

BUDGET JUSTIFICATION – INFORMATICS AND ANALYTICS CORE – UNIVERSITY OF SOUTHERN CALIFORNIA

The EpiBioS4Rx COW is an integrated program where centralized core responsibilities will be provided to each of the research projects. These projects each collect and analyze various data and all will be ingested, described and made available through the IAC. Because Project 3 will utilize data, whenever possible, collected as part of Projects 1 and 2 there is a somewhat smaller need for IAC services. However all projects have considerable statistical and scientific analyses needs. In particular, Projects 1 and 2 each will collect large volumes of imaging and continuously recorded electrophysiologic data. These will require complex feature extraction and classification techniques applied to large archives on a local cloud. These are computationally and labor/resource intensive endeavors. Each has multivariate and multimodality data analytic plans requiring sophisticated approaches. The utilization of common cores will help discover patterns and trends across data from all projects and help integrate activities throughout the program. Also there is an economy of scale whereby expertise, physical and computational resources, and storage can be leveraged far more efficiently with common cores. We have used similar approaches in other projects, and it has been beneficial scientifically and financially. As such, the proportion of the costs of the Informatics and Analytics Core relative to the projects is shown below:

	Project 1	Project 2	Project 3	Total
Informatics and Analytics Core Costs Breakdown	35%	35%	30%	100%

Arthur W. Toga, Ph.D., Co-Project Lead, 1.20 Calendar Months. Dr. Toga is the founder and director of the Laboratory of Neuro Imaging (LONI). He is the director of the USC Stevens Neuroimaging and Informatics Institute. His formal training in neuroscience, computer science, and informatics makes him well suited to lead this project. Dr. Toga has a career-long funding and publication record in informatics. He directs several national and international collaborative studies that involve multi-site acquisition of data, coordination of analysis, and dissemination of data and results. Dr. Toga has experience and expertise in image analysis, brain atlas, multimodal integration, large-scale multisite trials, databasing, and scientific visualization. He has developed a comprehensive supercomputing facility for neuroscience, incorporating the latest technology in the analysis of structure and function of the brain in health and disease. Dr. Toga has the skills, knowledge, and resources necessary to participate in the proposed project. He will coordinate activities in data management, computing infrastructure, and dissemination.

Rema Raman, Ph.D., Co-Investigator, 1.20 Calendar Months. Dr. Raman is a tenured Professor of Neurology at the University of Southern California (USC) and the Director of Biostatistics of USC's Alzheimer's Disease Research Institute. Her statistical research interests are in correlated and multi-level modeling topics (impact of missing data, analysis of ordinal data), and efficient clinical trial design and monitoring approaches. She has more than eighteen years of experience as a biostatistician in biomedical research projects, providing leadership in the data management, quality assurance and statistical support to the design, coordination, conduct and analyses of clinical trials and large observational studies. She will serve a critical role throughout the duration of this project on approaches for data harmonization across datasets, implementation of mixed effects models across cohorts, and cross-validation between cohorts.

John Van Horn, Ph.D., Co-Investigator, 0.60 Calendar Months. Dr. Van Horn is an Associate Professor of Neurology, Neuroscience, and Engineering at the Keck School of Medicine of USC. His areas of interest in neuroimaging include multi-modal analysis of clinical populations, large-scale data processing, informatics, applications of high-performance computing technologies, and data sharing. He has over 100 peer-reviewed publications and is a well-regarded university-level educator and mentor. Dr. Van Horn is well poised to apply his expertise to this proposed Center. His responsibilities will include the design of the software architecture for acquiring, archiving, managing, and displaying bioinformatics data. Dr. Van Horn will also aid with consortium efforts.

Dominique Duncan, Ph.D., Postdoctoral Fellow, 12.00 Calendar Months. Dr. Duncan will be leading the analytics for all projects by developing mathematical algorithms that may lead to models of epileptogenesis and by using cutting-edge statistical tools to validate those models. Her expertise in innovative mathematical techniques in epilepsy applications in addition to her interdisciplinary background combining mathematics, electrical engineering, and neurology will provide the knowledge and tools necessary for the search for biomarkers and to develop models of epileptogenesis after TBI.

Karen Crawford, M.S., Database Manager, 1.20 Calendar Months. Ms. Crawford has expert knowledge of database management systems and development of informatics systems. Ms. Crawford will oversee systems used to archive and catalog data acquired from investigators and collaborators. She will conduct data analyses, construct data models, develop and document data access requirements and strategies. She will also design databases, administer and supervise the metadata representation, determine feasibility of database applications, monitor and evaluate database performance, modify database design and/or implementation when appropriate, assist users in appropriate/approved use of database applications and functions, develop client-server and web-based user interfaces.

Rita Esquivel, Project Assistant, 6.00 Calendar Months. Ms. Esquivel will assist in coordinating and managing the data upload and download activities and user access control systems. While in that capacity, she will provide support to study site personnel performing data upload activities, assist with user access and security and provide statistical reports on data upload and download activities. She will also provide guidance to the researchers accessing and using the deposited data, and will be available to address questions regarding the data as needed.

Scott Neu, Ph.D., Software Developer, 3.60 Calendar Months. Dr. Neu earned a Ph.D. in Physics (focusing on computer simulations of plasmas) and a M.S. in Computer Science with a specialization in scientific computing. Dr. Neu has over ten years of experience in the area of numerical methods and simulation. He was the lead programmer for the UCLA RadStation, a high-performance imaging workstation that is currently in use throughout the UCLA hospitals. Dr. Neu has over ten years of experience in the design and development of image processing and medical informatics software. More recently, he has been developing comprehensive software architecture for LONI. Dr. Neu's duties include helping to develop complex neuroimaging-related applications and tools, and performing analysis tasks in advanced technology research and development. His responsibilities include database architecting, developing and maintaining image archive systems, tools and related software.

Petros Petrosyan, M.S., Pipeline Manager, 8.40 Calendar Months. Mr. Petrosyan is an experienced software tool developer. In addition to data download capabilities, he will link analysis software to the database and enable any analytic system to interoperate with the data archive is essential to making the data collection as usable as possible. Mr. Petrosyan will work with the investigators and programmers to seamlessly integrate analysis code into the LONI Pipeline for distribution. He will also be responsible for appropriate testing of the algorithms and data flow procedures to assure quality and reliability of the integrated software. Mr. Petrosyan will conduct training courses on LONI software both virtually and in person.

Samuel Hobel, Programmer, 3.60 Calendar Months. Mr. Hobel will be responsible for the development, integration, and support of collaborative neuroinformatics software tools. He will design, build, test, and debug components of neuroinformatics software. In addition, he will design and implement interoperability between software tools and data in coordination with scientists and software programmers, he will also document and provide support to users, and evaluate software performance to identify and fix inefficiencies.

Alexander Nizni, Programmer, 6.00 Calendar Months in years 1-3, 5.16 Calendar Months in year 4, and 8.76 Calendar Months in year 5. Mr. Nizni specializes in design of user-centered websites and web applications. He has designed many academic and commercial web applications reaching global audiences. His efforts will involve user experience design, user interface design and testing of the highly visual and interactive informatics web interfaces proposed.

Travel. Funds will be requested for the project personnel to attend scientific conferences held in the United States and internationally. These trips will be to present research results from the project. It is expected that the project personnel will spend at least 4 days at domestically held conferences. For international conferences, travel duration is usually longer. We request \$5,500/year for project related travel. This includes \$3,000 for domestic travel and \$2,500 for foreign travel costs. The travel costs include abstract fees, conference registration, airfare, hotel and meals.

Materials and Supplies. We request \$4,751 in year 1, \$4,752 in year 2, \$11,752 in year 3, \$6,283 in year 4, and \$4,475 in year 5 for the purchase of computer supplies, which include replacement parts for the existing computer systems/servers, external hard drives, DVDs, USB drives, and printing supplies.

Computer Services Costs. We request \$25,000/year for high-performance supercomputing time and maintenance services provided by the institute, which guarantee high throughput of the very large computational image datasets. The costs listed here are standard data storage or analysis costs associated with other imaging genetics, behavior and bio-data projects. These costs help defray the amortization costs for the equipment. These computational resources make its use essential for complicated algorithms typically used during the calculation of population-based statistics. This, coupled with access to the large database,

makes it an efficient system for many brain analytic problems. The hardware support provides 24/7 response coverage for Isilon, Cisco, Quantum and F5 equipment discussed under the Resources and Environment section. Because of concerted efforts eliminating single points of failure in our computing environment, this model is by far the most cost effective. The software maintenance provides our facility with immediate vendor software support, software licensing and version upgrades for sophisticated clustering, visualization, development and hierarchical file management software. Such upgrades become critical when new features that can facilitate daily operations are released.

Consultant Services. We request \$10,000/year for the services of two consultants.

Dr. Brian Litt, Professor of Neurology, Neurosurgery, and Bioengineering at the University of Pennsylvania and Director of the Center for Neuroengineering and Therapeutics at the University of Pennsylvania. His responsibilities include advising on the integration of EEG data into the IDA and harmonizing disparate data types from MR to electrophysiology.

Dr. Jean Gotman, Professor at McGill University and Leader of the Epilepsy Group at Montreal Neurological Institute and Hospital. Dr. Gotman has developed well-known algorithms and methods for the detection of epileptic spikes and described the first general system for detecting epileptic seizures in humans. He has been a pioneer in showing the power of EEG-fMRI to understand epileptic activity non-invasively. Recently, he has discovered that high frequency oscillations do not fluctuate like spikes and are affected by anti-epileptic medication. Dr. Gotman will be applying his expert knowledge in understanding EEG and applying his well-established automatic spike detection and HFO methods to our data, assisting with the analytics.

Consortium/Contractual Costs. This proposal includes participation from the following subcontract site. The subcontract's budget and budget justification is prepared individually.

Institution	Subaward PIs	Initial Budget Period			Entire Budget Period (5 Years)		
		Direct Costs	Indirect Costs	Total Costs	Direct Costs	Indirect Costs	Total Costs
University of California, Los Angeles	Vespa, Paul	17,367	9,378	26,745	86,835	46,890	133,725
Uniformed Services University	Agoston, Denes	14,105	7,618	21,723	379,260	204,830	584,090
Total Subaward Budget		31,472	16,996	48,468	466,095	251,720	717,815

The justification above is for this institution only. Please see Tables 1-3 in the following budget summary for budget distribution across the entire program.