Team-Centered Informatics:
A Necessary Adaptation to Translational and Implementation Science?

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Introduction

The rapidly maturing fields of translational science[1] and implementation science[2] have recognized the multidimensional nature of health outcomes, and the need for a holistic and integrative approach to address them. For example, several NIH-funded organizations have assembled multidisciplinary translational teams (MTT)[3] consisting of biologists, clinicians, informaticians, and statisticians to help accelerate the integration of multi-omics data across the basic-clinical-community continuum. Similarly, implementation scientists draw from many disciplines to overcome cultural, political, and technical hurdles that prevent the broad uptake of research results produced from translational science.
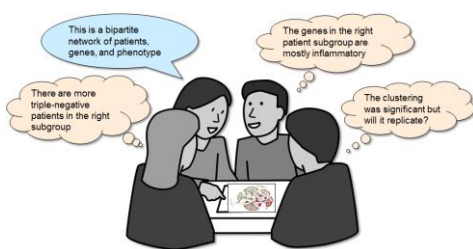

Fig. 1. A "boundary object" can help each member in a team comprehend patterns related to their discipline, while also help to integrate it with information from other disciplines.

Unfortunately, such teams face numerous barriers in integrating multidisciplinary knowledge, ranging from differing conceptualizations of a problem,[4] to narrow social and technical identification within a single discipline.[5] These hurdles often result in many teams having "low integrative capacity".[6] One approach, proposed by team science researchers to increase integrative capacity in teams, is through the use of "boundary objects",[7,8] which are external representations of information that facilitate the integration of diverse disciplinary knowledge. For example, as shown in Fig. 1, a boundary object could be designed to enable members of a multidisciplinary translational team to integrate their disciplinary knowledge, with the goal of generating novel insights that transcend individual disciplines.[9]

However, while boundary objects are used by the team science community to improve integrative capacity in teams, current informatics tools are mostly targeted to individual researchers. For example, powerful tools such as CRISPR[10] and Genome Browser[11] enable deep analyses of a few biological datatypes, but provide little support to investigators for integrating and interpreting results across multiple tools and disciplines. We therefore pose the question: *Could the fields of translational science and implementation science benefit by a new class of informatics tools that are team-centered?*

Goals and Structure of the Panel

Building on the concept of boundary objects from team science, this panel will explore the concept of "team-centered informatics"[9] designed to help members of multidisciplinary teams integrate knowledge from diverse disciplines. Fig. 2 shows an example of a *computational* boundary object, which simultaneously models both molecular and clinical information. Being computational, this representation can be partitioned, filtered, layered, and intersected with different combinations of variables from each discipline to enable comprehension of how they are related to each other. Such a representation on the one hand could be meaningful to individual experts specializing in one dimension of the data such
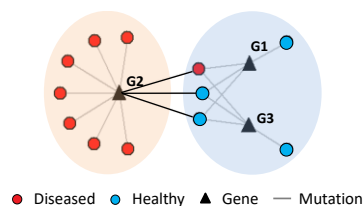

Fig. 2. A computational boundary object, which integrates molecular and clinical information about patients, enabling a multidisciplinary team to comprehend patterns related to discipline-specific information in addition to its interaction with the other disciplines.

as genes, but on the other hand could also provide an integrated understanding of how those genes interact with other dimensions such as the environment, leading to insights that transcend individual disciplines. However, to make such representations more amenable to teams, we need to develop new interaction methods and algorithms for enabling the real-time collaborative exploration of diverse information in massive datasets.

To debate whether we need to invest in such team-centered informatics tools, this panel brings together a diverse set of researchers from human-computer interaction, machine learning, causal modeling, hospital administration, and nursing. Each panelist will present a use case from their research to explore two challenge questions: (1) *is team-centered informatics old wine in new bottles?* In other words, do collaborative tools already exist that are sufficient for teams to integrate diverse disciplinary knowledge? (2) *does team-centered informatics provide low bang for the buck?* In other words, does the extra cost of building new ways to interact with complex data provide much added benefit to researchers?

Position Statements

1. Why do we Need Team-Centered Informatics? (Moderator: Suresh K. Bhavnani, PhD)

Dr. Bhavnani, is professor of biomedical informatics at the Institute of Translational Science in the University of Texas Medical Branch, with a background in human-computer interaction. As PI of the Discovery and Innovation through Visual Analytics lab, he specializes in (1) the discovery of complex patterns in big biomedical data such as discovering heterogeneity in diseases and their respective pathways,[12] and (2) the innovation of novel visual analytical methods to analyze and comprehend large and complex biomedical datasets.[13] His research has received 5 distinguished paper awards from AMIA, and an outstanding paper award from the Science of Team Science (SciTS) conference.

Dr. Bhavnani will provide a brief overview of the motivations underlying translational science, and implementation science, and how they both benefit from conducting research through multidisciplinary scientific teams. Next, he will discuss the importance of external representations of data and knowledge such as visualizations and flow diagrams for (1) reducing a researcher's cognitive load and freeing up resources to enable problem solving,[14] and (2) as a "boundary object",[7] to help other members in a team span disciplinary boundaries, leading to novel insights.[9] Using examples from translational science and implementation science, he will argue that the concept of a boundary object from team science could be the foundation for team-centered informatics solutions.[9] He will then ask the panelists to present use cases from their research, and address the two challenge questions: (1) *Old wine in new bottles?* (2) *Low bang for the buck?*

2. What is the Role of Team-Centered Informatics in Clinical Decision-Making? (Shyam Visweswaran, MD PhD)

Dr. Visweswaran is associate professor of biomedical informatics in the Department of Biomedical Informatics and the Intelligent Systems Program, at the University of Pittsburgh. He specializes in the application of artificial intelligence and machine learning to problems in clinical medicine and translational bioinformatics. As PI of the Vis lab, his research includes (1) computer-aided diagnosis and prediction, (2) discovery and prediction from high-dimensional genomic data, and (3) patient-specific predictive modeling for personalized medicine.

Dr. Visweswaran will present a use case from his research[15] focused on the use of Bayesian modeling and decision trees for clinical decision-making in multidisciplinary clinical teams. He will then address the two challenge questions with a focus on explainability of machine learning models in clinical decision-making.

3. What is the Role of Team-Centered Informatics in Identifying Causal Mechanisms? (Erich Kummerfeld, PhD)

Dr. Kummerfeld is research assistant professor in the Institute for Health Informatics at the University of Minnesota. He specializes in logic and computation applied to developing novel algorithms for discovering causal relationships, including relationships that involve, are between, or are confounded by latent variables, and applying them to health data to inform new treatments.

Dr. Kummerfeld will present a use case from his research[16] focused on the use of causal modeling in biomedical data, focused on the identification of disease mechanisms and design of targeted interventions. He will then address the two challenge questions with a focus on the social dynamics of collaborations between data scientists and domain experts.

4. What is the Role of Team-Centered Informatics in Hospital Administration? (Carlos Clark, DO)

Dr. Clark is Chief Medical Information Officer (CMIO) at the University of Texas Medical Branch hospital. He specializes in quality improvement including decreasing the smoking rate of clinic patients, improving the transition of care to reduce hospital readmission, and leads endeavors in population health for alignment of UTMB as a high value practicing organization.

Dr. Clark will present a use case from his research[17] focused on enabling providers to practice evidence-based medicine through EMR decision-support. He will then address the two challenge questions with a focus on overcoming social, political, and technical hurdles in implementing evidence-based practices.

5. What is the Role of Team-Centered Informatics in Designing and Implementing Discharge Protocols for Skilled Nursing Homes (Rebekah Penton, DNP RN)

Dr. Penton is Assistant Professor of Nursing in the School of Nursing at the University of Texas Medical Branch. Her research focuses on using methods from implementation science, and her 10 years of professional experience as a nurse practitioner, to improve care for geriatric patients in skilled nursing homes (SNFs).

Dr. Penton will present a use case from her research focused on the design and implementation of interventions to reduce hospital readmissions from SNFs. She will then address the two challenge questions with a focus on overcoming implementation hurdles related to hospital-SNF communication.

Discussion and Engagement of Panel Attendees

After each of the above position statements, the attendees will be first asked (with a show of hands) how many agree or disagree with the answers provided to the two challenge questions. For example, if a panelist claims that team-centered informatics is "old wine in new bottles", then the attendees will be asked if they agree or disagree with that conclusion. The moderator will then invite attendees to voice their opinions about the issues being discussed. The panel members will engage with these opinions, and the moderator will determine when the next position statement will begin. After all the positions statements are delivered and responded to, the attendees will be asked through a final show of hands to determine if team-centered informatics is "old wine in new bottles" or not, and whether it has "low bang for the buck or not". The results will be summarized by the moderator, and if the discussions lead to compelling arguments, will be documented in a report for publication. The first author has used the proposed panel format at the AMIA Informatics Summits in 2015, which resulted in high engagement among the panelists and attendees.

We expect this debate to enable attendees to comprehend the issues related to the design and use of team-centered informatics tools for a wide range of team-centered tasks in translational science and implementation science. The panel discussion should be of benefit to (1) **researchers** engaging in translation science and in implementation science, and (2) **program managers** from funding agencies who wish to understand how best to support the development, evaluation, and use of team-centered informatics approaches that have the potential of wide impact in making medical discoveries, and implementing them to improve patient care.

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