Editorial Preface

Knowledge Coupling and Graph-Based Modeling for Medical Care

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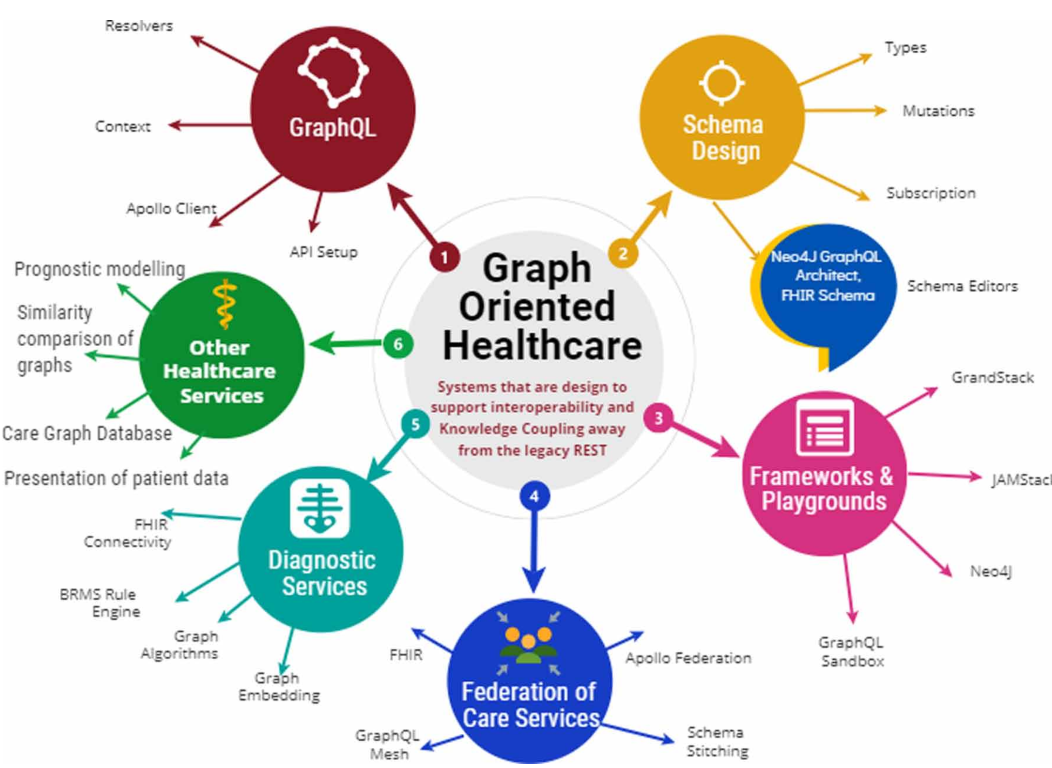
We are delighted to continue our efforts at IJEACH to create a new forum for exchange of information and publishing the excellent research work of scholars on all aspects of the emerging trends in the digitization and automation of healthcare. Since early 1970 when the father of modern healthcare records, Lawrence Weed, there is a growing need for new "knowledge coupling" in designing the future state of medical knowledge and analytics (Weed, 1991). Dr. Weed vision help overcome the inherent limitations of the human mind in decision making as well as the relational structure of the legacy medical databases (Burger, 1997). Processes in healthcare like getting the right diagnosis is a complex, collaborative and involving clinical reasoning and information gathering to determine a patient's health problem. Just as the diagnostic process, other medical processes will require collaboration among healthcare professionals, healthcare organizations, patients and their families, researchers, and policy makers as well as the existence of effective knowledge couplers among related processes and the data fragments. Thus it is rapidly becoming essential for healthcare organizations to effectively manage both internal knowledge and externally generated knowledge in order to provide the best possible healthcare, achieve operational excellence, and foster innovation (Haughom, 2014). The goal is to build a paradigm of evidence-based precision medicine that can provide comprehensive analysis of the disease phenotype as well as be the framework for robust diagnosis and prognosis. Achieving such goal requires seamless coupling of an enormous amount of diverse data, such as clinical, laboratory and imaging data, multiomics data (genomics, transcriptomics, proteomics or metabolomics), and electronic health records (EHRs) among other clinical information sources (Leopold & Loscalzo, 2018). Although this goal has been long recognized by the research communities where they created massive datasets, ontologies and standards to organize and structure relevant clinical data, the harmonization, coupling and integration between these data sources remain challenging because they are often diverse, heterogeneous and distributed across multiple platforms. This challenge has been universally known as the interoperability care bottleneck. This bottleneck has limited the degree to which results of clinical analyses to be integrated into the clinical decision-making process. However, efforts during the last decade have pointed to the natural way of representing and coupling information through the use graphs which can relate large collections of nodes (entities) and edges (relationships). The resulting flexible structure, called a knowledge graph, allows quick adaptation of complex data and connections through relationships. Their inherent inter-connectivity enables to solve the interoperability bottleneck and the use of the graph-based analysis techniques to unveil hidden patterns and infer new knowledge (Yoon et al., 2017). Using graph standards like GraphQL provided the long waited solution to connect healthcare date with every heterogeneous source including the HL7 FHIR electronic record (Mukhiya et al., 2019). Figure 1 illustrates the roadmap for using graphs and the GraphQL standard in healthcare.

IN THIS ISSUE

In this issue we are having four papers three regular papers and one invited paper. The invited paper is entitled "Artificial Intelligence-Assisted Endoscopy in Ulcerative Colitis" by Dr. Petros Zezos (MD, PhD) of Thunder Bay Regional Health Science Center, Division of Gastroenterology and Department of Internal Medicine. This paper describes how rapidly Artificial intelligence (AI) and Machine Learning (ML) integrating into the modern gastroenterology practice. Although in its nascence, AI and ML been used as a tool to assist in risk stratification, diagnosis, and pathologic identification and all other aspects of modern endoscopy and inflammatory bowel diseases (IBD) management. IBDs are disorders that cause chronic inflammation in the gastrointestinal (GI) tract. The inflammation is the result from dysregulated immune response to environmental triggers in genetically susceptible hosts. The two most common forms of IBD are Crohn's disease and Ulcerative Colitis (UC). In ulcerative colitis, the endoscopic appearance of the mucosa is depending on the degree of inflammation. Therefore, based on the endoscopic features of the inflammation, endoscopic grading scores (e.g. Mayo endoscopic subscore (MES)) are used to assess the disease severity and monitor the response to therapy.AI and ML assisted endoscopy in UC has the potential to open new exiting horizons and contribute to significant advantages in the field of endoscopic assessment of the disease severity and the detection of anomalies (e.g. polyp detection). In particular deep machine

Figure 1. The Roadmap of using Graphs in Healthcare



learning architectures like CNN and other neural networks have the ability to score ulcerative colitis and strongly differentiating between mild and severe endoscopic disease. Other research directions of using AI/ML in UC have been also described in this paper.

The second regular paper is entitled “Variable Practice May Enhance Ball Catching Skills in Some but Not All Children With DCD” by Dr. Eryk Przysucha, Dr. Taryn Klarner and Dr. Carlos Zerpa, Lakehead University. In this paper a new vision on diagnosing children diagnosed with Developmental Coordination Disorder (DCD) who exhibit motor issues that are due to factors other than known medical or cognitive condition, but are substantial enough to prevent them from meaningful participation in age-appropriate physical activities. This condition affects approximately 10 to 15 percent of school-age children, and it is more prevalent in boys as compared to girls (Crawford & Dewey, 2008). One of the most important characteristics of this population is its heterogeneity. For the clinical and research purposes children with DCD have been often classified based on their performance on formal assessment tests, such as Movement Assessment Battery for Children (MABC). Those whose scores fall at or below 5%ile, in terms of normative data, are classified as having serious motor problems, whereas those whose performance places them between 10th and 15%ile are considered as having moderate movement problems. Regardless of the degree of their movement deficit, majority of them exhibit problems with many fundamental skills such as ball catching. In the present study it was examined how, if at all, variable type of practice could enhance the ability of children with DCD, exhibiting various levels of movement difficulty, to organize such actions. In line with the predictions of the variability of practice hypothesis the data confirmed that children with moderate movement problems exhibited changes to the way they adapted the orientation of the hand and its velocity, whereas children with more severe problems did not. Conceptually, these changes were attributed to improvement of the “rules”, or schema as a result of practicing a variety of (programs) parameters in the spatial and temporal domain.

The third article is entitled “Exploring System Thinking Leadership Approaches to the Healthcare Cybersecurity Environment” by Dr. Darrell Norman Burrell, Amalisha Sabie Aridi, Quatavia McLester, Dr. Anton Shufutinsky, Dr. Calvin Nobles, Dr. Maurice Dawson and Dr. S. Raschid Muller**.** In this paper, the authors proposes the use of system thinking to treats and represent the world from multiple perspective that emphasizes the complexity, dynamism, and entirety of the system. Digital transformation in healthcare has offered exponential advances in capabilities and efficiencies, improving access, quality of care, chronic disease management, public health surveillance, and population health. However, the speed of change left security lagging, exposing cyber vulnerabilities that cost the U.S. 6.2 billion dollars annually, at an average cost of 2.2 million dollars, and 3,128 records breached per incident. Despite significant investments to close the gap on cyber vulnerabilities, cybersecurity remains a critical issue. Healthcare organizations needs to use the concept of systems thinking for formulating strategies and address the complexity of healthcare project dynamics and systems with the ever-changing external environment impacting the organizational performance. The described research discussion aims to use the literature’s contextual review to examine healthcare cybersecurity organizational behavior through systems thinking lens and how organizations employ systems for project risk management and healthcare leadership.

The fourth paper is entitled “Evaluating the Performance of a Hockey Helmet in Mitigating Concussion Risk Using Measures of Acceleration and Energy During Simulated Free Fall” by Dr. Carlos Zerpa, Dr. Stephen Carlson, Dr. Eryk Przysucha, Dr. Meilan Liu, Dr. Paolo Sanzo. This study evaluated the performance of an ice hockey helmet in mitigating concussion risk based on measures of head impact acceleration and energy loading during simulated free fall head collisions. The results provide a better understanding of current and new measurement techniques to assess the capabilities of a helmet in preventing the risk of head injury during a head collision. Furthermore, the results support and build on previous literature analyzing the performance of hockey helmet impacts by highlighting the importance of angle of impact, location of the impact, and neck strength in mitigating energy loading as a preventative measure for head injuries. The outcome of the study also highlights the need to improve measurement techniques in future research by isolating the helmet from the influence of the neck and headform material during dynamic impact testing. This approach will include the use of a surrogate headform without a neckform; with and without a helmet to determine the energy dissipation characteristics of the helmet during dynamic impacts. In summary, from the theoretical perspective, this study builds on the existing literature by introducing an energy measurement technique to assess helmet performance which accounts for the interaction of factors related to angle, location, and neck torque during head collisions. From the practical perspective, these outcomes provide an avenue for helmet manufacturers to take into consideration these factors when evaluating the performances of helmets in minimizing the risk of head injury before shipping these helmets to the market.

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