



## **BONE MARROW TRANSPLANTATION**

### **OVERALL DESCRIPTION**

- Inpatient Rotation (20 weeks):
  - During the day, fellows are responsible for the overall care of the inpatients (and time permitting, outpatients) covered by the bone marrow transplantation service at Phoenix Children's Hospital. The service is covered by a faculty member and a nurse practitioner or physician's assistant at all times. Fellows round with the clinical faculty during the day, and they are responsible for performing initial consults from other inpatient services, followed by discussion and supervision by the inpatient attending physician. All procedures, including bone marrow harvests, are performed under faculty supervision.
  - As fellows gain more experience in clinical care, they receive more autonomy from the teaching attending, but each patient still is discussed in its entirety before implementing recommendations and a plan of action.
  - Fellows are supervised in a similar manner by the teaching attending physician with regard to leading family care conferences during which complex diagnoses and treatment plans are discussed.
  - Inpatient rounds typically start daily at 8:30 AM with the bone marrow transplantation interdisciplinary team and last until 10:00 AM. Patients admitted to the intensive care unit typically are "co-managed" by the bone marrow transplant team and the intensivists.
  - Rounds are attended by fellows, attending physicians, inpatient nurses, pediatric residents, inpatient nurse practitioners, pharmacy staff with specialization in chemotherapy, nutritionists, and pain service staff. It is during these rounds that fellows acquire the skill set to discuss patient status changes in the prior 24 hours, to review and interpret any new findings on the patient history or physical exam, laboratory testing, or medical imaging, and to formulate a daily treatment plan based on these data. Full teaching rounds are held seven days per week, 52 weeks per year.
  - Fellow call schedule:
    - You will be first call at night with an attending physician as back-up call, except when a hematology/oncology fellow is on call
    - When a heme/onc fellow is on call, they will be first call, with the BMT fellow being available to ask questions and to teach the heme/onc fellow regarding these questions
    - You will be expected to work 1 weekend during each 4 week block (13 weekends during year)
- Outpatient Rotation (16 weeks):
  - Clinic days typically start at 8:00 AM and last until 5:00 PM
  - Additionally, you will be responsible for your own continuity clinic day
  - As a fellow, you will staff each patient with a BMT attending
  - As fellows gain more experience in clinical care, they receive more autonomy from the teaching attending, but each patient still is discussed in its entirety before implementing recommendations and a plan of action.

- You will be responsible to follow-up on any outstanding labs for any patient that you have seen and discuss results with attending
- Didactic and interactive teaching of pertinent topics in stem cell transplantation will be given by faculty members during the rotation.
- You will be required to give multiple presentations at various BMT conferences throughout your tenure as a BMT fellow.
- All fellows accepting a position within the BMT fellowship will be given a continuity clinic day that they will be expected to follow their primary patients on that day.
  - Fellows will take on at least 10 of their own BMT patients throughout their 12 month fellowship from initial consultation, continue management through the donor selection process, pre-transplant evaluation, conditioning regimen selection, transplant admission and post-transplant management.
- It is expected that all fellows participate in at least 3 bone marrow harvests during their one year fellowship.
- It is expected that all fellows participate in a peripheral blood stem cell collection with transfusion medicine rotation during their one year fellowship.

## GOALS AND OBJECTIVES

### a. Patient Care

*Fellows must be able to provide patient care that is compassionate, appropriate, and effective for the treatment of health problems and the promotion of health and must be able to competently perform all medical, diagnostic, and surgical procedures considered essential for the area of practice.*

(Source: ACGME Program Requirements for Graduate Medical Education in the Subspecialties of Pediatrics, ACGME, 7/1/16)

- Through supervised clinical experiences, fellows will develop their skills in the initial workup, treatment, and follow-up of a patient who is undergoing a hematopoietic stem cell transplant.
- The fellow will gain experience in management of patients with the following problems:
  1. Diagnostic evaluations and staging of new transplant patients and determining treatment plans for new transplant patients
  2. Staging and reassessment of established patients
  3. Administration of preparative regimens
  4. Management of complications such as nausea and vomiting, infections, febrile neutropenia, mucositis, and pain
  5. Provision of nutrition, both enteral and parenteral
  6. Use of blood components
  7. Care of terminally ill patients
- Through presentations of patients seen, fellows will develop the ability to report a detailed and appropriate history and physical examination along with pertinent diagnostic studies.
- Fellows will develop and provide rationale for the management plans of children on the transplant service.
- Fellows will discriminate changes in clinical status of patients or severity of clinical status of patients that need to be reported to the attending physician immediately from those which can be presented in rounds.
- Fellows will develop and provide rationale for the management plans of children

with acute life-threatening or major organ-threatening disease, including (but not limited to) sepsis and acute neurological compromise.

- Fellows will recognize the indications for and the risks of the following therapies and develop appropriate management plans for common complications of central venous lines, chemotherapy, transfusion therapy, radiation therapy, surgical therapy, nutritional support, and pain management.
- When requesting consultation services, fellows will demonstrate the ability to formulate an appropriate question and rationale justified by pertinent points of the history, physical examination, and laboratory data.
- Fellows will discriminate between patients who may be appropriately treated on the inpatient unit, and those who require escalation of care.
- Fellows will recognize the indications for, the common complications of, and perform the following procedures while on the transplant service: lumbar punctures (with and without intrathecal chemotherapy), bone marrow aspiration, and bone marrow biopsy.

b. Medical Knowledge

*Fellows must demonstrate knowledge of established and evolving biomedical, clinical, epidemiological and social-behavioral sciences, as well as the application of this knowledge to patient care.*

(Source: ACGME Program Requirements for Graduate Medical Education in the Subspecialties of Pediatrics, ACGME, 7/1/16)

- Fellows are required to demonstrate knowledge in the basic sciences and applied clinical aspects of stem cell transplantation during childhood. Knowledge is acquired through clinical interactions and related experiences and as well as didactic lectures. Fellows are expected to participate in didactic lectures.
- Fellows are expected gain sufficient knowledge and experience in the management of BMT patients. Topics include (but are not limited to):
  1. Pathophysiological principles
    - a. Hematopoiesis
      - Types of hematopoietic stem cells, including pluripotent versus committed progenitors
      - Basics of hematopoietic differentiation
      - Engraftment of transplanted hematopoietic stem cells
    - b. Basic immunology
      - Major histocompatibility complex function, tissue distribution, and genetics
      - Lymphoid development
      - T cell, B cell, and natural killer cell biology and functions
      - Immunologic memory
      - Antigen presentation, antigen-presenting cells, and antigen receptors
      - Principles of innate immunity
      - Natural and induced T regulatory cells
      - Immune reconstitution post transplantation
      - Data supporting/not supporting graft-versus leukemia/ lymphoma effect in allogeneic HCT
  2. Indications for HCT (adult and pediatric)
    - a. Acute and chronic leukemias
    - b. Myeloproliferative and myelodysplastic syndromes
    - c. Plasma cell dyscrasias
    - d. Lymphoproliferative diseases

- e. Paroxysmal nocturnal hemoglobinuria
  - f. Aplastic anemia and other marrow failure states
  - g. Solid tumors
  - h. Autoimmune disorders
  - i. Hemoglobinopathies
  - j. Pediatric metabolic disorders
  - k. Pediatric primary immune deficiencies, including severe combined immunodeficiency and non-severe combined immunodeficiency forms
3. Pre-HCT evaluation of recipients and donors
    - a. Recipient disease staging
    - b. Evaluation of recipient comorbidities
    - c. Donor selection, evaluation of suitability for donation, and ethical issues pertaining to donor choice
    - d. Stem cell mobilization and collection from peripheral blood and bone marrow
    - e. Selection and understanding of conditioning regimens
    - f. Planning for post transplantation therapy if indicated (eg, radiation therapy, maintenance therapy).
    - g. Assessment of a patient's caregiver situation and availability of adequate resources
  4. Pathophysiology, diagnosis, evaluation, and management of early HCT issues
    - a. Management of hematopoietic cell infusion toxicities and guidelines for infusion of ABO incompatible cell components
    - b. Principles of infection control (eg, environment, diet, handwashing, masks)
    - c. Fungal, viral, and bacterial prophylaxis
    - d. Short-term complications and an understanding of the relative frequencies of each in terms of different conditioning regimens and immunosuppressive therapies, including:
      - Mucositis (preventative strategies, evaluation, scoring, and therapy)
      - Infections (evaluation, diagnosis and therapy of all fungal, viral [including cytomegalovirus, human herpes virus 6, adenovirus, and respiratory syncytial virus]) and bacterial infections
      - Hemorrhagic cystitis
      - Sinusoidal Obstructive Syndrome (liver and pulmonary)
      - Interstitial and non-interstitial pneumonias
      - Diffuse alveolar hemorrhage
      - Hemolysis
      - Organ failure
      - Alloimmunization and transfusion strategies
      - Engraftment (neutrophils, red cells, and platelets) and chimerism
      - Minimal residual disease
      - Early graft failure (diagnosis and management options)
      - Acute graft-versus-host disease (GVHD) (including alloimmunity, role of CD4 and CD8 cells, and methods for prevention of disease and treatment)
      - Common side effects and drug interactions from standard transplantation therapies
  5. Pathophysiology, diagnosis, evaluation, and management of late HCT issues
    - a. Chronic GVHD
    - b. Post transplantation immunodeficiencies
    - c. Post transplantation autoimmune cytopenias
    - d. Late graft failure

- e. Relapse (including management with donor lymphocyte infusions)
  - f. Second cancers, including post transplantation lymphoproliferative disease
  - g. Late toxicities of all organ systems
  - h. Long-term follow-up guidelines and immunization schedules
  - i. Psychosocial issues, including those of caregivers
  - j. End-of-life issues
6. Methods and interpretations of clinical laboratory testing
- a. Blood smears
  - b. Cell counting technology
  - c. Flow cytometry
  - d. Red cell autoantibody and alloantibody testing
  - e. Red cell phenotyping and cross-matching
  - f. Basic cell viability assays
  - g. CD34+ cell evaluation
  - h. HLA typing
  - i. Donor search using the NMDP Traxis system
  - j. Apheresis techniques
  - k. Testing methods for chimerism
  - l. Polymerase chain reaction techniques for minimal residual disease
  - m. Infectious disease testing for pathogens, including cytomegalovirus, respiratory syncytial virus, adenovirus, Epstein-Barr virus, and fungal and bacterial pathogens
  - n. Interpretation of pulmonary function test results
7. Indications for, appropriate use of, and interpretation of results of procedures related to HCT
- a. Bone marrow biopsy and aspiration
  - b. Immunophenotyping, cytogenetics, and molecular studies of blood and marrow
  - c. Lumbar puncture and intraventricular access with instillation of chemotherapy by both routes
  - d. Management of indwelling catheters, including infections and thrombosis
  - e. Accurate ordering of chemotherapy and antiemetics
  - f. Hematopoietic cell apheresis for allogeneic or autologous HCT
  - g. Cryopreservation of cellular products
  - h. Thawing and administration of cellular products
8. Use of medications, blood product support, and chemotherapies pertaining to the practice of HCT
- a. Immunomodulating drugs for prophylaxis and therapy
  - b. Monoclonal antibodies (eg, rituximab) in mobilization, preparative regimens, and post transplantation maintenance
  - c. Chemotherapy and modifications by organ function
  - d. All types of blood products
  - e. Supportive care and medications for pain and symptom management
9. Knowledge pertaining to the practice of HCT
- a. Principles of safe and effective blood banking
  - b. Cryopreservation, storage, and manipulation of hematopoietic stem cells and other cellular products used for HCT
  - c. Requirements for accreditation of a hematopoietic stem cell laboratory from:
    - American Association of Blood Banks
    - FACT
    - Food and Drug Administration (FDA)

c. Practice-Based Learning and Improvement

*Fellows must demonstrate the ability to investigate and evaluate their care of patients, to appraise and assimilate scientific evidence, and to continuously improve patient care based on constant self-evaluation and life-long learning.*

(Source: ACGME Program Requirements for Graduate Medical Education in the Subspecialties of Pediatrics, ACGME, 7/1/16)

- Fellows will develop their knowledge of principles of hematopoietic stem cell transplantation by researching and referencing evidence-based practices from the literature.
- Fellows will make appropriate use of evidence-based techniques in available information technology.
- Fellows will learn cost-effective and evidence-based treatment of transplant patients.
- Fellows will interact with laboratory personnel to gather relevant information and specialized hematologic and transplant-related testing.
- Fellows will carefully review patients' records and other clinical information
- Fellows will be expected to manage time effectively
- Fellows are expected to be active and willing participants in the methods of self-critique, with the aid of faculty. Fellows are expected to reflect on their performance as necessary.
- Fellows are expected to participate in the education of patients, families, students and residents and other health professionals.
- Fellows will learn to use the Children's Oncology Group (COG) website effectively for information on clinical trials as they relate to patients undergoing hematopoietic stem cell transplantation.
- Fellows are expected to provide at least daily updates to patients and their families regarding the plan of care.

d. Interpersonal and Communication Skills

*Fellows must demonstrate interpersonal and communication skills that result in the effective exchange of information and collaboration with patients, their families, and health professionals.*

(Source: ACGME Program Requirements for Graduate Medical Education in the Subspecialties of Pediatrics, ACGME, 7/1/16)

- Fellows are expected to learn proper and efficient verbal and written communication skills when interpreting and communicating test results to patients, families, and other health care providers.
- Fellows are expected to observe and participate in counseling sessions of a newly diagnosed patient/family with an immunodeficiency.
- Fellows will learn effective communication with physicians and other health professionals and health related agencies.
- Fellows will develop proficiency in maintaining comprehensive, timely and legible medical records.
- Fellows will learn how to communicate effectively and in a developmentally appropriate manner with patients and families to create and sustain a professional and therapeutic relationship across a broad range of socioeconomic and cultural backgrounds.
- Fellows will develop the skills to lead the discussion with the family of a child who is about to undergo hematopoietic stem cell transplantation.

- Fellows will obtain informed consent for fellow-performed procedures, conscious sedation and protocol-based therapies for transplantation.
- Fellows will learn to communicate changes in patient status effectively to attending physicians and interdisciplinary team.
- Fellows will learn to present the inpatient and outpatient transplant service during daily clinical rounds and during weekly departmental meetings.
- Fellows will communicate with primary care physicians and keep them informed as to their patient's clinical status during the transplant process.

e. Professionalism

*Fellows must demonstrate a commitment to carrying out professional responsibilities and an adherence to ethical principles.*

(Source: ACGME Program Requirements for Graduate Medical Education in the Subspecialties of Pediatrics, ACGME, 7/1/16)

- Fellows are expected to improve their performance in the following areas:
  1. Consistently attend to details of patient comfort and delivery of care
  2. Accept inconvenience when necessary to meet the needs of the patient
  3. Consistently respect patient privacy when conducting examinations
  4. Provide care sensitive to patient's age, gender, disabilities, cultural/ethnic diversity, and sexual orientation
  5. Consistently be courteous and receptive to nursing and allied health staff
  6. Demonstrate consistent and excellent work ethic
  7. Consistently respond in a timely manner when paged or called
  8. Demonstrate dependability/commitment (patient follow-up, continuity of care)
  9. Maintain composure during stressful/crisis situations
  10. Demonstrate honesty/integrity
  11. Demonstrate high standards of ethical and moral behavior and accountability
  12. Demonstrate commitment to teaching at all learner levels
  13. Show compassion, integrity and respect for others
  14. Show responsiveness to patient needs that supersedes self-interest
  15. Show respect for patients' privacy and autonomy
  16. Consistently maintain respect, compassion, integrity, honesty and responsiveness to the needs of patients and the health care team in a way that supersedes self-interest
  17. Continually demonstrate accountability to all patients (even if other physicians are primarily responsible for their care)
  18. Demonstrate a commitment to excellence and ongoing professional development by being prepared, on-time, in appropriate attire and contributing in rounds, teaching conferences and didactic lectures
  19. Exercise sensitivity to the needs of the patient and the parent/guardian by applying cultural awareness, negotiation, compromise and mutual respect in the daily care of patients
  20. Recognize and demonstrate an understanding of ethical, cultural, religious or spiritual values of import to patients and families during communications and care decisions
  21. Demonstrate a commitment to confidentiality, privacy, and respect for patients and families
  22. Demonstrate empathy towards the child and family in negotiating and designing goals of treatment, including relevant medical, legal and psychological issues
  23. Demonstrate advocacy for patients and their families

24. Honestly assess one's contribution to errors that are made, accept responsibility for personal mistakes and implement plans to prevent one's self and others from making the mistake again.
25. Fellows are expected to self-critique and reflect upon their evaluations by faculty, patients and their families, ancillary staff, and secretarial staff and to continue to strive to become not only a competent clinician, but also an impassioned caregiver.

f. Systems-Based Practice

*Fellows must demonstrate an awareness of and responsiveness to the larger context and system of health care, as well as the ability to call effectively on other resources in the system to provide optimal health care.*

(Source: ACGME Program Requirements for Graduate Medical Education in the Subspecialties of Pediatrics, ACGME, 7/1/16)

- Fellows are expected to learn how to order efficient and cost-effective laboratory testing and in the care of patients in the transplant setting.
- Fellows are expected to learn proper aspects of medical coding and billing with respect to patient care.
- Fellows are expected to learn the function of office-based staff that is available to facilitate health care delivery.
- Fellows are expected to learn how to ensure efficient health care delivery by using other key personnel in the health care delivery system to best take care of their patients.
- Fellows are expected to participate in and learn how the process of performance improvement operates within the context of transplant medicine.
- Fellows also are expected to:
  - a. Coordinate patient care within the health care system
  - b. Work in inter-professional teams to enhance patient safety and improve patient care quality
  - c. Incorporate considerations of cost awareness and risk-benefit analysis in patient care
  - d. Participate in identifying systems errors and in implementing potential systems solutions
  - e. Prioritize the various modes of diagnostic testing and select the most appropriate testing modality, with a goal toward preventing unnecessary laboratory or imaging tests
  - f. Demonstrate the ability to work effectively with other members of the health care team, including, but not limited to, other physicians, nurses, pharmacists, dietitians, child life specialists and chaplains
  - g. Work effectively with the discharge planner to arrange home-care and follow-up for discharged patients
  - h. Work with pain management team to provide adequate and appropriate pain control to hospitalized patients
  - i. Work with dietitians to provide nutritional support (including TPN) to hospitalized patients
  - j. Acknowledge medical errors in a forthright manner, and report observed medical errors (real or potential) to the appropriate member of the care team, then work with the team to develop a plan for preventing future errors. For chemotherapy, this would require a report to the chemotherapy task force.



- k. Comply with institutional systems that have been developed to prevent errors in the administration of “high risk” medications, such as chemotherapy and immunosuppressive medications.
- l. Avoid use of ambiguous or unacceptable abbreviations in the medical record, prescriptions and medical orders.

#### **Teaching methods**

- a) Inpatient rounds both with the interdisciplinary team and on daily work rounds with the inpatient clinical faculty
- b) Continuous interaction with clinical faculty in all decisions made for all patients, both inpatient and outpatient
- c) Weekly tumor boards with the hematology/oncology division at Phoenix Children’s Hospital
- d) Weekly meetings with the bone marrow transplant team:
  - a. Patient Care meeting
  - b. Research meeting
  - c. Patient Selection
  - d. Protected Case Review
- e) Monthly Quality meeting (with quarterly meetings jointly between Phoenix Children’s Hospital and Mayo Clinic Arizona)
- f) Didactics as arranged with the bone marrow transplantation faculty

#### **Assessment methods (fellows)**

- a) Global assessments are completed by faculty at the end of each quarter. These assessments are shared with the fellow by written and verbal communication and reviewed with the fellow during a semiannual meeting with the program director and clinical advisor.
- b) Twice yearly multisource evaluations by multiple members of the interdisciplinary team and patients/families.
- c) Direct observation

#### **Assessment methods (Program evaluation)**

- a) Fellows complete a yearly, anonymous, confidential evaluation of the program
- b) Quarterly faculty meetings review the progress of the fellow and the program in general
- c) Yearly meeting for the faculty and fellows to review the program in general

#### **Level of supervision**

- a) The fellow works under the supervision of a clinical faculty member at all times
- b) During night call there is a clinical faculty member available at all times to discuss calls and patient issues