

Training in Transplantation Biology

This program is dedicated to the training and career development of pre- and postdoctoral (MD and/or PhD) trainees interested in pursuing careers as physician-scientists or scientists in transplantation biology and related areas of biomedical research.

Principal Investigators: Joren Madsen, MD, DPhil, and Jay A. Fishman, M.D.

About the program

Transplantation is an exciting field of clinical medicine with great potential for alleviating human disease. Because of its intimate association with immunology and infectious diseases, this field provides an opportunity for fertile interactions between basic scientists and clinicians. The availability of outstanding teams of M.D. and Ph.D. scientists devoted to all aspects of transplantation, from the most basic molecular level to the actual clinical transplants, make the Massachusetts General Hospital/Harvard Medical School a unique environment to foster such interactions. The purpose of this Program is to train young scientists and physician scientists in basic and translational research, on a wide variety of topics related to transplantation biology, in a multi-disciplinary environment, with emphases on immunological mechanisms and on translational application. Participating faculty members with diverse but complementary research interests, a successful record of collaboration, and a commitment to training young investigators, have been assembled to provide trainees with exposure to topics related to transplantation immunology including immunogenetics, tolerance induction, antigen processing and presentation, bone marrow transplantation, regulation of lymphocyte development, pathology of graft rejection, complement biology, autoimmune disease, dendritic cell biology, chemokines and lymphocyte trafficking, B and T cell biology, regulatory T cells, mucosal immunology, gene editing, and xenotransplantation. **The major goal of this program is to develop outstanding independent investigators capable of addressing fundamental questions in the field of transplantation and of applying the answers to achieve clinical goals.**

A Program Project grant on immunologic studies basic to transplantation is now in its 40th consecutive year of funding and an NIH-sponsored, "Training Program in Transplantation Biology" was established at the MGH in 1998. These awards have provided a vehicle for unifying many of the research efforts in transplantation over the years. The training grant provides support directly to selected trainees during 2-3 years of mentored research. This program has evolved to serve the entire HMS community. To facilitate this evolution, close ties have been forged with the HMS faculty in immunology through the teaching and administrative roles played by the leaders and preceptors on this T32 grant. Our growth has broadened opportunities for training into newer, important areas in transplantation biology including innate immunity (Luster, Mempel Labs), T and B-cell biology (Pillai, Markmann, Riella), infectious disease (Fishman, Elkhoury, Abraham), autoimmunity (Pillai), vascular biology (Ferran, Robson) organogenesis (Ott), cancer immunobiology (Hacohen, Maus, Sharp, Curry), and nanotechnology (Azzi, Reza). This growth also promotes a pipeline of talented pre-doctoral and doctoral trainees to achieve our important goals in diversity among trainees.

Participating Faculty and Institutions

Center for Transplantation Sciences, **MGH** (Madsen, Azimzadeh, Benichou, Cetrulo, Colvin, Cosimi, Fishman, Kawai, Markmann, Pierson, Sachs)
Immunology Department, Harvard Medical School (Abraham, Pillai, Sharpe)

Cancer Center for Research, **MGH** (Curry, Hacoheh, Maus, Spitzer)
Transplantation Research Center, **BWH** (Abdi, Azzi, Riella, Sage)
Center for Immunology and Inflammatory Diseases, **MGH** (Elkhoury, Luster, Mempel)
Transplant Research Program, **BCH** (Briscoe)
Program in Cellular and Molecular Medicine, **BCH** (Carroll)
Tissue Engineering and Organ Fabrication Laboratory, **MGH** (Ott)
Center for Life Sciences, **BIDMC** (Robson)
Stem Cell Transplant Center, **BCH** (Keane)

Abdi, Reza
Abraham, Jonathan
Azzi, Jamil
Benichou, Gilles
Briscoe, David
Carroll, Michael
Cetrulo, Curtis L.
Colvin, Robert B.
Cosimi, A. Benedict
Curry, William T.
Elkhoury, Joseph
Ferran, Christiane
Fishman, Jay A.
Hacoheh, Nir
Luster, Andrew
Kawai, Tatsuo
Kean, Leslie
Markmann, James
Mempel, Thorston
Madsen, Joren C.
Maus, Marcela V.
Ott, Harald C.
Pierson, R. Robin
Pillai, Shiv S.
Riella, Leonardo
Robson, Simon C.
Sachs, David H.
Sage, Peter
Sharpe, Arlene H.
Spitzer, Thomas R.

Course Work and Other Training Activities:

1) *Courses:* The specific curriculum for pre- and postdoctoral trainees are described in detail below. However, an integral part of this training program is the availability of formal course work. All trainees will have full privileges at Harvard University that will allow them to attend courses at Harvard College and Medical School as well as the Massachusetts Institute of Technology (MIT). In addition, trainees will have access to the superb library facilities of Harvard and MIT and to numerous courses offered online. Three

unique educational opportunities deserve special mention here, although are described in more detail under **Institutional Environment and Commitment to Training**.

1. *New HMS course in Transplantation Immunology*. This is new HMS mini-course developed by Dr. Shiv Pillai and Dr. Christian LeGuern, a CTS senior investigator, which emphasizes the intersection of basic immunology and clinical transplantation and will be a requirement for all T32 trainees.

2. *The Harvard Catalyst* (<http://catalyst.harvard.edu/>). This is a website which enables collaboration and provides tools, training and technologies to clinical and translational investigators, is a valuable resource for trainees in the translational pathway.

3. *Master's Program in Transplantation Immunology*. In development by T32 preceptor, Dr. Jamil Azzi, this HMS accredited 1-year program will offer instruction in transplantation immunology, basic immunologic investigation and research methods, clinical research skills including epidemiology, biostatistics, and clinical trial design; ethics, genetics, leadership, scientific communication and career development to postdoctoral transplantation fellows.

2) *Seminars*: Trainees are required to attend and participate in several regular series of research seminars. They will present "work in progress" research findings frequently at weekly individual laboratory meetings (see below), and in a more polished format at weekly CTS Seminar Series. Participation in this seminar series provides trainees with oral presentation skills which they will need for the remainder of their careers. Trainees are also encouraged to attend the weekly MGH Immunology Seminar Series.

3) *Journal Clubs*: Trainees are expected to participate in the CTS Journal Club held monthly during the academic year on Monday afternoons

4) *Laboratory meetings*: In addition to the above-mentioned activities, trainees will participate in smaller individual laboratory meetings. Currently, each participating faculty member conducts a regularly scheduled laboratory meeting of his/her research group, in several cases consisting of joint laboratory meetings for the smaller laboratories.

5) *Instrument and techniques training sessions*: A training program must include a mechanism for introducing trainees to the use of various types of large equipment and techniques. While most routine techniques needed to conduct research are best taught to trainees by more experienced individuals in preceptors' laboratories, the use of large, shared instruments and animal techniques are best taught by individuals with appropriate expertise. Therefore, training sessions are held for new laboratory members to introduce trainees to the use of various types of equipment and techniques. Theoretical background and basic principles are covered as well as potential applications. Based on the interest of trainees, the following training sessions will be offered on a rotating basis: 1) Flow cytometry; 2) Confocal and fluorescent microscopy; 3) Image analysis using phosphoimagers and densitometers; 4) Computer systems and analysis; 5) Cellular immunology techniques; 6) Small animal handling and basic techniques such as bleeding, breeding, injection etc.; 7) Large animal (Primate and swine) handling and care; 8) Biostatistics; 9) Luminex technology; 10) In vivo microscopy; 11) DNA and RNA preparation and analyses; 12) Nanostring technology and 13) Bioinformatics. These sessions involve an hour-long discussion about basic principles,

including theory and safety, and will be followed by an equipment demonstration. This training allows all users to acquire a base of knowledge that will allow trainees to be able to operate and maintain equipment properly and safely. In addition, all trainees engaged in research involving the use of animals will be required to attend an animal orientation and training lecture held by the MGH Center for Comparative Medicine (CCM). All trainees engaged in research involving human subjects must complete the Partners Human Research Committee (PHRC) approved basic education program, developed by the Collaborative Institutional Training Initiative (CITI).

6) Writing skills, manuscript preparation and grant writing: Manuscript writing will be taught to trainees by his/her preceptor. All trainees will also have the opportunity to then prepare an abbreviated NIH-style research proposal, under the close supervision of their preceptor, for submission to the executive committee prior to starting their research project. Attending these workshops and preparing a formal proposal will help provide trainees with skills they will need in the future to run an independent research program.

7) Annual HMS Immunology Program Retreat: In October of each year the Immunology Program Retreat is held at an external site.

8) Annual MGH Transplant Symposium: T32 trainees are required to present their work formally each year. One or more world-renowned keynote speakers are invited to present their own work and critique the presentations.

9) Annual Paul S. Russell Visiting Professorship.

Predoctoral Trainees: Training will be tailored to meet the individual's needs. Primarily, preceptors will guide their trainees in the selection of appropriate course work, seminars, and literature review, while fostering an increasing level of independence.

Postdoctoral Trainees: All postdoctoral trainees will have an MD, PhD, or MD/PhD degree.