Health Informatics Workshop: applications that use knowledge and data

Abstract collection

Table of contents:

Goal oriented Ontology supported methodology for treatment of multimorbidities
Mor Peleg, University of Haifa. .......................................................... 2

A model-driven methodology for exploring complex disease comorbidities applied to autism spectrum disorder and inflammatory bowel disease
Judith Somekh, University of Haifa and Technion. ................................. 3

Current trends in health natural language processing
Max Topaz, University of Haifa. ............................................................ 4

Completing clinical guideline knowledge: implications for methodological support
Erez Shalom, Ben Gurion University and Ruth Edry, RAMBAM hospital. ....................... 5

The correlation between the use of information systems and effective interventions: prevention of repeated hospitalizations
Efrat Shadmi, University of Haifa. ......................................................... 7

The Smart Baby Diary: Using crowd-based developmental norms to track early child development
Ayelet Ben-Sasson, University of Haifa. ........................................................ 8

Ontologies, Information Models, and Knowledge Bases: Their Representations and Uses
Samson Tu, Stanford. ................................................................. 9
Goal oriented ontology supported methodology for treatment of multi-morbidities
Alexandra Kogan1, Mor Peleg1,2, Samson Tu2, and Irit Hochberg3

1Dept. Of Information Systems, University of Haifa, 2Center for Biomedical Informatics Research, Stanford University, 3Medical School, Technion

Realizing the proven capabilities of computers in better processing of complex knowledge and data, medicine is heading toward computer-supported decision making. Following this vision, several research groups have started to develop languages that allow the representation of CPGs as computer-interpretable guidelines (CIGs). CIG engines match a patient’s data to the medical knowledge contained in the CIG in order to automatically deliver patient-specific recommendations at the point of care. However, existing CIG formalisms have not yet demonstrated in practice effective mechanisms for integrating CIGs to handle multi morbidities. The aim of this research is to develop and evaluate a new methodology for integrating the knowledge of CIGs for different chronic diseases to create non-conflicting management plans for patients with chronic comorbidities.

In the talk, I will present our approach, which is a work in progress. Our approach is goal-based, modular and reusable. Design patterns are used by our DSS’ algorithm to recognize conflicts between different CPG goals and actions. The DSS then suggests ways in which these conflicts may be mitigated. It relies on CPG knowledge supplemented with general medical knowledge about the physiological effects of drugs and about drug hierarchies. Our approach is being implemented using existing commercial tools and standards. We use the PROforma CIG formalism and tools, the NDF-RT drug ontology, and the HL7 FHIR standard for structuring, storing, and retrieving patients’ data.

Mor Peleg, PhD, is Assoc. Prof at the Dept. of Information Systems, University of Haifa, Israel, since 2003, and has been Department Head in 2009-2012. Her BSc and MSc in Biology and PhD in Information Systems are from the Technion, Israel. She spent 6 years at Stanford BioMedical Research during her post-doctoral studies and Sabbatical, and is currently on Sabbatical at Stanford (till July 2017). She was awarded the New Investigator Award by the American Medical Informatics Association (AMIA) for her work on clinical guideline based decision support and is International Fellow of the American College of Medical Informatics since 2013. She is Associate Editor of Journal of BioMedical Informatics and a member of the editorial board of Methods of Information in Medicine. Her research concerns knowledge representation, decision support systems, and process-aware information systems in healthcare. She has over 100 publications and an H-index of 33. She was the coordinator of the FP7-ICT large-scale project MobiGuide (http://www.mobiguide-project.eu/) in 2011-2015. She chaired the scientific PC of Artificial Intelligence in Medicine (2011), and has been co-chair of the annual BPM ProHealth Workshop and Knowledge Representation for Healthcare Workshop since 2007. http://mis.hevra.haifa.ac.il/~morpeleg/
A model-driven methodology for exploring complex disease comorbidities applied to autism spectrum disorder and inflammatory bowel disease

Judith Somekh

Department of Biomedical Informatics, Harvard Medical School; Department of Immunology, Medical School, Technion; Department of Information Systems, University of Haifa

The talk will present a model-driven methodology aimed to shed light on complex disorders. Our approach enables exploring shared etiologies of comorbid diseases at the molecular pathway level. The method, Comparative Comorbidities Simulation (CCS), uses stochastic Petri net simulation for examining the phenotypic effects of perturbation of a network known to be involved in comorbidities to predict new roles for mutations in comorbid conditions. To demonstrate the utility of our novel methodology, we investigated the molecular convergence of autism spectrum disorder (ASD) and inflammatory bowel disease (IBD) on the autophagy pathway. In addition to validation by domain experts, we used formal analyses to demonstrate the model’s self consistency. We then used CCS to compare the effects of loss of function (LoF) mutations previously implicated in either ASD or IBD on the autophagy pathway. CCS identified similar dynamic consequences of these mutations in the autophagy pathway. Our method suggests that two LoF mutations previously implicated in IBD may contribute to ASD, and one ASD-implicated LoF mutation may play a role in IBD. Future targeted genomic or functional studies could be designed to directly test these predictions.

Judith Somekh, PhD, is currently a post-doctoral fellow at the Department of Immunology, Medical School at the Technion. Her BSc (2001), MSc (2007) and Ph.D. (2013) in Information Systems Engineering are from the Technion–Israel Institute of Technology. She was a post-doctoral researcher fellow at the Department of Biomedical Informatics, Harvard Medical School under Porf. Isaac Kohane (2015-2017). Her research interests lies in modeling complex biological systems, knowledge representation and developing tools for analyzing gene expression data to understand the etiology of diseases in general and autism in specific.
Current trends in health natural language processing
Maxim Topaz
Dept. Of Nursing, University of Haifa

We will review the latest trends in health natural language processing with particular attention to health ontologies. The reported results are based on the systematic literature review of the health natural language processing application to analyze data from clinical settings (via electronic health records). In addition, a novel framework for rapid text mining will be described with implications for terminology and ontology creation and maintenance.

Maxim Topaz PhD, RN, MA, is a Nurse Informatician passionate about using data science and artificial intelligence to improve human health. His particular focus is on clinical decision support, standardized health terminologies, and data and text mining. In the past, Dr. Topaz was involved with health policy (national and international levels), leadership (e.g. Chair of the Students Working Group with International Medical Informatics Association) and health entrepreneurship. Maxim also has clinical experience in internal and urgent medicine. He received his Masters and Baccalaureate degrees from the University of Haifa, PhD from the University of Philadelphia. He completed a postdoctoral fellowship at the Harvard Medical School and Brigham Women's Hospital.
Completing “non-evidence” clinical guideline knowledge: implications for methodological support

Erez Shalom¹, Ruth Edry², Ayelet Goldstein³, Udi Gafni, Yuval Shahar¹

¹ The Medical Informatics Research Center, Ben Gurion University of the Negev; ²Anesthesia Department, Rambam Medical Center; ³Medoc. Ltd.

Abstract

Preparing a patient who takes a combination of two antiplatelet drugs (Dual Anti Platelet Therapy-DAPT) to surgery is controversial, because it raises the dilemma of whether to continue the treatment, risking high peri-operative bleeding, or stop it, and increase the peri-operative cardiovascular risk (e.g. having a myocardial infarction). Numerous guidelines of various medical societies have been published in this field, expressing the lack of consensus and lack of high-level evidence based management strategy. This may be reflected in contradictory recommendations - and as a result - lead to erroneous treatment, morbidity, and even mortality. The major challenge is the need to integrate multiple medical knowledge domains in a single guideline: cardiology, hematology, surgery, and anesthesiology, together with the effects of multiple comorbidities on outcome. Therefore, a unified Computer-Interpretable Guidelines (CIG) may offer the physician standardized recommendations for optimal personalized treatment of the patient.

In the process of formalizing the evidence-based official guidelines of several medical societies, we encountered a high ratio of clinical situations with “no-recommendation”, where only a general recommendation to consider the benefits and harms of DAPT continuation or discontinuation was given instead of a formal guideline recommendation. These are particularly frequent in extreme clinical scenarios (e.g. surgeries with high surgical bleeding risk or patients with high cardiac risk). Since the clinical situation is very complex in these cases, it impedes the possibility of conducting large scale randomized clinical studies, resulting as “non-evidence” areas. Nevertheless, in real life, these specific “non-evidence” area are the cases where guidelines are most needed, and a clinical decision has to be taken.

In this talk, we will present a new methodology for filling these “non-evidence” areas. This methodology includes: 1) identifying the “non-evidence” areas in the CIG; 2) using additional non-evidence narrative sources such as case reports; 3) converting the domain expert’s clinical experience and medical knowledge from implicit into explicit; and 4) consulting with domain experts from different medical specialties. We will also present its implementation in the case of the DAPT CIG, of which 50% of its recommendations were not evidence-based. At the end of this process, we intend to evaluate the compliance of several groups of physicians from different specialties to the CIG recommendations.
Dr. Erez Shalom, Ph.D. is a Medical Informatics Expert and technology leader in medical Decision Support Systems (DSS), specializing in knowledge representation, knowledge acquisition, and execution of clinical guidelines. He received his Ph.D. in Information Systems Engineering in 2013 from Ben-Gurion University Of the Negev, Israel. As a senior researcher at the Medical Informatics Research Center in BGU, Erez worked as a work package leader in the FP7 EU MobiGuide Project (http://www.mobiguide-project.eu/), and involve in many different projects in the area of digital health such as pain management, cyber in medical devices, and educational health. Erez has more than 7 years of experience in managing IT projects including, design and implementations information systems, building complex architectures and developing web and mobile applications. He Co-founded healthcare IT start-up (MediLogos Co.), and serves as its CTO since 2012. Also, Erez is adjunct lecture in information system engineering department at Ben-Gurion University Of The Negev and other collages teaching information systems, cloud and web-based technologies courses.

Dr Ruth Edry, M.D., is a senior anesthesiologist in the Anesthesia department at Rambam Medical Center since 1996, and has been lately nominated to be head of the acute pain service. Her medical degree is from Tel Aviv University and she did her internship in anesthesiology at Rambam Medical Center. She currently studies “genomics and bioinformatics” at Bar Ilan University. Ruth is an adjunct lecturer in the Faculty of Medicine at the Technion Institute, where she has been an instructor and 3rd year moderator for the past 10 years of the course “being a doctor”. Her research interests are pain, medical guidelines based computerized decision support systems, perioperative anti-platelet therapy, anesthesia of the patient with oro-maxillo-facial malformation, and ambulatory sedation. She serves as principal investigator and medical advisor at Medasense, an Israeli company developing a nociception monitor, and at Medoc, an Israeli company developing computerized medical decision support systems.
The correlation between the use of information systems and effective interventions: prevention of repeated hospitalizations

Shadmi, E.; The Cheryl Spencer Department of Nursing, University of Haifa

http://www.commonwealthfund.org/publications/fund-reports/2017/aug/ten-recommendations

BACKGROUND Reducing readmissions is a focus of health care systems worldwide to improve quality of care and efficiency. Evidence points to the importance of in-hospital interventions that address patient needs early to prevent unplanned hospital readmissions.

OBJECTIVE Develop and implement an ongoing strategy to prevent 30-day hospital readmissions among high-risk elderly patients insured by Clalit Health Services.

PATIENTS TARGETED All Clalit members, ages 65 and older, admitted to hospitals. A prediction algorithm (the Preadmission Readmission Detection Model or PREADM) uses electronic medical record and administrative data to derive a risk score and identify high-risk patients.

KEY FEATURES AND INTERVENTIONS The PREADM risk score is used by continuity of care (COC) nurses stationed in every hospital in Israel to target high-risk patients. COC nurses provide in-hospital coordination, discharge planning, and coordination with primary care clinic nurses for post-discharge follow-up and monitoring. Electronic messaging between nursing staff in hospital wards and general practices is used to facilitate joint discharge planning. Primary care clinics are responsible for post-discharge follow-up and monitoring, performed by nurses at the clinics according to structured outreach protocols. The PREADM score is used in all primary care clinics to prioritize outreach efforts to high-risk patients within 72 hours of discharge.

INFORMATION SYSTEMS Clalit operates an integrated information system that centralizes all electronic health and demographic patient data. This platform allows for identification of high-risk patients, sharing of information among providers, and periodic collection of patient data for monitoring. Additional systems include a platform for automated electronic messaging between hospitals and primary clinics and a post-discharge assessment tool that notifies primary clinics of admissions and discharges and facilitates discharge and post-discharge activities.

Efrat Shadmi is an Associate Professor at the Department of Nursing, University of Haifa, Israel. She received her doctoral degree from the Department of Health Policy and Management, the Johns Hopkins University Bloomberg School of Public Health, Maryland, USA. She is a Senior Policy Consultant to the Department of Health Policy Planning at Clalit Health Services headquarters. Her research focuses on developing and evaluating interventions for improving integration of care in multimorbid populations, and on assimilation of electronic health record predictive modeling and decision support tools to facilitate high quality care for high-cost high-need patients.
Title: Smart Baby Diary: Using crowd-based developmental norms to track early child development

Ayelet Ben-Sasson, University of Haifa

Abstract

Early screening for developmental disorders is critical for effective early intervention. Today, parents are recording their babies’ development online and seeking online information and advice regarding their development. This leads to a public health opportunity to engage parents in monitoring their baby’s milestones. Smart Baby Diary, known as Baby CROINC (CROwd INtelligence Curation) is a unique platform for developmental tracking of young children. Parents, providers and researchers can record and compare developmental milestones (“start crawling”, “first word”, etc.) to crowd-based statistics, using our free website or mobile app. Parents report milestones on their child's timeline by using their own words or by selecting from a list of milestones. Parents view their child's statistics relative to other children, view summary reports, learn about milestones that are coming up, and share parenting tips with other parents. The goals of the project are to empower parents of young children by facilitating parents’ personalized recording, tracking, and developmental education.

The research objectives are to determine the usability and validity of crowd-based developmental norms in Baby CROINC. Baby CROINC has 3,208 users reporting about 3,312 children internationally, of which 1,900 children have rich diaries. The median age of children at registration is 5 months, with 61% being first-born children, 52% boys, and 15% with preterm births. In this talk we will present the usability of the platform in terms of the patterns of use and the user’s satisfaction with the various diary functions. We will also display evidence regarding the validity of the crowd-based norms by showing their correlation with other developmental measures and by presenting data patterns that resemble traditional developmental test norms. In this talk we will discuss lessons learned from the design of and evidence from such a platform. We will weigh the costs versus benefits of relying on crowd wisdom for estimating developmental risk.

Dr. Ayelet Ben-Sasson is an assistant professor at the Occupational Therapy Department, University of Haifa. Her research interests are in early child development screening, e-health, autism, and sensory disorders. She completed her doctoral studies in Rehabilitation Science at Boston University and her post-doctoral fellowship at the Psychology Department at UMASS Boston. She is a co-founder of Baby.CROINC, an app for developmental tracking. She has presented and published papers in the area of early screening, autism, and e-health in various inter-disciplinary conferences and journals. Among them are works examining the utility of internet queries for autism screening. Ben-Sasson was a LEND fellow, a recipient of an International Reintegration Grant, and a Y. Alon Fellow.
The boundaries between ontologies, information models, and knowledge bases are often blurred and people are often confused about the representational choices that are appropriate for each. Over the years, numerous formalisms—semantic networks, rules, frames, UML, RDF, formal logic—have been used to make computational artifacts. In this talk, I will use examples in health informatics to illustrate some critical distinctions. Some formalisms provide templates for modeling; others formulate assertions as axioms. Some make the open-world assumption while others assume a closed world. Such distinctions may become pitfalls when formalisms and requirements are mismatched. I will argue that the current suite of tools do not provide the integration that we need to develop intelligent applications and discuss some emerging technologies that may ameliorate the situation.

Samson Tu is a senior research scientist at Stanford Center for Biomedical Informatics Research. Trained in computer science (with specialization in artificial intelligence), his research revolves around the representation of biomedical knowledge and the development of computational methods to apply such knowledge to solve biomedical problems. He has extensive knowledge and experience in (1) the formal representation of and reasoning on biomedical concepts in ontologies, (2) the development of algorithms to apply such representation in practical applications, and (3) extensive experience in modeling clinical protocols, guidelines, and medical terminologies. He had worked on projects that use such models to drive protocol-based decision support and on projects where he developed novel representations for autism, clinical research, and ICD-11 concepts.