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Generation of Personalized Ontology based on treatment schemes utilizing semantic rules for HPV

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Abstract

A dramatic increase of demand for providing treatment quality has occurred during last decades. The main challenge is to increase the treatment quality. The personalization of treatment is a must, since each patient constitutes a unique case. Health care provision encloses complex environment, since health care provision organizations are multidisciplinary. So create the conceptualization of Disease-Treatment Ontology for HPV. The Disease-Treatment Ontology HPVDt ontology comprises: The Clinical Pathway part, the quality assurance part, Details about virus, cost of treatments and diet maintenance. To explore human papillomavirus (HPV) occurrence in the great prevalence regions of cervical cancer and to educate the relationship amongst HPV contagion and cervical cancer HPVDt ontology is utilized. Viral load computation is a life-threatening requirement for HPV administration universally. The investigative tools presently existing are excessively restricted by their dimension and expenditure to spread numerous isolated and source-restricted residents. Hence HPVDt ontology is used for further investigation.

Keywords: Adaptive clinical pathway, clinical pathway ontology, personalized treatment.

INTRODUCTION

Ontology typically consists of a finite list of terms and the relationships between these terms. The terms denote important concepts (classes of objects) of the domain, while the relationships include hierarchies of classes. Ontology may also include other information, such as properties, value restrictions, disjointedness statements, and specifications of logical relationships between objects. Ontology languages are semantic markup languages for defining ontology's. Web Ontology Language (OWL) was used, which was proposed as W3C Recommendation, for ontology specification. OWL facilitates greater machine interoperability of web content than XML, RDF, and RDF Schema by providing additional vocabularies along with a formal semantics.

Current web's extension is semantic web. The Semantic Web is a collaborative movement led by the international standards body, the World Wide Web Consortium (W3C). The standard promotes common data formats that remain in the World Wide Web. By encouraging the inclusion of semantic content in web pages, the Semantic Web aims at converting the current web, dominated by unstructured and semi-structured documents into a "web of data". The Semantic Web stack builds on the W3C's Resource Description Framework (RDF).

According to the W3C, "The Semantic Web provides a common framework that allows data to be shared and reused across application, enterprise, and community boundaries". The term was coined by Tim Berners-Lee for a web of data that can be processed by machines.

A HPV cancer is one which is undoubtedly affected by HPV. HPV origins all cervical cancers and numerous cancers of the oropharynx, rectum, anus, penis, vulva and vagina. An analysis based population-used data as of cancer tissue to evaluate the proportion of cancers which are possibly initiated by HPV. In order to discover the numerous HPV-attributable cancers, the quantifiable HPV-related cancer is multiplied by the proportion of the cancers which are possibly instigated by HPV. 5,229 people are identified by anal cancer every respective year, and almost 91% among anal cancers remain to be affected by HPV. 4,800 is 91% of 5,229.

The increment of treatment quality with decrement of healthcare provision costs is to be achieved for HPV. Modeling and utilization of standardized Clinical Protocols used in various domain of medical practice. Standardized clinical protocols comprise details:

1. Medical plans
2. Corresponding actions for diagnosis
3. Treatment Scheme
4. Follow up.

Flow of clinical pathway

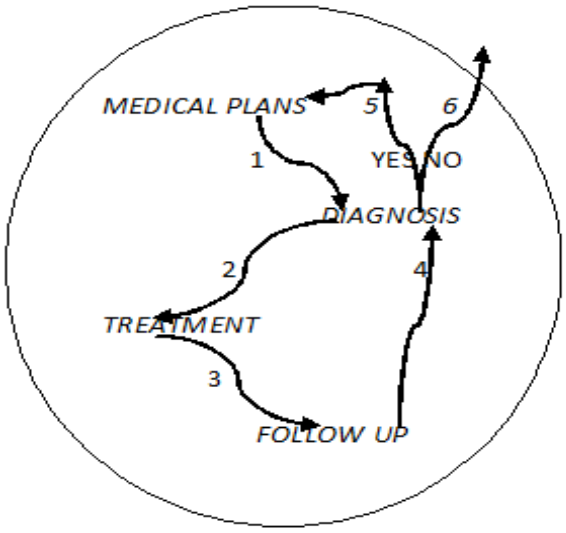

Figure 1: Flow of clinical pathway

"Clinical pathways" Fig.1 is the effective and efficient tool to

achieve the above mentioned objectives.

Clinical pathways allow the design and implementation of medical guidelines in a specific healthcare environment and decrease the occurrence of any undesired variability of medical practice. Disease-Treatment Ontology facilitates dynamic CP utilization for the development of Semantic Web Rules.

RELATED WORK

In [1]Dimitrios AI et al SEMPATH Ontology: Modeling Multidisciplinary Treatment Schemes Utilizing Semantics, allows the conceptual modeling of the multidisciplinary entities engaged in the execution of CP (medical, organizational, financial worlds modeling) in a consistent way, leveraging the further utilization of the semantic infrastructure.

In [2] Marut BURANARACH et al Design and Implementation of an Ontology-based Clinical Reminder, describes an ontology-based information and knowledge management framework that is important for chronic disease care management. The framework is designed to support two chronic care components: clinical information system and decision support.

In [3] Christopher S.G. Khoo et al Developing an Ontology for Encoding Disease Treatment Information in Medical Abstracts, Disease-Treatment ontology which represents specific treatments that are considered for a particular disease, are described in medical articles.

In [4] Syed Sibte et al Modeling the Form and Function of Clinical Practice Guidelines: An Ontological Model to Computerize Clinical Practice Guidelines System to Support Chronic Disease Healthcare is experimented.

In [5] Jiangbo Dang, An ontological knowledge framework for adaptive medical workflow, Ontologies are a formal declarative knowledge representation model. It provides a foundation upon which machine understandable knowledge can be obtained and as a result it makes machine intelligence possible. Healthcare systems can adopt these technologies to make them ubiquitous, adaptive, and intelligent and then serve patients better.

In [6] W.E.McCarthy the REA accounting model, the generalized framework for accounting system in a shared data environment is analyzed. The REA model is a technique for capturing information about economic pheno mena. It describes a business as a set of economic resources, economic events and economic agents as well as relationships among them.

In [16] Rachid Benlamri et al Building a Diseases Symptoms Ontology for Medical Diagnosis, An Integrative approach Medical ontologies are valuable and effective methods of representing medical knowledge is investigated. In this direction, they are much stronger than biomedical vocabularies. In the process of medical diagnosis, each disease has several symptoms associated with it. There are currently no ontologies that relate diseases and symptoms and only attempts at their infancy along with some simple proposed models exists.

In 1842 Rigoni-Stern first observed cervical cancer was found in married women and almost lacking in catholic nuns. Scientists concentrated on etiologic sources, which are transmitted by sexual contact. Human Papilloma-Virus (HPV) is the main source for sexually transmitted disease resulting in cervical cancer in women.HPV is responsible for squamous epithelial warts and lesions. Richard E. Shope was the first to examine cottontail rabbit and detached papillomavirus from warts (Shope & Hurst, 1933). As the result of this examination different types of papillomaviruses were isolated both from plants and animals. Infection in humans is caused by a group of Papillomavirus called Human papillomaviruses. Human papillomavirus belongs to small DNA virus family known as papillomaviridae.

Purola and Savia examined and stated the occurrence of HPV in dysplastic squamous epithelial cells in 1977. HPV is present in the nuclei of dysplastic squamous epithelial cells which has koilocytotic features. This examination was confirmed by ZurHausen and Gissman in 1980 which states that this virus is inevitable for cervical cancer.

Syrjanen et al. (2004) investigated the tariffs of attainment and the period of occurrence highrisk (HR) human papillomavirus (HPV) contaminations and Pap smear

irregularities and their extrapolative issues were in 423 womenfolk partaking in a multicenter screening learning and resolved that the attainment of HR HPV infection is suggestively age reliant.

Souho et al. (2015) studied the lessons from 1994 to 2014 and established that HPV septicity is expressively related to numerous contrary possessions on the generative fitness of both well-being and likewise modifies their productiveness frequency.

Wilting and Steenbergen (2016) encapsulates in what way HPV oncogenes own added possessions which affect using the DNA methylation machinery and mitotic checkpoints and continue to unusual assessment neoplasia or cancer and our existing information about the molecular alterations in the mass genome which happens throughout HPV-induced carcinogenesis assist us to rise considerate almost cervical cancer, to obtain biomarkers for initial analysis and to recognize therapeutic objectives for HPV persuaded precancerous tissue.

Proposed Work

Each patient is considered as unique and the real challenge to be provoked is to proliferate treatment quality in the personalization that lies in the treatment. Health care provision remains multidisciplinary which comprises complicated environment. A conceptualization for the domain of clinical pathways (CP) has been introduced. The treatment for disease in ontology constitutes three parts.

1. Part defining clinical path
2. Information part regarding virus.
3. Diet part and risk assessment.

A conceptualization for the multidisciplinary domain is obtained by this execution in healthcare provision. This execution is later used for the implementation of SWRL rules (Semantic Web Rules) repository. Modeling, implementing and execution of CP require conceptualization enclosing multidisciplinary domain of knowledge.

• First, Guidelines for clinical practice are becoming ever more popular in every sector of healthCare. Guidelines have the goal of indicating the decisions and tasks most appropriate for optimizing health outcomes and for controlling costs. They can be expressed either in the form of textual recommendations or as protocols or flow diagram. Standardized clinical protocols comprise details about Medical plans, Corresponding actions for diagnosis, Treatment Scheme, Follow up.

• Second, Virus Information is providing the total information's about virus such as Virus name, Virus Stage, Type, Symptoms. Risk Assessment is providing the information about side effect and Disease Effect.

• Third, Diet part tells about diet maintenance of the patients.

System Architecture

Fig. 2 illustrates the system architecture for HPVDt ontology. To develop Disease-Treatment ontology based on the ontology-based information and knowledge management comprise a set of evidence-based recommendations to both standardize and optimize the care process whilst ensuring patient safety and quality of care.

An ontology-based information and knowledge management process comprises a set of functional and temporal constraints, desired outcomes, set of actions and decision criterion. A typical disease, as a dependent continuant, enacts extending, branching, and fading processes before it disappears.

(i) The set of candidate ontology-based information and knowledge management were studied to extract and explicate the clinical knowledge.

(ii) ontology-based information and knowledge management elements were identified and analyzed, which led to either the specification of new or the refinement of existing ontology classes, attributes and constraints to model the ontology-based information and knowledge management elements.

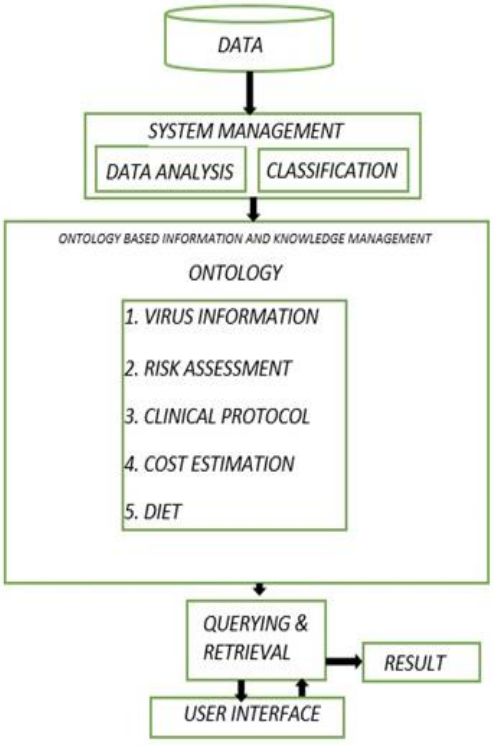

Figure 2: Architectural diagram of HPVDt ontology

(iii) Changes to the ontological model were reevaluated to ensure semantic consistency.

(iv) Virus information and diet - Retrieval modules are used to extract the relevant information from the ontology which consists of set of rules.

IMPLEMENTATION

Operative information illustration necessitates the usage of consistent terminologies to guarantee together pooled understanding amongst individuals and interoperability amid info schemes. Unexpectedly numerous prevailing biomedical terminology principles rest on unfinished, varying or disordered explanations of elementary expressions concerning to infections, diagnoses, and medical phenotypes.

A skeleton of what is trusted to be is reasonably and organically comprehensible structure for the illustration of entities and the associations amongst them. An observation of infection is preserved which are included in every single circumstance with physical base inside the creature that tolerates a temperament on the way to the implementation of pathological progressions.

This system comprises of:

1. System Management
2. Ontology based Information and Knowledge Management
3. Retrieval
4. User Interface Module

System Management

This module parses information from the medical data collection and adds them to the Ontology.

This includes data analysis and indexing, these two steps are used to classify the data based on their behaviors and used to create the Disease-treatment ontology and update the information's based on the clinical path ways.

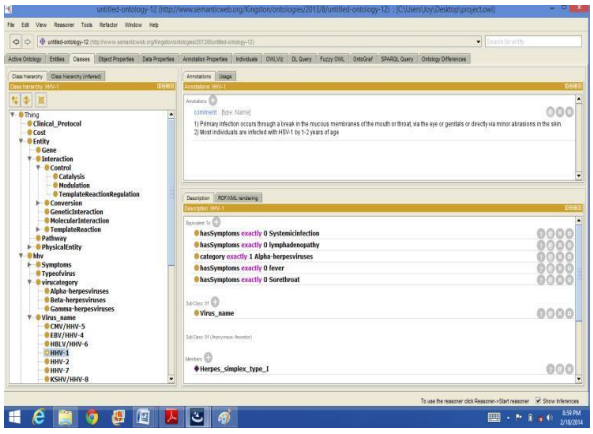

Figure 3: HPVDt ontology - Disease-Treatment Ontology

CLASSIFICATION

This fig.3 shows the detailed information about the viruses, treatment schemes and their symptoms.

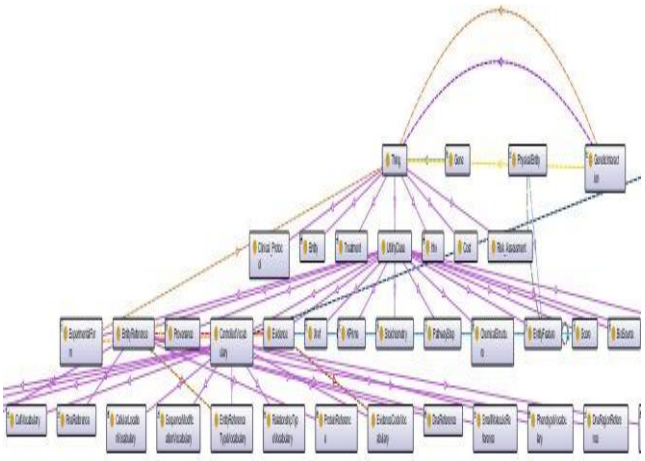

Figure 3.1: Graphical View of HPVDt Ontology

Fig.3.1 shows the graphical view of Ontology is used to determine different relation among the classes, objects and properties.

Ontology based Information and Knowledge Management

The main building block of ontology is the concept of a class. The ontology defines numerous classes that permit the explanation of research data. Objects possess the entirety of information for a particular study. Classes describe the independent variables of the research. Each variable identify the attributes to its instance. Subclasses describe the de-pendent variables, the values is from investigational trials. These classes describe metrics, the values is obtained from each participant during the research.

Objects, instances of the classes explain a fixed value of a feature. This determines the membership to a particular cell of the research design matrix. Classes describe a particular Dependent Variable.

Ontology-based information and knowledge management focuses on providing information and knowledge support on

1. Virus information
2. Risk Assessment
3. Clinical Protocol

4. Cost estimation.

Virus Information is providing total information such as Virus name, Virus Stage, Type, Symptoms.

Risk Assessment is providing the information about side effect and Disease Effect.

Standardized clinical protocols comprise details about Medical plans, Corresponding actions for diagnosis, Treatment Scheme and Follow up.

RETRIEVAL

Retrieval modules are used to extract the relevant information from the ontology. The design and development of the Disease-treatment ontology leverages the design and representation of the semantic rules utilizing the SWRL (Semantic Web Rule Language) format. SWRL facilitates the integration of the modeled rules with the Disease-treatment Ontology. The interaction between rules and ontology leads to new knowledge through the generation of new facts to be inserted as new concepts.

The Semantic Web Rule Language (SWRL) is a recommended language for the Semantic related web which is to define rules and logic, with OWL DL or OWL Lite having Rule Markup Language as subset (subset of Datalog).

SWRL decides the practical implementations of OWL DL which is regained by limiting the method of permissible rules by imposing an appropriate well-being situation.

Rules are between an antecedent (body) and consequent (head) which implies that if consequent conditions hold it is the condition that is held in antecedent.

XSLT transformation is extended for OWL XML Presentation syntax which implies the implication.

Translation from the XML Concrete Syntax to RDF/XML could be easily accomplished by extending the XSLT transformation for the OWL XML Presentation syntax.

User Interface Module

This module provides the system's functionality to its users. It includes the following

1. use the application
2. where the user uses the system's functionality
3. where the user enters a query
4. retrieves relevant documents and reformulates the query
5. if the results are inefficient answer the query

   present results to user, reformulate the user's query, where the user's query is expanded with new terms.

Code snippet for HPVDt ontology

```
<rdf:type rdf:resource="http://www.semanticweb.org/ontologies/2015/4/dt.owlseries"/>

<hasName rdf:datatype="http://www.w3.org/2015/XMLSchema#string">

</hasName> <owl:NamedIndividualrdf:about="http://www.semanticweb.org/ontologies/2015/4/
dt.owl#match">
<rdf:typerdf:resource="http://www.semanticweb.org/ontologies/2015/4/dt.owl#match"/>

<hasDate rdf:datatype="http://www.w3.org/2015/XMLSchema#string">4 junel 2012 </hasDate>
<hasStatus rdf:datatype="http://www.w3.org/2015/XMLSchema#string">

</hasStatus> <hasPatient
rdf:resource="http://www.semanticweb.org/ontologies/2015/4/dt.owl#medical "/>

<hasMedical rdf:resource="http://www.semanticweb.org/ontologies/2015/4/dt.owl#HPV Positive"/>
<hasTeam rdf:resource="http://www.semanticweb.org/ontologies/2015/4/dt.owl#HPVWomen"/>
</owl:NamePatient>
```

XML Coding:

```
<?xml version="1.0" encoding="UTF-8"?>
<!ENTITY % P "(#PCDATA)">
<!ELEMENT general (introduction, patient?)
<!ELEMENT introduction (patient*)>
 <!ELEMENT patient (name, HPV*)> <!ELEM
<!ELEMENT patient %P;>
 <!ATTLIST patient_ID ID #REQUIRED>
 <!ELEMENT patient (item*)>
<!ELEMENT item (technology, patient*)>
<!ELEMENT technology %P;>
<!ELEMENT patient %P;>
<!ATTLIST patient_ID ID #REQUIRED>
```

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RESULT

The HPVDt ontology predicts the prevalence and existence of HPV. This existence is depicted using the Fig. 4 which predicts how far the existence of HPV has been protruded in the existing population.

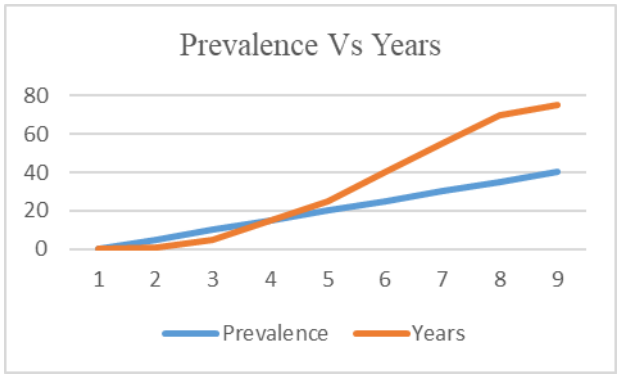

Figure. 4: Graph for the prevalence of HPV based on years

CONCLUSION

The modeling, implementation, and execution of HPVDt ontology require extensive conceptualization since it encloses

a highly multidisciplinary domain of knowledge. A disease encompasses with physical disorder and treatment Schemes. Cover information's about virus and diet for patients and rules for are used to extract the information from ontology. The future work of this project is to expand the HPVDt ontology and generate more rules for user extraction.

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