RSNA 2016 –

Knowledge Representation of Prostatic Sector Anatomy from PI-RADS in Standard Lexicons

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PixelMed Publishing
Background & Disclosures

- Owner, PixelMed Publishing, LLC
- Consultant to NCI QIICR project
- Consultant to Carestream, GE, Curemetrix, MDDX
- Editor of DICOM Standard
Application

- Multiparametric Magnetic Resonance Imaging (mpMRI) is increasingly used to evaluate prostate cancer.
- Reporting systems that standardize the features, locations and recommended action have been devised.
- The most recent of these is the Prostate Imaging and Report and Data System Version 2 (PI-RADS v2).
- Such reports and supporting evidence will be encoded in a structured form and anatomical locations need a standard encoding.
Precise localization of ROIs

- For reproducibility of reader performance
- Comparisons with a pathological reference
- Assess/improve regional specificity
- Improve the communication of results
- Draw attention to suspicious regions
- For targeted biopsies or therapy
- To improve staging
Localization Models

- EU Consensus Paper – 16 regions
- EU Consensus Paper – 27 regions
- PI-RADS v2 – 39 regions

- Whether or not such granular localization is practical for routine reporting is out of scope of this discussion

<table>
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<tr>
<td>Transition Zone</td>
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Knowledge Extraction

- If granular localization is used ...
- How does one extract more general knowledge?
- E.g., Apex L TZp “Left posterior apical transition zone of prostate”, is:
  - Left
  - Apical
  - Posterior
  - Transition zone
- Need not only codes, but “ontology” (relationships)
Encoding

- Narrative reports may use full name or abbreviations
- Structured reports with semantically extractable information need codes
- Codes should be standard so as to be interoperable
- Common schemes:
  - SNOMED CT
  - Foundational Model of Anatomy (FMA)
  - NCI Thesaurus
  - RadLex (radiology-specific)
Methods

● Evaluated FMA, SNOMED CT, NCIt and RadLex for current content – all lacking the necessary specificity
● Selected FMA as basis and Protégé as tool
● Extended FMA with new concepts:
  • sub-classes of existing concepts
  • regional spatial relationships (“posterior to”, etc.)
  • “disjoint from” relationships
● Offered result to FMA, SNOMED CT, NCIt, RadLex
Protégé

Spatial Relations
Transition Zone
Class Hierarchy
shown in OntoGraf
Posterior part of left side of apical part of transition zone of prostate

- has superclass (is a)
  - Subdivision of apical part of transition zone of prostate

- is regional part of
  - Left side of apical part of transition zone of prostate

- is constitutional part of
- is member of

FMA ID: 328775

PIRADS v3

Apex L, TZp
Structure of posterior apical part of transition zone of left half prostate (body structure)

SCTID: 716933002

Structure of posterior apical part of transition zone of left half prostate (body structure)

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Structure of posterior apical part of transition zone of left half prostate (body structure)

Structure of posterior apical part of transition zone of left half prostate (body structure)
Left Posterior Apical Transition Zone of Prostate (Code C128579)

Terms & Properties
Preferred Name: Left Posterior Apical Transition Zone of Prostate
Definition: The region of the prostate that is located on the anatomical left side of the posterior portion of the apical division of the transition zone.
Label: Left Posterior Apical Transition Zone of Prostate
NCI Thesaurus Code: C128579
Synonyms & Abbreviations: (see Synonym Details)
- Apex L T2a:
  Left Posterior Apical Transition Zone of Prostate
External Source Codes: None
Other Properties:
- Name: Value (qualifiers Indented underneath)
  - code: C128579
  - Contributing_Source: PI-RADS
  - Semantic_Type: Body Location or Region
Additional Concept Data:
- Defined Fully by Roles: No
Concept: [C4274173] Left posterior apical part of transition zone of prostate

Semantic Types
- Body Part, Organ, or Organ Component

Atoms (3)
- [AIU / RSAB / TTY / Code]
  - Left posterior apical part of transition zone of prostate [A27169763/SNOMEDCT_US/PF/T16933002]
  - Structure of posterior apical part of transition zone of left half prostate [A27172960/SNOMEDCT_US/SY/T16933002]
  - Structure of posterior apical part of transition zone of left half prostate (body structure) [A27169296/SNOMEDCT_US/FR/T16933002]
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Table CID n001. Prostate Sector Anatomy from PI-RADS v2

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**CID 6301 Prostate Sector Anatomy from PI-RADS v2**

**Note**

*From [PI-RADS v2]*

**Type:**

Extensible

**Version:**

20161106

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Conclusions

- PI-RADS V2 and EU Consensus sector anatomy now coded in FMA, SNOMED CT and NCI Thesaurus
- DICOM now includes values sets and codes for all three schemes – usable in Structured Reports and Segmentations
- UMLS will inherit since it regularly incorporates SNOMED CT, FMA and NCI Thesaurus
- RadLex expected to follow soon
- FMA and SNOMED CT include partology, and FMA includes spatial relationships – allows for interrogation of common parents and attributes
Acknowledgements

- This project was supported by funding from National Institutes of Health, National Cancer Institute, through grant U24 CA180918 (Quantitative Image Informatics for Cancer Research, QIICR)
- QIICR (BWH) – Andrey Fedorov
- SNOMED CT(IHTSDO) – Yongsheng Gao
- FMA (Univ. Wash. Seattle) – Todd Detwiler, Onard Mejino
- NCI Thesaurus – Teri Quinn, Lori Whiteman