Node-Arc-Node Graphs: Acquiring Nursing Domain Expert Knowledge

Introduction

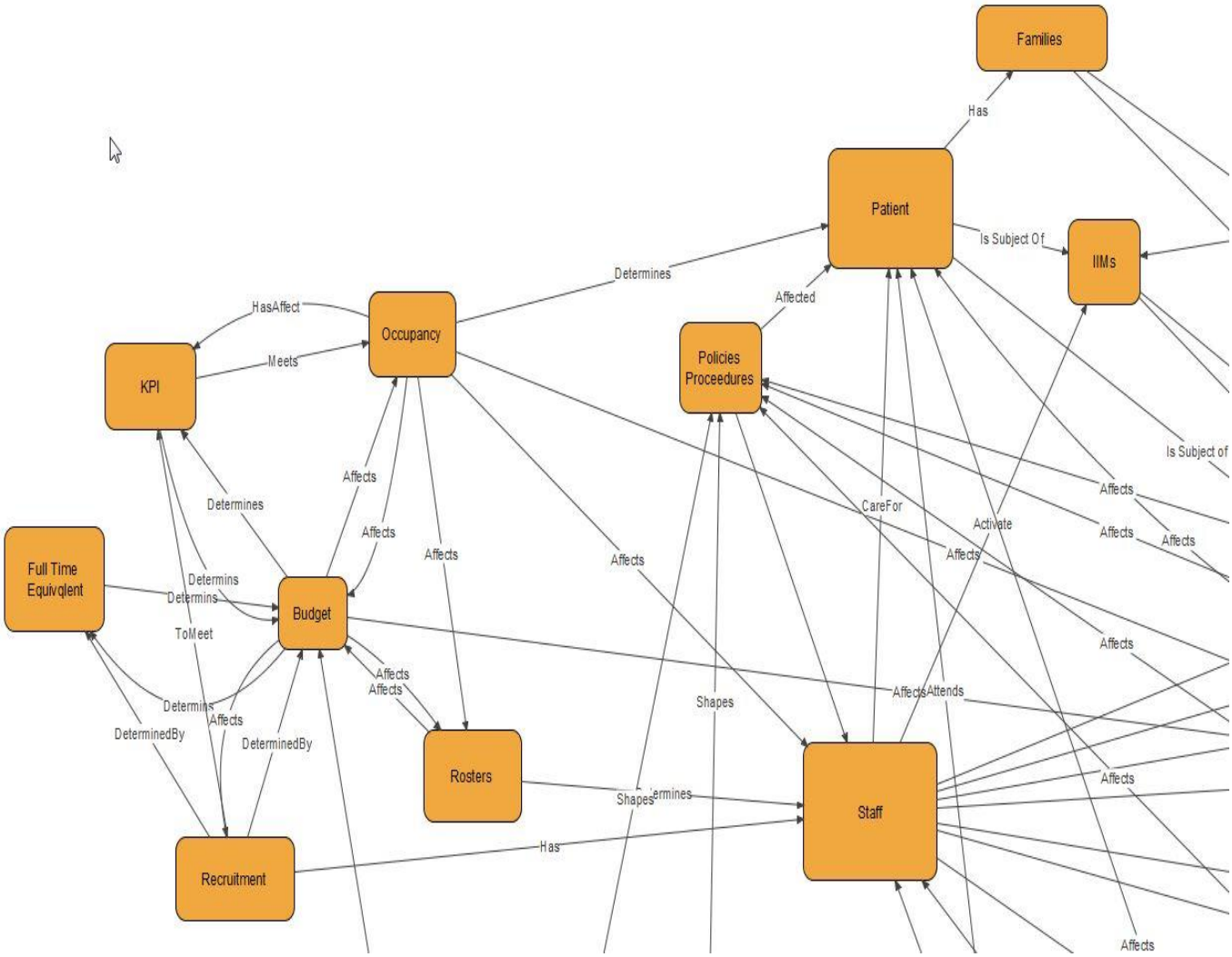
As a recent manifestation of earlier concept maps, node-arc-node graph architecture (graphs) are an important nursing knowledge acquisition technology (Novak, 1984). This is because they have a new role as an input modality for knowledge-acquiring software such as computer ontologies (Obitko, 2012). Graphs are a visual representation (abstract) of something in the world, the so-called domain of interest. They extract knowledge by depicting domain concepts and their relationships as nodes and arcs. Also, graphs contain labels describing things; these become the 'semantics' of the domain. For example, a domain expert describing a nursing domain of interest may represent concepts such as patients and medications as nodes connected with an arc describing their relationship.

Importantly, graphs not only extract knowledge but facilitate machine-readability, underpinning the Semantic Web (SW). The SW is a network comprised of computerised knowledge maps (ontologies) describing connected resources (Heath & Bizer, 2011) . This means, the graph of extracted domain knowledge is not only useful as a stand-alone display but can be incorporated into an ontology. Amazingly, an ontology has the ability to apply rules of logic using the graph's semantics to infer new machine generated knowledge. One application of this may be automated quality auditing (consistency) of a domain. As a first step, we conducted a pilot project to test Hayes, Saavedra, and Reichherzer (2003) observation that it is a trivial task for domain experts, with no prior knowledge of graphs, to visualise their nursing work domains.

Graph software pilot project

A nurse administrator and transitional care nurse with no prior knowledge of graphs were asked to use the Visual Understanding Environment (VUE[1]) graph software to visualise their domains in a large sub-acute facility[2]. Participants were given a half hour instruction on the software's operation with the researcher on hand to answer any functionality questions. They were asked to "start with you, and map concepts in your domain, don't proceed past four concepts away from yourself". Figure 1 illustrates a small section of the administrator's graph and figure 2, a section of a graph drawn by a transitional care nurse manager in the same facility.

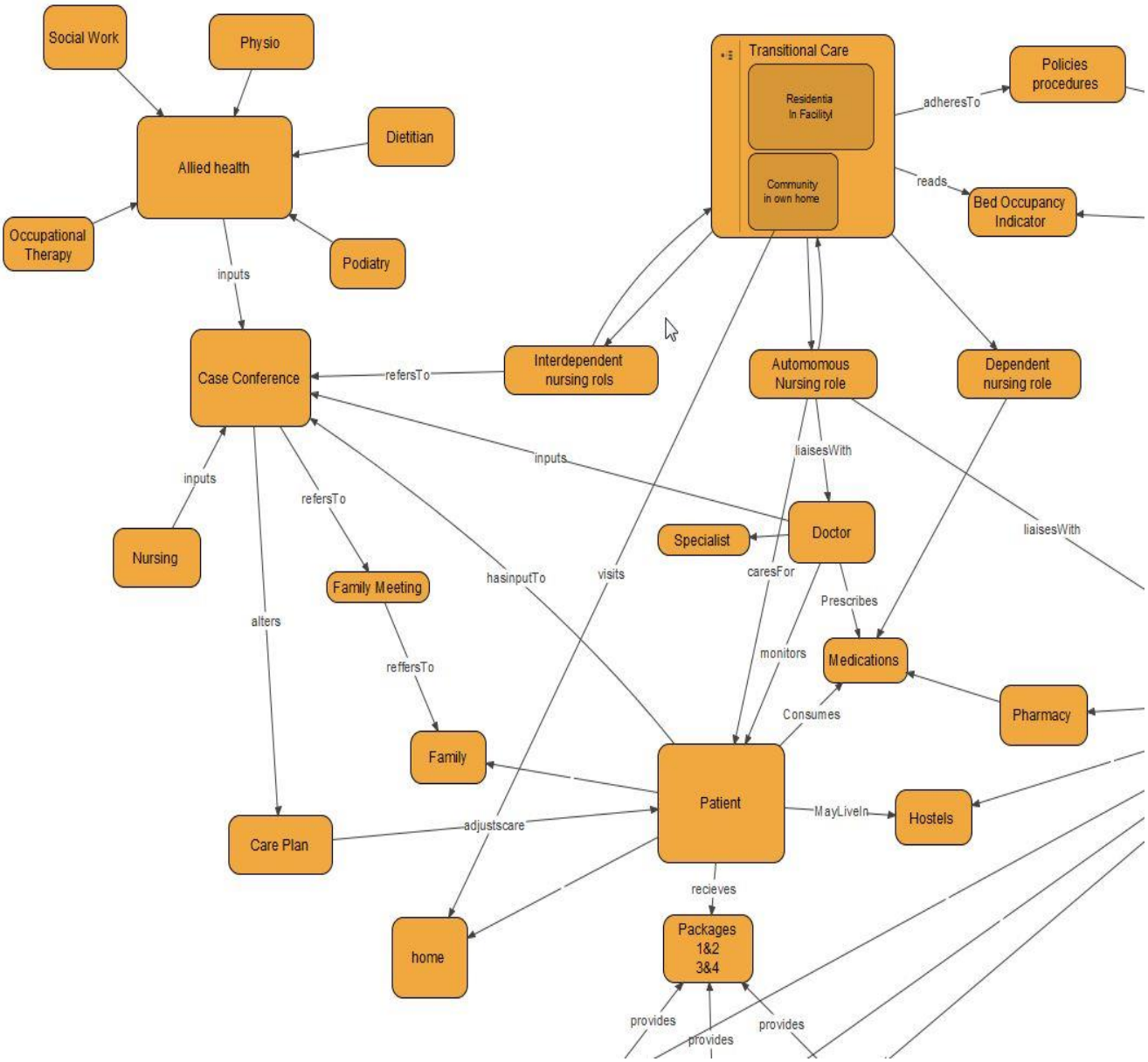
Figure 1: A small graph section of a nurse administrator's domain



[1] http://vue.tufts.edu/resources/

[2] http://www.cablesat.com.au/KA

Figure 2: *A small graph section of a nurse transitional care domain*



Discussion

In feedback from the participants, the pilot demonstrated graph software's 'point and click' modality was easy to use and participants became quickly proficient. Also, graphs provided:

- Connectivity: Although their nursing perspectives are quite different, some identical concepts such as patient, family and policy/procedure appear in both graphs. These would be used to link two graphs together and paint 'the big picture'.

- Clarification: The graphs helped the participants clarify their domains; the administrator remarked in feedback that she noted “the budget was more predominant than she imagined prior to doing the graph”. The transitional care graph displays detailed networking between agencies and allied health.
- Semantics: The graphs clearly record the semantics of each domain.
- Embedded metrics: The transitional care graph revealed an embedded quality indicator (bed occupancy).

Conclusion

Graphs are a powerful technology in the hands of a nurse analyst. Graphs enable nurses to acquire ‘locked-up’ knowledge to better place resources such as quality indicators, embedded technology or people in their clinical environment for improved efficiency and patient outcomes.

Keywords

Ontology, concept mapping, knowledge acquisition, OWL, node-arc-node graphs

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