Describing elements of **clinical performance communication** for learning health systems

Toward large-scale management of clinical quality dashboard visualizations: The Performance Summary Display Ontology

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BACKGROUND

Efforts to create and maintain clinical quality dashboards and reports are often siloed, making it hard to study the general conditions under which a particular visual artifact is useful for improving clinical practice. We propose a Performance Summary Display Ontology (PSDO) as a formal computable model for describing graphical, structural, and theoretical characteristics of information visualization artifacts. PSDO is part of a learning health system to study *when*, *where, and how* different visual artifacts can aid in quality improvement communication to healthcare professionals and teams. Our representation of visualization artifacts is intended to be broadly generalizable while accounting for the need to represent granular differences between displayed attributes such as color, spacing, and semantic content.

GOALS

- Develop an open-source ontology of atomic classes and relations to represent visual artifacts related to clinical performance communication in the Basic Formal Ontology (BFO) framework[1]
- Account for interpretation of visual artifacts
- Provide a framework to manage and annotate healthcare performance visualizations based on their information content
- Take steps towards automated tailoring of performance reports.

METHODS

- Designed PSDO according to BFO and Open Biomedical Ontology (OBO) Foundry best-practices to promote interoperability
- Adopted representational structures described by Zhang[2] and Munzner[3] for semantic representation of visual artifacts
- Developed key classes based on iterative content analysis of dashboards and reports
  - Considered input from administrators, designers and healthcare professionals
- Extended Information Artifact Ontology (IAO) Classes to model domain-specific visualization artifacts

RESULTS

- Developed PSDO, an open-source ontology to represent visual artifacts for performance communication in terms of qualities, dimensionality, type, information content, and sets of granular components (‘marks’)
- Represent the qualities and emergent properties of individual marks and mark aggregation in terms of their semantic content:
  - Performance measures (M)
  - Entities ascribed a performance (A)
  - Performance levels (P)
  - Time intervals (T)
- Account for semantic content at various levels of granularity to facilitate management and retrieval
- Provide basic mechanisms to separate intension and extension in the performance communication process

CONCLUSION

There is a need to manage knowledge about visual artifacts, even within a single healthcare organization, such that the effects on communication of the visual artifacts can be better understood. By strengthening ontological representation of information visualizations, we believe that we can contribute to (1) better access and management of artifacts, subject to constraints at different levels of specificity, and (2) a foundation for learning health systems that enable humans and computers to leverage each other’s respective strengths in order to understand how, why, and when different visualizations are effective.

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Performance Communication Context

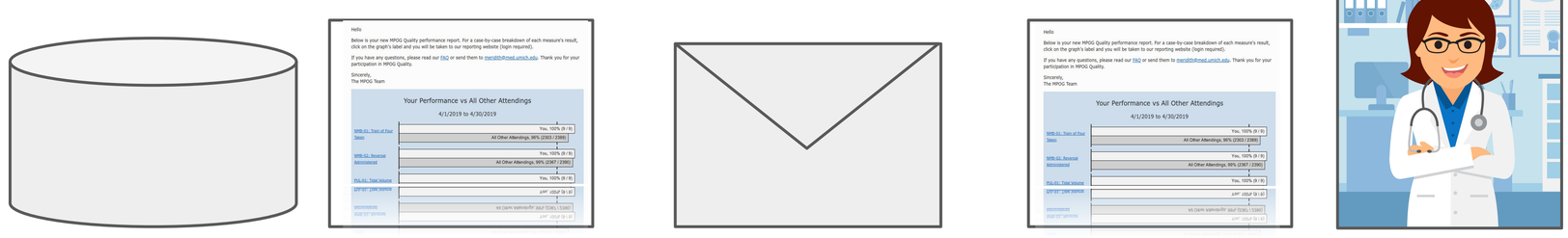


Figure 1. Communication model[4] with proposed representations of clinical performance information

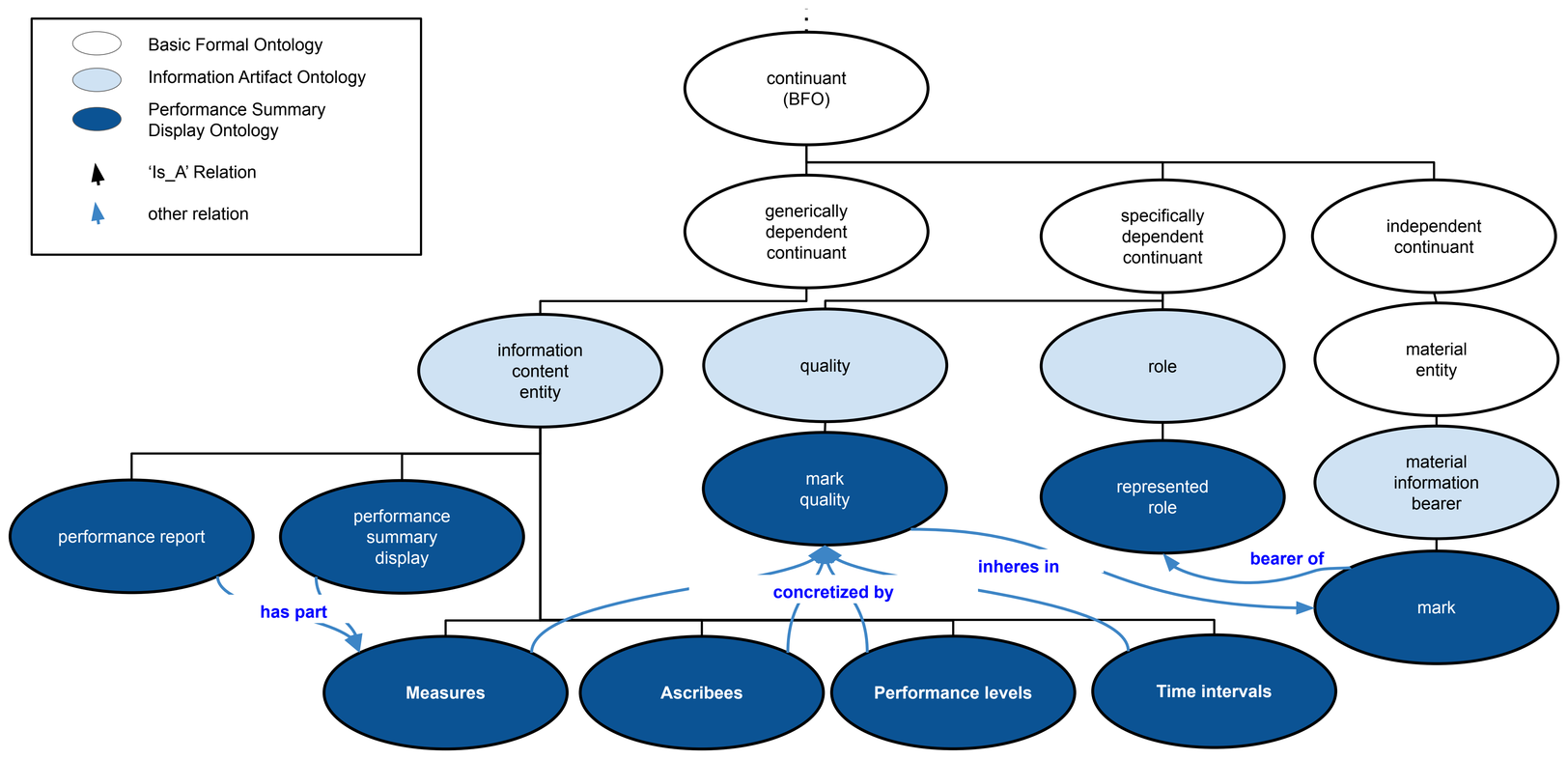
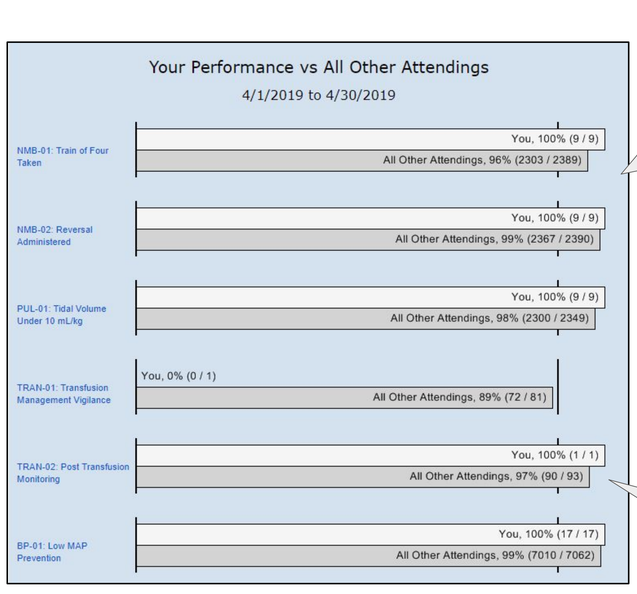


Figure 2. Representation of communication elements using Performance Summary Display Ontology classes

Using the classes in the ontology, what can we now say about this specific display?



Content	Form
Measures: 6	Text, position
Ascribees: 3 You, All other attendings Organizational goal	Text, bars, line Bars Line
Performance levels: 12 You, All other attendings Organizational goal	Text Bar length Distance from Y axis to line
Time intervals: 1	Text

Interpreted performance information content:
10 Positive performance gaps (You > others, goal)
2 Negative performance gaps (You < others, goal)
0 Positive trends
0 Negative trends

Figure 3. Describing visualization content and form for prioritization of performance feedback messages