Use of Fuzzy Logic in Quality Indicators and Applicability to the Arden Syntax

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Abstract and Objective

Background: Fuzzy logic constructs have been suggested for the Arden Syntax to represent imprecise reasoning. Prior work has demonstrated their widespread presence in clinical practice guidelines (CPGs). Objective: Assess the prevalence of these constructs in quality indicators (QIs) to determine their utility in Arden. Methods: Fuzzy constructs were tabulated in a corpus of 392 QIs. Results: At least 1 construct was present in 50 QIs (12.8%). A total of 70 constructs were present, including 52 characterizing the degree of a state, 15 characterizing some inference and 3 denoting some temporal association. Conclusion: Fuzzy logic occurs commonly in QIs but not as commonly as in CPGs. Fuzzy constructs in knowledge formalisms may facilitate implementation of QIs.

Keywords:

Clinical decision support systems, Knowledge bases, Fuzzy logic.

Introduction

Assessing Care of Vulnerable Elders (ACOVE) is a set of QIs dating to 1999. ACOVE-3 includes 392 QIs, covering screening and prevention, diagnosis, treatment and follow-up in 26 different categories or conditions [1]. Different from CPGs for the individual patient, ACOVE is meant to specify a standard for care to be measured at the level of the health system, plan or practice.

Fuzzy logic is a multi-valued logic that has gained use in formal decision-making because of its value in representing imprecise reasoning as degrees of truth or set membership [2]. QIs may employ fuzzy logic, using linguistic variables containing modifiers such as "severe" and "partial" without necessarily formally defining these or providing an objective quantification.

The Arden Syntax is a computable standard for medical knowledge representation (KR) that has been adopted by several vendors. It does not contain fuzzy operators [3]. Workers have proposed constructs—data attributes and operators—to implement fuzzy logic in Arden directly. Prior work has established that fuzzy logic is commonly used in CPGs. Indeed, every CPG in one corpus contained at least 1 fuzzy logic construct [3]. Other work demonstrated that Arden can adequately represent the logic of selected QIs. Nevertheless, perceived lack of utility has delayed adoption of fuzzy logic in the Arden Syntax. In this light, the present study was undertaken to assess the extent to which fuzzy logic is present in QIs in order to determine the utility of including such constructs in the Arden Syntax.

Methods

All 392 ACOVE-3 indicators were reviewed. The number and type of fuzzy statements in these QIs were tabulated, using categories established in a prior analysis involving CPGs.

Results

Of the 392 QIs, 50 QIs (12.8%) spread over 20 of the 26 categories contained at least 1 linguistic variable that would be amenable to fuzzy representation. A total of 70 linguistic variables were present: 52 indicating degree of a state ("very severe"), 15 indicating inference ("potentially contributing") and 3 that were temporal ("frequent").

Conclusions

A large, robust corpus of QIs contains a significant number of fuzzy logic constructs despite emanating from a single source about one population. The types of linguistic variables are approximately proportional to those found in a corpus of CPGs, but linguistic variables are less prevalent in the present corpus of QIs than they were in a collection of CPGs. The present observations lend support to the value of syntactic constructs to represent fuzzy logic in KR formalisms such as the Arden Syntax.

References

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