Paper review: Computer Integrated Surgery 2 - Using Big Data Analytics to Advance Precision Radiation Oncology

In this paper we will be reviewing the paper "Using Big Data Analytics to Advance Precision Radiation Oncology".

The paper primarily discusses the emerging role that Big Clinical Data Analytics is taking in the medical field and specifically in genomic and radionics research. It conceptualizes a learning health system (LHS) that utilizes clinically acquired data with machine learning to advance the initiative of precision medicine and reviews how such a system will impact the ultimate management and therapeutic course for patients.

To evaluate the paper we will be reviewing its discussion points. The paper states that "The goal of precision medicine is to improve overall patient care and determine when and how to personalize patients' treatments" and notes that in the current system while guidelines exist to assist in the overall pathways for specific diseases the "precision medicine is performed with finer granularity than the guidelines provide". The point discussed here is valid, especially in health systems we do not have a well enough understanding of the principles that determine the effectiveness of a procedure and coupled with the inherent randomness generated from an individual to individual basis clear guidelines are hard if not impossible to set.

The authors consider a learning health systems as a possible solution. They argue that the ability of big clinical data to represent the real world with minimal bias and accumulate over time should be considered to "unlock the potential". Here we have to note that the validity of the argument relies on the legitimacy and accuracy of the said data. The authors acknowledge

that big clinical data is not the pinnacle of meticulousness with the level of precision in measuring outcomes dictating the subsequent clinical conclusions as well as the data being limited by available time and resources used for the measurement. The authors use the selection of points on a dose volume histogram (DVH) as an example, the DHV essentially reduces a three-dimensional dose in a region to a single value of dose or volume.

The authors are clear that clinical data cannot be perfect, data reduction is a necessity and whether the reduction will preserve or discard useful relationships between features and outcomes is a problem that has to be solved. They argue that considerations for predictive models must include the purpose of building them, whether they are to be used for decision support or for discovery of new knowledge. There is more than one tool and selecting the right one to apply to the clinical question and purpose will be critical for making more precise patient care decisions.

The paper continues to discuss two main areas where a LHS can support health care, decision support and hypothesis derivation, outlining framework for the use of LHS in these areas. Both of these areas have seen continued introduction of computer learning algorithms in the recent years and their effectiveness in these areas are well known as well as their short-comings. The paper also acknowledges these limitations in that both decision support and discovery are limited by the knowledge contained in the database as well as issues that arise from the compatibility from various institutions. The learning health system would also be limited by pre-existing norms of clinical care as well as the selection of data used to construct it.

The authors still consider a LHS as a step forward as they discuss how at a higher level, Radiomics, Genomics and Pathology are patient-specific data that are subjected to feature extraction in clinical practice and for research and how the combination of the clinical data can provide precise treatment options for their patients. While it may be true that combining clinical data from these tree practices may result in better treatment options the argument is vague in that there is no clear described method to combine these sets of clinical data. This however may be to the benefit of LHS as it can be used to draw correlations with its role in hypothesis derivation.

The authors conclude that radiation oncology though precise in the treatment, presents a similar situation with a few rules of the road and acute observations, but may be dominated by unknowns and patterns of defensive practice. And thus they can only expect in the foreseeable future an implementation that works as a supplement to physician-bases clinical decision making. I would agree with the authors here, as noted there are currently too many issues preventing a automated LHS from being implemented ranging from political to the current practices in record keeping. As a review of the paper the paper is clear and concise bringing forth a balanced discussion of the issues as well as benefits of implementing a LHS, and looking forward the paper could discuss the specifics of how such a learning health system could be implemented as well as the other limitations that prevent its implementation such as confidentiality and security, legislation or a cost/benefit analysis of creating the framework of such a system.

References:

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