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Ontologies Applied to Prostate Cancer

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Perspective

When cells in the body begin to grow out of control, cancer develops. Cancer cells can develop in practically any part of the body and spread to other parts of the body. When cells in the prostate gland begin to grow out of control, prostate cancer develops. The prostate gland is only found in men. It produces some of the fluid found in sperm. The prostate is located beneath the bladder (a hollow organ that stores urine) and in front of the rectum (the last part of the intestines). Seminal vesicles, located just behind the prostate, produce the majority of the fluid for semen. The urethra, which is the tube that transports urine and sperm from the body to the penis, runs through the penis.

Prostate cancer, in the vast majority of cases, is asymptomatic. When men have advanced prostate cancer, they may suffer certain symptoms in rare circumstances. These symptoms, however, are also present in many men who do not have cancer, so it's advisable to talk to a doctor about them before drawing any conclusions. Difficulty emptying the bladder, blood in the urine, and bone pains are all possible signs.

Apart from skin cancer, prostate cancer is the most frequent type of cancer detected in males in the United States, and it often develops without symptoms. According to the American Cancer Society, 164,690 men will be newly diagnosed with prostate cancer in 2018, 29,430 men will die from the disease, and 1 in every 9 men will be diagnosed with prostate cancer at some point in their lives. Because prostate cancer is a slow-growing cancer, many men die of other ailments before it causes substantial issues. Many prostate cancers, on the other hand, are more aggressive and can spread outside of the prostate gland, which can be fatal. With early detection, the chances of surviving prostate cancer are considerably increased.

It is increasingly important for investigators to efficiently and effectively access, interpret, and analyze the data from diverse biological, literature, and annotation sources in a unified way. The heterogeneity of biomedical data and the lack of metadata are the primary sources of the difficulty for integration, presenting major challenges to effective search and retrieval of the information. As a proof of concept, the Prostate Cancer Ontology (PCO) is created for the development of the Prostate Cancer Information System (PCIS). PCIS is applied to demonstrate how the ontology is utilized to solve the semantic heterogeneity problem from the integration of two prostate cancer related database systems at the Fox Chase Cancer Center. As the results of the integration process, the semantic query language SPARQL is applied to perform the integrated queries across the two database systems based on PCO.

The Interdisciplinary Prostate Ontology Project [IPOP] aims to develop expertise with biomedical ontologies at the University of Western Ontario and the London Health Sciences Centre. This paper surveys results from the first stage of IPOP, which assessed existing biomedical ontology tools and applied them to clinical reporting about prostate cancer.

The main goal of IPOP is to improve communication between medical practitioners from radiology, oncology, anatomy, surgery, pathology, and other areas. Communication is often impeded by local variations in the use of terminology. Controlled vocabularies are part of the solution to this problem. Biomedical ontologies improve upon controlled vocabularies by linking together terms and thus allowing for better computerized data collection, search, and analysis. We hope that improving communication will ultimately lead to better patient outcomes.

OWL-DL is utilized to construct PCO for PCIS using the ontology editor tool, Protégé 3.3. PCO provides the common, shared, and formal description of the important concepts, relationships, and properties/attributes for prostate cancer. PCO is developed by merging the concepts from two commonly used vocabularies and ontologies, NCI Thesaurus and FMA. PCO inherits the concepts of prostate cancer from NCI Thesaurus. It also inherits the concepts of prostate anatomical structure from FMA. The new concepts identified from the database systems are added into PCO if they are not covered in either NCI Thesaurus or FMA. For example, the CNTO-328 is a monoclonal antibody to IL-6 used in one of the prostate cancer clinical trials at FCCC. It is added as one of the children for the concept “Drug in Clinical Trial” in PCO. The properties for each concept are introduced to PCO too. These properties are determined by the database systems. They are applied to annotate the data from the database systems.

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