

MEDINFO 2023 — THE FUTURE IS ACCESSIBLE

Studies in Health Technology and Informatics

Internationally, health informatics is driven by developments in biomedical technologies and medical informatics research that are advancing in parallel and form one integrated world of information and communication media and result in massive amounts of health data. These components include genomics and precision medicine, machine learning, translational informatics, intelligent systems for clinicians and patients, mobile health applications, data-driven telecommunication and rehabilitative technology, sensors, intelligent home technology, EHR and patient-controlled data, and Internet of Things.

The series Studies in Health Technology and Informatics (HTI) was started in 1990 in collaboration with EU programmes that preceded the Horizon 2020 to promote biomedical and health informatics research. It has developed into a highly visible global platform for the dissemination of original research in this field, containing more than 250 volumes of high-quality works from all over the world.

The international Editorial Board selects publications with relevance and quality for the field. All contributions to the volumes in the series are peer reviewed.

Volumes in the HTI series are submitted for indexing by MEDLINE/PubMed; Web of Science: Conference Proceedings Citation Index – Science (CPCI-S) and Book Citation Index – Science (BKCI-S); Google Scholar; Scopus; EMCare.

Series Editors:

B. Blobel, E. Borycki, M. Braunstein, C. Bühler, J.P. Christensen, R. Cooper, R. Cornet, J. Dewen, O. Le Dour, P.C. Dykes, A. Famili, K.W. Fung, M. González-Sancho, E.J.S. Hovenga, J.W. Jutai, Z. Kolitsi, C.U. Lehmann, J. Mantas, V. Maojo, A. Moen, J.F.M. Molenbroek, G. de Moor, M.A. Musen, P.F. Niederer, C. Nøhr, A. Pedotti, N. Peek, O. Rienhoff, G. Riva, W. Rouse, K. Saranto, M.J. Scherer, S. Schürer, E.R. Siegel, C. Safran, N. Sarkar, T. Solomonides, E. Tam, J. Tenenbaum, B. Wiederhold, P. Wilson and L.H.W. van der Woude

Volume 310

Recently published in this series

- Vol. 309 M. Giacomini, L. Stoicu-Tivadar, G. Balestra, A. Benis, S. Bonacina, A. Bottrighi, T.M. Deserno, P. Gallos, L. Lhotska, S. Marceglia, A.C. Pazos Sierra, S. Rosati and L. Sacchi (Eds.), *Telehealth Ecosystems in Practice – Proceedings of the EFMI Special Topic Conference 2023*
- Vol. 308 Y. Yu, B.P. Nguyen and J. Sang (Eds.), *Advances in Biomedical and Bioinformatics Engineering – Proceedings of the 3rd International Conference on Biomedicine and Bioinformatics Engineering (ICBBE 2023), 16–18 June, Nanjing, China*
- Vol. 307 R. Röhrig, N. Grabe, M. Haag, U. Hübner, U. Sax, C.O. Schmidt, M. Sedlmayr and A. Zapf (Eds.), *German Medical Data Sciences 2023 – Science. Close to People. – Proceedings of the 68th Annual Meeting of the German Association of Medical Informatics, Biometry, and Epidemiology e.V. (gmds) 2023 in Heilbronn, Germany*

ISSN 0926-9630 (print)

ISSN 1879-8365 (online)

MEDINFO 2023 — The Future Is Accessible

Proceedings of the 19th World Congress on Medical and Health
Informatics

Edited by

Jen Bichel-Findlay

*Honorary Associate,
University of Technology Sydney, Australia*

Paula Otero

*Pediatrician,
Hospital Italiano de Buenos Aires, Department of Medical Informatics,
Argentina*

Philip Scott

*Programme Director,
University of Wales Trinity St. David, BCS Health & Care, United Kingdom*

and

Elaine Huesing

*Chief Executive Officer,
the International Medical Informatics Association (IMIA), Canada*



IOS Press

Amsterdam • Berlin • Washington, DC

© 2024 International Medical Informatics Association (IMIA) and IOS Press.

This book is published online with Open Access and distributed under the terms of the Creative Commons Attribution Non-Commercial License 4.0 (CC BY-NC 4.0).

ISBN 978-1-64368-456-7 (print)

ISBN 978-1-64368-457-4 (online)

doi: 10.3233/SHTI310

Publisher

IOS Press BV

Nieuwe Hemweg 6B

1013 BG Amsterdam

Netherlands

e-mail: order@iospress.nl

For book sales in the USA and Canada:

IOS Press, Inc.

6751 Tepper Drive

Clifton, VA 20124

USA

Tel.: +1 703 830 6300

Fax: +1 703 830 2300

sales@iospress.com

LEGAL NOTICE

The publisher is not responsible for the use which might be made of the following information.

PRINTED IN THE NETHERLANDS

Preface

After many years of constrained travel, social movement, and large gatherings of people, the Editorial Committee for MedInfo 2023 welcome you to the resumption of our in-person biennial conference in the beautiful harbour city of Sydney, Australia. MedInfo conferences require considerable effort by numerous people, many of whom are volunteers, and our gratitude is extended to all those involved in the organisation of this 19th World Congress on Medical and Health Informatics. Our community will come together again to showcase our latest research and perspectives, reacquaint with trusted colleagues, and form new professional friendships. MedInfo conferences not only energise those attending but provide a common platform to commence or continue discussions focusing on applied approaches to data, information, knowledge, and wisdom in health and wellness.

The last few years have indeed demonstrated the theme of the conference – The future is accessible. The pandemic highlighted the value of global partnerships, the proficiency of converting laborious manual/analogue processes to an online/digital format for various health transactions, and the flurry of inventive approaches to improving the patient-centric journey and healthcare provider efficiency. It also emphasised the difference in the healthcare system when all its component parts collaborate and work together to deliver patient- and citizen-centric quality care. Finally, it accentuated the growing empowerment of citizens when they feel included in their health and wellness ventures and have access to their data.

During this time, enormous pressure was placed on the discipline of biomedical and health informatics to innovate quickly whilst the healthcare system adapted to the new landscape. Telehealth and remote monitoring were elevated from optional and nice-to-have to essential tools for many countries attempting to support the health outcomes of their citizens residing in urban, rural, and remote locations. Those with chronic disease enjoyed the saved opportunity costs derived from healthcare consultations via teleconferencing methods. Many healthcare providers and citizens like this new connected health landscape and fear the system will revert to its former offerings rather than embrace the future.

Unfortunately, not all countries had the existing infrastructure and could not pivot so quickly, which displayed the negative consequences of the digital divide. Preparing for a digital healthcare ecosystem required multifactorial opportunities – educating and upskilling of current staff, attracting, recruiting and retaining talent in digital health, and creating digital health career pathways. Emergent concerns around data sovereignty required many countries to review their laws and government policies to ensure compliance with privacy and data security obligations. Poorly designed IoT devices available in the healthcare environment reiterated the need for co-design to ensure the user experience was positive and healthcare providers were willing to prescribe them to other citizens. Lastly, digital literacy has become more prominent for both citizens and healthcare providers, and continued effort is required in this area.

The significant leap forward in artificial intelligence, machine learning, augmented reality, virtual reality, and genomics holds great hope for future healthcare planning, delivery, management, education, evaluation, and research. These themes feature in the

8–12 July MedInfo 2023 sessions, displaying how these digital approaches will revolutionise the healthcare environment through improved quality health outcomes and reduced potential for error. It is anticipated that attendees at MedInfo 2023 will not only exploit the benefits of these technologies but also collectively identify ways to overcome their associated challenges.

Dr Jen Bichel-Findlay FAIDH CHIA
MedInfo 2023 Editorial Chair

About the Conference

Like the phases of the Moon and the daily cycle of the sea tides, we have hopefully returned to the normal cycle of in-person biennial MedInfo conferences for the international medical and health informatics community.

Digital advances during the pandemic years rapidly moved so many things from ‘eternal pilots’ to business as usual and made continued services in those difficult times possible to continue, yet perennial challenges remain to be resolved in areas as diverse as public trust outside of emergency periods, equity of healthcare provision, workforce crises and building real learning health and care systems. These are all areas where informatics has pivotal contributions to make.

In Medinfo 2021, IMIA highlighted that human health cannot be considered in isolation, we need to consider the “one health” concept and recognise the planetary ecosystem. We cannot lose sight of that bigger picture as we now focus on the accessible future.

The future is accessible, but for whom? Of course, as science fiction author William Gibson is famously quoted as saying, “The future is already here – it’s just not very evenly distributed.” The digital divide is a major concern for health and care informatics professionals, whether in global economic disparities, digital literacy gaps in the healthcare workforce or the general public, or access to reliable information and knowledge about health.

The worldwide community of the International Medical Informatics Association continues to work as a global partnership for a healthy, digitally innovative future. The 19th World Congress on Medical and Health Informatics, MedInfo 2023, was hosted by the Australasian Institute of Digital Health in Sydney, New South Wales, from 8–12 July.

The Medinfo 2023 Scientific Program Committee (SPC) called for submissions under five themes:

- Information and knowledge management
- Quality, safety and outcomes
- Health data science
- Human, organisational and social aspects
- Global health informatics

We received 670 academic submissions and 265 industry submissions from 53 countries across all IMIA regions. Peer review was organised by the SPC co-chairs, and eight track chairs and co-chairs involving 279 reviewers. Finally, 228 full papers, 43 student papers and 117 posters were accepted and are included in these proceedings.

The SPC would like to thank the track chairs and co-chairs, the reviewers, and the CEO of IMIA for their invaluable contribution to the success of this first MedInfo conference since the global pandemic.

Dr Philip Scott and Dr Paula Otero
MedInfo 2023 SPC Co-chairs

Scientific Program Committee Track Chairs

Melissa Baysari, Co-Chair, Human, Organizational and Social Aspects Track,
University of Sydney, Australia

Arriel Benis, Co-Chair, Health Data Science & AI Track, Holon Institute of
Technology, Israel

Vasa Curcin, Co-Chair, Information and Knowledge Management Track, King's
College, United Kingdom

Craig Kuziemsky, Co-Chair, Human, Organizational and Social Aspects Track,
MacEwan University, Canada

Romarc Marcilly, Co-Chair, Quality, Safety and Outcomes Track, Université de Lille,
France

Carlos Otero, Co-Chair, Global Health Informatics Track, Hospital Italiano de Buenos
Aires, Argentina

Linda Peute, Co-Chair, Quality, Safety and Outcomes Track, Amsterdam University
Medical Center, The Netherlands

Lucia Sacchi, Co-Chair, Health Data Science and AI Track, University of Pavia, Italy

Vignesh Subbian, Co-Chair, Information and Knowledge Management Track,
University of Arizona, USA

Oscar Tamburisi, Co-Chair, Global Health Informatics Track, Università “Federico II”
Napoli, Italy

Contents

Preface	v
<i>Jen Bichel-Findlay</i>	
About the Conference	vii
Papers	
Track 1: Information and Knowledge Management	
Theme 1: Information Standards	
Topic 1: Interoperability	
ARDaC Common Data Model Facilitates Data Dissemination and Enables Data Commons for Modern Clinical Studies	3
<i>Nanxin Jin, Zuotian Li, Carla Kettler, Baijian Yang, Wanzhu Tu and Jing Su</i>	
Reviewing Challenges in Specifying Interoperability Requirement in Procurement of Health Information Systems	8
<i>Mattias Seth, Hoor Jalo, Eunji Lee, Anna Bakidou, Otto Medin, Ulrica Björner, Bengt Arne Sjöqvist and Stefan Candefjord</i>	
Design of HL7 FHIR Profiles for Pathology Reports Integrated with Pathology Images	13
<i>Chung-Yueh Lien, Tzu-Yun Ting, Li-Chun Kuo, Pau-Choo Chung, Yuan-Chia Chu and Chen-Tsung Kuo</i>	
Bringing Communities Together: Mapping the Investigation-Study-Assay-Model (ISA) to Fast Healthcare Interoperability Resources (FHIR)	18
<i>Sophie A.I. Klopfenstein, Julian Sass, Carina N. Vorisek, Felix Jorczik, Carsten Oliver Schmidt, Matthias Löbe, Martin Golebiewski, Haitham Abaza and Sylvia Thun</i>	
Evolving Interoperability Across a State Public Health Immunization Registry and Electronic Health Records	23
<i>Sripriya Rajamani, Naomi Jiter, Maureen Leeds, Miriam Muscoplat, Katie White, Aaron Bieringer and Genevieve B. Melton</i>	
Interoperability Is a Process – The Data Sharing Framework	28
<i>Hauke Hund, Reto Wettstein, Maximilian Kurscheidt, Simon T. Schweizer, Christoph Zilske and Christian Fegeler</i>	
Structured Queries to AQL: Querying OpenEHR Data Leveraging a FHIR-Based Infrastructure for Federated Feasibility Queries	33
<i>Lorenz Rosenau and Josef Ingenerf</i>	
Community of Interoperability Labs: Pragmatic Approach to Achieving Interoperability	38
<i>Miguel Aljibe, Jorn Bettin, Boonchai Kijsanayotin, Hsiu An Lee, Clube Ng, Thepphouthone Sorsavanh, Chaminda Weerabaddana and Alvin Marcelo</i>	
Interoperability in the Wild: Comparison of Real-World Electronic C-CDA Documents from Two Sources	43
<i>Brian E. Dixon and Nate C. Apathy</i>	
Multi-Institutional Collaborative Research Using Ophthalmic Medical Image Data Standardized by Radiology Common Data Model (R-CDM)	48
<i>ChulHyoung Park, Sang Jun Park, Da Yun Lee, Seng Chan You, Kihwang Lee and Rae Woong Park</i>	

Track 1: Information and Knowledge Management**Theme 1: Information Standards****Topic 2: Terminology**

A High-Fidelity Combined ATC-Rxnorm Drug Hierarchy for Large-Scale Observational Research <i>Anna Ostropelets, Polina Talapova, Marcel De Wilde, Hamed Abedtash, Peter Rijnbeek and Christian G. Reich</i>	53
An ICD for the Digital World: What Does the ICD-11 Research Show? <i>Susan H. Fenton, Mary H. Stanfill and Kathy Giannangelo</i>	58
International Patient Summary Terminology <i>Warren Del-Pinto, Renate A. Schmidt, Yongsheng Gao, Ghadah Alghamdi, Alejandro Lopez Osornio and Suzy Roy</i>	63
Promoting Learning Health System Cycles by Optimizing EHR Data Clinical Concept Encoding Processes <i>Piper Ranallo, Bronwyn Southwell, Christopher Tignanelli, Steven G. Johnson, Richard Krueger, Tess Severeid-Groth, Adam Carvel and Genevieve B. Melton</i>	68
Integrating a Categorical Structure for Clinical Practice into EHRs <i>Evelyn J.S. Hovenga</i>	74
Data Maps and Mapping – The Unseen Bomb! <i>Heather Grain</i>	79

Track 1: Information and Knowledge Management**Theme 1: Information Standards****Topic 3: Ontology**

Setting the Scene to Link SNOMED CT to Realism-Based Ontologies <i>Anuwat Pengput and Werner Ceusters</i>	84
Translation of Ontological Concepts from English into German Using Commercial Translation Software and Expert Evaluation <i>Richard Noll, Alexandra Berger, Carlo Facchinello, Oya Güngöze, Michael von Wagner, Sebastian Hoehl, Michaela Neff, Holger Storf and Jannik Schaaf</i>	89
User Centered Rare Disease Clinical Trial Knowledge Graph (RCTKG) <i>Jeremy Parker Yang, Devon Leadman, Richard M. Ballew, Eric Sid, Yanji Xu, Ewy A. Mathé and Qian Zhu</i>	94

Track 1: Information and Knowledge Management**Theme 1: Information Standards****Topic 4: Metadata**

FAIR+R: Making Clinical Data Reliable Through Qualitative Metadata <i>Caroline Bönisch, Dorothea Keszyüs and Tibor Keszyüs</i>	99
---	----

Track 1: Information and Knowledge Management**Theme 2: Information Management****Topic 1: Electronic Health Records**

Medication Reconciliation as Repair Work <i>Gunnar Ellingsen, Morten Hertzum, Gro-Hilde Severinsen and Rolf Wynn</i>	104
A Five-Step Workflow to Manually Annotate Unstructured Data into Training Dataset for Natural Language Processing <i>Yunshu Zhu, Ting Song, Zhenyu Zhang, Mengyang Yin and Ping Yu</i>	109
Mapping Patients' Online Record Access Worldwide: Preliminary Results from an International Survey of Healthcare Experts <i>Anna Kharko, Charlotte Blease, Monika Johansen, Anne Moen, Isabella Scandurra, Brian McMillan and Maria Hägglund</i>	114

Development of the Clinical Specimen Information Management System for Multicenter Clinical Studies	119
<i>Katsuki Okada, Kento Sugimoto, Shoya Wada, Shozo Konishi, Shirou Manabe, Yasushi Matsumura and Toshihiro Takeda</i>	
Automatic Speech Recognition System to Record Progress Notes in a Mobile EHR: A Pilot Study	124
<i>Carolina Paula Vargas, Alejandro Gaiera, Andres Brandán, Alejandro Renato, Sonia Benitez and Daniel Luna</i>	
Public Attitudes Towards Access to Health Data for Research Purposes Through Citizens' Jury in Uganda	129
<i>Lauren E. Walker, Lydia Nakyeyune, Andrew Ashaba, Simple Ahebwa, Ritah Nakijoba, Simon P. Asiimwe, Agnes Kiragga, Barbara Castelnovo and Catriona Waitt</i>	
A Post-Marketing Drug Evaluation Framework Based on Real-World Electronic Health Records Data	134
<i>Yu Wang, Shuang Ma, Hua Ru, Hongyi Ni and Jingsong Li</i>	
An Ontology-Based Architecture to Support Language Variants of Model-Driven Electronic Health Records	139
<i>John Chelsom, Stephanie Cabrer, Zikai Hao, Naveed Dogar and Ilyas Aden</i>	
Improving Waiting Time for Chemotherapy with Ahead-of-Time Drug Preparation	144
<i>Juan Marcos Descalzo, Eliana Ludmila Frutos, Javier Castro, Victoria Regia Lombardo, Cintia Gimenez, Paula Otero, Daniel Luna and Carlos Otero</i>	
Development and Usage Patterns of a Home-Grown Drug Information Tool	149
<i>Pierina Torrens, Julian Verdinelli, Luciana Rubin, Fernando Binder, Soledad Diaz, Laura Gambarte, Pilar Avila and Daniel Luna</i>	
Track 1: Information and Knowledge Management	
Theme 2: Information Management	
Topic 2: Data Quality	
How to Assess FAIRness of Your Data – A Summary of Testing Two FAIR Validators	154
<i>Caroline Stellmach and Michael Rusongoza Muzoora</i>	
Phenotype Systemic Lupus Erythematosus Patients from EPIC Cosmos	159
<i>Jay Patel, Lixia Yao, Ernest Vina, David Fleece, Jayatilleke Arundathi, Roberto Caricchio and Huanmei Wu</i>	
Toward Real-World Reproducibility: Verifying Value Sets for Clinical Research	164
<i>Scott L. DuVall, Craig G. Parker, Amanda R. Shields, Patrick R. Alba, Julie A. Lynch, Michael E. Matheny and Aaron W.C. Kamaau</i>	
Understanding Clinician EHR Data Quality for Reuse in Predictive Modelling	169
<i>Melinda Wassell, James L. Murray, Chaithra Kumar, Karin Verspoor and Kerry Butler-Henderson</i>	
Track 1: Information and Knowledge Management	
Theme 2: Information Management	
Topic 3: Registries and Health Information Exchange	
Large-Scale Standardized Image Integration for Secondary Use Research Projects	174
<i>Hannes Ulrich, Michael Anywar, Benjamin Kinast and Björn Schreiweis</i>	
Using Routine EMR Registration on a National Scale for Evaluating the Impact of HIV and ART on Childbirth in Burundi	179
<i>Alain Ndayikunda and Frank Verbeke</i>	
Case-Reported Data Management Methodology Using an RDF Data Model for Building a Multicenter Clinical Registry	184
<i>Masamichi Ishii, Hiroyuki Hoshimoto and Kengo Miyo</i>	
Direct Secure Messaging in Practice: Addressing Workflow Challenges	189
<i>James McCormack, Christoph U. Lehmann, Katherine G. Lusk, Kathryn Ayers Wickenhauser, Simone Arvisais-Anhalt and Kristian Feterik</i>	

Track 1: Information and Knowledge Management**Theme 2: Information Management****Topic 4: Medical Device Integration**

- Mobile Monitoring-Enabled Telehealth for Patients with Complex Chronic Illnesses 194
Ryan J. Shaw, Kristin Montgomery, Christopher Fiander, Kelcie Bullock, Ryan Craig, Gina Pennington and Matthew J. Crowley
- Integrating Dermoscopic Images into PACS Using DICOM and Modality Worklist 199
Guillermo Agustín Martínez, Eliana Ludmila Frutos, María Agustina Ricci Lara, Carolina Paula Vargas, María Victoria Rodríguez Kowalczyk, María Guillermina Ferrareso, Luciana Rubin, Alfredo Hernán Cancio, Carlos Martín Otero, Paula Otero, Daniel Luna, Luis Daniel Mazzuocolo and Sonia Elizabeth Benitez

Track 1: Information and Knowledge Management**Theme 2: Information Management****Topic 5: Security, Privacy and Consent**

- Consent Management System on Patient-Generated Health Data 204
Pietro Randine, Eliot Salant, Miroslav Muzny and Louise Pape-Haugaard

Track 1: Information and Knowledge Management**Theme 3: Computable Knowledge****Topic 1: Guideline Implementation**

- Digital Therapeutics for COPD Patient Self-Management: Needs Analysis and Design Study 209
Samina Raza Abidi, Tracey Rickards, William Van Woensel and Syed Sibte Raza Abidi
- Feasibility of Utilizing Electronic Dental Record Data and Periodontitis Case Definition to Automate Diagnosis 214
Jay Patel, Daniel Shin, Lisa Willis, Ahad Zai and Thankam Thyvalikakath

Track 1: Information and Knowledge Management**Theme 3: Computable Knowledge****Topic 2: Decision Support**

- Machine Learning for Risk Prediction of Recurrent AKI in Adult Patients After Hospital Discharge 219
Jianqiu Zhang, Paul E. Drawz, Gyorgy Simon, Terrence J. Adam and Genevieve B. Melton
- Towards Accurate Search for Neonatal Heartbeat: Weighted Algorithm for Reliable ECG Analysis of Premature Infants 224
Jessica Rahman, Aida Brankovic, Mark Tracy, Robert Halliday and Sankalp Khanna
- Digital Twins for More Precise and Personalized Treatment 229
Nilmini Wickramasinghe, Nalika Ulapane, Elliot B. Sloane and Vijay Gehlot
- What-You-See-Is-What-You-Get Computer-Interpretable Guidelines: The Case of NoviGuide Neonatal 234
Elon Danziger, Mary Muhindo and Joshua Bress
- An In-House Developed Probiotics Database E-Reference Information for Healthcare Professionals 239
Adison Goh, Brigitta Budijono, Christine Lim, Eng Hui Chew and Kevin Yap
- Planning for Actionable Precision Medicine 244
James J. Cimino
- Innovative Implemented Tools for Outpatient Clinic Scheduling 249
Vahid Riahi, Liz Cooper-Williams, Sankalp Khanna and Rajiv Jayasena
- Patient-Specific Mobile Phone-Generated Reminders and Quality of Hypertension Care in Western Kenya 254
Nicholas Kirui, Jemimah Kamano, Simon Savai, Lawrence Misoi, Steven Rono and Martin C. Were

- How Are Clinicians' Acceptance and Use of Clinical Decision Support Systems Evaluated Over Time? A Systematic Review 259
Nicki Newton, Adeola Bamgboje-Ayodele, Rowena Forsyth, Amina Tariq and Melissa T. Baysari

Track 1: Information and Knowledge Management

Theme 3: Computable Knowledge

Topic 3: Artificial Intelligence

- Temporal Phenotyping for End-Stage Renal Disease Using Longitudinal Electronic Health Records 264

Shengqiang Chi, Feng Wang, Xueyao Li, Minghong Xu and Jingsong Li

- Predicting In-Hospital Death from Derived EHR Trajectory Features 269

Rajeev Bopche, Lise Tuset Gustad, Jan Egil Afset, Jan Kristian Damås and Øystein Nytrø

- Time-Series Aware Metrics for the Evaluation of Intraoperative Electroencephalography-Based Ischemia Detection 274

Amir I. Mina, Jeremy U. Espino, Allison M. Bradley, Parthasarathy Thirumala, Kayhan Batmanghelich and Shyam Visweswaran

- How Well Do AI-Enabled Decision Support Systems Perform in Clinical Settings? 279

Anindya Pradipta Susanto, David Lyell, Bambang Widyantoro, Shlomo Berkovsky and Farah Magrabi

- Individual Activity Anomaly Estimation in Operating Rooms Based on Time-Sequential Prediction 284

Koji Yokoyama, Goshiro Yamamoto, Chang Liu, Kazumasa Kishimoto, Yukiko Mori and Tomohiro Kuroda

Track 1: Information and Knowledge Management

Theme 3: Computable Knowledge

Topic 4: Curation

- Analyzing the Spread of Informatics with PubMed 289

Brian E. Chapman, Wendy W. Chapman and Jeremiah Chapman

Track 2: Quality, Safety and Outcomes

Theme 1: Evaluation

Topic 1: Methods

- Adapting an Environmental Scan for 'Insights Reporting': Learnings from an Online Brain Cancer Peer Support Platform 294

Kara Burns, Kit Huckvale, Ann Borda, Cecily Gilbert, Hasan Ferdous, Mahima Kalla, Wendy Chapman and Daniel Capurro

- Using Clinical Simulation to Evaluate AI-Enabled Decision Support 299

David Lyell, Adriaan Lustig, Kate Denyer, Satya Vedantam and Farah Magrabi

Track 2: Quality, Safety and Outcomes

Theme 1: Evaluation

Topic 2: Health Quality and Patient Safety

- Unscheduled Emergency Department Revisits Within 48 Hours of Discharge 304

María Florencia Grande Ratti, Ignacio Martingano, Paula Daniela Otero, Carlos Martin Otero, Juan Maria Farina, Luciana Rubin, Daniel Luna, Jorge Ariel Esteban, Ana Soledad Pedretti, María de la Paz Rodriguez, Micaela Sanchez Del Cid and Bernardo Julio Martínez

- Performance Evaluation of the Commonly-Used Portable Cholesterol Sensors for Telehealth Services in the Unreached Communities 309

Rafiqul Islam, Saori To, Rieko Izukura, Yoko Sato, Mariko Nishikitani, Kimiyo Kikuchi, Fumihiko Yokota, Subaru Ikeda, Rakibul Islam, Ashir Ahmed, Masashi Miyazaki and Naoki Nakashima

Blood Culture Ordering After Sepsis Alerts and Subsequent Patient Outcomes: An Electronic Health Record-Based Study	314
<i>Ling Li, Kasun Rathnayake, Scott Walter, Mary Fullick, Amith Shetty, Paul Hudson, Harvey Lander and Johanna I. Westbrook</i>	
Construction of a Prediction Model for Voriconazole-Induced Hepatotoxicity Based on Mixed-Effects Random Forest	319
<i>Danyang Tong, Yu Wang, Jing Ma, Jiaqi Wang and Jingsong Li</i>	
Learning from Non-Routine Events and Teamwork in Intensive Care Units: Challenges and Opportunities	324
<i>Yang Gong and You Chen</i>	
Stepped-Wedge Cluster RCT to Assess the Effects of an Electronic Medication System on Medication Administration Errors	329
<i>Johanna I. Westbrook, Ling Li, Amanda Woods, Tim Badgery-Parker, Virginia Mumford and Magdalena Z. Raban</i>	
Digital Health Safety Matters: A Promising Practice Study into the Adoption of Patient Safety Guidelines in Australia	334
<i>Melissa Andison</i>	
The Health Innovation Series: Translating Research Evidence into Practice	339
<i>Magdalena Z. Raban, Alison Merchant, Chrissy Clay, Erin Fitzpatrick and Johanna I. Westbrook</i>	
Towards Automated Evaluation of Patient Centered Care—Assessing the Potential of Electronic Health Records	344
<i>Hanna von Gerich, Erika Lozada-Perezmitre, Lisiane Pruinelli and Laura-Maria Peltonen</i>	
Development of Integrated Data Quality Management System for Observational Medical Outcomes Partnership Common Data Model	349
<i>Seol Whan Oh, Soo Jeong Ko, Yun Seon Im, Surin Jung, Bo Yeon Choi, Jae Yoon Kim, Sunghyeon Park, Wona Choi and In Young Choi</i>	
Accurate Dosing Weight: When the 10% Really Matters	354
<i>Swaminathan Kandaswamy, Sarah Thompson and Evan Orenstein</i>	
Effectiveness of Clinical Management of COVID-19 Based on Structured Clinical Knowledge and Process Paths	359
<i>Satoko Tsuru, Tetsuro Tamamoto, Akihiro Nakao, Yutaka Machida, Kouichi Tanizaki and Naohisa Yahagi</i>	
Safety and Quality Within the Healthcare Supply Chain: A Great Unknown	364
<i>Sean Smith, Michael Lane, Mark Toleman and Anup Shrestha</i>	
A Patient-Centered Approach to Collecting and Displaying Patient Identifiers	369
<i>Christina Van Hal, Jennifer L. Mills, Mary Gatmaitan and Yang Gong</i>	
Track 2: Quality, Safety and Outcomes	
Theme 2: Quality Improvement	
Topic 1: New Service Delivery Models	
Applying Team Science to Collaborative Digital Health Research: Learnings from the Wearable Clinic	374
<i>Niels Peek, Charlotte Stockton-Powdrell, Alexander Casson, Matthew Sperrin, Bijan Parsia, Andrea Manca, Cynthia Iglesias, Ibrahim Habli, Lamiece Hassan, Steven Antrobus and Matthew Machin</i>	
The Viability and Acceptability of a Virtual Wound Care Command Centre in Australia	379
<i>Michelle Barakat-Johnson, Badia Kita, Aaron Jones, Mitchell Burger, David Airey, John Stephenson, Thomas Leong, Jana Pinkova, Georgina Frank, Natalie Ko, Andrea Kirk, Astrid Frotjold, Kate White and Fiona Coyer</i>	
Patients' Use of Telemedicine Mobile Application During COVID-19 Restrictions	384
<i>Abdulmonem Alabdulmunim, David Hailey and Ping Yu</i>	

Track 2: Quality, Safety and Outcomes**Theme 2: Quality Improvement****Topic 2: Measuring Outcomes**

- A Human-Centered Approach to Measuring the Impact of Evidence-Based Online Resources 389
Maria Alejandra Pinero De Plaza, Mandy Archibald, Michael Lawless, Rachel Ambagtsheer, Penelope McMillan, Alexandra Mudd, Michelle Freeling and Alison Kitson
- Effect of the COVID-19 Lockdown on Patients Valuation of Usability of Telemedicine 394
Lucila Bruchanski, Ana Clara Torre, Nuria Bibiloni, Janine Sommer, Bruno Boietti, María Florencia Grande Ratti, Romina Rapisarda, Daniel Luna, Luis Mazzuocollo and Fernando Plazzotta
- Effectiveness, Costs and Satisfaction of Telemedicine: Review of the Current State 399
Lucila Bruchanski, Santiago Frid, Luis Tejerina, Janine Sommer, Jennifer Nelson, Paula Otero, Alexandre Bagolle and Fernando Plazzotta
- Designing an Informatics Infrastructure for a National Aged Care Medication Roundtable 404
Johanna I. Westbrook, Karla Seaman, Nasir Wabe, Magdalena Z. Raban, Rachel Urwin, Tim Badgery-Parker, Crisostomo Mecardo, Virginia Mumford, Amy D. Nguyen, Jo Root, Sarah Balmer, Karen Waugh, Sonali Pinto, Birgit Burge, Eric Aldeguer, Travis Dunstan, Mikaela Jorgensen, Len Gray, Tracey Bucknall, Christopher Etherton-Ber, Ben Newell, Gillian Caughey, Elizabeth Beattie, Kristin Xenos and Anne Cumming
- Surveillance for Diabetes in Hospital-Evaluation of Dashboard Effectiveness 409
Tien-Ming Hng, Reshma Kolambkar, Ching Luo and David Pryce
- Factors Affecting Family Caregivers' Satisfaction During Virtual Care Visits 414
Saif Khairat, Cheeti Srilakshmi, Sara Helvey, Jami Mann and Amir Barzin

Track 2: Quality, Safety and Outcomes**Theme 2: Quality Improvement****Topic 3: Counterfactual Modelling**

- Real-World Effectiveness of Lung Cancer Screening Using Deep Learning-Based Counterfactual Prediction 419
Zheng Feng, Zhaoyi Chen, Yi Guo, Mattia Prosperi, Hiren Mehta, Dejana Braithwaite, Yonghui Wu and Jiang Bian

Track 2: Quality, Safety and Outcomes**Theme 3: Innovation****Topic 1: Emerging Technologies**

- Utilising Mobile Health Apps – A Comparison of GP Perceptions Across Australia and Germany 424
Tanja Schroeder, Amy D. Nguyen, Karla Seaman, Heiko Gewald and Andrew Georgiou
- Digital Health for Myocardial Infarction: Research Topics and Trends 429
Melissa Pelly, Farhad Fatehi, Mahnaz Samadbeik, Danny Liew and Antonio Verdejo-Garcia
- Sensing Swelling: Towards Remote Monitoring of Craniectomy Patients 434
DanaKai Bradford, Karl von Richter, Ganesha Thayaparan, Simon Gibson, Aeyohan Furtado, Mark Owbridge and Paul D'Urso
- LIV Well when Life Is Limited: Technology to Support Independence at Home 439
Mahnoosh Kholghi, David Silvera, Glen Wong, Janine Walker, Jennifer Wilson and DanaKai Bradford
- Patient-Centered Clinical Decision Support—Where Are We and Where to Next? 444
Prashila Dullabh, Desirae Leaphart, Rina Dhopeshwarkar, Krysta Heaney-Huls and Priyanka Desai

Informing Personalised Gamification Interventions Through a Novel Gamified Quiz <i>Christiaan R. Dippenaar, Christian Redd and Marlien Varnfield</i>	449
PD-Buddy: A Feasibility Study of Mobile Health to Support the Management of Peritoneal Dialysis <i>Marlien Varnfield, Kaley Butten, Ashik Hayat, Robyn Rogers and Marnie Budd</i>	454
Making Digital Health Equitable <i>W. Ed Hammond and Vivian L. West</i>	459
Track 2: Quality, Safety and Outcomes	
Theme 3: Innovation	
Topic 2: Novel Applications	
Introducing a Comprehensive Score of Systemic Anticancer Treatment Relevance <i>Travis Zack and Jeremy L. Warner</i>	464
Track 2: Quality, Safety and Outcomes	
Theme 3: Innovation	
Topic 3: Governance, Change and Adoption	
The Impact of Social and Broadcast Media on Public Health Initiatives: Study of the COVID-19 Infodemics <i>Umashankar Upadhyay, Eshita Dhar, Sherali Bomrah, Yarou Huang, Mohy Uddin, Muhammad Ashad Kabir and Shabbir Syed-Abdul</i>	469
Case Study: Design of an Approach for Assessing a Novel Health Capability Maturity Model <i>Lemai Nguyen, Paul Cooper, Bronwyn Taylor, Imran Muhammad and Sandeep Reddy</i>	474
Digital Interventions and Their Unexpected Outcomes – Time for Digitalovigilance? <i>Guillermo Lopez-Campos, Elia Gabarron, Fernando Martin-Sanchez, Mark Merolli, Carolyn Petersen and Kerstin Denecke</i>	479
Track 2: Quality, Safety and Outcomes	
Theme 4: Patient-Facing Technology	
Topic 1: Personal Health Records	
Oncology Patient Portal: Understanding User’s Needs and Expectations <i>Giuliana Colussi, Juan Descalzo, Agustin Paoloni, Oscar Obregón, Melanie Cassarino and Pablo Jaca</i>	484
Primary Healthcare Professionals’ Improvement Suggestions for the Patient Accessible Health Record <i>Irene Muli, Isabella Scandurra and Maria Hägglund</i>	489
Citizens Access to Health Information in National Portals in the Nordic Countries <i>Christian Nøhr, Heidi Gilstad, Tuulikki Vehko, Jarmo Reponen, Sidsel Villumsen, Gudrun A. Hardardottir, Rune Pedersen, Vivian Vimarlund and Sabine Koch</i>	494
Development Process for Type 2 Diabetes Patient Applications: Findings from a Literature Review <i>Viviane Passos Trindade and Stefano Bonacina</i>	499
A Quantitative Analysis of Patient-Facing Technologies for Patient Self-Reporting <i>Mengchen Ding, Youmin Cho, Yun Jiang and Yang Gong</i>	504
Track 2: Quality, Safety and Outcomes	
Theme 4: Patient-Facing Technology	
Topic 2: Symptom Checkers	
Post-Implementation Outcomes of a Remote Patient Monitoring Program After Emergency Department Discharge <i>Eric W. Maurer, Terrence Adam, Lynn E. Eberly, Ahmed Alsharit, Stephanie Billecke, Tucker Annis, Sameer Badlani, Susan Pleasants and Genevieve B. Melton</i>	509
Assessing the Safety of a New Clinical Decision Support System for a National Helpline <i>Nirvana Luckraj, Renee Strazzari, Enrico Coiera and Farah Magrabi</i>	514

A New Role for Chatbots: Automation of a Sleep-Dependent Memory Task <i>David Ireland, Aaron Lam, DanaKai Bradford and Sharon Naismith</i>	519
Feasibility of “Symptom Discovery,” a Longitudinal and Comprehensive Data Collection Tool During COVID-19 <i>Sayantani Sarkar, Katherine Kim, Xin Liu, Jill Joseph and Joanne Natale</i>	524
Patient-Centred, Technology-Based Interventions for High Treatment Burden: An Overview of the State of the Art <i>Ramsay Meiklem, Matt-Mouley Bouamrane, David Kingsmore, Karen Stevenson, Mark Dunlop and Peter Thomson</i>	529
Adjustable Cuffless Smartphone Attachment (ACSA+) for Estimation of Blood Pressure Trends: A Pilot Study <i>Kseniia Sholokhova, Wen-Shan Jian, Hsuan-Chia Yang and Yu-Chuan (Jack) Li</i>	534
Exploring a Mechanism Toward Automated Feedback for Cancer Patient Self-Reporting <i>Kevin Phong, Mengchen Ding, Youmin Cho, Yun Jiang and Yang Gong</i>	539
Track 2: Quality, Safety and Outcomes	
Theme 4: Patient-Facing Technology	
Topic 3: Fitness Trackers	
Preliminary Results of a Grounded Theory Study on Using Mobile Health for Physical Activity <i>Rui Wang, Michelle Honey and Karen Day</i>	544
Effect of Step Count Measurement on Glycemic Control: Secondary Analysis of a Randomized Controlled Trial <i>Ryo Saito, Wei Thing Sze, Kayo Waki, Syunpei Enomoto, Toshimasa Yamauchi, Masaomi Nangaku and Kazuhiko Ohe</i>	549
Track 2: Quality, Safety and Outcomes	
Theme 4: Patient-Facing Technology	
Topic 4: Social Media	
Detection of Adverse Event Signals with Severity Grade Classification from Cancer Patient Narrative <i>Satoshi Nishioka, Masaki Asano, Shuntaro Yada, Eiji Aramaki, Hiroshi Yajima, Hayato Kizaki and Satoko Hori</i>	554
Track 3: Health Data Science and Artificial Intelligence	
Theme 1: Methods	
Topic 1: Natural Language Processing	
Towards Structuring Clinical Texts: Joint Entity and Relation Extraction from Japanese Case Report Corpus <i>Daisaku Shibata, Emiko Shinohara, Kiminori Shimamoto and Yoshimasa Kawazoe</i>	559
<i>Dolores</i> : A Mobile Chatbot for People Living with Chronic Pain <i>David Ireland, Pranavie Vijayakumar and Nicole Andrews</i>	564
Classification of Diagnostic Certainty in Radiology Reports with Deep Learning <i>Kento Sugimoto, Shoya Wada, Shozo Konishi, Katsuki Okada, Shirou Manabe, Yasushi Matsumura and Toshihiro Takeda</i>	569
Using Natural Language Processing to Predict Risk in Electronic Health Records <i>Duy Van Le, James Montgomery, Kenneth Kirkby and Joel Scanlan</i>	574
Automatic Extraction of Skin and Soft Tissue Infection Status from Clinical Notes <i>Jamie L.W. Rhoads, Lee Christensen, Skylar Westerdahl, Vanessa Stevens, Wendy W. Chapman and Mike Conway</i>	579
Rule-Based Natural Language Processing Pipeline to Detect Medication-Related Named Entities: Insights for Transfer Learning <i>Zoie S.Y. Wong, Neil Waters, Data Artist Team, Nicholas I-Hsien Kuo and Jiaying Liu</i>	584

NLP-Assisted Differential Diagnosis of Chronic Obstructive Pulmonary Disease Exacerbation <i>Fatemeh Shah-Mohammadi and Joseph Finkelstein</i>	589
Locating Loneliness Through Social Intelligence Analysis <i>Hurmat Ali Shah and Mowafa Househ</i>	594
Final Report on the German Clinical Reference Corpus 3000PA <i>Udo Hahn, Luise Modersohn, Jakob Faller and Christina Lohr</i>	599
Automating the Identification of Safety Events Involving Machine Learning-Enabled Medical Devices <i>Ying Wang, David Lyell, Enrico Coiera and Farah Magrabi</i>	604
Advanced Care Planning Content Encoding with Natural Language Processing <i>Benjamin C. Knoll, Melissa Gunderson, Geetanjali Rajamani, Elizabeth C. Wick, Alexis Colley, Elizabeth Lindemann, Rubina Rizvi, Molly Diethelm, Gretchen Hultman, Logan Pierce, Rui Zhang and Genevieve B. Melton</i>	609
Using Natural Language Processing to Extract and Classify Symptoms Among Patients with Thyroid Dysfunction <i>Sy Hwang, Sujatha Reddy, Katherine Wainwright, Emily Schriver, Anne Cappola and Danielle Mowery</i>	614
Relation Detection to Identify Stroke Assertions from Clinical Notes Using Natural Language Processing <i>Audrey Yang, Sam Kamien, Anahita Davoudi, Sy Hwang, Meet Gandhi, Ryan Urbanowicz and Danielle Mowery</i>	619
Rule-Based Text Classification of Dental Diagnosis <i>Mei Wang, Anushka Agrawal, Nicole Rogers, Vanchit John and Thankam Thyvalikakath</i>	624
Answering List-Type Questions in Health Domain with Pretrained Large Language Model: A Case for COVID-19 Symptoms <i>Keyuan Jiang, Mohammed M. Mujtaba and Gordon R. Bernard</i>	629
Extracting Spatio-Temporal Trends in Medical Research Prioritization Through Natural Language Processing of Case Report Abstracts <i>Lean Franzl Lim Yao, Kongmeng Liew, Shoko Wakamiya and Eiji Aramaki</i>	634
Extracting Drug-Protein Relation from Literature Using Ensembles of Biomedical Transformers <i>Avisha Das, Zhao Li, Qiang Wei, Jianfu Li, Liang-chin Huang, Yan Hu, Rongbin Li, Wenjin Jim Zheng and Hua Xu</i>	639
Fertility-Related Conversations in the Context of COVID-19 and Vaccinations <i>Christopher Palmer, Sedigh Khademi, Muhammad Javed, Gerardo Luis Dimaguila and Jim Buttery</i>	644
TAXN: Translate Align Extract Normalize, a Multilingual Extraction Tool for Clinical Texts <i>Antoine Neuraz, Ivan Lerner, Olivier Birot, Camila Arias, Larry Han, Clara Lea Bonzel, Tianxi Cai, Kim Tam Huynh and Adrien Coulet</i>	649
Predicting Medical Event Occurrence Using Medical Insurance Claims Big Data <i>Hiromasa Yoshimoto, Naohiro Mitsutake and Kazuo Goda</i>	654
Development of a Natural Language Processing System to Identify Clinical Documentation of Electronic Cigarette Use <i>Patrick R. Alba, Qiwei Gan, Mengke Hu, Shu-Hong Zhu, Scott E. Sherman, Scott L. DuVall and Mike Conway</i>	659
Development of an ASR System for Medical Conversations <i>Alejandro Renato, Daniel Luna and Sonia Benitez</i>	664
Influence of Context in Transformer-Based Medication Relation Extraction <i>Luise Modersohn and Udo Hahn</i>	669
COVID-19 Event Extraction from Twitter via Extractive Question Answering with Continuous Prompts <i>Yuhang Jiang and Ramakanth Kavuluru</i>	674

Applying and Improving a Publicly Available Medication NER Pipeline in a Clinical Cancer EMR	679
<i>Meg Stevens, Georgina Kennedy and Timothy Churches</i>	
Detection of Medication Mentions and Medication Change Events in Clinical Notes Using Transformer-Based Models	685
<i>Yuting Guo, Yao Ge and Abeed Sarker</i>	
Data Augmentation with Nearest Neighbor Classifier for Few-Shot Named Entity Recognition	690
<i>Yao Ge, Mohammed Ali Al-Garadi and Abeed Sarker</i>	
Identifying Mentions of Pain in Mental Health Records Text: A Natural Language Processing Approach	695
<i>Jaya Chaturvedi, Sumithra Velupillai, Robert Stewart and Angus Roberts</i>	
Extracting Symptoms of Agitation in Dementia from Free-Text Nursing Notes Using Advanced Natural Language Processing	700
<i>Dinithi Vithanage, Yunshu Zhu, Zhenyu Zhang, Chao Deng, Mengyang Yin and Ping Yu</i>	
Track 3: Health Data Science and Artificial Intelligence	
Theme 1: Methods	
Topic 2: Deep Learning	
Developing Robust Clinical Text Deep Learning Models – A “Painless” Approach	705
<i>Yutong Wu, James A. Hughes, Anna-Lisa Lyrstedt, Sarah Hazelwood, Nathan J. Brown, Lee Jones, Clint Douglas, Rajeev Jarugula, Kevin Chu and Anthony Nguyen</i>	
Treatment Prediction in the ICU Using a Partitioned, Sequential, Deep Time Series Analysis	710
<i>Michael Shapiro and Yuval Shahar</i>	
Graph Representation Learning-Based Fixed-Length Clinical Feature Vector Generation from Heterogeneous Medical Records	715
<i>Tomohisa Seki, Yoshimasa Kawazoe and Kazuhiko Ohe</i>	
A Hemodialysis Mortality Prediction Model Based on Active Contrastive Learning	720
<i>Feng Wang, Shengqiang Chi, Xueyao Li, Hang Zhang and Jingsong Li</i>	
Graph Neural Network Based Multi-Label Hierarchical Classification for Disease Predictions in General Practice	725
<i>Shengqiang Chi, Yuqing Wang, Ying Zhang, Weiwei Zhu and Jingsong Li</i>	
Physician-Centered EHR Data Utilization: A Pilot Study	730
<i>Chengkai Wu, Tianshu Zhou, Yu Tian, Huiyao Sun, Zhong Liu and Jingsong Li</i>	
Transfer Learning for Mortality Prediction in Non-Small Cell Lung Cancer with Low-Resolution Histopathology Slide Snapshots	735
<i>Matthew Clark, Christopher Meyer, Jaime Ramos-Cejudo, Danne C. Elbers, Karen Pierce-Murray, Rafael Fricks, Gil Alterovitz, Luigi Rao, Mary T. Brophy, Nhan V. Do, Robert L. Grossman and Nathanael R. Fillmore</i>	
Prognosticating Fetal Growth Restriction and Small for Gestational Age by Medical History	740
<i>Herdiantri Sufriyana, Fariska Zata Amani, Aufar Zimamuz Zaman Al Hajiri, Yu-Wei Wu and Emily Chia-Yu Su</i>	
Pericardial Effusion Detection on Post-Mortem Computed Tomography Images Using Convolutional Neural Networks	745
<i>Haoyu Kong, Jia Rong, Chris Bain, Xinyu Zhang, Sarah Parsons, Guanliang Chen and Richard Bassed</i>	
A Multi-Resolution Denoising Method for Low-Dose CT Based on the Reconstruction of Wavelet High-Frequency Channel	750
<i>Jinnan Hu, Peijun Hu, Yiwei Gao, Yanxia Zhao and Jingsong Li</i>	

Hierarchical Label Distribution Learning for Disease Prediction <i>Yi Ren, Jing Xia, Ziyi Yu, Zhenchuan Zhang, Tianshu Zhou, Yu Tian and Jingsong Li</i>	755
YouTube Videos for Public Health Literacy? A Machine Learning Pipeline to Curate Covid-19 Videos <i>Yawen Guo, Xiao Liu, Anjana Susarla and Rema Padman</i>	760
Personalized Prediction of Parkinson's Disease Progression Based on Deep Gaussian Processes <i>Changrong Pan, Yu Tian, Tianshu Zhou and Jingsong Li</i>	765
Track 3: Health Data Science and Artificial Intelligence	
Theme 1: Methods	
Topic 3: Data Visualisation	
Data Visualization of CRISPR-Cas9 Guide RNA Design Tools <i>Yatish Jain, Fathima Afra Mohamed Izzath, Laurence O.W. Wilson and Denis C. Bauer</i>	770
Say Goodbye to the 'Paper on Screen', Rethinking Presentation of and Interaction with Medical Information <i>Dennis Rausch, Zuzanna Kwade, Michael Dahlweid, Irina Kozinova, Shainal Nathoo and Mobin Yasini</i>	775
Graphical Presentations in Systemic Anticancer Treatment Network Meta-Analyses: A Systematic Review <i>Sandeep Jain, Xuanyi Li and Jeremy Warner</i>	780
Modelling Planned vs. Actual Start Time to Control the Efficiency of Surgery <i>Justin Boyle, Hamed Hassanzadeh, Sankalp Khanna, Barbara Biki, Faraz Syed, Ellen Borkwood and Lianne Sweeney</i>	785
Visualising Healthcare Process Variability <i>Hunter Chen Chen, Abel Armas-Cervantes, Vickie Irving, Brian Dorricott and Daniel Capurro</i>	790
Defining the Boundaries of Psychiatric and Medical Knowledge: Applying Cartographic Principles to Self-Organising Maps <i>Andrew Amos, Kyungmi Lee, Tarun Sen Gupta and Bunmi Malau-Aduli</i>	795
Visualising Variation in the Real-World Clinical Delivery of Chemotherapy Protocols <i>Georgina Kennedy, Meg Stevens and Timothy Churches</i>	800
Graphical Association Analysis for Identifying Variation in Provider Claims for Joint Replacement Surgery <i>James Kemp, Christopher Barker, Norm Good and Michael Bain</i>	805
Track 3: Health Data Science and Artificial Intelligence	
Theme 1: Methods	
Topic 4: Simulation	
PEPS: Polygenic Epistatic Phenotype Simulation <i>Roc Reguant, Mitchell J. O'Brien, Arash Bayat, Brendan Hosking, Yatish Jain, Natalie A. Twine and Denis C. Bauer</i>	810
Continuous Remote Patient Monitoring for Post-Discharge Heart Failure Management: Workflow Modeling Using Discrete Event Simulation <i>Rema Padman, Anirudh Vaidhyaa Venkatasubramanian, Wei Ning Chi, Anthony Solomonides and Nirav Shah</i>	815
An Approach for Generating Realistic Australian Synthetic Healthcare Data <i>Ibrahima Diouf, John Grimes, Mitchell J. O'Brien, Hamed Hassanzadeh, Donna Truran, Hoa Ngo, Parnesh Raniga, Michael Lawley, Denis C. Bauer, David Hansen, Sankalp Khanna and Roc Reguant</i>	820

Track 3: Health Data Science and Artificial Intelligence**Theme 1: Methods****Topic 5: Process Mining**

- Automated Process Mining and Learning of Therapeutic Actions in the Intensive Care Unit 825
Anna Romanov and Yuval Shahar
- Extracting Dynamic Information of Temporal Clinical Data to Predict the Outcome in Critically Ill Patients 830
Jing Xia, Yi Ren, Zhenchuan Zhang, Feng Wang, Yu Tian, Tianshu Zhou and Jingsong Li

Track 3: Health Data Science and Artificial Intelligence**Theme 1: Methods****Topic 6: Data Cleansing**

- Quality of Person-Generated Healthy Walking Data: An Explorative Analysis 835
Hyeoneui Kim, Eun-young Im and Ga-in Ahn
- Instance Selection Algorithms for Predictive Modelling in Telehealth Applications 840
Fabian Wiesmüller, Dieter Hayn, Florian Hoffmann, Sten Hanke, Peter Kastner, Markus Falgenhauer and Günter Schreier
- Challenges in Interpreting Norwegian Child and Adolescent Mental Health Records 845
Kaban Koochakpour, Frida Sofie Solheim, Øystein Nytrø, Carolyn Clausen, Thomas Frodl, Roman Kuposov, Bennett Leventhal, Dipendra Pant, Thomas Brox Røst, Line Stien, Odd Sverre Westbye and Norbert Skokauskas

Track 3: Health Data Science and Artificial Intelligence**Theme 2: Applications****Topic 1: Disease Surveillance**

- Dementia Prediction in Older Adults Using Sex-Specific Health Trajectory Clustering 850
Omar A. Ibrahim, Muskan Garg, Sunyang Fu, Maria Vassilaki, Ronald C. Petersen, Jennifer St Sauver and Sunghwan Sohn
- Assessing Internet Search Models in Predicting Daily New COVID-19 Cases and Deaths in South Korea 855
Atina Husnayain and Emily Chia-Yu Su
- A Symptom-Based Natural Language Processing Surveillance Pipeline for Post-COVID-19 Patients 860
Greg M. Silverman, Geetanjali Rajamani, Nicholas E. Ingraham, James K. Glover, Himanshu S. Sahoo, Michael Usher, Rui Zhang, Farha Ikramuddin, Tanya E. Melnik, Genevieve B. Melton and Christopher J. Tignanelli
- Elucidating Discrepancy in Explanations of Predictive Models Developed Using EMR 865
Aida Brankovic, Wenjie Huang, David Cook, Sankalp Khanna and Konstanty Bialkowski
- Equitable Machine Learning for Hypoglycaemia Risk Management 870
Jhordany Rodriguez, Daniel Padilla, Lenert Bruce, Ben Thow and Malcolm Pradhan
- Implementation of an HIV Case Based Surveillance Using Standards-Based Health Information Exchange in Rwanda 875
Tom Oluoch, Baptiste Byiringiro, Elysee Tuyishime, Frank Kitema, Loic Ntwali, Samuel Malamba, Sridevi Wilmore and Eric Remera
- Artificial Intelligence Approach for Severe Dengue Early Warning System 881
Dina Nur Angraeni Ningrum, Yu-Chuan (Jack) Li, Chien-Yeh Hsu, Muhammad Solihuddin Muhtar and Hanif Pandu Suhito
- A New Statistical Method to Detect Disease Outbreaks from Hospital Emergency Department Data 886
Jin Yoon and Justin Boyle

Predicting Urgent Dialysis at Ambulance Transport to the Emergency Department Using Machine Learning Methods	891
<i>Sheida Majouni, Karthik Tennankore and Syed Sibte Raza Abidi</i>	
Characterizing Cluster-Based Frailty Phenotypes in a Multicenter Prospective Cohort of Kidney Transplant Candidates	896
<i>Syed Hani Raza Abidi, Nur Zincir-Heywood, Syed Sibte Raza Abidi, Kranthi Jalakam, Samina Abidi, Lakshman Gunaratnam, Rita Suri, Héloïse Cardinale, Amanda Vinson, Bhanu Prasad, Michael Walsh, Seychelle Yohanna, George Worthen and Karthik Tennankore</i>	
Track 3: Health Data Science and Artificial Intelligence	
Theme 2: Applications	
Topic 2: Biomedical Imaging and Image Analysis	
MSPA-DLA++: A Multi-Scale Phase Attention Deep Layer Aggregation for Lesion Detection in Multi-Phase CT Images	901
<i>Titinunt Kitrungrotsakul, Yingying Xu, Qingqing Chen, Jing Liu, Yinhao Li, Lanfen Lin, Hongjie Hu, Ruofeng Tong, Jingsong Li and Yen-Wei Chen</i>	
A Deep Multi-Task Network to Learn Tumor Pathological Representations for Lymph Node Metastasis Prediction	906
<i>Danqing Hu, Bing Liu, Lechao Cheng, Rui Guo, Jin Wang, Xudong Lu and Nan Wu</i>	
A Deep Learning-Based System for the Assessment of Dental Caries Using Colour Dental Photographs	911
<i>Maryam Mehdizadeh, Mohamed Estai, Janardhan Vignarajan, Jilen Patel, Joanna Granich, Michael Zaniovich, Estie Kruger, John Winters, Marc Tennant and Sajib Saha</i>	
Multimodality Fusion Method Based on Multiview Subspace Clustering for Pulmonary Embolism Diagnosis	916
<i>Peijun Hu, Qianqian Qi, Yanxia Zhao, Miaomiao Fu and Jingsong Li</i>	
Explainable Artificial Intelligence for Deep-Learning Based Classification of Cystic Fibrosis Lung Changes in MRI	921
<i>Friedemann G. Ringwald, Anna Martynova, Julian Mierisch, Mark Wielpütz and Urs Eisenmann</i>	
Whole-Liver Based Deep Learning for Preoperatively Predicting Overall Survival in Patients with Hepatocellular Carcinoma	926
<i>Chao Huang, Peijun Hu, Yu Tian, Yangyang Wang, Yiwei Gao, Qianqian Qi, Qi Zhang, Tingbo Liang and Jingsong Li</i>	
Dual-Attention Model Fusing CNN and Transformer for Pancreas Segmentation	931
<i>Yan Zhu, Peijun Hu, Yu Tian, Kaiqi Dong and Jingsong Li</i>	
CMIR: A Unified Cross-Modality Framework for Preoperative Accurate Prediction of Microvascular Invasion in Hepatocellular Carcinoma	936
<i>Jing Liu, Yang Ai, Chao Huang, Fang Wang, Yingying Xu, Titinunt Kitrungrotsaku, Jing Ma, Lanfen Lin, Yen-Wei Chen and Jingsong Li</i>	
Reshaping Wound Care: Evaluation of an Artificial Intelligence App to Improve Wound Assessment and Management	941
<i>Michelle Barakat-Johnson, Aaron Jones, Mitch Burger, Thomas Leong, Astrid Frotjold, Sue Randall, Judith Fethney and Fiona Coyer</i>	
Vision-Based Assistance for Vocal Fold Identification in Laryngoscopy with Knowledge Distillation	946
<i>Thao Thi Phuong Dao, Minh-Khoi Pham, Mai-Khiem Tran, Chanh Cong Ha, Boi Ngoc Van, Bich Anh Tran and Minh-Triet Tran</i>	
Position Prior Attention Network for Pancreas Tumor Segmentation	951
<i>Kaiqi Dong, Peijun Hu, Xiang Li, Yu Tian, Yan Zhu, Xueli Bai, Tingbo Liang and Jingsong Li</i>	

Track 3: Health Data Science and Artificial Intelligence**Theme 2: Applications****Topic 3: Population Health**

- Identifying Determinants of Survival Disparities in Multiple Myeloma Patients Using Electronic Health Record Data 956
Wanting Cui and Joseph Finkelstein
- Pneumococcal Vaccination Lowers the Risk of Alzheimer's Disease: A Study Utilizing Data from the IBM® MarketScan® Database 961
Xingyue Huo and Joseph Finkelstein
- Health-Analytics Data to Evidence Suite (HADES): Open-Source Software for Observational Research 966
Martijn Schuemie, Jenna Reys, Adam Black, Frank Defalco, Lee Evans, Egill Fridgeirsson, James P. Gilbert, Chris Knoll, Martin Lavallee, Gowtham A. Rao, Peter Rijnbeek, Katy Sadowski, Anthony Sena, Joel Swerdel, Ross D. Williams and Marc Suchard
- Readmission Risk Based on Debility and Psychosocial Measures: The Western 9 Algorithm 971
Norm Good, Craig Nelson, Jason Plant, Kirsty Barnes and Catherine Grant
- Development and Usability Evaluation of an Opioid Management App 976
Sagar Deshpande, Melissa Gunderson, Geetanjali Rajamani, Suhyun Park, Molly Diethelm, Jenna Marquard, Genevieve Melton and Rubina Rizvi
- Facebook Post Credibility as a Predictor of Vaccine Hesitancy in the US 981
Ana Aleksandric, Anisha Dangal, Shirin Nilizadeh and Gabriela Mustata Wilson
- Strategies to Improve Statin Medication Adherence Among Patients at Risk of Cardiovascular Disease Identified Through Electronic Health Records: A Literature Review 986
Shagoofa Rakhshanda, Siaw-Teng Liaw, Joel Rhee, Kerry-Anne Rye and Jitendra Jonnagaddala

Track 3: Health Data Science and Artificial Intelligence**Theme 2: Applications****Topic 4: Precision Medicine**

- Uncertainty in Breast Cancer Risk Prediction: A Conformal Prediction Study of Race Stratification 991
Alexander S. Millar, John Arnn, Sam Himes and Julio C. Facelli
- Bioinformatics Architecture for Integrating Genomics Data into Electronic Health Records 996
Mauricio Brunner, Matias Butti, Sebastián Menazzi, Hernan Chanfreau, Matias Tajerian, Alfonso Quiroga, Paula Otero, Daniel Luna and Sonia Benitez
- Development of Machine Learning Prediction Models for Self-Extubation After Delirium Using Emergency Department Data 1001
Koutarou Matsumoto, Yasunobu Nohara, Mikako Sakaguchi, Yohei Takayama, Takanori Yamashita, Hidehisa Soejima and Naoki Nakashima
- Machine-Learning Based Risk Assessment for Cancer Therapy-Related Cardiac Adverse Events Among Breast Cancer Patients 1006
Quynh T.N. Nguyen, Phuc T. Phan, Shwu-Jiuan Lin, Min-Huei Hsu, Yu-Chuan (Jack) Li, Jason C. Hsu and Phung-Anh Nguyen
- A Step Towards Building Health Digital Twins: Patient Phenotype Representation for Health Outcome Prediction 1011
Hamed Hassanzadeh, Justin Boyle and Sankalp Khanna
- Architecture of the Mass Spectrometry Data Management Pipeline in the SMART-CARE Project 1016
Friedemann G. Ringwald, Aleksei Dudchenko, Petra Knaup, Felix Czernilofsky, Sascha Dietrich and Matthias Ganzinger
- Prediction of Coronary Artery Disease Risk Using Genetic and Phenotypic Variables 1021
Letitia M.F. Sng, Reevanshi Sharma, Sam Bagot, Denis C. Bauer and Natalie A. Twine

Comparing Predictive Performance of Time Invariant and Time Variant Clinical Prediction Models in Cardiac Surgery	1026
<i>David A. Jenkins, Glen P. Martin, Matthew Sperrin, Benjamin Brown, Linda Kimani, Stuart Grant and Niels Peek</i>	
Ensemble Clustering to Generate Phenotypes of Kidney Transplant Donors and Recipients	1031
<i>Syed Sibte Raza Abidi, Kranthi Jalakam, Syed Hani Raza Abidi and Karthik Tennankore</i>	
A Text Mining Approach to Explore IFN ϵ Literature and Biological Mechanisms	1036
<i>Mary McCabe, Helen E. Groves, Ultan F. Power and Guillermo Lopez Campos</i>	
Track 4: Human, Organisational and Social Aspects	
Theme 1: User Experience	
Topic 1: Ui/Ux Design	
Tabular, Annotated, Visual, or Trends + Contextual Information? Preferences for Online Laboratory Results Displays	1041
<i>Helen Monkman, Leah MacDonald, Amanda L. Joseph and Blake J. Lesselroth</i>	
Using Google Analytics with Health Information-Seeking Model to Evaluate the Design of Health Information Websites	1046
<i>Patrick Cheong-Iao Pang, Megan Munsie and Shanton Chang</i>	
Initial User-Centred Design of an AI-Based Clinical Decision Support System for Primary Care	1051
<i>Michaela Christina Neff, Jannik Schaaf, Richard Noll, Svea Holtz, Dania Schütze, Susanne Maria Köhler, Beate Müller, Najia Ahmadi, Michael von Wagner and Holger Storf</i>	
Medication Adherence Support Applications for Chronic Arthritis Patients: Healthcare Providers' Perspective in Saudi Arabia	1056
<i>Saleh Altuwayrib, Khin Than Win and Mark Freeman</i>	
Interpreting Laboratory Results with Complementary Health Information: A Human Factors Perspective	1061
<i>Amanda L. Joseph, Helen Monkman, Leah MacDonald and Claudia Lai</i>	
Track 4: Human, Organisational and Social Aspects	
Theme 1: User Experience	
Topic 2: Human-Computer Interaction	
Fighting the Same Battles on a New Battleground: Embedding Technologies in a Virtual Care Environment	1066
<i>Adeola Bamgboje-Ayodele, Adrian Boscolo, Owen Hutchings, Miranda Shaw, Mitchell Burger, Richard Taggart, Mark Simpson, Tim Shaw, Steven McPhail and Melissa T. Baysari</i>	
Towards an Environmentally Robust Speech Assistant System for Emergency Medical Services	1071
<i>Zhenchuan Zhang, Yu Tian, Tianshu Zhou, Yinghao Zhao, Jungen Zhang and Jingsong Li</i>	
Why Parents Do Not Use Digital Health Interventions for Their Child's Mental Health?	1076
<i>Daniel Peyton, Greg Wadley, Naomi Hackworth and Harriet Hiscock</i>	
Track 4: Human, Organisational and Social Aspects	
Theme 1: User Experience	
Topic 3: Workflow	
Development of Ward Visitor Management System in the COVID-19 Epidemic	1081
<i>Yongdong Bi, Siru Liu and Jialin Liu</i>	

- Matching Patients to Accelerate Clinical Trials (MPACT): Enabling Technology for Oncology Clinical Trial Workflow 1086
Nhan V. Do, Danne C. Elbers, Nathanael R. Fillmore, Samuel Ajarapu, Steven J. Bergstrom, John Bihn, June K. Corrigan, Rupali Dhond, Svitlana Dipietro, Arkadiy Dolgin, Theodore C. Feldman, Sergey D. Goryachev, Linden B. Huhmann, Jennifer La, Paul A. Marcantonio, Kyle M. McGrath, Stephen J. Miller, Vinh Q. Nguyen, George R. Schneeloch, Feng-Chi Sung, Kaitlin N. Swinerton, Amelia H. Tarren, Hannah M. Tosi, Danielle Valley, Austin D. Vo, Cenk Yildirim, Chunlei Zheng, Robert Zwolinski, Gisele A. Sarosy, David Loose, Colleen Shannon and Mary T. Brophy
- End Users' Perceived Engagement with Clinical Dashboards: A Rapid Review 1091
Grace Gao, Christie L. Martin, Camille Vaughan, Alayne Markland, Ursula Kelly, Neha Pathak, Joseph Wallace and Zachary Burningham
- The Impact and Usability of the eRIC System in the ICU – A Qualitative Study 1096
Julie Li, Rae-Anne Hardie, Maria R. Dahm and Andrew Georgiou

Track 4: Human, Organisational and Social Aspects

Theme 1: User Experience

Topic 4: Patient-Clinician Communication

- Clinical Evaluation of a Lay-Language Radiology Glossary Integrated into an Electronic Health Record System 1101
Charles E. Kahn, Jr.
- Predictors of the Use of Physician's Televisits During the COVID-19 Pandemic in Poland 1106
Mariusz Duplaga
- Developing eHealth for Home Dialysis: Clinicians' Needs for a Digital Patient Engagement Platform 1111
Sini Hölsä, Johanna Viitanen, Paula Valkonen, Tinja Lääveri and Virpi Rauta
- Facial Mimicry and Doctor-Patient Satisfaction: The Feasibility of Artificial Empathy in a Clinical Video Data 1116
Annisa Ristya Rahmanti, Chih-Wei Huang, Muhammad Solihuddin Muhtar, Hsuan-Chia Yang and Yu-Chuan (Jack) Li
- Speech Emotion Recognition Applied to Real-World Medical Consultation 1121
Ching-Tzu Huang, Chih-Wei Huang, Hsuan-Chia Yang and Yu-Chuan (Jack) Li

Track 4: Human, Organisational and Social Aspects

Theme 2: Health Policy and Ethics

Topic 1: Integrating with Mental Health, Social and Community Care

- Analyzing Patient-Sharing Network Using an Administrative Claim Database in Japan 1126
Tomoki Ishikawa, Akihito Kako, Hiromasa Yoshimoto, Junko Hattori, Kazuo Goda and Naohiro Mitsutake

Track 4: Human, Organisational and Social Aspects

Theme 2: Health Policy and Ethics

Topic 2: Learning Health Systems

- Building Research Infrastructure to Develop Greater Learning Efficiencies (BRIDGE) 1131
Danne C. Elbers, Nathanael R. Fillmore, Jennifer La, Hannah M. Tosi, Samuel Ajarapu, Rupali Dhond, Karen Murray, Danielle Valley, Colleen Shannon, Mary T. Brophy and Nhan V. Do
- Implementation of Artificial Intelligence Applications in Australian Healthcare Organisations: Environmental Scan Findings 1136
Anna B. Janssen, Shah Kavisha, Alison Johnson, Anna Marinic, Helena Teede and Tim Shaw

Exploration of the Voice of the Patient in Learning Health Systems: A Socio-Technical Perspective	1141
<i>Sonja Cassidy, Øivind Skeidsvoll Solvang, Terje Solvoll and Ove Lintvedt</i>	
Interdisciplinary Learning Health System Response to Public Vaccine Concerns	1146
<i>Gerardo Luis Dimaguila, Muhammad Javed, Hazel J. Clothier, Jo Hickman, Dan Petrovic, Francesca Machingaifa, Jessica Kaufman, Sedigh Khademi Habibabadi, Christopher Palmer and Jim Buttery</i>	
Track 4: Human, Organisational and Social Aspects	
Theme 2: Health Policy and Ethics	
Topic 3: Citizen Co-Design	
Rare Diseases in Citizen Science – Preliminary Experiences in Developing a Personal Health App	1151
<i>Jannik Schaaf, Andreas Khouri, Thomas Zerr, Jörg Scheidt, Michaela Neff and Holger Storf</i>	
Track 4: Human, Organisational and Social Aspects	
Theme 2: Health Policy and Ethics	
Topic 4: Consumer Perspectives	
What Do Health Service Users Think About the Use of Their Data for AI Development?	1156
<i>Rosie Dobson and Robyn Whittaker</i>	
Insights on the Future of Digital Health: An Analysis of Twitter Posts of IMIA Fellows	1161
<i>David T. Marc, Karima Lalani, Susan H. Fenton and Kerryon Butler-Henderson</i>	
Track 4: Human, Organisational and Social Aspects	
Theme 3: Education and Training	
Topic 1: Formal Education	
CBL on FHIR: A FHIR-Based Platform for Health Professional Education	1166
<i>Mark Braunstein, Ben Barry, Jim Steel, Deanne Ukovich, John Grimes, David Conlan, Sophie Jones, Chelsea Dobbins and David Hansen</i>	
Lessons Learned from an Interprofessional European Summer School in Health Informatics	1171
<i>Ursula H. Hübner, Pedro Vieira-Marques, Jens Hüasers, Tiina Haukkakallio, Johanna Ikonen, Nicole Egbert, Joao Almeida, Birgit Babitsch, Ulla-Mari Kinnunen, Ricardo Correia and Kaija Saranto</i>	
Teledermatology: Simulating Hybrid Workflows for Telemedicine Education	1176
<i>Blake Lesselroth, Helen Monkman, Ryan Palmer, Andrew Liew, Christina Kendrick, Liz Kollaja, Shannon Ijams, Juell Homco, Elizabeth Soo, Kristen Foulks and Frances Wen</i>	
Case-Based Learning in a Simulated Electronic Medical Record: Digital Health Education for Nursing Students	1181
<i>Sophie Jones, Marie Gertz, Deanne Ukovich, Philippa Marriott and Mark Merolli</i>	
Teaching Module to Train Students in the Participatory Design of Digital Technologies for Disability Assistance	1186
<i>Adrien Ugon, Corinne Isnard Bagnis and Sylvia Pelayo</i>	
A Skills Assessment Pathways-Based Program Assessment Approach in Multidisciplinary Graduate Health Informatics	1191
<i>Saptarshi Purkayastha, Akshita Venkat Patri and Vedasree Yerrabandi</i>	
Nursing Informatics: Competency Challenges for Nursing Faculty	1196
<i>Lisa Reid, Didy Button, Katrina Breaden and Mark Brommeyer</i>	
Track 4: Human, Organisational and Social Aspects	
Theme 3: Education and Training	
Topic 2: Continuing Professional Development	

- Simulating Telemedicine, Medication Reconciliation, and Social Determinants: A Novel Instructional Approach to Health Systems Competencies 1201
Blake Lesselroth, Helen Monkman, Andrew Liew, Ryan Palmer, Kimberly Crosby, Deirdra Kelly, Liz Kollaja, Shannon Ijams, Kristin Rodriguez, Juell Homco and Frances Wen

Track 4: Human, Organisational and Social Aspects

Theme 3: Education and Training

Topic 3: Workforce Development

- Health Service Managers' Digital Competencies: A Conceptual Framework 1206
Mark Brommeyer, Maxine Whittaker and Zhanming Liang
- The Australian Health Informatics Competency Framework: Conceptual Design, Framework Development, and Certification Delivery 1211
Mark Brommeyer, Jen Bichel-Findlay, Tanija Tarabay, Louise Schaper, David O'Driscoll and Kerryn Butler-Henderson
- User Perceptions and Use of Decision Support Medical Apps Among Medical Students: Cross-Sectional Study 1216
Raniah Aldekhyyel, Jwahr Almulhem, Samar Binkheder, Manahel Almulhem, Eman Mohamed, Shahad Aldekhyyel, Reem Alqahtani and Sripriya Rajamani
- Demonstrating Digital Health Clinical Competence in Practice: A Method for Developing Entrustable Professional Activities 1221
Mark Merolli and Kathleen Gray
- Health Informatics Workforce in the Digital Health Ecosystem 1226
Rebecca Meehan
- Building a More Diverse Public Health Informatics Workforce: Preliminary Results 1231
Susan H. Fenton and Gabriela Mustata Wilson
- An Exploration of the Certified Health Informatician Australasia (CHIA) Participants 1236
Desiree McNeile McCormick, Jen Bichel-Findlay, David O'Driscoll, Kerryn Butler-Henderson and Tanija Tarabay
- Designing an Interprofessional Online Course to Foster Learning Health Systems 1241
Sathana Dushyanthen, Dawn Choo, Meg Perrier, Kathleen Gray, Daniel Capurro, Douglas Pires, Brian E. Chapman, Graeme K. Hart, Kit Huckvale, Wendy W. Chapman and Kayley Lyons

Track 4: Human, Organisational and Social Aspects

Theme 3: Education and Training

Topic 4: Online Learning

- Health Professionals' Use of Online Communities for Interprofessional Peer Education 1246
Rowena Forsyth, Krestina L. Amon, Brad Ridout and Andrew J. Campbell

Track 4: Human, Organisational and Social Aspects

Theme 3: Education and Training

Topic 5: Serious Gaming

- The Saltomachy War – A Metaverse Escape Room on the War Against Salt 1251
Arasyulhaq Bin Ahmad, Serene Tan and Kevin Yap
- Developing a Framework for the Design and Deployment of Virtual Reality (VR) in Clinical Education 1256
Nathan Moore, Naseem Ahmadpour, Jennifer Davids, Philip Poronnik and Martin Brown

Track 4: Human, Organisational and Social Aspects

Theme 3: Education and Training

Topic 6: Health Information Literacy

YouTube Video Analytics for Patient Education: An Exploratory Clustering of Obstructive Sleep Apnea Videos <i>Ruoyu Zhang, Jennifer Shin, Kristine Schulz, Xiao Liu, Anjana Susarla and Rema Padman</i>	1261
Track 5: Global Health Informatics	
Theme 2: Public Health	
Topic 1: Sustainable Development Goals	
Open Source Software in Healthcare: International Case Series from the IMIA Open Source Working Group <i>Chris Paton, Pamod Amarakoon, Jørn Braa, Shinji Kobayashi, Alvin Marcelo, Tom Kane, Hamish Fraser and Terry Hannan</i>	1266
Herding Cats in Pandemic Times – Towards Technological and Organizational Convergence of Heterogeneous Solutions for Investigating and Mastering the Pandemic in University Medical Centers <i>Dagmar Krefting, Nico T. Mutters, Rüdiger Pryss, Martin Sedlmayr, Martin Boeker, Christoph Dieterich, Carolin Koll, Martina Mueller, Anna Slagman, Dagmar Waltemath, Antje Wulf and Sven Zenker</i>	1271
Track 5: Global Health Informatics	
Theme 2: Public Health	
Topic 2: Disaster Management	
Resilience Informatics for Public Health <i>M. Sriram Iyengar, Nirav Merchant, Kacey Ernst, Stephen Rains, Mona Arora, Maiya G. Block Ngaybe and Myla Gonzalez</i>	1276
Data-Driven Interventions for an Emergency Preparedness System: A National Experience in Australia <i>Andre Q. Andrade, Mhairi Kerr and Elizabeth E. Roughead</i>	1281
Emergency Department Demand and the First Year of the COVID-19 Pandemic <i>Justin Boyle, Sankalp Khanna and James Lind</i>	1287
Track 5: Global Health Informatics	
Theme 2: Public Health	
Topic 3: Healthcare Access and Equity	
Piloting a Big Data Epidemiology Approach to Support Frail, Homebound, and Bedridden People <i>Maria Alejandra Pinero De Plaza, Aline Beleigoli, Alison Kitson, Penelope McMillan and Carlos Javier Barrera Causil</i>	1292
Citizens' Access to Online Health Information – An International Survey of IMIA Member Countries <i>Jeppe Eriksen, Helen Monkman, Julia Adler-Milstein, Kristina Tornbjerg Eriksen and Christian Nøhr</i>	1297
National Trial Overview: Towards Accessible and Patient-Centered Healthcare <i>Ditte Weber and Christian Nøhr</i>	1302
Survey of Potential Disparity Issues Among Minority Stroke Survivors in Central Brooklyn <i>Adiebonye E. Jumbo, David R. Kaufman, Mohammad A. Faysel, Aimee Afable and Steven R. Levine</i>	1307
Track 5: Global Health Informatics	
Theme 2: Public Health	
Topic 4: Social Determinants	
Discovering Social Determinant of Health Risk Factors for Perinatal Morbidity Through Real World Data <i>Cheng Gao and You Chen</i>	1312

- Measuring Associations Between Community-Level Social Determinants of Health and Bariatric Surgery Weight Loss Outcomes 1317
Nicholas Skoufis, Rui Zhang and You Chen
- Utilizing Electronic Dental Records to Predict Neuro-Degenerative Diseases in a Dental Setting: A Pilot Study 1322
Jay Patel and Huanmei Wu
- Exploring the Geospatial Relationship Between COVID-19 Positivity and Income in Mixed Urban-Rural Population 1327
Butros M. Dahu, Solaiman Khan, Lincoln R. Sheets and Grant J. Scott

Posters

Track 1: Information and Knowledge Management

Theme 1: Information Standards

Topic 1: Interoperability

- A Blockchain-Based Approach for Patient Data Alignment Across Institutions 1335
Tianshu Zhou, Yao Lu, Yin Zhang, Jiaqi Wang, Yu Tian and Jingsong Li
- The Role of HL7 FHIR in the European Project GATEKEEPER 1337
Roberta Gazzarata, Catherine Chronaki, Alba Gallego, Eugenio Gaeta, Giuseppe Fico, Paolo Zampognaro, Franco Mercalli, Francesco Giuliani, Carlo Allocca and Giorgio Cangioni
- Designing Medication-Related Profiles for Japanese ePrescriptions with HL7 FHIR 1339
Shinji Kobayashi, Masahiko Kimura, Yoshinori Kodama, Atsushi Takada and Kazuhiko Ohe
- Evaluation of Smart Pump Interoperability with an Electronic Medical Record System to Improve Infusion Safety 1341
Karen Chin, Jarrod Donovan, Gordon Bingham, Susan Poole and Erica Tong

Track 1: Information and Knowledge Management

Theme 1: Information Standards

Topic 2: Terminology

- Defining the Standard of the Terminology of the Mechanical Ventilation Data in Japan 1343
Kenichi Saito, Shinji Kobayashi, Takahiko Tsutsumi, Shunsuke Takaki and Satoru Hashimoto
- Current Status of SNOMED CT National Extensions and Terminology Managements 1345
Seoun Kim, Soo-Yong Shin, Ji Eun Hwang and Hyeoun-Ae Park

Track 1: Information and Knowledge Management

Theme 1: Information Standards

Topic 3: Ontology

- Literature Analysis on Ontologies Applied in Clinical Decision Support Systems 1347
Xia Jing, Hua Min, Yang Gong, Paul Biondich, David Robinson, Timothy D. Law, Christian G. Nohr, Arild Faxvaag, Lior Rennert, Nina C. Hubig and Ronald W. Gimbel

Track 1: Information and Knowledge Management

Theme 1: Information Standards

Topic 4: Metadata

- Feasibility of Applying the OMOP Common Data Model to Traditional Eastern Asian Medicine Dataset 1349
Jiyun Cha, Eun Kyoung Ahn, Young-Heum Yoon and Man Young Park

Track 1: Information and Knowledge Management

Theme 2: Information Management

Topic 1: Electronic Health Records

- Interprofessional Documentation: Where is Everyone? 1352
Graham Ikler, Carolyn Dickens and Andrew D. Boyd

New Prediction Model for Incidence of Dementia in Patients with Type 2 Diabetes <i>Phan Thanh Phuc, Phung Anh Nguyen and Jason C. Hsu</i>	1354
Electronic Health Records Role in Predicting Outcomes to Work-Related Musculoskeletal Disorders: A Study Protocol <i>Melinda Wassell, Andrew Vitiello and Henry Pollard</i>	1356
Visit-to-Visit Blood Pressure Variability in Cardiovascular Disease <i>Mifetika Lukitasari, Siaw-Teng Liaw, Bin Jalaludin and Jitendra Jonnagaddala</i>	1358
Implementation of a Multilingual Electronic Medical Questionnaire: For Use Inside or Outside the Hospital <i>Shozo Konishi, Shirou Manabe, Yoshie Shimai, Yoshiki Namiuchi, Kento Sugimoto, Shoya Wada, Katsuki Okada, Yasushi Matsumura and Toshihiro Takeda</i>	1360
Discontinuity of Stroke Care in a Black Urban Cohort: Insight from EHR Data <i>Mohammad A. Faysel, David Kaufman, Aimee Afable, Adieboney Jumbo and Steven Levine</i>	1362
Track 1: Information and Knowledge Management	
Theme 2: Information Management	
Topic 3: Registries and Health Information Exchange	
An Informatics Platform for the Management of Data for Australian Dementia Network (ADNeT) Initiative <i>Julie Trinder, Pierrick Bourgeat, Ying Xia, Jurgen Fripp and Parnesh Raniga</i>	1364
Data-Exchange Between Electronic Medical Record and Viral-Load Laboratory Database Towards Improving HIV Care in Ethiopia <i>Asaminew Petros, Daniel Melese Desalegn, Getachew Fikadie Dessie, Bedri Ahmed Mumme, Kalechristos Abebe, Dagim Melkie Haile, Hiwot Berhanu Bogale, Minen Sead Mohammed, Yohannes Tesfaye, Yared Tedla, Gonfa Ayana Gutta, Desalegn Lulu Bekeidami, Zenebe Melaku, Dereje Habte and Sileshi Lulseged</i>	1366
Track 1: Information and Knowledge Management	
Theme 2: Information Management	
Topic 5: Security, Privacy and Consent	
Digital Health Consent – for Better Interoperability and Consumer Control <i>Zoran Milosevic and Frank Pyefinch</i>	1368
High Accuracy Open-Source Clinical Data De-Identification: The CliniDeID Solution <i>Stéphane Meystre and Paul Heider</i>	1370
Track 1: Information and Knowledge Management	
Theme 3: Computable Knowledge	
Topic 2: Decision Support	
Evaluation of the Proposed Arden Syntax v3.0 to Represent Query Data Mappings Using FHIR <i>Robert A. Jenders</i>	1372
Development of Clinical Decision Support System for Patient Blood Management in Hospital Information System <i>Ye Seul Bae and Kyung Hwan Kim</i>	1374
Clinical Implementation of an AI Early Warning System Algorithm: Lessons Learned <i>Anne M. Meehan, Marcia A. Core, Jared M. Ross, Parvez A. Rahman, Bijan J. Borah and Pedro J. Caraballo</i>	1376
Decision Support System Detecting Patients at Risk of Prolonged QT and Associated Mortality <i>Pedro J. Caraballo, Johan M. Bos, Ray Qian, Karen M. Fischer, Paul J. Johnsen, Diana J. Schreie, Gyorgy Simon and Michael J. Ackerman</i>	1378
Usability of Clinical Decision Support for Adult Sepsis Detection <i>Khalia Ackermann, Johanna Westbrook and Ling Li</i>	1380

- Understanding the Technical Implementation of a Clinical Decision Support SmartApp:
A Qualitative Analysis 1382
*Mollie Hobensack, Jennifer Withall, Kenrick Cato, Patricia Dykes,
Graham Lowenthal, Sandy Cho, Catherine Ivory, Po-Yin Yen and Sarah Rossetti*
- MoCab: A Model Management System Based on FHIR for Clinical Decision Support 1384
Zhe-Ming Kuo and Yi-Ju Tseng
- A Personal Healthcare Knowledge Graph Framework for Diagnosis of Pelvic Masses
Diseases 1386
Ran Xin, Jia Chen, Feifei Bao, Yong Shang, Xu Han and Jingsong Li
- Track 1: Information and Knowledge Management**
Theme 3: Computable Knowledge
Topic 3: Artificial intelligence
- An Image Retrieval Pipeline in a Medical Data Integration Center 1388
*Ka Yung Cheng, Santiago Pazmino, Björn Bergh, Markus Lange-Hegermann
and Björn Schreiweis*
- Track 2: Quality, Safety and Outcomes**
Theme 1: Evaluation
Topic 1: Methods
- The Economics of Medication Safety: A Cost-Benefits Analysis Framework for
Evaluating an Electronic Medication System 1390
*Virginia Mumford, Magdalena Z. Raban, Ling Li, Alison Merchant, Erin Fitzpatrick,
Tim Badgery-Parker and Johanna I. Westbrook*
- Exploring Nurse' Use of Digital Nursing Technology 1392
Wen-Chun Chen and Ting-Ting Lee
- Track 2: Quality, Safety and Outcomes**
Theme 1: Evaluation
Topic 2: Healthcare Quality and Patient Safety
- Enhancing Clinical Safety and Cancer Patient Experience Through Comprehensive
eLearning on Central Venous Access Devices 1394
*Lisa McLean, Kerrie Curtis, Jacqueline Hodges, Lisa King, Laura Wuellner,
Annie Zheng, Shelley Rushton and Tracey O'Brien*
- User-Centered Data Display for Clinicians to Diagnose and Manage Hypertension 1396
Carly Ho, Oluwatuminu Layinka, Valerie Chukelu, Kevin Phong and Yang Gong
- Investigation of Medical Accidents for the Development of Alert System to Reduce
Alert Fatigue 1398
Yuki Shiroto, Kota Torikai, Rei Noguchi and Yuichiro Saito
- Track 2: Quality, Safety and Outcomes**
Theme 1: Evaluation
Topic 3: Safety and Security
- Effectiveness of Leakage Prevention System in Communicating Important Diagnostic
Information 1400
Yuji Tani, Tatsuya Hayashi and Tatsuya Iwata
- Track 2: Quality, Safety and Outcomes**
Theme 2: Quality Improvement
Topic 1: New Service Delivery Models
- Implementing Tap-to-Witness Technology in the Electronic Medical Record 1402
*Rebecca Miriam Jedwab, Anthony Pham, Janette Gogler, James-Norbert Garduce,
Joanne Foster, Rebecca Brook and Naomi Dobroff*

Track 2: Quality, Safety and Outcomes**Theme 2: Quality Improvement****Topic 2: Measuring Outcomes**

- Development of Cross-Sector Health Care Quality Indicators Based on Claims Data 1404
*Walter Gall, Hana Šinkovec, Alexander Niessner, Patrick Sulzgruber
 and Georg Heinze*
- Evaluation of a Machine Learning-Based Decision Support Intervention for Inpatient Falls 1406
Insook Cho, MiSoon Kim and Mi Ra Song
- Processes and the Electronic Health Record: Challenges and Difficulties Faced when Creating an OB Quality Dashboard 1408
Kendria C. Hall and Michele Lauria
- A Pragmatic Informatics Approach to Develop Knowledge Tools for Supporting Cardiac Surgical Patients' Mental Health Needs 1410
*Susan Smith, Esben Strodl, Marlien Varnfield, David Kavanagh, Tricia Rolls,
 Usha Gurunathan, Bo Janoschka and Rishendran Naidoo*

Track 2: Quality, Safety and Outcomes**Theme 3: Innovation****Topic 1: Emerging Technologies**

- DR.BEAT: Initial Functional Testing of a BCG Wearable Prototype for Recording Ballistocardiographic Signals 1412
*Marie Cathrine Wolf, Moritz Wübbeler, Christoph Richter, Peter Klein
 and Klaus-Hendrik Wolf*

Track 2: Quality, Safety and Outcomes**Theme 3: Innovation****Topic 2: Novel Applications**

- Expanding Technology-Enabled Nurse-Delivered Chronic Disease Care: EXTEND 1414
Ryan J. Shaw and Matthew J. Crowley
- Web-Based Intervention for Multilingual Family Carers of People with Dementia: Insights from the DrawCare Study 1416
*Nalika Ulapane, Nilmini Wickramasinghe, Thu Ha Dang, Antonia Thodis
 and Bianca Brijnath*
- Accuracy Evaluation of an Estimation System for Dental Treatment Sites by Using Image Recognition 1418
Shintaro Nishimoto, Shintaro Oka and Kazunori Nozaki

Track 2: Quality, Safety and Outcomes**Theme 3: Innovation****Topic 3: Governance, Change and Adoption**

- Feasibility of Embedding a Randomised Clinical Trial (RCT) into an Electronic Medical Record (EMR) for Patients Admitted to an Intensive Care Unit (ICU) 1420
*Hauistine Patt Panganiban, Chinh Dam Nguyen, Yasmin Ali Abdelhamid,
 Melissa Ankravs, Emily Karahalios, Christopher Macisaac, Tom Rechnitzer,
 Lucy Sharrock, An Tran-Duy, Timothy Fazio and Adam M. Deane*

Track 2: Quality, Safety and Outcomes**Theme 4: Patient-Facing Technology****Topic 1: Personal Health Records**

- Adolescents' and Young Adults' Experiences of Offense from Reading Their Health Records Online 1422
*Josefin Hagström, Charlotte Blease, Jonas Moll, Hanife Rexhepi, Isabella Scandurra
 and Maria Hägglund*

Patients' Experiences of Demanded Access to Online Health Records	1424
<i>Annika Bärkås, Anna Kharko, Rose-Mharie Åhlfeldt and Maria Högglund</i>	
A Narrative Review of Sociodemographic Disparities in Relation to PEHR Access	1426
<i>Luke Newbegin and Brian E. Chapman</i>	
Track 2: Quality, Safety and Outcomes	
Theme 4: Patient-Facing Technology	
Topic 2: Symptom Checkers	
Machine Learning Approaches for Exercise Exertion Level Classification Using Data from Wearable Physiologic Monitors	1428
<i>Aref Smiley, Te-Yi Tsai, Ihor Havrylchuk, Aileen Gabriel, Elena Zakashansky, Taulant Xhakli, Jinyan Lyu, Wanting Cui, Irena Parvanova and Joseph Finkelstein</i>	
Design of Household Cognitive Level Assessment System Based on Grip Force and Finger Force Distribution	1430
<i>Ge Shu, Tianshu Zhou, Yu Tian and Jingsong Li</i>	
Challenges in Selecting Patient-Reported Outcome Measures for Use in a Patient-Facing Technology	1432
<i>Priyank Raj, Youmin Cho, Yun Jiang and Yang Gong</i>	
Track 2: Quality, Safety and Outcomes	
Theme 4: Patient-Facing Technology	
Topic 3: Fitness Trackers	
Assessing Patient Perspectives on Pulmonary Telerehabilitation Using Thematic Analysis of Semi-Structured Qualitative Interviews	1434
<i>Aileen S. Gabriel, Irena Parvanova, Te-Yi Tsai and Joseph Finkelstein</i>	
Track 3: Health Data Science and Artificial Intelligence	
Theme 1: Methods	
Topic 1: Natural Language Processing	
Automated Feature Selection from Medical Literature	1436
<i>Alberto Purpura, Tobia Boschi, Francesca Bonin, Rodrigo Ordonez-Hurtado, Natasha Mulligan, Joao H. Bettencourt-Silva and Alessandra Pascale</i>	
Prediction Models for Readmission Using Home Healthcare Notes and OMOP-CDM	1438
<i>Sujin Gan, Chungsoo Kim, Dong Yun Lee and Rae Woong Park</i>	
Text Extraction and Standardization System Development for Pathological Records in the Korea Biobank Network	1440
<i>SooJeong Ko, Sunghyeon Park, SeolWhan Oh, YunSeon Im, Surin Jung, BoYeon Choi, Jaeyoon Kim, Wona Choi and InYoung Choi</i>	
Detecting Emotional Context for Safer Digital Mental Health Agents	1442
<i>Adi Choi, Weihua Li and Jim Warren</i>	
A Linguistic Analysis Examining the Impact of COVID-19 on Pneumonia Diagnosis and Disease Models	1444
<i>Alec B. Chapman, Kelly S. Peterson, Elizabeth Rutter, Mckenna Nevers, Jian Ying, David Classen, Makoto Jones, Matthew Samore and Barbara Jones</i>	
An NLP Framework for the Extraction of Concept Measurements from Radiology and Pathology Notes	1446
<i>Annie Bowles, Cris Perez, Anil Vachani, Jennifer Steltz, Brent Rose, Alex K. Bryant, Hannah Eyre, Scott L. DuVall, Julie A. Lynch and Patrick R. Alba</i>	
Answering Japanese Fill-in-the-Blank Questions in the Radiological Technology Field Using BERT	1448
<i>Ayako Yagahara, Noriya Yokoyama and Mao Higashi</i>	
Evaluation of Machine Translation Accuracy Focused on the Adverse Event Terminology for Medical Devices	1450
<i>Ayako Yagahara, Masahito Uesugi and Hideto Yokoi</i>	

Machine Learning Model to Extract Malnutrition Data from Nursing Notes <i>Mohammad Alkhalaf, Mengyang Yin, Chao Deng, Hui-Chen (Rita) Chang and Ping Yu</i>	1452
Track 3: Health Data Science and Artificial Intelligence	
Theme 2: Applications	
Topic 1: Disease Surveillance	
Designing a Digital Health Solution: A Platform for Automated Surveillance of Fungal Infection <i>Anna Khanina, Vlada Rozova, Sri Elkins, Karin Verspoor and Karin Thursky</i>	1454
Track 3: Health Data Science and Artificial Intelligence	
Theme 1: Methods	
Topic 1: Natural Language Processing	
A De-Identification Model for Korean Clinical Notes: Using Deep Learning Models <i>Junhyuk Chang, Jimyung Park, Chungsoo Kim and Rae Woong Park</i>	1456
Annotation of Opioid Use Disorder Entity Modifiers in Clinical Text <i>Abdullateef I. Almudaifer, Sue S. Feldman, Tobias O'Leary, Whitney L. Covington, JaMor Hairston, Zachary Deitch, Estera Crisan, Kevin Riggs, Lauren Walters and John D. Osborne</i>	1458
Uncovering Variations in Clinical Notes for NLP Modeling <i>Jinghui Liu, Daniel Capurro, Anthony Nguyen and Karin Verspoor</i>	1460
Track 3: Health Data Science and Artificial Intelligence	
Theme 1: Methods	
Topic 2: Deep Learning	
Ensemble Learning Method for In-Hospital Cardiac Arrest Prediction <i>Ja Hyung Koo, Sun Jung Lee, Yun Kwan Kim and Hee Seok Song</i>	1462
Track 3: Health Data Science and Artificial Intelligence	
Theme 1: Methods	
Topic 3: Data Visualisation	
Structured Data Retrieval and Analysis of HL7 v2 Messages with Elasticsearch <i>Ka Yung Cheng, Santiago Pazmino, Hao Qian, Björn Bergh and Björn Schreibeis</i>	1464
Exploring the Knowledge Structure and Trends for Severe COVID-19 Risk Factors Using Text Network Analysis <i>Min-Ah Kang and Soo-Kyoung Lee</i>	1466
A Data Visualisation Approach in Understanding the Obstetrics Patients Conversion <i>Ching Yee Sim and Bee Keow Goh</i>	1468
Effect of Push-Pull HEPA Filters on Air Age in a Dental Treatment Room <i>Eriko Nambu, Kazunori Nozaki, Kazuma Kokomoto and Mikako Hayashi</i>	1470
Use of Electronic Quality Monitoring Tool and Central Dashboard to Improve Clinical and Programmatic Decisions <i>Binyam Eskinder, Dereje Habte, Masresha Molla, Fasil Hailemeskel, Esayas Teweldebirhan, Tekeste Kebede, Tamrat Assefa, Daniel Kabtyimer, Worknesh Amidino and Sileshi Lulseged</i>	1472
RHEA: Real-World Observational Health Data Exploration Application <i>Soobeen Seol, Jimyung Park, Chungsoo Kim, Dong Yun Lee and Rae Woong Park</i>	1474
Track 3: Health Data Science and Artificial Intelligence	
Theme 1: Methods	
Topic 4: Simulation	
Compatibility in Missing Data Handling Across the Prediction Model Pipeline: A Simulation Study <i>Antonia Tsvetanova, Matthew Sperrin, David Jenkins, Niels Peek, Iain Buchan, Stephanie Hyland and Glen Martin</i>	1476

Track 3: Health Data Science and Artificial Intelligence**Theme 1: Methods****Topic 5: Process Mining**

- Developing an Appendectomy Surgical Pathway Ontology (ASPO) 1478
Nadeesha Pathiraja Rathnayaka Hitige and Ping Yu

Track 3: Health Data Science and Artificial Intelligence**Theme 1: Methods****Topic 6: Data Cleansing**

- Evaluating Effects of Resting-State Electroencephalography Data Pre-Processing on a Machine Learning Task for Parkinson's Disease 1480
Robin Vlieger, Elena Daskalaki, Deborah Apthorp, Christian J. Lueck and Hanna Suominen

Track 3: Health Data Science and Artificial Intelligence**Theme 2: Applications****Topic 1: Disease Surveillance**

- Design and Application of Multi-Center Clinical Research Platform for Phenotyping of Voriconazole Hepatotoxicity 1482
Ying Zhang, Yuqing Wang, Shengqiang Chi, Hua Ru, Yifan Jiang, Yu Tian, Tianshu Zhou and Jingsong Li

- Is the Fast Track Safe? A Safety Evaluation of the COVID-19 Drugs with Real-World Data 1484
Hyo Jung Kim, Jeong-Hwa Yoon and Kyehwa Lee

- A Reproducible Model Based on Clinical Text for Predicting Suicidal Behavior 1486
Jihad S. Obeid, Athanasios Tsalatsanis, Chaitanya Chaphalkar, Sara Robinson, Sierra Klein, Sarah Cool, Elizabeth Szwest and Brian E. Bunnell

- Does a Digital Health Application Could Be the Supplement to the Influenza Surveillance System? 1488
Jia Chen, Feifei Bao, Huiyao Sun, Yu Tian, Tianshu Zhou and Jingsong Li

Track 3: Health Data Science and Artificial Intelligence**Theme 2: Applications****Topic 2: Biomedical Imaging and Image Analysis**

- Automated Diabetic Retinopathy Diagnosis for Improved Clinical Decision Support 1490
Justin Boyle, Janardhan Vignarajan and Sajib Saha

- A FHIR Native Radiology Informatics Platform 1492
Parnesh Raniga, Hang Min and Hugo Leroux

- Temporomandibular Joint Disorders Multi-Class Classification Using Deep Learning 1495
Bhornsawan Thanathornwong, Treesukon Treebupachatsakul, Thitirat Teechot, Suvit Poomrittigul, Kritsasith Warin and Siriwan Suebnukarn

- Deep Learning for Midfacial Fracture Detection in CT Images 1497
Kritsasith Warin, Sothana Vicharueang, Patcharapon Jantana, Wasit Limprasert, Bhornsawan Thanathornwong and Siriwan Suebnukarn

- Panoramic Radiograph Generation and Image Reconstruction from Latent Vectors Using a Generative Adversarial Network 1499
Kazuma Kokomoto, Rena Okawa, Kazuhiko Nakano and Kazunori Nozaki

Track 3: Health Data Science and Artificial Intelligence**Theme 2: Applications****Topic 3: Population Health**

- Towards an Explainable AI Platform to Study Interruptions in Cancer Radiation Therapy 1501
Arash Shaban-Nejad, Nariman Ammar, Fekede Kumsa, Soheil Hashtarkhani, Brianna White, Lokesh K. Chinthala, Chase A. Owens, Neil Hayes and David L. Schwartz

Predicted Body Composition Against COVID-19: A Potential Digital Health Strategy <i>Seongsong Jeong, Yo Hwan Lim, Myeong Hoon Lee and Hyun Wook Han</i>	1503
Moderate-to-Vigorous Physical Activity Changes with the Risk of SARS-CoV-2 Infection: A Nested Case-Control Study <i>Yo hwan Lim, Myeong Hoon Lee, Gang Hyun Kim, Dan Bi Pyun, Seongsong Jeong and Hyun Wook Han</i>	1505
Track 3: Health Data Science and Artificial Intelligence	
Theme 2: Applications	
Topic 4: Precision Medicine	
An International Standard RWD Database Designed – Taiwan Experience <i>Hsiu-An Lee, Po-Sheng Yang and Chien-Yeh Hsu</i>	1507
Data Derived Disease Diagnostics <i>Gráinne Butler, Josiah Shanks, Jim Buttery and Cathy Quinlan</i>	1509
Track 4: Human, Organisational and Social Aspects	
Theme 1: User Experience	
Topic 3: Workflow	
Re-Engineering Data Processing Workflow to Automate Abbreviations Audit of Clinical Documentation <i>Bee Keow Goh, Galvin Gan, Mark Chuah, Teddy Suratots Fabila, Terrence Thomas, Mary Pauline Alphonse, Elise Koh, Esther Goh and Hwee Teng Neo</i>	1511
A Hybrid Physical-Digital Simulation Laboratory to Expedite Context-Aware Design and Usability Testing in Digital Health <i>Kit Huckvale, Frank Smolenaers, Hasan Ferdous, Kara Burns, Mahima Kalla, Mady Mani, Daniel Capurro and Wendy Chapman</i>	1513
Daily Hospital Emerging Infectious Disease(EID) Workflow & Data Processing Automation <i>Bee Keow Goh, Ching Yee Sim, Mark Chuah, Chee Meng Siang and Terrence Thomas</i>	1515
Track 4: Human, Organisational and Social Aspects	
Theme 1: User Experience	
Topic 4: Patient-Clinician Communication	
Sharing Colorectal Cancer Follow-Up Using an E-Care Plan Between Cancer Services and Primary Health Care <i>Jane Taggart, Melvin Chin, Winston Liauw and Mark F. Harris</i>	1517
Track 4: Human, Organisational and Social Aspects	
Theme 2: Health Policy and Ethics	
Topic 3: Citizen Co-Design	
Visualising Findings in the Co-Design of Telepractice for the Disability Community <i>Cloe Benz, Mai Welsh, Richard Norman, Suzanne Robinson, Will Scott-Jeffs, KA McKercher and Delia Hendrie</i>	1519
Participatory Process Anchored in Systems Thinking for Implementing Ethics in Medical AI: A Qualitative Study <i>Magali Goirand, Elizabeth Austin and Robyn Clay-Williams</i>	1522
Track 4: Human, Organisational and Social Aspects	
Theme 2: Health Policy and Ethics	
Topic 4: Consumer Perspectives	
Patient Access to Health Data: A Review of Philosophic and Healthcare Issues <i>Andrew Xu and Brian E. Chapman</i>	1524

- Remote Monitoring for Type 2 Diabetes: What Do Patients, Healthcare Professionals, and Executives Think? 1526
Eleanor Farenden, Jaimon Kelly, Anthony Russell and Anish Menon
- Educational Needs Assessment for Family Caregivers of Dementia Patients 1528
Eunyoung Im and Hyeoneui Kim

Track 4: Human, Organisational and Social Aspects

Theme 3: Education and Training

Topic 2: Continuing Professional Development

- User-Led Learning Preferences to Inform Rapid Learning Online Education Supporting Evidence-Based Best Practice in Oncology 1530
Lisa McLean, Catherine Bullivant, Tia Moeke, Jacqueline Hodges, Laura Wuellner, Shelley Rushton and Tracey O'Brien
- Improving Accessibility of Continuing Professional Development for Oncology Health Professionals Through the EviQ Education App 1532
Lisa McLean, Annie Zheng, Catherine Bullivant, Laura Wuellner, Shelley Rushton and Tracey O'Brien
- Evaluating Informatics Competencies Requirements for Hospital Nurse Managers in Japan 1534
Sachiko Shobuzawa, Yoshihito Endo and Mizuho Okada

Track 4: Human, Organisational and Social Aspects

Theme 3: Education and Training

Topic 4: Online Learning

- Developing a Digital Health Metacademy for Continuing Professional Education 1536
Kevin Yap
- Development of a Cloud-Based Electronic Nursing Record System (ENR) for Nursing Student Practice 1538
Hongshin Ju, Minsul Park and Dongkyun Lee
- Providing Practical Knowledge and Skills to Handle Real-World Data? Lessons Learned from Med RWD Program 1540
Kazumi Kubota, Tomohisa Seki, Kana Miyake, Masafumi Okada, Kazuyuki Nishio and Kazuhiko Ohe

Track 4: Human, Organisational and Social Aspects

Theme 3: Education and Training

Topic 5: Serious Gaming

- Gamified Smartphone-App Interventions on Behaviour and Metabolic Profile in Patients at Risk of Cardiovascular Disease 1542
Sayan Mitra, Cynthia M. Kroeger, Tian Wang, Andrius Masedunskas, Sophie A. Cassidy, Robin Huang, Luigi Fontana and Na Liu

Track 5: Global Health Informatics

Theme 1: One Health

Topic 1: Mental and Emotional Well-Being

- Mental Health Monitoring: Design Concept of a Smartphone Application 1544
Upeka De Silva, Sam Madanian, John Michael Templeton, Christian Poellabauer, Sandra L. Schneider and Dave Parry
- Objective Smartwatch Indices of Affective Switching: A Pilot Study in Premenstrual Dysphoric Disorder 1546
Juliana Prim, Oleg Favorov, Jolie Jeffrey, Susan Girdler and Crystal Schiller

Track 5: Global Health Informatics

Theme 1: One Health

Topic 2: Economics

Developing a Cost-Effectiveness Model of Digital Therapeutics for Smoking Cessation <i>Sung Goo Yoo, Dai Jin Kim, Ji Won Chun and In Young Choi</i>	1548
Track 5: Global Health Informatics	
Theme 2: Public Health	
Topic 2: Disaster Management	
Pandemic Management: Health Data and Public Health Surveillance <i>Mohammad Nazayer, Samaneh Madanian, Hamidreza Rasouli Panah and Dave Parry</i>	1550
Evaluation of a COVID-19 Risk Tool <i>Sue S. Feldman, Abdulaziz Ahmed, Justine Maxwell and Benjamin Schooley</i>	1552
COVID-19 Online Health Monitoring System to Support Municipal Health Centers <i>Takumi Tanikawa, Masayuki Koyama, Ryuichi Nakayama, Tsuyoshi Mukohara, Naoki Fujimoto, Shintaro Takatsuka, Jun Fukuda and Hidehiro Ozawa</i>	1554
Track 5: Global Health Informatics	
Theme 2: Public Health	
Topic 3: Healthcare Access and Equity	
Telemedicine and COVID-19 Pandemic: Experiences of Western China Hospital <i>Jialin Liu, Miao Wang and Siru Liu</i>	1556
Optimal Transport System for Acute Ischemic Stroke Patients: A Cost-Effectiveness Analysis <i>Yasuhiro Morii, Toshiya Osanai, Kensuke Fujiwara, Yuji Tani, Soichiro Takamiya, Takumi Tanikawa and Katsuhiko Ogasawara</i>	1558
Substance Use Telemedicine Retention and Outcomes <i>Justine F. Maxwell, Li Li and Sue S. Feldman</i>	1560
Improving Health Equity to Primary Care for First Nations Peoples Living in Northern Queensland <i>Gilyan Thorn and Janine Cox</i>	1562
Clinical Experiences of Working with Patient-Generated Health Data in Primary Care <i>Noushin Nazarian, Wendy Chapman and Daniel Capurro</i>	1564
Track 5: Global Health Informatics	
Theme 2: Public Health	
Topic 4: Social Determinants	
Traffic Exposure and Breast Cancer Mortality by Area of Residence: Incorporating Clinical and Socioeconomic Data <i>Hyo Jung Kim, Sangyong Cho, Soo-Yong Shin, Se Kyung Lee, Haeyoung Kim, Sumeeta Srinivasan, S.V. Subramanian and Yeon Hee Park</i>	1566
Towards a Patient-Centered Design of a Cancer Telerehabilitation System <i>Irena Parvanova and Joseph Finkelstein</i>	1569
Symbolic Artificial Intelligence to Diagnose Tuberculosis Using Ontology <i>Naphaline Gerard, Sarah Ben Othman, Pajanivel Rangandin, Marc Broucqsault and Slim Hammadi</i>	1574
GCN-Based Risk Prediction for Necrosis Slide of Hepatocellular Carcinoma <i>Boyang Deng, Yu Tian, Qiancheng Ye, Zhenxing Chai, Tianshu Zhou, Qi Zhang, Tingbo Liang and Jingsong Li</i>	1579
Effects of Language Differences on Inpatient Fall Detection Using Deep Learning <i>Insook Cho, EunJu Lee and Dong-geon Lee</i>	1584
Patient Satisfaction on Telehealth Services Used in Urban Sri Lankan Settings, During the COVID-19 Pandemic <i>S.N. Silva and M.D.A.I. Karunaratne</i>	1586

Implementation of Digital Health Ethics: A First Step with the Adoption of 16 European Ethical Principles for Digital Health <i>Brigitte Seroussi and Isabelle Zablit</i>	1588
Pharmaceutical Decision Support System Using Machine Learning to Analyze and Limit Drug-Related Problems in Hospitals <i>Sarah Ben Othman, Bertrand Decaudin, Pascal Odou, Chloé Rousselière, Etienne Cousein and Slim Hammadi</i>	1593
Reducing the Environmental Impact of Digital Health: Development of an Ecoscore for Health Apps <i>Nathalie Baudiniere, Olivier Philippot, Thierry Leboucq and Brigitte Seroussi</i>	1598
Subject Index	1603
Author Index	1617

The Australian Health Informatics Competency Framework: Conceptual Design, Framework Development, and Certification Delivery

Mark BROMMEYER^{a,b,1}, Jen BICHEL-FINDLAY^b, Tanija TARABAY^{b,c}, Louise SCHAPER^b, David O'DRISCOLL^b and Kerry BUTLER-HENDERSON^{b,d}

^aCollege of Business, Government and Law, Flinders University, Australia

^bAustralasian Institute of Digital Health

^ceHealth Queensland, Australia

^dRMIT Digital Health Hub, RMIT University, Australia

Abstract. The Australian Health Informatics Competency Framework (AHICF) guides the healthcare workforce in identifying the required competencies to perform as a health informatician, and more definitively defines the foundational body of knowledge on which the discipline is based. The aim of this paper is to describe the conceptual foundations in developing the AHICF v1.0, detail the methods used to revise and publish AHICF v2.0, and explore the certification and workforce outcomes achieved. This paper contributes to the competency framework and certification discourse, and knowledge of the increasing importance and recognition of health informaticians through certification. Further, implications for workforce training and education, career advancement and recruitment strategies, are also discussed.

Keywords. Competency frameworks, professional certification, professionalism, workforce development

1. Introduction

Most countries are attempting to digitise their healthcare environments, improve the digital health literacy of their workforce, and ensure they have qualified health informatics personnel to guide the design, adoption, implementation, and evaluation of clinical information systems. To formally recognise health informatics knowledge, some countries have developed credentialing programs based on a framework of competencies. Ten years ago, Australia chose certification as a pathway in response to limited undergraduate and postgraduate degrees related to health informatics [1].

The Australian Health Informatics Competencies Framework (AHICF) was launched in 2013 by the Health Informatics Society of Australia (HISA), in collaboration with the Australasian College of Health Informatics (ACHI) and the Health Information Management Association of Australia (HIMAA), to provide a framework for the discipline. The framework was also intended to assist in recruitment, education and

¹ Corresponding Author: Mark Brommeyer, email: mark.brommeyer@flinders.edu.au.

training activities, career pathway definitions, and raising the profile of health informaticians [1]. Guided by similar programs available worldwide (American Medical Informatics Association, International Medical Informatics Association, and Canada's Health Informatics Association, for example), the framework comprised six knowledge domains and 52 competencies across four levels – knowledge, comprehension, application, and analysis. For eight years the AHICF was used as the basis for Australia's professional certification program (Certified Health Informatician Australasia) [2] and informed a range of postgraduate health informatics and digital health programs.

The dynamic and evolving nature of the digital healthcare landscape and the need for professional practice to lead and not just respond to this dynamism, resulted in the newly formed Australasian Institute of Digital Health (by the merging of HISA and ACHI), embarking on a comprehensive review of the framework to ensure it is fit for contemporaneous use. The aim of this paper is to describe the conceptual foundations in developing the AHICF v1.0, detail the methods and rationale used to revise and publish AHICF v2.0, and explore the certification and workforce outcomes achieved.

2. Methods

As previously described by Martin-Sanchez et al. (2017), the initial framework was developed and published in 2012. Following the establishment of the Certified Health Informatician Australasia (CHIA) program and Examination Committee (EC) in 2014, the EC assumed custodianship of the framework. The EC contains expert members of the healthcare and health informatics sector covering academia, clinical expertise, health information management, technology professionals, and industry consultants. The EC undertook a comprehensive process to review the competency framework, commencing with an international environmental scan to examine changes in the extant competency frameworks to which the AHICF was mapped [3-5]. This included international frameworks from Canada, Saudi Arabia, the United States of America, and the United Kingdom. The competency domains were compared and analysed for contemporary applicability in the Australian health informatics context.

Secondly, relevant, contextual competency frameworks were identified, compared and analysed for contemporary applicability in the Australian health informatics context [6-8]. Thirdly, other new or additional competencies and frameworks in the technology, healthcare, and management environment were also reviewed for their relevance for inclusion. The EC collectively undertook an expert analysis review using in-person and online discussions and reached a consensus draft version of the revised competency framework, which was then submitted for review by the CHIA Board. The EC analysed and responded to feedback received from the Board, and agreed on a final revision of the competency framework.

The revised competency domains were reviewed against Bloom's Revised Taxonomy of Educational Objectives [9] in a top-down approach, to ensure consistency of the underlying competencies and related questions. This also included a decision to eliminate the use of Bloom's *Remember* level, as simple recall of facts was considered insufficient for health informaticians to demonstrate their competency, and thus achieve certification. The next stage of the review then included specific analysis and comparison of the competencies themselves, with both domains and competencies being reworded to use Bloom's verbs between *Understand* and *Analyse*. The advantage of having a live

'use-case' for competencies in the certification program meant the EC was able to apply the drafted AHICF to the certification, to test the value of the updated Framework.

An analysis of the examination multiple-choice question repository demonstrated that in addition to the necessity for questions related to the new competencies, the merger or division of old competencies required a remapping of some questions, and the associated revision of questions required to match the updated Bloom's Taxonomy levels. The EC, working in small teams, produced and reviewed an initial automated mapping, with individual questions remapped as required. The revised mapping was reviewed by three teams to ensure consistency.

A final review of all examination questions was undertaken by the EC Chair, with subject matter expert support as required, to ensure consistency of mapping, levelling and style across all questions in the multiple-choice examination repository. The *Australian Health Informatics Competency Framework*, second edition was published in April 2022 [10] and the revised question bank for CHIA was placed into production. Ongoing monitoring of outcomes of the revised questions was implemented in line with the quality management framework adopted by the EC.

3. Results

The AHICF version 1.0 comprised 52 informatics competencies across 6 domains of expertise. The six domains of expertise were: 1) Health Sciences, 2) Information Science, 3) Information Technology, 4) Leadership and Management, 5) Social and Behavioural Sciences, and 6) Core Health Informatics. The review of the competencies by the EC resulted in these domains being streamlined, simplified, and modernised, commensurate with the cognitive competence required of health informaticians.

In version 2.0 of the AHICF, all competency statements across the six domains, except the domain *Health Sciences*, were deemed to require cognitive competence at Bloom's level of *Applying*, at a minimum. All competency statements in the *Health Sciences* domain are at the *Understanding* level, as the EC determined practitioners only require an understanding of health science to be able to communicate and contextualise their work. Table 1 shows the distribution of competency statements mapped to Bloom's levels. Bloom's level indicates the minimum level of cognitive competence required for that competency statement, recognising many candidates will have a higher level of cognitive competence in some domains compared to others, and that this variation will differ depending on the candidate's formal training and experience.

Table 1: Mapping of version 2 of the AHICF to Bloom's Taxonomy.

Domain	Bloom's level		
	Understanding	Applying	Analysing
1) Health Sciences	9		
2) Information Science	1	5	
3) Information Technology	1	2	
4) Leadership and Management		11	
5) Social and Behavioural Sciences		6	
6) Core Health Informatics	1	5	12

Several competency statements were merged during the review and a number of new competency statements created to address gaps in version 1, and include emerging areas

of health informatics and digital health. Additional leadership competencies were added to the ‘Leadership and Management’ domain and two new areas of skills were also added – *Leadership strategies* and *Stakeholder engagement*. *Sociotechnical concepts* were added to ‘Social and behavioural sciences’ to recognise the importance of informational, technological, and social systems in digital health. *Health literacy* was also added to this domain to recognise the need to integrate best practice in health literacy in digital health. There were several additions to the domain ‘Core health informatics’ to recognise the evolving nature of the discipline, including *Health economic concepts*, *Stakeholder education*, *Indigenous Data Sovereignty*, and *Digital divide*.

The new competency statement for *Indigenous Data Sovereignty* was developed in consultation with a First Nations health information organisation. Some competency statements were moved to align with more relevant domains, such as *Health informaticians ascertain the appropriateness, ethics, effectiveness, and efficiency of information and information system governance* was moved from the ‘Core Principles and Methods’ to the ‘Leadership and Management’ domain. This resulted in the AHICF version 2.0 comprising of 53 informatics competencies across the 6 domains of expertise.

4. Discussion

This paper contributes to the competency framework and certification discourse, and knowledge of the increasing importance and recognition of health informaticians through certification and professionalism. It showcases the maturity of the Australian health informatics sector and has global relevance to other similar frameworks. A mature, validated, and most importantly, industry relevant framework provides the foundations for workforce planning and strategy, at both the individual and organisational level.

In Australia, the framework is intended for several purposes. It is the basis of the CHIA program, which was established in 2013, and includes certification via an online examination that is based on the competencies outlined within the framework. Any revision of the underlying framework, therefore, impacts the existing repository of over 300 multiple-choice examination questions. Whilst certification is not a requirement in all health informatics position descriptions, there are successful CHIA candidates who, as individuals or through organisational sponsorship, value the attainment of knowledge across the framework domains to fulfil their digital health roles and progress their health informatics careers. The credibility of certification programs is strongly associated with currency and comprehensiveness of content, and therefore it is necessary to ensure the framework that it is built upon reflects the currency of knowledge in digital health.

Further, the framework is the basis of a proposed accreditation framework for education providers and underpins the work the AIDH is progressing with building digital health and health informatics capability across the Australian health sector. With the Institute forming a Professionalism Committee in 2023 to develop, amongst other areas within its scope, an accreditation program for Australia, this framework will again provide a foundation for quality evaluation. There will be other workforce training and education development implications, and career advancement and recruitment strategies, related to the framework which will serve to further validate the framework and improve its evolution and practical value, as Australia continues to address the digital health capabilities its health workforce requires, both now and into the future.

5. Conclusions

The AHICF guides the healthcare workforce in identifying the required competencies to perform as a health informatician, and defines the foundational body of knowledge on which the discipline is based. The conceptual foundations in developing the AHICF v1.0 underpinned the comprehensive review which was completed in early 2022. This review included an environmental scan, a review of relevant competency frameworks, an identification of new competencies in the technology, healthcare and management environment, and an expert analysis review submitted for evaluation by the CHIA Board. The CHIA EC analysed and responded to feedback received from the Board, and agreed on a final revision of the competency framework. The revised competency domains were reviewed against Bloom's Revised Taxonomy and then published as AHICF v2.0.

This paper contributes to the competency framework, certification and professionalism discourse, and knowledge of the increasing importance and recognition of health informaticians through credentialling. Further, implications for workforce training and education development, career advancement and recruitment strategies, are also presented. In the fast-moving digital world, currency of knowledge in digital health is essential, therefore, it is necessary to ensure that the AHICF reflects the currency and comprehensiveness of content, to guide assessment of competence, associated credentialling, accreditation programs and the foundation for quality and impact evaluation, which could provide the focus of future research endeavours.

References

- [1] Martin-Sanchez F, Rowlands D, Schaper L, Hansen D. The Australian health informatics competencies framework and its role in the Certified Health Informatician Australasia (CHIA) program. In: MEDINFO 2017: Precision Healthcare through Informatics; IOS Press; 2017. p. 783-7. doi: 10.3233/978-1-61499-830-3-783783
- [2] Certified Health Informatician Australasia. Available at: <https://www.healthinformaticscertification.com/> [accessed 20 November 2022].
- [3] Kulikowski CA, Shortliffe EH, Currie LM, Elkin PL, Hunter LE, Johnson TR, Kalet JJ, Lenert LA, Musen MA, Ozbolt JG, Smith JW, Tarczy-Hornoch PA, Williamson JJ. AMIA Board white paper: definition of biomedical informatics and specification of core competencies for graduate education in the discipline. *J Am Med Inform Assoc.* 2012 Nov;19(6):931-8, doi: 10.1136/amiajnl-2012-001053.
- [4] Mantas J, Ammenwerth E, Demiris G, Hasman A, Haux R, Hersh W, Hovenga E, Lun KC, Marin H, Martin-Sanchez F, Wright G. Recommendations of the International Medical Informatics Association (IMIA) on education in biomedical and health informatics. *Methods Inf Med.* 2010;49(2):105-20, doi: 10.3414/ME5119.
- [5] COACH Canada's Health Informatics Association. Health Informatics Professional Core Competencies: Version 3.0. 2012. Available at: <https://digitalhealthcanada.com/wp-content/uploads/2019/07/Health-Informatics-Core-Competencies.pdf> [accessed 14 November 2022].
- [6] Skills Framework for the Information Age (SFIA). The global skills and competency framework for a digital world. 2021. Available at: <https://sfia-online.org/en> [Accessed 14 November 2022].
- [7] US Department of Health and Human Services, Centers for Disease Control and Prevention. Competencies for public health informaticians. 2021. Available at: https://www.pfhf.org/resourcestools/Documents/Core_Competencies_for_Public_Health_Professionals_2021October.pdf [accessed 14 November 2022].
- [8] EDISON Project. Data Science Competence Framework (CF-DS) Release 2. 2017. Available at: <https://edison-project.eu/data-science-competence-framework-cf-ds/#> [Accessed 14 November 2022].
- [9] Krathwohl D. A revision of Bloom's taxonomy: an overview. *Theory Pract.* 2002;41(4):212-8, doi: 10.1207/s15430421tip4104_2.
- [10] Certified Health Informatician Australasia, Revised competency framework to support digital health careers. Available at: <https://www.healthinformaticscertification.com/revised-competency-framework-to-support-digital-health-careers/> [accessed 20 November 2022].