Improving the Development of Composite Educational Guidelines Using Decomposition of Concept Lattices

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Objective. To provide a method to improve the development and maintainability costs of composite Educational Guidelines (EG) by decomposing decision tables represented as concept lattices.

Background. The development of complex didactic content of EG has been shown to require a specific formalism as compared to the one of traditional guidelines[1]. The personalization of EGs' content according to complex combinations of clinical conditions can lead to an explosion of EGs, thus increasing development and maintenance costs. Some knowledge-based EG tailoring techniques have previously been published[2,3], but require a complete "integrated" revision of the guidelines' content by experts, thus precluding the automated "on the fly" use of guidelines produced from heterogeneous sources. With the increasing interoperability of clinical information system and the upsurge of personal e-health portals, it is expected that opportunities for exchange and reuse of EG will be more common. Automated formal methods could reduce the cost of development and maintenance of sharable EGs.

Methods. The detailed methods of combining EGs for the MI HEART trial have been described elsewhere[1]. Three sets of EGs were merged and specialized to target different population of patients in order to provide individualized content. In the course of the specialization, the narrative content of EGs from heterogeneous sources were parsed in Atomic EGs (AEG). Each AEG were ascribed to its relevant Combination of Clinical Conditions (CCC). AEGs then organized in Decision Tables (DT) and organized in groups sharing the same CCC, clarified and disambiguated. In order to decrease the effort required to transform each set of AEG to a coherent narrative (which requires a manual revision), the DTs were *decomposed in unions of smaller DTs using formal concept analysis of concept lattices*[4].

Results. In the course of the preparation of the EG for the MI HEART Study, we observed that the DT containing the AEG presented some recurrent characteristics. We then explored formal techniques that could automate the perceived decomposition of the DT into smaller sets of DT. The original DT contained 80 different sets of guidelines combined around six clinical conditions and two cognitive conditions (level of their education). The two resulting sets of guidelines had respectively, 18 and 8 EG. The decomposition was realized around two groups of guidelines for which the mathematical decomposition coincided with some clinical relevance: one of the resulting DT contains the tailored education material for symptoms suggestive of an acute myocardial infarction, while the other resulting DT contains the tailored education relative to the actions to be taken in presence of such warning symptoms.

Discussion. The decomposition of DT in smaller ones lead to a significant reduction of the total number of guidelines sets and consequently the development efforts. While the heterogeneous EGs used for the MI HEART Trial intuitively suggested such decomposition, the mathematical analysis provides a formal framework to proceed for more complex sets EGs. For the DTs that may have multiple potential decompositions, we propose that the ones with clinical relevance should first be explored.

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