Stanford

Elizabeth Egan

Assistant Professor of Pediatrics (Infectious Diseases) and of Microbiology and Immunology

Pediatrics - Infectious Diseases

CLINICAL OFFICES

- **Pediatric Infectious Disease**

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Bio

BIO

Elizabeth Egan, MD, PhD is an Assistant Professor in the Division of Infectious Diseases in the Department of Pediatrics. She obtained her B.A. at Barnard College in NYC and her MD/PhD from Tufts University School of Medicine in Boston. Prior to medical school she worked in Will Talbot's lab studying early pattern formation in zebrafish. Her PhD in Matthew Waldor's lab focused on defining essential replication factors for the two Vibrio cholerae chromosomes. As a postdoc in Manoj Duraisingh's lab at Harvard School of Public Health she performed a genetic screen to identify critical host factors for Plasmodium falciparum malaria using red blood cells derived from hematopoietic stem cells. Clinically, she completed training in Pediatrics and Pediatric Infectious Diseases at Boston Children's Hospital and now sees patients on the Pediatric Infectious Diseases service at Lucille Packard Children's Hospital. Her research is focused on understanding how host factors from the human erythrocyte influence the biology and pathogenesis of the malaria parasite Plasmodium falciparum.

CLINICAL FOCUS

- Pediatric Infectious Diseases

ACADEMIC APPOINTMENTS

- Assistant Professor, Pediatrics - Infectious Diseases
- Assistant Professor, Microbiology & Immunology
- Member, Bio-X
- Member, Maternal & Child Health Research Institute (MCHRI)

HONORS AND AWARDS

- New Innovator Award, NIH Office of the Director (2016-2021)
- Baxter Foundation Faculty Scholar Award, Donald E. and Delia B. Baxter Foundation (2016)
- Clinical Scientist Development Award, Doris Duke Charitable Foundation (2016-2019)
- ASCI 2016 Young Physician-Scientist Award, The American Society for Clinical Investigation (2016)
- Eleanor and Miles Shore Fellowship for Scholars in Medicine, Boston Children's Hospital and Harvard Medical School (2011-2013)

- Maxwell Finland Award for Excellence in Research, Massachusetts Infectious Diseases Society (2011)
- Pediatric Scientist Development Program Fellowship Award, Eunice Kennedy Schriver National Institute of Child Health and Human Development (2009-2012)
- Dean's Award for the best Ph.D. thesis, Tufts University Sackler School of Biomedical Sciences (2005)
- New England Pediatric Society Prize, New England Pediatric Society (2005)
- Kass Award, Infectious Disease Society of America (2004)
- Hermann Biological Prize, Barnard College, Columbia University (1995)

PROFESSIONAL EDUCATION

- PhD Training: Tufts University School of Medicine MA
- Fellowship: Boston Children's Hospital (2011) MA
- Residency: Boston Children's Hospital (2008) MA
- Internship: Boston Children's Hospital (2006) MA
- Medical Education: Tufts University School of Medicine (2005) MA
- Board Certification: Pediatric Infectious Diseases, American Board of Pediatrics (2011)
- B.A., Barnard College, Columbia University , Biological Sciences
- M.D., Tufts University School of Medicine , Medicine
- Ph.D., Tufts University Sackler School of Biomedical Sciences , Genetics
- Internship, Boston Children's Hospital , Pediatrics
- Residency, Boston Children's Hospital , Pediatrics
- Fellowship, Boston Children's Hospital , Pediatric Infectious Diseases
- Board Certification: Pediatrics, American Board of Pediatrics (2008)

LINKS

- Egan Lab website: https://eganlab.stanford.edu

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

Severe malaria caused by Plasmodium falciparum is a leading cause of morbidity and mortality in the developing world, particularly among young children and pregnant women. Population genetic studies dating back to the mid-20th century first proposed that erythrocytes (red blood cells), the host cell for P. falciparum, have been under natural selection due to malaria. Hemoglobinopathies, thalassemias, ovalocytosis, and G6PD deficiency are all examples of red cell disorders that appear to provide protection against severe malaria.

Although the notion that malaria has helped shape the human genome is well- accepted, the lack of a nucleus in human erythrocytes has hindered our ability to study genetic interactions between these unusual host cells and P. falciparum parasites. Recently, we developed a hematopoietic stem cell-based approach to tackle this issue, in which we can genetically alter nucleated hematopoietic precursor cells and differentiate them ex-vivo to mature erythrocytes that can be infected by P. falciparum. Using this approach, we performed a forward genetic screen of human blood groups to identify critical host factors for P. falciparum, and discovered several candidates that appear to be required for efficient parasite invasion of red blood cells. We found that the Cromer blood group antigen CD55 (DAF) is essential for parasite invasion and is necessary for proper attachment of merozoites to the erythrocyte surface. Importantly the requirement for CD55 appears to be strain-transcendent, suggesting that it may act as a critical receptor during malaria infection.

We are currently pursuing fundamental questions related to host-pathogen interactions in malaria, with the host erythrocyte as a focal point. We employ a variety of approaches spanning molecular parasitology, stem cell biology, cell biology, biochemistry and genomics. We welcome self-motivated individuals interested in joining us as we seek to learn more about the fascinating biology underlying host-pathogen interactions in malaria.

Publications

PUBLICATIONS

- **A forward genetic screen identifies erythrocyte CD55 as essential for Plasmodium falciparum invasion.** *SCIENCE*
  Egan, E. S., Jiang, R. H., Moechtar, M. A., et al
  2015; 348: 711-714

- **Erythrocyte CD55 mediates the internalization of Plasmodium falciparum parasites.** *eLife*
  Shakya, B., Patel, S. D., Tani, Y., Egan, E. S.
  2021; 10

- **Mitochondria-Rich Extracellular Vesicles From Autologous Stem Cell-Derived Cardiomyocytes Restore Energetics of Ischemic Myocardium.** *Journal of the American College of Cardiology*
  Ikeda, G. n., Santoso, M. R., Tada, Y. n., Li, A. M., Vaskova, E. n., Jung, J. H., O'Brien, C. n., Egan, E. n., Ye, J. n., Yang, P. C.
  2021; 77 (8): 1073–88

- **A common polymorphism in the mechanosensitive ion channel PIEZO1 is associated with protection from severe malaria in humans.** *Proceedings of the National Academy of Sciences of the United States of America*
  Nguetse, C. N., Purington, N. n., Ebel, E. R., Shakya, B. n., Tetard, M. n., Kremsner, P. G., Velavan, T. P., Egan, E. S.
  2020

- **MICROSCALE MAGNETIC LEVITATION FOR MULTIPLEXED ANALYSIS OF MALARIA-INFECTED BLOOD SAMPLES IN RESOURCE-LIMITED SETTINGS**
  Deshmukh, S. S., Durmus, N., Greenhouse, B., Egan, E., Demirci, U.
  AMER SOC TROP MED & HYGIENE.2019: 130–31

- **Beyond Hemoglobin: Screening for Malaria Host Factors** *TRENDS IN GENETICS*
  Egan, E. S.
  2018; 34 (2): 133–41

- **Erythrocytes lacking the Langereis blood group protein ABCB6 are resistant to the malaria parasite Plasmodium falciparum** *COMMUNICATIONS BIOLOGY*
  Egan, E. S., Weekes, M. P., Kanjee, U., Manzo, J., Srinivasan, A., Lomas-Francis, C., Westhoff, C., Takahashi, J., Tanaka, M., Watanabe, S., Brugnara, C., Gygi, S. P., Tani, et al
  2018; 1

- **Erythrocytes lacking the Langereis blood group protein ABCB6 are resistant to the malaria parasite Plasmodium falciparum.** *Communications biology*
  Egan, E. S., Weekes, M. P., Kanjee, U., Manzo, J., Srinivasan, A., Lomas-Francis, C., Westhoff, C., Takahashi, J., Tanaka, M., Watanabe, S., Brugnara, C., Gygi, S. P., Tani, et al
  2018; 1: 45

- **CRISPR/Cas9 knockouts reveal genetic interaction between strain-transcendent erythrocyte determinants of &ITPlasmodium falciparum&IT invasion** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
  Kanjee, U., Gruring, C., Chaand, M., Lin, K., Egan, E., Manzo, J., Jones, P. L., Yu, T., Barker, R., Weekes, M. P., Duraisingh, M. T.
  2017; 114 (44): E9356–E9365

- **Host-parasite interactions that guide red blood cell invasion by malaria parasites** *CURRENT OPINION IN HEMATOLOGY*
  Paul, A. S., Egan, E. S., Duraisingh, M. T.
  2015; 22 (3): 220-226

- **Plasmodium falciparum transmission stages accumulate in the human bone marrow** *SCIENCE TRANSLATIONAL MEDICINE*
  Joice, R., Nilsson, S. K., Montgomery, J., Dankwa, S., Egan, E., Morahan, B., Seydel, K. B., Bertuccini, L., Alano, P., Williamson, K. C., Duraisingh, M. T., Taylor, T. E., Milner, et al
  2014; 6 (244)

- **Optimization of flow cytometric detection and cell sorting of transgenic Plasmodium parasites using interchangeable optical filters** *MALARIA JOURNAL*
  Vorobjev, I. A., Buchholz, K., Prabhat, P., Ketman, K., Egan, E. S., Marti, M., Duraisingh, M. T., Barteneva, N. S.
  2012; 11
- **Independent control of replication initiation of the two Vibrio cholerae chromosomes by DnaA and RctB** *JOURNAL OF BACTERIOLOGY*
  Duigou, S., Knudsen, K. G., Skovgaard, O., Egan, E. S., Lobner-Olesen, A., Waldor, M. K.
  2006; 188 (17): 6419-6424
- **Autorepression of RctB, an initiator of Vibrio cholerae chromosome II replication** *JOURNAL OF BACTERIOLOGY*
  Egan, E. S., Duigou, S., Waldor, M. K.
  2006; 188 (2): 789-793
- **Divided genomes: negotiating the cell cycle in prokaryotes with multiple chromosomes** *MOLECULAR MICROBIOLOGY*
  Egan, E. S., Fogel, M. A., Waldor, M. K.
  2005; 56 (5): 1129-1138
- **Synchronous replication initiation of the two Vibrio cholerae chromosomes** *CURRENT BIOLOGY*
  Egan, E. S., Lobner-Olesen, A., Waldor, M. K.
  2004; 14 (13): R501-R502
- **Distinct replication requirements for the two vibrio cholerae chromosomes** *CELL*
  Egan, E. S., Waldor, M. K.
  2003; 114 (4): 521-530
- **An extraretinally expressed insect cryptochrome with similarity to the blue light photoreceptors of mammals and plants** *JOURNAL OF NEUROSCIENCE*
  Egan, E. S., Franklin, T. M., Hilderbrand-Chae, M. J., McNeil, G. P., Roberts, M. A., Schroeder, A. J., Zhang, X. L., Jackson, F. R.
  1999; 19 (10): 3665-3673
- **A genetic linkage map for zebrafish: Comparative analysis and localization of genes and expressed sequences** *GENOME RESEARCH*
  GATES, M. A., Kim, L., Egan, E. S., Cardozo, T., Sirotkin, H. I., Dougan, S. T., Lashkari, D., Abagyan, R., Schier, A. F., Talbot, W. S.
  1999; 9 (4): 334-347
- **Zebrafish organizer development and germ-layer formation require nodal-related signals** *NATURE*
  Feldman, B., GATES, M. A., Egan, E. S., Dougan, S. T., Rennebeck, G., Sirotkin, H. I., Schier, A. F., Talbot, W. S.
  1998; 395 (6698): 181-185
- **Mutant rescue by BAC clone injection in zebrafish** *GENOMICS*
  Yan, Y. L., Talbot, W. S., Egan, E. S., Postlethwait, J. H.
  1998; 50 (2): 287-289
- **Vertebrate genome evolution and the zebrafish gene map** *NATURE GENETICS*
  Postlethwait, J. H., Yan, Y. L., GATES, M. A., Horne, S., Amores, A., Brownlie, A., Donovan, A., Egan, E. S., Force, A., Gong, Z. Y., Goutel, C., Fritz, A., Kelsh, et al
  1998; 18 (4): 345-349
- **Genetic analysis of chromosomal rearrangements in the cyclops region of the zebrafish genome** *GENETICS*
  Talbot, W. S., Egan, E. S., GATES, M. A., Walker, C., Ullmann, B., Neuhauss, S. C., Kimmel, C. B., Postlethwait, J. H.
  1998; 148 (1): 373-380