Chapter 32

# Ontology Driven Cross-Linked Domain Data Integration and Spatial Semantic Multi Criteria Query System for Geospatial Public Health

**Sunitha Abburu**
*Department of Science and Technology, India*

## ABSTRACT

*This article describes how public health information management is an interdisciplinary application which deals with cross linked application domains. Geospatial environment, place and meteorology parameters effect public health. Effective decision making plays a vital role and requires disease data analysis which in turn requires effective Public Health Knowledge Base (PHKB) and a strong efficient query engine. Ontologies enhance the performance of the retrieval system and achieve application interoperability. The current research aims at building PHKB through ontology based cross linked domain integration. It designs a dynamic GeoSPARQL query building from simple form based query composition. The spatial semantic multi criteria query engine is developed by identifying all possible query patterns considering the ontology elements and multi criteria from cross linked application domains. The research has adopted OGC, W3C, WHO and mHealth standards.*

## INTRODUCTION

The physical environment determines public health in many ways (Lindsay et al., 2009). WHO carried health impact assets (HIA) to summarise the determine of human health. The findings are several factors such as physical, social and economic environment, education level, individual characteristics and behaviours combine together affect individual and community health. Few geospatial and meteorological determents of human health are like transport, water, radiation, urbanization etc. (HIA, 2016). It is ob-

served that the research is heading towards techniques for integration of geospatial environment features and human diseases. The knowledge gaps towards climate changes and health is addressed in (Kathleen et al., 2011). Semantic standards will advance understanding about the impacts of environmental exposures on human diseases (Carolyn et al., 2016). Adopting appropriate international standards is essential for an effective public health system. The major recommendation was focus on importance and need of integration of meteorological, environmental, geospatial, and disease data. The emphasis is on building an information infrastructure that promotes interdisciplinary collaborations.

Health data analytics supports better decision making, predictive analysis, strategic planning, cost-effective solutions, etc. Society can derive the benefits from the treasure of health data by facilitating health data integration and analytics. Right and timely information exchange among the stakeholders is the huge barrier. The R&D project "Development of Semantics Driven Geospatial Public Health Management System" funded by Department of Science and Technology (DST), Ministry of Science and Technology, Govt. of India has been initiated for an effective public health information system ("Health-GIS," 2015). Interactions with various health officials in the state of Tamilnadu is been conducted to identify challenges and knowledge gaps in public health care system. The administrative decisions regarding public health reforms, preparedness, actions, responses etc., need effective Public Health Knowledge Base (PHKB), semantic querying from cross-linked domains, visualization and health data analytics system.

Data driven approach supports structured queries. The data driven integration tools are quite established and delivers promising results. However, data driven approach cannot execute vast number of semantic queries in cross domain applications. It is very well proved that semantic approach gives effective information querying system than data driven approach (Evgeny et al., 2014). The various queries of public health care system involve the factors that effect the public health. Ontology based semantic technology plays a vital role in cross linked domain applications and data integration. The queries can be on any ontology element like concept, concept hierarchical, predicate, and instance or hybrid queries.

A sample set of data driven and ontology driven queries in public health care system are shown in Table 1.

To facilitate multi criteria spatial semantic queries, an ontology based public health care system has to be designed by integrating heterogeneous database sources from multiple application domains. The impact of various geospatial environment, place, meteorology parameters on public health analysis facilitates effective decision making.

Various meteorological, geospatial environment and disease domain ontologies exist in the literature. Ontologies have to be tailored according to the application needs to fit into PHKB system and supports spatial semantic queries. The various challenges to facilitate the effective multi-criteria, multi-domain attribute-based query system are:

*Table 1. A sample set of data driven and ontology driven queries*

| Data driven queries | Ontology driven queries |
|---|---|
| List Cholera cases | List infectious diseases |
| Diseases recorded at 10km or less distance from a river | List diseases nearby hydrographic features |
| Diseases recorded with Tamilnadu state and at 10km/less distance from NH7 | Diseases recorded with First order administrative division and nearby NH7 (National Highway 7) |

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