Knowledge-based Systems: Contrasting Realities and Expectations and Possible Ways Forward

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The paper by Spreckelsen et al. [1] in the present issue of Methods of Information in Medicine discusses the results of an online survey of researchers and developers of medical knowledge-based systems (KBSs) in Germany, Austria and Switzerland, and reports on insights into the current applications and their clinical roles, as well as the obstacles, challenges and expectations faced by developers of KBSs in trying to broaden the impact of these systems in clinical and research settings.

The online survey had a response rate of about 33% which is reasonable. It is noteworthy that almost half of the participants stated that they had experience in medical informatics for 10 years or longer, and over 72% indicated they were currently working on a research project. Questions were designed to elicit both quantitative and qualitative responses. Quantitative responses included the type of application fields of KBS developed by the institutions of the responding researchers, which were predominantly (70%) in decision support, data interpretation, pattern recognition/classification, information retrieval or text mining, with only 9% in ontology development, 8% in control or simulation, 6% in modeling or process modeling, 5% in image processing/interpretation and 1% in language processing. This illustrates a strong bias towards KBSs designed for decision-support and related interpretation tasks which may explain some of the contrasting or apparently contradictory results of the survey.

The most striking results of the survey come from the Likert scale responses to the questions about the demand, acceptance, routine use and future application of KBSs. In specifying whether they agreed with the statement “There is high demand for knowledge based systems in medicine” 67.8% of respondents agreed at the two highest levels of the Likert scale. However, in saying whether they agreed with the statement “There is a high acceptance for KBS in the clinical context”, only 14.6% agreed at the two highest levels, with 33.4% strongly or somewhat strongly disagreeing, and 34.4% indicating neutrality. This contrast between perceived demand and acceptance is even more pronounced on the issue of routine use. In specifying agreement with the statement “KBSs are well established in the clinical practice” no respondents agreed strongly, only 6.3% agreed somewhat strongly, but 31.2% disagreed either most strongly or somewhat strongly with the statement. Yet, on future application the numbers swing again to the optimistic side with 68.8% of respondents agreeing that KBSs will grow strongly in the future, and only 4.2% disagreeing somewhat (and none disagreeing strongly).

The qualitative questions from the survey produced answers that included:
1. listing the main fields of application of KBSs in medicine, reported by the developer-respondents in German-speaking countries. These cited Arden syntax, ontologies, pharmaco-vigilance/prescribing as the top three principal fields, with CPOE, guidelines, laboratory information systems, ambient assisted living scoring systems, semantic web frameworks, and search engines as the others;
2. citing specific exemplary applications, for which a drug information system, an

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expert system shell and a web-based consultant for abdominal pain, and an expert system for internal medicine were at the top;
3. the main challenges (or problems) faced by KBSs applications in biomedicine, for which Acceptance, Knowledge Representation, System Integration, and Sustainability were the top four;
4. the most promising fields for KBSs which were cited by those surveyed included pharmaco-vigilance, intensive care monitoring, and support for guidelines and clinical pathways;
5. the most severe challenges faced by KBS development itself were identified in the survey as standarization, usability, acceptance, process integration, system integration, and knowledge representation/modeling – as the top six most severe.

The contrast between the generality of these last severe generic challenges for KBS development, and the specificity of the promising fields illustrate a fundamental conundrum for biomedical and health informatics: how to translate successful experience with focused applications of restricted scope to deal with complex problems of much wider scope and generality.

The paper’s conclusions about the survey’s results on the demand for, and potential future growth of KBSs are, as might be expected, strongly influenced by the natural optimism of developers, whose goal is to produce clinically useful KBSs. The paper is valuable in being an update on developers’ perceptions of KBSs, since these systems have faced serious challenges in demonstrating usefulness in practical clinical environments from their inception 40 years ago, which is reflected in the negative results for acceptance and routine use reported in the survey. Despite this, KBSs are expected to play an increasingly central role in the practice of medicine, with the spread of Web 3.0, or semantic technologies, and as informatics systems become ever more ubiquitous in clinical environments. A very recent editorial in the New England Journal of Medicine [2] entitled “Escaping the EHR Trap – The Future of Health IT” speaks to this issue directly by stating “Only a small subset of loosely coupled information technologies need to be highly specific to health care. Many components can be generic.” They argue that secure private storage, inter-provider communications, documentation tools, analytics tools and software for rule-based systems are already generic and commercially available in non-medical applications. Pointing out that commercial EHR developers have largely locked physicians into pre-Internet-era EHRs, and failed to stay up to date with current flexible and modular business IT infrastructure methods and software, they effectively argue for the abandonment of these obsolete EHR systems in medicine, which would ideally lead to “bundled, best of breed, interoperable, substitutable technologies … that can be optimized for use in health care improvement”. The contradiction between today’s poor acceptance and routine use of KBSs and the expectations for demand and potential growth for KBSs noted in the survey of Spreckelsen et al. might, from this point of view, be reconciled by such an escape from this “EHR Trap” of obsolete technologies.

References