ACADEMIC PEDIATRICS AND DEVELOPMENTAL AND BEHAVIORAL PEDIATRICS

University of Chicago Comer Children's Hospital is a 172-bed acute care facility founded in 2005, uniting advanced technology with a family-centered, child-friendly philosophy to provide state-of-the-art care in a six-floor, 242,000-square-feet building. As a major tertiary referral center, Comer Children's sees children with common as well as the most complex medical problems. It admits about 5,000 patients annually from the Chicago area, the Midwest, and around the world. Each year its outpatient clinics accommodate nearly 37,000 general pediatric and specialty visits. Comer Children's is staffed by close to 170 highly trained pediatricians, as well as specially trained nurses and caring support staff, who work together to provide general and specialty medical care for newborns to young adults.

SECTION OF ACADEMIC PEDIATRICS: The University of Chicago is situated on Chicago's South Side, a medically underserved area. Our Primary Service area comprises a population of three-quarter of a million people. There is an acute need for primary care practitioners to improve health in the state of Illinois (FY2025 projected shortage -4.0% and specifically among this population (Chicago South Side Primary Care HPSA score =19). Physicians in this area deliver care that addresses complex medical, psychosocial, and behavioral needs. They lead efficient, patient-centered primary care practices in underserved communities.

The Section of Academic Pediatrics is dedicated to managing the unique primary care needs of newborns, children and adolescents. The scope of its clinical service covers both the outpatient and inpatient areas located in Comer Children's Hospital and community sites. Its clinical programs include Comer and community hospital medicine, general care nursery, pediatric primary care, Sports Medicine, Child Advocacy and Protective Services and the Comer Mobile Unit. To support this grant, we will leverage our academic institution and its expanding clinical network across Chicago's South Side, as well as neighboring federally qualified health centers, to provide diverse and complementary experiences in team-based care. Dr. James Mitchell is the Medical Director for patient services.

Our provider network includes community health centers and Federally Qualified Health Centers (FQHCs). Sites will include: Comer Children's Hospital General Pediatrics Clinic, Friend Family Health Center, Erie Family Health Center, ACCESS Community Health Network, and Asian Human Services. All sites have Health Professional Shortage Area designation with scores of 19-21. Some of patient volume statistics are provided as follows:

Comer Children's Hospital General Pediatrics Clinic, located on the University of Chicago Medical campus, serves approximately 12,000 pediatric patients over 22,000 visits annually. Approximately 56

The Friend Family Health Center is a large, multi-site Federally Qualified Health Center. It has served as the primary ambulatory training site for University of Chicago Pediatrics Residency Program since the 1990s. Friend Health serves over 27,000 patients from Chicago's South Side as part of its mission to provide access to high quality, comprehensive health care

The Erie Family Health Center, a Federally Qualified Health Center with seven primary care centers and five school-based health centers, provides care to more than 74,000 patients over 300,000 visits annually. These health centers cares for patients across 62 languages. The patient population is 71

ACCESS Community Health Network, a large Federally Qualified Health Center with 35 health centers across Chicago, cares for more than 183,000 patients per year. ACCESS services the largest proportion of Medicaid beneficiaries in Illinois.

Asian Human Services (AHS) is a multi-site Federally Qualified Health Center which services a largely immigrant population. AHS provides comprehensive care to more than 30,000 people from more than 55 countries.

THE SECTION OF DEVELOPMENTAL AND BEHAVIORAL PEDIATRICS (DBP): The Section of DBP is a Center of Excellence in developmental diagnosis, biomedical management and family supports for children with motor, communicative, sensory, developmental, genetic, neurological, learning and behavior disorders. The section's goals are to:

- Promote the highest quality interdisciplinary assessment and biopsychosocial management practices to optimize child functioning, support families and maximize prevention strategies across health, education

and community care systems.

- Provide the necessary leadership to ensure that children with complex challenges have a high quality medical home and that best practices are used to improve their ability to communicate, move, regulate behavior, interact socially, learn functional and adaptive skills, perform in school and participate in the community.
- Serve as a resource for primary care practitioners and pediatric subspecialists for children with the highest biomedical and psychosocial risks associated with suboptimal educational outcomes. •
- Serve as a resource for community professionals and agencies for children with developmental delays, complex disorders after prematurity, genetic, neurological, or cardiopulmonary disorders or experiencing complex behavioral challenges after life-threatening illnesses. .
- Enhance training and research so families will benefit from the best clinical and scientific advances with the highest standards of ethics, professionalism and advocacy.
- For children with complex medical and/or behavioral challenges and for families with psycho-social or economic stress, DBP provides interventions and assistance. Many of these children and families require teamwork and leadership to promote their health, development, and social competencies. DBP physicians take into account the entire family dynamic and provide guidance in securing ancillary therapies, support services and special school considerations as needed.
- We have the clinical expertise coupled with research, educational; advocacy and public policy activities needed for insuring that children receiving translational technologies have information and supports for long term success. Our scope and leadership roles are recognized at the local, regional, national and international levels. We have established clinical, advocacy and research cooperative activities with specialists in community pediatrics, child and adolescent psychiatry, neonatology, critical care medicine, genetics, neurology, child protective services, developmental psychology, public policy and social sciences. These collaborations are not limited to the University of Chicago campus, but extend to other institutions nationally and internationally. Our activities are complementary to those of our collaborators—bringing cross-fertilization of ideas to bear on topics of life course outcomes of children with prematurity. Our Section's activities are interdisciplinary and include faculty from Public Policy, Social Sciences and Economics to work towards our common interests in improving the quality of life for children with disabilities.

The Woodlawn Center is the clinical home of DBP. It is a site for clinical evaluation and research that can accommodate patients 6 days a week with two exam rooms, equipped to provide developmental assessments from 0-18 years of age. The focus at the Woodlawn Center is on early developmental and cognitive assessments that provide early definition of school-age diagnosis and both clinical and educational needs.

Interdisciplinary professionals at this center include speech and occupational therapists, social work, developmental psychology, and community outreach professionals. We provide Autism Diagnostic Observation Schedule (ADOS) testing for accurately assessing and diagnosing autism spectrum disorders. ADOS is a standardized diagnostic test which provides information on communication, social interaction, and play (or imaginative use of materials) for individuals suspected of having autism or other pervasive developmental disorders, and, as appropriate, provide access to services which may be recommended for each child. .

DBP and the **Pediatric Neuropsychology Service** both maintain up to date assessment protocols and manuals for the interdisciplinary assessment of children's motor, manipulative, conceptual, cognitive, behavioral, and educational skills. These include all the assessment instruments specified in the neurodevelopmental assessment protocol for children in this study. These assessment tools have been used by health professionals representing developmental pediatrics, developmental psychology, physical therapy, occupational therapy, speech language pathology, and special education. A specialized library of current assessment references as well as audiovisual and computer assisted training materials are available. The Pediatric Neuropsychology Service is a clinical, training and research program within the Section of Child and Adolescent Psychiatry, in the Department of Psychiatry. The Service provides assessment and Diagnostic services for infants and children with neurodevelopmental learning, emotional regulation and medical disorders and conditions. The service is also involved in collaborative clinical research, examining the neurocognitive and behavioral sequelae of a wide range of disorders.

COMPUTATIONAL FACILITIES

The principal investigators have access to extensive computational facilities available at the University of Chicago to carry out the tasks described.

Access to Clinical Data for AI-enabled Analytics: The ZeD lab (overseen by Professor Chattopadhyay) is housed within the Department of Medicine at the University of Chicago, and has access to the full range of high end computing resources offered by the University of Chicago. In addition, Prof. Chattppadyay's laboratory has access to the HIPAA compliant clinical data warehouse maintained by the Biological Sciences Division as detailed below:

The Clinical Research Data Warehouse: (CRDW) within the Biomedical Sciences Division of the University of Chicago is one of the deepest, richest, and most research-ready data repositories of its kind. Containing more than a decade of University of Chicago medical data, it seamlessly brings together multiple internal and external data sources to provide researchers with access to more than 12 million encounters for 2.3 million patients. The associated diagnoses, labs, medications, and procedures number in the tens of millions each. The CRDW is run on IBM Netezza Pure Data System for Analytics servers, a patented Asymmetric Massively Parallel Processing architecture designed to deliver exceptional query performance and modular scalability on highly complex mixed workloads.

In order to meet the acute need for data related to COVID-19, the CRDW team has constructed three data marts (de-identified, limited, and identified) to provide the most commonly requested data elements for this patient population. The initial instance of the COVID-19 data mart includes de-identified structured data on patient demographics, encounters, diagnoses, labs, medications, flow sheets, and procedures. Additional data will be added based on resource availability and urgency.

Cohort Discovery Tool: The purpose of this tool (SEE Cohorts) is to provide a secure web-based tool for the initial exploration of de-identified data. It allows researchers to search available data, build a cohort of patients, and view actual de-identified data within the interface. The data in SEE Cohorts is refreshed weekly.

Research Computing Center: The University of Chicago Research Computing Center (RCC) provides high-end research computing resources to researchers at the University of Chicago, which include high-performance computing and visualization resources; high-capacity storage and backup; software; high-speed networking; and hosted data sets. Resources are centrally managed by RCC staff who ensure the accessibility, reliability, and security of the compute and storage systems. A high-throughput network connects the Midway Compute Cluster to the UChicago campus network and the public internet through a number of high-bandwidth uplinks. To support data-driven research RCC hosts a number of large datasets to be accessed within the RCC compute environment.

RCC maintains three pools of servers for distributed high-performance computing. Ideal for tightly coupled parallel calculations, tightly-coupled nodes are linked by a fully non-blocking FDR-10 Infiniband interconnect. Loosely-coupled nodes are similar to the tightly-coupled nodes, but are connected with GigE rather than Infiniband and are best suited for high-throughput jobs. Finally, shared memory nodes contain much larger main memories (up to 1 TB) and are ideal for memory-bound computations. The types of CPU architectures RCC maintains are tabulated in Table 1.

RCC also maintains a number of specialty nodes:

- *Large shared memory nodes* - up to 1 TB of memory per node with either 16 or 32 Intel CPU cores. Midway is always expanding, but at time of writing RCC contains a total of 13,500 cores across 792 nodes, and 1.5 PB of storage.
- *Hadoop:* Originally developed at Google, Hadoop is a framework for large-scale data processing.
- *GPU Computing:* Scientific computing on graphics cards can unlock even greater amounts of parallelism from code. RCC GPU nodes each include two Nvidia Tesla-class accelerator cards and are integrated in the Infiniband network. RCC currently provides access to Fermi-generation M2090 GPU devices and Kepler-generation K20 and K40 devices.
- *Xeon Phi:* The Many Integrated-Core architecture (MIC) is Intel's newest approach to manycore computing. Researchers can experiment with these accelerators by using MIC nodes, each of which have two Xeon Phi cards, and are integrated into the Infiniband network.

Persistent and High-Capacity Storage. Storage is accessible from all compute nodes on Midway1 and Midway2 as well as outside of the RCC compute environment through various mechanisms, such as mounting directories as network drives on your personal computer or accessing data as a Globus Online endpoint (at the time of this writing, Globus Online is supported on Midway1). RCC takes snapshots of all home directories (users' private storage space) at regular intervals so that if any data is lost or corrupted, it can

TABLE 1

University of Chicago Research Computing Center Capabilities Summary

Cluster	Partition	Compute cores (CPUs)	Memory	Other configuration details
midway1	westmere	12 x Intel X5675 3.07 GHz	24 GB	
	sandyb	16 x Intel E5-2670 2.6GHz	32 GB	
	bigmem	16 x Intel E5-2670 2.6GHz	256 GB	
		32 x Intel E7-8837 2.67GHz	1 TB	
	gpu	16 x Intel E5-2670 2.6GHz	32 GB	2 x Nvidia M2090 or K20 GPU
		20 x Intel E5-2680v2 2.8GHz	64 GB	2 x Nvidia K40 GPU
	mic	16 x Intel E5-2670 2.6GHz	32 GB	2 x Intel Xeon Phi 5100 coprocessor
	amd	64 x AMD Opteron 6386 SE	256 GB	
	ivyb	20 x Intel E5-2680v2 2.8GHz	64 GB	
midway2	broadwl	28 x Intel E5-2680v4 2.4GHz	64 GB	
	bigmem2	28 x Intel E5-2680v4 @ 2.4 GHz	512 GB	
	gpu2	28 x Intel E5-2680v4 @ 2.4 GHz	64 GB	4 x Nvidia K80 GPU

easily be recovered. RCC maintains GPFS Filesystem Snapshots for quick and easy data recovery. In the event of catastrophic storage failure, archival tape backups can be used to recover data from persistent storage locations on Midway. Automated snapshots of the home and project directories are available in case of accidental file deletion or other problems. Currently snapshots are available for these time periods: 1) 7 daily snapshots, 2) 4 weekly snapshots.

Tape Backups. Backups are performed on a nightly basis to a tape machine located in a different data center than the main storage system. These backups are meant to safeguard against events such as hardware failure or disasters that could result in the complete loss of RCC's primary data center.

Data Sharing. All data in RCC's storage environment is accessible through a wide range of tools and protocols. Because RCC provides centralized infrastructure, all resources are accessible by multiple users simultaneously, which makes RCC's storage system ideal for sharing data among your research group members. Additionally, data access and restriction levels can be put in place on an extremely granular level.

Data Security & Management. The HIPAA compliant security of the Research Computing Center's storage infrastructure, protected by two-factor authentication, gives users peace of mind that their data is stored, managed, and protected by HPC professionals. Midway's file management system allows researchers to control access to their data. RCC has the ability to develop data access portals for different labs and groups.