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Utility of Arden Syntax for Representation of Fuzzy Logic in Clinical Quality Measures

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Abstract

Background—Prior work has established that fuzzy logic is prevalent in clinical practice guidelines and that Arden Syntax is suitable for representing clinical quality measures (CQMs). Approved since then, Arden Syntax v2.9 (2012) has formal constructs for fuzzy logic even as new formalisms are proposed to represent quality logic.

Objectives—Determine the prevalence of fuzzy logic in CQMs and assess the utility of a contemporary version of Arden Syntax for representing them.

Methods—Linguistic variables were tabulated in the 329 Assessing Care of the Vulnerable Elderly (ACOVE-3) CQMs, and these logic statements were encoded in Arden Syntax.

Results—In a total of 392 CQMs, linguistic variables occurred in 30.6%, and Arden Syntax could be used to represent these formally.

Conclusions—Fuzzy logic occurs commonly in CQMs, and Arden Syntax offers particular utility for the representations of these constructs.

Keywords

Clinical decision support systems; knowledge representation

Introduction

Fuzzy logic is a multi-valued logic for representing imprecise reasoning. Unlike the typical binary logic employed in knowledge representation (KR) formalisms in clinical medicine, fuzzy logic incorporates degrees of truth or set membership. Clinical quality measures (CQMs) may employ fuzzy logic, using linguistic variables containing modifiers such as “severe” and “partial” without necessarily defining them.

The Arden Syntax standard is a computable formalism for procedural medical knowledge that has been adopted by several vendors. Knowledge is represented in units known as medical logic modules (MLMs). Prior work has established the significant prevalence of fuzzy logic in clinical practice guidelines (100% of a sample had at least 1 linguistic

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variable) [1] and the utility of the Arden Syntax for representing CQMs, specifically a subset of measures Assessing Care of the Vulnerable Elderly (ACOVE-3) applicable to EHR system and administrative data that were published by RAND in 2007[2]. More recent work has established formal constructs for fuzzy logic representation, including variable declarations and logic statements, in v2.9 of the Arden standard certified in 2012.

Nevertheless, despite this demonstrated prior utility, additional formalisms have been proposed to represent CQMs. The present work was undertaken, in light of recent incorporation of support specifically for fuzzy logic representation in contemporary versions of Arden, to assess the value of these constructs and the consequently improved utility of Arden for representation of CQMs.

Methods

Expanding from the subset of 36 ACOVE-3 CQMs previously used in the assessment of the utility of Arden Syntax as a formalism for CQMs, all 392 ACOVE-3 CQMs were tabulated for the presence of linguistic variables. Logic statements containing these variables then were encoded in Arden Syntax.

Results

The instrument (VES-13) used to determine that an elder is vulnerable, which is a condition of all the ACOVE-3 CQMs, itself contains 3 self-evaluation linguistic variables applied to 6 different criteria. Of the 392 CQMs, 120 (30.6%) contained at least 1 linguistic variable. Four of these contained 2 linguistic variables to yield a total of 124 in ACOVE-3.

Conclusions

A large corpus of CQMs had fewer measures (30.6%) with linguistic variables than a prior corpus of clinical practice guidelines (100%). Nevertheless, fuzzy logic is sufficiently prevalent in CQMs such that, when coupled with prior evidence of its utility for representing CQMs, Arden Syntax--with its new formal constructs for fuzzy logic--offers particular utility for such representation.

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