Facilities and other Resources

The scientific environment of the **University of Massachusetts Medical School** (UMMS) is rich with resources for supporting the creation of new knowledge. The facilities and resources available to the PI and her research team include everything needed to undertake and complete the proposed research project successfully. Dr. Perry is an associate professor in the Graduate School of Nursing at the University of Massachusetts Medical School in Worcester, MA. The UMMS campus is a freestanding, university-based academic health sciences campus that includes a medical school, a graduate school of nursing, and a graduate program in biomedical sciences.

University of Massachusetts Medical School is one of five University of Massachusetts' campuses, and one of 28 freestanding, university-based academic health sciences campuses in the United States. It includes 3 graduate schools; a 416-bed teaching hospital and its clinics, with more than 300,000 outpatient visits per year. Its mission is to advance the health and well-being of the people of the Commonwealth and the world through pioneering developments in education, **research,** and health care delivery. UMMS receives more than $254 million per year in research funding. We have a Center for Clinical and Translational Science that serves the research communities across the five University of Massachusetts Campuses and our clinical partners, UMass Memorial Medical Center and Baystate Medical Center. With the receipt of an NIH Clinical and Translational Science Award in 2010, and its successful renewal in 2015, the UMass Center for Clinical and Translational Science offers many services, tools and resources that enhance collaboration, research and data management https://www.umassmed.edu/ccts/resources/.The Albert Sherman Center, is a 480,000 square-foot research and education facility and when built in 2012, doubled the UMMS research capacity fostering collaboration among scientists and promoting innovation across the disciplines. This space houses the Center for Experiential Learning and Simulation, a dedicated suite designed to support state-of-the-art simulation technology. The Center also includes learning communities for nursing, medicine, population health and basic science students to intermingle; creating an inter-professional environment for growth and collaboration. The **Office of Research** strives to maintain research as a priority within the University's overall mission and within the regional, state and national landscape, while promoting a culture of excellence in research practice and regulatory compliance. A number of service areas assist faculty and departmental administration with technical, administrative and operational aspects related to research. Additionally, the Office of Research provides internal funding to faculty through its Small Grants Program, and assistance to junior faculty through its mentorship program. Research Funding Services supports faculty and department administrators in primarily pre-award and some post-award activities by serving as an information resource on all aspects of research administration, providing assistance in locating funding, reviewing and signing proposals, negotiating grants and contracts and developing and disseminating institutional policies related to research administration.

University of Massachusetts Medical School, Graduate School of Nursing (GSN) was established in 1985, to prepare nurse scientists and advanced practice nurses who together improve the delivery of health care in the Commonwealth of Massachusetts and across the nation. The GSN has a strong public mission, focusing on care of the underserved through clinical partnerships to improve access and delivery of care for at-risk populations. The UMMSS GSN is the only publicly funded nursing school in the Commonwealth that focuses solely on graduate nursing education. The mission of the Graduate School of Nursing is to prepare practice-focused and research-focused nurses and leaders to improve the quality of life and health outcomes for the Commonwealth and beyond. Through partnerships with multi-cultural communities and

clinical organizations, research, practice, service and education are integrated to advance nursing knowledge, science and competencies to provide exemplary health care for all. The GSN has an Associate Dean for Research and Innovation supporting the research and scholarly endeavors of the faculty. Dr. Perry has the full support of the Dean of the GSN to conduct the proposed project and can access the resources of the GSN as well as the greater UMMS community. She has her own private office with a devoted computer and administrative support staff to assist as appropriate.

University of Massachusetts Medical School, Lamar Soutter Library works to strengthen access to evidence-based health information for all faculty, staff, students, researchers, clinicians and the general public. Founded in 1973, it is the only public medical academic health sciences library in the Commonwealth. The library provides students and faculty with a strong collection of biomedical literature and 57 computer workstations. Computerized databases are available to students and faculty via MEDlinesNet with access controlled by personal long-ins and passwords. The library is a member of multiple networks and consortia. Inter-library borrowing is available. The library contains over 1600 current journals with accesses to many bibliographic databases including but not limited to: PubMed, CINAHL, Cochrane Library, MEDLINE, PsychINFO, HaPI, Health Reference Center Academic, Google™ Scholar, and Ovid. The library encompasses a 42,000 square foot three story building. Reference librarians focus their time on providing outreach, clinical, and education services to the community outside the physical library at the point of need or care.

Computers

The research project offices where the study will be conducted are on the University's computer network which as extensive mainframe and microcomputer facilities and capacities. Each of these is equipped with a high-performance personal computer using shared storage on the UMMS network where it is backed up daily. Drives where research data are stored are access limited and password protected and isolated from other components of the network. The UMMS network follows the Internet Engineering Task Force conventions. Each personal computer is directly linked to the internet and has e-mail access with the capacity to handle large dataset attachments. Personal computers used by the data analysts and statisticians are capable of analyzing extremely large datasets; these staff also have access to workstations and direct use of mainframe computers when needed.

Through the UMMS library system, all personal computers have access to PubMed, Ovid, and a large array of on-line journals. Faculty and staff have computers at the top end of capabilities and each has an array of statistical (SAS, Stata, R, SPSS) and study design (East, nQuery, PASS) software available. In terms of data management, QHS runs SQL Server as its primary data management system and utilizes both RedCAP and Teleform for data entry. Two Tbytes of disc space on UMMS servers are available for QHS file storage and processing.

UMMS Regulated Environment: Academic and Research Computing Services:

In 2010 Information Services (IS) completed construction of a "state of the art" data center to house the many hundred computer servers and mass storage devices used for administrative, research and educational computing at UMass Medical School. When the new data center was designed, Information Services included in the design plans a physically secure and electronically protected portion of the data center with its own insulated network space labeled "the Regulated Environment" to provide a secure environment for the storage and handling of sensitive electronic data including protected

health information (PHI) and protected personal information (PPI). The Regulated Environment is securely housed within the new IS data center meaning physical access is limited to only those IT professionals employed by IS with a job related need and with proper electronic identification.

Data Access for Researchers:

Electronic access to sensitive data resources within the regulated environment has been controlled using the highest standard of proven network architecture. For Investigational Review Board (IRB) approved investigations with PHI or PPI, IRB approved principal investigators (PIs) and their staff must all be CITI (The Collaborative Institutional Training Initiative) certified. Research data can be transferred into the regulated environment by one of three ways:

1. By direct data entry, controlled web interface form-fill-out into a REDCAP database;
2. By physical transfer of encrypted physical media delivered to Data Center staff; or
3. By cgi script mediated one way file transfer from user location within the umassmed.edu domain onto PIs account on the regulated-Statistics Server (rSTATS).

Within the Regulated Environment Research Computing provides a Dell PowerEdge R905 server (known as rSTATS) running the most current version of the RedHat Linux operating system. This server was configured in consultation with SAS Institute to maximize its capability for analyses of very large datasets using SAS, such as those encountered often in health services research. This server also has the latest version of the STATA system (STATA MP), which is optimized to use the servers' multiple processors, as well as the latest version of the R statistical software package. rSTATS can ONLY be accessed within the Regulated Environment using protocols designed to maintain the strictest security and to minimize disclosure of PHI and other sensitive data. Access to rSTATS is only provided to investigators and their staff who have current IRB approved studies and current CITI HIPAA/privacy training certification.

Server Configuration

Dell PowerEdge R905 Server • 6 Opteron 2.8 Ghz Quad Core Processors (24 cores total) 256 Gb DDR2 memory • CX4-24 Clariion 15 Tray Head with 4.2 Tb usable system and 15k RPM disks with RAID5 array configuration • 4 Gb fiber channel bus to EMC Clariion storage array expandable to 180 TB of secured, Dell PowerEdge R905 Server backed-up and archived storage. • RedHat Linux Enterprise Version 6

IRB approved and CITI certified PIs and their CITI certified staffs will be able to work with their data on the statistics server rSTATS using UNIX commands and applications like R, SAS and STATA. They will connect to rfSTATS by a virtual private network connection (VPN) with secure socket layers (SSL) (single factor authentication) into a terminal server program which provides an additional layer of isolation and protection by prohibiting SSH and by limiting the ability to transfer files back over the VPN or do such operations as "cut and paste" text without inhibiting the ability to use x11 X-windows terminal sessions and applications like the statistics packages. Any systems level access within the regulated environment will ONLY be permitted by approved IS staff using multifactor authentication (i.e. RSA card). Multifactor authentication via "virtual token" technology is being investigated for all classes of users. Statistical reports generated in this process can be transferred via controlled cgi script as PDF files to locations outside of the regulated environment. There are no UNIX printers permitted nor are there any FTP like operations allowed.

Data files cannot be transferred electronically outside of the regulated environment. Data files can only be written to encrypted removable physical media and then physically

handed to CITI certified personnel with proper UMass identification that have been previously identified by the IRB approved PI. Research data on rSTATS within the regulated environment is stored on EMC CLARiiON data arrays with journaling and other features to insure HIPAA compliance. IS disks are configured in RAID arrays to ensure robustness to failures and are backed up according to a rigorous schedule. Data backups are retained to comply with retention requirements of funding agencies as well as more demanding Massachusetts regulations which requires retention for a minimum of 6 years or longer in some circumstances.

UMass also participates in the *Massachusetts Green High Performance Computing Cluster* is located in Holyoke, MA which provides computing to the five University of Massachusetts Campuses. The High Performance Computing Cluster (HPCC) consists of the following hardware: an FDR based Infiniband (IB) network and a 10GE network for the storage environment, qty three (3) GPU nodes (Intel with 256GB RAM) with two NVIDIA Tesla C2075 - GPU computing processor - Tesla C2075 - 6 GB GDDR5 - PCI Express 2.0 x16 units, qty seven (7) AMD (2x AMD Opteron 6278, 2.4GHz, 16C, Turbo CORE, 16M L2/16M L3, 1600Mhz) based Dell chassis with 64 cores / 512GB RAM per blade (42 blades), qty two (2) Intel (Xeon E5-2650 2.00GHz, 20M Cache, 8.0GT/s QPI, Turbo, 8C, 95W, Max Mem 1600MHz) based chassis with 16 cores / 196GB RAM per blade (16 blades), qty two (2) SGI UV200 with 512 Intel (Intel® Xeon® processor E5-4600) cores and 4TBs of fully addressable memory, qty one (1) AMD based Dell chassis with 128 cores Quad-Core AMD Opteron(tm) Processor 2376 and 256GB RAM, qty three (3) AMD (six-core Intel(R) Xeon(R) CPU X5650 @ 2.67GHz) based Dell chassis with 12 cores / 48GB RAM per blade (16 blades). The HPC environment runs the IBM LSF scheduling software for job management.