Shareable Clinical Pathways in Radiation Oncology Using BPMN and DMN

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Radiation Therapy

https://www.varian.com/oncology/products/treatment-delivery/truebeam-radiotherapy-system

https://www.elekta.com/radiotherapy/treatment-delivery-systems/versa-hd/

Cancer Diagnosis

Radiation Therapy Indicated

Radiation Course

    1..N CT/PET/MRI Simulations

    1..M Treatment Plans Created

       Plan Check/Verification

    1..Y Radiation Treatments

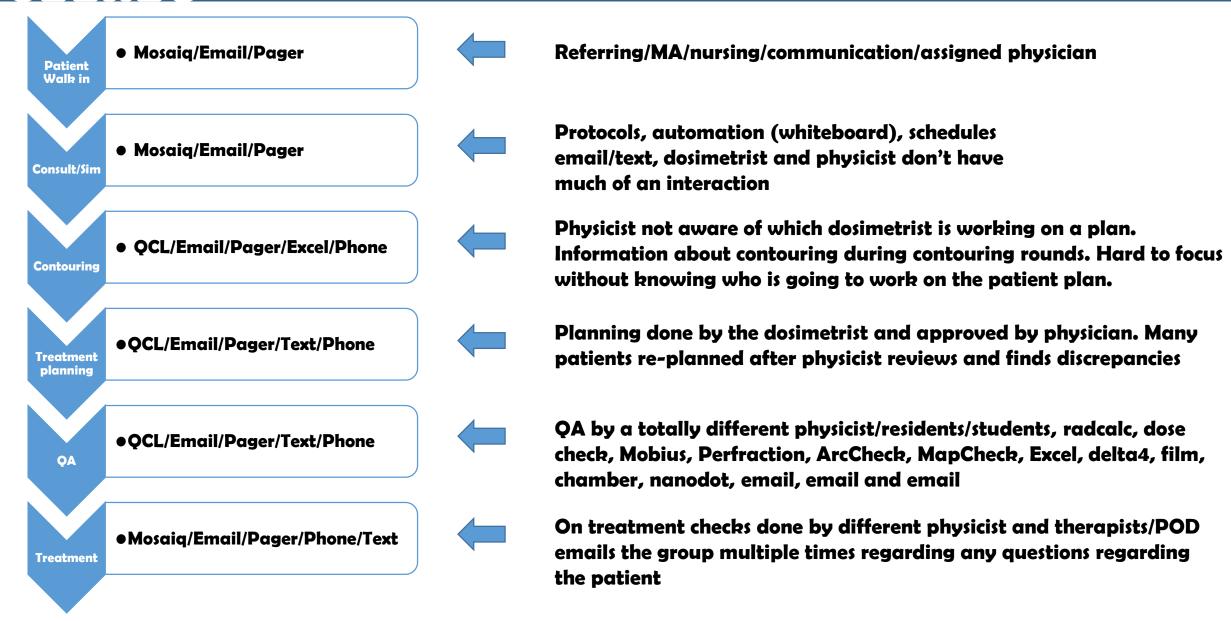**Care Team:** **Radiation Oncologists, Nurses, Medical Physicists, Medical Dosimetrists, Radiation Therapists, Managers, IT**

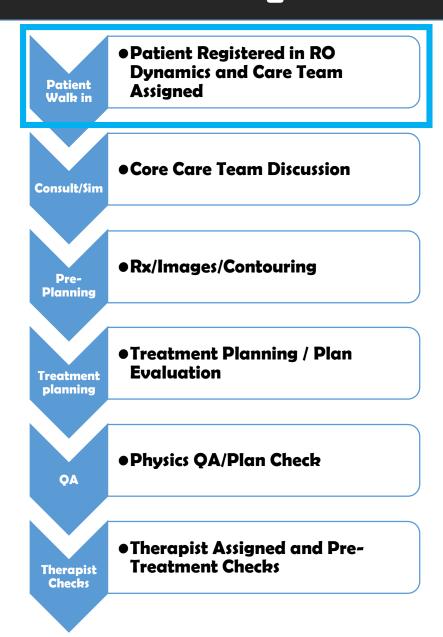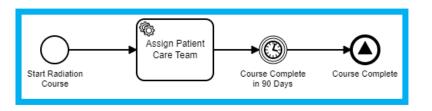**Highly Complex, Technical Treatment with Diverse Care T**

OHSU Current Workflow in Clinic

QUANTEK Systems

Stage	Tools	Notes
Patient Walk in	• Mosaiq/Email/Pager	Referring/MA/nursing/communication/assigned physician
Consult/Sim	• Mosaiq/Email/Pager	Protocols, automation (whiteboard), schedules email/text, dosimetrist and physicist don't have much of an interaction
Contouring	• QCL/Email/Pager/Excel/Phone	Physicist not aware of which dosimetrist is working on a plan. Information about contouring during contouring rounds. Hard to focus without knowing who is going to work on the patient plan.
Treatment planning	•QCL/Email/Pager/Text/Phone	Planning done by the dosimetrist and approved by physician. Many patients re-planned after physicist reviews and finds discrepancies
QA	•QCL/Email/Pager/Text/Phone	QA by a totally different physicist/residents/students, radcalc, dose check, Mobius, Perfraction, ArcCheck, MapCheck, Excel, delta4, film, chamber, nanodot, email, email and email
Treatment	•Mosaiq/Email/Pager/Phone/Text	On treatment checks done by different physicist and therapists/POD emails the group multiple times regarding any questions regarding the patient

OHSU Proposed Workflow

QUANTEK Systems

BPMN Workflows

Left workflow (vertical arrows):

- Patient Walk in
  - • Patient Registered in RO Dynamics and Care Team Assigned
- Consult/Sim
  - • Core Care Team Discussion
- Pre-Planning
  - • Rx/Images/Contouring
- Treatment planning
  - • Treatment Planning / Plan Evaluation
- QA
  - • Physics QA/Plan Check
- Therapist Checks
  - • Therapist Assigned and Pre-Treatment Checks

BPMN diagrams (right):

Start Radiation Course → Assign Patient Care Team → Course Complete in 90 Days → Course Complete

Simulation: Start Simulation → Simulation → Simulation Complete

Radiation Plan & Treatment: Start Plan and Treatment Message → Plan and Treatment → Plan and Treatment Complete

OHSU Proposed Workflow

Patient Walk in
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Consult/Sim
- Core Care Team Discussion

Pre-Planning
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OHSU Proposed Workflow

BPMN Workflows

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OHSU Proposed Workflow

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- Physics QA/Plan Check

Treatment
- Therapist Assigned and Pre-Treatment Checks

Treatment Planning Call Activity Example

QUANTEK Systems

Cardiac Implantable Electronic Device

AAPM TG-203 Report: Management of radiotherapy patients with implanted cardiac pacemakers and defibrillators

"Managing radiotherapy patients with implanted cardiac devices (implantable cardiac pacemakers and implantable cardioverter-defibrillators) has been a great practical and procedural challenge in radiation oncology practice."

Patient	Dose region and risk category			
	<2 Gy	2–5 Gy	>5 Gy	Neutrons present
Pacing independent	Low risk	Medium risk	High risk	High risk
Pacing dependent	Medium risk	Medium risk	High risk	High risk

CIED Workflow in BPMN/DMN

Patient with CIED and indicated Radiotherapy

- Inform treating cardiologist and inform patient
- Determine patients' pacing-dependency
- Inform if anti-tachycardia therapy can be switched off by magnet when ICD.

- Estimate dose on CIED
  - More than 10 cm from treatment field edge – dose probably <2 Gy
  - Less than 10 cm from field edge – measure to confirm dose
  - Within 3 cm from field edge – can rely on TPS calculation
- Minimize dose to CIED with treatment plan optimization

DOSE 0-5 Gy
No neutrons

DOSE > 5 Gy OR
Neutron producing therapy

- Pacing-independent patient **and**
- Dose on CIED < 2 Gy

NO

YES

LOW-RISK
- Resuscitation protocol.
- Pacemaker magnet, pulse oximetry, and AED available at treatment unit.
- Close monitoring of the CIED patient with an audio-visual system during treatment.
- Communication with cardiology/electrophysiology.
- ICD patients: consult with cardiology/electrophysiology on setting program tachycardia OFF or the use of magnet.
- CIED interrogation before 1st fraction and after last fraction.

MEDIUM-RISK
Low-Risk **AND**:
- Formal consultation with cardiology/electrophysiology
- Pacing-dependent: consult with cardiology/electrophysiology on the use of magnet and pulse oximetry.
- Appropriate cardiac support available to manage complications from potential CIED malfunctions.
- CIED technologist to interrogate the device at mid-treatment.

HIGH-RISK
Medium-Risk **AND**:
- ECG weekly monitoring.
- Trained staff examines ECG.
- Cardiologist/pacemaker technologist should be available, if needed.
- CIED technologist to interrogate the device weekly once the device receives > 5 Gy.

- CIED evaluated by cardiology/electrophysiology following treatment (at 1 and 6 months).

When the tumor is within this zone, the CIED dose could be:

>5Gy

2-5Gy

<2Gy

New CIED Evaluation

CIED Workflow in BPMN/DMN

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CIED Workflow in BPMN/DMN

CIED Planning Evaluation

Systems
QUANTEK

CIED Planning Evaluation

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What is the Estimated Dose to the CIED?

CIEDEstimatedDose

U	Input +		Output +	
	CIED Distance to Field Edge (cm) `CIEDDistance`	TPS Estimated Dose (cGy) `CIEDTPSDose`	CIED Estimated Dose (cGy)	CIED Measurement Required
	integer	integer	integer	boolean
1	>=10	-	199	false
2	(3..10)	-	CIEDTPSDose	true
3	<=3	-	CIEDTPSDose	false

What is the Patient CIED Risk Level?

PatientCIEDRisk

F	Input +			Output +
	CIED Estimated Dose (cGy)	Neutron Producing Therapy	Pacing Independent	Risk
	long	boolean	boolean	string
1	<200	false	true	"LOW"
2	(200..500)	false	-	"MEDIUM"
3	>500	-	-	"HIGH"
4	-	true	-	"HIGH"

CIED Planning Evaluation

Live Demo

Systems
QUANTEK

Customizable, Shareable Clinical Pathways with BPMN/DMN Now Possible in Radiation Oncology

Questions?

Contact

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