

# Chapter 16

## An Ontology–Driven Approach to Clinical Evidence Modelling Implementing Clinical Prediction Rules

**Derek Corrigan**

*Royal College of Surgeons in Ireland, Ireland*

**Lucy Hederman**

*Trinity College Dublin, Ireland*

**Haseeb Khan**

*Trinity College Dublin, Ireland*

**Adel Taweel**

*Kings College London, UK*

**Olga Kostopoulou**

*Kings College London, UK*

**Brendan Delaney**

*Kings College London, UK*

### ABSTRACT

*Diagnostic error is a major threat to patient safety in the context of the primary care setting. Evidence-based medicine has been advocated as one part of a solution. The ability to effectively apply evidence-based medicine implies the use of information systems by providing efficient access to the latest peer-reviewed evidence-based information sources. A fundamental challenge in applying information technology to a diagnostic clinical domain is how to formally represent known clinical knowledge as part of an underlying evidence repository. Clinical prediction rules (CPRs) can provide the basis for a formal representation of knowledge. The TRANSFoRm project defines the architectural components required to deliver a solution by providing an ontology driven clinical evidence service to support provision of diagnostic tools, designed to be maintained and updated from electronic sources of research data, to assist primary care clinicians during the patient consultation through delivery of up to date evidence based diagnostic rules.*

### INTRODUCTION

Diagnostic error has been shown to be a major threat to patient safety, particularly within the context of the primary care setting (Elder & Dovey, 2002). Where diagnostic errors occur there is the

potential for an adverse event to take place that may undermine the safety of the patient, sometimes with disastrous results (Fisseni, Pentzek, & Abholz, 2008). Proponents of evidence-based medicine have analysed the diagnostic process itself and described the flaws they see as existing in traditional diagnostic approaches that can contribute to the possibility of adverse events

DOI: 10.4018/978-1-4666-2657-7.ch016

taking place (Kostopoulou, Delaney, & Munro, 2008). Steps have been proposed that describe the diagnostic process and are seen as requirements for implementing a more rigorous diagnostic process (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996a). The formal steps describe a methodology which advocates obtaining, evaluating and utilising the best available clinical evidence that has been previously demonstrated to be effective and pertains to each clinical case as it arises (Knottnerus & Buntinx, 2002).

If we are to practice evidence-based medicine effectively there is a need to efficiently and easily access the latest validated clinical guidelines that have been shown to be applicable to the diagnostic context and circumstances of the particular case being considered. The use of information technology and the internet for this purpose has greatly assisted in this task and its use has been formalised as part of the steps of the evidence-based medicine philosophy (Greenhalgh, 2010). Whilst this approach has been useful it can still be manually intensive and not without its problems.

There are a number of widely proposed models of clinical knowledge but acceptance of these models has not been without question and more generic ontology driven approaches advocated as possible improvements (Smitha & Ceustersc, 2006). Dissemination of accepted clinical guidelines is often done in the form of peer-reviewed hard-copy texts, soft-copy textual documents or textual web pages. It is difficult for consistent interpretation and representation of those guidelines that allow for their subsequent incorporation into integrated clinical information systems providing more sophisticated functionality such as clinical decision support. This problem can therefore be rephrased as follows: how can we more formally define and represent what constitutes recognised 'clinical knowledge' with a view to disseminating that knowledge more effectively for use by both clinical practitioners and information systems designed to support their use? The use of clinical prediction rules (CPRs) has long been accepted as

a valuable means of deriving and disseminating clinical guidelines in respected evidence based journals such as the JAMA series (Ebell, Smith, Barry, Ives, & Carey, 2000). Because of their well defined structure they can be more easily incorporated and utilised in clinical decision support systems. CPRs can also be derived using well understood statistical methods such as logistic regression that could be applied to large sources of epidemiological data that are currently available in the form of both public and privately owned electronic research repositories.

Another problem is the time lag and delay that exists between clinical research outputs and their translation into frontline primary care practice (Lenfant, 2003). The ability of primary care practitioners to effectively practice evidence-based medicine is undermined by the delays that exist in disseminating accepted clinical best practice that has been derived from epidemiological based clinical research. This second question can be stated as: how do we expose our formal models of clinical knowledge with a view to easily integrating them with other systems that are utilised to bridge the gaps that exist between the research and primary care processes.

The work presented here is currently in development as part of a wider project called TRANSFoRm. The TRANSFoRm project is an EU funded FP7 project consisting of academic and industry partners who are developing an electronic infrastructure to support the vision of a rapid-learning healthcare system that integrates the research domain and the frontline primary care domain. A key development output of this project is the development of a decision support service that provides diagnostic decision support tools through a clinical evidence service utilised by primary care practitioners as part of the patient consultation. Integration with electronic health record systems will be achieved through the development of an ontology driven model of clinical evidence. This model for representation of clinical evidence allows for the utilisation of

26 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

[www.igi-global.com/chapter/ontology-driven-approach-clinical-evidence/73116](http://www.igi-global.com/chapter/ontology-driven-approach-clinical-evidence/73116)

## Related Content

---

### Role of Information Technology in Healthcare Quality Assessment

Stamatia Ilioudi, Athina A. Lazakidou and Maria Tsironi (2012). *Quality Assurance in Healthcare Service Delivery, Nursing and Personalized Medicine: Technologies and Processes* (pp. 242-253).

[www.irma-international.org/chapter/role-information-technology-healthcare-quality/58738](http://www.irma-international.org/chapter/role-information-technology-healthcare-quality/58738)

### Proposed Design and Assessment Methodology of a Wearable Device for Prevention and Performance Evaluation of Athletes

Athanasios Anastasiou, Angeliki Nikaki, Stavros Pitoglou and Yiannis Koumpourous (2022). *International Journal of Reliable and Quality E-Healthcare* (pp. 1-13).

[www.irma-international.org/article/proposed-design-assessment-methodology-wearable/297089](http://www.irma-international.org/article/proposed-design-assessment-methodology-wearable/297089)

### State of IS Integration in the Context of Patient-Centered Care: A Network Analysis and Research Directions

Ali Reza Montazemi, Jeff J. Pittaway and Karim Keshavjee (2013). *Healthcare Information Technology Innovation and Sustainability: Frontiers and Adoption* (pp. 127-144).

[www.irma-international.org/chapter/state-integration-context-patient-centered/73818](http://www.irma-international.org/chapter/state-integration-context-patient-centered/73818)

### Ethical E-Health: A Possibility of the Future or a Distant Dream?

Debarati Das, Prasenjit Maji, Goutami Dey and Nilanjan Dey (2014). *International Journal of E-Health and Medical Communications* (pp. 17-28).

[www.irma-international.org/article/ethical-e-health/118219](http://www.irma-international.org/article/ethical-e-health/118219)

### Toward a Better Understanding of the Assimilation of Telehealth Systems

Joachim Jean-Jules and Alain O. Villeneuve (2010). *Health Information Systems: Concepts, Methodologies, Tools, and Applications* (pp. 2012-2024).

[www.irma-international.org/chapter/toward-better-understanding-assimilation-telehealth/49978](http://www.irma-international.org/chapter/toward-better-understanding-assimilation-telehealth/49978)