MEDICINSKA INFORMATIKA 2018

EFMI STC 2018
Decision Support Systems and Education – Help and Support in Healthcare

15 – 16 October 2018, Zagreb, Croatia

Book of Abstracts
Workshop, Panels, Demonstrations, Short Communications, Posters
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2018

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Editors: Vesna Ilakovac
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Publishers: Hrvatsko društvo za medicinsku informatiku
Rockefellerova 4, 10000 Zagreb
Medicinska naklada, d.o.o.
Cankarova 13, 10000 Zagreb

Med. inform., Volume 14, Str. 1 - 54, Zagreb, October 2018.
Under Auspices of:
Ministry of Health of the Republic of Croatia
Ministry of Science and Education of the Republic of Croatia

Partners:
Croatian Public Health Institute
University of Applied Health Sciences

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Great ideas in a small format

This abstract book presents ideas and researches in the field of Medical Informatics with the focus on decision support systems and education as a help and support in healthcare, which is the main topic of the Special Topic Conference of the European Federation for Medical Informatics EFMI STC 2018, held in Zagreb, Croatia in October 2018.

Here are gathered short presentations of contributions submitted in a form of workshop, panel, demonstration and poster. We hope this abstract book will intrigue your curiosity and imagination and motivate you to advance your own research or start a new one and thus contributing to better healthcare.

We would like to thank all participants, guests, reviewers and everyone else who helped this event happen in our beautiful capital and hope that it won't take another 11 years to meet again in Croatia.

Vesna Ilakovac and Mario Somek, editors

Zagreb, October 2018
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WORKSHOP, PANELS, DEMONSTRATIONS
Helping and Supporting Patients Through their 21st Century Health and Social Care Journey: Nursing Holds the Key

Inge MADSEN a,1, Paulette LACROIX b, Elizabeth BORYCKI c and Paula PROCTER d

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1. Topic

In today's complex arena of health and social care there is one professional role that is considered central to healthcare. That profession is nursing [1]. While there are many layers of complexity to a healthcare organization, with each function requiring activity data; there is one primary source for such data which is the electronic health record. The value of nursing in the patient journey is not easily captured with the types and structures of data collection in the electronic health record and, indeed, in some countries nursing input to the care and well-being of the patient is categorized as 'room and board' [2].

According to the National League for Nursing one of the four core values for nursing is "Excellence: co-creating and implementing transformative strategies with daring ingenuity" [3], but there is need for a clearer framework built around co-creation that readily offers a stepped approach to the changing provision of healthcare as suggested in the Care Navigation Competency Framework [4]. Nursing is in a prime position to take the lead role of care navigator (co-creator) as the profession holds the knowledge and skills within the education programme as demonstrated within every professional encounter with other care providers and with the patients they serve. However, the fact is that nursing-sensitive quality indicator data may not be identified or collected in co-created initiatives. It is this reality that nursing must address so the value that nursing contributes to the co-created care pathway will not be lost.

2. Rationale

The value of nursing in co-created care pathways must be defined and captured electronically in the electronic health record. The results of this effort will enable healthcare organizations to determine the value of nursing in quality patient outcomes within a health and social context, thus leading to the development of programme models that capitalize on the role of nursing in co-created care pathways.

3. Outcome

The workshop discussion will examine critical factors for nursing in the co-creation of clinical pathways and other initiatives using the following key questions:

- What kinds of initiatives are needed to ensure nursing is visible in co-creation?
- What competencies are needed to ensure nursing is visible in co-creation?
- Would the creation of a common standardized European Nursing Minimum Data Set help to capture the right data to measure the quality nursing care in co-created initiatives?

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4. Programme

The workshop will consist of four presentations (10 minutes each) with discussion of the three questions over the remaining 50 minutes. Comments will be recorded during the discussion using a note taking app. The outcome of the workshop will be summarized and circulated to the group within six weeks of the conclusion of the conference. With consent of the participants the summary will form the basis for a larger debate as part of a grant proposal to develop competency standards for co-creation in nursing.

References

Artificial Intelligence Applications Enabling Clinical Decision Support

Stéphane M. MEYSTRE a,1, Christian LOVIS b, Carlos Luis PARRA CALDERÓN c, Erin R. WEEDA a, Andrew J. MATUSKOWITZ a and Jihad S. OBEID a

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b Division of Medical Information Sciences, University of Geneva, Switzerland
c Institute of Biomedicine of Seville, Seville, Spain

1. Introduction and panel Topic

Artificial Intelligence (AI) is developing at a fast pace in healthcare, enabled by cheap powerful computing resources and an important growth in patient information becoming available in electronic format. AI usually defines computer software algorithms mimicking cognitive functions that humans associate with other human minds, such as learning and problem solving [1]. AI’s scope is not universally accepted but typically encompasses data mining, knowledge discovery and representation, natural language processing (NLP), reasoning, machine learning, and perception. The tools used in AI include methods based on statistics and probability, logic, mathematical optimization, and artificial neural networks. The latter have seen recent renewed interest as multilayered networks enabling deep learning.

In healthcare, AI has already been applied in multiple domains, often either enabling decision support (e.g., by providing the required structured coded data extracted from unstructured clinical notes) or providing the data analysis and knowledge. Applications included NLP for multiple purposes such as the extraction of clinical information [2] or automatic de-identification of clinical notes [3]. Image recognition is another topic of AI research in healthcare, to detect metastasis in pathology images, [4] or skin cancer in clinical images [5] as examples. Numerous applications of machine learning have been attempted in healthcare, for data mining, NLP, or predictive analytics. The latter is central in recent efforts by IBM (Watson Health), Microsoft (Hanover project) and Google (DeepMind). Predictive analytics also allowed optimizing operating room or outpatient services utilization,[6] or predicting hospital readmissions [7].

2. Panelists

Stephane Meystre, MD, PhD, FACMI, will introduce the panel and present “Automatic Trial Eligibility Surveillance to Support Patient Screening Decisions”: Dr. Meystre is Associate Professor and SmartState Chair in Translational Biomedical Informatics at the Medical University of South Carolina (Charleston, SC, USA) with research activities focused on easing access to unstructured clinical data for research and clinical care purposes, using techniques such as NLP for information extraction and automated de-identification. He was also chair of the AMIA Natural Language Processing working group and is current chair of the IMIA Health Information Systems working group.

Insufficient patient enrollment in clinical trials remains a serious and costly problem. Healthcare providers’ lack of awareness of appropriate trials and the difficulty to correlate eligibility criteria with patient characteristics are often cited reasons. Dr. Meystre will discuss ongoing efforts to automate patient trial recruitment using NLP to detect patients eligible for a specific clinical trial, linking the information extracted from the narrative description of clinical trial eligibility criteria to the corresponding clinical information extracted from the EHR, and alerting clinicians taking care of the patient.

Jihad Obeid, MD will present “Automated Detection of Altered Mental Status in Emergency Department Clinical Notes for Use in Decision Support”: Dr. Obeid is Associate Professor, Division Leader of Biomedical Informatics, Health Systems and Policy, in the Department of Public Health Sciences.
and Co-Director of the Biomedical Informatics Center at the Medical University of South Carolina.

Several decision support instruments utilized in the Emergency Department (ED) setting require Altered Mental Status (AMS) as an input variable, for example the Pulmonary Embolism Severity Index (PESI). In order to implement a decision support tool that employs PESI, AMS has to be extracted from clinical notes. Dr. Obeid will discuss ongoing work at the Medical University of South Carolina on using clinical text classifiers to assign patients into AMS categories based on ED clinical notes.

Carlos Luis Parra Calderòn will present “Natural Language Processing in Spanish EHR for Precision Healthcare Decision Support Systems in lung cancer”: Dr. Parra Calderòn is Head of Technological Innovation and Information Security of Virgen del Rocío University Hospital. Head of Research & Innovation in Biomedical Informatics, Biomedical Engineering and Health Economy of Institute of Biomedicine of Seville. Member of the SEIS Board. EFMI and IMIA Spanish representative. Member of the EFMI Translational Health Informatics WG. Member of the IMIA Health Information Systems WG. Member of HL7 Spain and author of several implementation guidelines.

Carlos Parra will present NLP research applied to the extraction and normalization of lung cancer information from EHRs.[8] Focusing on lung cancer, Precision Healthcare Decision Support Systems (PHDSS) aims to provide personalized recommendations for treatment plans, defining and validating new therapeutic models associated with new target therapies and novel techniques for radiotherapy or predicting the toxicity of certain chemotherapeutics.

Christian Lovis, MD, MPH, will present “Automated Knowledge Acquisition for Image-Based Learning Systems”: Prof. Christian Lovis is director of the division of medical information sciences at the University Hospitals of Geneva (HUG), Switzerland. He has developed the clinical information system used at HUG, the consortium of all state university hospitals of Geneva state. His division is focused on research and development, with special emphasis on human-machine interfaces, interaction paradigms between systems, data and humans, as well as usage of large and heterogeneous datasets.

While AI is getting into every field of Medicine, its use in clinical settings remains subject to the availability of good learning sources. Two major sources today are information or knowledge (e.g., PubMed, papers, textbooks) and data. For the latter, data, one of the most promising field today focuses on images (e.g., dermatology, radiology, pathology, ophthalmology). However, learning tools require reliable sources of learning, such as reports associated with images. NLP of reports as knowledge source for AI in image-based learning systems is therefore a major need today. The author will present a hybrid approach based on formal NLP and probabilistic learning to cluster the most efficient documents requiring manual annotation.

References

Education in Biomedical and Health Informatics: Needs and Reality

Kristina FIŠTER a,1, Antoine GEISSBUHLER b, Simon de LUSIGNAN c, Jadranka BOŽIKOV a and John MANTAS d

a University of Zagreb School of Medicine, Andrija Štampar School of Public Health, Zagreb, Croatia
b Geneva University, Geneva, Switzerland
c University of Surrey, Guildford, United Kingdom
d University of Athens, Athens, Greece

1. Brief Description of the Panel’s Topic

Amid the digital transformation that is reshaping medicine into as yet unimaginable health care infosphere of tomorrow, one which will be populated by highly interconnected informational organisms, or inforgs [1], spanning health professionals as well as patients and decision makers—how are educational systems to respond?

What knowledge and skills are going to be needed, and are they being taught [2-4]?

From general population health literacy and further patient empowerment, to medical and nursing graduates’ conversance with scientific literature and electronic health records, to education with and about mHealth, artificial intelligence [5], digital governance [6], and truly harnessing the power of big data: where are we, and where are we trying to arrive?

Is there consensus on how to shape the human project in the transition to the digital society, and medicine and health care within it [7]? Should, and indeed, could such a consensus exist?

Do we need more national and international regulation of education and employment opportunities in biomedical and health informatics?

Our panelists span Europe and varied educational and experiential backgrounds. They will explore and discuss the needs and offerings in biomedical and health informatics education in Europe, as well as where we should try to get to, and how.

2. Panelists’ Short Biographies

John Mantas is Professor of Health Informatics, Director of the Laboratory of Health Informatics, and Director of Postgraduate Studies at the University of Athens, Greece, as well as Chair of the European Federation for Medical Informatics Working Group on Education. Professor Mantas headed the International Medical Informatics Association Task Force and was the lead author on the Recommendations of the International Medical Informatics Association (IMIA) on Education in Biomedical and Health Informatics. Current research interests of Professor Mantas are in health information systems, patient safety, biomedical informatics education, and management of healthcare. He is the organiser for more than fifteen years of the International Conference on Informatics, Management, and Technology in Healthcare. Professor Mantas is author of more than 250 publications, as well as author and the main editor of fifteen books published by international publishers. He is serving in many international scientific publications as associate editor and reviewer. Professor Mantas was the President of the European Federation for Medical Informatics from 2010 to 2012, as well as the Vice-President of IMIA from 2012 to 2014. He received the Fellowship of EFMI in 2015 and became founding Fellow of the Academy of the International Association for Health Sciences Informatics.

Antoine Geissbuhler is Professor of Medicine, Chairman of the Department of Radiology and Medical Informatics at Geneva University, and Director of the Division of eHealth and Telemedicine at Geneva University Hospitals, Switzerland. He is also President of the executive committee of the Health-On-the-Net Foundation, and former President of the International Medical Informatics Association. He trained as a

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physician at Geneva University where he specialised in internal medicine, then, after a post-doctoral fellowship, became Associate Professor of biomedical informatics at Vanderbilt University. In 1999, he returned to Geneva to take the responsibility of medical information systems at Geneva University Hospitals. In 2005, Professor Geissbuhler’s efforts in developing telemedicine and tele-education are recognised by the creation of the UNESCO chair for telemedicine and multidisciplinary teaching, and, in 2010, of the World Health Organization Collaborating Center for eHealth and Telemedicine. Author of more than 120 original scientific publications, his current research focuses on the development of innovative, knowledge-enabled information systems and computer-based tools for improving the quality, safety, and efficiency of care processes, at the local level of the hospital, the regional level of a community healthcare informatics network, the implementation of the national eHealth strategy for Switzerland, at the global level with the Health-On-the-Net Foundation (http://www.hon.ch) and with the development of a large telemedicine network in developing countries (http://raft.hcuge.ch). Professor Geissbuhler is also leading an effort by Geneva University Hospitals to develop a world-class medical tele-expertise network.

Simon de Lusignan is Professor of Primary Care and Clinical Informatics, Head of the Department of Clinical and Experimental Medicine at University of Surrey, United Kingdom. In parallel he continues to work in his general practice in Guildford, UK where he has practiced for over 30 years. Professor Lusignan is an active researcher, with over 350 peer reviewed papers published, and key interests in how to infer meaning from routine data, incorporate technology into clinical workflow, and develop new clinical roles that harness technology. He is Director of the Royal College of General Practice Research and Surveillance Centre. Professor Lusignan is Fellow of the British Computer Society (BCS), and a Foundation Fellow of the Faculty of Clinical Informatics. He is also a Fellow of the Australasian College of Health Informatics. Within BCS, his roles are Editor-in-Chief of the Journal of Innovation in Health Informatics (JoIHi)—new reviewers and members of the editorial team are welcome any time, please contact Simon—and UK representative to European Federation of Medical Informatics (EFMI) where he is National Representative, a member of EFMI Board, and leads the Primary Care Informatics Working Group.

Jadranka Božikov is recently retired Tenured Full Professor in Medical Informatics and former director of the Andrija Štampar School of Public Health, a part of the University of Zagreb School of Medicine in Zagreb, Croatia. She is a mathematician by background who earned her MSc and PhD degree in Public Health and Health Care. Professor Božikov participated in several internationally supported projects intended for capacity building in medical and public health education, including the joint project with the Japan International Cooperation Agency which established a Croatian network for continuing education in primary health care using digital and video technology already in mid-1980s. At the University of Zagreb School of Medicine she participated in the postgraduate MSc program in medical informatics started already in the mid-1980s and in the development of a modular PhD program in Biomedicine and Health Sciences based on the Bologna principles introduced in the early 2000s. Professor Božikov co-authored more than 100 journal articles and book chapters and co-edited two books published in English.

Kristina Fišter is Assistant Professor of Medical Informatics at the University of Zagreb School of Medicine, Andrija Štampar School of Public Health in Zagreb, Croatia and member of the Committee for eHealth at the Croatian Academy for Medical Sciences. A medical doctor, she holds MSc in information sciences and PhD in epidemiology. She heads the Division of Medical Informatics and leads biomedical informatics courses across graduate and postgraduate studies spanning medical and nursing students, PhD students, as well as medical doctors specialising in several primary care disciplines. She has served as research editor for general medical journals BMJ and CMAJ. Assistant Professor Fišter is recipient of the Zagreb University Chancellor Award and Best Poster Award at the European Federation for Medical Informatics MIE2000 meeting in Hannover.

References


Early detection of type 2 diabetes mellitus

Leona CILAR a,1, Sergej KMETEC a, Petra POVALEJ BRŽAN a,b, Nino FIJAČKO a, Primož KOCBEK a, Janja LORBER c and Gregor ŠTIGLIC a,b

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1. Topic

The prevalence of Type 2 diabetes mellitus [T2DM] among adults worldwide was 7.4% in 1995 and has risen to 8.5% (422 million) in 2014 [1]. Often the symptoms of T2DM are not obvious, which can lead to a high number of undiagnosed cases and can consequently cause serious complications [1]. This makes the early detection and treatment even more important. The demonstration will focus on development of a screening tool for T2DM risk evaluation in Slovenia as well as validation of the deployed applications.

2. Contents of the demonstration

Risk factors for developing T2DM

The introductory part of the demonstration will provide information on risk factors for development of prediabetes and undiagnosed T2DM outlining the importance of including actionable risk factors in development of screening test. For example, each individual can influence his or her lifestyle and habits, but cannot influence their gender or age. Nurses can have a big impact on early detection of T2DM, especially in preventive healthcare tasks that include nurses working with healthy population. Thus, in different countries various questionnaires were developed to improve preventive work in early detection of T2DM. In our demonstration we focus on The Finnish Diabetes Risk Score (FINDRISC), which is also used at the primary healthcare level in Slovenia and was used as a baseline for development of a novel SLORISK predictive models.

Development of screening tool for T2DM in Slovenia

In our recent paper [2], we presented the development of two simplified screening tools for undiagnosed T2DM and pre-diabetes in the Slovenian population. The data from electronic health records (EHR) for comprehensive medical examinations in five Slovenian healthcare centres (n =2073) was used to develop two predictive models. Both models showed a significant improvement in performance when compared with the original version of FINDRISC questionnaire.

Additionally, we developed an online application for early detection of pre-diabetes and undiagnosed T2DM for the general population. This test is focused on the general population and will also be demonstrated. Separate versions of the online application one for general public and one for healthcare professionals working at the primary healthcare level were developed and deployed. This demonstration will focus on the latter application, as we believe it can significantly improve the success of convincing people to change their lifestyle by an explicit presentation of the risk and possible consequences.

Validation of the deployed applications

After the deployment of the SLORISK tool in the clinical environment, we started collecting data on how perceive the risk over time as well as the hypothetic effect of changing their lifestyle has on the risk for prediabetes or undiagnosed T2DM. It is given healthcare professionals the opportunity to demonstrate how a change in lifestyles can influence the risk over time with the purpose to increase a person’s motivation to live.

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healthier. Currently we are exploring the possibilities to extend the current applications to other chronic diseases, especially to cardiovascular diseases.

References


Where is additive manufacturing in medicine in Croatia?

Mladen ŠERCER a,1, Miodrag KATALENIĆ a and Damir GODEC a

Faculty of Mechanical Engineering and Naval Architecture

1. Introduction

Medicine is an ideal area for applying our knowledge and skills in conjunction with additive production. Each person is unique in his character traits as well as in physiological and anatomical characteristics. The use of individual medical products on a patient basis, whether it is a model for planning a medical surgery, surgical guides for preparation and setting of implants or on individually tailored implants, facilitates medical procedures for doctors, as they can pre-plan surgery, shorten the surgery time by using our products, and thus reducing stress and effort in the process, while increasing efficiency and helping patients improve their treatment with the medical products that were specifically made for them.

2. Application of AM in medicine

The development of additive manufacturing in the clinical world has been rendered possible by the concomitant advances in three fundamental steps [1] (Figure 1):

- Medical imaging (data acquisition)
- Image processing (image segmentation and reconstruction by means of appropriate software)
- Additive manufacturing itself

The capability to translate data from clinical imaging techniques, such as computed tomography (CT) and magnetic resonance imaging (MRI), makes AM technologies particularly useful for many biomedical applications.

The AM allows an easy conversion of digital models from medical imaging of a patient’s anatomy for the fabrication of patient-specific anatomical models and medical implants from various biomaterials, offering a high level of control over the architecture, and guarantees reproducibility.

The procedure took place in several stages and began by creating a precise digital 3D model of the patient’s bone. The medical team worked closely with us (Centre of Additive Technologies at the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb). Patient was recorded using the CT machine, and then CT scan was digitally processed in software for processing 3D STL files. We have modelled the implant in CAD software, tailored to the patient's implant, and then the mould according to the implant. Mould was printed by using PolyJet Matrix technology.

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At the request of the neurosurgeon to solve the problem of making large and geometric complex implants for cranioplasty from bone cement, we have developed our methods of designing and making 3D-printed moulds based on patient's CT. Through our research, we have been able to find the most accurate manufacturing technology and material that allows the doctor to easily create patient's implants during surgery.

First case study was a young girl of 23 years who had a benign change in the bones of the head and part of the diseased bone had to be removed. The deformed part of the skull was on the forehead and visible, so apart from the bone removal it was necessary to eliminate cosmetic defects to reduce the psychological consequences of the surgery and to help the patient to recover quicker. Tailored implant placement surgery was carried out successfully with shortened operation time of one hour. Surgeons performed the operation with a lot less stress and more quickly and ultimately better for the patient with the aesthetic result that could not be better in no other way than an implant tailor-designed by computer for specific patient. The patient was very pleased with the result of the operation.

Using our knowledge of the mould design we have created a new method adapted to the additive manufacturing and by using our method of making implants from bone cement in a 3D printed mould, geometrically very demanding implants can be made and tailored to the patient's needs, which was not possible with previous methods. By using this method so far, we have created 10 personalized implants for cranioplasty, total replacement and reconstruction of cervical vertebrae and reconstruction of half of the mandible.

References

Incorporating uncertainty in decision support: 
an end-of-life illustration

Mette Kjer KALTOFT a,b, Jesper Bo NIELSEN b and Jack DOWIE b,c,1

a Odense University Hospital Svendborg
b University of Southern Denmark
c London School of Hygiene and Tropical Medicine

1. Introduction

Uncertainty is the normal situation in decision making, in fact without it decision making – and therefore decision support - will often be unnecessary. How uncertainty should be dealt with varies with the paradigm within which the decision process, and hence decision support for it, is conceptualised. In the currently dominant paradigm in healthcare, researchers establish the expected average outcomes for parameters, along with their uncertainties, and hand over the burden of dealing with the separate outputs – e.g. Means and Credible Intervals - to the decision maker. Whether individual or group, the decision maker (owner) is expected to make the necessary trade-off between them as part of a final ‘making up their mind’. There is no attempt to synthesise, transparently and analytically, the joint means and uncertainties of the performance ratings for all options on all criteria, simply to report them fully and transparently [1,2]. This creates a problem if empowering person-centred care is the aim.

2. Method

We take the view that computerised interactive decision support tools built in value-based, compensatory Multi-Criteria Decision Analysis are the best way to deliver person-centred care that is genuinely empowering without being overpowering [3,4]. In these tools the person’s quantitative preferences for outcomes and process considerations (as ‘criterion weightings’) are combined with quantified evidence and expert assessment (for ‘option performance ratings’ on all criteria) to produce a personalised quantified preliminary opinion (as a set of ‘option scores’) on what is best for this individual. The opinion is comprehensive preference-sensitive index Score (one number) for each option. This implies the decision maker cannot be supplied with uncertainty information alongside, and separate from, the mean. The required mean-uncertainty preference trade-offs must be those of the decision maker, and they are not to be left for them to tackle, unsupported, outside the tool. The personalised Scores produced by the decision support tool must incorporate their personal mean-uncertainty trade-offs, by elicitng them from the decision maker within the tool. To be of use at the individual level, the tool must be both accessible and practical at the point of decision, whether in the community or clinic. We find ‘end-of-life’ decisions to be an excellent setting for exploring this issue because it is generally accepted that both expectation and uncertainty are decision-relevant, and the individual is highly motivated to address the tough questions (about ‘trade-offs’) involved. In our exemplary tool there are separate mean and uncertainty criteria [5]. The performance ratings for length of life under each option are evidence-based and entered in the tool by the decision analytic supporter. The preferences of the individual in relation to mean and uncertainty (their criterion weightings) are elicited at the point of decision. The tool then calculates and displays the expected value of the two options using these weightings, yielding a preference-sensitive opinion.

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3. Result

A conversation between an individual and a healthcare decision analysis professional is presented. Will Tremain faces a choice between palliative care (mean expected length of life 6 months, absolute credible interval around mean 3 to 9 months) and a risky operation (mean 9 months, credible interval 0 to 18 months). He is helped to engage with a decision support tool that elicits his trade-offs between expectation and uncertainty and displays the resulting preference-sensitive opinion for his consideration and exploration. Additional criteria (option side effects and option burden) are added. The exemplary tool is available at https://goo.gl/ehGy6k and the full conversation text is available at https://goo.gl/gv7n3h.

4. Discussion

Three main objections are met when this idea is presented. The first is essentially opposition to any attempt to approach individual decisions in this quantitative analytical way, especially in relation to such ‘sensitive’ decisions. We take the view that obtaining a fully informed and preference-based consent to any provider action cannot be obtained without such a personalised assessment of all the harms and benefits of all the relevant options. The second objection is to the trading off of mean and uncertainty, where some argue that the mean already incorporates and reflects the uncertainty so that adding it as a separate criterion involves ‘double-counting’. We agree that there are sound normative Bayesian reasons for always going with the expectation and ignoring uncertainty, and this can be achieved in the tool by giving zero weight to the uncertainty criteria. On the other hand, we think the decision owner should be offered the chance to trade-off the uncertainty and the expectation, if they wish. The third objection concerns the (im)practicality of elicitation. On this issue, which occurs in delivering almost all decision support tools, we take the view that the task must be tackled as best one can, not abdicated in favour of some disempowering non-person-centred alternative.

5. Conclusion

The conversation shows that parameter uncertainty can be incorporated in a decision support tool and engaged with in a feasible, meaningful and educational way. However, the main aim here is to open the topic for debate. Alternative suggestions of how uncertainty can be incorporated in decision support, within the context of person-centred decision making, are welcome.

References

Interrelation of drug search on the Internet and police seizure in the Republic of Croatia

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1. Introduction

In many countries, the problem of drugs as a transnational, transcultural, and global phenomenon occupies a very high place in the ranking of priorities related to national security and the health of the nation itself [1]. Drug abuse and drug dependence as a consequence, with accompanying contagious diseases such as HIV, hepatitis and sexually transmitted diseases affect all social groups, the social community and all countries [2]. Given the globality of drug abuse, Croatia is not and cannot be isolated, and drug abuse in the Republic of Croatia is one of the most important issues that society must face seriously. Croatia, given its geostrategic position, is a transit country through which drugs are smuggled on the road between producers and consumers countries (Balkan route phenomenon) [3]. Talking about the problem of drug abuse almost always raises the question of how to solve it and whether it is at all possible. It is more common to hear the opinions about its ineligibility and satisfaction if it is kept within the limits of "social acceptability". Offering the internet has never been bigger and consequently has increased demand, especially among young people. This has created new challenges for the development of new supply and demand reduction programs.

The aim of this paper was to determine whether there is a correlation between search through Google's search engine and the seizure of the most commonly used drugs by counties of the Republic of Croatia in the period from 1 January 2012 to 31 December 2016 and in case of correlation the Google Trends tool to present for timely obtaining useful data based on which timely interventions could be carried out.

2. Method

The analysis used the online Google Trends tool that provided us with information on the most commonly used drugs in the counties of the Republic of Croatia, searched for in the period from 1 January 2012 to 31 December 2016. Five-year data on seizures per county were obtained from the Statistical Survey of Basic Security Indicators and results of the Ministry of Interior's Strategic Planning, Analytics and Development Department. In order to determine the correlation between searches through the Google search engine and the seizure of the most commonly used drugs, Spearman's correlation coefficient was calculated. Also non-parametric sign test was performed.

3. Results

The results of the research have shown that the cocaine correlation is excellent ($r_s=0.79$, $p<0.001$ / $Z=0.229$, $p=0.819$), for hashish ($r_s=0.61$, $p=0.014$ / $Z=0.688$, $p=0.491$), heroin ($r_s=0.61$, $p=0.008$ / $Z=1.606$, $p=0.108$), ecstasy ($r_s=0.63$, $p=0.003$ / $Z=0.447$, $p=0.655$), marijuana ($r_s=0.64$, $p=0.002$ / $Z=0.943$, $p=0.346$) and amphetamine ($r_s=0.65$, $p=0.006$ / $Z=0.688$, $p=0.491$) correlation is good while for LSD correlation is weak ($r_s=0.41$, $p=0.14$ / $Z=0.447$, $p=0.655$). The calculated Z values in the sign test indicate the lack of systematic relationship between search rankings and seizures.

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4. Discussion

No literature has been found to investigate the link between searches through the Google search engine and the amount of seized drugs. American withdrawal site has published results related to online drug search trends across federal states and cities of the United States in the period from 2004 to 2014 [4]. Similar to our research, research was conducted in the area of Switzerland, Germany and Austria where Gamma and his associates [5] sought a link between the search for “meth” and methamphetamine related crimes (use, possession and trading) between January 2004 and February 2016. Search trends correlated with the number of criminal offenses. Kapitány-Fövény and Demetrovics [6] investigated whether the illegal status of mephedrone in Hungary reduced search (“demand”) by Google search engine. Search results correlated with legal or illegal status. Caputi [7] was researching whether in some US federal states the introduction of a higher tax on cigarettes increased the demand for cheap cigarettes. Connections have been noted for ten of the twelve federal states. Borron and his associates [8] found an increased demand for loperamide in the Texas area as a substitute for unauthorized funds for the period 2009-2015. Parker and associates [9] have provided data that Google Trends based on a series of terms can predict the suicidal rate and the deaths caused by over-consumption of alcohol and drugs. Although this paper does not calculate the correlation between the rates of treatment of addicts per 100,000 population aged 15-64 [10] and the search index by Google search engine, it can be seen that counties that are more burdened with the number of treated addicts also have higher Google Trend index.

5. Conclusion

Given that the statistical reports are published with a significant time lag and given the timely availability of data through Google Trend, as well as the fast-growing computer literacy and global computerization of the society both in the world and in Croatia, predictive models that include internet data searches that are not subject to social and psychological bias certainly become an area of interest in all systems and policies, as well as healthcare, which confirms the rise of the publications related to nowcasting in the last two years.

However, the context of online behavior is unknown and search motives are difficult to identify. Currently, through this and similar platforms, it is impossible to obtain age and gender data to standardize. The results should be considered as a useful infodemiology indicator. The research should certainly be repeated in the following specified time periods to see if the same results are being repeated. Methodology used in this paper could be the basis for further research and the better quality allocation of resources to preventive and intervention programs in real time.

References

Patient Decision Aids: A Decision Tree Analysis of Current Tools

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1. Introduction

This paper presents the preliminary results of a decision-tree analysis of Patient Decision Aids (PDA). It analyses the theoretical framing of the decision trees described by the PDAs analyzed.

2. Method

Twenty PDAs are randomly selected from the International Patient Decision Aids Standards (https://decisionaid.ohri.ca/AZlist.html) approved list. An evaluation tool is built bottom-up and results are described in terms of communicating uncertainty, completeness of the decision tree, ambiguous or misleading phrases, overall strategies suggested within personal stories, and so on.

3. Results

12 of the analyzed PDAs had branches of the decision tree which were not discussed in the tool and 6 had phrasing problems. Many tools included dichotomous options, when the option range was wider. Several options were clustered within the “Do not take/Do not do” option and thus failing to provide all comparisons necessary to make a decision. Some tools do not differentiate between lack of information about the effects of an option and known negative effects. Other tools provide unequal amounts or non-comparable bits of information about the options.

4. Discussion

These results indicate a very loose range of interpretations of what constitutes an option, a treatment, and a treatment option. It thus emphasizes a gap between theory and practice in the evaluation of PDAs.

5. Conclusion

Based on these results future developments of PDA evaluation tools should keep track of missing decision tree branches, accurate communication of uncertainty, ambiguity, and lack of knowledge and consider using measures for evaluating the completeness of the option spectrum at an agreed period in time.

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Pilot analysis of knee arthroplasty patient characteristics relevant for building a decision support system for nurses

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1. Introduction

Knee arthroplasty is a common and frequently performed operation [1]. The primary indication for knee arthroplasty is advanced degenerative joint diseases (e.g. osteoarthritis) [1]. These conditions are related to significant psychological, social, and economic costs [2]. Patients usually undergo knee arthroplasty surgery when non-operative treatment is inadequate to maintain knee function and relieve pain [1]. The annual incidence of patients undergoing knee arthroplasty is increasing worldwide due to demographic changes in the population and an rising prevalence of people with osteoarthritis [1, 3]. Around 8500 operations are performed annually in Denmark [4].

The process of surgical treatment and care have advanced the last decades leading to implementation of fast-track surgery as a standard of care [5, 6]. The fast-track program increases the cost-effectiveness of knee arthroplasty surgery by decreasing in-hospital costs [7]. The principles behind fast-track surgery includes a coordinated approach with multimodal pain management, early mobilization, improved nutrition, and intensified rehabilitation [8, 9]. Although it is a severe surgical trauma, the average hospital stay has decreased from about 10-14 days to about 2-3 days [5, 6]. Furthermore, the patients are now in most hospitals discharged directly to their homes rather than rehabilitation facilities [6, 8, 10]. Studies have shown that a significant number of patients experience care related problems after fast track knee arthroplasty [5, 10].

The objective of the present pilot study was to explore correlations between factors in knee arthroplasty with the aim to gain knowledge that is relevant for building a decision support system for nurses for care planning to improve patient care.

2. Methods

Data from 130 patients from Aalborg Municipality undergoing knee arthroplasty at Aalborg University Hospital, Denmark were collected. As a pilot study 8 variables were selected for a descriptive analysis of correlations between various patient factors and factors indicating postoperative care needs. The correlations were analyzed using pairwise, bootstrapped Pearson’s Correlation Coefficients with 1,000 replications.

The variables in this pilot study were: 1) Preoperative BMI, 2) Preoperative quality of life score EQ5D3L, 3) Preoperative Oxford Knee Score, 4) Preoperative pain in rest on a VAS scale, 5) Preoperative pain in activity on a VAS scale, 6) Oxford Knee Score 6 months follow-up, 7) Oxford Knee Score 12 months follow-up, 8) Oxford Knee Score 24 months follow-up (OKS: questionnaire designed to assess function and pain).
3. Results

Only Preoperative EQ5D3L and Preoperative OKS correlated statistically significant with all three follow-up variables, as shown in Table 1.

<table>
<thead>
<tr>
<th>Prim var</th>
<th>OKS 6 months</th>
<th>OKS 12 months</th>
<th>OKS 24 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preop EQ5D3L</td>
<td>0.34 (95% CI: 0.05 to 0.52)*</td>
<td>0.32 (95% CI: 0.02 to 0.63)*</td>
<td>0.31 (95% CI: 0.09 to 0.59)*</td>
</tr>
<tr>
<td>Preop OKS</td>
<td>0.35 (95% CI: 0.18 to 0.50)*</td>
<td>0.32 (95% CI: 0.01 to 0.49)*</td>
<td>0.30 (95% CI: 0.08 to 0.49)*</td>
</tr>
</tbody>
</table>

4. Discussion

Even though it may seem plausible that Preoperative EQ5D3L and Preoperative OKS correlated with the OKS outcome variables, there seems to be no obvious reason why the other three preoperative variables did not show the same clear picture. Further studies, both quantitative and qualitative, should explore this.

References

Decades of Learning in Medical Decision Support – Mapped into a Blended Learning Module for Health Professionals

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1. Introduction

From the very beginning of computer use in medicine there have been concepts about clinical decision support. The development was driven from very different directions: From new technologies (e.g. ECG and biosignal analysis in the 60ties and sensors 40 years later). From acute clinical needs (e.g. closed loop monitoring in intensive care of open heart surgery). From complex clinical situations endangering impact (e.g. handling of patients with uncharacteristic chest pain in the 80ties or similar questions for emergency triage today). Complex high dimensional questions have been addressed all the time with many new mathematical approaches (e.g. acute abdominal pain in the seventies or support in multi-dimensional precision medicine today). Especially the analysis of sensoring and decision support to improve critical incident care for elderly citizens has demonstrated that not only algorithms, nomenclatures, and mathematics play a role but also trust, sensibility, and understandability for patients and health professionals. The acceptance dimension of the matter proved to be as important as the maintenance of the IT and algorithmic infrastructure.

2. Method

HiGHmed is one of 4 national medical informatics projects aiming to improve data exchange and usage between medical research and treatment in Germany [1]. Reflecting the background summarized above, in HiGHmed 12 universities and technical colleges have agreed to develop a blended learning infrastructure addressing digitization of health in Germany. The medical school in Goettingen is coordinating issues of decision support in clinical care – collaborating with ADA and Siemens Healthineers. The approach links traditional course work, a training lab in collaboration with Siemens, and a training module of the ADA software [2]. The blended learning solution targets all levels from health managers on the top to young students. In the future additional offers shall be developed for citizens and patients.

3. Results

The systems infrastructure leverages existing architectures in Germany which is the most promising approach considering long-term sustainability and maintainability within and past project boundaries. Open source software based learning platforms available at the partner sites will be connected using the cross-institutional authentication and authorization infrastructure for German higher education [3]. Combining instances of e-learning systems Moodle [4], Ilias [5], and Stud.IP [6] and opening up the existing systems for project-wide participation and collaboration in a decentralized “best of breed” architecture enables dynamic extension and exchange of tools and content.

The project has started to evaluate several other examples of blended learning approaches to avoid repetition of curricular, financial or administrative mistakes (e.g. Hasso Plattner Institut, Potsdam [7]; Virtual
University of Bavaria, Bamberg [8]; University for Health Sciences, Medical Informatics and Technology, Hall, Austria [9]; Fraunhofer Academy, München [10]). They show relatively uniform, that it is a long-term undertaking with substantial changes in teaching culture, infrastructures, and financing. Therefore it is planned to formulate a list of stringent recommendations to be followed by partners interested in joining the HiGHmed blended learning project. Currently 12 universities and polytechs contribute each with a different content module. End of 2018 the first version of the blended learning teaching modules will be available.

4. Discussion

Many researchers and politicians dream of the positive future for patients in a “precision medicine” – a world full of data, artificial intelligence, and participating patients. They underestimate the fact that neither the nomenclatures in medicine nor the training procedures are prepared to handle such an information flood – not to speak about acceptance and maintenance of approaches. Also a new generation of IT-Platforms for care in doctors’ offices and hospitals will be needed and seems to be under construction. All this makes the project very complex as it addresses a moving target and the content of its blended learning modules will need updating every year. This means that a key problem to be solved is how the maintainability of such an infrastructure can be financed continuously. Thus success will not only depend on the educational components but also on how the existing traditional processes and structures can be changed.

5. Conclusion

The methodological questions how to validate decisions strategies need to be addressed not only at the algorithmic kernel. The results of these scientific, societal, and legal approaches need to be made transparent and understandable to population and to professionals. Blended learning approaches are a long term option for this challenge.

References

1. Introduction

The evolution and specificity of the health sector impose their professional knowledge increasingly rigorous mechanisms that explain the increasing difficulties in managing this area of activity both at the macro level and at the level of the various units which lend themselves healthcare.

The skills are the building blocks of job performance and competency models are increasingly being used as the basis of management of human resources. The increasing competitiveness of organizations requires a search of health professionals with ever more skilled and qualified professionals. The need to increase the skills assistance, management, research and teaching, is gradually incorporates professional skills [1].

The aim of this study is to analyze the competencies expressed by nursing managers. To identify areas of need in learning or administration / management.

2. Method

In this study, we recorded the full transcript of the interviews to ensure precisely what was said by the nurse manager. After transcribing the interviews, we have a first reading of all the interviews and then we made the codification and organizing frameworks.

We defined categories, subcategories and registration units, which shall order the information.

The speeches made by respondents, were assessed using the content analysis according to the principles described by Bardin [2].

3. Results

From the interviews analysis, the following main categories emerged: communication, management of human resources, management of conflicts, leadership, negotiation and the improvement of the quality.

4. Discussion and Conclusion

Today is demanded that the manager in nursing have a combination of knowledge, attitudes and behaviours that are fluid in its tonic in different types of organizations. We need to construct a plan of professional development for the nurse managers, which is adjusted in competencies and takes technical, ethical-politics, communicative and the development of the citizenship dimensions in consideration.

Practical relevance

- That nurse manager encourages teamwork in the formulation of purpose and seeks new methods of work planning.
- To integrate in curricula of Bachelor degrees content of nursing management.

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Research implications

This study was centred only on qualitative aspects of the experience of nurse manager who works in central hospitals. Development of other research projects dealing with management and satisfaction of nurses and nurse managers is recommended.

References

OntoPharma: Clinical Decision Support System based on ontologies

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1. Introduction
Several studies have shown that medication errors are a major contributing factor to morbidity and mortality [1, 2]. Drugs errors are attributed to several factors, including the poor computerization of health information systems and the increasing complexity of therapeutic procedures [3].

Clinical decision support systems (CDSSs) may help to reduce medical errors and increase health care quality and efficiency [4, 5]. Because of the complexity of health information, characterized by hierarchical and multilevel data structures, it is difficult to represent and store it in the traditional relational databases. In order to build the knowledge base of a CDSS, it is more suitable to represent drug information through a domain ontology. An ontology is a formal, explicit specification of a shared conceptualization [6-9].

Therefore, our goal was to develop OntoPharma, a CDSS based on a set of ontologies that represent available drug knowledge.

2. Method
The design, implementation and maintenance of OntoPharma has been coordinated by a multidisciplinary team that includes Health Informatics Specialists, Specialist Clinical Pharmacists and others physicians.

For the development of OntoPharma, we have used the following elements:

- OWL: computational logic-based language [10].
- Protégé: open source ontology editor and a knowledge management system [10].
- SPARQL: SQL-like language for querying RDF data.

The development of OntoPharma includes the following phases [12]:

1. Selection and collection of drug knowledge.
2. Drug knowledge representation through a domain ontology.
   2.1. Definition of classes and class hierarchy.
   2.2. Definition of the properties of classes—slots.
   2.3. Definition of the facets of the slots.
   2.4. Creation of instances
   2.5. Coding terms and concepts using a standardized clinical terminology (SNOMED CT), if possible.
2.6. Implementation of the ontology in a formal representation using OWL.
3. Connection with information system (under development).

It is expected that the connection between OntoPharma and other information systems will be through web services. The invoking system (example: electronic prescription system) will send clinical parameters to OntoPharma through web services using SPARQL. OntoPharma will return information about drug adequacy to the invoking system in the same way.

In this manner, OntoPharma can be used interchangeably by heterogeneous systems and can be easily updated, without affecting applications connected with the ontology.

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3. Results

The main sources of information have been the drug database of the Spanish Agency for Medicine and Health Products [13], in addition to drug safety information from Catalan Health Service. On the basis of the information provided, we have modeled it in order to create a set of ontologies interrelated which represent drug knowledge. The ontologies represent technical information related to drug identification and information to improve drug adequacy.

Concerning the later, five SPARQL queries have been defined in order to check the knowledge represented in OntoPharma taking into account the clinical parameters of the patient. The queries refer to the following data: Maximum daily dose (in adults and neonates, respectively); Drug dosing in renal disease; Allergy alerts; Drug interactions; FDA pregnancy categories.

The clinical parameters that are needed to query OntoPharma are: age, weight (kg), drug prescription (brand name, active ingredient, dose, dose unit, posology and administration route), allergy data, renal function data (glomerular filtration rate ml/min/1.73 m2), and in case of women, to know if they are pregnant.

We have verified queries work well but it is still pending to finish developing a web service which connects the invoking system with OntoPharma. It is also necessary to develop an interface that display the alerts generated by OntoPharma.

4. Discussion

We have managed to model drug information to create a set of ontologies. A main limitation is to use drug knowledge bases, which usually are incomplete, low structured and inconsistent. A panel of experts comprised of 21 healthcare professionals from different areas of expertise help to model the knowledgement.

It is expected that the use of Ontopharma on the everyday life as the knowledge base of a CDSS improves drug adequacy and reduce medication errors. It is necessary to evaluate the economic and health results arising from OntoPharma implementation in different healthcare levels. Continue to expand and update the knowledge represented in OntoPharma is key to obtain a suitable return.

5. Conclusion

We have developed OntoPharma, a CDSS based on a set of ontologies that represent available drug knowledge.

References

Trends in medical informatics journal publishing - a scoping review in the Web of Science Core Collection database

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1. Introduction

Medical informatics has become one of the crucial components of medical knowledge in this century. Information and communication technology is improving day by day and new technologies are coming ahead. As technology, scientific publications are on the rise and therefore the aim of this study was to analyze the trends in journal publishing in medical informatics field in the last five years.

2. Method

We have done a scoping review in Web Of Science Core Collection database (WoSCC), which is chosen because of its automatic analysis functionality and citation report. First, we have searched the WoSCC database using the keywords „Medical Informatics“ OR „Health informatics“ and its versions (TOPIC: ("medical informatics") OR TOPIC: ("health informatics") OR TOPIC: ("medical-informatics") OR TOPIC: ("health-informatics") OR TOPIC: ("medical-informatic") OR TOPIC: ("health-informatic") OR TOPIC: ("medical-informatic") OR TOPIC: ("health-informatic"). Then, the results were limited from year 2012-2017 and to articles, reviews and editorial material. We have analyzed the publication records by publication year, country and most cited publication records.

3. Results

There were 5621 records in the database containing the keywords “medical informatics” OR “health informatics”. Out of all records, 2179 (38.8%) were published in the last 5 years, and all together 1540 (70.6%) were articles, reviews and editorials. Out of 1540, 725 (47.1%) records were published in open access mode. Almost half of the articles were published from authors from the US and then UK, Canada, Australia and Germany. Majority of the articles were published in the Journal of Medical Internet Research [81(5.3%)], International Journal of Medical Informatics [78(5.3%)] and Journal of the American Medical Informatics Association [64(4.2%)]. Ten most cited articles were cited from 63 to 320 times. Out of 10 most cited articles 6 were published in the medical informatics journals, 3 in medical journals and one in informatics journal. The most cited article was Moher et al “CONSORT 2010 explanation and elaboration: Updated guidelines for reporting parallel group randomised trials”.

4. Discussion

There are more and more articles published each year in the field of medical informatics as technology is developing. Majority of the articles were published in high impact (>3.0) medical informatics journals. What is interesting is that the most cited article (320) is published in a medical journal and is about updated

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CONSORT guidelines for reporting parallel group randomized trials. The rest of the most cited articles are related to: wearable technologies (175 citations), clinical decision support systems (112 citations), algorithm in tumor diagnosis (90 citations), secondary use of EHR data (77 citations), social media (76 citations), big data (75 citations), prevention programs (74 citations), AMIA white paper (65 citations) and misleading health-related information (63 citations).

5. Conclusion

Publishing in medical informatics is on the rise in accordance to the global publication rise. Most of the articles are published in high impact journals and topics that rise most interest among readers are related to guidelines and new technologies.
Teaching High School Students eHealth through Role-play and Laboratory Simulation

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1. Introduction

The transformation and digitalisation of health and care services foresees a need for recruitment of young individuals having a combination of health- and computer science knowledge to contribute in the workforces of the future. At the University of Agder in Norway there has been an eHealth Centre since year 2010 [1], where both already implemented and proposed eHealth services can be simulated and tested. In the project High School Students as Co-researchers in eHealth, experienced researchers allowed high school students to be enrolled in a project course to actively play and test an eHealth scenario. This paper aims at sharing the experiences on how the pilot of a class consisting of 10 high school students at the age of 17-19 years, were taught eHealth through role-play and simulation in the eHealth Centre. The research question stated was: How to introduce high school students to eHealth research and services in a life-long learning perspective?

2. Method

As a part of the project High School Students as Co-researchers in eHealth, a role-play scenario with simulation of a telecare alarm scenario was developed by researchers based on recent experiences and results from the project Model for Telecare Alarm Services at the eHealth Centre [2]. The eHealth Centre consisted of laboratory facilities with several test rooms and a control room to carry out the role-play scenarios [3][4]. Four researchers were present from the University of Agder with a multi-disciplinary background within health informatics, computer science and health science, all with teaching experience. The Research Council of Norway funded this work with grant number 283737.

3. Results

The simulation started with a short briefing session including information on the different scenarios and a walk-through the eHealth Centre. Based on a pre-defined scenario, the students were assigned roles in small groups which were: a) patient at home triggering a telecare alarm with a GPS geolocation and communication device, b) telecare alarm service operator, c) municipal home nurse on duty using a mobile phone device, d) family member and e) observer in the observation room following the interactions. The test rooms were used simultaneously, with interactions only through technology, observed by a group of students and researchers in the control room. The scenarios ended with a group debrief, where the students’ reflections on the scenarios were discussed and comments were made on how to improve the scenarios. The students had little or no background from healthcare and this remarked a need for more instructions on how to behave and act as a health care worker during the scenarios. The learning outcomes were how technology can help patients and support health service providers, by experiencing the different roles in a typical telecare scenario, and by testing out devices for activating, receiving and handling telecare alarms.

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4. Discussion

The role-play and simulation in the eHealth Centre allowed the high school students to understand and experience eHealth technology by carrying out a telecare scenario. The structure with applying theory into a practical simulation in the eHealth Centre laboratory provided a student-centred approach endeavoring an early understanding of eHealth concepts. The instructors were active and experienced researchers in eHealth, and the laboratory simulation aimed at providing the students with insights and hands-on real problems to solve within eHealth, also reflecting on-going and recent research projects. Hopefully, some of the students will choose an eHealth-related career in the future.

References

Concerns about data protection and privacy in a European online community of multiple sclerosis patients

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1. Introduction

It has been pointed out the need for identifying how the virtual communities helped people in coping with complex health issues, such as those present in patients suffering chronic diseases.

The rise of health-related social networks and online communities of patients in the digital age represent a good example of how patient empowerment occurs, and may help to redefine the actual meaning of this key feature of a modern and equitable approach to health care [1]. A virtual community in health care has been defined as “a social unit that involves members who relate to one another as a group and interact using communication technologies that bridge geographic distance”. In this context we chose to study the case of Carenity, an online free social network created in France in 2011 bringing together 300,000 patients across Europe and the US, aimed at connecting people affected by chronic diseases. We selected patients suffering Multiple Sclerosis (MS) at the different stage of the disease. In this study we describe and analyze their perceptions about the benefits obtained from their participation in the Carenity platform, and their concerns about privacy and trust when they communicate with other participants.

2. Methods

We conducted an exploratory-descriptive online survey, which was applied to Carenity members suffering Multiple Sclerosis. For this survey we selected six close-ended and one open-ended question. The survey was displayed on the Carenity website during four weeks. A total of 253 patients completed the questionnaire online. We performed a descriptive analysis on quantitative data, using simple frequencies and contingency tables for specific variables.

3. Results

More than half of respondents (51.4%) declared that platform exchanges of daily experiences provided them psychological support; 43.9% of the respondents declared, a positive impact on their quality of life. A relevant result was that only 12.3% declared that the relationship with their treating physicians changed as a result of their participation on the platform. 28.1% joined Carenity as a remedial action to solve the inadequate amount of information they received from their physicians. With regard to the confidentiality of the data, 75.5% considered that sensible data they shared at the site were well protected. This result, added to the high

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percentage of patients sharing information with other members of Carenity that they would not share with others, is consistent with that finding, reflecting collective trust in the platform, allowing a sense of ownership over the data they post. 82.2% of respondents indicated that their perception of privacy has not changed since they joined the platform.

4. Discussion

Although some of the respondents manifested restrictions on the personal information they share about their illness with other people they do not know personally, most consider that the exchanges are beneficial in providing emotional and informational support, reinforcing the sense of trust and reciprocity within the platform. Thus, we may conclude that Carenity participants do not consider that by sharing their personal experiences and data associated with their health condition, their privacy is threatened. There is a paradox, however, that should be explained: on the one hand, most respondents declared that there was no problem with their privacy and that sharing information would not alter the nature of it; on the other hand, according to common sense, you cannot ensure the privacy of the information you interchange with strangers. It may be argued that the existence of a community of patients, affected by the same anxiety and anguish, occasioned by the same evil, i.e. an unpredictable and potentially disabling condition, created a special sense of trust, amongst a group of otherwise unrelated people. In previous reviews, authors complained that although plenty of descriptive and anecdotal information existed on the potential benefits and harms of online peer support, there was a paucity of good quality evidence supporting the efficacy of virtual communities [2]. Our findings, notwithstanding, are consistent with anecdotal findings, showing that emotional support received in online communities is effective in improving psychological quality of life, particularly on stigmatized patients [3].

References

Technical students training for developing healthcare systems

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1. Introduction

In the current day to day life people started to become more and more dependent on embedded systems, as digital information technology embedded in our specific environment. To achieve the competences needed to create complex systems at an affordable price it is important to train young students to gain practical knowledge starting from first years in the university. Students start to design and implement small scale projects during the 1st, 2nd and 3rd year during the bachelor program and may continue after they graduate a bachelor’s degree with Master studie s on Informatic Systems Applied in Healthcare [1]. There is also the possibility to continue with a PhD program with research in medical informatics domain.

2. Methods and materials

One of the projects consist of an Arduino UNO, an ECG Shield and a Pulse sensor [2]. The signal is monitored with a desktop application developed using Windows Forms and Visual Studio.NET. The Arduino kit sends the values read by the pulse sensor, sends alarms if they are not in the normal range and saves them in the database.

The source code is written in C language and the programming environment is the Arduino Integrated Development Environment (IDE), an open-source Arduino Software, an easy to write code and upload it on the board. The current example uses Arduino UNO. This assembly can be used in more complex applications, it can be connected to a C# application and saves the received data into a database for further processing.

3. Discussions

Due to market demands it is important for future engineers or informaticians to start working on projects applying embedded systems in healthcare, using an Arduino module and different components and sensors from the 1st year. They will gain the basic abilities for the future when they can develop more complex systems. The difficulty of the project increases gradually in 2nd and 3rd year and the complexity increases at the master program. For example, if they develop new skills related to biomedical domain, like working with biomedical sensors or platforms, they can continue with Informatic Systems Applied to Healthcare master program and after that can continue with a PhD thesis in medical informatics domain (e.g. IoT research or Deep Learning).

4. Conclusions

The laboratory and the project designed and developed during the bachelor program and the master program is intended to train future engineers and informaticians to work with modern tools and to prepare for interdisciplinary domains. They may develop further complex IoT systems and continue working in a company or research in a PhD program. The paper describes activities and tools giving examples of lab & projects preparing the basis for complex applications and give research directions. During the labs students

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gave good feedbacks and most of them are interested and enthusiastic to develop this type of projects, and they like to see that the theoretical part has application in real world. They feel more confident due to the continuity in working style during the 3 years and feel more prepared for the master and PhD programs.

References

eConsultations via Zdravlje.net PRO; a GP-medical specialist communication tool development and piloting experience

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1. Introduction

From 2015 to 2017 Health centre Zagreb – Centre has, as a part of the innovation action of the City of Zagreb Reference site of the European Innovation Partnership on Active and Healthy Ageing (EIP-AHA) and partnering with medical ICT focused SME, developed multiple online communication tools built on top of the existing eHealth platforms.

2. Method

eConsultations via Zdravlje.net PRO provide two-way communication with secondary and tertiary health care specialist started by the GP. GP creates a short query using existing and new medical history and examination data and can attach any relevant medical data from their healthcare program (Medicus.net) e.g. lab results, radiological finding, etc., and sends it in a form of a referral letter towards a specific field of medicine, healthcare institution or directly to a specified specialist. Specialists receive the request via Zdravlje.net PRO web-based interface and can respond with a report or request for further information.

3. Results

eConsultations have been extensively piloted in over 100 GP and over 40 secondary care specialist practices in 4 different institutions and a scale-up strategy has been developed for nation-wide implementation.

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4. Discussion

Using “patient stays – information travels” approach eConsultations reduce unnecessary healthcare expenditures and save time to patients and optimize and save time to medical professionals. Specialists save 10-15 minutes per report using eConsultations. Patients save ~4 hours not travelling and waiting for specialist examination. eConsultations are answered in 2-14 days, waiting times for specialist appointments range from 2 weeks to more than a year.

5. Conclusion

The users experience was predominantly positive: eConsultations were found to be especially useful in reducing waiting time to secondary care and helping patients with low mobility to receive specialist advice and optimize their medications treatment.
Cancer ontology for identifying cancer information needs

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1. Introduction

As cancer incidence and survival rate are increased, need for cancer information has increased, and use of health information has become very important in the primary and secondary preventions of cancer. Those who seek cancer information are using social media to search for cancer information and share experiences with others who have similar experiences. Understanding what kind of information they are searching for or sharing with others is the basis for providing them with tailored information. One way to identify the need for cancer information is to analyze social data. In this study, we developed a cancer ontology in order to identify cancer information needs from social data and develop tailored information for those who seek cancer information.

2. Method

We developed a cancer ontology according to the Ontology development 101 [1]. First, we searched existing cancer ontologies and examined the reusability of these ontologies. There were ontologies for a specific cancer such as liver cancer. However, there was no comprehensive ontology available covering general topics of cancers with terminology for social data. Second, we determined domain and scope of the ontology by developing competency questions such as ‘what are the risk factors of cancer?’ Third, we collected cancer-related concepts and terms from four cancer information portals including National Cancer Institution and Q&A board of cancer patients at a general hospital in Korea. Fourth, we defined hierarchies and relationships of the concepts. Fifth, structure and coverage of the ontology was evaluated by the experts’ interview and comparing the concepts and terms from social big data.

3. Results

Cancer ontology developed in this study with the first and second level class concepts is shown in Figure 1. The ontology consisted of 268 concepts with 4061 synonyms under four first level class concepts: prevention, diagnosis, treatment, and dealing with cancer. Concepts were related each other such as ‘IsRiskfactorOf’ relation between ‘Risk factor’ and ‘Cancer’ have. For example, ‘salty foods’ is ‘IsRiskfactorOf’ of ‘gastric cancer’. Structure of the ontology was modified based on the experts’ recommendations. For example, policy was added to the ‘Dealing with cancer’ class. More terms were identified from social data analysis and added to the terminology.

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4. Discussion

The cancer ontology developed in this study is first of its kind ontology covering general topics of cancer from prevention to dealing with cancer. This ontology added terms cancer patients might use in social media postings for social data collection and analysis. Thus, the ontology developed in this study can be used for social big data analysis to study cancer information needs in the future.

5. Conclusion

We developed a cancer ontology covering general topics of cancer with 268 concepts with 4061 synonyms under four first level class concepts: prevention, diagnosis, treatment, and dealing with cancer.

References

An approach to clinical decision support by establishing abundant and reliable patient profile information

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d Tottori University

1. Introduction

Clinical decision making (CDM) can be supported from various approaches [1]. If the necessary information for decision making was supplied, we could present candidates from the knowledge-based or statistical analysis approach, based on that information. If the necessary information was insufficient and inaccurate, the reliability of presented candidates had to be low. For CMD the health professionals have to take account of the patient profile information (PPI), in addition to the progress of present illness and newest results of tests. However, the data elements of PPI were rather varied among health institutions in Japan [2] and PPI data of each patients were rather poor [3]. The reliability of PPI data have not been sufficiently discussed. Then in this paper we propose an approach to clinical decision support by establishing abundant and reliable PPI.

2. Methods

At first in the diagnostic process and the selection of therapy we listed up what kinds of information were needed for these decisions making and assessed the reliability of those information. We showed that PPI data were a large part of necessary information for CDM. Next, we identified problems establish abundant and reliable PPI. Finally we considered solutions about the past medical history and drug allergy.

3. Results

3.1. Necessary information for CDM and its reliability

At the beginning of diagnosis a physician interviews a patient in order to obtain the progress of present illness and the elements of PPI. Since the information obtained by the patient interview depends on the patient's memory, it is often incomplete and inaccurate. Sometimes the patient erroneously memorized clinical results. After a final diagnosis, the physician has to select the best therapy for the patient. For this decision the physician needs the patient information related to therapy as the present and past medication, surgical history, allergy and so on. The physicians often directly obtain those from their patients. Here the reliability problems also exist.

3.2. Basic reliability problems on PPI data

PPI data contain the health professionals’ decisions, findings and treatments, and patients’ memories. In many electronic medical (EMR) systems, former data are not directly registered on the PPI database. As a result, PPI data are partially reliable and unreliable. Each health professional has interests in limited elements of PPI and the PPI database in a medical institute is not abundant. To combine PPI data among institutes could solve

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a problem of the poor PPI database. However, the data elements of PPI are rather different among institutes [2].

4. Discussion

In order to establish abundant and reliable PPI, we consider how we should establish common database of PPI. We pick up the past medical history and drug allergy. If all diseases diagnosed at each clinical facility are stored in a common database of PPI, records as the past medical history are perfect. However, many diseases are only meaningful for a short period. But the diagnosis of acute infection of upper respiratory tract within one or two weeks should be supplied to the physician for the diagnosis of meningitis, because the virus infection is one of causes of this disease. Therefore we should have two categories in the past medical history: one is permanently stored history and another is temporally stored one.

The drug allergy is very troublesome for the physician at the selection of medication. Usually only the name of drug is identified and all drugs containing the same element as the allergic drug are not used. If we can supply information that a drug which has the same effect as the allergic drug was safely dosed to the patient, this information must be very helpful for the physician to select the medication.

References

Development of a Self-Assessment Chatbot for Patient Support and Guidance as Part of the Ada 2020 Project

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1. Introduction

Access to health services should be a fundamental human right, yet according to the report of WHO 400 million people do not have access to basic health care worldwide [1]. The unmet need of health services requires patients to get more involved in the management of their own health [2, 3]. To enhance patients’ engagement Ada created a CB application that supports symptom assessment and provides actionable next steps.

2. Method

To collect all necessary information, exclude the unreliable inputs and limit the unstructured load of excess data was amongst the greatest challenges of Ada. The CB similarly to a physician who performs the anamnesis, provides guidance to the users and compensates for their lack of medical knowledge. The CB mimics the conversation between the physician and the patient by creating a flow of questions. This innovative method allows the collection of reliable information and perform symptom assessment without the supervision of a medical expert. The methodology relies on two main pillars of the technology the (i) probabilistic reasoning engine and the (ii) in-house built medical knowledge base. The interaction is initiated by the user who enters the presenting complaint to the application. Ada continues by asking further questions that serve to broaden the evidence space so that the reasoning engine can (i) eliminate potential errors, (ii) rule out less likely causes and dangerous conditions and (iii) narrow down the list of probable conditions. The outcome of the dialogue is a report that states the probable conditions the user may suffer from and a triage level. Additionally, the report contains guidance to inform the user where to seek experts’ opinion for diagnosis.

3. Results

Ada can interpret over 1000 conditions and over 5000 associated findings covering almost 10 000 ICD-10 codes. The CB was well accepted among health-conscious people worldwide as proven by the large number of signups (3.5 million) and positive user reviews (4.7/5). Ada CB has acquired over 4 million users, who completed over 6 million assessments in more than 200 countries all around the globe (Ada2020 Project Video). Preliminary results also support our hypothesis according to which people tend to inquire information with sensitive nature more openly and frequently by using “impersonal” applications. Within 2 years we detected a relatively high rate of sexually transmitted disease cases, such as gonorrheal infection (0.74%), and chlamydia infection (0.76%). This suggests a higher occurrence rate among our users as compared to the incidence of these diseases in the general population [4]. In 2016 Ada2020 received the EU’s Horizon 2020 Research & Innovation Programme grant funding which played an important role in the development of the CB as an R&D-grounded healthcare solution.

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4. Discussion

Ada CB shows a great promise to empower patients and improve patient-doctor relationship in the healthcare system. The CB received positive feedback by both the general audience and the medical expert community. It has been regarded the most accurate self-assessment app [5, 6]. Compared to other clinical decision support systems (DXplain, TheraSim CS-HIV) the Ada CB’s target users are lay people who lack medical knowledge rather than medical experts [7,8]. Furthermore, unlike other symptom checkers, Ada CB is creating a dynamic conversation with the user [9–11]. By leading the conversation, it is able to collect the required information for the accurate assessment. Additionally, the CB provides a user experience similar to a real conversation with a doctor opposed to existing symptom checkers. Major obstacles encountered by the users were identified as the lack of free text support and voice recognition both of which is currently being investigated by Ada’s Research Team. Further advancements, such as the integration of genetic profile and data collection by sensors are also on the horizon of Ada’s CB development.

5. Conclusion

Ada has successfully developed a reasoning technology and a medical knowledge space which is blended together in a CB application to support diagnostics by engaging patients. This is the first application which is able to collect information following a method that is adaptive and adequately structured to assess the probable cause of the problem with high precision.

References

The Potential Impact of a Diagnostic Support System on Rare Disease Cases

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b Ada Health GmbH, Berlin, Germany

1. Introduction

Diagnostic decision support systems (DDSS) can be used to enhance clinical diagnosis by assessing case data based on incorporated medical knowledge [1, 2, 3, 4]. We report about the use of Ada/DX, a DDSS in development, in an outpatient clinic for rare inflammatory systemic diseases. Presenting preliminary results, we evaluate the system’s diagnostic accuracy and potential impact on the time to diagnosis.

2. Method

This retrospective study is being conducted at the outpatient clinic for rare inflammatory systemic diseases at the Hannover Medical School, Germany. To date, 67 patient cases with secured diagnosis were included. The final number of cases will be 100. Ethical approval was obtained from the local ethics committee.

For each patient, the time of the visit of first documented symptoms including visits at general practitioners, specialist and other clinics was identified. The time of diagnosis was identified and time to diagnosis (TD) was calculated. Clinical symptoms, findings, risk factors and dates were obtained from the medical record. Information was pseudonymised and transferred to the DDSS. The DDSS displayed disease suggestions in a common disease list (with incidences of diseases taken into account) and a rare disease list (incidences not taken into account). Output was assessed and evaluated.

Primary endpoint was the correctness of the number one disease suggestion in the common list for the visit of diagnosis. In cases with correct suggestion at time of diagnosis, secondary endpoints were (a) the time to first correct top rare disease suggestion (TR) and (b) the time to first correct rare disease suggestion among the top 5 suggestions (T5R). For each case, the difference between TD and TR (TD - TR) as well as the difference between TD and T5R (TD T5R) was calculated. Wilcoxon signed-rank test was conducted.

3. Results

On preliminary evaluation, primary accuracy of top suggestions of the DDSS at the time of diagnosis was 80.60% (71.06% to 90.34%, 95% CI). Table 1 shows a comparison of time to diagnosis with and without the aid of the DDSS.

The Wilcoxon signed-rank test shows that the null-hypothesis that there is on average no difference between the time to diagnosis in the medical record and the time to correct disease suggestion is to be dismissed for TD -TR (z-score -4.78, α=0.05, p-value <0.001) and TD -T5R (z-score -5.44, α=0.05, p-value <0.001).

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Table 1. Comparison of the original time to diagnosis without the use of the DDSS and the time to correct disease suggestions with the use of the DDSS. All times are expressed in months.

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<td>Mean</td>
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<td>4.0</td>
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<td>Difference in time</td>
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4. Discussion

The purpose of our study was to evaluate the correctness of suggestions and the possibility of early correct suggestions provided by the DDSS Ada/DX in rare diseases cases. We conducted a retrospective analysis of rare disease cases with secured diagnosis and assessed the correctness and timing of suggestions provided by the DDSS. Our findings suggest that a DDSS can provide accurate rare disease suggestions based on information from the medical record at the time of diagnosis. Our findings further suggest that accurate suggestions could be provided at a time prior to the diagnosis in many cases. This accurate early suggestions might facilitate diagnosis and reduce time to diagnosis.

The limitation of this study is its retrospective approach, suggesting the results to be interpreted only exploratively. While case input was not blinded to the diagnosis, it was based on previously written documented information from the medical records. Future research is needed to verify our explorative results and should aim for a prospective, blinded and multicentric study methodology in order to increase validity.

5. Conclusion

The DDSS suggested the correct diseases based on information from the medical record in most of the analysed rare inflammatory systemic disease cases. The DDSS often suggested the correct diseases at times significantly prior to the visits of diagnosis, implicating DDSS might help to reduce time to diagnosis and to improve patient outcomes. Prospective research is needed to verify the results.

References

Doctor in the Digital Transformation Era: Victim, User or Co-creator?

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1. Introduction

One of the main trends in the era of digital transformation of health care is the replacement of executors of routine mental processes with artificial intelligence systems (AI). This tendency is also spreading to medicine, and in the presentation of non-professional press this will be expressed in the replacement of the doctor by the robot in "simple" cases - but if the case turns out to be "complicated", then an expert doctor will be needed. But if all simple cases of seeking medical help are resolved with the help of robots, then where will the doctors come from, who can deal with complex cases? How can a young doctor gain the necessary experience without having to treat patients in the traditional sense?

2. Methods

One possible answer is to model the process of making clinical decisions by a doctor. The approach to such modeling is presented in the article. It is based on the method of "diagnostic games" (DG) developed in the 70s - 80s of the last century in the team of IM Gelfand ([1] - [4]).

"DG" is an intensive method of expert's knowledge acquisition and formalization, developed in collaboration with physicians. DG is a modeling procedure in which patient is substituted by a questionnaire, examination of the patient – by asking questions and getting answers as they are stored in the questionnaire. The basic feature of the DG is that doctor is simulating his clinical work in the controlled information environment.

We analyzed DG as an object for digital transformation.

3. Results

DG may be digitalized by substituting questionnaires by data from clinical information systems, and informaticians – by intellectual system. In this case it will be possible to build the platform for DG, which may be used in many ways.

- Developing a tool for "crowd expertise" – possibility to collect and organize of expertise of several experts – not to "average" personal experts' knowledge but to integrate.
- To use it as a "Teaching tool" – beginning physician will receive possibility to learn in virtual contact with best experts with no risk for patients.
- Diagnostic games will help to draw conclusions based on expert experience, which is as evidential as the conclusions of randomized prospective studies - the summit of reliability in the paradigm of evidence-based medicine.
- It may be used as a tool of "translational medical informatics" – transference of the results of scientific investigation into clinical practice.

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4. Conclusion

The use of the proposed platform of diagnostic games is unlikely to be limited to the above opportunities. With the development of the proposed project, new, completely unexpected opportunities may appear. But most importantly, when implementing this project, doctors will be able to directly participate in the digital transformation of medicine and become co-creators of new health care.

References

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<thead>
<tr>
<th>Author Name</th>
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<tr>
<td>Michael CHEKROUN</td>
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