

**Pennsylvania Department of Health
Final Performance Summary Report
Formula Grants**

Overview of the Health Research Project Performance Review Process and Criteria

An applicant that receives a health research grant under Tobacco Settlement Act / Act 77 of 2001, Chapter 9, is subject to a performance review by the Department of Health upon completion of the research project. The performance review is based on requirements specified by Act 77 and criteria developed by the Department in consultation with the Health Research Advisory Committee.

As part of the performance review process, each research project contained in a grant is reviewed by at least three experts who are physicians, scientists or researchers. Reviewers are from the same or similar discipline as the research grant/project under review and are not from Pennsylvania. Reviewers use the applicant's proposed research plan (strategic plan), the annual progress report and final progress reports to conduct the review. A grant that receives an unfavorable performance review by the Department may be subject to a reduction in funding or become ineligible for health research funding in the future. The overall grant evaluation rating is based on the ratings for the individual research projects contained in the grant.

This performance review report contains the outcome of the review for the grant as a whole (outstanding, favorable, or unfavorable), strengths and weaknesses of each research project, as well as recommendations for future improvement.

The following criteria were applied to information submitted by research grant recipients:

- **Criterion 1 - How well did the project meet its stated objectives? If objectives were not completely met, was reasonable progress made?**
 - Did the project meet the stated objectives?
 - Were the research design and methods adequate in light of the project objectives?
 - Consider these questions about data and empirical results: Were the data developed sufficiently to answer the research questions posed? Were the data developed in line with the original research protocol?
 - If changes were made to the research protocol, was an explanation given, and, if so, is it reasonable?
 - Consider (only for clinical research projects) the extent of laboratory and clinical activities initiated and completed and the number of subjects relative to the target goal.
 - Were sufficient data and information provided to indicate or support the fact that the project met its objectives or made acceptable progress?
 - Were the data and information provided applicable to the project objectives listed in the strategic research plan?

- **Criterion 2 - What is the likely beneficial impact of this project? If the likely beneficial impact is small, is it judged reasonable in light of the dollars budgeted?**
 - What is the significance of this project for improving health?
 - Consider the value of the research completed towards eventual improvement in health outcomes.
 - Consider any changes in risk factors, services provided, incidence of disease, death from disease, stage of disease at time of diagnosis, or other relevant measures of impact and effectiveness of the research being conducted.
 - Consider any major discoveries, new drugs and new approaches for prevention, diagnosis and treatment, which are attributable to the completed research project.
 - What are the future plans for this research project?

- **Criterion 3 - Did the project leverage additional funds or were any additional grant applications submitted as a result of this project?**
 - If leveraging of funds were expected, did these materialize?
 - Are the researchers planning to apply for additional funding in the future to continue or expand the research?

- **Criterion 4 - Did the project result in any peer-reviewed publications, licenses, patents, or commercial development opportunities? Were any of these submitted/filed?**
 - If any of the above listed were expected, did these materialize?
 - Are the researchers planning to submit articles to peer-reviewed publications, file for any licenses, or patents or begin any commercial development opportunities in the future?
 - Consider the number/quality of each.

- **Criterion 5 - Did the project enhance the quality and capacity for research at the grantee's institution?**
 - Were there improvements made to infrastructure?
 - Were any new investigators added or were any researchers brought into the institution to help carry out this research?
 - Were funds used to pay for research performed by pre- or post-doctoral students?

- **Criterion 6 - Did the project lead to collaboration with research partners outside the institution, or new involvement with the community?**
 - Are the researchers planning to begin any collaborations as a result of the research?
 - For clinical research only: consider the number of hospitals and health care professionals involved and the extent of penetration of the studies throughout the region or the Commonwealth.

Overall Evaluation Rating

An overall evaluation rating is assigned to each research project. The rating reflects the overall progress the project attained in meeting the stated goals and objectives. The rating is based on a scale of 1–3, with 1 being the highest. An average rating is obtained from all the reviews (minimum of 3) of each project and is the basis for the determination of the final overall rating for each project as follows:

1.00 – 1.33 = *Outstanding*

1.34 – 2.66 = *Favorable*

2.67 – 3.00 = *Unfavorable*

The grant level rating is an average rating from all projects as above. The numerical rating appears in parentheses for the grant and each project in the ***Overall Grant Performance Review Rating*** section of the report.

Overall Grant Performance Review Rating

Grant Rating: Favorable (1.67)

Project Ratings:

Project	Title	Average Score
0862201	E-Coaching to Support the Modification of Risk Factors of Metabolic Syndrome using Mediterranean Diet	Favorable (1.67)
0862202	The Use of High Flow Oxygen During ED PSA with Propofol: A Randomized Trial	Outstanding (1.33)
0862203	Performance Evaluation of Spatial Normalization Protocols for Brains with Focal Lesions	Favorable (2.00)
0862204	Development of a Haptic Virtual Environment for Upper Limb Rehabilitation	Favorable (1.67)

Project Number: 0862201
Project Title: E-Coaching to Support the Modification of Risk Factors of
Metabolic Syndrome using Mediterranean Diet
Investigator: Figueredo, Vincent

Section A. Project Evaluation Criteria

Criterion 1 - How well did the project meet its stated objectives? If objectives were not completely met, was reasonable progress made?

STRENGTHS AND WEAKNESSES

Reviewer 1:

The project met the general objectives of the project, although only 15 rather than 20 subjects were enrolled, with 12 completing. The key data regarding outcomes, including body weight, each of the parameters for metabolic syndrome, and measures of depression were assessed and provided insights into the possibility of using the Mediterranean diet within this population. With only physical and biochemical data on only 12 subjects, many of whom made small improvements, the evidence provided is not conclusive. An example of one subject who was particularly successful is provided. The goal of changing behavior to lose weight in a minority population presents many challenges, so the evidence of implementation is admirable.

Although consistent specific aims were enumerated in each progress report, the original plan addressed them in a less clear narrative.

The design of the study provided clear opportunity to see how effective the intervention was at changing outcomes, such as weight, waist circumference and biochemical measures. Although there is mention of the means of assessing process measures in the original plan, the final report does not reflect information on barriers and issues in the implementation of the Mediterranean diet in this population. Objective process data is provided regarding the number of subjects enrolled versus completed. It would be helpful to have more information on the extent to which the women read and interacted with the emails and what information they found most helpful, especially in regard to addressing barriers they experienced.

Information on the statistical analyses used was limited. In the original plan, general statements were made, such as "Multivariate repeated measures analysis of variance will be used for longitudinal data." But there was no indication of what specific data that would be. In the end when data were collected at only two time points, another analysis may have been done. The results simply indicated the results were not statistically significant. No p- values were provided and there was no mention of what statistical tests were performed for comparisons of which data.

Several changes were made from the original plan. Rather than telephone coaching, electronic coaching was utilized. The original three-hour workshop to introduce the diet appeared to have

evolved to a discussion with each individual about the diet. Although measurement was originally planned for initial, three-month and six-month time points, the original PI leaving the institution resulted in no three-month measurements being made. Reasonable explanation is provided and the two most important time points were maintained.

Reviewer 2:

Reasonable progress was made in meeting stated project objectives. It fell short in the benefits documented from the intervention and in the lack of full recruitment with no adequate explanation offered.

Reviewer 3:

The project met the stated objectives. The research design and methods were adequate to attain the objectives. Data for the most part were developed sufficiently. The only concern is that waist/hip ratio has been deemed a measure that is not accurately measured due to the difficulties with measuring hip circumference (NIH/NHLBI Obesity Education Initiative).

Originally 20 women were to be recruited. Fifteen were recruited, with one signing the consent and then dropping out. Eventually, with three later dropouts, the N was 12.

Data were adequate and met the original proposed parameters.

Participants did voice that they wished to have more face-to-face contact. The purpose of using the e-coaching format was that it would allow busy participants to have contact without traveling to a class.

Criterion 2 - What is the likely beneficial impact of this project? If the likely beneficial impact is small, is it judged reasonable in light of the dollars budgeted?

STRENGTHS AND WEAKNESSES

Reviewer 1:

A particular strength of this project is the demonstration of the feasibility of providing this type of diet advice through email and keeping a group of African-American women involved in the program across six months. Use of stages of change assessment in screening may have contributed to better than usual retention.

Although this project did not report statistically significant findings, as a pilot with a small group of subjects it did provide a model for a larger trial. It appears that the impact of this intervention on these subjects was small. The researchers do point to a reasonable retention rate, with 11/15 completing the project (50% retention is common among weight control studies).

It is unfortunate that a study involving this level of weekly support did not report measures of behavior change. It would be helpful to see how the food records and activity records reflected change in behavior of the subjects.

Of note, the project appeared to utilize only a small amount of the originally budgeted funds, which is somewhat fitting given the changes of no three-month assessment and recruitment of 75% of the intended cohort.

Reviewer 2:

The project is disappointing in its poor recruitment and its results, but the results are what they are.

Reviewer 3:

Overall, there were very few positive changes in outcome variables. It is interesting that there was one participant who was very successful in weight loss and resulting health parameters. The future plans include the idea of increasing the sample size to allow for generalization of findings.

Criterion 3 - Did the project leverage additional funds or were any additional grant applications submitted as a result of this project?

STRENGTHS AND WEAKNESSES

Reviewer 1:

It does not appear that any additional funds were utilized. In fact, the majority of the budgeted funds did not appear to be used.

Reviewer 2:

No leveraging of funds was obtained, and there were no plans to apply for further funding mentioned.

Reviewer 3:

It is indicated that no additional funds were leveraged.

Criterion 4 - Did the project result in any peer-reviewed publications, licenses, patents, or commercial development opportunities? Were any of these submitted / filed?

STRENGTHS AND WEAKNESSES

Reviewer 1:

Although the plan did indicate the intention to submit at least one abstract for presentation and a manuscript for publication, neither had been achieved at the time of the final report, but intent to do so in the future was mentioned.

Reviewer 2:

There are none thus far.

Reviewer 3:

At this point the PI plans to present and/or publish the findings of this pilot study. The work is only in the planning stage.

Criterion 5 - Did the project enhance the quality and capacity for research at the grantee's institution?

STRENGTHS AND WEAKNESSES

Reviewer 1:

It appears that this grant fostered interdepartmental research efforts.

Reviewer 2:

The PI states that the project enhanced the relationship between the three units at Einstein involved in this pilot study.

Reviewer 3:

This project is reported to have improved research infrastructure at Einstein by improving the research relationships among the following departments at Einstein: the Center for Urban Health Policy and Research, the Department of Cardiology, and the Gutman Diabetes Institute.

Criterion 6 - Did the project lead to collaboration with research partners outside of the institution or new involvement with the community?

STRENGTHS AND WEAKNESSES

Reviewer 1:

The only extent of collaboration with other institutions was the involvement of Dr. Harralson, the original PI, as a consultant after she left the institution. The project did reach into the community in recruitment efforts and may have enhanced the extent to which community members may take advantage of preventive services available from the health center.

Reviewer 2:

No collaborations with research partners outside the institution were mentioned.

Reviewer 3:

There was a description of the study and information about metabolic syndrome published in a local paper. This publication was for purposes of recruitment. No other community collaborations were indicated.

Section B. Recommendations

SPECIFIC WEAKNESSES AND RECOMMENDATIONS

Reviewer 1:

1. One weakness noted was the dearth of process assessment that could provide further insights into how well the messaging and design of the intervention worked in this population. It is unclear whether the participants did follow through with regular submission of food and activity logs. If so, analysis of this information could shed light on which new dietary strategies were most likely adopted by these African-American women.

2. Statistical analyses description: In the final report it would be helpful to state which statistical tests were performed to conclude there was not a statistically significant change, as well as including p-values in the results table.
3. Regarding dissemination of findings, it is recommended that the approach used and the findings be submitted as an abstract for presentation at a national or regional meeting. It would be particularly valuable to share what engaged the participants to remain in the project across the six months.

Reviewer 2:

1. The initial recruitment goal was not reached, despite its modest extent (20 participants). No adequate explanation is offered. The cost works out to over \$10,000 per subject, a rather expensive pilot with little to show for it.
2. While perhaps unavoidable, having three PIs over the course of two years could not have had a good effect on the project, and this may be reflected in the results.
3. Was no effort made to involve students or post-doctoral fellows?

Reviewer 3:

I would not recommend the use of waist/hip ratios in the next larger study.

Generic Recommendations for the Institution

Reviewer 1:

This project is to be commended for designing a means of reaching larger numbers of clients with important behavior change approaches. It will be worthwhile to explore this type of intervention further, perhaps morphing it into a hybrid that includes some face to face sessions, as well as weekly email guidance.

ADDITIONAL COMMENTS

Reviewer 3:

Specific strengths of this project are that the proposed research was carried out. Future research will include a larger number of participants and therefore a greater ability to look at data that are more generalizable.

Project Number: 0862202
Project Title: The Use of High Flow Oxygen During ED PSA with Propofol:
A Randomized Trial
Investigator: Deitch, Kenneth

Section A. Project Evaluation Criteria

Criterion 1 - How well did the project meet its stated objectives? If objectives were not completely met, was reasonable progress made?

STRENGTHS AND WEAKNESSES

Reviewer 1:

The project met the stated objectives, and the research design and methods are adequate. The data developed was in line with the original research protocol and supported the findings sufficiently to answer the research question posed. The strength of the study is that being a blinded, randomized-controlled study, it provided level-I evidence that high-flow oxygen supplementation should be used during ED propofol sedation. The weakness of the study is that there are no long-term outcome data collected for evaluation. For example, the study assumes hypoxemia less than 93% is "bad," but it would have been more relevant to show that hypoxemia during ED propofol sedation resulted in cognitive impairment (mini-mental state examination, MMSE), clinically worsening functional status (Barthel Index) and/or organizationally longer length of ED stay.

Reviewer 2:

The research design and methodology were adequate to meet the stated objective, and the research question of whether high flow oxygen during procedural sedation in the emergency department will reduce hypoxic events was answered. They met the targeted enrollment, and the number was adequate to generate the required data. Data was relevant and supported the analysis of the primary hypothesis as well as some interesting secondary questions.

It appears that they changed the research protocol from the initial description provided in the strategic plan. Initially health care providers were to be blinded to the capnography results, with the rationale that it was not the standard of care. Capnography was made available to the providers during the study, however, since it was felt to be unethical to withhold information that might prevent hypoxia. This explanation was reasonable, since it is generally recommended that capnography be used to avoid the delayed recognition of hypoventilation potentially associated with supplemental oxygen. This change is unlikely to have biased the results towards a greater difference (rather the opposite), and the change makes the results more applicable to the current practice environment.

Reviewer 3:

The study demonstrated a decrease in hypoxia. The stated goal was a decrease of 20% and the study demonstrated such an effect, yet the CI was 6-38%. A larger sample size would help

answer how significant the difference is with more certainty. The project had very good research design and methods. The data appropriately targeted the goals and were adequately developed. The project fell just short of their sample size calculation of 60 subjects in each arm, yet it did demonstrate significant difference. The design was excellent overall.

Criterion 2 - What is the likely beneficial impact of this project? If the likely beneficial impact is small, is it judged reasonable in light of the dollars budgeted?

STRENGTHS AND WEAKNESSES

Reviewer 1:

The likely beneficial impact of this project is possibly delineating minimizing adverse events during ED propofol sedation with respect to patient safety. The likely beneficial impact is that since the study provided Level I evidence, it will be cited to change clinical policy for ED propofol sedation or in the broader category of procedural sedation.

Reviewer 2:

This has significant potential for improving health outcomes by reducing the incidence of hypoxia and its potential for associated morbidity by providing high flow oxygen prior to and during procedural sedation with propofol when used in association with capnography. This should also translate to settings outside the emergency department where procedural sedation is used. Interesting data was obtained on the use of capnography to predict respiratory depression prior to hypoxia and analysis of capnographic changes was planned for future studies.

Reviewer 3:

The project demonstrated decreased hypoxia with high flow oxygen delivery with similar adverse events in each group other than hypoxia. Most define transient hypoxemia as a significant adverse event, so this study does demonstrate an effect on that measure. I would argue that the true effect of transient hypoxia has not been demonstrated. I would deem the impact of this research as moderate, since the other, more significant adverse events monitored for were similar between groups. However, many have previously argued that such supplemental oxygen therapy puts one at risk for delayed recognition of oversedation and risk for other adverse events which were not demonstrated to occur any more frequently with the treatment. The future plans are related to capnography and not the objectives of this study. Again, I would rate the significance as moderate, yet the budget was not terribly large either. I do not think it is a large difference maker, but it will likely lead the treatment to be utilized by a significant number of practitioners.

Criterion 3 - Did the project leverage additional funds or were any additional grant applications submitted as a result of this project?

STRENGTHS AND WEAKNESSES

Reviewer 1:

The project did not leverage for additional funds but is planning to submit additional grant applications as a result of this project and to expand the research.

Reviewer 2:

No other funds were applied for based on this research.

Reviewer 3:

The project was also funded with \$16,000 from an Albert Einstein Society research grant.

Additional funding is to be applied for, however it is for a different target intervention with sedation, capnography.

Criterion 4 - Did the project result in any peer-reviewed publications, licenses, patents, or commercial development opportunities? Were any of these submitted / filed?

STRENGTHS AND WEAKNESSES

Reviewer 1:

The project resulted in peer-reviewed publications.

Reviewer 2:

The research was published in the *Annals of Emergency Medicine*, which is the highest circulation emergency medicine journal and the one originally targeted by the investigators. No future articles or patents were planned.

Reviewer 3:

The research will result in one peer-reviewed publication without other significant licenses, patents, or commercial development.

Criterion 5 - Did the project enhance the quality and capacity for research at the grantee's institution?

STRENGTHS AND WEAKNESSES

Reviewer 1:

Funds were used to pay for research performed by research associates.

Reviewer 2:

This was not identified by the investigators.

Reviewer 3:

None

Criterion 6 - Did the project lead to collaboration with research partners outside of the institution or new involvement with the community?

STRENGTHS AND WEAKNESSES

Reviewer 1:

Given the results of the project, collaboration with research partners outside of the institution is highly likely.

Reviewer 2:

None

Reviewer 3:

None

Section B. Recommendations

SPECIFIC WEAKNESSES AND RECOMMENDATIONS

Reviewer 1:

As stated in Section A, it would be more relevant to evaluate higher impact outcomes rather than transient hypoxemia.

Reviewer 2:

None

Reviewer 3:

Their objective has only a moderate impact. They achieved their goals; yet I will be eager to see other similarly performed excellent studies that target adverse events other than transient hypoxia that readily respond to minimal intervention.

Generic Recommendations for the Institution

Reviewer 1:

To carry out this project seemed like a daunting task, and it seems that many stakeholders and institutional leaders were included, resulting in the success of the project.

ADDITIONAL COMMENTS

Reviewer 2:

The study met its stated objectives, met its enrollment target and most importantly answered a question which has direct relevance to clinical care and should improve patient safety during a common procedure.

Reviewer 3:

The study was very well-designed and completed as targeted. The randomization, blinding, and follow through were all excellent. Overall, it was an excellent research study.

Project Number: 0862203
Project Title: Performance Evaluation of Spatial Normalization Protocols for
Brains with Focal Lesions
Investigator: Kim, Junghoon

Section A. Project Evaluation Criteria

Criterion 1 - How well did the project meet its stated objectives? If objectives were not completely met, was reasonable progress made?

STRENGTHS AND WEAKNESSES

Reviewer 1:

There were two stated objective to this project: 1) evaluation of the performance of existing spatial normalization procedures in the presence of focal lesion; and, 2) to build a database of brains with focal lesions where landmarks were manually planted. I think the project somehow met the stated criteria by comparing the different spatial normalization methods.

The original design of the study to compare the four different normalization methods was adequate; however, there was no allowance made for potential design deviation and remedy if such deviation occurs. Without a clear plan most of the decisions the investigators made along the way seem to be arbitrary. For example, there was no allowance made for the potential impact of inter-rater reliability (since they are now using three raters to put the landmark implant). Note that investigating intra-rater reliability is not the same as addressing the inter-rater reliability. This probably contributes to the variance estimate of the root mean square (RMS), which in turn impacts the comparison between normalization methods.

The data initially was collected to address the stated questions, particularly to evaluate the performance of the normalization method in the presence of focal lesion in the brain. However, at the end the decision to exclude traumatic brain injury (TBI) subjects is based on criteria that were not initially stated. The study of the effect of normalization on each hemisphere was not in the original plan. The impact of focusing on this new question is that the reduction of the original sample size by almost 50%, which might contribute to large variances, reduced power of the test and the subsequent inconclusive results.

There were a number of changes made to the protocol that contribute to the reduction of data points and the decision in most cases seems to be arbitrary. For example, the decision to exclude the TBI cases not only reduced the sample size but also the generalizability of any findings, since it is now restricted only to stroke cases. Similarly, the decision to exclude anatomical landmarks that deviate by a fixed amount (3mm) from a given rater's second landmark implant seems to be arbitrary.

In terms of collecting and analyzing the data, the project is completed. And the investigators plan to submit a manuscript and NIH grant application in the future.

I think the project had a reasonable goal of comparing different spatial normalization procedures so that researchers could choose the best method for their particular situation when the patient population has focal lesions. In this project the researchers tried to address this issue. However, the lack of accounting for the inter-rater variation and the excluding of a large number of patients from the study may have contributed to the inconclusive result.

Reviewer 2:

The goal of the proposal was met, and the proposed analyses and method comparisons have been done. The amount of work performed is in line with the total budget amount. Clear results have been established and will need to be communicated to the scientific community in the form of a methods paper that is to be written this summer.

Reviewer 3:

This project was intended to identify the best way to process brain image data with focal and diffuse lesions. The investigators also planned to develop a database of said images for testing. Both aims were achieved. They also published their work as an abstract and full article in the *Journal of Neurotrauma*.

Criterion 2 - What is the likely beneficial impact of this project? If the likely beneficial impact is small, is it judged reasonable in light of the dollars budgeted?

STRENGTHS AND WEAKNESSES

Reviewer 1:

The identification of correct spatial normalization procedures that can be used to accommodate patients with focal lesions to do group analysis would be beneficial to researchers. However, given the small sample size used, the subgroup analysis (only stroke patients) and the inconclusive result make the impact marginal or small.

Reviewer 2:

This is a methodological proposal that aimed at evaluating different algorithms to produce normalized lesion frequency maps, which is an important area of research that needs strong and sound methods. The results have direct impact on how clinical and cognitive neuroscience (e.g., lesion symptom mapping) studies will be performed.

Reviewer 3:

Brain images with lesions present difficult problems in registration and comparison. Defining a robust approach to dealing with this is important in the study of trauma as well as the development of models that predict recovery following therapy. This is an important area. The investigators plan on continuing this work to better refine specific parameters and other variable effects on the results. They will seek funding using the NIH R21 mechanism.

Criterion 3 - Did the project leverage additional funds or were any additional grant applications submitted as a result of this project?

STRENGTHS AND WEAKNESSES

Reviewer 1:

There was no additional funding needed or obtained for this project. There is a plan to apply for an NIH grant to extend this research, although it is not clear what the extension would be.

Reviewer 2:

An application has been put forward, but from my reading it appears that no additional funding has been secured yet.

Reviewer 3:

They were successful in obtaining an R01 grant entitled, "A Longitudinal Multi-modal Neuroimaging Investigation of Functional Recovery after Diffuse Traumatic Brain Injury."

Criterion 4 - Did the project result in any peer-reviewed publications, licenses, patents, or commercial development opportunities? Were any of these submitted / filed?

STRENGTHS AND WEAKNESSES

Reviewer 1:

At this point, the researchers presented a poster in a research day at their institution and plan to submit a publication in the future. Currently, there are no publications or grant applications submitted.

Reviewer 2:

The project resulted in one publication that used part of the analysis from this proposal, with the PI being the first author. In order to make their results useful to the wide community, a methods paper, which is apparently in progress, will be necessary.

Reviewer 3:

The investigators, as noted above, published an abstract and a paper in the *Journal of Neurotrauma*. This work is time-consuming and difficult, and the productivity is on par with the degree of difficulty.

Criterion 5 - Did the project enhance the quality and capacity for research at the grantee's institution?

STRENGTHS AND WEAKNESSES

Reviewer 1:

Based on the information I have, no new investigator, post-doctoral student or pre-doctoral student was hired for this project.

Reviewer 2:

The optimal normalization approach will be used by members of the PI's research group and other researchers at the institution.

Reviewer 3:

This institution has a number of excellent people in related areas. Working in trauma and brain injury will leverage their expertise and open up new opportunities for further study. Although there were collaborations, no students were trained during the course of this project.

Criterion 6 - Did the project lead to collaboration with research partners outside of the institution or new involvement with the community?

STRENGTHS AND WEAKNESSES

Reviewer 1:

The project was conducted with three collaborators from the University of Pennsylvania that were involved in the data analysis and other investigators from the PI's institute.

Reviewer 2:

The project spawned collaborations with several outside collaborators.

Reviewer 3:

As noted above, collaborations were established with others at the PI's institution as well as a colleague at the University of Pennsylvania.

Section B. Recommendations

SPECIFIC WEAKNESSES AND RECOMMENDATIONS

1. Reviewer 1:

At the design stage of the study, it is important to anticipate many possible scenarios and plan accordingly how to handle them. In this case, I think the small sample size attained for the final analysis was 50% less than the original, and this might have had an impact on the conclusions.

2. The other issue was the use of a custom template (based on only 20 brains) for landmark implantation. Why not use a standard template generated from a large number of subjects and freely distributed with the software that you used to evaluate the spatial normalization procedures (SPM, FSL, etc.)? This way, other researchers could use the template with the landmark identified either to replicate your results or to do their own investigations.

3. Whenever one uses multiple raters to evaluate or do a manual task (such as landmark implant) the variability between the raters needs to be accounted for adequately. This can be addressed by including the variation induced by the different raters in the modeling of the data.

Reviewer 2:

It would be important to assure that the results are indeed published as a methodological paper.

Reviewer 3:

The product of the work is important but not transformative. While this is certainly a successful effort, more work is still needed to result in usable software and methods for basic and clinical science. Hopefully, the follow-on efforts will continue this work towards broad utility.

Generic Recommendations for the Institution

Reviewer 3:

For the budget this was a success. Publications and successful grants were produced. Excellent collaborations were fostered. The hope is that follow-on work will result in approaches that significantly contribute to the analysis of brain images from patients with brain injuries.

ADDITIONAL COMMENTS

Reviewer 2:

One minor weakness that is being worked on is that the method results need to be made available to the wider scientific community through a methods paper.

Project Number: 0862204
Project Title: Development of a Haptic Virtual Environment
for Upper Limb Rehabilitation
Investigator: Jax, Steven

Section A. Project Evaluation Criteria

Criterion 1 - How well did the project meet its stated objectives? If objectives were not completely met, was reasonable progress made?

STRENGTHS AND WEAKNESSES

Reviewer 1:

Strength: The project achieved its goal of component testing and system construction of a haptic virtual reality system which provides vibrotactile feedback to guide movements. The details of the design and construction of the system were presented at two national conferences and include one conference proceeding (Kapur, 2009).

Weakness: Supported by other funding, there was some pilot testing of the system on college students, but the results and data were not provided in the final report. The main criticism is that there was little, if any, data provided to support that the project made progress. A stronger argument for progress could have been made if actual data were presented to support the haptic virtual reality (VR) system.

Reviewer 2:

The objectives of the project were met. The PI and collaborators selected the components of the VR system, constructed a prototype and developed a user interface.

The project did not include human subject testing or a specific hypothesis, since the main purpose of the project was to build an instrumented sleeve with factors to provide feedback of limb configuration. A motion capture system was also selected to assess the state of the limb.

The prototype was demonstrated at a top virtual (haptic) reality conference, and a conference paper was also produced.

Weaknesses were not noted, although it would have been desirable to include some technical specifications for the prototype.

Reviewer 3:

This project made progress toward the stated objective of designing a low-cost virtual reality system for upper extremity rehabilitation that included both visual and haptic feedback. There is a sense that some regrouping was required in revising a design that was not acceptable at first, but this is to be expected in technological development projects. (A different motion capture

system was needed--one that worked in a smaller space.) Adequate, not copious, information was provided to evaluate the project, generally addressing all the project objectives. Publication has been slow, although there have been presentations at conferences. The idea of vibrotactile input that would have salience as guidance for the upper limb is clever and seems to work in preliminary studies.

Criterion 2 - What is the likely beneficial impact of this project? If the likely beneficial impact is small, is it judged reasonable in light of the dollars budgeted?

STRENGTHS AND WEAKNESSES

Reviewer 1:

Strength: The project developed a prototype sleeve system.

Weakness:

It is difficult to evaluate the beneficial impact of the project to improve health, since there was little data provided. The final progress report mentioned that, "If pilot testing in healthy controls indicate it [the VR system] improves performance in younger, neurologically-intact participants, we will begin pilot testing with stroke patients to determine whether the same system can be a useful therapeutic device for this large clinical population." There was no indication of how, "improved performance" would be measured and quantified. There are numerous outcomes that indicate performance improvement, such as reaction time, accuracy, speed, etc.

The progress report included a sentence that states, "We think of the applied stimuli as tactile joint torques that seeks to reduce the angular error."

The project would be improved if performance was defined and if there were a clear rationale to support why their haptic VR system would have a beneficial effect on health outcome.

The goal was to develop an affordable system, but the total cost numbers, labor, materials, etc. were not provided in the final report. There was no mention of how much a marketable system would cost; and there was no mention of a marketing program.

Reviewer 2:

The long-term goal of this project is to develop a virtual reality system that can be used to retrain upper arm movements in stroke patients. The project resulted in a prototype that the PI now seeks to validate in a young population of healthy college students. If successful, they will test the system with patients later on.

No weaknesses were noted.

Reviewer 3:

This project has the potential to result in a rehabilitation system for upper extremity dysfunction that will have utility, likely in the clinical setting, rather than the home setting. This is because it uses technology that will require the expertise of a therapist and, while relatively low cost, still is

not inexpensive enough for home use. The investigators plan to test the system clinically in stroke patients, and this is a good direction for improving health outcomes.

Criterion 3 - Did the project leverage additional funds or were any additional grant applications submitted as a result of this project?

STRENGTHS AND WEAKNESSES

Reviewer 1:

Strength: The final progress report lists additional funds from the National Science Foundation and the American Association for the Advancement of Science L'Oréal USA Fellowships for Women in Science program. Presumably these funds were limited to Dr. Kuchenbecker. In their final progress report, the investigators mentioned applying for internal funding and pursuing grant funding (NIH R03 and R21).

Reviewer 2:

From the report, I gather that two proposals were submitted and funded, including a \$500,000 proposal submitted to the National Science Foundation.

The PI is planning to continue the research if positive results are obtained from the initial validation with college students.

Reviewer 3:

A National Science Foundation grant was obtained towards the beginning of the project period, and a small industry grant was funded. There is no evidence of an NIH application, successful or unsuccessful. The final project report states that more pilot data is needed before even an R21 application can be submitted, which is surprising, since pilot data is not even required for such a grant, and there should be pilot data from the last few years. However, as the investigators point out, it has not yet been acquired in stroke patients.

Criterion 4 - Did the project result in any peer-reviewed publications, licenses, patents, or commercial development opportunities? Were any of these submitted / filed?

STRENGTHS AND WEAKNESSES

Reviewer 1:

The project resulted in one publication. (I am not sure if the publication was peer-reviewed). The publication is the following:

- Kapur, P., Jensen, M., Buxbaum, L. J., Jax, S. A., & Kuchenbecker, K. J. (2010). Spatially distributed tactile feedback for kinesthetic motion guidance. Proceedings of the 2010 IEEE Haptics Symposium Conference, 519 – 526.

In the final progress report it is mentioned, "Later follow-up work not funded by the present grant resulted in an additional paper on our initial experiences with pilot testing the system in

college students." However, the citation for that particular paper was not listed in the final progress report.

Weakness: There was no mention of licenses or patents or commercial development opportunities in the final progress report. If the haptic VR system was patented and licensed to a commercial entity, that would have been a positive outcome.

Reviewer 2:

The project resulted in a demonstration at the World Haptic Conference in 2009, followed by a conference publication at the same conference in 2010. This avenue for scientific dissemination is appropriate.

Reviewer 3:

There were no publications, except for conference proceedings, which may have been refereed.

Criterion 5 - Did the project enhance the quality and capacity for research at the grantee's institution?

STRENGTHS AND WEAKNESSES

Reviewer 1:

Strength: Salary support was provided for Jax, Buxbaum and Kapur. Kapur is listed as "graduate assistant." The curriculum vitae for Kapur was not provided in the final progress report, but one may assume that Kapur is a pre-doctoral student, and it can be argued that Kapur's career was developed as he/she was the first author on the conference proceeding. It appears that some other students may have been involved on the project.

Weakness: The PI, Jax, did not publish a first or senior author paper from the project. A first or senior author paper from this year-long project would certainly have strengthened his career development and positioned him for a future grant application.

Reviewer 2:

The project did not result in improvements to the infrastructure. No new investigators were added to the institution. Funds were used to pay for research performed by a graduate assistant.

Reviewer 3:

A collaboration between investigators in different disciplines and different organizations was initiated that should enhance research in the home institution in the future. One student had training as a result of this work.

Criterion 6 - Did the project lead to collaboration with research partners outside of the institution or new involvement with the community?

STRENGTHS AND WEAKNESSES

Reviewer 1:

Strength: It appears that the collaboration with Dr. Kuchenbecker, Drs. Jax and Bruxbaum has been strengthened by this project.

Weakness: If the eventual goal is to improve mobility in patients with movement disorders (i.e., stroke), future proposals may be strengthened with input from clinical professionals who work with patients in the field. The team did not include a physical or occupational therapist or physician involved in movement disorders.

Reviewer 2:

The project resulted in the beginning of a research collaboration between Drs. Jax and Buxbaum at Albert Einstein and Dr. Kuchenbecker and her students at the University of Pennsylvania.

Reviewer 3:

There were essentially two Pennsylvania institutions involved, with a new collaboration that should continue.

Section B. Recommendations

SPECIFIC WEAKNESSES AND RECOMMENDATIONS

Reviewer 1:

1. There was some pilot testing of the system on college students, but the results and data were not provided in the review. The main criticism is that there was little, if any data provided to support that the project made progress.

Recommendation: In future applications, actual data should be presented to support the benefits, outcomes, utility and cost of the haptic VR system.

2. The progress report included a sentence that states, "We think of the applied stimuli as tactile joint torques that seeks to reduce the angular error."

Recommendation: In the future, the project would be improved if performance were defined, outcomes were presented and if there were a clear rationale to support why their VR system would have a beneficial effect on the outcome.

3. One of the main purposes for collecting pilot data is to support future grant submissions.

Recommendation: In the future, the project would have been strengthened if the aims for a future grant proposal were listed. If the objectives of the present project were met, then they would have corresponded with the aims of the future grant proposal.

4. There was no mention of license, patents or commercial development opportunities in the final progress report.

Recommendation: For the future, a provisional patent for the haptic VR system would be a positive outcome and protect the intellectual property of the developers for one year.

5. The team did not include a clinician with specific expertise in movement disorders.

Recommendation: For the future, one may argue that the team would be strengthened if engineers, psychologists, movement disorder scientists and clinicians all have input on the product.

Reviewer 2:

None

Reviewer 3:

1. There were no publications. I recommend publication in a peer-reviewed journal of data from normal subjects with this VR system. While it may be difficult to frame as a paper, the value of vibrotactile input could be tested, since the hypothesis is that such input adds to visual input in an important way.
2. No invention was pursued as a result of this research. I recommend discussion with intellectual property officials at the home institution regarding a potential patent for the technique developed.