

**TRANSLATIONAL SCIENCE AT THE NEURAL INJURY CENTER**

MUS Research and Economic Development Initiative

4<sup>th</sup> Quarterly Report

May 2016-July 2016

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**Objective 1: Expand current clinical capabilities of the Neural Injury Center (NIC) and support translational research.**

*a) Hirings:*

- The Neuropsychologist position will begin in August to offer some supportive counseling for patients in addition to testing and evaluation, as our student veterans identified this as a need.
- A volunteer student with excellent background was identified to help work with data in the Motor Control lab, assisting Dr. Santos in expediting his balance software and product.

*b) Equipment:*

- N/A

*c) Progress towards milestones:*

- Though we anticipated a summer slowdown in screening; screening of patients (student veterans, community members and student athletes) has continued throughout the summer at a rate of 1-2 patients/wk. Data from these visits continues to serve the goals of the other MREDI objectives. Over this quarter, mTBI screenings and full testing sessions have averaged 1-3 sessions per week.
- NIC staff were approached by the Grizzly sports Head Athletic Trainer, asking our assistance in screening Grizzly athletes that have had a concussion. We screened several athletes this month, and provided the Trainer with results to help make decisions about return-to-play. We anticipate this type of work to increase during fall semester.
- The Medicare Application was fully submitted and we are just awaiting approvals to be able move forward with the VA Choice Provider status application.
- The Center staff hosted a visit from researchers affiliated with the Seattle VA on July 21 to discuss potential collaborations.
- Dr. Santos and Cindi Laukes hosted a visit from the Co-Chairs of the Governor's TBI council.
- Progress related to dissemination of information about the Center:
  - 1) The **Research View** article on the NIC was printed and has been widely mailed and distributed to broaden awareness about the Center.
  - 2) A **link to the Research View** was distributed throughout the University of Washington research networks, via newsletters and social media hosted by the Institute of Translational Health Sciences.

- 3) Congressman Zinke again visited the center on August 4 and the NIC team was **featured on a local news channel.**

The team had been previously **featured in a news story on June 21<sup>st</sup>.**

- 4) The **Montanan** magazine did an interview with Dr. Santos and Cindi Laukes on August 3<sup>rd</sup> for a story that will co-feature the NIC's work.
  - 5) The NIC team, at the advice of Senator Daines, had several communications with an **ex-NFL player, George Visger**, who is very active in the TBI advocacy community at the national level.
  - 6) Student veteran advisors are meeting regularly with Cindi Laukes and continue to spread the word about our services throughout their community.
- Representative Zinke brought with him Chairman Miller of the House VA Committee in D.C. Dr. Miller received a full tour of the NIC's services, and a copy of the VA R&D Center proposal was shared with him.
  - Ms. Laukes was selected as a Patient Centered Research Outcomes Scholar at the University of Washington, and recently had a pilot study funded by AHRQ/UW to study barriers to mTBI screening in two at risk Montana populations—Student Veterans and Confederated Salish and Kootenai Tribal Community members. This work has begun and it is anticipated a survey will go out to communities this fall to begin data collection. She is currently working with advisory groups from both populations. Findings from this study will help to inform approaches to encouraging screening and diagnosis in hard to access populations.
  - Ms. Laukes finalized a protocol/project that will be presented at an upcoming Pharmacy conference, working with a PharmD student and local physician. This project is looking at a treatment for emotional liability associated with TBI.

**Objective 2: Develop a comprehensive panel of objective tests to diagnose mild TBI (mTBI).**

*a) Hirings:*

A post-doctoral fellow was hired to aid the production of scientific articles. Two hourly student workers and one graduate assistant continue to work on facilitating the process of recruitment, data collection, and analysis.

*b) Equipment purchased:*

- N/A

*c) Progress towards milestones:*

Our studies are on schedule and since our last report we have achieved the following milestones:

- Recruitment, data collection, and preliminary data analysis from control and TBI participants continue. Initial data analysis has shown exciting results that will be presented in the next quarterly report.
- A series of journal articles are now in preparation.
- Development of the balance system (BalanceLab) continues and the 1<sup>st</sup> clinical viable prototype was delivered in the month of February. Its user interface continues to be developed based on feedback received from clinicians consulted. A dedicated electronic database is also now under development to expedite data management of the system.

*d) Other:*

- In collaboration with Dr Erik Guzik a proposal for the development of a mobile oculomotor testing system was filed. This proposal represents one follow-up project based on this current work funded by the MUS.
- We are working closely with the projects developed under the other objectives to effectively maximize the reach of funds provided by the MUS.

**Objective 3: Develop miRNA inhibitors to reduce neuropathology after TBI.**

a) *Hirings:*

- N/A

b) *Equipment purchased:*

- N/A

c) *Progress towards milestones:*

- Continued *in-vitro* testing of candidate miRNA agomiRs and inhibitors on protein expression of miRNA targets by western analysis using the WES System (ProteinSimple, San Jose, CA).
- Behavioral analysis in 16 rats exposed to mild and severe TBI paradigms to assess the effects of TBI on neurocognitive and neuro-motor abilities using novel behavioral testing methods developed at UM.
- Continuing analysis of human chronic traumatic encephalopathy (CTE) tissue received from the Center for Traumatic Encephalopathy brain bank, Boston University (Boston, MA). Both protein and miRNA measures are being evaluated.

**Objective 4: VAST: Next Generation Learning, Complete the development of a computer-based cognitive training (CCT) system for TBI subjects with cognitive impairment.**

*a) Hirings:*

- N/A

*b) Equipment purchases:*

- N/A

*c) Progress towards milestones:*

**VAST Milestones Completed**

**Previous (Q1/Q2/Q3)**

- HTML5 mobile training app completed, including backend/database and user interface (UI), for mTBI treatment on iOS and Android mobile systems;
- Development of set of 8 training levels and 40 training exercises for mTBI identified and completed.
- Testing of prototype with 25 subjects completed and user feedback captured.
- Divergent thinking data obtained and scored from 25 subjects.
- Gamification of 8 levels of mTBI divergent thinking training completed, including intra-exercise scoring feedback and development of incremental training levels necessary for subject engagement and adequate progression through tasks.
- Prototype completed of new variation of figural Trail Making Test as part of updated figural training package.
- Research of RUFF figural test as potential component of mTBI training package.
- Enhancement of front-end UI/UX based on user feedback in Q2.

**Newly Completed (Q4)**

- Development of scoring norms for training exercises.
- Development of new components of training based on Trail Making Test, Ruff Figural Fluency Test, and Reyes Complex Figural Test.
- Additional gamification of exercise presentation, scoring, and presentation of training progress.
- Initial testing of Virtual Reality (VR) prototype and software platform, including eye-tracking.

**In Progress (Q5)**

- Identification of testing subjects for training levels (mTBI and non-mTBI); preparation for controlled testing.
- Development of Virtual Reality version of tests.
- Research and development of hardware components of VR necessary to support TBI diagnostics and cognitive rehabilitation.

**Objective 5: Complete the development and testing of a novel post-traumatic epilepsy diagnostic analysis program.**

### **N-SITE LLC Status Report**

<b>Project</b>	01030-MUSRI2015-01, Objective 5
<b>Reporting Period</b>	February 2016 – May 3, 2016
<b>Project/Engagement Manager</b>	Alex Philp, Ph.D. - PI

a) *Hirings:*

- N/A

b) *Equipment purchases:*

- N/A

c) *Progress towards milestones:*

#### **Database**

- Discovered Streams filter operator bug and worked with IBM engineering staff to validate the issue and identify workaround. The nature of the error meant all the initial data was invalid.
- After modifying the Streams application to account for the filter issue, all the data for both the Subset and the full EEG\_MGH was completely reprocessed from the EEG input files, the databases rebuilt, and the indexes recreated.
- New databases were delivered to UM and installed for use by the EIDOS application.

#### **Notebooks**

- Eidos application development was completed and deployed to an Amazon EC2 instance.
- Implemented multiuser EIDOS access via Jupyterhub.
- Developed the multigraph database viewer application and deployed it for use on EC2.
- Created function-demonstrating extraction of arbitrary length waveforms from any location in the database.

#### **Machine Learning/Cognitive**

- Enhanced the H2O Jupyter notebook to use an unsupervised deep auto-encoder to build models against data selected by the EIDOS application.



- Used the H2O/EIDOS models to perform dimensional reduction and provide multiple analytical views related to the relative occurrence of signal types present in the respective PTE and Control data groups.
- Demonstrated how Watson Analytics can be used to operate on the data selected by the Eidos application.

**Other**

- Provided demonstration and update for Drs. Westover and Poulsen.
- Presented project status and demonstration to UM.
- Provided background information and demonstration for the EIDOS application to Dr. Rau.
- Scheduled full day onsite work session with Dr. Rau and other UM personnel for August 22.

## Quarterly Budget Reports

### Objective 1:

#### MUS MREDI Objective 1 - Operating Statement - Inception to Date

Institution: University of Montana (BMED/NIC)

PI: Dr. Sarjubhai Patel

Banner #: MPHR01

Report Date: 8/12/2016

Account	Description	Total Budget	Expenses to Date	Remaining
61124	Contract Professional	-	85147.84	
61125	Classified Employee		9590.64	
<b>61199</b>	<b>Personnel Services-General</b>	<b>383,000.00</b>	<b>94,738.48</b>	<b>288,261.52</b>
61401	FICA	-	5844.95	
61402	Retirement		804.29	
61403	Group Insurance	-	28205.97	
61404	Workers Compensation	-	608.86	
61409	Medicare Tax	-	1366.97	
61410	State Unemployment Tax	-	236.91	
61415	TIAA-CREF Retirement	-	8192.84	
61415A	TIAA-CREF 1% HB95	-	851.47	
61498	Grant & Contract Leave Assessmen	-	10308.09	
<b>61499</b>	<b>Benefits-General</b>	<b>185,863.00</b>	<b>56,420.35</b>	<b>129,442.65</b>
62102	Consult & Professional Services		6,262.62	
<b>62199</b>	<b>Contracted Services-General</b>	<b>47,000.00</b>	<b>6,262.62</b>	<b>40,737.38</b>
62208	Laboratory Supplies	-	1,423.63	
62241	Office Supplies		156.70	
62245	Computer Equipment <\$5,000		2,581.26	
62282	Ink		85.44	
<b>62299</b>	<b>Supplies-General</b>	<b>-</b>	<b>4,247.03</b>	<b>(4,247.03)</b>
62371	Telephone Equipment		212.00	
62382	Data Circuits-Add/Move/Change		42.00	
<b>62399</b>	<b>Communications-General</b>	<b>-</b>	<b>254.00</b>	<b>(254.00)</b>
62401	In State Personal Car Mileage		65.07	
62408	In state Lodging		207.3	
62497	Non-Employee In State		675.4	
<b>62499</b>	<b>Travel-General</b>	<b>-</b>	<b>947.77</b>	<b>(947.77)</b>
62815	Recruiting		73.00	
<b>62899</b>	<b>Other Expenses</b>	<b>-</b>	<b>73.00</b>	<b>(73.00)</b>
<b>TOTALS</b>		<b>615,863.00</b>	<b>162,943.25</b>	<b>452,919.75</b>

**Objective 2:**

**MUS MREDI Objective 2 - Operating Statement - Inception to Date**

**Institution: University of Montana (BMED/NIC)**

**PI: Dr. Sarjubhai Patel**

**Banner #: MPHR02**

**Report Date:**

8/12/2016
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Account	Description	Total Budget	Expenses to Date	Remaining
61123	Contract Faculty	-	149,561.57	
61124	Contract Professional		9,488.32	
61126	Graduate Teaching Assistant		7,200.00	
61127	Graduate Research Assistant		1,337.13	
61225	Student		7,920.00	
<b>61199</b>	<b>Personnel Services-General</b>	<b>334,478.00</b>	<b>175,507.02</b>	<b>158,970.98</b>
61401	FICA	-	9,648.26	
61403	Group Insurance	-	13,674.12	
61404	Workers Compensation	-	1,107.65	
61409	Medicare Tax	-	2,256.48	
61410	State Unemployment Tax	-	398.35	
61415	TIAA-CREF Retirement	-	15,296.47	
61415A	TIAA-CREF 1% HB95	-	1,590.48	
61498	Grant & Contract Leave Assessment		6,743.31	
<b>61499</b>	<b>Benefits-General</b>	<b>130,949.00</b>	<b>50,715.12</b>	<b>80,233.88</b>
62157	Printing Services-Internal		285.00	
<b>62199</b>	<b>Contracted Services-General</b>	<b>37,500.00</b>	<b>285.00</b>	<b>37,215.00</b>
62208	Laboratory Supplies	-	12,729.78	
62210	Minor Equipment		655.99	
62245	Computer Equipment <\$5,000		186.75	
62249	Minor Software <\$100,000		30,349.58	
<b>62299</b>	<b>General Supplies</b>	<b>25,000.00</b>	<b>43,922.10</b>	<b>(18,922.10)</b>
62304	Postage & Mailing		4.94	
<b>62399</b>	<b>Communications-General</b>	<b>-</b>	<b>4.94</b>	<b>(4.94)</b>
62701	Buildings & Grounds		427.80	
<b>62799</b>	<b>Repairs &amp; Maintenance</b>	<b>-</b>	<b>427.80</b>	<b>(427.80)</b>
<b>TOTALS</b>		<b>527,927.00</b>	<b>270,861.98</b>	<b>257,065.02</b>

**Objectives 3, 4 & 5**

**MUS MREDI Objectives 3, 4 & 5 - Operating Statement - Inception to Date**  
*Includes Subcontracts to VAST (Obj 4) and N-SITE (Obj 5)\**

**Institution: University of Montana (BMED/NIC)**

**PI: Dr. Sarjubhai Patel**

**Banner #: MPHR03**

**Report Date:**

8/12/2016
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Account	Description	Total Budget	Expenses to Date	Remaining
61123	Contract Faculty	-	60,606.90	
61125	Classified Employee	-	66,781.17	
<b>61199</b>	<b>Personnel Services-General</b>	<b>250,844.00</b>	<b>127,388.07</b>	<b>123,455.93</b>
61401	FICA	-	7,331.48	
61402	Retirement	-	2,647.22	
61402C	ORP-Staff TIAA Cref	-	2,950.67	
61403	Group Insurance	-	27,656.95	
61404	Workers Compensation	-	2,938.77	
61409	Medicare Tax	-	1,714.57	
61410	State Unemployment Tax	-	318.50	
61415	TIAA-CREF Retirement	-	5,838.47	
61415A	TIAA-CREF 1% HB95	-	606.05	
61498	Grant & Contract Leave Assessment		10,266.85	
<b>61499</b>	<b>Benefits-General</b>	<b>122,932.00</b>	<b>62,269.53</b>	<b>60,662.47</b>
62147	Subcontract Payments*	-	50,000.00	
62147A	Sub Contract Payments > 25,000*	-	300,862.34	
62195	Professional Services-Internal	-	85.91	
<b>62199</b>	<b>Contracted Services-General</b>	<b>562,000.00</b>	<b>350,948.25</b>	<b>211,051.75</b>
62208	Laboratory Supplies	-	32,550.24	
62208A	Laboratory Supplies - Animals		2,240.95	
62245	Computer Equipment <\$5,000		59.99	
62249	Minor Software < \$100,000		150.00	
62263	Veterinary Supplies		101.25	
<b>62299</b>	<b>General Supplies</b>	<b>155,268.00</b>	<b>35,102.43</b>	<b>120,165.57</b>
62304	Postage & Mailing		158.50	
<b>62399</b>	<b>Communications-General</b>	-	<b>158.50</b>	<b>(158.50)</b>
<b>TOTALS</b>		<b>1,091,044.00</b>	<b>575,866.78</b>	<b>515,177.22</b>

*Subcontract Subtotals Next Page --->*

<b>Subcontract Totals to Date*</b>			
<b>Company</b>	<b>Total Budget</b>	<b>Expenses to Date</b>	<b>Remaining</b>
VAST (Objective 4)	262,000	111,062.24	<b>150,937.76</b>
N-SITE (Objective 5)	300,000	239,800.00	<b>60,200.00</b>
<b>TOTALS</b>	<b>562,000</b>	<b>350,862.24</b>	<b>211,137.76</b>