## Appendix III

### Lexicon

#### Abnormality

<table>
<thead>
<tr>
<th>Focal abnormality</th>
<th>Localized at a focus, central point or locus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus</td>
<td>Localized finding distinct from neighboring tissues, not a three-dimensional space occupying structure</td>
</tr>
<tr>
<td>Index Lesion</td>
<td>Lesion identified on MRI with the highest PIRADS Assessment Category. If the highest PIRADS Assessment Category is assigned to two or more lesions, the index lesion should be one that shows EPE or is largest. Also known as dominant lesion</td>
</tr>
<tr>
<td>Lesion</td>
<td>A localized pathological or traumatic structural change, damage, deformity, or discontinuity of tissue, organ, or body part</td>
</tr>
<tr>
<td>Mass</td>
<td>A three-dimensional space occupying structure resulting from an accumulation of neoplastic cells, inflammatory cells, or cystic changes</td>
</tr>
<tr>
<td>Nodule</td>
<td>A small lump, swelling or collection of tissue</td>
</tr>
<tr>
<td>Non-focal abnormality</td>
<td>Not localized to a single focus</td>
</tr>
<tr>
<td>Diffuse</td>
<td>Widely spread; not localized or confined; distributed over multiple areas, may or may not extend in contiguity, does not conform to anatomical boundaries</td>
</tr>
<tr>
<td>Multifocal</td>
<td>Multiple foci distinct from neighboring tissues</td>
</tr>
<tr>
<td>Regional</td>
<td>Conforming to prostate sector, sextant, zone, or lobe; abnormal signal other than a mass involving a large volume of prostatic tissue</td>
</tr>
</tbody>
</table>

#### Shape

<table>
<thead>
<tr>
<th>Round</th>
<th>The shape of a circle or sphere</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oval</td>
<td>The shape of either an oval or anellipse</td>
</tr>
<tr>
<td>Lenticular</td>
<td>Having the shape of a double-convex lens, crescentic</td>
</tr>
<tr>
<td>Lobulated</td>
<td>Composed of lobules with undulating contour</td>
</tr>
<tr>
<td>Water-drop-shaped</td>
<td>Having the shape of a tear or drop of water; it differs from an oval because one end is clearly larger than the other</td>
</tr>
<tr>
<td>Tear-shaped</td>
<td>Having the shape of a wedge, pie, or V-shaped</td>
</tr>
<tr>
<td>Term</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Linear</td>
<td>In a line or band-like in shape</td>
</tr>
<tr>
<td>Irregular</td>
<td>Lacking symmetry or evenness</td>
</tr>
<tr>
<td><strong>MARGINS</strong></td>
<td></td>
</tr>
<tr>
<td>Circumscribed</td>
<td>Well defined</td>
</tr>
<tr>
<td>Non-circumscribed</td>
<td>Ill-defined</td>
</tr>
<tr>
<td>Indistinct</td>
<td>Blurred</td>
</tr>
<tr>
<td>Obscured</td>
<td>Not clearly seen or easily distinguished</td>
</tr>
<tr>
<td>Irregular</td>
<td>Uneven</td>
</tr>
<tr>
<td>Spiculated</td>
<td>Radiating lines extending from the margin of a mass</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Bounded by a distinct, uniform, smooth low-signal line (BPH nodule)</td>
</tr>
<tr>
<td>Organized chaos</td>
<td>Heterogeneous mass in transition zone with circumscribed margins, encapsulated (BPH nodule)</td>
</tr>
<tr>
<td>Erased charcoal sign</td>
<td>Blurred margins as if smudged, smeared with a finger; refers to appearance of a homogeneously T2 low-signal lesion in the transition zone of the prostate with indistinct margins (prostate cancer)</td>
</tr>
<tr>
<td>Hyperintense</td>
<td>Having higher signal intensity (more intense, brighter) on MRI than background prostate tissue or reference tissue/structure</td>
</tr>
<tr>
<td>T2 Hyperintensity</td>
<td>Having higher signal intensity (more intense, brighter) on T2-weighted imaging</td>
</tr>
<tr>
<td>Isointense</td>
<td>Having the same intensity as a reference tissue/structure to which it is compared; intensity at MRI that is identical or nearly identical to that of background prostate</td>
</tr>
<tr>
<td>Hypointense</td>
<td>Having less intensity (darker) than background prostate tissue or reference tissue/structure</td>
</tr>
<tr>
<td>Markedly hypointense</td>
<td>Signal intensity lower than expected for normal or abnormal tissue of the reference type, e.g., when involved with calcification or blood or gas</td>
</tr>
<tr>
<td>T2 hypointensity</td>
<td>Having lower signal intensity (less intense, darker) on T2-weighted imaging</td>
</tr>
</tbody>
</table>
PI-RADS™ v2

MR IMAGING SIGNAL CHARACTERISTICS

**Restricted diffusion**
Limited, primarily by cell membrane boundaries, random Brownian motion of water molecules within the voxel; having higher signal intensity than peripheral zone or transition zone prostate on DW images acquired or calculated at b values $>1400$ accompanied by lowered ADC values. Synonymous with "impeded" diffusion

**Diffusion-weighted hyperintensity**
Having higher signal intensity, not attributable to T2 shine-through, than background prostate on DW images

**Apparent Diffusion Coefficient (ADC)**
A measure of the degree of motion of water molecules in tissues. It is determined by calculating the signal loss in data obtained with different b-values and is expressed in units of mm$^2$/sec or $\mu$m$^2$/sec

**ADC Map**
A display of ADC values for each voxel in an image

**ADC Hyperintense**
Having higher signal intensity (more intense, brighter) than background tissue on ADC map

**ADC Isointense**
Intensity that is identical or nearly identical to that of background tissue on ADC map

**ADC Hypointense**
Having lower intensity (darker) than a reference background tissue on ADC map

**b-value**
A measure of the strength and duration of the diffusion gradients that determines the sensitivity of a DWI sequence to diffusion

**Dynamic contrast enhanced**

**DCE Wash-in**
Early arterial phase of enhancement; a period of time to allow contrast agent to arrive in the tissue

**DCE Wash-out**
Later venous phase, de-enhancement, reduction of signal following enhancement; a period of time to allow contrast agent to clear the tissue

**Pharmacodynamic analysis**

**PD curves**
Method of quantifying tissue contrast media concentration changes to calculate time constants for the rate of wash-in and wash-out

**Time vs. signal intensity curve**

**Enhancement kinetic curve**
Graph plotting tissue intensity change (y axis) over time (x axis); enhancement kinetic curve is a graphical representation of tissue enhancement where signal intensity of tissue is plotted as a function of time

**ENHANCEMENT PATTERNS**

**Early phase wash-in**
Signal intensity characteristic early after contrast agent administration; wash-in phase corresponding to contrast arrival in the prostate

**Delayed phase**
Signal intensity characteristic following its initial (early) rise after contrast material administration
<table>
<thead>
<tr>
<th>Persistent delayed phase</th>
<th>Continued increase of signal intensity over time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1 curve</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plateau delayed phase</th>
<th>Signal intensity does not change over time after its initial rise, flat; plateau refers to signal that varies &lt;10% from the peak signal over the duration of the DCE MRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 2 curve</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Washout delayed phase</th>
<th>Signal intensity decreases after its highest point after its initial rise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 3 curve</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Positive DCE</th>
<th>Focal, early enhancement corresponding to a focal peripheral zone or transition zone lesion on T2 and/or DWI MRI</th>
</tr>
</thead>
</table>

| Negative DCE             | Lack of early enhancement  
Diffuse enhancement not corresponding to a focal lesion on T2 and/or DWI MRI  
Focal enhancement corresponding to a BPH lesion |
|--------------------------|-------------------------------------------------------------------------------------------------------------------|

**ANATOMICAL TERMS**

**Prostate: Regional Parts**

- **The prostate is divided from superior to inferior into three regional parts:** the base, the midgland, and the apex
- **Base of prostate**
  - The upper 1/3 of the prostate just below the urinary bladder
- **Mid prostate**
  - The middle 1/3 of the prostate that includes verumontanum in the mid prostatic urethra; midgland
- **Apex of prostate**
  - The lower 1/3 of the prostate
- **Peripheral zone**
  - Covers the outer posterior, lateral, and apex regions of the prostate; makes up most of the apex of the prostate
- **Transition zone**
  - Tissue around the urethra that is separated from the peripheral zone by the "surgical capsule" delineated as a low signal line on T2-weighted MRI; it is the site of most BPH
- **Central zone**
  - Tissue surrounding the ejaculatory ducts posterior and superior, from the base of the prostate to the verumontanum; it has the shape of an inverted cone with its base oriented towards the base of the gland; contains more stroma than glandular tissue
- **Anterior fibromuscular stroma**
  - Located anteriorly and contains smooth muscle, which mixes with periurethral muscle fibers at the bladder neck; contains no glandular tissue

**Prostate: Sectors**

- Anatomical regions defined for the purpose of prostate targeting during interventions, may include multiple constitutional and regional parts of the prostate. Thirty-six sectors for standardized MRI prostate localization reporting are identified, with addition of seminal vesicles and membranous urethra. Each traditional prostate sextant is subdivided into six sectors, to include: the anterior fibromuscular stroma,
the transition zone anterior and posterior sectors, the peripheral zone anterior, lateral, and medial sectors. The anterior and posterior sectors are defined by a line bisecting the prostate into the anterior and posterior halves. See Diagram

Prostate "capsule" Histologically, there is no distinct capsule that surrounds the prostate, however historically the "capsule" has been defined as an outer band of the prostatic fibromuscular stroma blending with endopelvic fascia that may be visible on imaging as a distinct thin layer of tissue surrounding or partially surrounding the peripheral zone

Prostate pseudocapsule Imaging appearance of a thin "capsule" around transition zone when no true capsule is present at histological evaluation. The junction of the transition and peripheral zones marked by a visible hypointense linear boundary, which is often referred to as the prostate "pseudocapsule" or "surgical capsule"

Seminal vesicle One of the two paired glands in the male genitourinary system, posterior to the bladder and superior to the prostate gland, that produces fructose-rich seminal fluid which is a component of semen. These glands join the ipsilateral ductus (vas) deferens to form the ejaculatory duct at the base of the prostate

Neurovascular bundle of prostate NVB Nerve fibers from the lumbar sympathetic chain extend inferiorly to the pelvis along the iliac arteries and intermix with parasympathetic nerve fibers branching off S2 to S4. The mixed nerve bundles run posterior to the bladder, seminal vesicles, and prostate as the "pelvic plexus". The cavernous nerve arises from the pelvic plexus and runs along the posterolateral aspect of the prostate on each side. Arterial and venous vessels accompany the cavernous nerve, and together these structures form the neurovascular bundles which are best visualized on MR imaging at 5 and 7 o'clock position. At the apex and the base of the prostate, the bundles send penetrating branches through the "capsule", providing a potential route for extraprostatic tumor spread

Right neurovascular bundle Located at 7 o'clock posterolateral position

Left neurovascular bundle Located at 5 o'clock posterolateral position

Vas deferens The excretory duct of the testes that carries spermatozoa; it rises from the scrotum and joins the seminal vesicles to form the ejaculatory duct, which opens into the mid prostatic urethra at the level of the verumontanum
Verumontanum
The verumontanum (urethral crest formed by an elevation of the mucous membrane and its subjacent tissue) is an elongated ridge on the posterior wall of the mid prostatic urethra at the site of ejaculatory ducts opening into the prostatic urethra.

Neck of urinary bladder
The inferior portion of the urinary bladder which is formed as the walls of the bladder converge and become contiguous with the proximal urethra.

Urethra: Prostatic
The proximal prostatic urethra extends from the bladder neck at the base of the prostate to verumontanum in the mid prostate. The distal prostatic urethra extends from the verumontanum to the membranous urethra and contains striated muscle of the urethral sphincter.

Urethra: Membranous
The membranous segment of the urethra is located between the apex of the prostate and the bulb of the corpus spongiosum, extending through the urogenital diaphragm.

External urethral sphincter
Surrounds the whole length of the membranous portion of the urethra and is enclosed in the fascia of the urogenital diaphragm.

Periprostatic compartment
Space surrounding the prostate.

Rectoprostatic compartment
Space between the prostate and the rectum.

Rectoprostatic angle

Extraprostatic
Pertaining to an area outside the prostate.

Prostate–seminal vesicle angle
The plane or space between the prostate base and the seminal vesicle, normally filled with fatty tissue and neurovascular bundle of prostate.

STAGING TERMS

Abuts “capsule” of prostate
Tumor touches the “capsule”.

Bulges “capsule” of prostate
Convex contour of the “capsule”.
Bulging prostatic contour over a suspicious lesion: Focal, spiculated (extraprostatic tumor).
Broad-base of contact (at least 25% of tumor contact with the capsule).
Tumor-capsule abutment of greater than 1 cm.
Lenticular tumor at prostate apex extending along the urethra below the apex.

Mass effect on surrounding tissue
Compression of the tissue around the mass, or displacement of adjacent tissues or structures, or obliteration of the tissue planes by an infiltrating mass.
### Invasion

- **Tumor extension across anatomical boundary; may relate to tumor extension within the gland, i.e. across regional parts of the prostate, or outside the gland, across the “capsule” (extracapsular extension of tumor, extraprostatic extension of tumor, extraglandular extension of tumor)**

### Invasion: “Capsule”

- **Extra-capsular extension ECE**
  - Tumor involvement of the “capsule” or extension across the “capsule” with indistinct, blurred or irregular margin

- **Extraprostatic extension EPE**
  - Retraction of the capsule

- **Extraglandular extension**
  - Breach of the capsule
  - Direct tumor extension through the “capsule”
  - Obliteration of the rectoprostatic angle

### Invasion: Pseudocapsule

- Tumor involvement of pseudocapsule with indistinct margin

### Invasion: Anterior fibromuscular stroma

- Tumor involvement of anterior fibromuscular stroma with indistinct margin

### Invasion: Prostate – seminal vesicle angle

- Tumor extends into the space between the prostate base and the seminal vesicle

### Invasion: Seminal vesicle

- **Seminal vesicle invasion SVI**
  - Tumor extension into seminal vesicle
    - There are 3 types:
      1. Tumor extension along the ejaculatory ducts into the seminal vesicle above the base of the prostate; focal T2 hypointense signal within and/or along the seminal vesicle; enlargement and T2 hypointensity within the lumen of seminal vesicle; Restricted diffusion within the lumen of seminal vesicle; Enhancement along or within the lumen of seminal vesicle; Obliteration of the prostate-seminal vesicle angle
      2. Direct extra-glandular tumor extension from the base of the prostate into and around the seminal vesicle
      3. Metachronous tumor deposit – separate focal T2 hypointense signal, enhancing mass in distal seminal vesicle

### Invasion: Neck of urinary bladder

- Tumor extension along the prostatic urethra to involve the bladder neck

### Invasion: Membranous urethra

- Tumor extension along the prostatic urethra to involve the membranous urethra

### Invasion: Periprostatic, extraprostatic

- Tumor extension outside the prostate
| Invasion: Neurovascular bundle of prostate | Tumor extension into the neurovascular bundle of the prostate  
Asymmetry, enlargement or direct tumor involvement of the neurovascular bundles  
Assess the recto-prostatic angles (right and left):  
1. Asymmetry – abnormal one is either obliterated or flattened  
2. Fat in the angle – infiltrated (individual elements cannot be identified or separated); clean (individual elements are visible)  
3. Direct tumor extension |
| Invasion: External urethral sphincter | Tumor extension into the external urethral sphincter  
Loss of the normal low signal of the sphincter, discontinuity of the circular contour of the sphincter |

**MRI CHARACTERISTICS OF ADDITIONAL PATHOLOGIC STATES**

| BPH nodule | A round/oval mass with a well-defined T2 hypointense margin; encapsulated mass or "organized chaos" found in the transition zone or extruded from the transition zone into the peripheral zone |
| Hypertrophy of median lobe of prostate | Increase in the volume of the median lobe of the prostate with mass-effect or protrusion into the bladder and stretching the urethra |
| Cyst | A circumscribed T2 hyperintense fluid containing sac-like structure |
| Hematoma - Hemorrhage | T1 hyperintense collection or focus |
| Calcification | Focus of markedly hypointense signal on all MRI sequences |