Human Factors and Organizational Issues: Contributions from 2022

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Summary

Objectives: To review publications in the field of Human Factors and Organisational Issues (HF&OI) in the year 2022 and to assess major contributions to the subject.

Method: A bibliographic search was conducted following refinement of standardized queries used in previous years. Sources used were PubMed, Web of Science, and referral via references from other papers. The search was carried out in January 2023, and (using the PubMed article type inclusion functionality) included clinical trials, meta-analyses, randomized controlled trials, reviews, case reports, classical articles, clinical studies, observational studies (including veterinary), comparative studies, and pragmatic clinical trials.

Results: Among the 520 returned papers published in 2022 in the various areas of HF&OI, the full review process selected two best papers from among 10 finalists. As in previous years, topics showed development including increased use of Artificial Intelligence (AI) and digital health tools, advancement of methodological frameworks for implementation and evaluation as well as design, and trials of specific digital tools.

Conclusions: Recent literature in HF&OI continues to focus on both theoretical advances and practical deployment, with focus on areas of patient-facing digital health, methods for design and evaluation, and attention to implementation barriers.

Keywords

International Medical Informatics Association Yearbook; human factors; organizational issues, digital health, usability

Yearb Med Inform 2023:210-4

http://dx.doi.org/10.1055/s-0043-1768750

1 Introduction

Human Factors and Organizational Issues (HF&OI) is an exceptionally broad field. The field encompasses the psychology of design and use of material and virtual artifacts and borrows from the cognitive sciences to understand how humans and machines may collaborate and how human cognitive biases may feed and amplify biases in a "soft" machine. Stepping over into organizations, HF&OI develops new "sciences"—team science, implementation science and reflecting back on its own epistemology, the field brings practices from an even wider array of disciplines—from anthropology to engineering—to enrich its armory of methods. It should be clear from this that attempting to select 'best papers' on HF&OI is bound to prove both a varied and rich experience, and a more or less hopeless task. There will be some marvelous work we have failed to notice, or been unaware of, or encountered but failed to appreciate. Craig Kuziemsky's accompanying review of HF&OI from a "one health" perspective nicely complements this overview with an insightful methodology for the analysis of such a rich harvest of literature. He examines the perspective at "micro, meso, and macro" levels, as he identifies structures and behaviors out of the network of interactions, leading to the formulation of an integrative approach to the field.

2 Methods

In keeping with our acknowledgement of the breadth of our field, the papers we finally selected have a recognizable "HF&OI" flavor about them, but not a great deal more in common. The initial PubMed and Web of Science search found 3,400 articles which were filtered down to 520 on relevance. From these, we selected a long list of 32 articles and from this, a short list of 10 which were submitted for review. Finally, two papers were selected as best papers for 2022.

We performed the search on January 15, 2023. Our query listed in Figure 1 yielded 520 results and we imported into citation manager (Endnote©) and filters were applied to yield 3,400 articles.

((computer[Title/Abstract]) OR (informatics[Title/Abstract]) OR (information technology[Title/Abstract]) OR (interface[Title/Abstract]) OR (graphic user interface[Title/Abstract]) OR (mobile application[Title/Abstract]) OR (mobile app*[Title/Abstract]) OR (computerized medical record*[Title/Abstract]) OR (EHR[Title/Abstract]) OR (EMR[Title/Abstract]) OR (HIT[Title/Abstract]) OR (Health Information Technology*[Title/Abstract]) OR (paper record*[Title/Abstract]) OR (electronic health record*[Title/Abstract]) OR (electronic medical record*[Title/Abstract]) OR (medical device*[Title/Abstract]) OR (NICT[Title/Abstract]) OR (m-health[Title/Abstract]) OR (e-health[Title/Abstract]))
AND
((acceptance[Title/Abstract]) OR (adoption[Title/Abstract]) OR (human computer interaction[Title/Abstract]) OR (HCI[Title/Abstract]) OR (human machine interaction[Title/Abstract]) OR (usability[Title/Abstract]) OR (user experience*[Title/Abstract]) OR (user centered design[Title/Abstract]) OR (human centered design[Title/Abstract]) OR (usage[Title/Abstract]) OR (context of use[Title/Abstract]) OR (human factor*[Title/Abstract]) OR (sociotechnical[Title/Abstract]) OR (socio-technical[Title/Abstract]))

Fig. 1 Query for HF&OI.

We exported all NIH formatted articles to a text file and then used OnlineTextTools (https://onlinetexttools.com/extract-regex-matches-from-text) to extract PMIDs.

3 Results

3.1 Wellbeing, Workplace Health, Mental Health

Thematically, we found noteworthy publications on all aspects of health and wellbeing, reflecting and refracting the theme of "one health". Implementation is a central consideration [1,2]. The focus may be individuals in good health looking to stay healthy [2] or to maintain motivation towards healthy behaviors [3], or people living with an acute or chronic condition [4,5]. In age, the subjects range from the unborn [6] to those in decline through ageing. Physical, cognitive, or mental health all figure among the publications [4,7]. The wellbeing of providers themselves is known to be impacted by the conditions under which they work to care for patients and how they must document that care, so the usability of electronic health records (EHRs) also receives a good deal of attention. Unwarranted alerts that nevertheless must be overridden before continuing are a particular annoyance, leading to what has come to be known as "alert fatigue" [8-10]. With increasing emphasis on AI, automation and augmented intelligence in the healthcare space, [11] provides a timely analysis of agency and collaboration between a human operator and an automatic process. Issues of situation awareness, attention span, and human supervision of agent processes are carefully considered.

Remote monitoring devices are increasingly used to support patients away from medical settings. A salient application is in self-management of chronic conditions. Visualization is already known to help patients undergoing painful procedures [12]. Here we have an analysis of attempts to use the same principle for chronic pain. In [13] we see an equivalent principle applied to pediatric anxiety around surgery. Diet and movement are recognized behavioral targets and many applications aim to support healthy choices, in life, at home and at work [14]. Access to one's own health information can be a useful engagement motivator, so various forms of "personal health record" also feature, from solutions that allow the individual a measure of control to simpler applications that authenticate the person for access to their health system record [15]. Wearable devices serve a variety of purposes, from measuring activity, often against a goal, with simple moral rewards, to remote monitoring of patients, *e.g.*, post-discharge or to detect deterioration in a movement disorder [16]. Virtual reality systems have been in use for some time to encourage therapeutic movement. Now augmented reality is beginning to impact, enhancing the visual field with information about the environment, providing prompts to action, and measuring responses.

3.2 Design, Personal Health Records, Decision Support

Social networks have been used to understand population health in some communities [17], while gamification has inspired medication adherence applications [18]. Ideas from the "Internet of Things" have led to active medication inhalers that measure and report their use [19], giving rise to ethical concerns and, as with other remote monitoring, to questions of technology acceptance [20]. Such questions arise even more sharply in the field of neuroengineering [21], *e.g.,* of brain implants for device or prosthesis control. At a more abstract level, attention has focused on cognitive tools, decision support, design of apps, and questions of attention span and mental workload [22-24]. Human-robot "collaboration" also figures among current concerns, with an emphasis on the issue of who must adapt to whom [25, 26].

There has been considerable discussion, especially in the context of AI, of the virtues of "small," often paper decision support models *vs.* more complex online tools. Röbbelen *et al.* [27] show that in times of stress and limited resources, a hand-held flowchart serves at least as well as an online decision support tool. The comparative study used the CDC Covid-19 self-assessment algorithm placed into a static and interactive mock tool, as well as a control (no tool) testing participants' accuracy, decision certainty (after deciding) and mental effort, to measure decision support quality. The paper is notable as it demonstrates that when the decision space is limited, static flowcharts might prove as beneficial in enhancing decision quality as interactive tools. The static flowcharts reveal the underlying decision algorithm more transparently and require less effort to develop, so might prove more efficient in providing guidance to the public.

In [28], a noted group of HCI researchers examines the opportunities and potential uses of the Theory of Distributed Cognition for teamwork, triggered by the need for more sophisticated collaboration at a distance due to the COVID-19 pandemic. They point out opportunities where design thinking may differ for creative remote work, and where AI-based tools may facilitate both creation and prototyping. While the relevance to healthcare is not very directly applied, the paper brings up important considerations for how HCI and collaborative work may be affected by changes in tooling and design thinking methods. They call attention to specific tools, such as the Eve system for transforming low-fidelity prototyping into useful tools with higher fidelity.

3.3 Implementation, Ethics

Resilience, equity and accessibility are important design goals for any health information technology system. In [29], the IMIA open source working group has conducted a rapid review of real-world systems which illustrate how open source contributes to these goals, with examples from around the world. Some of these systems are considered 'global goods' with estimated value (if they were commercial) of $1 billion. These include the District Health Information Software (DHIS), based on Sri Lankan tools with additional tools developed and used in Rwanda for COVID-19, including for surveillance, large scale vaccination tracking and many administrative purposes. Another example is the adoption of openEHR-based tools in Europe for many cities and countries as their official EHR. OpenEHR tools developed by the German HIGHMed consortium defined an open-source data model which increased

resilience by permitting development of varied tools, changeable as needed. The paper considers several other open-source systems aiming to solve problems of usability and access, contributing to equity. An important aspect of all these OS projects is the fact that they share work across countries with large volunteer developer communities.

Harris *et al.* [30], offer a well-researched summary of major issues emerging in the quest to use machine learning algorithms in healthcare. The authors describe a prototype system and concepts for a 5-phase deployment paradigm, which addresses issues of real-world development, machine learning operations needed in healthcare, responsible AI in practice, including model explainability, safety including fail-safes, dynamic model calibration, and the need for continuous clinical evaluation. They take issue with the current split between teams developing algorithms and those responsible for deployment, stating that these phases need to be combined. They also make analogy with the drug development paradigm consisting of phases with increasing realism and risk assessment. The paper is useful for its placement of current gaps, thoughtful exposition of concepts, and description of the system they have built and required architectures. Given that so little attention has been placed on actual issues of deployment this is a useful contribution to the literature of AI implementation into care.

The advent of major initiatives in in-silico medicine ('digital health') and particularly the use of AI-based tools also gives rise to many ethical and medico-legal issues. In [31], Leo *et al.* discuss these and how they may be examined and addressed, using varied research methods across the range of stakeholders. The narrative review presents concepts without data, but calls attention to a range of ethical and potential legal issues including of computer simulation, the approach to enable the effective participation of patients and stakeholders in the decision-making process, the influence on the decision-making capacity of physicians and patients, the access to personal information, intellectual property issues, the balance of benefits and harms to patients, and the burden of a possible mistake in the simulation due to potential sources of bias leading to an incorrect definition of the algorithm.

Table 1 Selection of best papers for the 2023 IMIA Yearbook of Medical Informatics for the section Human Factors and Organizational Issues. The articles are listed in alphabetical order by the first author's surname.

Section
Human Factors and Organizational Issues
▪ Roschka S, Leddig T, Bullerjahn M, Richter G, Liedtke W, Langanke M, Hoffmann W. Secondary use of health care data and left-over biosamples within the 'Medical Informatics Initiative' (MII): a quasi-randomized controlled evaluation of patient perceptions and preferences regarding the consent process. BMC Med Inform Decis Mak 2022 Jul 15;22(1):184.
▪ Turner JA, Calhoun VD, Thompson PM, Jahanshad N, Ching CRK, Thomopoulos SI, Verner E, Strauss GP, Ahmed AO, Turner MD, Basodi S, Ford JM, Mathalon DH, Preda A, Belger A, Mueller BA, Lim KO, van Erp TGM. ENIGMA + COINSTAC: Improving Findability, Accessibility, Interoperability, and Re-usability. Neuroinformatics 2022 Jan;20(1):261-75.

4 Conclusion

The two best papers are listed in Table 1. All reviewers placed these in the top scores. The papers cover topics with interesting and important methods and conclusions. A content summary of these best papers can be found in the appendix of this synopsis.

Acknowledgement

We would like to acknowledge the support of Adrien Ugon, Martina Hutter, Kate Fultz Hollis, Lina Soualmia, and the whole Yearbook Editorial Committee as well as the reviewers for their contribution to the selection process of the Human Factor and Organizational Issues section for the IMIA Yearbook 2023.

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Appendix: Summary of Best Papers Selected for the IMIA Yearbook 2023, Section on Human Factors and Organizational Issues (HFOI)

Roschka S, Leddig T, Bullerjahn M, Richter G, Liedtke W, Langanke M, Hoffmann W

Secondary use of health care data and left-over biosamples within the 'Medical Informatics Initiative' (MII): a quasi-randomized controlled evaluation of patient perceptions and preferences regarding the consent process

BMC Med Inform Decis Mak 2022 Jul 15;22(1):184. doi: 10.1186/s12911-022-01922-6

Data routinely collected in healthcare delivery have immense potential for reuse in research, quality improvement, and optimization of services. In general, patients support the idea of secondary use of their data to advance medical science and to improve healthcare services. It is desirable—and sometimes legally necessary—that such reuse be made only with the patient's (or a proxy's) informed consent. A similar need arises in relation to residual biospecimens. This work answered the question: How do patients and their caretakers like to be informed and to provide consent? In this well-designed study, acceptability of the consent process was assessed in a comparison between two groups, one consented on admission and the other having to meet someone separately to provide consent. Both groups reported no pressure to provide consent. All who were consented immediately were informed before providing consent. About half of those who had to meet separately provided their consent without attending the informative meeting. The paper is notable for the rigor of the study and its implications for many types of patient data consent processes.

Turner JA, Calhoun VD, Thompson PM, Jahanshad N, Ching CRK, Thomopoulos SI, Verner E, Strauss GP, Ahmed AO, Turner MD, Basodi S, Ford JM, Mathalon DH, Preda A, Belger A, Mueller BA, Lim KO, van Erp TGM

ENIGMA + COINSTAC: Improving Findability, Accessibility, Interoperability, and Re-usability

Neuroinformatics 2022 Jan;20(1):261-75. doi: 10.1007/s12021-021-09559-y

With increasing emphasis on the learning health system (LHS), research is seeking to translate "real-world data" into "real-world evidence". The FAIR principles characterize data that are available for such use: they must be Findable, Accessible, Interoperable, and Reusable. The goal is computable biomedical knowledge (CBK) in the form of "machine-actionable data objects." Exemplars of systems that build on existing applications by integrating the FAIR principles provide evidence for the viability of the concepts of LHS and CBK. Here we have a description of a platform that combines the virtues of decentralized analysis and trustworthy data sharing. COINSTAC allows for secure distributed analysis of neuroimaging data. ENIGMA is a very large consortium that integrates data and coordinates large-scale analyses of brain imaging, genetic, clinical, and behavioral data. Their combined approach was demonstrated through a complex meta-analysis of sex differences in symptom severity in individuals with schizophrenia. The paper contributes to the advancement of FAIR principles in complex datasets.