**QIBA fMRI Biomarker Committee (BC) Call**

Wednesday, October 21, 2020 at 11 a.m. (CT)

*Call Summary*

**In attendance**

*Jay Pillai, MD (Co-chair)*
*David Soltysik, PhD (Co-chair)*
Shruti Agarwal, PhD
Henry Szu-Meng Chen, PhD
Cathy Elsinger, PhD
Ping Hou, PhD
Ichiro Ikuta, MD, MMSc
Ho-Ling (Anthony) Liu, PhD
Nancy Obuchowski, PhD
David Scott, PhD
James Voyvodic, PhD
Francisco Zamorano, PhD

**RSNA staff**

Joe Koudelik
Susan Stanfa

**Moderator:** Dr. Soltysik

**Review of Previous Call Summary**

- The 10.07.2020 call summary was approved as presented

**September 29-30, 2020 Virtual QIBA Annual Meeting Review**

- Discussions included overarching, general QIBA-related topics, rather than modality- or BC-specific updates
- Results of the QIBA Participant Satisfaction Survey were shared and discussed
- A detailed meeting summary was distributed following the meeting; the document can also be requested from staff at: qiba@rsna.org
- The need to promote QIBA work through publications was emphasized; the fMRI BC has been expending effort in this area, specifically related to Dr. Voyvodic's Round-1 NIBIB-funded DRO Project and his language reproducibility study
- It was noted that the "Reproducibility of task-free (resting-state) fMRI as a clinical brain biomarker," project description was well-received by the SC at the time of its submission in early 2019; additional information on possible funding opportunities is desired
- Presentations have been linked to the 2020 QIBA Annual Meeting website

**Introduction to Graph Theory and Graph Measures (Henry Szu-Meng Chen, PhD)**

- Dr. Chen related the analogy of the Seven Bridges of Königsberg to the challenges faced with analyzing brain network connectivity and efficiency
    - The difficulty faced was the development of a suitable technique of analysis, and of subsequent tests that established this assertion with mathematical rigor
    - It was proven that the problem has no solution
- Explanation of "from brain to graph" process/workflow: Resting-state fMRI -> parcellation -> parcellated brain -> correlate BOLD signal among all parcels -> parcel-wise correlation matrix (function connectome) -> function connectome (after thresholding) -> graph theoretical analysis -> Graph measures that capture key topological aspects of function connectome
- Graph theory: a graph is a set of nodes connected by edges
    - Edges connects two nodes: Unweighted / Weighted and Undirected / Directed
    - A simple graph has no loops or parallel connections
- Categories of graph metrics include measures of integration, segregation, centrality, resilience, and many more
- Basic graph measures include degree (centrality), shortest path (integration), number of triangles (segregation), on which there was further elaboration
- Also explained were measures of functional integration, or how rapidly the brain can combine information from all different brain regions and measures of functional segregation, or how well the brain can process specialized information in subregion

- Several tool boxes were recommended, including the Brain Connectivity Toolbox, which can be downloaded
- Small-world network strikes a good balance between integration and segregation, have high clustering coefficient, and short average path length (efficient wiring) compared to a randomly connected graph with the same number of nodes and edges
- Constructing connectome with lesioned brain:
    - Brain normalization affects parcellation of lesioned brain and the functional connectome
    - Cost function masking (CFM) can be avoided with optimized normalization methods

- Post-surgical functions are associated with changes in graph measures
- Simulated/virtual surgery may better predict post-surgery outcomes in the future
- It was noted that there are challenges with abstractions in terms of what functional nodes represent anatomically; the correlates between metrics and actual cognitive performance is very encouraging
- Discussion occurred regarding the reproducibility of graph metrics; published studies seem to show robust metrics, but no standardization
    - Individual networks in the brain cannot be separately interrogated; a more global perspective is used
    - Parcellation has a definite impact on graph measures, so a standard is needed
    - Normalization is also very important, as it can make a visible impact on results

- Dr. Chen to send the presentation to staff for distribution

**Next call**: Wednesday, November 4, 2020 at 11 a.m. CT (1st & 3rd weeks of each month)

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