

Applying Axiomatic Design Methodology to Create Guidelines that are Locally Adaptable

Aziz A. Boxwala, MBBS, PhD¹, Qing Zeng, PhD¹, Derrick Tate, PhD³,
Robert A. Greenes, MD, PhD¹, David G. Fairchild MD, MPH²

¹ Decision Systems Group, ² Department of Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, MA, ³ Leadership Development International, Evergreen, CO

Clinical guidelines developed at a national level are often difficult to use in specific-settings because of contextual factors. We have created a model for guideline representation that enables local adaptation of nationally developed guidelines. Guidelines are specified in a setting-independent manner and are then locally adapted by each practice. A guideline is represented hierarchically with the top level steps of the guideline specifying broad objectives and the lower level steps providing details of the recommendations. The axiomatic design framework provides a principled method for hierarchical design. The approach has been implemented by incorporation in the GLIF guideline modeling environment.

INTRODUCTION

Guideline recommendations that do not recognize necessary variations in practice environments can adversely affect acceptance by care providers [1].

Guidelines must balance the goals of achieving standardization of care based on scientific evidence and of maintaining consistency with local practice. We have created a model for representing guidelines with the aim of enhancing their acceptance.

MODEL

The overall approach is to express setting-independent intentions for the guideline that are then contextualized to the practice. Guidelines are created in a hierarchical or top-down manner with the top level of the guideline specifying high-level objectives. Deeper levels contain detailed specifications of the recommended actions and decision criteria. Authors can specify constraints on how particular steps can be modified during local adaptation.

Axiomatic design theory [2] is used to guide the hierarchical design of the setting-independent guideline.

The process of axiomatic design involves (1) identifying the customer's needs; (2) mapping those needs to functional requirements; (3) creating a design to satisfy the requirements; and (4) specifying a process to implement the design. Two axioms guide the design process. The *Independence Axiom* states that the independence of functional requirements must be maintained in the design. The steps of a flowchart produced following this axiom are uncoupled or decoupled from each other. The steps can thus be adapted with minimal impact on other steps. Furthermore, the axiom can guide the order in which steps must be

adapted. The *Information Axiom* states that the design must contain the least information.

This axiom thus provides a criterion for selecting from alternative design solutions. We applied the axiomatic approach to guideline modeling by mapping the elements of axiomatic design to the Guideline Interchange Format (GLIF) representation [3]. We have developed a software tool for authoring setting-independent guidelines, by extending software developed for the GLIF project.

RESULTS AND DISCUSSION

We encoded a cholesterol guideline [4] in a setting-independent format. The steps of the top-level guideline suggested strategies for implementation. For example, LDL screening recommendations would be implemented as automated reminders to the physician, and treatment of elevated cholesterol as a disease-management program.

We are extending the approach and the representation to build a complete and robust model. We will also explore the use of the information axiom in comparing alternative algorithm designs. We intend to conduct a trial to study the impact of locally adapted guidelines on acceptance by physicians.

Acknowledgments

This research was supported by grant LM06955 from the National Library of Medicine and grant LM06594 from the NLM, the US Army, and the AHRQ.

References

1. Grol R, Dalhuijsen J, Thomas S, Veld C, Rutten G, Mokkink H. Attributes of clinical guidelines that influence use of guidelines in general practice: observational study. *BMJ* 1998;317:858-61.
2. Suh NP. *The principles of design*. New York: Oxford University Press; 1990.
3. Peleg M, Boxwala AA, Ogunyemi O, Zeng Q, Tu S, Lacson R, et al. GLIF3: The evolution of a guideline representation format. *Proc AMIA Annu Fall Symp* 2000:645-9.
4. Executive summary of the 3rd report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). *JAMA* 2001;285:2486-97.