TRANSLATIONAL SCIENCE AT THE NEURAL INJURY CENTER

MUS Research and Economic Development Initiative

3rd Quarterly Report

February 2017-April 2017

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

a)   Hirings:

- N/A

b)   Equipment:

- N/A

c)   *Progress towards milestones:*

Patient Recruitment
- Student veterans and athletes have continued to be screened throughout the quarter. Grizzly athletic trainers have been regularly referring complicated concussion cases to the NIC for further testing and referral advisement. Patient screening and follow-up visit rates have averaged 6-7 patients a month.

Education and Public Presentations
- Cindi Laukes presented the work of the NIC at an All College Meeting on January 20.

- Navy Rear Admiral Kitchener visited the Neural Injury Center and spent time with MREDI investigators and Cindi Laukes on April 13.

- Cindi Laukes presented the work of the NIC at an advanced UM class of Speech and Language Students on April 4.

- Tom Rau and Sarj Patel will present at a Community Concussion conference in Butte May 12.

- Cindi Laukes will be taped for a television interview regarding the work of the NIC by Mountain Pacific Quality Health in Helena for a television segment they are producing on concussion.

Project and Network Development
- Cindi Laukes has completed all data collection and data coding for her PCORI Scholar project related to *barriers to TBI screening amongst UM student veterans and CSKT Tribal community* members. This data is now in the hands of the statistician for analysis of results.

- Cindi Laukes, Tom Rau, Sarj Patel and Erik Guzik met with several local community clinicians to further develop avenues for clinical/translational grant submissions.

- Cindi Laukes, Tom Rau, Sarj Patel and a Special Ops Veteran advisor conferenced with a group of researchers out of Mount Sinai to discuss possible collaboration on biomarker work.

- Cindi Laukes, Sarj Patel and Tom Rau conferenced with a group of individuals from the DC Veterans Affairs Office and VISN 19 about the possibility of creating a 5/8 VA position at UM for Tom Rau, and about additional mechanisms for building VA collaborations.

Publications this Quarter—Cindi Laukes

- The Northwest Participant and Clinical Interactions Network: Increasing opportunities for patients to participate in research across the Northwestern United States Laura-Mae Baldwin, Laurie Hassell, Cindi Laukes, Michelle Doyle, Anne Reedy, Brenda Mollis, Sandra Albritton, Elizabeth Ciemins, Robert Coker, Jeannine Brant, Katherine R. Tuttle, Laura Baker and Bonnie Ramsey. Journal of Clinical and Translational Science. April 2017.

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

a)   *Hirings:*

- N/A

b)   *Equipment purchased:*

- N/A

c)   *Progress towards milestones:*

The work proposed for this objective has up to this date achieved the proposed milestones and extended its reach to the development of new technologies that will facilitate clinical research and services to our community, open new ventures for the delivery of educational content, facilitate positioning the Montana University System and the State of Montana as a silo for the development of translational research.

Specifically, we have achieved the following milestones:

- A Master student supported by this award graduated (Spring 2017) from the UM Interdisciplinary program.

- Multiple journal articles have been recently submitted to reputable journal to disseminate our findings.

- A partnership with Montana State University and the VA hospital at Pudget Sound (WA) is being established. A pilot study will be conducted during the summer months at MSU as a proof of concept of the capabilities of the rapid screening methods developed by our group.

- Data collection for Balance and Oculomotor performances have reached and excelled the number of participants proposed. However, we continue to offer the procedures to our community members as an aid to their health care providers.

- We have found sensitive performance markers indicating the presence of long-term neural impairments. These findings have been included in our daily operations of screening and referrals at the Neural Injury Center. The results of our research (both basic and applied) are now being reported in reputable journals including Scientific Reports/Nature and Brain Injury (copies are available per request). Several other reports are currently being prepared for publication.

- We have extended our reach beyond student veterans and athletes by conducting studies aiming our elderly and children. This initiative is allowing us to establish normative values to be used clinically to establish higher risks of falls and the foundation for future applications on early detection of Parkinson's disease. Data recording for these studies are now completed their results are now being analyzed and reports being prepared.

- A partnership with a Brazilian group of researchers from the Federal University of Piaui has been established where they are currently investigating the ability of our systems to early detect Parkinson's.

- A partnership with a Brazilian company (EMG Systems of Brazil http://www.emgsystem.com.br/) is being established. This partnership allowed the creation of a local company (*Synergy Applied Medical and Research*) to conduct development of instrumented technologies and clinical trials here in the State of Montana. This tech company is now on the track to attract capital and revenue to the Missoula area.

- We also have extended our reach by researching best practices to counter-act the effects of mTBI (mild traumatic brain injury) neural impairments leading to higher risks of falls. A full 16 weeks protocol for balance treatment was carried on by our research assitants. Reporting of results are being prepared for publication. This study is the first one of a series of investigations planned for the years of 2017 to 2019.

- We have also extended our reach by creating new technologies aiming to address the needs of the State of Montana including:

- A prototype of interface to allow mapping of TBI (traumatic brain injuries) occurrences (Figure 1). This interface has been presented to members of the Traumatic Brain Advisory Council. The system would facilitate the process of recognize vulnerable areas, incidence, and quality of care. The first prototype was developed in Matlab language and currently awaits translation to Android/IOS platforms.
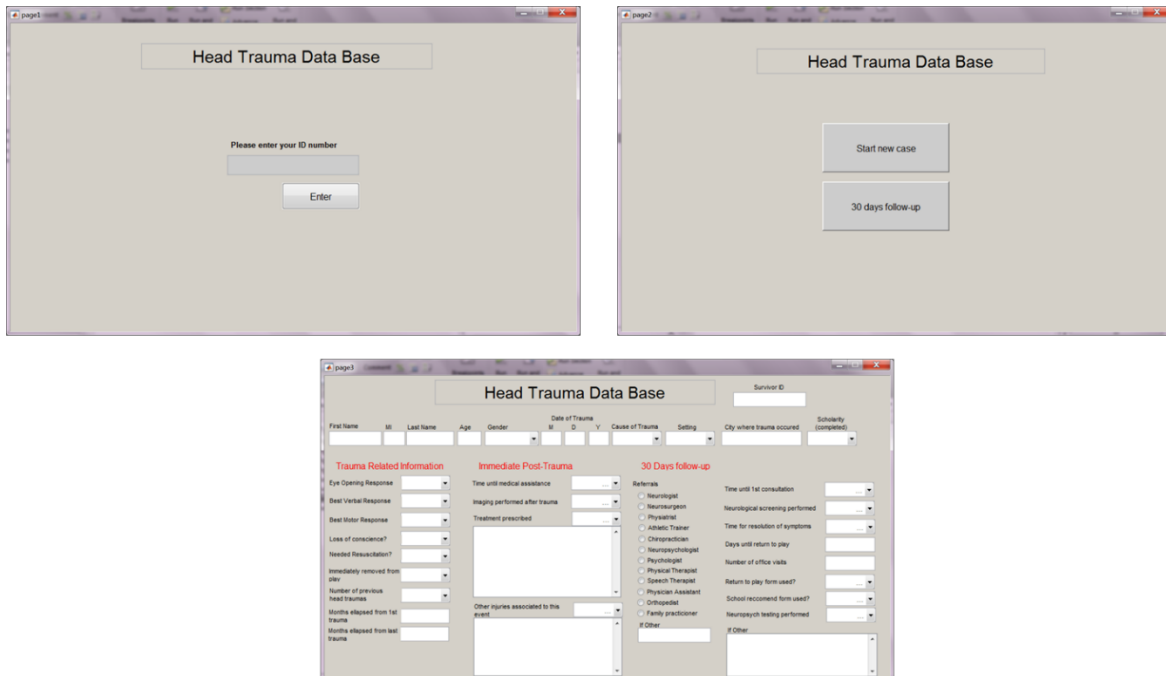

Figure 1. Screenshots of interface developed for tablet application in the field (rurals areas, schools, sport organizations. Analytical interface hosted by Synergy Inc. and UM MCLab.

- A mobile system intended to deliver interventional procedures through interactive virtual reality. This system differs from the current versions in the market by its ability to deliver

interactive sessions without the use of tracking cameras. The prototype is in a secondary phase of development and can be used to deliver educational content as well.
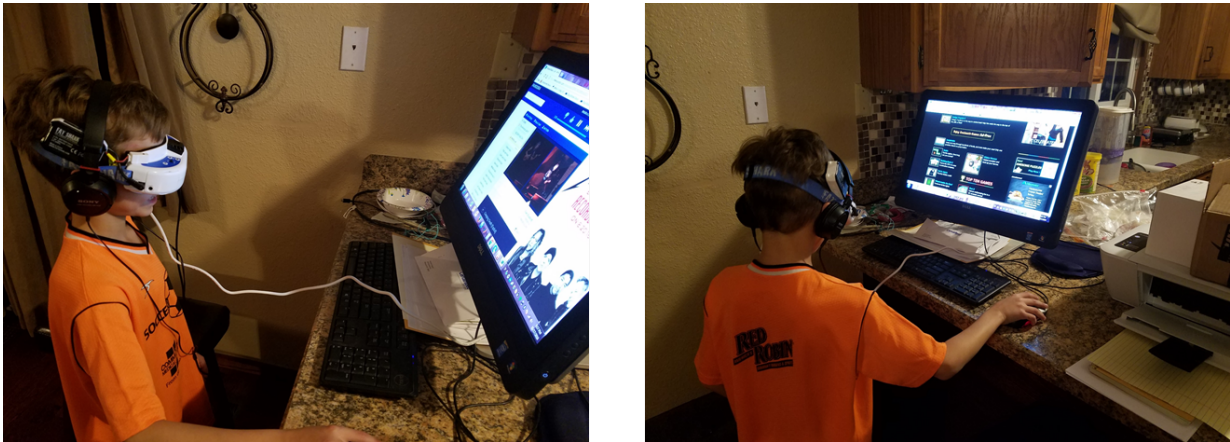

Figure 2. 8 year-old boy interacting with virtual setting. Note: the computer screen is only to demonstrate what he sees inside the apparatus. The same system can work on selected cell phones and therefore becomes mobile. Cost of system is below US$ 400.

- System for acquisition and analysis of biological signals (*Lucius vs1.0*). This system allows the acquisition of any signals from instruments to be used in laboratory and clinical settings. Its simplicity of use and customizable interface and analytics will allow the development of several products intended to test performance of patients suffering from traumas and insults to their bodies. in Figure 3 one can see one of the interfaces developed for the University of Montana Motor Control Laboratory (Left panel), integration of instrumentation utilized for balance screenings and electromyography (Middle panel), and its potential use on interfacing systems designed for testing multi-finger coordination and dexterity. This same system is capable of integrating electroencephalography, electrocardiography, goniometers, accelerometer, thermocouples, among many others.
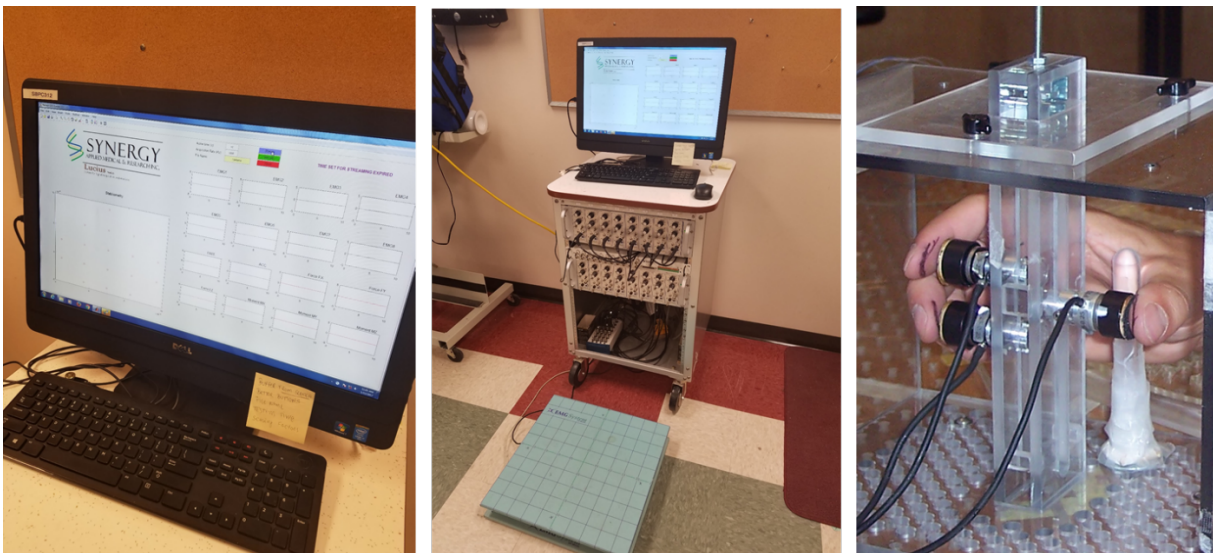
Figure 3. Lucius interface and acquisition system of biological signals (Left panel). Application being used with balance and EMG equipment (Middle panel) and interface created for testing of multi-finger coordination and force production (Right panel). The system can also integrate any other instruments (thermocouples, encephalography, electrocardiography, etc) and produce biofeedback to patients and researchers. Analytical system is customizable for future clinical

6

use and systems are mobile. Lucius is currently being commercialized by one of the spin-off companies from awarded financial support (Synergy Applied Medical and Research Inc.) and made available for its use at the MCLab at the University of Montana.

- System for body balance analysis (BalanceLab vs1 to 5). This system was in fact included in our proposal it comprises of a software dedicated to the analysis of body balance control. The system allows on-site analysis and reporting of results inclusing comprisons to normative indices facilitating further investigations of impairments caused by mTBI, progression and subclinical signs of Parkinson's development. We have also focused on using the system as a tool to quantify rates of recovery from injuries and disease, facilitate studies aiming to test the efficacy of rehabilitation interventions as well as to define higher risks of falls in older adults. The system is very portable and can be used in clinical settings. Figure 4 shows the use of BalanceLab vs3.

- Figure 4. Data recording using BalanceLab vs3.

- Drs. Patel and Rau patent entitled "Detection of Traumatic Brain Injury" issued on March 28, 2017, as U.S. Serial No. 9,605,315.

- Drs. Patel and Rau have received and are analyzing miRNA screening data for female subjects and athlete for determination of sex-dependent blood-based biomarkers.

- Drs. Patel and Rau welcomed Kevin Robinson, a 4 time X-games gold medalist, a Guinness Book of World Records holder and an ESPN commentator. He has had over 30 concussions and was looking for help diagnosing and managing his concussion issues. He heard about our research through a documentary on concussion on PBS and was frustrated that no one will even talk to him about his concussions. He participated in our ongoing studies to correlate changes in

cognition and neurological motor activity following concussion and TBI with biochemical measures such as miRNA biomarkers in the blood we have been developing at UM.

- The Office of Technology Transfer agreed a licensing agreement with Glia Diagnostics for the development of the miRNA TBI panel for a federally approved *in vitro* diagnostic (IVD) test.

- A recent collaboration and partnership with Dr. Stephanie McCalla of Montana State University has continued the development of new technology for rapid molecular detection of blood-based biomarkers to assess severity of injury and recovery duration. She has been supplied RNA samples for testing of this technology.

Continuation of work.

- During the remaining 2 months of this award, a server-based data depository for balance results will be implemented and all initiatives will continue to progress.

- Even though our progress has been considered by us as positive, it is important to clarify that the milestones reached represented only a small fraction of the work that needs to be done. We set our objectives to the development of feasible technology to improve our chances of success in developing interventions that will increase the quality of life of our community. We are positive that with the collaborations in place between the University of Montana, State of Montana, MREDI office, MUS, and our partners around the world we will be able to move this technology in an effective manner towards our schools, universities, and clinics.

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

a)   Hirings:

- N/A

b)   Equipment purchased:

- Purchased Thermo Fisher -80oC freezer for dedicated secure storage of human plasma samples.

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 assessment of TBI animal treated with novel neuroprotective drug demonstrated improvement of cognitive performance in the Barnes maze.

- Continuing analysis of human chronic traumatic encephalopathy (CTE) tissue received from the Center for Traumatic Encephalopathy brain bank, Boston University (Boston, MA). RNA-seq analysis of 24 human samples is currently in progress to identify miRNA signature for CTE.

- Preparing IP disclosure for novel panel of blood-based biomarker for CTE.

Objective 4: <u>VAST: Next Generation Learning,</u> 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-Q6)

- 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.
- 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.
- Identification of testing subjects for training levels (mTBI and non-mTBI); preparation for controlled testing.
- Research and development of Virtual Reality version of tests.
- Research and development of hardware components of VR necessary to support TBI diagnostics and cognitive rehabilitation.
- Completion of original proposed 10 levels of mobile CCT system based on gamification of divergent thinking tasks.

- Completion of 8 additional, new exercise types for assessing frontal lobe performance and executive function using mobile platforms.
- Completion of usability and feasibility testing of training exercises with 500 adults.
- Addition of testing site in Tulsa, OK for preliminary testing into usability as intervention into age-related cognitive decline.
- As part of post-project deployment and commercialization, now in discussions to introduce the VAST frontal lobe tests as part of comprehensive research study led by Dr. Rex Jung.

Newly Completed (Q3_Y2)

TBI Testing and Training using VR

- Submission of full patent application to USPTO for novel VR testing solution.
- Receipt of IRB approval from Western Institutional Review Board (WIRB) for ongoing research of VR software with human subjects. Launch of reliability testing of VR tests in MonTEC office.
- Integration of eye-tracking technology from SMI and incorporation into VR-based testing.
- Completion of 9 distinct, original VR tests for cross-platform application, including VR versions of the Trail Making Test, Stroop Task, and working memory tests, including integration of new eye-tracking technology. Research and development of 3 entirely new cognitive tests.
- Completion of fully functioning builds for HTC Vive and research into builds for Google Daydream and Samsung Gear VR. Submission of build for HTC Vive to Steam marketplace.
- Completion of backend code and database updates requires to collect VR testing information from subjects via the cloud. Completion of innovative platform for tracking user results, providing basis for future VR-based cognitive testing and rehabilitation.
- Completion of physical therapy (PT) training exercises with UM graduate students using Steam sensor technology in VR to track physical movement. Innovative technology will allow patient to complete PT exercises at home, with results sent to clinicians for review over the cloud. Completion of 2 prototype exercises using Unity engine, HTC Vive, and SteamVR sensor technology.
- Ongoing integration of new hardware and sensors required to track physical movement in virtual reality using infrared light detection.
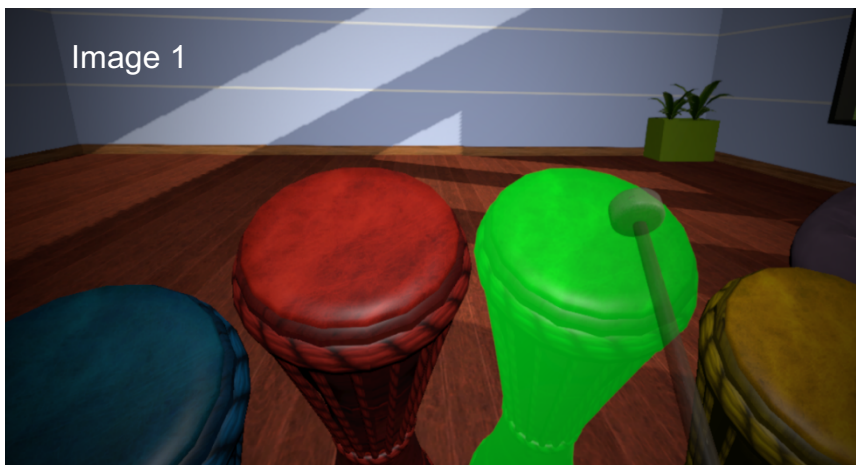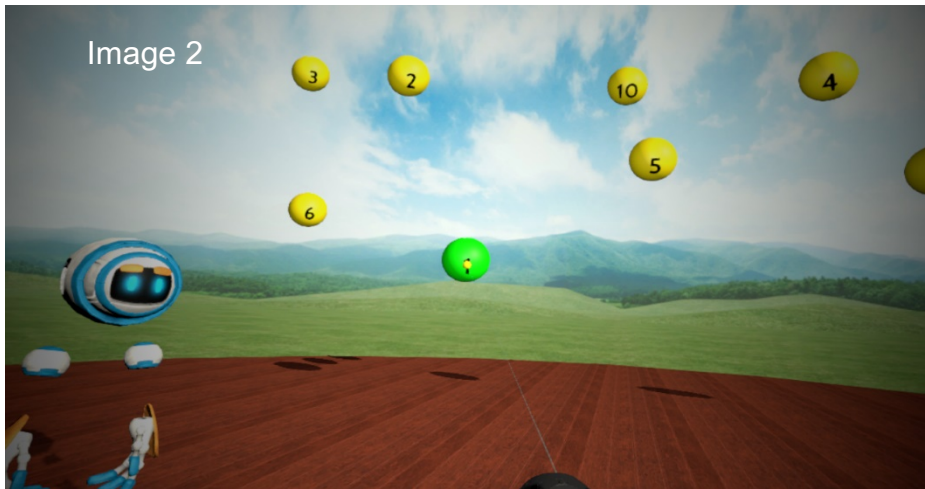

Image 1

Image 2

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

N-SITE LLC Status Report

Project	01030-MUSRI2015-01, Objective 5
Reporting Period	November 2016 – January, 2017
Project/Engagement Manager	Alex Philp, Ph.D. - PI

a)   *Hirings:*

- N/A

b)   *Equipment purchases:*

- *N/A*

c)   *Progress towards milestones:*

- After exploratory analysis with t-testing and Hotelling's t-testing, we used a modern data mining technique called random forest to build a predictive model. The forest is an aggregation of several hundred decision trees randomized in a few strategic ways. The forest uses all predictor variables in the data to some extent, but we can rank the overall importance of each one. The most important predictors - those that decreased accuracy most if they were removed - are the relative energy and mean in the D4 frequency band. Our maximum overall accuracy rate was 0.825. This threshold gave a sensitivity, or true positive rate, of 0.951 and a specificity, or true negative rate, of 0.512. This means that, in terms of PTE prediction, our model catches most instances of PTE in the data set (it's sensitive), but also gives a lot of false alarms (it's unspecific).

- This shows that we have found a predictive biomarker that is accurate .825% of the time in determining whether a EEG data set (associated variables) can be accurately placed in the TBI (no PTE) group vs. the PTE group based upon our available data. This is significant.

- The predictive biomarker represents a specific set or ratio of variables present.   In a future clinical setting, if an EEG was run, and this specific biomarker was detected, it would either be diagnostic for PTE or, more probably, indicative of TBI-induced trending to toward, i.e., patient at increased risk.

- We have determined that the PTE vs. TBI classes are different, different for specific variables, and it is statistically possible to predict using Random Forest method where a particular EEG will fall into either class. So, this is valuable for diagnosis, it is valuable for potential prediction of increases risk, and very valuable for drug design.

- The full analysis and complete report will reflect this significant finding.

- Appropriate credit needs to go to the Math Dept., Dr. Brian Steele, Rachel Ehlers, Kristen Owens, and Claire Seibold for their outstanding work between mid-January and May 8th, 2017.

Statistical Analysis of EEG Data

●●●

Predicting Post-Traumatic Epilepsy in Patients with a Traumatic Brain Injury

Background

- **Patients with a traumatic brain injury**
  - ❏ Post-Traumatic Epilepsy (PTE)
    - ❏ 21 patients, 103 EEGs
  - ❏ No Post-Traumatic Epilepsy (Control)
    - ❏ 27 patients, 42 EEGs
- **Variables:**
  - ❏ Wavelet bands d1 (largest frequency), d2, d3, d4, d5, d6 (smallest frequency)
    - ❏ Relative Energy (proportion of each second in that band)

Database: EEG_MGH | Filename: MGH_TBI_020_01_ARed2.edf | Label: Fp1 | Offset: 0:10:14 | Previous Offset | Next Offset | Display Longer Series

ent: 0.99 pp: 187.71 rms: 39.39 re: 0.00 0.00 0.01 0.08 0.53 0.38 std: 1.66 2.61 9.37 30.85 113.81 134.24 m: 0.17 -0.16 -1.57 2.61 -11.32 23.88
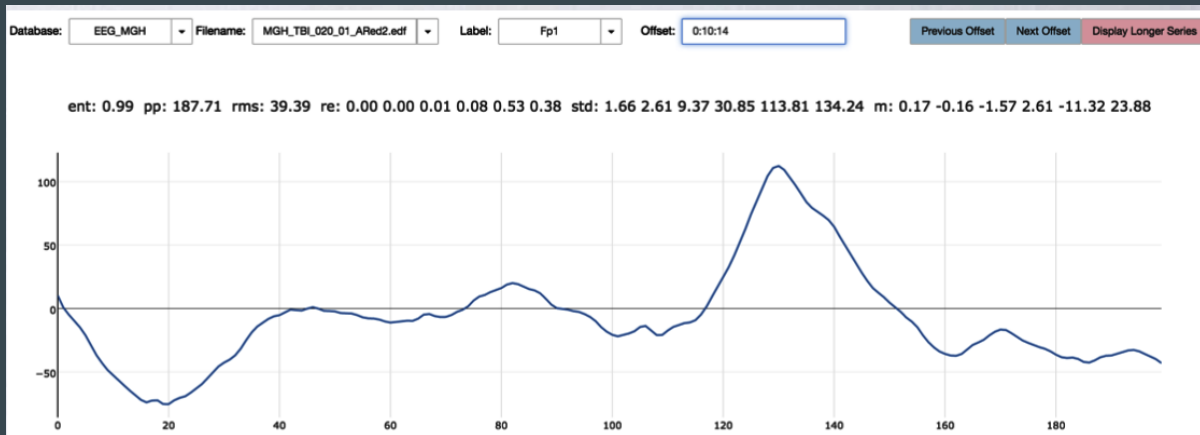
Testing Methods

- **Hotelling's T-Squared Test**
  - ❏ Computes the difference in a **vector** of means
  - ❏ Our vector is the deciles of each variable in each EEG
  - ❏ H_0 : vector of deciles is the same for the two groups of EEGs (control and PTE)
  - ❏ Results are in form of a p-value for each variable
- **Random Forest**
  - ❏ Finds the best categorization using a set of predictor variables
  - ❏ Predictors are the quartiles of each variable in each EEG

Results: Hotelling T-Square Test
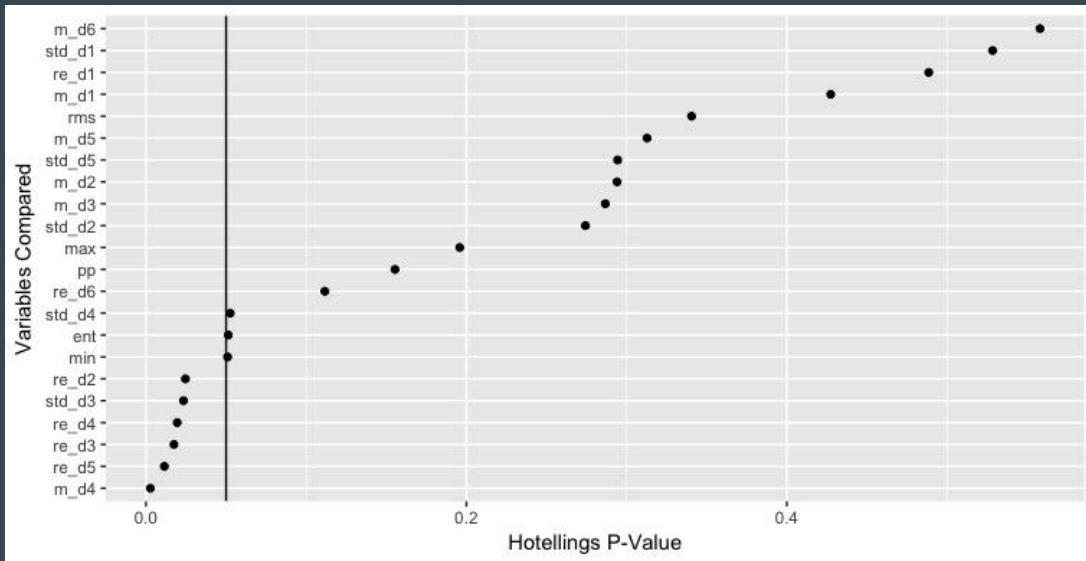
Classification Trees

Imitate human decision making: Most important decisions first, in the end it makes a binary choice

Cons: high variance, overfitting

Solved by using random forest
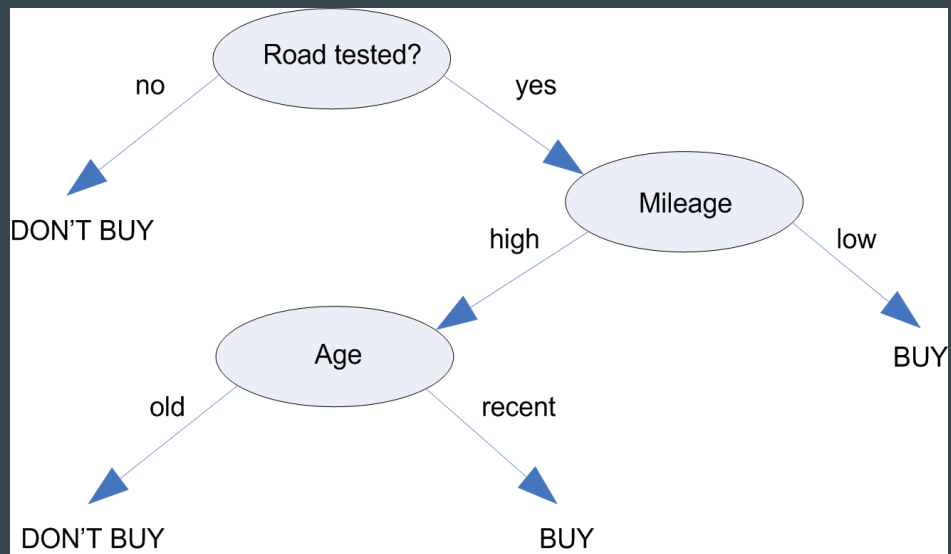
Results: Random Forest
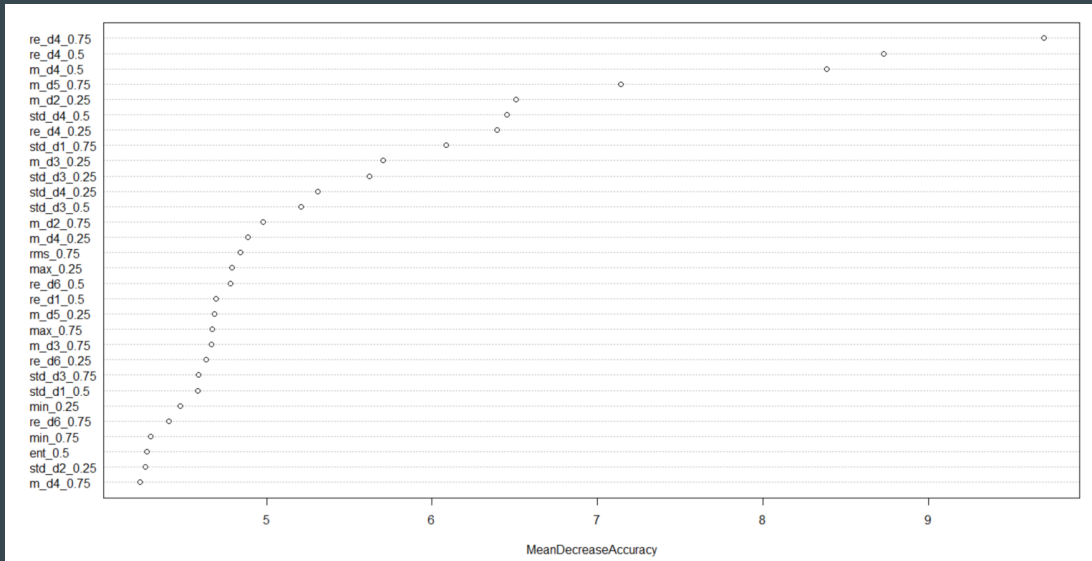
Accuracy Measures

- **Sensitivity**: True Positive Rate. The number of times it chooses PTE and is Correct.
- **Specificity**: True Negative Rate. The number of times it chooses non-PTE and is Correct.
- **Accuracy**: Number of times it chooses correctly overall

- At 52% Threshold (Maximum Accuracy):
  Accuracy = 0.825   Sensitivity = 0.952   Specificity = 0.512

- **AUC Accuracy**: A general measure of the overall accuracy of the test, regardless of prediction threshold.
  AUC Accuracy: 0.797

Effect of Probability Threshold
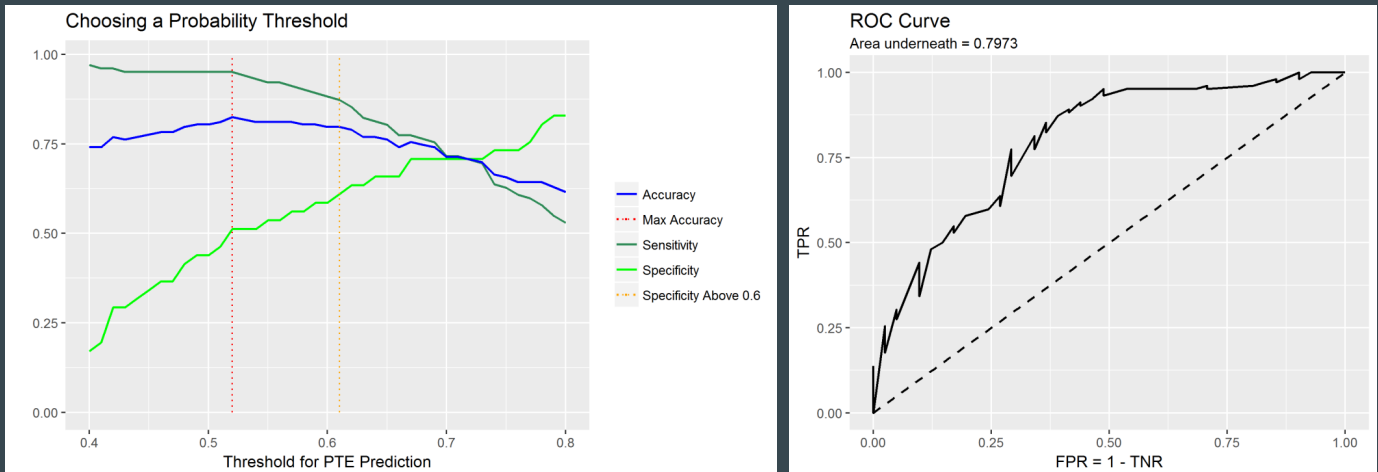
Conclusions

- We are confident that it is possible to predict PTE based on EEG results

- We have shown that relative energy can be a valid predictor for PTE

- More data is needed to decide exactly what combination of variables is key to the biomarker

- In the future, we hope to differentiate pre- and post- diagnosis EEGs in order to determine if this biomarker is present before PTE develops

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: 5/3/2017

Account	Description	Total Budget	Expenses to Date	Remaining
61124	Contract Professional	-	190972.54	
61125	Classified Employee		17862.72	
61199	**Personnel Services-General**	**250,000.00**	**208,835.26**	**41,164.74**
61401	FICA	-	12876.3	
61402	Retirement		1504.95	
61403	Group Insurance	-	63666.09	
61404	Workers Compensation	-	1236.03	
61409	Medicare Tax	-	3011.44	
61410	State Unemployment Tax	-	522.2	
61415	TIAA-CREF Retirement	-	18432.38	
61415A	TIAA-CREF 1% HB95	-	1915	
61498	Grant & Contract Leave Assessmen	-	24961.85	
61499	**Benefits-General**	**155,000.00**	**128,126.24**	**26,873.76**
62102	Consult & Professional Services		21,981.67	
62191	Printing		326.25	
62199	**Contracted Services-General**	**69,000.00**	**22,307.92**	**46,692.08**
62204	Educational Supplies		51.00	
62208	Laboratory Supplies	-	2,332.43	
62210	Minor Equipment		4.88	
62214	Printing Supplies		61.59	
62241	Office Supplies		156.70	
62245	Computer Equipment <$5,000		3,931.25	
62282	Ink		242.26	
62299	**Supplies-General**	**10,121.00**	**6,780.11**	**3,340.89**
62371	Telephone Equipment		344.50	
62372	Telephone-Add/Move/Change		15.00	
62382	Data Circuits-Add/Move/Change		42.00	
62399	**Communications-General**	**600.00**	**401.50**	**198.50**
62401	In State Personal Car Mileage		65.07	
62408	In state Lodging		207.3	
62497	Non-Employee In State		675.4	
62499	**Travel-General**	**1,000.00**	**947.77**	**52.23**
62815	Recruiting		142.00	
62899	**Other Expenses**	**142.00**	**142.00**	**-**
	TOTALS	**485,863.00**	**367,540.80**	**118,322.20**

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: | 5/3/2017

Account	Description	Total Budget	Expenses to Date	Remaining
61123	Contract Faculty	-	246,605.02	
61124	Contract Professional		3,654.99	
61126	Graduate Teaching Assistant		17,333.28	
61127	Graduate Research Assistant		2,674.26	
61225	Student		10,862.74	
61199	**Personnel Services-General**	**334,478.00**	**281,130.29**	**53,347.71**
61401	FICA	-	15,319.28	
61403	Group Insurance	-	22,995.49	
61404	Workers Compensation	-	1,688.60	
61409	Medicare Tax	-	3,582.74	
61410	State Unemployment Tax	-	633.76	
61415	TIAA-CREF Retirement	-	24,121.96	
61415A	TIAA-CREF 1% HB95	-	2,502.62	
61498	Grant & Contract Leave Assessment		13,369.79	
61499	**Benefits-General**	**101,971.00**	**84,214.24**	**17,756.76**
62102	Consultant & Professional Services		30,039.00	
62157	Printing Services-Internal		285.00	
62199	**Contracted Services-General**	**19,000.00**	**30,324.00**	**(11,324.00)**
62208	Laboratory Supplies	-	13,910.74	
62210	Minor Equipment		1,040.94	
62241	Office Supplies		30.45	
62245	Computer Equipment <$5,000		1,964.50	
62249	Minor Software <$100,000		30,399.57	
62282	Ink		143.88	
62299	**General Supplies**	**65,000.00**	**47,490.08**	**17,509.92**
62304	Postage & Mailing		250.30	
62399	**Communications-General**	**50.00**	**250.30**	**(200.30)**
62426	Foreign Travel		4,183.74	
62497	Non-employee In State		2,815.58	
62499	**Travel-General**	**7,000.00**	**6,999.32**	**0.68**
62701	Buildings & Grounds		427.80	
62799	**Repairs & Maintenance**	**428.00**	**427.80**	**0.20**
	TOTALS	**527,927.00**	**450,836.03**	**77,090.97**

Objectives 3, 4 & 5

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

Institution: University of Montana (BMED/NIC)
PI: Dr. Sarjubhai Patel
Banner #: MPHR03

Report Date: | 5/3/2017 |

Account	Description	Total Budget	Expenses to Date	Remaining
61123	Contract Faculty	-	120,338.01	
61125	Classified Employee	-	105,663.11	
61199	**Personnel Services-General**	**250,844.00**	**226,001.12**	**24,842.88**
61401	FICA	-	13,249.47	
61402	Retirement	-	5,748.20	
61402C	ORP-Staff TIAA Cref	-	3,552.09	
61403	Group Insurance	-	48,996.47	
61404	Workers Compensation	-	4,744.66	
61409	Medicare Tax	-	3,098.67	
61410	State Unemployment Tax	-	565.05	
61415	TIAA-CREF Retirement	-	11,150.81	
61415A	TIAA-CREF 1% HB95	-	1,155.07	
61498	Grant & Contract Leave Assessment		19,029.09	
61499	**Benefits-General**	**124,000.00**	**111,289.58**	**12,710.42**
62106	Laboratory Testing	-	4,089.50	
62108	Legal Fees & Court Costs	-	4,000.00	
62147	Subcontract Payments*	-	50,000.00	
62147A	Sub Contract Payments > 25,000*	-	537,123.91	
62195	Professional Services-Internal	-	115.91	
62199	**Contracted Services-General**	**741,658.00**	**595,329.32**	**146,328.68**
62204	Educational Supplies	-	469.98	
62208	Laboratory Supplies	-	75,889.52	
62208A	Laboratory Supplies - Animals	-	3,015.95	
62210	Minor Equipment	-	4,254.09	
62245	Computer Equipment <$5,000	-	411.92	
62249	Minor Software < $100,000	-	675.00	
62263	Veterinary Supplies	-	101.25	
62299	**General Supplies**	**103,231.00**	**84,817.71**	**18,413.29**
62304	Postage & Mailing	-	271.25	
62399	**Communications-General**	**500.00**	**271.25**	**228.75**
62713	Laboratory Equipment	-	711.00	
62799	**Repairs & Maintenance-General**	**711.00**	**711.00**	**-**
62802	Subscriptions	-	99.00	
62899	**Other Expenses**	**100.00**	**99.00**	**1.00**
	TOTALS	**1,221,044.00**	**1,018,518.98**	**202,525.02**

Subcontract Subtotals Next Page --->

Subcontract Totals to Date*			
Company	Total Budget	Expenses to Date	Remaining
VAST (Objective 4)	312,000	276,325.91	35,674.09
N-SITE (Objective 5)	315,000	310,798.00	4,202.00
MSU/McCalla	15,000	-	15,000.00
Synergy	50,000	-	50,000.00
TOTALS	692,000	587,123.91	104,876.09