TEXAS CHILDREN'S HOSPITAL
EVIDENCE-BASED OUTCOMES CENTER
Fever and Neutropenia in Children Receiving Cancer Treatment or with Blood Disorders Evidence-Based Guideline

Definition: Fever is a common sign that suggests infection in children. However, signs and symptoms are often absent or minimized in the child with cancer because of inability to evoke an inflammatory response. In this population, fever is defined as a single temperature >38.3°C (101°F) or a temperature ≥38.0°C (100.4°F) on two occasions one hour apart. Rectal temperatures are not taken in children with cancer. Caregivers should be advised NOT to add a degree to any type of temperature reading. Neutropenia is classified as mild (ANC >500-1000/mm³), moderate (ANC ≥200-500/ mm³) or severe (ANC <200/mm³). [1,2]

Pathophysiology: Chemotherapy agents and radiation therapy cause myelosuppression. In addition, certain malignancies that metastasize to the bone marrow (e.g., leukemia, lymphoma, neuroblastoma, sarcomas) cause a decrease in the number of normal blood cell precursors. When the myelosuppressive effect is severe enough, the child becomes predisposed to infection, anemia, or bleeding, depending on which blood cell line is affected. The risk for serious infection in a child receiving treatment for cancer is related to the degree and duration of neutropenia. Children with brief periods of neutropenia (ANC ≥500) and fever (<7 days) respond better than those with moderate to severe neutropenia (ANC ≤500) lasting more than 7 days. Pneumonitis, cellulitis, bacteremia and abscess can occur when the ANC falls below 500. The risk for bacteremia/septicemia increases when the ANC is <200. [1,2] ***Common Organisms*****:** Gram + bacteria account for 60-70% of microbial documented infections in children with cancer. [1,2]

Inclusion Criteria
Child with fever and neutropenia receiving therapy for cancer
Child with fever and neutropenia with a blood disorder
Child with fever after BMT, see p. 4 & BMT algorithm

Exclusion Criteria
Patients with shock symptoms (proceed to shock protocol)

Diagnostic Evaluation
Because of the high mortality rate associated with untreated infection, all febrile children with cancer who have neutropenia are considered at risk for a life-threatening infection until proven otherwise. Evaluation of a child with fever and neutropenia should be completed as quickly as possible. The child with fever and neutropenia is at risk for septic shock.

Table 1. Vital Sign Changes of Sepsis [3]

Age	Heart Rate	Resp Rate	Systolic BP	Temp (°C)
0d - 1m	> 205	> 60	< 60	<36 or >38
> 1m - 3m	> 205	> 60	< 70	<36 or >38
> 3m - 1y	> 190	> 60	< 70	<36 or >38.5
> 1y - 2y	> 190	> 40	< 70 + (age in yr x 2)	<36 or >38.5
> 2y - 4y	> 140	> 40	< 70 + (age in yr x 2)	<36 or >38.5
> 4y - 6y	> 140	> 34	< 70 + (age in yr x 2)	<36 or >38.5
> 6y - 10y	> 140	> 30	< 70 + (age in yr x 2)	<36 or >38.5
> 10y - 13y	> 100	> 30	< 90	<36 or >38.5
> 13y	> 100	> 20	< 90	<36 or >38.5

Table 2. Signs and Symptoms of Shock [3]

	Sign and/or Symptom
Peripheral Pulses	Decreased or weak Bounding
Capillary refill	≥ 3 sec Flash (< 1 sec)
Skin	Mottled, cool Flushed, ruddy, erythroderma (other than face) Petechiae below the nipple, any purpura
Mental status	Decreased, irritability, confusion inappropriate crying or drowsiness, poor interaction with parents, lethargy, diminished arousability, obtunded

*↑ HR followed by ↓ HR with BP changes will be noted as shock becomes uncompensated.

History: Assess for
- Date of last treatment and details of therapy (agents, dose, route)
- Onset of fever and highest temperature (Note: Dexamethasone may mask fever)
- Other symptoms including nausea, vomiting, diarrhea, pain (e.g., mouth, abdomen, perianal), swelling, redness, drainage
- Recent diagnosis of GI or GU tumor
- Exposure to infection (e.g., TB, history of MRSA, recent CVC infection) and seasonal illnesses (i.e., RSV, influenza)
- Recent invasive procedure
- Recent foreign travel
- Renal/Hepatic dysfunction

Physical Examination: Assess
- For signs/symptoms of shock (see Tables 1 and 2)
- Entire body for signs, tenderness/pain, induration, redness or discharge from any area; ***examine closely the skin, nose, teeth, pharynx, sinuses, joints and extremities, procedure sites, perineal and perirectal areas***
- Central line - note any redness or drainage along tunnel or at exit site
- Mental status and changes in sensorium

Laboratory Tests:
- Complete CBC, Chem 7, urinalysis (bagged or clean catch only), blood culture from central and peripheral site of appropriate volume
- **Optional studies to consider:** C-reactive protein (CRP), stool cultures for history of diarrhea, aspirate or biopsy of any suspicious skin lesion after Attending MD consultation
- Urine culture if UA abnormal (non-catheterized)
- CXR in presence of respiratory symptoms, chest pain, tachypnea or decreased pulse oximetry [4-10]

Critical Points of Evidence

Evidence Supports

Utilize a validated risk stratification rule for patients with fever and neutropenia due to cancer treatment. [2,11-13] – Strong recommendation, moderate quality evidence
Remarks: Evaluation of the evidence does not demonstrate that one prediction rule is more effective over another. Due to the Alexander rule's documented effectiveness for pediatric patients in North America and England, this rule was chosen as best suited for risk stratification of TCH patients presenting to the ED with fever and neutropenia due to cancer treatment.

Manage low risk patients with fever and neutropenia due to cancer treatment outpatient with oral antibiotics ensuring frequent follow-up and monitoring. [2,12,14-16] – Strong recommendation, moderate quality evidence

Empiric antibiotics for hematology and oncology patients with fever and neutropenia should be based upon the patient's risk for bacteremia. See below for antibiotic selection: [2,12,13,17-21] – Strong recommendation, moderate quality evidence

- Outpatient Low Risk - Levofloxacin
- Inpatient Low Risk – Ceftriaxone
- High Risk – Cefepime
- High Risk with suspicion of GI issues or typhlitis – Add Metronidazole

Empiric antibiotics for patients with a history of bone marrow transplant should include vancomycin and cefepime. If there is a suspicion of GI issues or typhlitis, metronidazole should be added. [2,12,13,17-21] – Strong recommendation, moderate quality evidence

Administer empirical antifungal therapy to high risk patients with no identified infectious source that have persistent fever after 4 – 7 days of broad spectrum antibiotics. [2,12,22-24] – Strong recommendation, low quality evidence
Remarks: There is no one antifungal agent that has been proven superior for use in this population. Unless the patient has concerns for renal or liver toxicity, the guideline development team would recommend the use of liposomal amphotericin B. An equally equivalent selection would be an echinocandin.

In febrile neutropenic patients, antibiotics should be discontinued (although patient may remain hospitalized for observation) if the following criteria are met. – Strong recommendation, low quality evidence [25-29]

- Blood cultures are negative for 48 hours
- Patient is afebrile for 24 hours, has no focal findings and is clinically stable

Evidence Lacking/Inconclusive

Draw complete blood counts (CBC) at least every three days. More frequent monitoring may be warranted in for patients who are being assessed for count recovery. – Strong recommendation, very low quality evidence

Perform baseline renal functioning testing at initial presentation. – Strong recommendation, very low quality evidence

Consider liver function tests in patients with clinical concerns for liver dysfunction. – Weak recommendation, very low quality evidence

Use of prolonged steroids greater than 7 days may be associated with a higher risk of infection. [30-32] – Strong recommendation, very low quality evidence
Remarks: Knowledge of the use of prolonged steroids should heighten the clinicians' suspicion for infection; however, management decisions may not be affected. The dose and duration of steroids along with the status of the malignancy and immunodeficiency determine the individual patient's risk for infection.

Repeat sampling for blood cultures should be obtained from the central line, if applicable, after the initial assessment for CLABSI has been performed. [2,33-37] – Strong recommendation, low quality evidence
Remarks: Central and peripheral blood cultures are obtained initially to diagnosis CLABSI using time-to-positivity. Thereafter, repeat sampling of blood cultures can be obtained from one site. If the initial peripheral culture is positive, repeat sampling of blood cultures from the central site allow for monitoring of organism growth from the CLC and decrease the need for peripheral venipunctures in the patient.

Consider galactomannan and/or CT scans in the patients with persistent fever and neutropenia. [2,12,38-45] – Weak recommendation, low quality evidence

Consider further diagnostic evaluation such as bronchopulmonary lavage or biopsy in FN patients with pulmonary lesions that suggest invasive fungal infections. Preferred approach should be chosen based on the patient's clinical picture. [12,46-51] – Weak recommendation, low quality evidence

Evidence Against

Only obtain a chest x-ray for the initial assessment of patients with fever and neutropenia if respiratory signs and/or symptoms are present. [4-10] – Strong recommendation, moderate quality evidence

Patients with fever and neutropenia without a clinical change in presentation should not have blood culture sampling repeated daily if adequate volume cultures was obtained on day #1. If initial blood cultures result positive, repeat blood cultures should be obtained until clearance (48 - 72 hours). [12,52-54] – Strong recommendation, low quality evidence
Remarks: If adequate volumes were not obtained on initial cultures, cultures should be repeated the next day ensuring optimal volume. Unnecessary repeat blood cultures can result an increase rate of false positives in commensal organisms, avoidable waste of blood volume and increase attempts to access central lines. Improvements in optimal blood culture volumes and technology has resulted in the vast majority of positive blood cultures exhibiting growth within 24 hours.

Condition-Specific Elements of Clinical Management

Risk Assessment at Presentation of FN [11,12]

Patient is considered High Risk if ANY of the following clinical criteria is present:

- High-risk diagnoses
  - ALL and lymphoma patients who are **not in maintenance therapy**
  - Lymphoma patients other than lymphoblastic lymphoma (i.e. mature lymphomas)
  - Infant ALL
  - Acute Myeloid Leukemia (AML)
  - Relapsed/Progressive Leukemia
  - Bone Marrow Transplant patients
  - HLH patients
  - Severe aplastic anemia / Bone marrow failure patients
  - Primary Immunodeficiencies patients
- Age <1 year
- Down Syndrome
- >2 normal saline boluses in the ED
- Abnormal vital signs (except temperature) at time of disposition or changes in mental status
- Focal infection (e.g., mucositis, abdominal pain, cellulitis, pneumonia, perianal tenderness)

Patient should be admitted for Low Risk treatment management if any of the following exclusions are present:

- Inability to take PO antibiotics
- Allergy to Levofloxacin
- Parents with a history of poor compliance or follow-up
- Absence of working telephone
- Families that live farther than 1 hour/40 miles from the main campus ED of TCH
- Parental preference to be admitted
- If patient cannot be seen in the Oncology Clinic Urgent Care Bay or obtain a follow-up appointment within 3 calendar days of discharge from the ED

Patient is eligible for Low Risk outpatient management if they have no exclusion above.

Early Assessment and Diagnostic Work-up

- Careful, detailed history and thorough physical exam
- Initiate Life Threatening Lab System - CBC, BUN, Cr
- Draw other labs: Lytes, LFTs, urinalysis, blood culture from a central and peripheral site of appropriate volume, site specific cultures as clinically indicated
- Diagnostic Imaging - CXR if respiratory signs/symptoms present including chest pain, tachypnea, decreased pulse oximetry

Empiric Antibiotic Selection [2,12-21,55]

- **High Risk Inpatient Intravenous Treatment:** Cefepime (Table 3)
- **High Risk Inpatient with GI issues and/or typhlitis:** Add Metronidazole (Table 3)
- **Low Risk Inpatient Intravenous Treatment:** Ceftriaxone (Table 3)
- Initiate antibiotics ASAP (preferably within ONE HOUR of arrival)
- All antibiotics should be rotated among the different CVC lumens, so all lumens are exposed to all antibiotics. If only one lumen has a positive blood culture, all antibiotics should then be administered through that lumen [1,2]

Treatment and Ongoing Management

- Be prepared to start IV or access CVC and draw blood
- Normal saline bolus for hypotension
- Blood product support if needed
- Daily evaluate: Central venous catheter site(s), surgical incisions, other breaks in skin, oral mucosa, peri-rectal area
- With continued fever, repeat urine, stool, and tissue cultures, obtain diagnostic imaging as clinically indicated

Monitoring

- Careful monitoring should continue as long as the child is neutropenic
- Complete blood count with differential at least every 3 days [2]
- Baseline renal function testing at initial presentation
- Monitor liver function tests if clinical concern for liver dysfunction
- Serum chemistries at least every 3 days - monitor for electrolyte depletion [2]
- Monitor creatinine daily if rises over baseline
- Urine samples – monitor for glycosuria, hematuria, and albuminuria, sodium and potassium, as clinically indicated
- Patients with history of renal dysfunction calculate antibiotic dosing with creatinine clearance method below

Specific monitoring:

- **Aminoglycosides**: Serum drug peak and trough to be obtained with the 3rd to 5th dose
- ***Creatinine Clearance estimation method by Modified Schwartz equation:**

GFR (mL/min/1.73 m^2) = 0.413 x length (cm)/serum creatinine (mg/dL)

Preserving/Removing the Central Line [2,56-58]

The benefits of catheter removal must be weighed against the difficulty of obtaining alternate venous access for each individual patient. Prompt removal of the central line should be considered when any of the following conditions and/or organisms exists:

- Severe sepsis
- Endocarditis
- Bloodstream infection that continues despite >72 h of antimicrobial therapy to which the infecting microbes are susceptible
- Infections due to *S. aureus*, gram-negative bacilli including *P. aeruginosa, Bacillus* species, and/or enterococci

Prompt removal of the catheter is necessary in cases of:

- Infections due to mycobacteria and/or fungi
- Tunnel site infection (e.g., redness, inflammation along catheter line, purulent drainage)
- Suppurative thrombophlebitis

Consider removal of the central line when the integrity of the line is compromised as evidence by broken, cracked or clotted lumens.

Management of Persistent Fever

- If fever continues on broad spectrum antibiotics for >4 - 7 days, begin antifungal agents and perform evaluation for invasive fungal disease. [2,12,22-24] Obtain an ID consult. Consider monitoring galactomannan and/or CT scans. [2,12,38-45]
- CT evaluations to assess fungal infection should include scans of the lungs and other areas as clinically indicated. CT scans of the sinuses can be considered in children two years of age or older, and especially in those with complaints of sinus pain. [2]
- In patients with pulmonary lesions suggestive of fungal infection, consider further diagnostic evaluation such as bronchopulmonary lavage or biopsy. Preferred approach should be chosen based on the patient's clinical picture. [12]
- If there is clinical or laboratory evidence of HSV, administer antiviral treatment. [2]
- Consider culture for HSV in patients with mucositis.

THE BMT PATIENT WITH FEVER AND SUSPECTED INFECTION

Definition: Fever is a common sign that suggests infection in children. However, signs and symptoms are often absent or minimized in the child following BMT because of inability to evoke an inflammatory response. In this population, fever is defined as a single oral temperature ≥38.0°C (100.4°F). Rectal temperatures are NOT taken in BMT patients. Caregivers should be advised to NOT add a degree to any type of temperature reading. Neutropenia is classified as mild (ANC >500-1000/mm³), moderate (ANC ≥200-500/mm³) or severe (ANC <200/mm³). [1,2]

Pathophysiology: After allogeneic BMT, there is a loss of both innate and acquired immunity, which persists for more than 12 months, and even longer in patients receiving immunosuppressive medications. Consequently, BMT patients are particularly at risk for not only bacterial, but fungal and viral infections post-transplant. Oftentimes, BMT patients may have systemic infection in the absence of neutropenia. In fact, the vast majority of BMT patients will not be neutropenic but may still present with bacterial sepsis, especially those with indwelling central catheters and active GvHD. While the risk for serious infection in a neutropenic child is related to the degree and duration of neutropenia, BMT patients may have serious infection with normal neutrophil counts. Judicious use of fluid resuscitation is necessary in BMT patients as they have a high incidence of capillary leak and pulmonary disease and can easily be fluid overloaded. [59-61]

Rationale: Because of the high-risk of infection post BMT (bacterial, fungal or viral), patients who present to the ED with or without fever, should be promptly triaged and isolated from other patients. Children with underlying immunodeficiencies, such as SCID, should be in reverse isolation at all times. Blood cultures and labs should be promptly obtained and appropriate antibiotics given within 60 minutes. The BMT physician on call should be notified immediately upon arrival of any BMT patient. In general, patients who are less than 100 days post BMT are at a much higher risk of serious bacterial infection and should be considered for admission after appropriate antibiotics given. Children who are hemodynamically unstable or exhibiting even mild signs of early shock (including chills) should be admitted with triple antibiotic coverage. [62]

***Common Organisms*:** Gram positive bacteria account for 60-70% of microbial documented infections [1,2]

Gram positive		Gram negative
Staphylococcus	*E. coli*	*Enterobacter*
Streptococcus		*Klebsiella*
Enterococcus		*Pseudomonas*

Diagnostic Evaluation: Because of the high mortality rate associated with untreated infection, all febrile children who have received a BMT are considered at risk for a life threatening infection until proven otherwise. Additionally, BMT patients experiencing chills, who may not yet have fever, also should be considered at risk for a life-threatening infection until proven otherwise. Evaluation of a BMT patient with suspected infection should be completed as quickly as possible as they are at risk for septic shock. Signs and symptoms include:

- Fever and/or chills or rigors
- Tachypnea
- Pulse oximetry < 95%
- Early - warm, flushed, dry skin
- Tachycardia
- Hypotension
- Decreased urine output
- Late - cool, clammy skin

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Table 2. Signs and Symptoms of Shock [3]

	Sign and/or Symptom
Peripheral Pulses	Decreased or weak Bounding
Capillary refill	≥ 3 sec Flash (< 1 sec)
Skin	Mottled, cool Flushed, ruddy, erythroderma (other than face) Petechiae below the nipple, any purpura
Mental status	Decreased, irritability, confusion inappropriate crying or drowsiness, poor interaction with parents, lethargy, diminished arousability, obtunded

*↑ HR followed by ↓ HR with BP changes will be noted as shock becomes uncompensated.

History: Assess

- Date of BMT and time post BMT (< or > 100 days)
- Onset of fever and highest temperature
- Presence of central line
- Medications, such as immunosuppressants (tacrolimus, cyclosporine, prednisone and MMF most common)
- Other symptoms including nausea, vomiting, diarrhea, pain (e.g., mouth, abdomen, perianal), swelling, redness, drainage
- Recent invasive procedure
- Renal/Hepatic dysfunction

Physical Examination: Assess

- For signs/symptoms of shock (Tables 1 and 2)
- Pulse oximetry
- Entire body for signs of infection, including tenderness/pain, induration, redness or discharge from any area; ***examine closely the skin, nose, teeth, pharynx, sinuses, joints and extremities, procedure sites, perineal and perirectal areas***
- Central line note any redness or drainage along tunnel or at exit site
- Mental status and changes in sensorium

Diagnostic and Laboratory Studies: Assess

- Complete CBC, Chem 10, LFTs
- Blood cultures from central (CVC-all lumens, include portacath) and peripheral site of appropriate volume
- Nasal wash for RSV, flu, viral culture and “respiratory viral panel” in patients with rhinorrhea
- Diarrheal stools for bacteria, ova/parasites, viral particles and Clostridium difficile toxin
- UA, U/C (bagged or clean catch only)
- Chest x-ray

Considerations for Discharge

Bedside providers should use clinical judgement and assessments to determine when to discharge patients home, taking into consideration:

- Blood cultures are negative for 48 hours
- Patient is afebrile for 24 hours (Off empiric antibiotics if blood cultures were negative)
- Patient is clinically stable
- Patient is tolerating oral intake
- Patient has no focal findings
- Patient lives within 1 hour geographically to return for immediate medical assessment if cause for concern
- If family is reliable / comfortable with managing at home

Measures

Process

- Antibiotic administration initiated within one hour of patient arrival to ED or TXCH
- Frequency of adequate volume blood cultures
- Frequency of optimal volume blood cultures
- Method of diagnosis of fungal infections

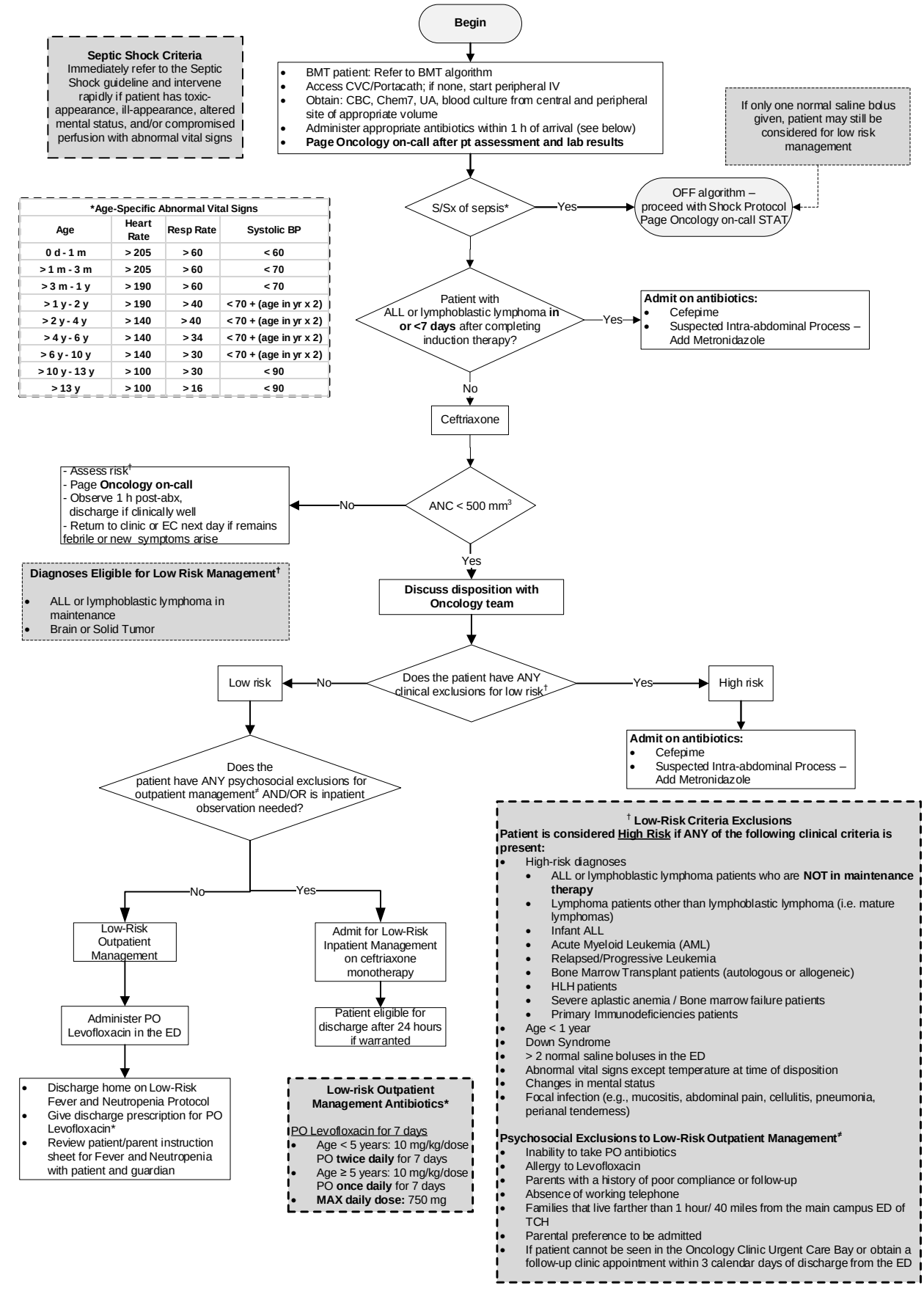
Outcome

- Readmission through ED or TXCH triage for fever and neutropenia
- Patients transferred to PICU within 72 hours of admission
- Patients admitted for monotherapy whose antibiotics were changed
- Admission due to positive blood culture after discharge from ED or TXCH triage
- Rate of bacteremia for low risk patients
- Admission rate for low risk patients discharged home from the ED

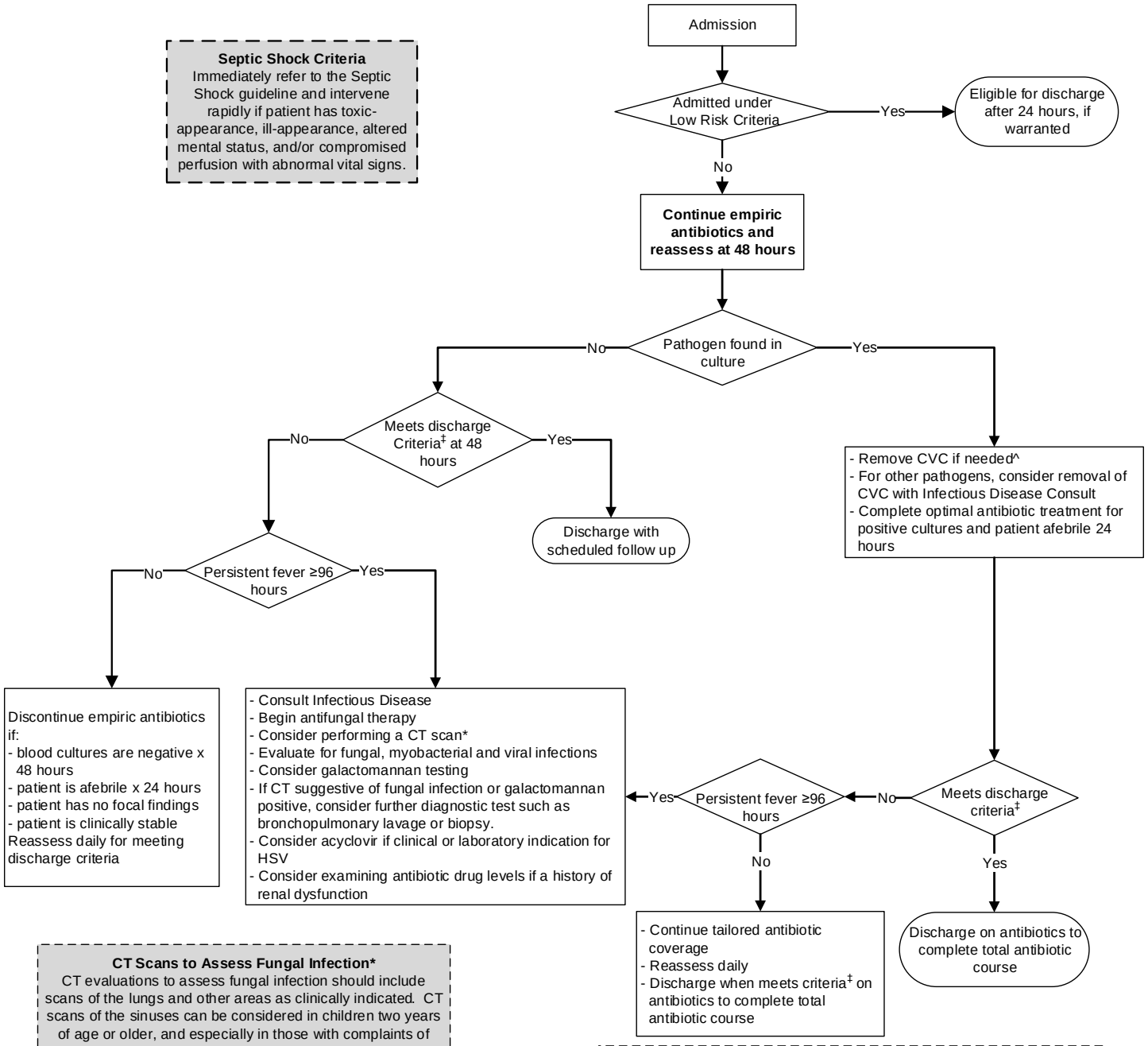
Table 3. Antibiotic Therapy [2,12-21,55]
(For Hematology/Oncology and BMT Patients)

Patient Class	Medications	Dose and Frequency
On Arrival in ED or TXCH Clinic	Ceftriaxone	50 mg/kg/dose IV for one dose **MAX**: 2 grams/dose
Outpatient Low Risk Treatment (refer to Patient ***Risk Assessment*** for eligibility)	Levofloxacin	Age <5 years: 10 mg/kg/dose PO twice daily for 7 days Age ≥5 years: 10 mg/kg/dose PO once daily for 7 days **MAX** daily dose: 750 mg
Inpatient Low Risk Management	Ceftriaxone	50 mg/kg/dose IV every 24 hours **MAX**: 2 grams/dose
Inpatient High Risk Hematology/Oncology Management	Cefepime	50 mg/kg/dose IV every 8 hours **MAX**: 2 grams/dose
	Suspected Intra-abdominal Process Add MeTRONidazole	7.5 mg/kg/dose IV every 6 hours **MAX**: 500 mg/dose
Inpatient Bone Marrow Transplant Management	Vancomycin	Weight <70 kg: 15 mg/kg/dose IV every 8 hours Weight ≥70 kg: 1000 mg/dose IV every 12 hours **MAX**: 1 gram/dose
	Cefepime	50 mg/kg/dose IV every 8 hours **MAX**: 2 grams/dose
	Suspected Intra-abdominal Process Add MeTRONidazole	7.5 mg/kg/dose IV every 6 hours **MAX**: 500 mg/dose

TCH Evidence-Based Outcomes Center
Clinical Algorithm for Fever and Neutropenia in Children Receiving Cancer Treatment or With Blood Disorders
ED Algorithm



TCH Evidence-Based Outcomes Center
Clinical Algorithm for Fever and Neutropenia in Children Receiving Cancer Treatment or With Blood Disorders
Inpatient Algorithm



Septic Shock Criteria
Immediately refer to the Septic Shock guideline and intervene rapidly if patient has toxic-appearance, ill-appearance, altered mental status, and/or compromised perfusion with abnormal vital signs.

CT Scans to Assess Fungal Infection*
CT evaluations to assess fungal infection should include scans of the lungs and other areas as clinically indicated. CT scans of the sinuses can be considered in children two years of age or older, and especially in those with complaints of sinus pain.

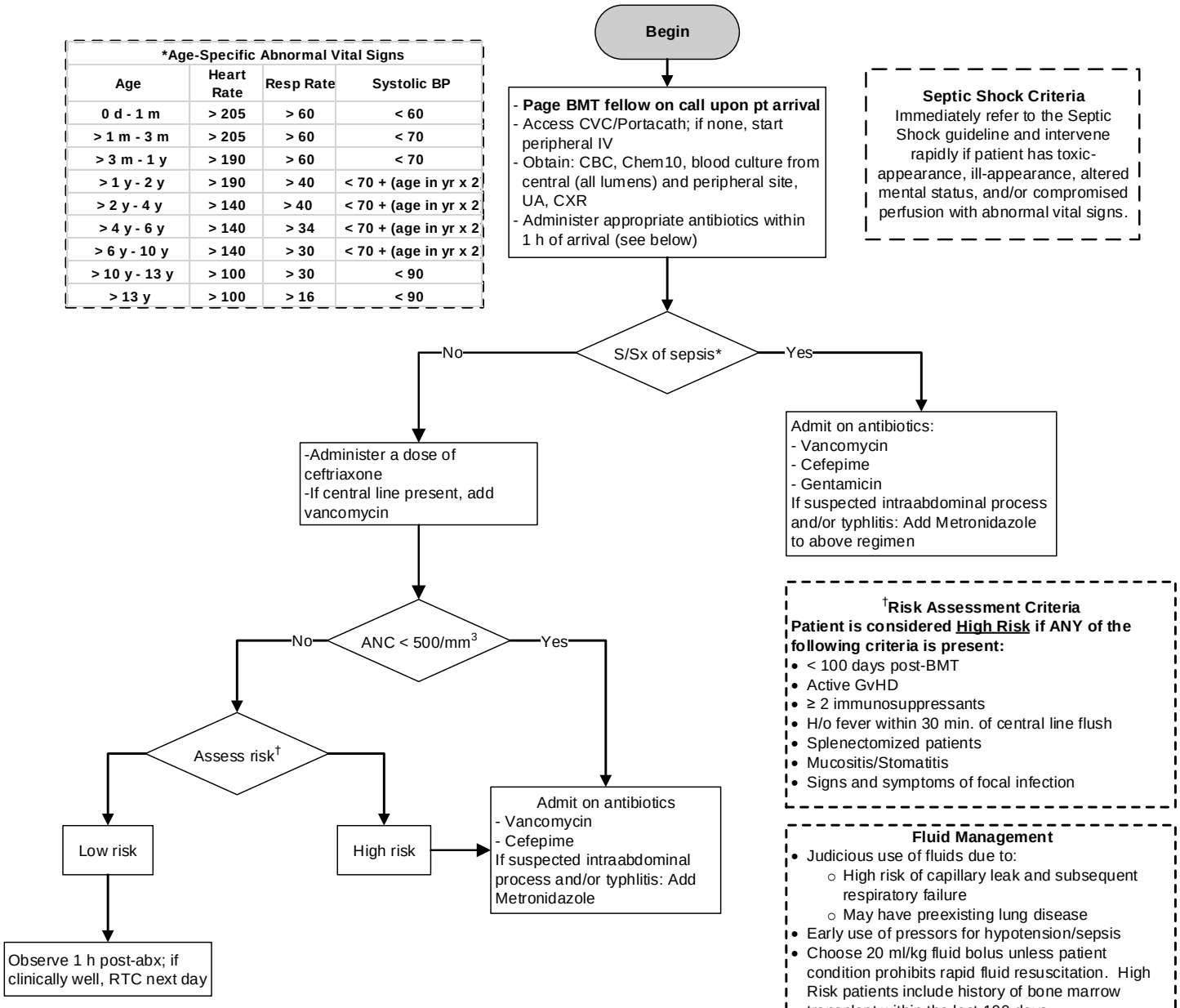
‡Discharge Criteria
Bedside providers should use clinical judgment and assessments to determine when to discharge patients home, taking into consideration:
- blood cultures are negative x 48 hours
- patient is afebrile x 24 hours (Off empiric antibiotics if blood cultures were negative)
- patient is clinically stable
- patient is tolerating oral intake
- patient has no focal findings
- patient lives within 1 hour geographically to return for immediate medical assessment if cause for concern
- if family is reliable/comfortable with managing at home

Preserving/Removing the Central Line ^
Prompt removal of the central line should be considered when any of the following conditions and/or organisms exists:
- Severe sepsis
- Endocarditis
- Bloodstream infection that continues despite > 72 h of antimicrobial therapy to which the infecting microbes are susceptible
- Infections due to *S. aureus*, gram-negative bacilli including *P. aeruginosa, Bacillus* species, and/or enterococci

Prompt removal of the catheter is necessary in cases of:
- Infections due to mycobacteria and/or fungi
- Tunnel site infection (e.g., redness, inflammation along catheter line, purulent drainage)
- Suppurative thrombophlebitis

TCH Evidence-Based Outcomes Center
Clinical Algorithm for Management of BMT Patient with Fever

*Age-Specific Abnormal Vital Signs			
Age	**Heart Rate**	**Resp Rate**	**Systolic BP**
0 d - 1 m	> 205	> 60	< 60
> 1 m - 3 m	> 205	> 60	< 70
> 3 m - 1 y	> 190	> 60	< 70
> 1 y - 2 y	> 190	> 40	< 70 + (age in yr x 2
> 2 y - 4 y	> 140	> 40	< 70 + (age in yr x 2
> 4 y - 6 y	> 140	> 34	< 70 + (age in yr x 2
> 6 y - 10 y	> 140	> 30	< 70 + (age in yr x 2
> 10 y - 13 y	> 100	> 30	< 90
> 13 y	> 100	> 16	< 90



†Risk Assessment Criteria
Patient is considered <u>High Risk</u> if ANY of the following criteria is present:
- < 100 days post-BMT
- Active GvHD
- ≥ 2 immunosuppressants
- H/o fever within 30 min. of central line flush
- Splenectomized patients
- Mucositis/Stomatitis
- Signs and symptoms of focal infection

Fluid Management
- Judicious use of fluids due to:
  - High risk of capillary leak and subsequent respiratory failure
  - May have preexisting lung disease
- Early use of pressors for hypotension/sepsis
- Choose 20 ml/kg fluid bolus unless patient condition prohibits rapid fluid resuscitation. High Risk patients include history of bone marrow transplant within the last 100 days.
- If additional fluid is required, discuss with BMT team
- Assess need for stress dose steroid

ISSUES SPECIFIC TO BMT PATIENTS
- BMT fellow is to be called immediately upon patient arrival. If fellow does not respond within 10 minutes, please call the BMT attending.
- Fever in BMT Patient – Temp ≥ 100.4°F regardless of source
- Must check previous culture results and tailor antibiotics and/or make admission decisions accordingly (e.g., make sure to cover same bacteria present previously)
- Patient should be placed in a private room.
- SCID patients should be placed in a private room; healthcare providers must wear mask, gloves and gown in room.
- Be cautious of renal dysfunction and use renal dosing of antibiotics as necessary.
- Ask patient if they have a portacath. Many patients have both a port and an external PICC line. All lumens must be cultured.
- If admitted, must rotate antibiotics through all lumens.

References

1. Wolff, L., Altman, A., Berkow, R., & Johnson, L. (2004). The management of fever and neutropenia. In A. Altman (Ed.), *Supportive care of children with cancer* (3rd ed., pp.25-38). Baltimore: Johns Hopkins University Press.
2. Freideld, A., Bow, E., Sepkowitz, K., Boeckh, M., Ito, J., et al. (2011). Clinical practice guidelines for the use of antimicrobial agents in neutropenic patients with cancer: 2010 update by the Infectious Disease Society of America. *Clinical Infectious Disease, 52*(4), e56-e93.
3. American Heart Association & American Academy of Pediatrics. (2016). Pediatric Advanced Life Support: Provider Manual. Dallas, TX: American Heart Association.
4. Renoult, E., Buteau, C., Turgeon, N., Moghrabi, A., Duval, M., & Tapiero, B. (2004). Is routine chest radiography necessary for the initial evaluation of fever in neutropenic children with cancer? *Pediatric Blood Cancer, 43*(3), 224-228.
5. Donowitz, G. R., Harman, C., Pope, T., & Stewart, F. M. (1991). The role of the chest roentgenogram in febrile neutropenic patients. *Archives of Internal Medicine, 151*(4), 701-704.
6. Feusner, J. (1997). Routine chest radiography for pediatric oncology patients with febrile neutropenia: Is it really necessary? *Cancer*, *80*(6), 1009-1010.
7. Feusner, J., Cohen, R., O'Leary, M., & Beach, B. (1988) Use of routine chest radiography in the evaluation of fever in neutropenic pediatric oncology patients. *Journal of Clinical Oncology, 6*(11), 1699-1702
8. Cox, J., DeMasi, J., McCollom, S., Jackson, G., Scothorn, D., et al. (2011). The diagnostic utility of routine chest radiography in the evaluation of the initial fever in patients undergoing hematopoietic stem cell. *Pediatric Blood Cancer, 57(*4), 666-668.
9. Phillips, B., Wade, R., Westwood, M., Riley, R., & Sutton, A. (2012). Systematic review and meta-analysis of the value of clinical features to exclude radiographic pneumonia in febrile neutropenic episodes in children and young people. *Journal of Paediatrics and Child Health, 48*(8), 641-648.
10. Roberts, S., Wells, G., Gandhi, N., York, N., Maron, G., et al. (2012). Diagnostic value of routine chest radiography in febrile, neutropenic children for early detection of pneumonia and mold infections. *Support Care Cancer, 20*(10), 2589-2594.
11. Phillips, R., Lehrnbecher, T., Alexander, S., & Sung, L. (2012). Updated systematic review and meta-analysis of the performance of risk prediction rules in children and young people with febrile neutropenia. *Plos One, 7*(5), e38300.
12. Lehrnbecher, T., Phillips, R., Alexander, S., Alvaro, F., Carlesse, F., et al. (2012). Guideline for the management of fever and neutropenia in children with cancer and/or undergoing hematopoietic stem-cell transplantation. *Journal of Clinical Oncology, 30*(35), 4427-4438.
13. National Collaborating Centre for Cancer. (2012). Neutropenic sepsis: Prevention and management of neutropenic sepsis in cancer patients. Accessed July 31, 2015 from https://www.nice.org.uk/guidance/cg151/evidence/full-guideline-188303581.
14. Teuffel, O., Ethier, M., Alibhal, S., Beyene, J., & Sung, L. (2011). Outpatient management of cancer patients with febrile neutropenia: a systematic review and meta-analysis. *Annals of Oncology, 22*(11), 2358-2365.
15. Manji, A., Beyene, J., Dupuis, L., Phillips, R., Lehrnbecher, T., et al. (2012). Outpatient and oral antibiotics management of low-risk febrile neutropenia are effective in children – A systematic review of prospective trials. *Support Care Cancer, 20*(6), 1135-1145.
16. Vidal, L., Ben dor, I., Paul, M., Eliakim-Raz, N., Pokroy, E., et al. (2013). Oral versus intravenous antibiotic treatment for febrile neutropenia in cancer patients. Cochrane Database of Systemic Reviews, Issue 10. Art No.: CD003992.
17. Paul, M., Diskstein, Y., Schlesinger, A., Grozinsky-Glasberg, S., Soares-Weiser, K., et al. Beta-lactam versus beta-lactam-aminoglycoside combination therapy in cancer patients with neutropenia. Cochrane Database of Systematic Reviews 2013, Issue 6. Art. No.: CD003038.
18. Lehrnbecher, T., Robinson, P., Fisher, B., Alexander, S., Ammann, R., et al. (2017). Guideline for the management of fever and neutropenia in children with cancer and hematopoietic stem-cell transplantation recipeints: 2017 Update. *Journal of Clinical Oncology, 35*(18), 2082-2094.
19. Beyar-Katz, O., Dickstein, Y., Borok, S., Vidal, L., Leibovici, L., & Paul, M. (2017). Empirical antibiotics targeting gram-positive bacteria for the treatment of febrile neutropenic patients with cancer. Cochrane Database of Systematic Reviews, Issue 6, Art. No.: CD003914.
20. Robinson, P., Lehrnbecher, T., Phillips, R., Dupuis, L., & Sung, L. (2016). Strategies for empiric management of pediatric fever and neutropenia in patients with cancer and hematopoietic stem-cell transplantation recipients: A systematic review of randomized trials. *Journal of Clinical Oncology, 34*(17), 2054-2060.
21. Manji, A., Lehrnbecher, T., Dupuis, L., Beyene, J., & Sung, L. (2012). A meta-analysis of antipseudomonal penicillins and cephalosporins in pediatric patients with fever and neutropenia. *The Pediatric Infectious Disease Journal, 31*(4), 353-359.
22. Caselli, D., Cesaro, S., Ziino, O., Ragusa, P., Pontillo, A. et al. (2012). A prospective, randomized study of empirical antifungal therapy for the treatment of chemotherapy-induced febrile neutropenia in children. *British Journal of Haematology, 158*(2), 249-255.
23. Cordonnier, C., Pautas, C., Maury, S., Vekhoff, A., Farhat, H., et al. (2009). Empirical versus preemptive antifungal therapy for high-risk, febrile, neutropenic patients: a randomized, controlled trial. *Clinical Infectious Disease, 48*(8), 1042-1051.
24. Schiel, X., Link, H., Maschmeyer, G., Glab, B., Cornely, D., et al. (2006). A prospective, randomized multicenter trial of the empirical addition of antifungal therapy for febrile neutropenic cancer patients: Results of the paul elrich society for chemotherapy (PEG) multicenter trial II. *Infection, 34*(3), 118-126.
25. Ahmed, N., El-Mahallawy, H., Ahmed, I., Nassif, S., El-Beshlawy, A., et al. (2007). Early hospital discharge versus continued hospitalization in febrile pediatric cancer patients with prolonged neutropenia: A randomized, prospective study. *Pediatric Blood Cancer, 49*(6), 786-792.
26. Campbell, M., Friedman, D., Dulek, D., Zhao, Z., Huang, Y., & Esbenshade, A. (2018). Safety of discharge for children with cancer and febrile neutropenia off antibiotics using absolute neutrophil count threshold values as a surrogate marker for adequate bone marrow recovery. *Pediatric Blood Cancer, 65*(3), e26875.
27. Lehrnbecher, T., Stanescu, A., & Kuhl, J. (2002). Short courses of intravenous empirical antibiotic treatment in selected febrile neutropenic children with cancer. *Infection, 30*(1), 17-21.
28. Miedema, K., Tissing, W., Abbink, F., Ball, L., Michiels, E., et al. (2016). Risk-adapted approach for fever and neutropenia in paediatric cancer patients—A national multicenter study. *European Journal of Cancer, 53*, 16-24.
29. Villanueva, M., & August, K. (2016). Early discharge of neutropenic pediatric oncology patients with fever. *Pediatric Blood Cancer, 63*(10), 1829-1833.
30. Hol, J., Wolfs, T., Bierings, M., Lindemans, C., Versluys, A., et al. (2014). Predictors of invasive fungal infection in pediatric allogeneic hematopoietic SCT recipients. *Bone Marrow Transplantation, 49(*1), 95-101.
31. te Poele, E., de Bont, E., Boexen, H., Revesz, T., Bokkerink, J., et al. (2007). Dexamethasone in the maintenance phase of acute lymphoblastic leukaemia treatment: Is the risk of lethal infections too high? *European Journal of Cancer, 43*(17), 2532-2536.
32. Baden, L., Bensinger, W., Angarone, M., Casper, C., Dubberke, E., et al. (2012). Prevention and treatment of cancer related infections. *Journal of National Comprehensive Cancer Network, 10*(11), 1412-1445.
33. Falagas, M., Kazantzi, M., & Bliziotis, I. (2008). Comparison of utility of blood cultures from intravascular catheters and peripheral veins: A systematic review and decision analysis. *Journal of Medical Microbiology, 57*(Pt 1), 1-8.
34. Handrup, M., Moller, J., Rutkjaer, C., & Schroder, H. (2014). Importance of blood cultures from peripheral veins in pediatric patients with cancer and a central venous line. *Pediatric Blood Cancer, 62*(1), 99-102.

35. Kumar, A., Sharma, R., Jaideep, C., & Hazra, N. (2014). Diagnosis of central venous catheter-related bloodstream infection without catheter removal: A prospective observational study. *Medical Journal Armed Forces India, 70*(1), 17-21.
36. Rodriquez, L., Ethier, M., Phillips, B., Lehrnbecher, T., Doyle, J., et al. (2012). Utility of peripheral blood cultures in patients with cancer and suspected blood stream infections: a systematic review. *Supportive Care in Cancer, 20*(12), 3261-3267.
37. Tarai, B., Das, P., Kumar, D., & Budhiraja, S. (2012). Comparative evaluation of paired blood culture (aerobic/aerobic) and single blood culture, along with clinical importance in catheter versus peripheral line at a tertiary care hospital. *Indian Journal of Medical Microbiology, 30*(2), 187-192.
38. Agrawal, A., Saini, N., Gildengorin, G., & Feusner, J. (2010). Is routine computed tomographic scanning justified in the first week of persistent febrile neutropenia in children with malignancies? *Pediatric Blood Cancer, 57*(4), 620-624.
39. Dignan, F., Evans, S., Ethell, M., Shaw, B., Davies, F., et al. (2009). An early CT-diagnosis-based treatment strategy for invasive fungal infection in allogeneic transplant recipients using caspofungin first line: An effective strategy with low mortality. *Bone Marrow Transplantation, 44*(1), 51-56.
40. Ho, D., Lin, M., Schaenman, J., Rosso, F., Leung, A., et al. (2009). Yield of diagnostic procedures for invasive fungal infections in neutropenic febrile patients with chest computed tomography abnormalities. *Mycoses, 54(*1), 59-70.
41. Leeflang, M., Debets-Ossenkopp, Y., Wang, J., Visser, C., Scholten, R., et al. Galactomannan detection for invasive aspergillosis in immunocompromised patients. Cochrane Database of Systematic Reviews 2015, Issue 12. Art. No.: CD007394.
42. Penack, O., Rempf, P., Graf, B., Blau, W., & Thiel, E. (2008). Aspergillus galactomannan testing in patients with long-term neutropenia: Implications for clinical management. *Annals of Oncology, 19*(5), 984-989.
43. Badiee, P., Alborzi, A., Karimi, M., Pourabbas, B., Haddadi, P., et al. (2012). Diagnostic potential of nested PCR, galactomannan EIA, and beta-d-glucan for invasive aspergillosis in pediatric patients. *Journal of Infection in Developing Countries, 6*(4), 352-357.
44. Guitard, J., Tabone, M., Senghor, Y., Cros, C., Moissenet, D., et al. (2016). Detection of β-d-glucan for the diagnosis of invasive fungal infection in children with hematological malignancy. *Journal of Infection, 73*(6), 607-615.
45. Koltz, A., Rath, P., Schöning, S., Steinmann, J., Wichelhaus, T., et al. (2015). B-D-Glucan screening for detection of invasive fungal disease in children undergoing allogeneic hematopoietic stem cell transplantation. *Journal of Clinical Microbiology, 53*(8), 2605-2610.
46. Efrati, O., Sadeh-Gornik, U., Modan-Moses, D., Barak, A., Szeinberg, A., et al. (2009). Flexible bronchoscopy and bronchoalveolar lavage in pediatric patients with lung disease. *Pediatric Critical Care Medicine, 10*(1), 80-84.
47. Efrati, O., Gonik, U., Bielorai, B., Modan-Moses, D., Neumann, Y., et al. (2007). Fiberoptic bronchoscopy and bronchoalveolar lavage for the evaluation of pulmonary disease in children with primary immunodeficiency and cancer. *Pediatric Blood Cancer, 48*(3), 324-329.
48. Ho, D., Lin, M., Schaenman, J., Rosso, F., Leung, A., et al. (2009). Yield of diagnostic procedures for invasive fungal infections in neutropenic febrile patients with chest computed tomography abnormalities. *Mycoses, 54(*1), 59-70.
49. Park, J., Fogarty, S., & Crogan, T. (2002). Clinical utility of bronchoalveolar lavage in pediatric cancer patients. *Medical and Pediatric Oncology, 39*(3), 175-180.
50. Peikert, T., Rana, S., & Edell, E. (2005). Safety, diagnostic yield, and therapeutic implications of flexible bronchoscopy in patients with febrile neutropenia and pulmonary infiltrates. *Mayo Clinic Proceedings, 80*(11), 1414-1420.
51. Rao, U., Piccin, A., O'Hanlon, K., Breatnach, F., O'Meara, A., et al. (2013). Utility of bronchoalveolar lavage in the diagnosis of pulmonary infection in children with hematological malignancies. *Irish Journal of Medical Science, 182(*2), 177-183.
52. Rosenblum, J., Lin, J., Kim, M., & Levy, A. (2013). Repeating blood cultures in neutropenic children with persistent fevers when the initial blood culture is negative. *Pediatric Blood Cancer, 60*(6), 923-927.
53. Serody, J., Berrey, M., Albritton, K., O'Brien, S., Capel, E., et al. (2000). Utility of obtaining blood cultures in febrile neutropenic patients undergoing bone marrow transplantation. *Bone Marrow Transplantation, 26*(5), 533-538.
54. Wattier, R., Dvorak, C., Auerbach, A., & Weintrub, P. (2015). Repeat blood cultures in children with persistent fever and neutropenia: Diagnostic and clinical implications. *Pediatric Blood Cancer, 62(*8), 1421-1426.
55. Kim, P., Wu, Y., Cooper, C., Rochester, G., Valappil, T., et al. (2010). Meta-analysis of a possible signal of increased mortality associated with cefepime use. *Clinical Infectious Disease, 51*(4), 381-389.
56. Vasudevan. C. & McGuire, W. Early removal versus expectant management of central venous catheters in neonates with bloodstream infection. *Cochrane Database of Systematic Reviews* 2011, Issue 8. Art. No.: CD008436.
57. Adler, A., Yaniv, I., Solter, E., Freud, E., Samra, Z., et al. (2006). Catheter-associated bloodstream infections in pediatric hematology-oncology patients: Factors associated with catheter removal and recurrence. *Journal of Pediatric Hematology/Oncology, 28*(1), 23-28.
58. Nazemi, K. J., Buescher, E. S., Kelly, R. E., & Karlowicz, M. G. (2003). Central venous catheter removal versus in situ treatment in neonates with enterobacteriaceae bacteremia. *Pediatrics, 111*(3), e269-e274.
59. Deckker, A., & Engelhard, D. (2004). Bacterial infections. In K. Atkinson (Ed.), *Clinical bone marrow and blood stem cell transplantation* (3rd ed., pp.1158-1179). Cambridge University Press.
60. Ljungman, P. & Einsele, H. (2004). Viral infections. In K. Atkinson (Ed.), *Clinical bone marrow and blood stem cell transplantation* (3rd ed., pp. 1180-1206). Cambridge University Press.
61. Tolleman, J. (2004). Fungal infections. In K. Atkinson (Ed), *Clinical bone marrow and blood stem cell transplantation* (3rd ed., pp. 1207-1224). Cambridge University Press.
62. Bradfield, S. M., Neudorf, S., Rubin, E., & Sandler, E. S. (2006). Preventions and treatment of infectious diseases. In R. M. Kline (Ed.), *Pediatric hematopoietic stem cell transplantation* (pp. 2763). New York: Informa Healthcare.

Related Documents

Low Risk Fever and Neutropenia Discharge Instructions - English

Low Risk Fever and Neutropenia Discharge Instructions - Spanish

Clinical Standards Preparation

This clinical standard was prepared by the Evidence-Based Outcomes Center (EBOC) team in collaboration with content experts at Texas Children's Hospital. Development of this clinical standard supports the TCH Quality and Patient Safety Program initiative to promote clinical standards and outcomes that build a culture of quality and safety within the organization.

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No relevant financial or intellectual conflicts to report.

Development Process

This clinical standard was developed using the process outlined in the EBOC Manual. The literature appraisal documents the following steps:

1. Review Preparation
   - PICO questions established
   - Evidence search confirmed with content experts

2. Review of Existing External Guidelines
   - TCH Fever and Neutropenia in Children Receiving Cancer Treatment (April 2010), Guideline for the Management of Fever and Neutropenia in Children With Cancer and/or Undergoing Hematopoietic Stem-Cell Transplantation (Dec 2012), Infectious Disease Society of America Clinical Practice Guideline for the Use of Antimicrobial Agents in Neutropenic Patients with Cancer (2010), Prevention and Treatment of Cancer Related Infections National Comprehensive Cancer Network (2012), Neutropenic Sepsis: Prevention and Management of Neutropenic Sepsis in Cancer Patients (2012)
3. Literature Review of Relevant Evidence
   - Searched: PubMed, Cochrane, CINAHL, Google Scholar
4. Critically Analyze the Evidence
   - 12 meta-analyses, 3 randomized studies, 19 non-randomized studies
5. Summarize the Evidence
   - Materials used in the development of the guideline, evidence summary, and order sets are maintained in a Fever and Neutropenia in Children Receiving Cancer Treatment or with Blood Disorders Clinical Guideline evidence-based review manual within EBOC.

Evaluating the Quality of the Evidence

Published clinical guidelines were evaluated for this review using the **AGREE II** criteria. The summary of these guidelines are included in the literature appraisal. AGREE II criteria evaluate Guideline Scope and Purpose, Stakeholder Involvement, Rigor of Development, Clarity and Presentation, Applicability, and Editorial Independence using a 4-point Likert scale. The higher the score, the more comprehensive the guideline.

This clinical standard specifically summarizes the evidence *in support of* or *against* specific interventions and identifies where evidence is *lacking/inconclusive*. The following categories describe how research findings provide support for treatment interventions. ***"Evidence Supports"*** provides evidence to support an intervention ***"Evidence Against"*** provides evidence against an intervention. ***"Evidence Lacking/Inconclusive"*** indicates there is insufficient evidence to support or refute an intervention and no conclusion can be drawn *from the evidence.*

The **GRADE** criteria were utilized to evaluate the body of evidence used to make practice recommendations. The table below defines how the quality of the evidence is rated and how a strong versus weak recommendation is established. The literature appraisal reflects the critical points of evidence.

Recommendation	
STRONG	Desirable effects clearly outweigh undesirable effects or vice versa
WEAK	Desirable effects closely balanced with undesirable effects
Quality	**Type of Evidence**
High	Consistent evidence from well-performed RCTs or exceptionally strong evidence from unbiased observational studies
Moderate	Evidence from RCTs with important limitations (e.g., inconsistent results, methodological flaws, indirect evidence, or imprecise results) or unusually strong evidence from unbiased observational studies
Low	Evidence for at least 1 critical outcome from observational studies, RCTs with serious flaws or indirect evidence
Very Low	Evidence for at least 1 critical outcome from unsystematic clinical observations or very indirect evidence

Recommendations

Practice recommendations were directed by the existing evidence and consensus amongst the content experts. Patient and family preferences were included when possible. The Content Expert Team and EBOC team remain aware of the controversies in the diagnosis/management of Fever and Neutropenia in Children Receiving Cancer Treatment or with Blood Disorders Clinical Guideline in children. When evidence is lacking, options in care are provided in the clinical standard and the accompanying order sets (if applicable).

Approval Process

Clinical standards are reviewed and approved by hospital committees as deemed appropriate for its intended use. Clinical standards are reviewed as necessary within EBOC at Texas Children's Hospital. Content Expert Teams are involved with every review and update.

Disclaimer

Practice recommendations are based upon the evidence available at the time the clinical standard was developed. Clinical standards (guidelines, summaries, or pathways) do not set out the standard of care and are not intended to be used to dictate a course of care. Each physician/practitioner must use his or her independent judgment in the management of any specific patient and is responsible, in consultation with the patient and/or the patient's family, to make the ultimate judgment regarding care.

Version History

Action	Date
Originally completed	June 2010
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