Final Progress Report for Research Projects Funded by Health Research Grants

Instructions: Please complete all of the items as instructed. Do not delete instructions. Do not leave any items blank; responses must be provided for all items. If your response to an item is "None", please specify "None" as your response. "Not applicable" is not an acceptable response **for any of the items. There is no limit to the length of your response to any question. Responses** should be single-spaced, no smaller than 12-point type. The report **must be completed using MS Word**. Submitted reports must be Word documents; they should not be converted to pdf format. Questions? Contact Health Research Program staff at 717-783-2548.

1. **Grantee Institution:** Temple University – Of The Commonwealth System of Higher Education

2. **Reporting Period (start and end date of grant award period):** 1/1/2010-12/31/2013

3. **Grant Contact Person (First Name, M.I., Last Name, Degrees):** Germaine A Calicat, MA

4. **Grant Contact Person's Telephone Number:** 215.204.7655

5. **Grant SAP Number:** 4100050909

6. **Project Number and Title of Research Project:** Project 16 - Relationships of Histochemistry to Muscle Activity in the Child with Cerebral Palsy

7. **Start and End Date of Research Project:** 7/1/2010 – 6/30/2012

8. **Name of Principal Investigator for the Research Project:** Richard T. Lauer, PhD

9. **Research Project Expenses**.

   9(A) Please provide the total amount of health research grant funds spent on this project for the entire duration of the grant, including indirect costs and any interest earned that was spent:

   $ 17,282.11

   9(B) Provide the last names (include first initial if multiple individuals with the same last name are listed) of **all** persons who worked on this research project and were supported with health research funds. Include position titles (Principal Investigator, Graduate Assistant, Post-doctoral Fellow, etc.), percent of effort on project and total health research funds expended for the position. For multiple year projects, if percent of effort varied from year to year, report in the % of Effort column the effort by year 1, 2, 3, etc. of the project (x% Yr 1; z% Yr 2-3).

Last Name, First Name	Position Title	% of Effort on Project	Cost
Lauer, Richard	Principle Investigator	30	5,000
Taylor, Daveda	Research Coordinator	50	18,000
Amin, Mamta	Lab Assistant	30	10,500
Mullen, Courtney	Research Assistant	100	7,000

9(C) Provide the names of **all** persons who worked on this research project, but who *were not* supported with health research funds. Include position titles (Research Assistant, Administrative Assistant, etc.) and percent of effort on project. For multiple year projects, if percent of effort varied from year to year, report in the % of Effort column the effort by year 1, 2, 3, etc. of the project (x% Yr 1; z% Yr 2-3).

Last Name, First Name	Position Title	% of Effort on Project
Barbe, Mary	Co-Investigator	30
Miller, Freeman	Medical Consultant	10
		10

9(D) Provide a list of **all** scientific equipment purchased as part of this research grant, a short description of the value (benefit) derived by the institution from this equipment, and the cost of the equipment.

Type of Scientific Equipment	Value Derived	Cost
Lab Assay Kits	Needed to process tissue samples	12,500

10. Co-funding of Research Project during Health Research Grant Award Period. Did this research project receive funding from any other source during the project period when it was supported by the health research grant?

Yes_____ No_____X_____

If yes, please indicate the source and amount of other funds:

11. Leveraging of Additional Funds

11(A) As a result of the health research funds provided for this research project, were you able to apply for and/or obtain funding from other sources to continue or expand the research?

Yes_____ No_____X_____

If yes, please list the applications submitted (column A), the funding agency (National Institutes of Health—NIH, or other source in column B), the month and year when the application was submitted (column C), and the amount of funds requested (column D). If you have received a notice that the grant will be funded, please indicate the amount of funds to be awarded (column E). If the grant was not funded, insert "not funded" in column E.

Do not include funding from your own institution or from CURE (tobacco settlement funds). Do not include grants submitted prior to the start date of the grant as shown in Question 2. If you list grants submitted within 1-6 months of the start date of this grant, add a statement below the table indicating how the data/results from this project were used to secure that grant.

A. Title of research project on grant application	B. Funding agency (check those that apply)	C. Month and Year Submitted	D. Amount of funds requested:	E. Amount of funds to be awarded:
	☐NIH ☐ Other federal (specify:_____ _____) ☐ Nonfederal source (specify: _____)		$	$
	☐NIH ☐ Other federal (specify:_____ _____) ☐ Nonfederal source (specify: _____)		$	$
	☐NIH ☐ Other federal (specify:_____ _____) ☐ Nonfederal source (specify: _____)		$	$

11(B) Are you planning to apply for additional funding in the future to continue or expand the research?

Yes_____ No___X_____

If yes, please describe your plans:

12. Future of Research Project. What are the future plans for this research project?

The findings were inconclusive and do not support development of an additional research project.

13. New Investigator Training and Development. Did students participate in project supported internships or graduate or post-graduate training for at least one semester or one summer?

Yes_____X___ No_____

If yes, how many students? Please specify in the tables below:

	Undergraduate	Masters	Pre-doc	Post-doc
Male				
Female	1			
Unknown				
Total	**1**			

	Undergraduate	Masters	Pre-doc	Post-doc
Hispanic				
Non-Hispanic				
Unknown	1			
Total	**1**			

	Undergraduate	Masters	Pre-doc	Post-doc
White	1			
Black				
Asian				
Other				
Unknown				
Total	**1**			

14. Recruitment of Out-of–State Researchers. Did you bring researchers into Pennsylvania to carry out this research project?

Yes_____ No____X_____

If yes, please list the name and degree of each researcher and his/her previous affiliation:

15. Impact on Research Capacity and Quality. Did the health research project enhance the quality and/or capacity of research at your institution?

Yes_____ No____X_____

If yes, describe how improvements in infrastructure, the addition of new investigators, and other resources have led to more and better research.

16. Collaboration, business and community involvement.

16(A) Did the health research funds lead to collaboration with research partners outside of your institution (e.g., entire university, entire hospital system)?

Yes___X_____ No_____

If yes, please describe the collaborations: Collaboration with AI DuPont Hospital for Childen in Wilmington Delaware for subject recruitment.

16(B) Did the research project result in commercial development of any research products?

Yes_____ No_____X____

If yes, please describe commercial development activities that resulted from the research project:

16(C) Did the research lead to new involvement with the community?

Yes_____ No____X_____

If yes, please describe involvement with community groups that resulted from the research project:

17. Progress in Achieving Research Goals, Objectives and Aims.

List the project goals, objectives and specific aims (as contained in the grant agreement). Summarize the progress made in achieving these goals, objectives and aims for the period that the project was funded (i.e., from project start date through end date). Indicate whether or not each goal/objective/aim was achieved; if something was not achieved, note the reasons why. Describe the methods used. If changes were made to the research goals/objectives/aims, methods, design or timeline since the original grant application was submitted, please describe the changes. Provide detailed results of the project. Include evidence of the data that was generated and analyzed, and provide tables, graphs, and figures of the data. List published abstracts, poster presentations and scientific meeting presentations at the end of the summary of progress; peer-reviewed publications should be listed under item 20.

This response should be a DETAILED report of the methods and findings. It is not sufficient to state that the work was completed. Insufficient information may result in an unfavorable performance review, which may jeopardize future funding. If research findings are pending publication you must still include enough detail for the expert peer reviewers to evaluate the progress during the course of the project.

Health research grants funded under the Tobacco Settlement Act will be evaluated via a performance review by an expert panel of researchers and clinicians who will assess project work using this Final Progress Report, all project Annual Reports and the project's strategic plan. After the final performance review of each project is complete, approximately 12-16 months after the end of the grant, this Final Progress Report, as well as the Final Performance Review Report containing the comments of the expert review panel, and the grantee's written response to the Final Performance Review Report, will be posted on the CURE Web site.

There is no limit to the length of your response. Responses must be single-spaced below, no smaller than 12-point type. If you cut and paste text from a publication, be sure symbols print properly, e.g., the Greek symbol for alpha (α) and beta (ß) should not print as boxes (□) and include the appropriate citation(s). DO NOT DELETE THESE INSTRUCTIONS.

Background. Cerebral palsy (CP) is '… a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of CP are often accompanied by disturbances of sensation, perception, cognition, communication, and behavior, by epilepsy, and by secondary musculoskeletal problems.' While the injury to the brain in CP is non-progressive, the secondary neuromuscular changes are dynamic. Recent work in our laboratory has demonstrated the dynamic nature of muscle spasticity and muscle activity, as assessed through surface electromyography (sEMG), in the child with CP between the ages of 5 to 13. However, the underlying histochemical mechanisms behind these dynamic changes, while speculative, are yet unknown.

Specific aim. Thus, the aim of this study is to establish the interrelationship between the sEMG measurements of muscle activity and muscle histochemistry/histomorphology in the child with CP. We *hypothesize* that the time-frequency changes in the sEMG signal will correlate directly with myofiber type, cross sectional area and acetylcholine receptor distribution, satellite cell type and frequency. We further *hypothesize* that time-frequency alterations in the sEMGs will inversely correlate with intramuscular collagen content, fibroblast and adipose cell number frequency in the biopsied muscles. A cross-sectional study will be conducted with 15 children classified as spastic, diplegic or spastic, quadriplegic CP between 5 and 13 years of age. All of the children in this study will be undergoing a gait assessment at the Motion Analysis Laboratory (MAL) at the Alfred I. duPont Hospital for Children prior to a surgical intervention that would involve orthopedic management of the secondary neuromuscular problems associated with CP. sEMG signals will be recorded during gait for a select set of lower extremity muscles. Muscle biopsies will then be collected from the same muscles during the surgical procedure. The sEMG signal will be processed using innovative techniques developed by the investigators, and correlations between the signals and muscle fiber type, muscle receptors, collagen content, and satellite cell infiltration will be determined.

Progress made in achieving the aim. We were unable to address our specific aim as the sEMG data collected could not be converted into a format that would allow for the appropriate time-series analysis. Thus, only the muscle findings are presented here.

Despite long delays negotiating the IRB approval through both Temple University and Alfred I. duPont Hospital for Children, we received IRB approval and collected data on several subjects to date, with more coming before September 1, 2012. A cross-sectional study was conducted with 6 children classified as spastic diplegic CP between 5 and 13 years of age. All children were classified on the Gross Motor Function Classification Scale (GMFCS) as between Level I and Level III, with Level I indicating near normal ambulation and Level III indicating the use of assistive technologies (i.e. walkers, crutches and/or braces) for ambulation. In addition, Gross Motor Function Measure (GMFM) scores were also provided, with lower scores indicating greater levels of movement disorders. (Table 1) The Tanner stage for maturation was recorded and used as a co-factor in the statistical analysis along with age. All of the children in this study underwent a gait assessment at the Motion Analysis Laboratory (MAL) at the Alfred I. duPont Hospital for Children prior to a surgical intervention that involved orthopedic management of the secondary neuromuscular problems associated with CP. For these 6 subjects, incidental tissue biopsies were collected for our examination purposes.

<u>Muscle electromyography results:</u> Surface electromyography (sEMG) was recorded from the following muscle bilaterally: the vastus lateralis, rectus femoris, anterior tibialis and gastrocnemius. All recordings were obtained as the children walked at a self selected paced in the MAL. Markers were also placed on the children for the recording and calculation of gait kinematic and kinetics. As the sEMG data were recorded using the Cortex Motion Analysis system, several issues arose regarding the conversion of the data set into a format that could be used to perform the time-series analyses of the signals. Consequently, the time series analysis could not be accomplished.

<u>Muscle histology results (See Table 2 for summary):</u> A muscle biopsy (5x5x10 ml in volume) was collected from one or all of the following muscles: vastus lateralis (VL), rectus femoris

(RF), medial hamstring (MH, semitendinosis to be exact), and the medial gastrocnemius (MG). The selection of muscles depended upon the surgery that was already being performed on the child as part of standard medical care, in order to minimize risk and discomfort. We were fortunate that we were able to receive bilateral tissue biopsies from several of the patients. Biopsied specimens were snap frozen, and sent from Alfred I. duPont Hospital for Children to Temple for histological examination. Biopsies were divided without thawing with a scalpel into two subparts, one part used for histology and the other reserved for biochemistry, for all samples from all subjects but two, which were too small for this division. The subparts for histology were cyrosectioned into 10 μm thick cross-sections, mounted on charged slides serially, and dried briefly before storing in a -80°C freezer. Before staining, one half of the sections (on slides) were fixed in ice cold methanol for 3 min, the other half were fixed in 4% paraformaldehyde in 0.1 M phosphate buffer for 10 min. The selected histochemistry and immunohistochemistry was performed in batched sections under identical conditions to reduce variability. Cell counts and pathology (hematoxylin and eosin stained, H&E), myofiber cross-sectional area, collagen type I (immunostained), all collagen (Masson Trichrome stained), connective tissue growth factor (CTGF immunostained; stains activated fibroblasts), axons profiles (pgp9.5-stained), and satellite cell numbers (Pax7 immunostained) were quantified using a microscope (Nikon E800) with a digital camera linked to a computer with an image analysis program (Bioquant, Nashville, TN). All counts were performed in a blinded fashion, with a random start, and thereafter, systematic slice analysis techniques. Several of our findings are summarized below in Table 2. Adipocytes were not increased in or around muscles in any samples, and are therefore not included in the table of results.

Initial Conclusions: A precursory analysis of the muscle histology would indicate that with increases in markers for potential muscle damage (cellularity scores) there is a correlation with increasing levels of collagen infiltration in the muscle. The increases in the cellularity score and collagen infiltration is inversely correlated with overall mobility and ambulatory function, as measured with the GMFM and GMFCS classifications. Thus, the more mobile, and potentially more active, the child, the greater the potential for an increase in muscle markers that would indicate overuse injury. While the prevention of overuse by the restriction of activity is not an option, our findings do seem to indicate that reactive strategies that target muscle function exclusively may not be as effective as a stand alone treatment, but clinical treatments that work in concordance to provide muscle re-education and motor relearning to more appropriately use the muscle for a specific task is also warranted.

Associations with muscle activity and muscle histology are purely speculative at this time, as the specific sEMG recordings associated with these muscle samples cannot be performed. However, based upon our previous work we can place the histological findings into a more global perspective of muscle activity. First, our publications on muscle spasticity in the child with CP indicated that children classified as Level I on the GMFCS exhibited a trend towards a greater passive resistance to movement as compared to children classified as Level III. The histological findings from this pilot study provide valuable insight into this observation with the indication that children with greater function do have greater collagen infiltration as potentially based upon their greater activity level. Thus, future work needs to be directed on the measure of muscle spasticity, per our previous methodology, in conjunction with muscle biopsy.

Secondly, across all subjects in this study, the medial hamstring muscle demonstrated a consistently high proportion of collagen content. In our previous studies, through the use of surface electromyography, we observed no changes to hamstring muscle activation with age in the child with CP as compared to the child of typical development. The increased collagen content, as observed here, would explain our previous finding as one would not expect a muscle that has a high passive component to change its activity with age. Future work needs to be directed to recording from a larger cross sectional sample of children with CP across a wide range of ages to correlate changes in activity with muscle histology.

Table 1. Subject Motor Classifications

Subject	GMFM Classification	GMFCS level
1	39	I
2	34	I
3	11	III
4	34	I
5	19	II
6	23	III

Table 2. Summary of intramuscular histological and immunohistological findings.

Sample & muscle	**Pathological findings (Assessed with Masson's trichrome stain and Hematoxylin and eosin (H&E) staining)**	**Cellularity (0, normal, to 3)**	**Intramuscular collagen (% area with staining)**	**Intramuscular CTGF (% area with staining)**
Subject 1				
Right MG	Increased cellularity (small cells); Loss of myofiber size variability	2	20.37% Masson's 8.30% IH	1.75
Left MG	Slight increase in cellularity Some loss of myofiber size variability	1	9.83 % Masson's 3.61% IH	2.01
Right MH	Increased cellularity (small cells); Normal myofiber size variability	1.5	12.10% Masson's 2.85% IH	Slide broken
Left MH	Increased cellularity (small cells); Hypertrophied	2	29.06% Masson's IH - NA	2.33
Subject 2				
Right MH	Slight increase in cellularity (small cells);	1	14.58% Masson's	1.03

	Loss of myofiber size variability		1.56% IH	
Left MH	Increased cellularity (small cells); Loss of myofiber size variability	1	9.47% Masson's 1.18% IH	1.37
Subject 3				
Right MG	Normal cellularity; Normal myofiber size variability	0	12.37% Masson's IH - NA	1.66
Left MG	Normal cellularity; Normal myofiber size variability	0	7.70% Masson's 0.97% IH	1.45
Right MH	Slight increase in cellularity; Normal myofiber size variability	0.5	11.97% Masson's 0.99% IH	2.53
Left MH	Increased cellularity (small cells); Normal myofiber size variability	1	1.13% Masson's 0.84% IH	0.95
Subject 4				
Right MG	Increased cellularity (small cells); Slight loss of myofiber size variability	1.5	9.29% Masson's 5.18% IH	1.20
Left MG	Increased cellularity (fibroblasts and increased inflammatory cells indicative of on-going contracture injury to muscle); Loss of myofiber size variability; Atrophy evident	1.5	8.69% Masson's 2.26% IH	1.41
Right MH	Increased cellularity (fibroblasts and increased inflammatory cells indicative of on-going contracture injury to muscle); Slight loss of myofiber size variability;	2	N/A Masson's 3.36% IH	completing
Left MH	Slight increase in cellularity; Normal myofiber size variability, although irregular in shape	0.5	5.71% Masson's 2.91% IH	0.65
Subject 5				

Left MG	Slight increase in cellularity; Myofiber cell replacement in several sites by small cells, indicative of site-specific myofiber cell death; Normal myofiber size variability although slightly atrophied	1	23.22% Masson's 2.28% IH	2.16
R Quad (RF)	Increased cellularity (small cells); Loss of myofiber size variability; Clear signs of atrophy	1	12.81% Masson's 0.99% IH	1.06
R Quad (VL)	Slight increase in cellularity; Loss of myofiber size variability; Clear signs of atrophy	0.5	23.22% Masson's 2.28% IH	0.98
Subject 6				
L quad (not specified)	Normal cellularity; Normal myofiber size variability; but irregular organization	0	6.62% Masson's 2.13% IH	0.99

IH = immunohistochemistry; Masson's = Masson's trichrome staining in which all collagen stains blue; MG = medial gastrocnemius; MH = medial hamstring (semitendinosis to be exact); NA = unable to assess, must be repeated; RF = rectus femoris; Quad = quadriceps; VL = vastus lateralis (VL).

18. Extent of Clinical Activities Initiated and Completed. Items 18(A) and 18(B) should be completed for all research projects. If the project was restricted to secondary analysis of clinical data or data analysis of clinical research, then responses to 18(A) and 18(B) should be "No."

18(A) Did you initiate a study that involved the testing of treatment, prevention or diagnostic procedures on human subjects?

_____Yes
___X___No

18(B) Did you complete a study that involved the testing of treatment, prevention or diagnostic procedures on human subjects?

_____Yes
___X___No

If "Yes" to either 18(A) or 18(B), items 18(C) – (F) must also be completed. (Do NOT complete 18(C-F) if 18(A) and 18(B) are both "No.")

18(C) How many hospital and health care professionals were involved in the research project?

_____Number of hospital and health care professionals involved in the research project

18(D) How many subjects were included in the study compared to targeted goals?

_____Number of subjects originally targeted to be included in the study
_____Number of subjects enrolled in the study

Note: Studies that fall dramatically short on recruitment are encouraged to provide the details of their recruitment efforts in Item 17, Progress in Achieving Research Goals, Objectives and Aims. For example, the number of eligible subjects approached, the number that refused to participate and the reasons for refusal. Without this information it is difficult to discern whether eligibility criteria were too restrictive or the study simply did not appeal to subjects.

18(E) How many subjects were enrolled in the study by gender, ethnicity and race?

Gender:
_____Males
_____Females
_____Unknown

Ethnicity:
_____Latinos or Hispanics
_____Not Latinos or Hispanics
_____Unknown

Race:
_____American Indian or Alaska Native
_____Asian
_____Blacks or African American
_____Native Hawaiian or Other Pacific Islander
_____White
_____Other, specify:_____
_____Unknown

18(F) Where was the research study conducted? (List the county where the research study was conducted. If the treatment, prevention and diagnostic tests were offered in more than one county, list all of the counties where the research study was conducted.)

19. Human Embryonic Stem Cell Research. Item 19(A) should be completed for all research projects. If the research project involved human embryonic stem cells, items 19(B) and 19(C) must also be completed.

19(A) Did this project involve, in any capacity, human embryonic stem cells?
_____Yes
___X___ No

19(B) Were these stem cell lines NIH-approved lines that were derived outside of Pennsylvania?
_____Yes
_____ No

19(C) Please describe how this project involved human embryonic stem cells:

20. Articles Submitted to Peer-Reviewed Publications.

20(A) Identify all publications that resulted from the research performed during the funding period and that have been submitted to peer-reviewed publications. Do not list journal abstracts or presentations at professional meetings; abstract and meeting presentations should be listed at the end of item 17. **Include only those publications that acknowledge the Pennsylvania Department of Health as a funding source** (as required in the grant agreement). List the title of the journal article, the authors, the name of the peer-reviewed publication, the month and year when it was submitted, and the status of publication (submitted for publication, accepted for publication or published.). Submit an electronic copy of each publication or paper submitted for publication, listed in the table, in a PDF version 5.0.5 (or greater) format, 1,200 dpi. Filenames for each publication should include the number of the research project, the last name of the PI, and an abbreviated title of the publication. For example, if you submit two publications for Smith (PI for Project 01), one publication for Zhang (PI for Project 03), and one publication for Bates (PI for Project 04), the filenames would be:

Project 01 – Smith – Three cases of isolated
Project 01 – Smith – Investigation of NEB1 deletions
Project 03 – Zhang – Molecular profiling of aromatase
Project 04 – Bates – Neonatal intensive care

If the publication is not available electronically, provide 5 paper copies of the publication.

Note: The grant agreement requires that recipients acknowledge the Pennsylvania Department of Health funding in all publications. Please ensure that all publications listed acknowledge the Department of Health funding. If a publication does not acknowledge the funding from the Commonwealth, do not list the publication.

Title of Journal Article:	Authors:	Name of Peer-reviewed Publication:	Month and Year Submitted:	Publication Status (check appropriate box

				below):
1.				☐Submitted ☐Accepted ☐Published
2.				☐Submitted ☐Accepted ☐Published
3.				☐Submitted ☐Accepted ☐Published

20(B) Based on this project, are you planning to submit articles to peer-reviewed publications in the future?

Yes_____ No_____X____

If yes, please describe your plans:

21. Changes in Outcome, Impact and Effectiveness Attributable to the Research Project. Describe the outcome, impact, and effectiveness of the research project by summarizing its impact on the incidence of disease, death from disease, stage of disease at time of diagnosis, or other relevant measures of outcome, impact or effectiveness of the research project. If there were no changes, insert "None"; do not use "Not applicable." Responses must be single-spaced below, and no smaller than 12-point type. DO NOT DELETE THESE INSTRUCTIONS. There is no limit to the length of your response.

None

22. Major Discoveries, New Drugs, and New Approaches for Prevention Diagnosis and Treatment. Describe major discoveries, new drugs, and new approaches for prevention, diagnosis and treatment that are attributable to the completed research project. If there were no major discoveries, drugs or approaches, insert "None"; do not use "Not applicable." Responses must be single-spaced below, and no smaller than 12-point type. DO NOT DELETE THESE INSTRUCTIONS. There is no limit to the length of your response.

None

23. Inventions, Patents and Commercial Development Opportunities.

23(A) Were any inventions, which may be patentable or otherwise protectable under Title 35 of the United States Code, conceived or first actually reduced to practice in the performance of work under this health research grant? Yes_____ No___X_____

If "Yes" to 23(A), complete items a – g below for each invention. (Do NOT complete items a - g if 23(A) is "No.")

a. Title of Invention:

b. Name of Inventor(s):

c. Technical Description of Invention (describe nature, purpose, operation and physical, chemical, biological or electrical characteristics of the invention):

d. Was a patent filed for the invention conceived or first actually reduced to practice in the performance of work under this health research grant?
Yes_____ No____

If yes, indicate date patent was filed:

e. Was a patent issued for the invention conceived or first actually reduced to practice in the performance of work under this health research grant?
Yes_____ No____
If yes, indicate number of patent, title and date issued:
Patent number:
Title of patent:
Date issued:

f. Were any licenses granted for the patent obtained as a result of work performed under this health research grant? Yes_____ No____

If yes, how many licenses were granted?_____

g. Were any commercial development activities taken to develop the invention into a commercial product or service for manufacture or sale? Yes___ No____

If yes, describe the commercial development activities:

23(B) Based on the results of this project, are you planning to file for any licenses or patents, or undertake any commercial development opportunities in the future?

Yes_____ No____X_____

If yes, please describe your plans:

24. Key Investigator Qualifications. Briefly describe the education, research interests and experience and professional commitments of the Principal Investigator and all other key investigators. In place of narrative you may insert the NIH biosketch form here; however, please limit each biosketch to 1-2 pages. *For Nonformula grants only – include information*

for only those key investigators whose biosketches were not included in the original grant application.

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME Lauer, Richard Thomas	POSITION TITLE Assistant Professor of Physical Therapy Assistant Professor of Computer and Electrical Engineering
eRA COMMONS USER NAME (credential, e.g., agency login) LAUER1	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	MM/YY	FIELD OF STUDY
Catholic University of America, Washington DC	BBE	05/93	Biomedical Engineering
Case Western Reserve University, Cleveland OH	MS	01/96	Biomedical Engineering
Case Western Reserve University, Cleveland OH	PhD	05/01	Biomedical Engineering

A. Personal Statement

B. Positions and Honors

Positions and Employment

1998-2002 Research Assistant, MetroHealth Medical Center, Cleveland OH
1999-2000 Research Fellow, Louis Stokes Cleveland Dept of Veterans Affairs Medical Center, Cleveland OH
2001-2002 Biomedical Engineer, Louis Stokes Cleveland Dept of Veterans Affairs Medical Center, Cleveland OH
2002-2006 Research Associate, Shriners Hospitals for Children, Philadelphia PA
2002-2009 Visiting Research Assistant Professor, School of Biomed. Engineering, Drexel University, Phila. PA
2006- 2009 Assistant Investigator, Shriners Hospitals for Children, Philadelphia PA
2008 - Assistant Professor, Physical Therapy, Temple University, Philadelphia PA
2009- Assistant Professor, Computer and Electrical Engineering, Temple University, Philadelphia PA

Other Experience and Professional Memberships

1997-present International Functional Electrical Stimulation Society (IFESS)
2002-present Institute of Electrical and Electronics Engineers (IEEE)
2002-present IEEE/ Engineering in Medicine and Biology Society
2002-present IEEE/ Neural Networks Society
2002-present Scientific Staff, Shriners Hospitals for Children, Philadelphia PA
2004-present International Society of Electromyography and Kinesiology (ISEK)
2007-present International Society of Biomechanics (ISB)
2008-present American Society of Biomechanics (ASB)
2008-present American Society of Mechanical Engineers (ASME)

Honors and Awards

1995 Whitaker Student Scientific Paper Competition, Honorable Mention, RESNA
1996 National Institutes of Health Training Program Recipient, Case Western Reserve University
1999 Whitaker Student Scientific Paper Competition, 1ST place, RESNA
1999 "Robbie" Robinson Memorial Award, Cleveland FES Center of Excellence

1999,2000 Dept. of Veterans Affairs Pre Doctoral Fellowship
2002 Dept. of Veterans Affairs Post Doctoral Fellowship
2007 Senior Member, Institute of Electrical and Electronics Engineers (IEEE)
2008 Overseas Fellow, Royal Society of Medicine.

C. Selected Peer-reviewed Publications (Selected from 38 peer reviewed publications**)**

Most relevant to the current application

1. Prosser LA, Lee SC, Barbe MF, Vansant AF, Lauer RT. Trunk and hip muscle activity in early walkers with and without cerebral palsy - A frequency analysis. J Electromyogr Kinesiol. 20(5):851-859, 2010.PMID: 20472460.
2. Prosser LA, Lee SC, Vansant AF, Barbe MF, Lauer RT. Trunk and Hip Muscle Activation Patterns Are Different During Walking in Young Children With and Without Cerebral Palsy. Phys Ther. 90(7):986-997, 2010.PMID: 20430948.
3. Pierce SR, Prosser LA, Lauer RT. Relationship between age and spasticity in children with diplegic cerebral palsy. Arch Phys Med Rehabil, 91(3), 448-51, 2010. PMID: 20298838.
4. Lauer RT, Pierce SR, Tucker CA, Barbe MF, Prosser LA. Age and electromyographic frequency alterations during walking in children with cerebral palsy. Gait Posture, 31(1), 136-9, 2010. PMID: 19854058
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Additional recent publications of importance to the field

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D. Research Support.

Ongoing Research Support

R01 HD069 769 Lauer (P!)
Balance and Posture in Adults with Cerebral Palsy 04/01/2012-3/31/16

R01 AR056019 Barbe (PI)
Biomarker of Tissue Tolerance and Behavior in a Rat Model of WMSD 06/01/10 – 05/31/15
Role: Co-Investigator

Completed Research Support (Last three years only)

Temple University Faculty Senate Seed Money Fund Lauer (PI)
07/01/10 - 06/30/11
Assessment of visual dependence on balance instability in adults with cerebral palsy.
Role: PI

Temple University Provost Seed Grant Lauer (PI)
07/01/10 - 06/30/11
Relationships of histochemistry to muscle activity in the child with cerebral palsy
Role: PI