DICOM℠
Digital Imaging and Communications in Medicine

Supplement 191: Patient Radiation Dose Reporting (P-RDSR)

Supplement is developed by DICOM Working Group 28 (WG-28-Physics)

Patient Radiation Dose SR (P-RDSR)

- Current Radiation Dose SR contains only information about the x-ray system or information the x-ray system can determine, e.g.:
    - radiation output, geometry, x-ray source, detector system, etc.

- Estimation of patient/organ dose requires knowledge of:
  - Radiation beam characteristics
  - Models of the patient/organs
  - Models of radiation interaction within the patient

- Methods to do patient dose estimations are being developed and improved continuously
  - storage of these estimations in a different object would allow more versatile utilization of the data

Patient Radiation Dose SR (P-RDSR)

- Goals of the Patient Dose SR
  - Store the results of Patient Organ Dose calculations:
    - of a SINGLE procedure or MULTIPLE procedures
    - including one or more modalities and procedure steps/phases
    - of one or more organs
    - by one or more calculation methods
  - Exchange intermediate results with peers

- Examples of modalities and procedures:

Single modality, single procedure step

- **CT**
  - internal organ dose
  - eye dose
- **XA/RF** (one time point)
  - skin dose map
  - internal organ dose
- **Mammography**
  - glandular dose
- **Projection x-ray (CR/DX)**
  - entrance skin dose
  - internal organ dose
- **NM/PET**
  - internal organ dose

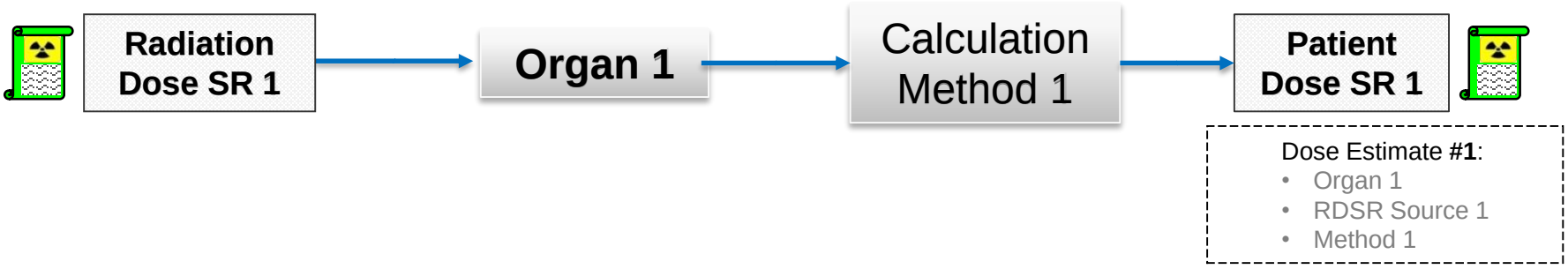
Multi-modality, single procedure step

- **SPECT** and **PET/CT**
  - internal organ dose

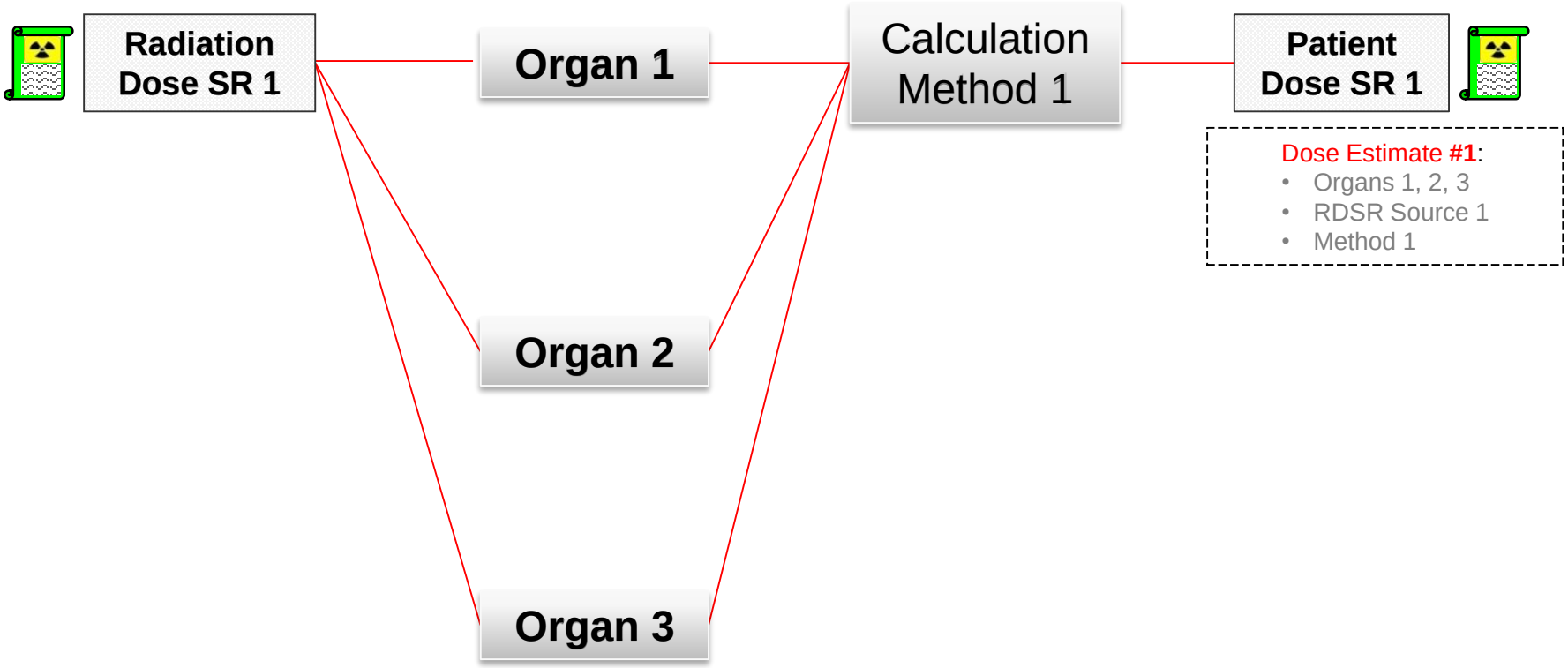
Single modality, multi-procedure step

- **CT**
  - internal organ dose
  - eye dose
- **XA/RF** (multi time points being combined)
  - skin dose map
- **XA** localization / disgnostic plus intervention
  - skin dose map
  - internal organ dose
- **Mammography/Projection X-ray**
  - Tomosynthesis

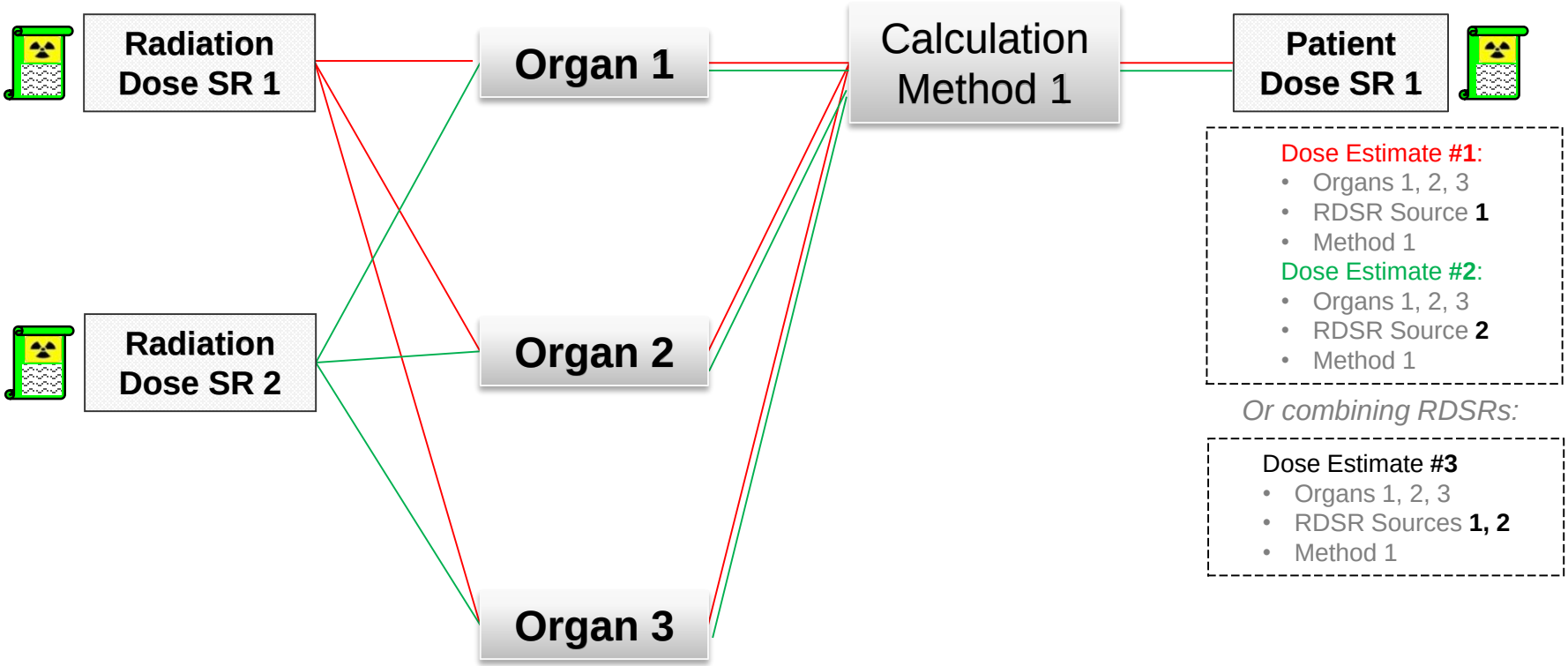
Data flow – simple case



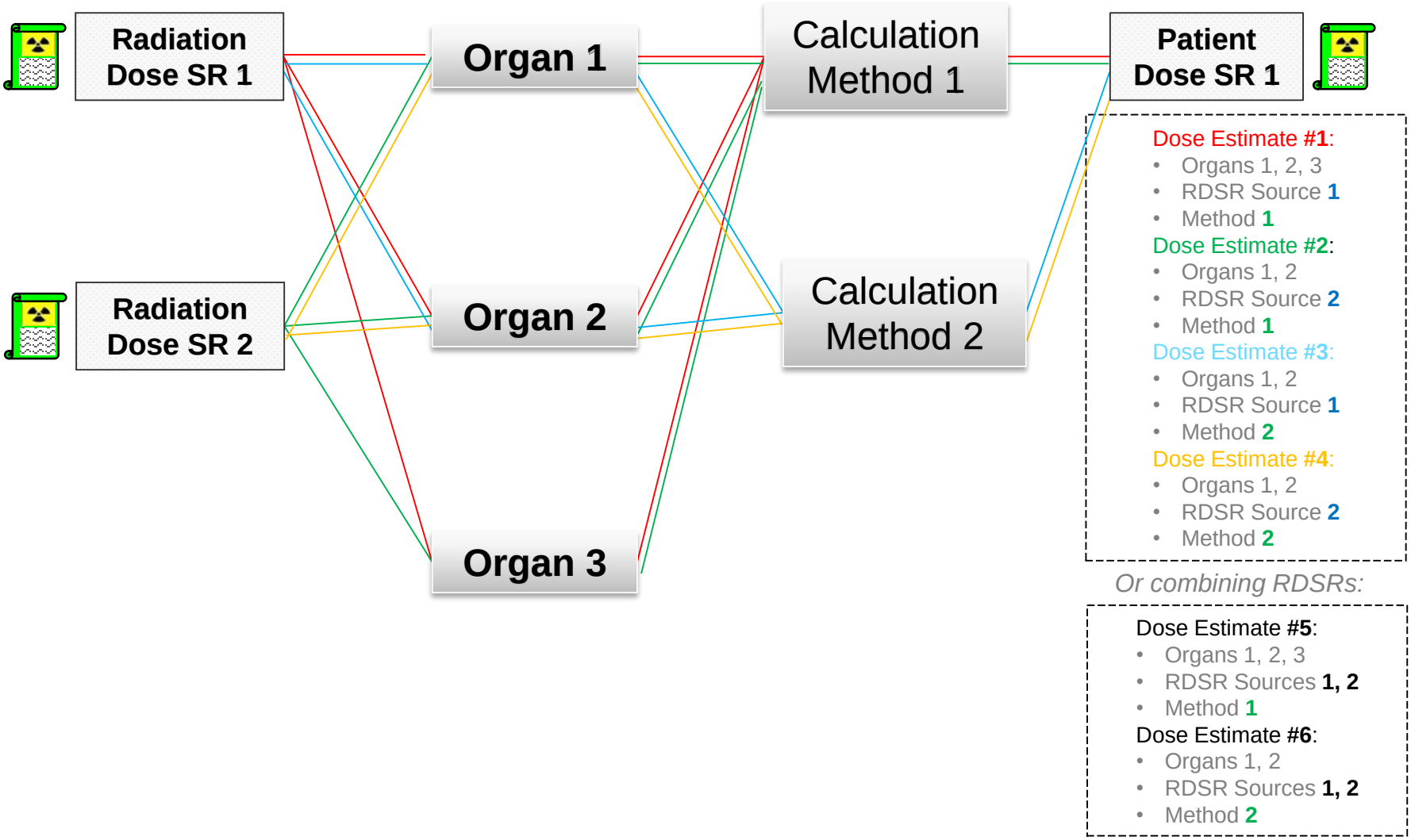
One RDSR, multiple organs



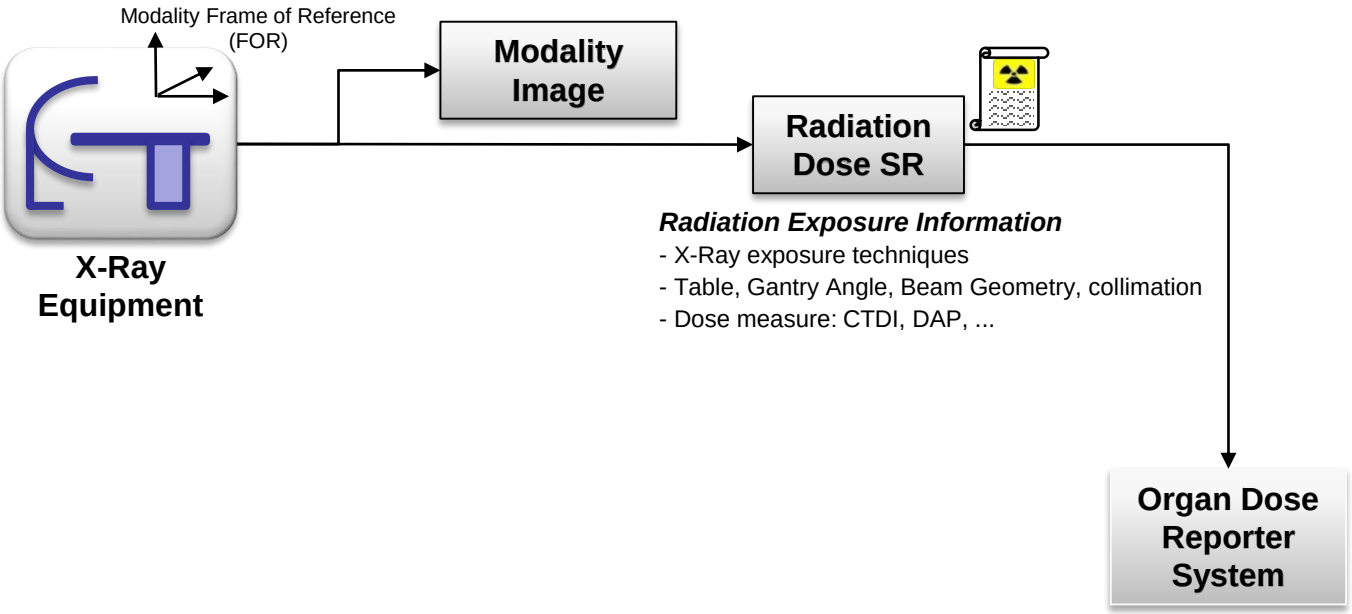
Multiple RDSRs, multiple organs



Multiple RDSRs, multiple organs, multiple methods

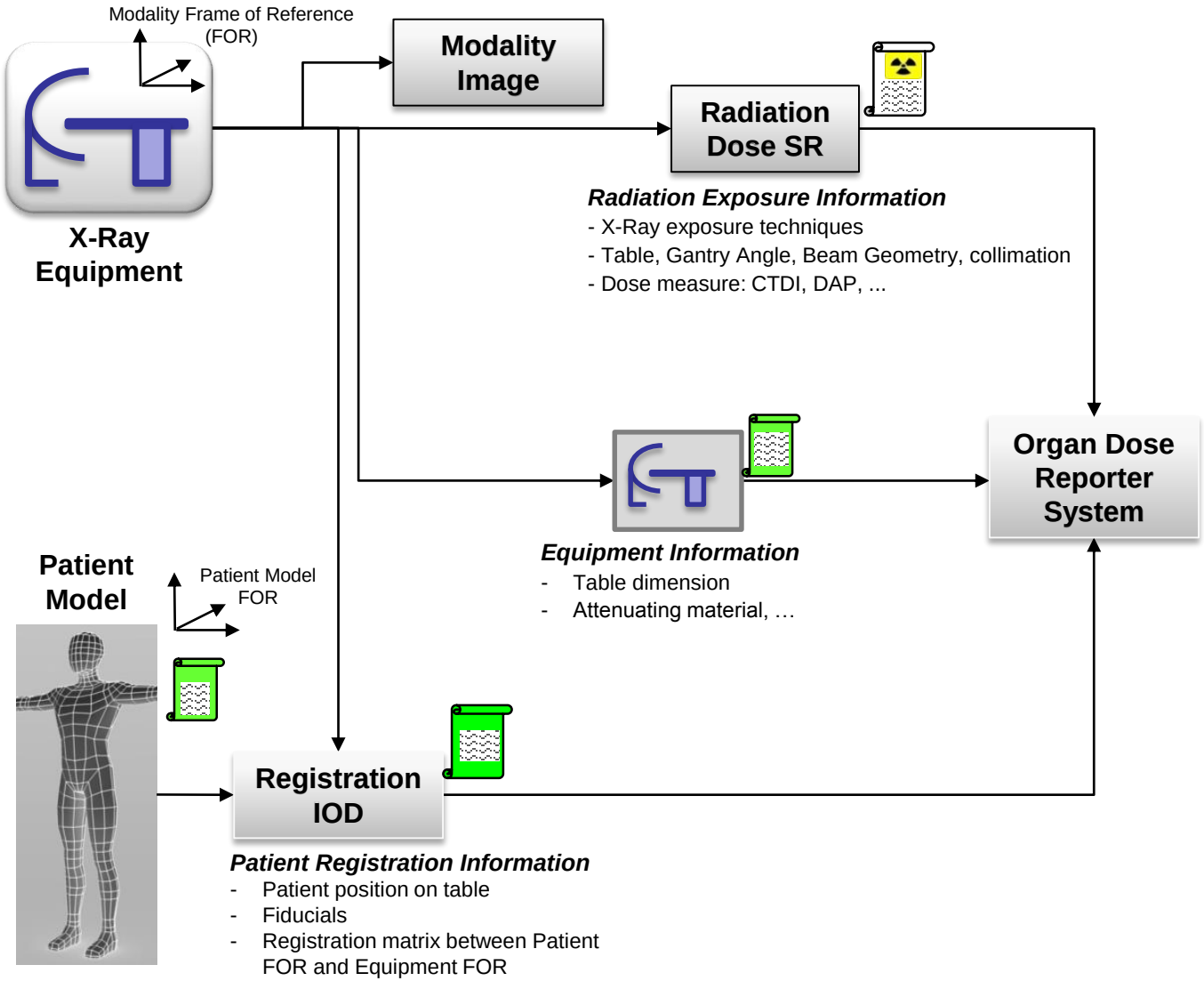


Patient Dose Determination: Data Flow Requirements

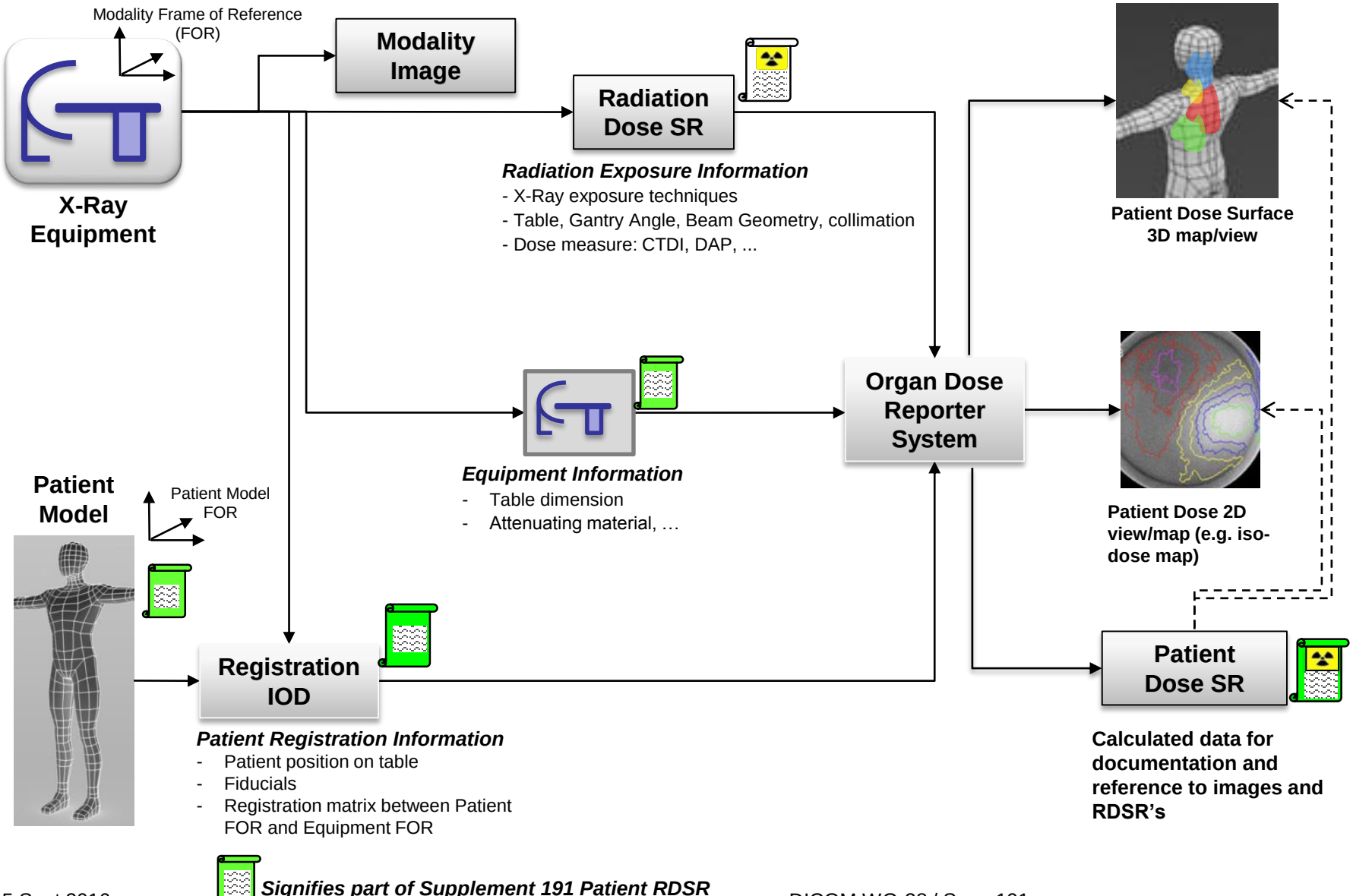


Signifies part of Supplement 191 Patient RDSR

Patient Dose Determination: Data Flow Requirements



Patient Dose Determination: Data Flow Requirements

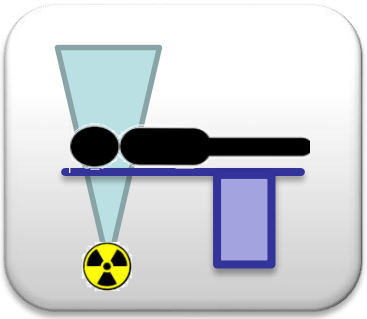


Registration between Patient Model and RDSR

Case #1

Patient Images FOR

X-Ray Images



X-Ray Equipment

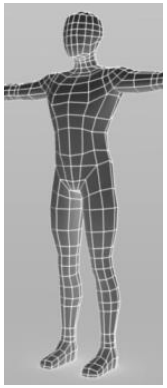
Radiation Dose SR (RDSR)

- Table, position
- Gantry Angle
- Beam Geometry, collimation

Registration

$$\begin{bmatrix} {}^{A}x \\ {}^{A}y \\ {}^{A}z \\ 1 \end{bmatrix} = \begin{bmatrix} M_{11} & M_{12} & M_{13} & T_x \\ M_{21} & M_{22} & M_{23} & T_y \\ M_{31} & M_{32} & M_{33} & T_z \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} {}^{B}x \\ {}^{B}y \\ {}^{B}z \\ 1 \end{bmatrix}$$

Registration matrix between:
- each RDSR FOR and
- the Patient Model FOR

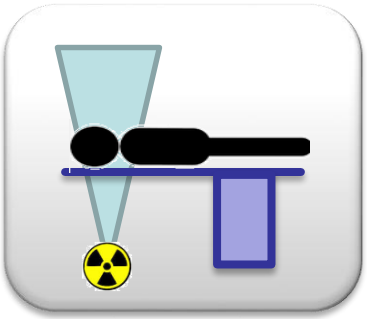


Patient Model FOR

Patient Model (3D image)

Registration between Patient Model and RDSR

Case #2



X-Ray Equipment

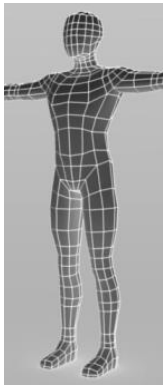
FOR

TABLE TOP HEAD

Equipment Fiducials

Radiation Dose SR (RDSR)

- Table position vs. Isocenter
- Gantry Angle vs. Isocenter
- Beam Geometry, collimation



Patient Model FOR

Patient Model (3D image)

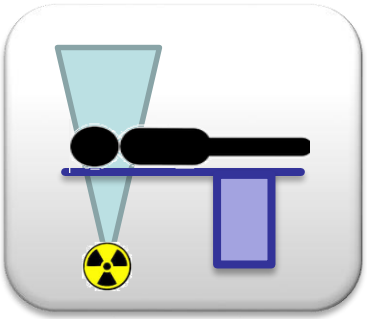
Registration

$$\begin{bmatrix} {}^{A}x \\ {}^{A}y \\ {}^{A}z \\ 1 \end{bmatrix} = \begin{bmatrix} M_{11} & M_{12} & M_{13} & T_x \\ M_{21} & M_{22} & M_{23} & T_y \\ M_{31} & M_{32} & M_{33} & T_z \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} {}^{B}x \\ {}^{B}y \\ {}^{B}z \\ 1 \end{bmatrix}$$

Registration matrix between:
- each RDSR **Fiducial** FOR and
- the Patient Model FOR

Registration between Patient Model and RDSR

Case #3



X-Ray Equipment

FOR

TABLE TOP HEAD

Equipment Fiducials

Radiation Dose SR (RDSR)

- Table position vs. Isocenter
- Gantry Angle vs. Isocenter
- Beam Geometry, collimation

Registration

$$\begin{bmatrix} {}^{A}x \\ {}^{A}y \\ {}^{A}z \\ 1 \end{bmatrix} = \begin{bmatrix} M_{11} & M_{12} & M_{13} & T_x \\ M_{21} & M_{22} & M_{23} & T_y \\ M_{31} & M_{32} & M_{33} & T_z \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} {}^{B}x \\ {}^{B}y \\ {}^{B}z \\ 1 \end{bmatrix}$$

Registration matrix between:
- each RDSR **Fiducial** FOR and
- the Patient **Fiducial** FOR

FOR

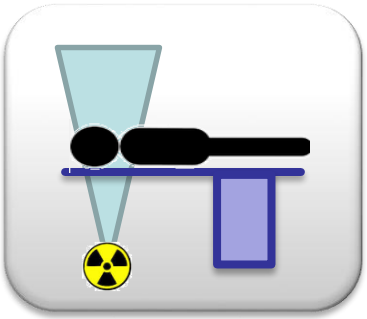
PATIENT TOP HEAD

Patient Fiducials

Note: the patient fiducials can be defined through a manual measurent on the actual patient landmarks, or through image-based measurements of landmarks visible on the X-Ray images.

Registration between Patient Model and RDSR

Case #4



X-Ray Equipment

No X-Ray Images
No Equipment Fiducials

Radiation Dose SR (RDSR)

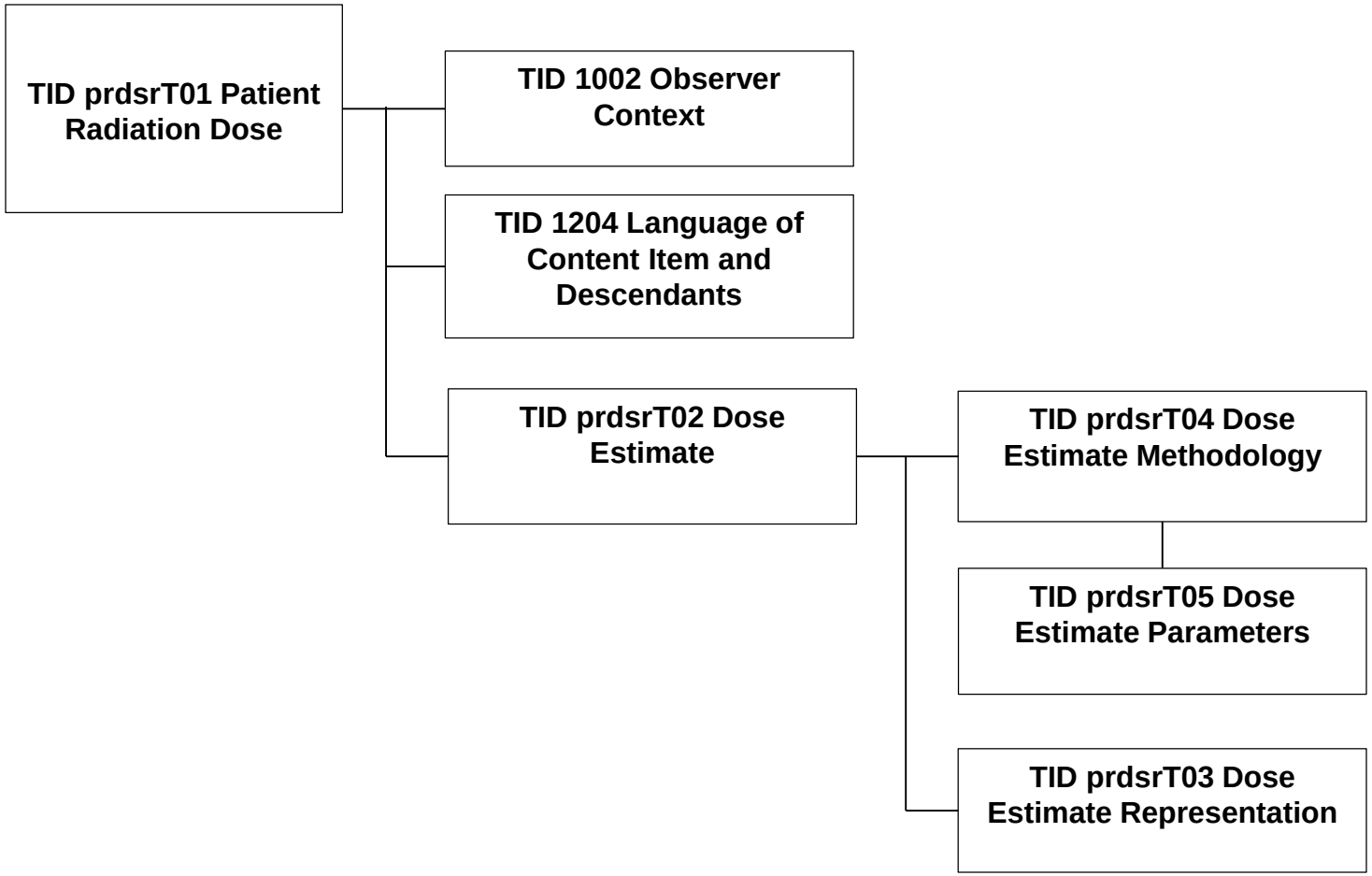
- Table position vs. Isocenter
- Gantry Angle vs. Isocenter
- Beam Geometry, collimation

Registration

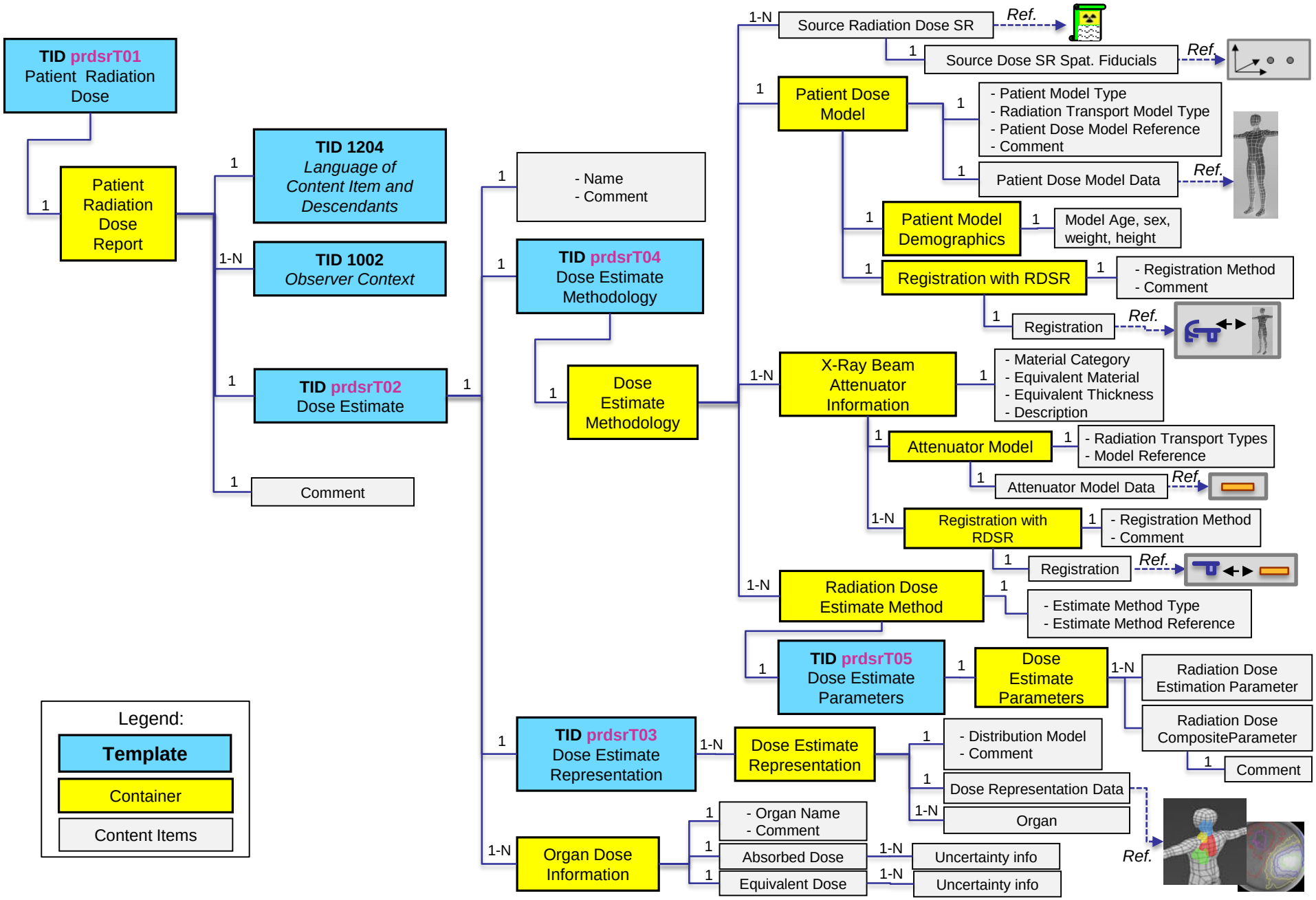
Free Text Comment:
E.g. "**Distance from Patient Head to Table Top Head is 15 cm**"

No Patient Model

Patient Dose SR IOD Templates



Patient Radiation Dose SR: Detailed Structured Content



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Thank you for your attention!