from the patient (purple top EDTA tube) and completed "Request for Blood" form must be sent to the Blood Center, via Children's Laboratory, for ABO identification
    - in an emergency, when the patient's blood type is unknown, Type AB plasma will be issued when order placed by phone.

- **Special Considerations**

- Volume: **1 unit FFP = 225 to 250mL**  
**Pediatric unit = 50mL**
- Rh does not matter with FFP (Rh positive may be transfused to Rh negative)

### Cryoprecipitate (Cryo)

--Cryo is available as:

- Single units
  - Contains approximately 350 mg of fibrinogen
  - Volume = approximately **20 mL**
- Six-unit Pool
  - Contains approximately 2,1000 mg of fibrinogen
  - Volume = approximately **120 mL**

- **Indications**

- Bleeding or prior to invasive procedure in patients with significantly low fibrinogen level
  - Hypofibrinogenemia: **Fibrinogen level <80 - 150mg/dL**
  - Patients will have prolonged PT, PTT, and TT even in the absence of other coagulation factor deficiencies.
- Factor XIII Deficiency

- **Dosage**

- In a 10 kg patient, 1 unit will increase fibrinogen level by approximately 70 mg/dL
- Dose is related to baseline fibrinogen level; in the average situation, a desired increase in fibrinogen level is between 100 – 150 mg/dL

## General Cryo Dosing Guidelines

Patient Weight (kg)	Cryo Dose
<2.5	0.4 unit (6 mL) per kg body weight
2.5 - 5	1 unit (15 mL)
5 - 10	1 – 2 units (15 – 30 mL)
10 - 30	2 – 4 units (30 – 60 mL)
30 - 50	6 units (90 mL)
50 - 80	6 or 12 units (90 or 180 mL)
80	12 units (180 mL)

- **Rate**
  - As rapidly as tolerated by patient's condition
- **Ordering**
  - **No compatibility sample is required**
  - Order by phone
- **Special Considerations**
  - Rh does not matter with cryo (Rh positive may be transfused to Rh negative)
  - Infants (<2 years of age): cryo issued ABO type-specific or Type AB
  - Children (> 2 years of age): **ABO does not matter**

**Granulocytes**

- **Indications**
  - Severe neutropenia **with:**
    - Life-threatening bacterial or fungal infection not responsive to antibiotic therapy
    - Neonates with sepsis
- **Dosage**
  - Collection from **one donor per day**
- **Rate**
  - Infuse slowly **over 2 to 4 hours**
- **Ordering**
  - Concentrate contains large number of RBCs  
**--REQUIRES crossmatching** (compatibility specimen required)
- **Special Considerations**
  - Must be scheduled through the physician on-call at Puget Sound Blood Center (522-2462) (**MUST be ordered well ahead of planned transfusion time**)
  - Collection by apheresis
  - Are **ALWAYS irradiated**
    - prevention of Transfusion-Associated Graft Versus Host Disease

**Special Considerations in Blood Component Transfusion****Pre-medication**

- History of **mild** transfusion reaction (fever, chills, rash)
  - Order:
    1. **Tylenol 15mg/kg PO**
    2. **Benadryl 1mg/kg IV**
--to be administered **15 to 30 minutes before** start of transfusion
- History of **significant** transfusion reaction
  - Also order:
    3. **Hydrocortisone 1mg/kg IV**
--also to be administered **15 to 30 minutes before** start of transfusion
- Problem List in patient's chart should note premedications for transfusions, if needed.
- Leukoreduced blood components may also decrease the risk of transfusion reaction.
- Volume reduced blood components may be considered if transfusion reactions persist after leukoreduction.

### Infant Blood Protocol

- **Rationale**
  - Newborns rarely make alloantibodies; therefore, do not require repetitive crossmatching during the first four months of life.
  - Allows repetitive transfusions after a single, initial ABO typing and antibody screen
- **Criteria**
  - Newborns ONLY (defined by PSBC as < 4 months old)
- **Parameters**
  - Protocol is for Emergency Department or hospitalized patient ONLY (not for outpatients)
  - Protocol is active for ONE admission ONLY
    - Infant must be re-initiated (new specimen submitted) with each separate hospital admission within the first 4 months of life
    - EXCEPTION:** Emergency direct transfer between local hospitals
      - Blood Center will release Infant Protocol blood to Children's with originating hospital's patient identification
      - KEEP ORIGINATING HOSPITAL ID BAND ON PATIENT**
  - **When whole blood is ordered, a new specimen must be submitted on an Infant Protocol Request for Blood form (unless patient is Type O)**
  - Protocol is active until patient is discharged from hospital, becomes older than 4 months of age, or is taken off of the protocol
- **Preparation**
  - All blood issued is Type O (Rh specific to patient)
  - No crossmatch is performed on issued blood components
- **Ordering**
  - Initiating specimen (purple top EDTA tube or TWO (2) purple top microtainers) must be accompanied by **"Infant Protocol Request for Blood" form**
  - Subsequent orders should be placed as phone orders ONLY
  - **Protocol is inactivated if any subsequent order is sent to Blood Center on a standard "Request for Blood" form**
  - ECMO blood can be ordered while patient is on Infant Blood Protocol (no crossmatch required)

### Other Special Blood Component Ordering

- In special circumstances, usually involving elective surgical procedures, arrangements can be made for storage of autologous blood units or for the collection of **"Directed Donor"** units from blood type compatible family
- There is also a procedure for drawing crossmatch specimens **up to 10 days before surgery** for patients who have not been recently transfused (**Preadmission Blood Protocol**).
- Information regarding these procedures is available in surgery clinics, from PSBC, or check with unit-based CNS's or the Transfusion Nurse Specialist.

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## INFORMED CONSENT FOR TRANSFUSION OF BLOOD AND BLOOD COMPONENTS

Dana Matthews, MD, Dee Townsend-McCall, BSN, RN and Ann Nakamoto, JD

JCAHO standards require that all patients or patients' parent/legal guardians give informed consent prior to the transfusion of blood and blood components. Consent should include the indication for the transfusion, the risks, benefits and any available alternatives. While documentation in a progress note would suffice, this is rarely done, and would be very difficult to locate at the time of subsequent transfusions. Alternatively, consent can be documented on a hospital form, which expressly states that the topics noted above have been covered. The Blood Usage Committee of the Medical Executive Committee has mandated that the *"Informed Consent for Transfusion of Blood and Blood Components"* form (CHPMC form #51365) be available on all patient care areas for this purpose.

Consent must be obtained for all non-emergent transfusions provided at Children's, and must be renewed annually. Medical Records will keep the consent form in the active chart volume. When computerized order entry is available, the transfusion order will remind you that this consent form is required and provide information when one has already been signed. An annual reminder system will also be incorporated.

Our requirement is to assure that signed consent forms are in the chart for all patients receiving transfusions. We recognize emergency transfusions will always be required in life-threatening situations. In these situations, when informed consent cannot be obtained prior to emergency transfusion, JCAHO standards require clear documentation of the emergency nature of the transfusion in the medical record.

Please note that although the *"Special Consent to Operation, Post Operative Care, Medical Treatment, Anesthesia, or Other Procedure"* form does include transfusion of blood and blood components, it does not document that indications, risks, benefits and alternatives have been discussed. The *"Informed Consent for Transfusion of Blood and Blood Components"* form should also be signed by patients or a legal guardian when a patient is about to undergo any surgical procedure where the potential of blood and blood component transfusion is judged to be high enough for the surgeon to obtain a pre-operative type and crossmatch.

For help in educating patients and their families, a pamphlet entitled *"Transfusion"* is available at most patient care areas and also from Children's Laboratory Transfusion Support.

It is recommended that the following points be covered in discussing transfusion risks with your patients' and families:

### **Infectious Risks**

Transfusion-Transmitted Virus	Published Risk
HIV	<1:2,500,000
HBV	<1:1,000,000
HCV	<1:1,000,000
HTLV	<1:600,000

The Puget Sound Blood Center minimizes these risks by screening blood donors by personal history and blood tests.

### **Transfusion Reactions**

- Hemolytic Transfusion Reactions – these occur when an inappropriate blood type is mistakenly transfused to the recipient. The Puget Sound Blood Center carefully tests your patient's and the donor's blood to avoid such reactions. By carefully checking the patient's identification when drawing blood for crossmatch and before transfusion this complication can be avoided.
- Febrile Transfusion Reactions – occur in <5% of all transfusions. Although these are not dangerous, they can be uncomfortable for your patient. They can be treated with medications such as Tylenol and Demerol. These occur more commonly in patients who undergo multiple transfusions. In these cases leukoreduction of blood components may decrease these reactions.
- Bacterial Contamination – blood component-associated bacterial sepsis may be associated with any type of blood product (e.g., red cells, cryoprecipitate, fresh frozen plasma, platelets) but is most frequent with platelets because they are stored at room temperature for up to 5 days (rather than refrigerated or frozen).
- Other Reactions - allergic reactions may be manifested as hives or, more rarely, bronchospasm and laryngeal edema; the most severe form would be anaphylaxis. Circulatory overload may be a problem for patients with diminished cardiac reserve or chronic anemia. Transfusion-related acute lung injury (TRALI) is a rare immune-mediated reaction resulting in pulmonary injury.

Patients or parent/guardians who refuse consent for transfusion in non-life threatening situations must be given and asked to sign the Preference Statement form (CHRC form #50964). Contact the Administrator on-call in cases of refusal of consent for transfusion in emergent or life threatening situations.