**Facilities & Other Resources**

**INSTRUCTIONS:**

*Instructions are taken directly from the* [*NIH SF424 Application Guide*](https://grants.nih.gov/grants/how-to-apply-application-guide/forms-d/general-forms-d.pdf)*. For internal use only, do not distribute. Please delete prior to submission.*

**Format:** No page maximum, 11pt font or larger (suggest fonts - Arial, Garamond, Georgia, Helvetica, Palatino Linotype, Times New Roman, Verdana), at least 0.5” margins, single column formats are highly encouraged. Attach this information as a PDF file.

**Content:** Describe how the scientific environment in which the research will be done contributes to the probability of success (e.g., institutional support, physical resources, and intellectual rapport). In describing the scientific environment in which the work will be done, discuss ways in which the proposed studies will benefit from unique features of the scientific environment or from unique subject populations or how studies will employ useful collaborative arrangements. If there are multiple performance sites, describe the resources available at each site.

Describe any special facilities used for working with biohazards and any other potentially dangerous substances. **Note: Information about select agents must be described in the Research Plan, Select Agent Research.**

For early stage investigators (ESIs), describe institutional investment in the success of the investigator. See NIH's [New and Early Stage Investigator Policies](https://grants.nih.gov/policy/new_investigators/index.htm). Your description may include the following elements:

* resources for classes, travel, or training;
* collegial support, such as career enrichment programs, assistance and guidance in the supervision of trainees involved with the ESI’s project, and availability of organized peer groups;
* logistical support, such as administrative management and oversight and best practices training;
* financial support, such as protected time for research with salary support.

**THE BROAD INSTITUTE, INC**

**A. Institutional Resources**

The Broad Institute physical laboratory and office space in Cambridge is ~700,000 total gross sq ft. The new building at 75 Ames Street is the Broad's latest addition to its Cambridge campus. Located adjacent to the headquarters at 415 Main Street, the facility is approximately 375,000 gross square feet of new laboratory and office. As well as the twelve stories that Broad will occupy, the building also comprises a basement, and three mechanical equipment floors. The new building was constructed over the existing Cambridge Center West Garage, and is also physical connected to 415 Main by a six story bridge (floors 2 through 7 in each building will be contiguous).

The remaining physical location consists of a large sequencing center building at 320 Charles Street, which is approximately 100,000 sq. ft. This building is a few blocks from the 415 Main/75 Ames headquarters and is less than a 10 minute walk.

**COMPUTATIONAL**

Approximately 5,000 sq. ft. of space is dedicated to three computer data centers, one in a Broad facility, the others hosted by two distinct (and geographically disparate) commercial collocation facilities.

The principal computing resource is a large compute farm containing primarily Dell and Cisco server hardware comprising more than more than 8000 processor cores. Workload across the compute farm is managed by Platform Computing's Load Sharing Facility (LSF), and also by Sun Grid Engine (SGE). In addition to the compute farm, we have more than 100 physical and 1,000 virtual servers running Linux or Windows, dedicated to specific applications as well as several dozen large memory (256-2048GB) servers running Linux for memory-intensive applications such as whole-genome assembly.

Data storage is provided by network-attached storage (NAS) products from Isilon Systems, Infinidat, Network Appliance, and Oracle, which collectively offer access to over 25PB of usable file space via NFS and CIFS/SMB protocols. Current SAN storage capacity is over 1.5PB, hosted on EMC VMAX, Violin Memory, and Infinidat. We also store data on Object Storage Technology from EMC and Amplidata, as well as in the Amazon Web Services environment, where appropriate.

Our primary database environment is Oracle 11g, with approximately 400TB of SAN-attached storage currently allocated across 44 Oracle database servers. Production and research instances of MySQL and MongoDB databases are also supported.

Electronic data are always maintained in a facility separate from that storing the primary data to provide recoverability in case of disaster. To manage and perform backups, we use EMC's Networker software and Avamar backup systems in conjunction with a Data Domain storage library. Other data classes are replicated on mulitple Isilon and Infinidat storage arrays, distributed between our three data centers.

We support over 1000 desktop and laptop client computers, about 75% of which are PCs running Windows and 25% are Apple Macs. Data on these systems are protected through a separate system served by Crash Plan Pro software.

Cisco, Force 10, and Brocade network switches provide 1Gbps connectivity throughout our buildings, with a 10Gbps infrastructure providing server-to-server and server-to-storage connectivity and 20-80Gbps inter-building links. We maintain multiple 1Gbps connections to commercial internet service providers, as well as a 10Gbps connection to the research computing backbone Internet2.

All production services are monitored 24x7, and the server and storage infrastructure is protected by both UPS and diesel generators that ensure continuous power for both the computational hardware and the associated cooling systems. An IT staff of ~55 employees provides support for all computing resources, including production and research applications.

**B. Scientific Environment**

The Broad Institute is a unique scientific community of diverse talents that brings together world-class faculty, professional staff, postdoctoral fellows and students from throughout the MIT and Harvard communities and beyond in a collaborative environment. The Institute is organized around scientific programs and platforms, a transparent infrastructure that allows biology- and technology-focused scientists to jointly build, apply, and share cutting-edge tools and knowledge with scientists worldwide. The programs bring scientists together into research groups with a shared commitment to addressing critical biomedical challenges in either specific diseases or areas of biomedicine including: Cancer, Epigenomics, Psychiatric Disease, Metabolic Disease, Medical and Population Genetics, Chemical Biology, Infectious Disease, Computational Biology and Bioinformatics, and Genome Biology and Cell Circuits. The Broad currently maintains six specialized scientific platforms, which provide centers for technological innovation and large scale genomics projects –Chemical Biology, Genomics (comprised of Samples, Genetic Arrays, and Sequencing), Imaging, Metabolite Profiling, Proteomics, and RNAi.

This organization will facilitate the success of our grant proposal in several key ways.

**1. A vibrant and diverse community conducts collaborative science by multi-disciplinary teams.** Our community consists of biologists, clinicians, experimental technologists and engineers, computational scientists, and software engineers, and involves staff scientists, graduate students, postdoctoral fellows, platform directors, and Core and Associate Member faculty. As a result, we have developed an institutional culture of respect and a mutual scientific ‘language’ that facilitates effective research across disciplines. In particular, our team-based approach to genomics ensures that computational efforts are driven by biological questions, that computational scientists impact the conception and design of experiments, and that biologist users can quickly and critically evaluate computational solutions, and affect their development. To facilitate this, we have weekly program meetings as well as outside seminar series that focus on both the laboratory and computational aspects of genomics.

**2. Direct and sustained interactions between academic research labs and technology platforms.** The technology platforms (**1**) provide exceptional capabilities and scale to conduct genomics research; (**2**) are the ‘next step’ when a technology that initially emerged in a research lab needs to be scaled up; and (**3**) are partners with the research labs in developing new technologies, bringing know-how, technological innovation and exceptional human resources and equipment to this process..

**3. A nimble culture of innovation and scientific entrepreneurship.** The non-hierarchical culture of the Broad, combined with unprecedented expertise and resources, encourages nimble science and fast development and adoption of new approaches. In particular, it encourages grass-roots initiatives, by trainees (grad students and postdocs) and young investigators, providing them the resources and backbone to conduct large scale genomics research.

**4. Open space and mixed lab organization** facilitates the sharing of ideas, know how, technologies and equipment, thus increasing the pace of discoveries and leading to exciting new directions for research.

**5. Organizational infrastructure and institutional culture promote integrated research programs.** The Broad facilitates and assists in the formation and propagation of research programs and initiatives, providing organizational support and institutional culture to maintain such activities.

**HOSPITAL ESCUELA UNIVERSITARIO**

The Hospital Escuela Universitario (HEU, University Teaching Hospital) is a public institution specialized in comprehensive, timely, and high quality health services. It also contributes to the scientific development of health and the training of human resources through incorporation of new trends in healthcare with an efficient and transparent administration. The Teaching Hospital complex was created in 1978, when the Medical-Surgical Unit was inaugurated to complement the existing Maternal and Child Unit (opened in 1969). HEU is currently the national reference hospital center and also a pre and postgraduate medical education center. It is the only hospital in Tegucigalpa with emergency service in all specialties for children and adults with coverage 24 hours a day, 365 days a year. The total area of the Teaching Hospital complex is 60,000 sq. ft. It is located in Tegucigalpa, boulevard Suyapa, 1ro de enero avenue, Central District. Website: www.hospitalescuela.edu.hn

**A. Institutional organization and mission**

In 2012, HEU’s management and administration were transferred to the National Autonomous University of Honduras (UNAH). Since that time on, HEU has has focused its mission on three essential functions:

1. Teaching. The insertion of the HEU in the UNAH system, creates a solid base for the formation and development of human resources, during undergraduate, postgraduate (masters) and specific specialization studies. It also provides a permanent interaction between the academic and practical scopes that improves curricular performance and learning.
2. Research. It must respond to the institutional health needs, and it is structured around: i) Actions on the health of the population in general or of specific groups, such as maternal and child health and chronic degenerative diseases; ii) Actions that focus on priority diseases or groups, such as HIV/AIDS, dengue and malaria; iii) Technical and methodological platforms supporting the development of research in health-related areas such as biostatistics, communication networks, clinical trials, relations with educational institutions, and promotion of research initiatives that contribute to the development of protocols and standards of care to improve diagnostic and therapeutic approaches, as well as the promotion, prevention and rehabilitation of patients.
3. Assistance. Through education, promotion, prevention, healing and rehabilitation, by providing the services of the specialties described in the portfolio of medical services, with a focus on continuous improvement of technical quality and humane assistance.

**B. Medical Services**

HEU is the one with the largest number of beds in Honduras, providing care to between 4,000 to 5,000 people daily. It has the greatest complexity, and most comprehensive offer of services:

* Emergency: Consisting of care for critically ill patients through surgical medical care, as well as assessment of pregnant women and delivery care and specialties for children and adults; these services are 24 hours a day, 365 days a year.
* External consultation: It consists in providing specialized medical services to patients with clinical symptoms, who can become an internal patient depending on the evaluation or the clinical or laboratory diagnosis.
* Hospitalization: Consists of sending the patient for hospitalization either by external consultation or emergency, to take care of the different diseases diagnosed to patients.
* Surgery: It consists of specialized professional work that requires the diagnosis and medical treatment and selective or emergency surgical interventions, whose main purpose is to provide medical assistance to the patient until their recovery.

In order to attend these four services, HEU has: clinical departments (internal medicine, general surgery, orthopedic-traumatology, neurosurgery, pediatrics and gynecology-obstetrics), four emergencies (internal medicine, General Integrated Surgery, pediatrics, Gynecology and Obstetrics), several hospitalization services for specialties with 1,200 beds, several multidisciplinary clinical units, and specialty outpatient consultations. Within the services of HEU there are three peripheral emergency clinics, called CLIPER, located in the Colonia el Sitio, Hato de Enmedio and Las Crucitas, all within the municipality of the Central District. These clinics provide emergency services, and if the patients received at the CLIPER present a higher degree of complexity, they are referred to the HEU’s emergency department.

**C. Diagnostic and treatment support**

Diagnostic and treatment support groups different assisting activities over all specialties. It is composed of the following areas:

* Clinical laboratory: It has cutting-edge technology in Hematology, Microbiology, Blood chemistry, Microscopy, Immunoserology and Special Immunology. There is a permanent reserve of blood that allows adequate and timely care to surgical patients needed transfusions. In an outpatient clinic, sampling begins at 6:30 AM and the delivery of results is done the next day with an average of 24 hours.
* Health Surveillance: Interdisciplinary group that collects, analyzes and interprets data that are disseminated in a timely manner through the reporting units. Develops activities to monitor, prevent and conduct effective controls in: Intrahospital Infections, Epidemiological Surveillance System, Childhood Violence Surveillance System, Food and Nutritional Surveillance System.
* Imaging: The latest technology is available for the following services: Digital radiology and special examinations of levels I, II and III
* Ecography: For all types of patients in which tests are performed such as: Obstetric, Pelvic, Transvaginal, Breast, Kidney, Hepatobiliary, Transfontanellar, Complete Abdomen, Neck, Thyroid, Scrotal, Small parts, Urinary tract, Transrectal, Biophysical profile and Thoracic
* Doppler services for the following studies: Placental fetus, Neck vessels, Arterial vessels, Lower limbs, Testicular, Renal, Transfontanellar, Abdominal vessels.
* Computed tomography scanning facilities. Equipped with latest-technology, 16-section CT machines for studies in: Upper and Pelvic Abdomen; ATM; Axial Rotula; Column (Cervical, Dorsal and Lumbar); Skull (Simple and Contrast); Neck; Extremities and Joints; Larynx; Maxillae; Ear; Orbits; Pelvis; Rhinopharynx; Paranasal sinuses; Sella turcica; Chest; Soft tissues
* Pathology: Simple and multiple biopsies. Anatomopathological study of surgical specimens.
* Pharmacy: Preparation of parenteral nutrition in the laminar flow cabinet. Unidosis. Repackaging medications. Dispensing to outpatient and hospitalized patients.
* Rehabilitation Services: Including Respiratory Therapy, Physical Therapy, Language Therapy, Occupational Therapy, Psychology, Nutrition, Social Work
* Additional institutional programs: High-risk Obstetric Program, Kangaroo Care Integral Attention Program, Cervical Pathology Program, Family Planning Program, Program Of Pediatric Respiratory Therapy, and Special Procedures

**BOSTON CHILDREN’S HOSPITAL**

Boston Children’s Hospital (BCH) is built on a longstanding foundation of excellence in pediatric clinical care, research, teaching, and community service. BCH is the pediatric teaching hospital of Harvard Medical School and is one of the largest and best regarded free-standing academic pediatric medical centers in the U.S. A 395 bed comprehensive center for pediatric health care with approximately 25,000 inpatient admissions each year and our 200+ specialized clinical programs schedule 557,000 visits annually. Last year the hospital performed more than 26,500 surgical procedures and 158,700 radiological examinations. It has nearly 1,000 active medical and dental staff and 775 residents and fellows. BCH is an international referral center for many complex pediatric conditions and a regional center for highly specialized care. BCH is the nation’s largest pediatric research facility, ranking first in federal research funding with $225 million in research grants. Research faculty at BCH conduct biomedical research in 36 departments. A leading teaching facility, BCH hosts 32 clinical fellowship programs and 16 federally-funded training programs. The hospital places a high priority on training and nurturing clinical researchers. More than 1,100 scientists comprise our research community, including 9 members of the National Academy of Sciences, 11 on-staff members of the Institute of Medicine and 9 members of the Howard Hughes Medical Institute.

***The Computational Hospital Informatics Program (CHIP)***http://www.chip.org, founded in 1994, is a multidisciplinary applied research and education program. Biomedical informatics has become a major theme and methodology for biomedical science, health care delivery, and population health, involving high-dimensional modeling and understanding of patients from the molecular to the population levels. We design information infrastructure for molecular characterization of the patient, medical decision-making, diagnosis, therapeutic selection, care redesign, public health management, and re-imagined clinical trials. The field is inherently interdisciplinary, drawing on traditional biomedical disciplines, the science and technology of computing, data science, biostatistics, epidemiology, decision theory, omics, implementation science, and health care policy and management. Our faculty are trained in medicine, data science, computer science, mathematics and epidemiology. Though CHIP has a robust pediatric research agenda, our interests span across all ages. For the work of CHIP, Health 2.0 recently voted Boston Children's Hospital the [10 Year Global Retrospective Top Influencer](https://www.youtube.com/watch?v=z3KIPz1oOjM&feature=youtu.be) among all health care organizations.

CHIP, a collaborating program of the Harvard Medical School Department of Biomedical Informatics has 25 faculty and trains postdoctoral fellows in the National Library of Medicine Boston-area Informatics Training Program. CHIP is located at One Autumn Street and the Enders Building, with 3,500 square feet of office space, including desk space for all trainees and faculty in the Informatics Program. Fully networked with 1Gbps ethernet to the hospital’s intranet and to the Internet (via firewall). Computers and networking hardware includes more than 50 machines running various versions of Windows, Linux and MacOS. Server resources are provided by the Research Computing group and include Hadoop and LSF clustering software, several terabytes of dedicated storage as well as virtualized web and application servers for CHIP projects. Database and Web servers are housed within the HIPAA-compliant Boston Children’s Hospital secure data facility in Needham, MA. Security is maintained via firewall and through controlled physical access at the data center. Security features ensure that any staff member accessing the database has the proper authority to perform the functions requested of the system.

CHIP researchers and trainees use extraordinary massive datasets in their work. In partnership with Aetna and other payors, we analyze big data on 50 million lives to glean insights into the inner workings of the healthcare system and to discover relationships among diseases, their consequences, and their heritability, not visible at lower scales. The SCILHS network includes electronic health record and patient-reported outcome data on more than 11 million patients across 13 health care systems. The i2b2 system at Boston Children’s Hospital enables datasets on millions of encounters. Through academic relationships with Twitter and Google, CHIP researcher analyze billions of Tweets and searches. CHIP manages enrollment into the genotype-phenotype research cohort as well as a biobank currently undergoing CAP certification.

Major projects within CHIP include:

* **SMART Health IT**, an open, standards based technology platform that enables innovators to create apps that seamlessly and securely run across the healthcare system.
* **HealthMap**, which brings together disparate data sources to achieve a unified and comprehensive view of the current global state of infectious diseases and their effect on human and animal health. This freely available Web site integrates outbreak data of varying reliability, ranging from news sources (such as Google News) to curated personal accounts (such as ProMED) to validated official alerts (such as World Health Organization). Through an automated text processing system, the data is aggregated by disease and displayed by location for user-friendly access to the original alert. HealthMap provides a jumping-off point for real-time information on emerging infectious diseases and has particular interest for public health officials and international travelers.
* **Appache cTAKES**, a widely used, open source and free tool for clinical natural language processing. Unlike general purpose NLP tools, cTAKES is specialized for clinical texts, incorporating UMLS resources for finding medical concepts and packaged with machine learning models trained on gold standard clinical texts.

**Informatics Infrastructure and Information Services Department** of BCH is an over 300 person department. *Information Technology (IT).* BCH’s IT infrastructure includes state-of-the art email, a wireless and wired network throughout all BCH facilities, and technical support for all BCH-located faculty and fellows. Clinical computer systems include computerized physician order entry and full availability of data and images on and off campus through a secure VPN network. BCH’s network architecture features fully redundant distribution and core Nexus 7000/Cisco 6509 switches and routers serving 1 Gbps to the desktop, 10Gbps closet uplinks are also underway in anticipation of additional user demand. Research servers and storage reside in an offsite data center connected to the BCH main campus by a fully redundant high speed optical network. The data center has dual network connections and power sources to all equipment with battery and generator power backup. Data backup is performed daily and stored off site to ensure that lost data can be readily recovered. Our clinical health record system is Cerner’s PowerChart, hosted internally. The BCH i2b2 infrastructure is run on a clustered SQL 2008 enterprise environment. The enterprise data warehouse (EDW) is built on a Netezza back end using Microstrategy as the business intelligence tool for many of the BI needs. I2b2 is sourced from this EDW.

**Information Services Department (ISD).** ISD provides the physical security, hardware recovery, contingency planning, and data recovery and backup routines for all informatics services. Research data are secured through a combination of network and application-level user authentication and authorization mechanisms, and data auditing schemes are employed by all clinical data management systems and online workspace implementations. Database and applications servers are backed-up daily, and hardware recovery and contingency plans are administered by the ISD data center.

**Research Computing (RC)** is devoted to the specialized computing needs of the research community at BCH. RC offers the following services: data storage and backup for over 90 research labs (>800 terabytes); desktop support and backup services (RC technicians are certified by Apple, IBM, and Dell); server support and administration; purchase and maintenance of scientific analysis applications (e.g. SAS, STATA); and custom application development and developer support for research-specific functions. RC also provides services for conducting webinars across multiple sites as well as electronic transmission of large data files (e.g., large administrative databases and report documents).

**The Clinical Research Center (CRC)** is available to help on the proposed research. The CRC is a scientific support service organization with 15 faculty and 20 professional and technical staff that is committed to providing technical and methodological support, education, and collaborative assistance to BCH investigators for the design, conduct, and analysis of clinical research. The CRC was established to support researchers in designing and carrying out clinical research projects so that they may achieve continued excellence in conducting the highest quality clinical research. Support is provided to investigators at all stages of protocol development and study conduct (e.g., study design, sample size and power calculations, statistical analysis methods, randomization, survey design, database development, study implementation, data analysis and interpretation, manuscript preparation). CRC staff include senior clinical researchers with extensive experience in conducting clinical research studies, biostatisticians, survey epidemiologists, clinical research specialists, and applications specialists. The Director of the CRC is a faculty member in the Division of General Pediatrics. The CRC collaborates closely with the Committee on Clinical Investigation, BCH’s institutional review board, to ensure that research is designed in such a way as to maximize benefits and minimize risks to human subjects. CRC contains research computers with maximized internal memory, fast processing speeds and large amounts of storage space to accommodate the statistical analysis of large administrative datasets. These computers are equipped with software (e.g., SAS, STATA, SUDAAN, and JMP) to support all types of statistical analyses. CRC has the IT infrastructure to securely transmit and receive large files electronically.