

# **Design and implementation of a prototype radiotherapy menu in a patient portal to reduce patient anxiety**

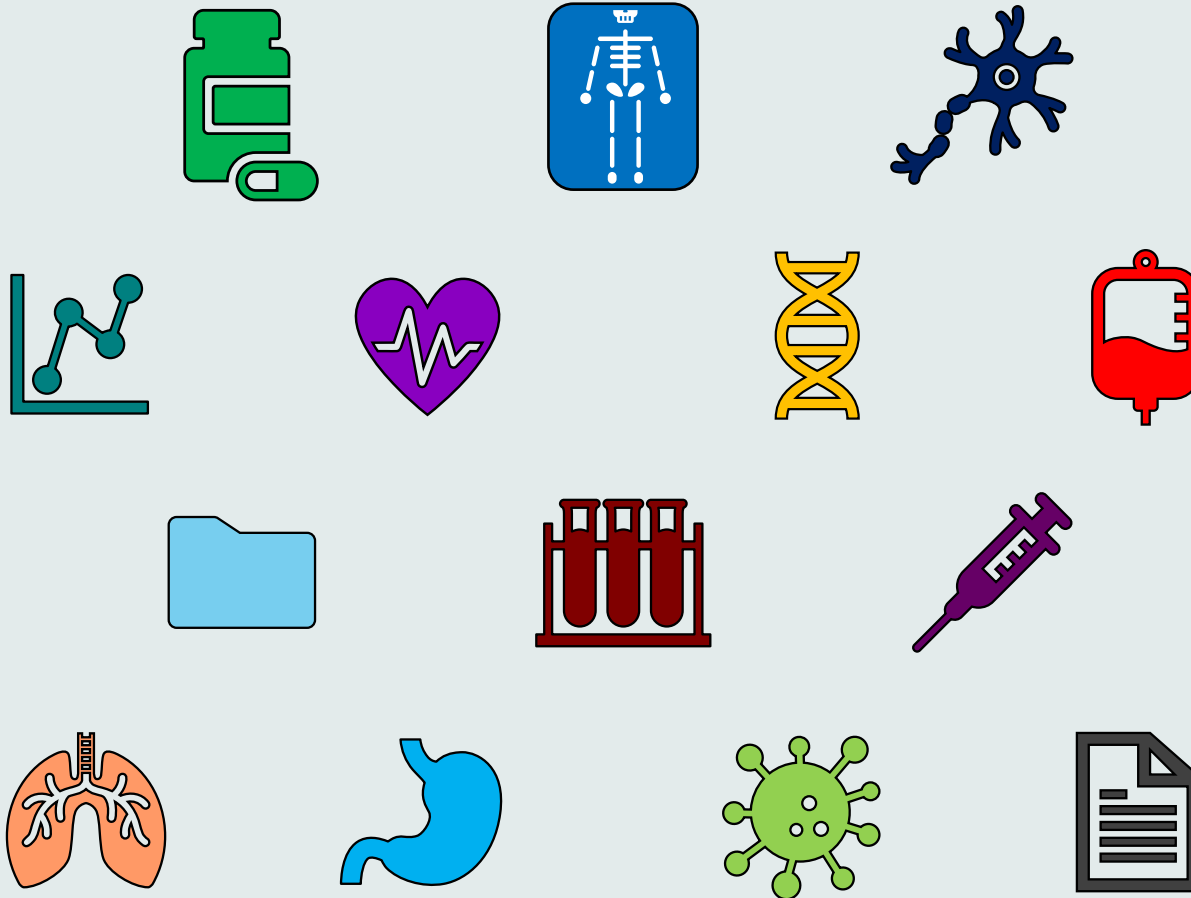
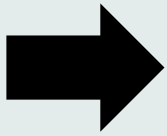
**Presenter:** Kayla O'Sullivan-Steben

**Co-Authors:** L. Galarneau, S. Judd, A. Laizner,  
T. Williams, J. Kildea

# Healthcare Data



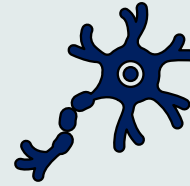
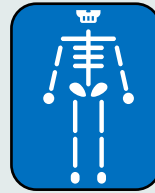
Patients



# Healthcare Data



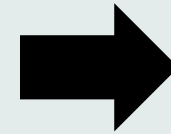
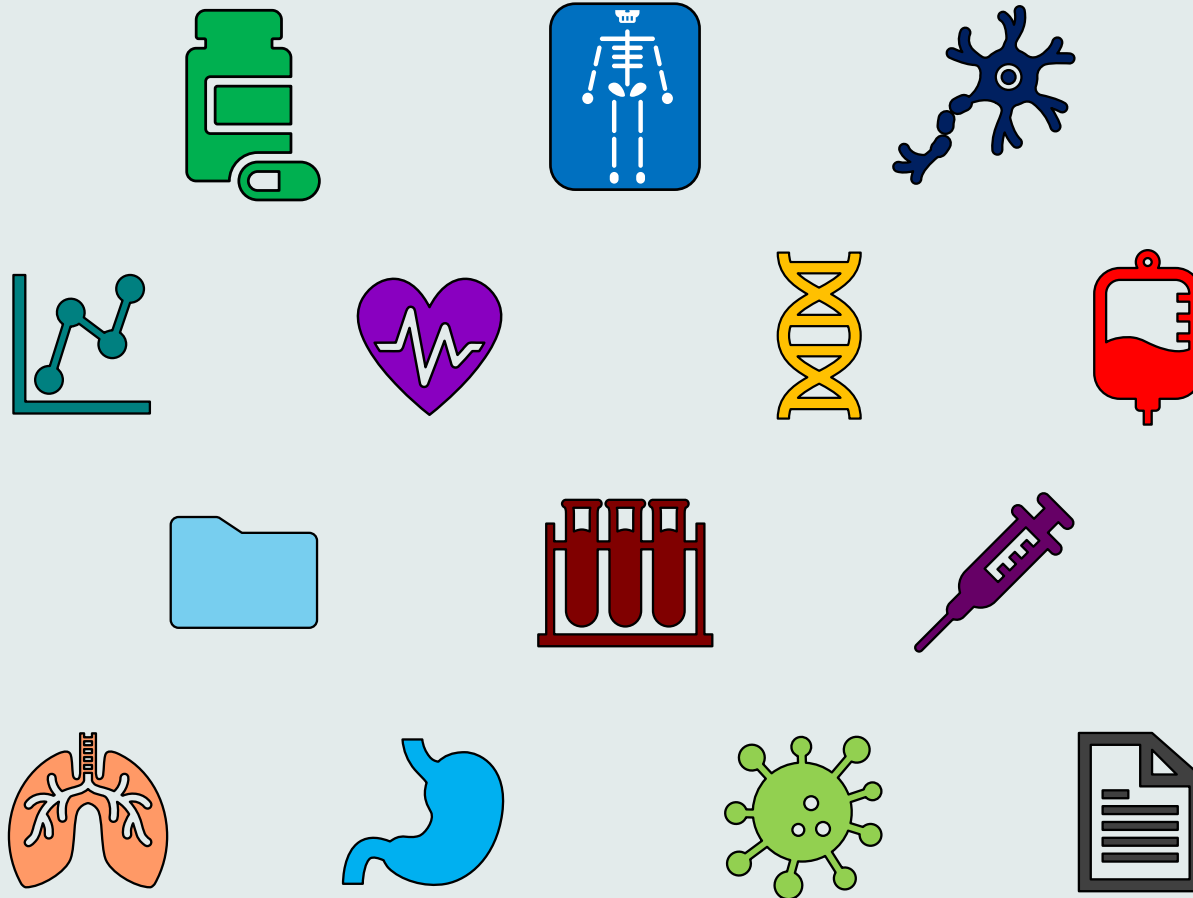
Patients



# Healthcare Data



Patients

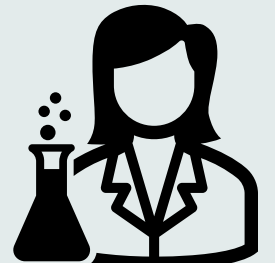
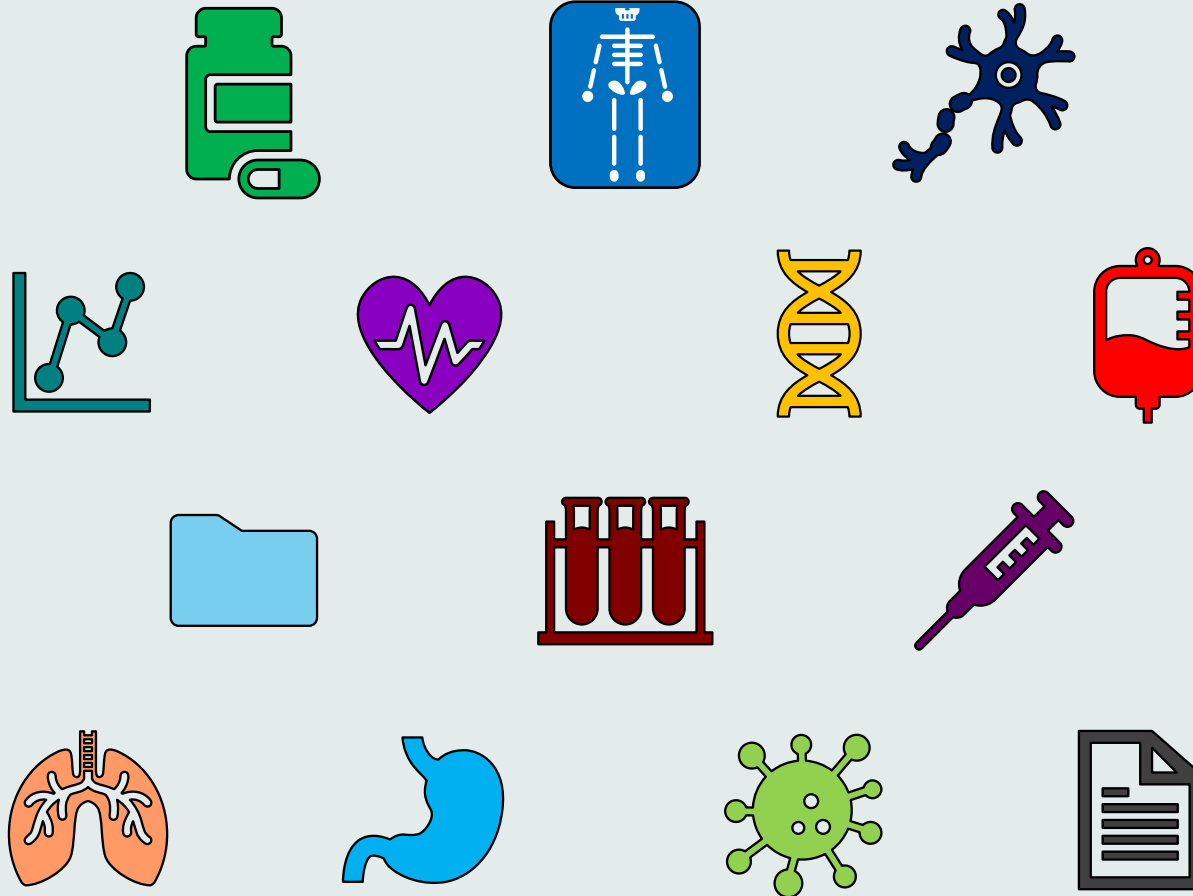


Researchers

# Healthcare Data



Patients

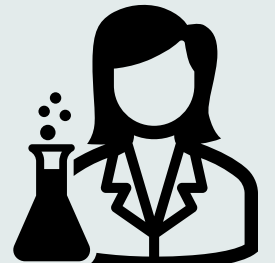
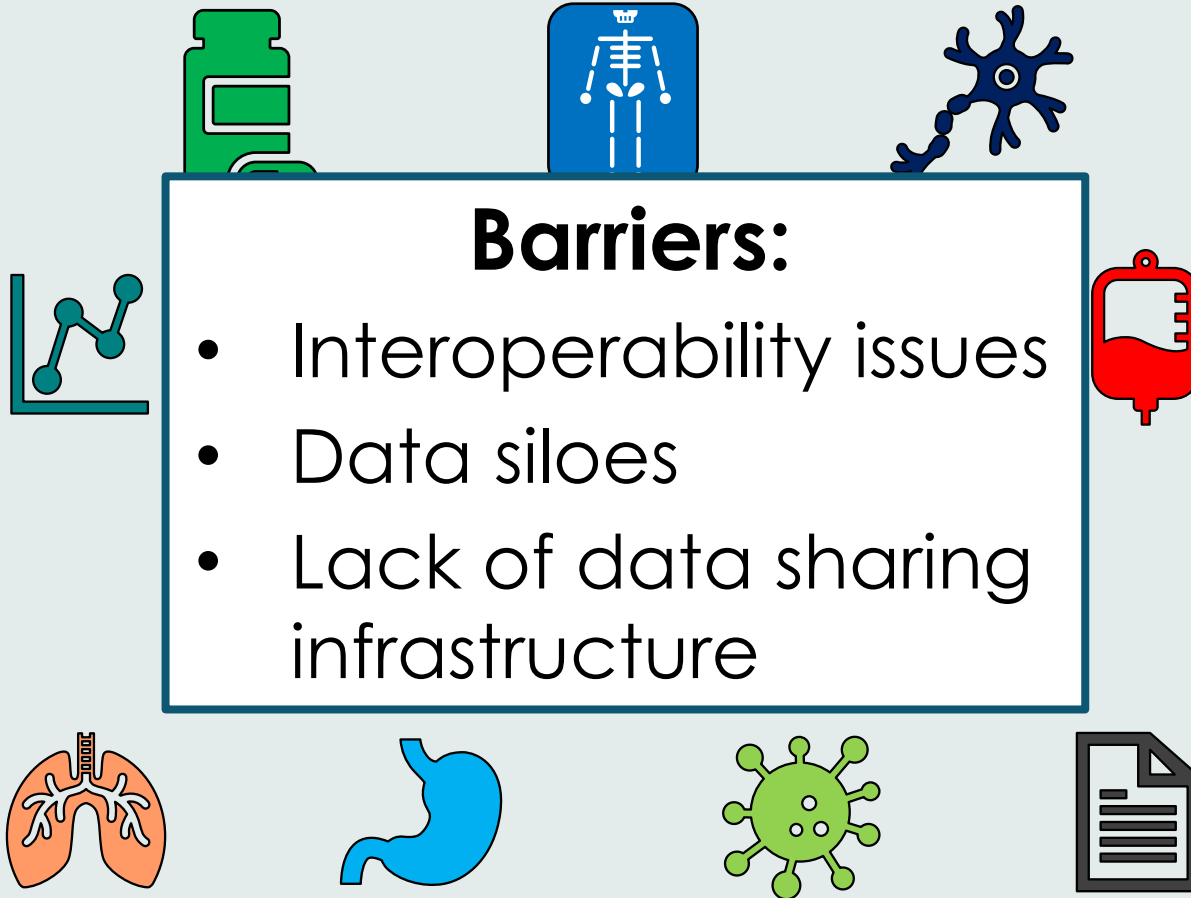


Researchers

# Healthcare Data



Patients



Researchers

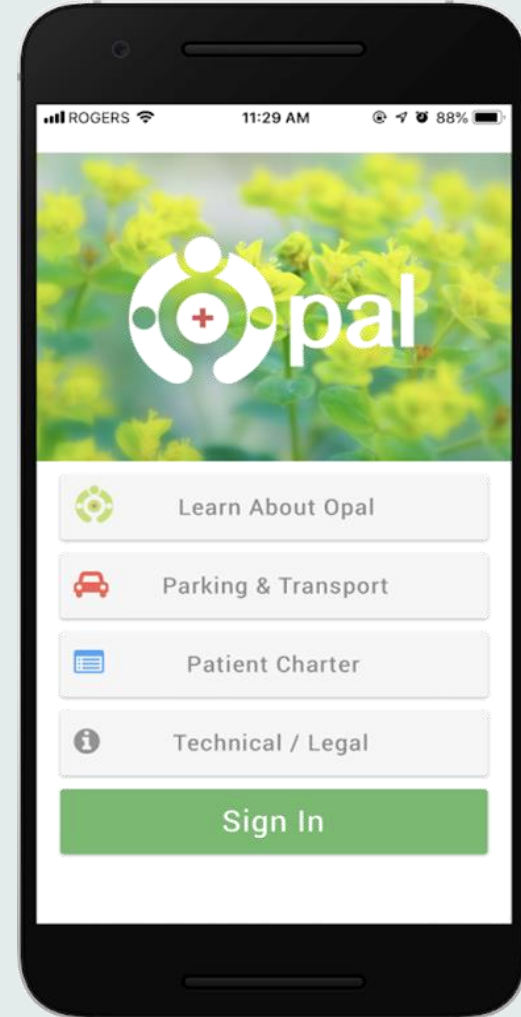
## **Vision:**

Empower patients  
with access to and  
control over their  
health data



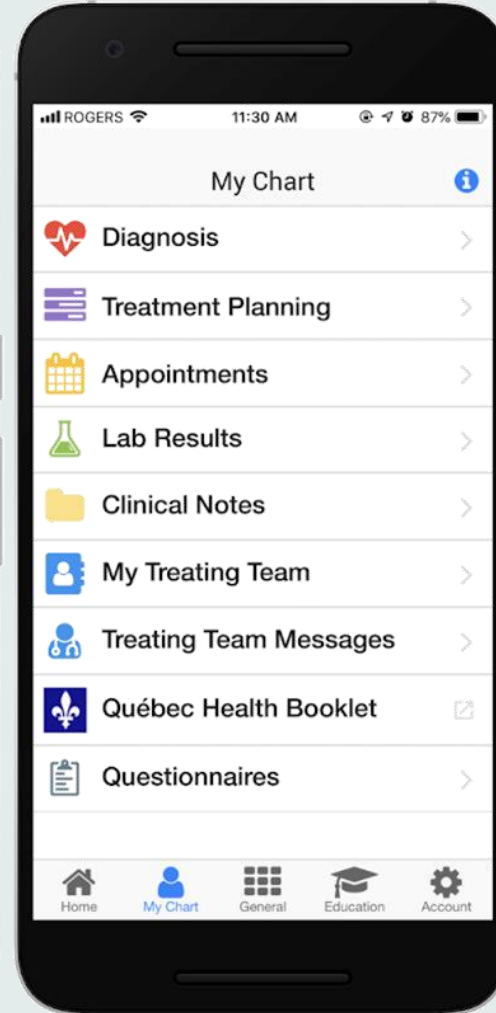
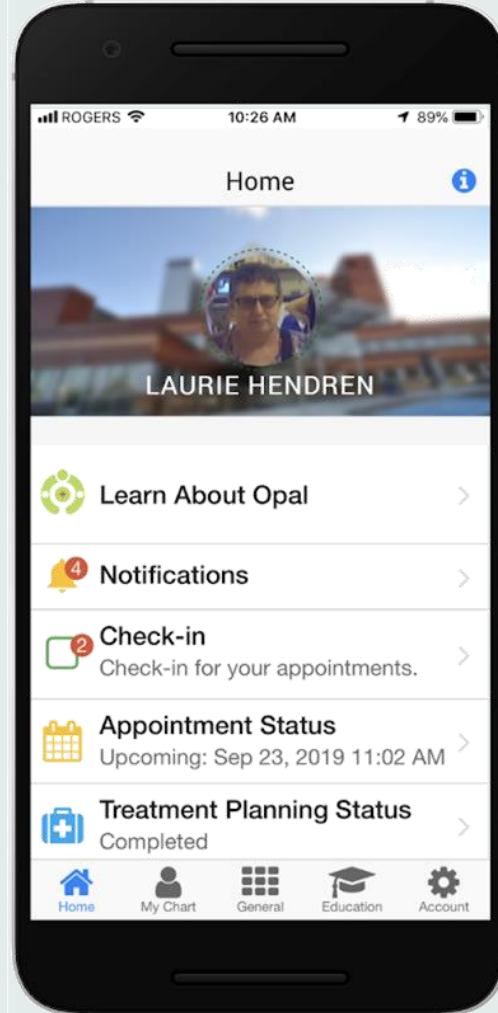
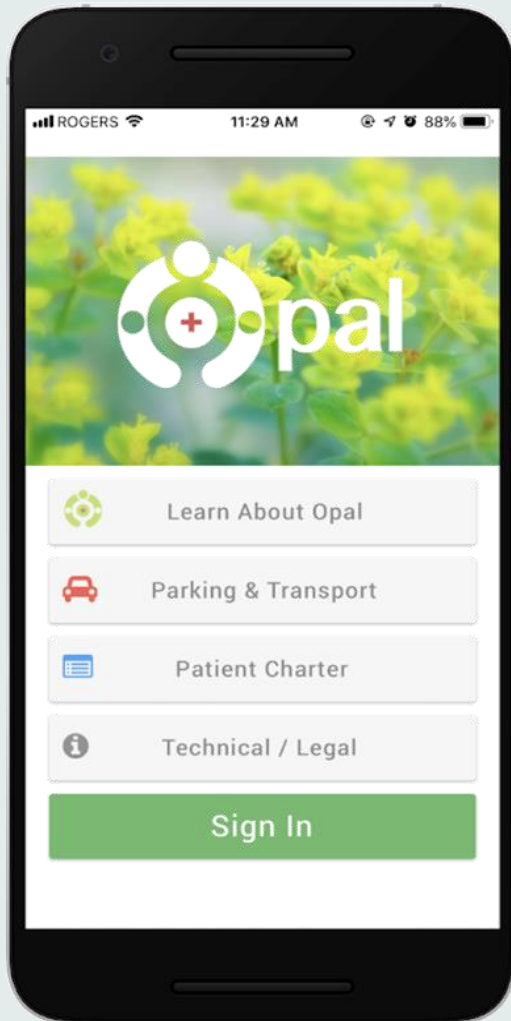
## **Vision:**

Empower patients  
with access to and  
control over their  
health data

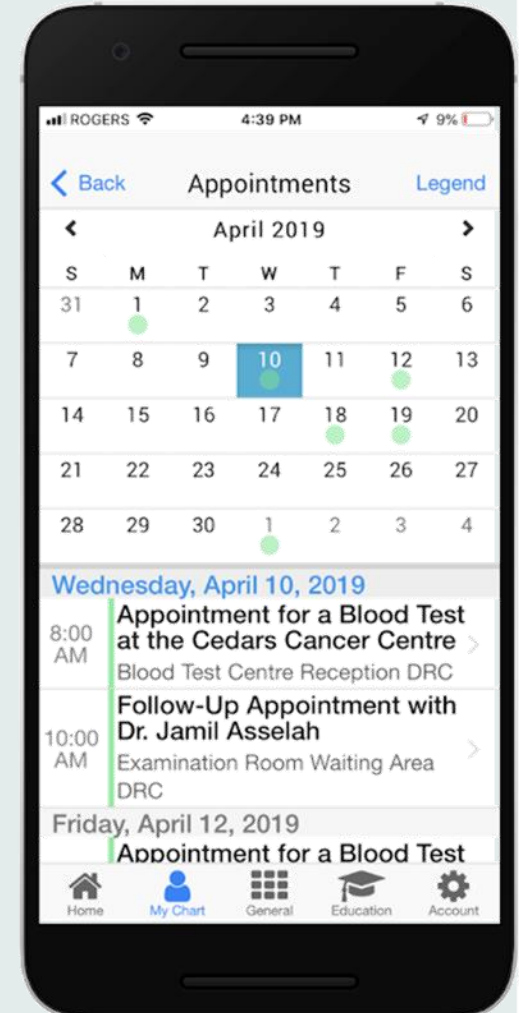
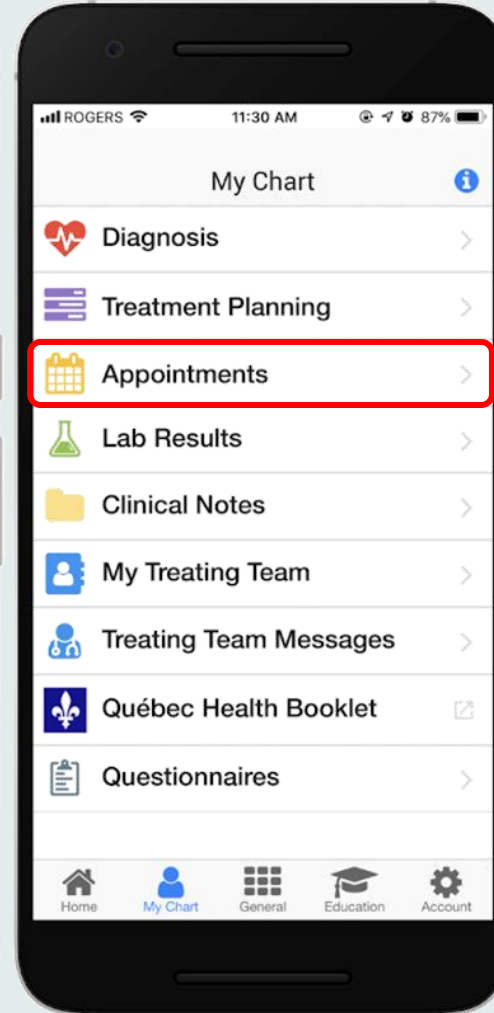
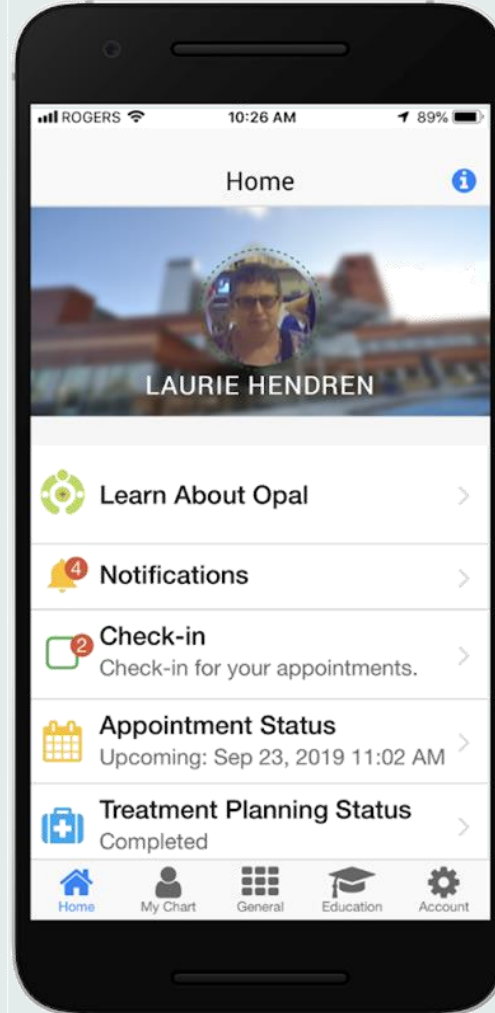
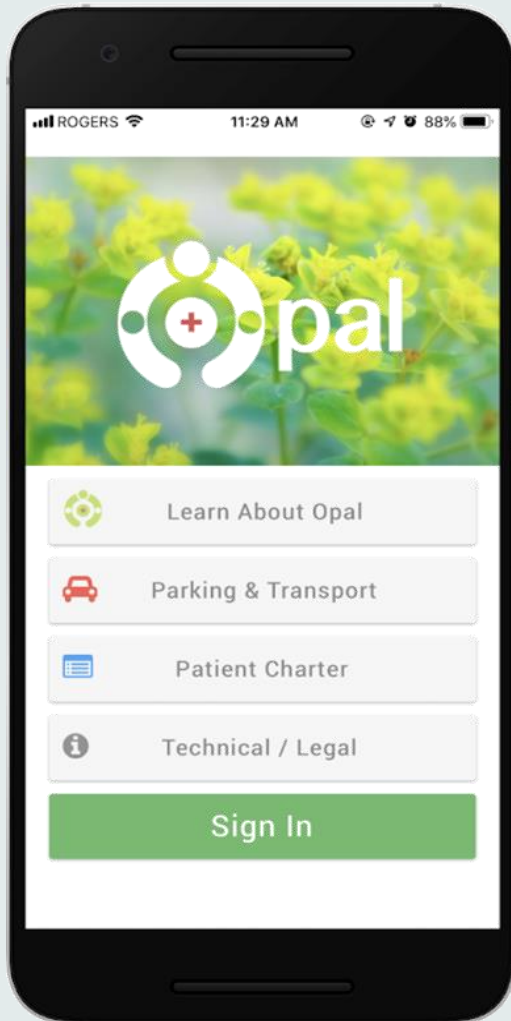




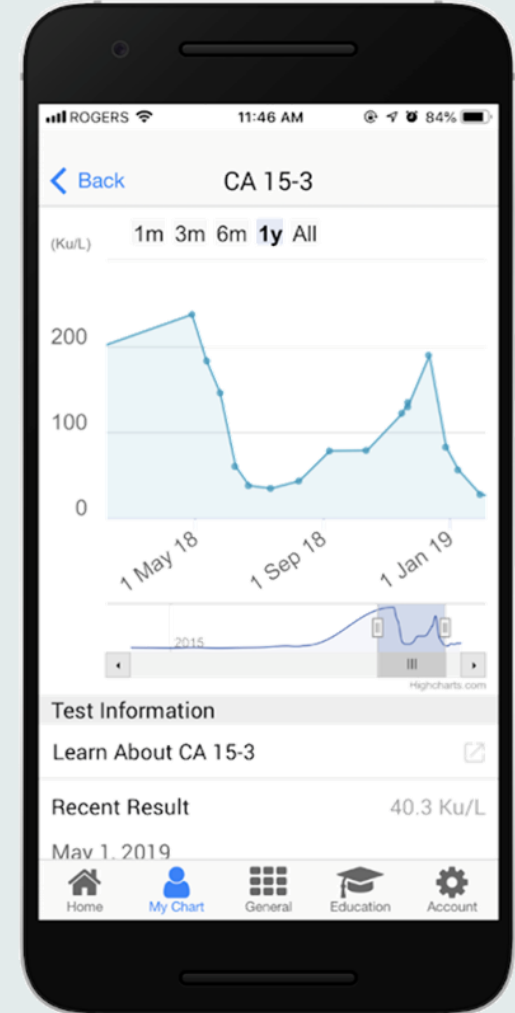
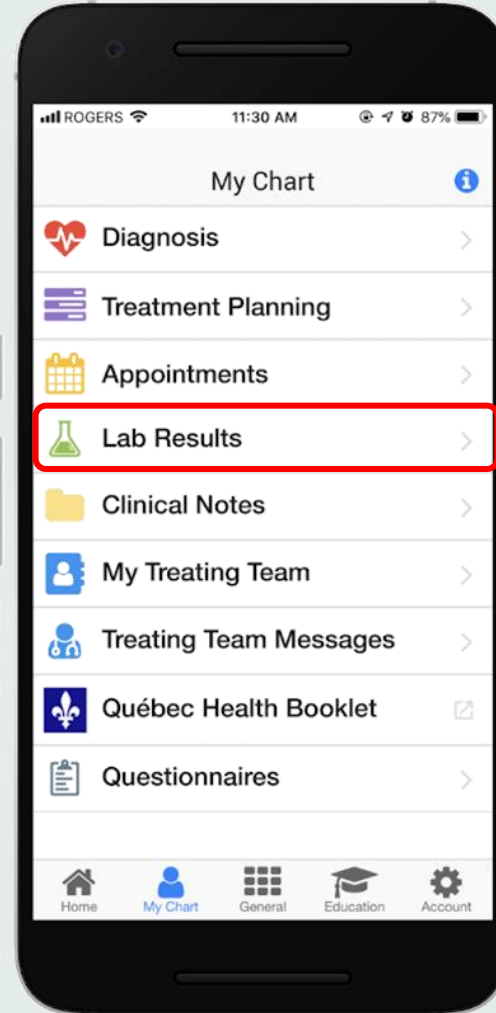
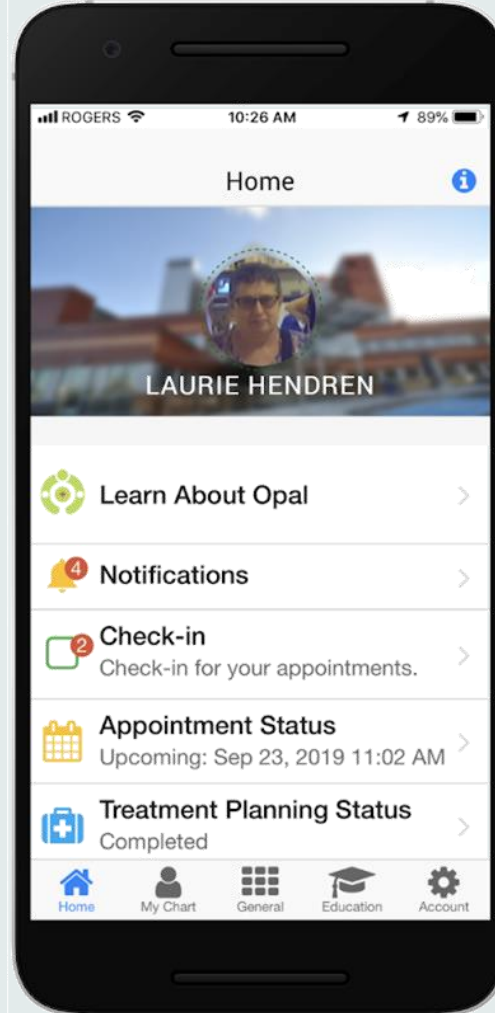
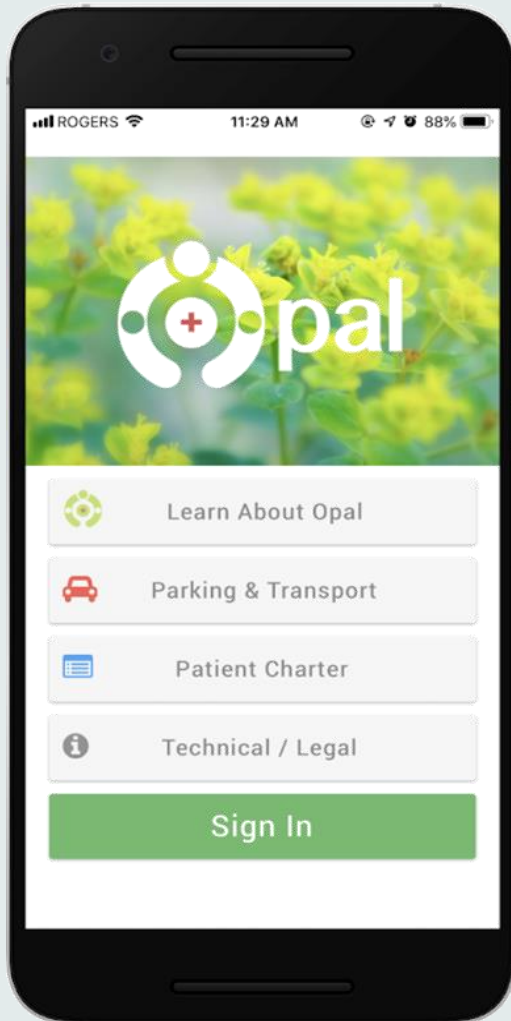
# Opal



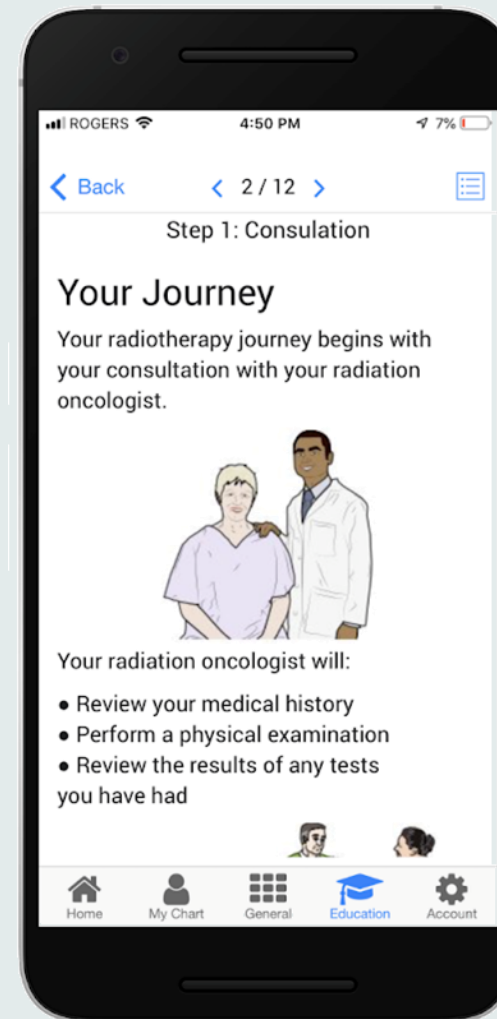
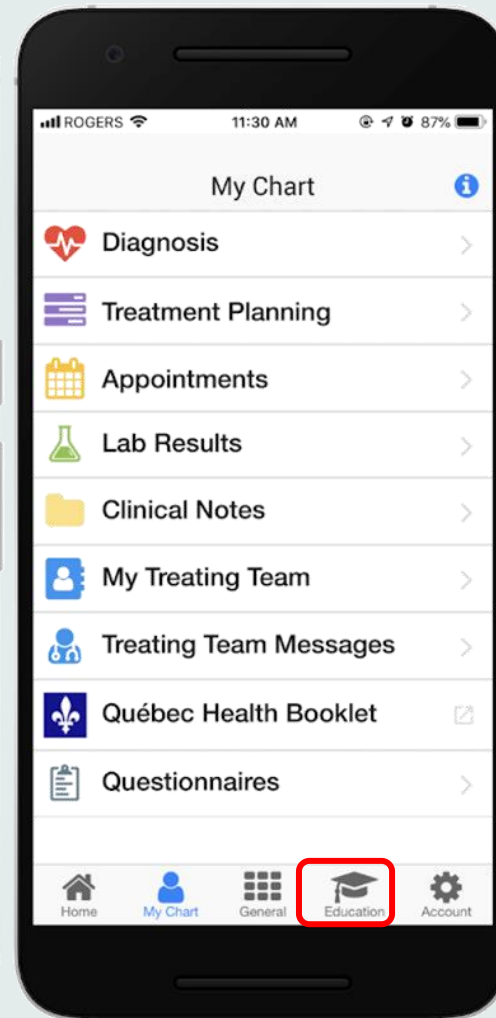
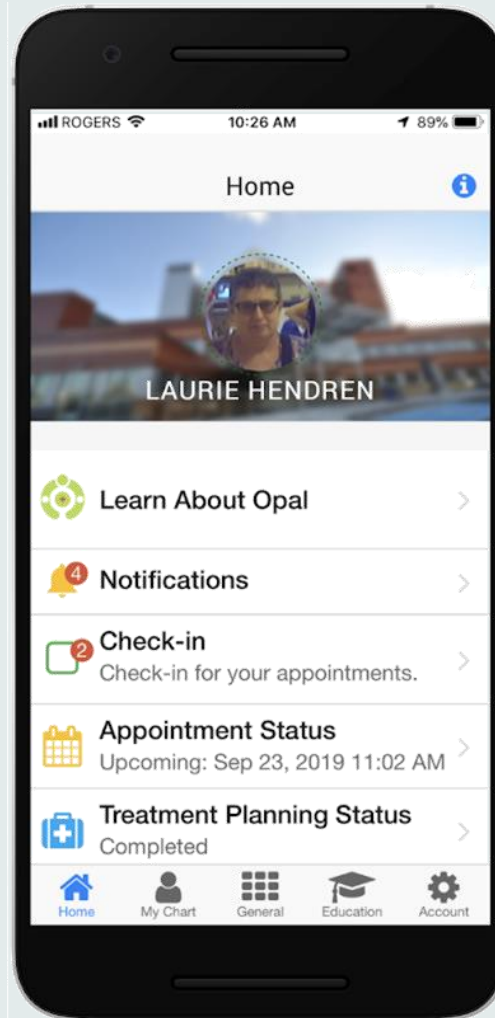
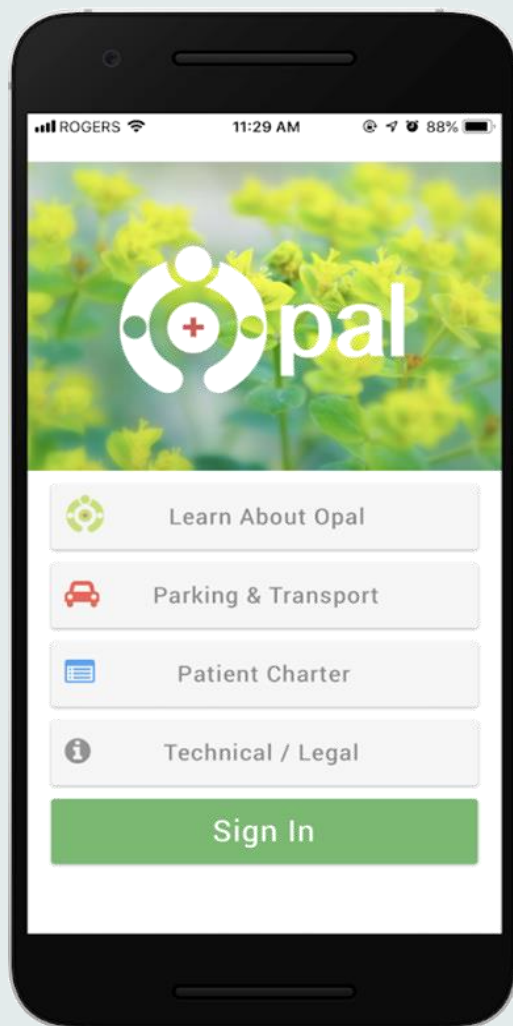
# Opal



# Opal



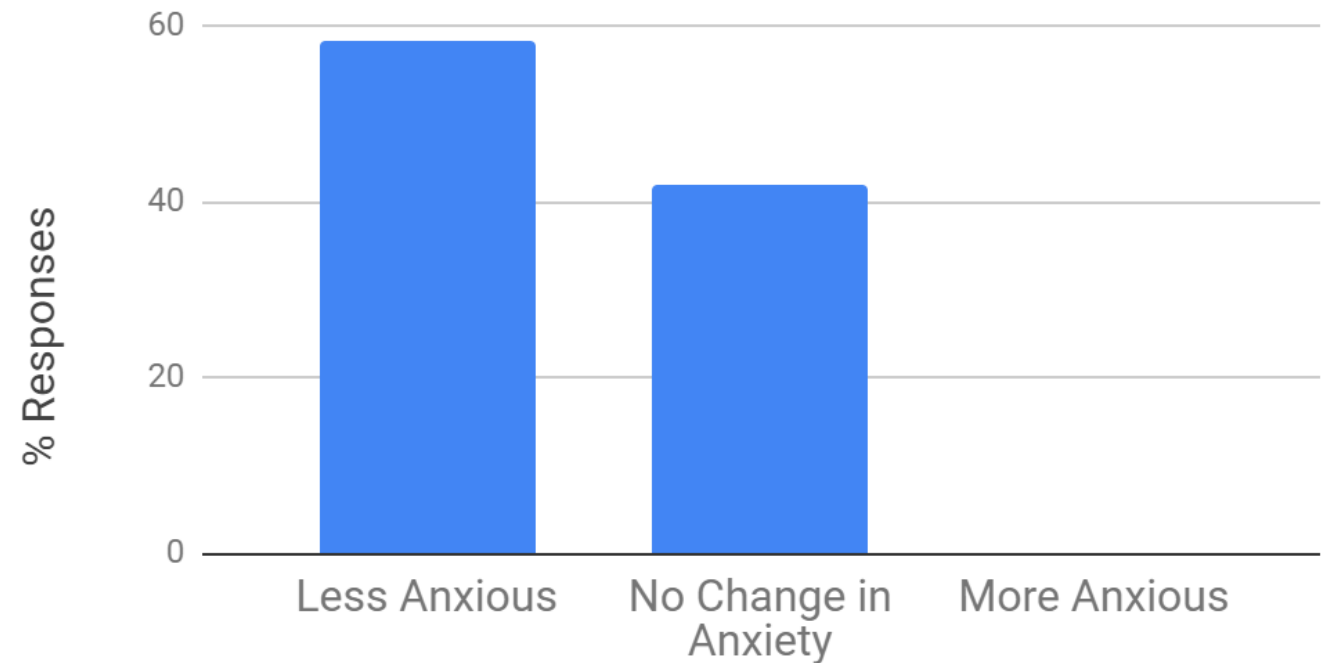
# Opal



# Opal Feedback

Access to data  
reduces patient  
anxiety.

In your experience, how has receiving your blood test results in real time using Opal affected your anxiety?



# Radiotherapy Data

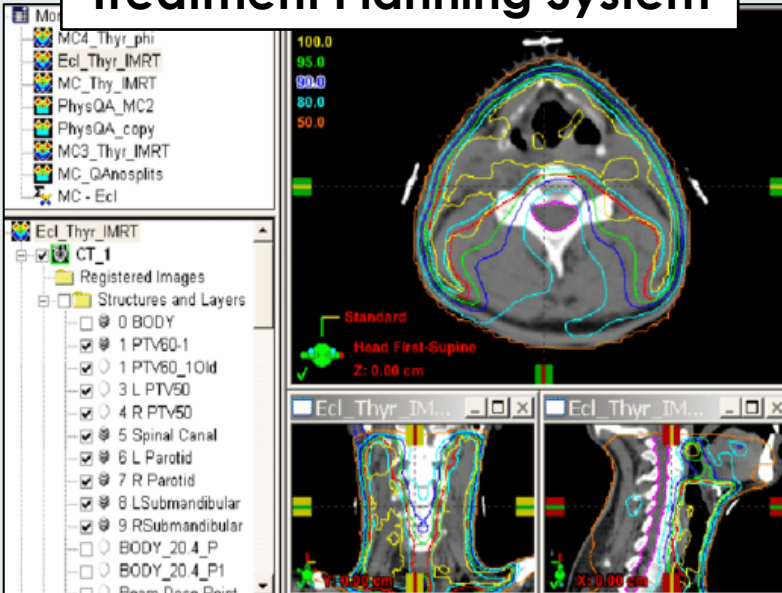
- Patients facing radiotherapy experience **anxiety** that could be lessened with access to data



# Radiotherapy Data

- Patients facing radiotherapy experience **anxiety** that could be lessened with access to data

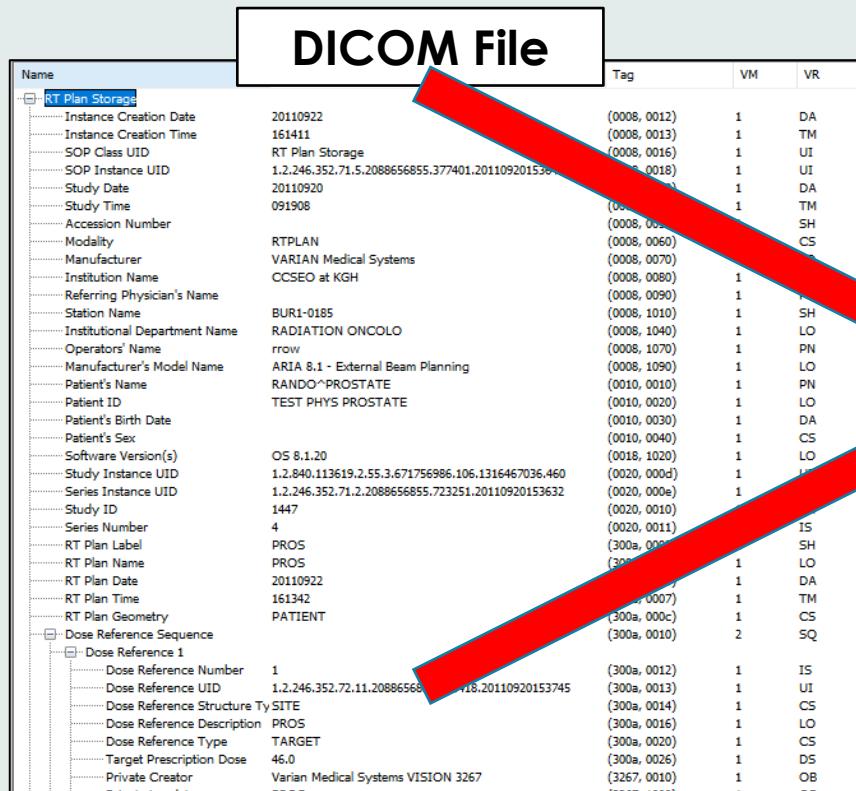
DICOM File				
Name	Tag	VM	VR	
RT Plan Storage				
Instance Creation Date	20110922	(0008, 0012)	1	DA
Instance Creation Time	161411	(0008, 0013)	1	TM
SOP Class UID	RT Plan Storage	(0008, 0016)	1	UI
SOP Instance UID	1.2.246.352.71.2.2088656855.377401.20110920153647	(0008, 0018)	1	UI
Study Date	20110920	(0008, 0020)	1	DA
Study Time	091908	(0008, 0030)	1	TM
Accession Number		(0008, 0050)	1	SH
Modality	RTPLAN	(0008, 0060)	1	CS
Manufacturer	VARIAN Medical Systems	(0008, 0070)	1	LO
Institution Name	CCSEO at KGH	(0008, 0080)	1	LO
Referring Physician's Name		(0008, 0090)	1	PN
Station Name	BUR1-0185	(0008, 1010)	1	SH
Institutional Department Name	RADIATION ONCOLO	(0008, 1040)	1	LO
Operators' Name	rrow	(0008, 1070)	1	PN
Manufacturer's Model Name	ARIA 8.1 - External Beam Planning	(0008, 1090)	1	LO
Patient's Name	RANDO*PROSTATE	(0010, 0010)	1	PN
Patient ID	TEST PHYS PROSTATE	(0010, 0020)	1	LO
Patient's Birth Date		(0010, 0030)	1	DA
Patient's Sex		(0010, 0040)	1	CS
Software Version(s)	OS 8.1.20	(0018, 1020)	1	LO
Study Instance UID	1.2.840.113619.2.55.3.671756986.106.1316467036.460	(0020, 000d)	1	UI
Series Instance UID	1.2.246.352.71.2.2088656855.723251.20110920153632	(0020, 000e)	1	UI
Study ID	1447	(0020, 0010)	1	SH
Series Number	4	(0020, 0011)	1	IS
RT Plan Label	PROS	(300a, 0002)	1	SH
RT Plan Name	PROS	(300a, 0003)	1	LO
RT Plan Date	20110922	(300a, 0006)	1	DA
RT Plan Time	161342	(300a, 0007)	1	TM
RT Plan Geometry	PATIENT	(300a, 000c)	1	CS
Dose Reference Sequence		(300a, 0010)	2	SQ
Dose Reference 1				
Dose Reference Number	1	(300a, 0012)	1	IS
Dose Reference UID	1.2.246.352.72.11.2088656855.250418.20110920153745	(300a, 0013)	1	UI
Dose Reference Structure Ty	SITE	(300a, 0014)	1	CS
Dose Reference Description	PROS	(300a, 0016)	1	LO
Dose Reference Type	TARGET	(300a, 0020)	1	CS
Target Prescription Dose	46.0	(300a, 0026)	1	DS
Private Creator	Varian Medical Systems VISION 3267	(3267, 0010)	1	OB

Treatment Planning System									
									
Fields   Dose Prescription   Dose Statistics   Plan Sum									
Field ID	Technique	Machine/Energy	Weight	Scale	Gantry Rtn [deg]	Coll Rtn [deg]	Coax Rtn [deg]	Wedge	Field X [cm]
1 GA.70	STATIC-I	VICEDAR_21B - 6X	1.00	VAR_IEC	70.0	0.0	0.0	None	16.8
2 GA.50	STATIC-I	VICEDAR_21B - 6X	1.00	VAR_IEC	50.0	0.0	0.0	None	18.3

# Radiotherapy Data

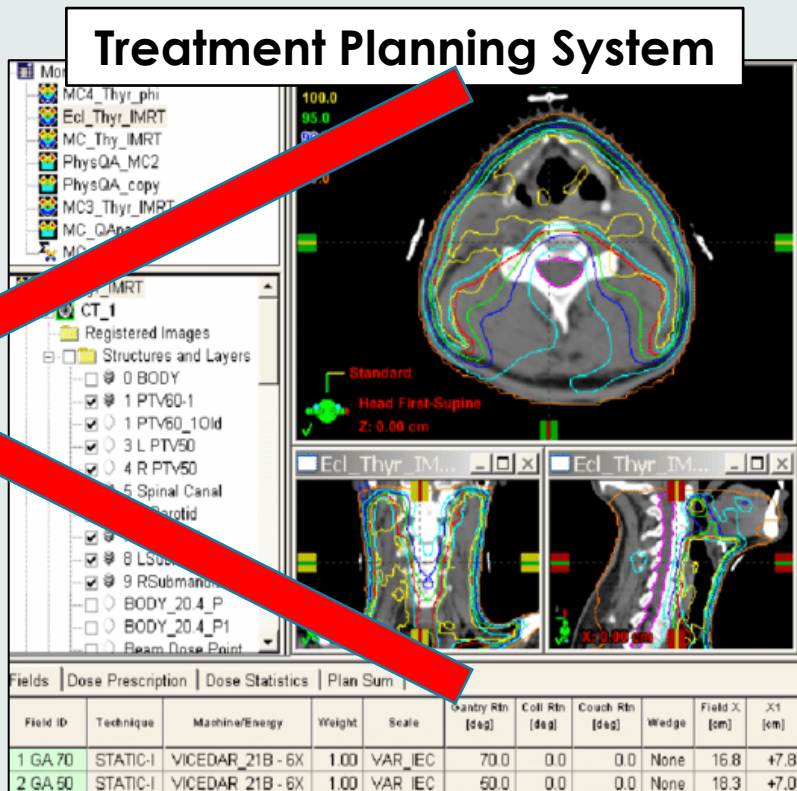
- Patients facing radiotherapy experience **anxiety** that could be lessened with access to data

### DICOM File



Name	Tag	VM	VR
RT Plan Storage			
Instance Creation Date	20110922	(0008, 0012)	1 DA
Instance Creation Time	161411	(0008, 0013)	1 TM
SOP Class UID	RT Plan Storage	(0008, 0016)	1 UI
SOP Instance UID	1.2.246.352.71.5.2088656855.377401.201109201536	(0008, 0018)	1 UI
Study Date	20110920	(0008, 0012)	1 DA
Study Time	091908	(0008, 0013)	1 TM
Accession Number		(0008, 0005)	1 SH
Modality	RTPLAN	(0008, 0060)	1 CS
Manufacturer	VARIAN Medical Systems	(0008, 0070)	1 LO
Institution Name	CCSEO at KGH	(0008, 0080)	1 LO
Referring Physician's Name		(0008, 0090)	1 LO
Station Name	BUR1-0185	(0008, 1010)	1 SH
Institutional Department Name	RADIATION ONCOLO	(0008, 1040)	1 LO
Operators' Name	rrow	(0008, 1070)	1 PN
Manufacturer's Model Name	ARIA 8.1 - External Beam Planning	(0008, 1090)	1 LO
Patient's Name	RANDO*PROSTATE	(0010, 0010)	1 PN
Patient ID	TEST PHYS PROSTATE	(0010, 0020)	1 LO
Patient's Birth Date		(0010, 0030)	1 DA
Patient's Sex		(0010, 0040)	1 CS
Software Version(s)	OS 8.1.20	(0018, 1020)	1 LO
Study Instance UID	1.2.840.113619.2.55.3.671756986.106.1316467036.460	(0020, 000d)	1 UI
Series Instance UID	1.2.246.352.71.2.2088656855.723251.20110920153632	(0020, 000e)	1 UI
Study ID	1447	(0020, 0010)	1 LO
Series Number	4	(0020, 0011)	1 IS
RT Plan Label	PROS	(300a, 0000)	1 SH
RT Plan Name	PROS	(300a, 0001)	1 LO
RT Plan Date	20110922	(300a, 0002)	1 DA
RT Plan Time	161342	(300a, 0007)	1 TM
RT Plan Geometry	PATIENT	(300a, 000c)	1 CS
Dose Reference Sequence		(300a, 0010)	2 SQ
Dose Reference 1			
Dose Reference Number	1	(300a, 0012)	1 IS
Dose Reference UID	1.2.246.352.72.11.2088656855.723251.20110920153745	(300a, 0013)	1 UI
Dose Reference Structure Ty	SITE	(300a, 0014)	1 CS
Dose Reference Description	PROS	(300a, 0016)	1 LO
Dose Reference Type	TARGET	(300a, 0020)	1 CS
Target Prescription Dose	46.0	(300a, 0026)	1 DS
Private Creator	Varian Medical Systems VISION 3267	(3267, 0010)	1 OB

### Treatment Planning System



The screenshot shows a Treatment Planning System interface. On the left, there is a list of objects including MC4\_Thyr\_phi, Ecl\_Thyr\_IMRT, MC\_Thyr\_IMRT, PhysQA\_MC2, PhysQA\_copy, MC3\_Thyr\_IMRT, and MC\_QA. Below this is a tree view for 'Ecl\_Thyr\_IMRT' showing 'Registered Images' and 'Structures and Layers'. The 'Structures and Layers' list includes 0 BODY, 1 PTV60-1, 1 PTV60\_1old, 3 L PTV50, 4 R PTV50, 5 Spinal Canal, 5 Parotid, 8 LSUV, 9 RSubmandib, BODY\_20.4\_P, and BODY\_20.4\_P1. On the right, there are three main display windows: a top window showing a cross-sectional CT scan of a head with various colored contours (red, yellow, green, blue) and a 'Standard' label; a bottom-left window showing a sagittal view of the same area; and a bottom-right window showing a coronal view. At the bottom, there is a table with columns: Field ID, Technique, Machine/Energy, Weight, Scale, Santry Rtn [Gg], Coll Rtn [Gg], Coach Rtn [Gg], Wedge, Field X [cm], and X1 [cm]. The table contains two rows of data.

Field ID	Technique	Machine/Energy	Weight	Scale	Santry Rtn [Gg]	Coll Rtn [Gg]	Coach Rtn [Gg]	Wedge	Field X [cm]	X1 [cm]
1 GA.70	STATIC-I	VICEDAR_21B - 6X	1.00	VAR_IEC	70.0	0.0	0.0	None	16.8	+7.8
2 GA.50	STATIC-I	VICEDAR_21B - 6X	1.00	VAR_IEC	50.0	0.0	0.0	None	18.3	+7.0



# Project Overview

**Goal:** To develop a prototype Radiotherapy Menu in Opal

# Project Overview

**Goal:** To develop a prototype Radiotherapy Menu in Opal

## 1) Pre-Treatment Plans

- Educational presentation of radiotherapy plan data to reduce anxiety



# Project Overview

**Goal:** To develop a prototype Radiotherapy Menu in Opal

## 1) Pre-Treatment Plans

- Educational presentation of radiotherapy plan data to reduce anxiety



## 2) Post-Treatment Summaries

- Record of delivered treatment
- Shareable with clinicians and researchers



# Ensuring Project Success

## Stakeholder Co-Design:



**Patients**



**Clinicians**



**Researchers**



**Software  
Developers**

# Ensuring Project Success

## Stakeholder Co-Design:



Patients



Clinicians



Researchers



Software  
Developers

**Data Standards:** to facilitate communication and interoperability

# 1) Pre-Treatment Plans

# Creating Pre-Treatment Plans

---

# Creating Pre-Treatment Plans

**Explanatory  
Text**

## Text Template

You will be treated with \_\_\_\_\_  
beams, which are \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

---



# Creating Pre-Treatment Plans

**Explanatory  
Text**

## **DICOM RT-PLAN**

Particle type  
Beam energy  
Patient position  
Dose  
Fractions

## **Text Template**

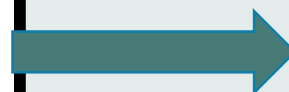
You will be treated with \_\_\_\_\_  
beams, which are \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

# Creating Pre-Treatment Plans

**Explanatory  
Text**

## **DICOM RT-PLAN**

Particle type  
Beam energy  
Patient position  
Dose  
Fractions



## **Text Template**

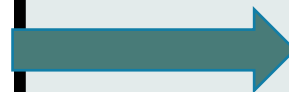
You will be treated with **photon** beams, which are beams of high energy x-rays and the most common type of radiotherapy.

# Creating Pre-Treatment Plans

**Explanatory  
Text**

**DICOM  
RT-PLAN**

Particle type  
Beam energy  
Patient position  
Dose  
Fractions



**Text Template**

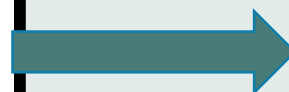
You will be treated with **electron** beams, which are used when the tumour is very close to the surface or on the skin. This is because...

# Creating Pre-Treatment Plans

**Explanatory  
Text**

## **DICOM RT-PLAN**

Particle type  
Beam energy  
Patient position  
Dose  
Fractions



## **Text Template**

You will be treated with **photon** beams, which are beams of high energy x-rays and the most common type of radiotherapy.

# Creating Pre-Treatment Plans

Explanatory  
Text

DICOM  
RT-PLAN

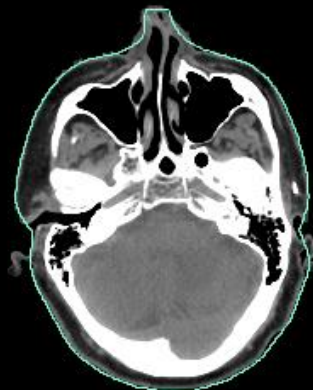
Particle type  
Beam energy  
Patient position  
Dose  
Fractions

Text Template

You will be treated with **electron** beams, which are used when the tumour is very close to the surface or on the skin. This is because...

3D  
Visuals

DICOM  
RT STRUCT



# Creating Pre-Treatment Plans

## Explanatory Text

### DICOM RT-PLAN

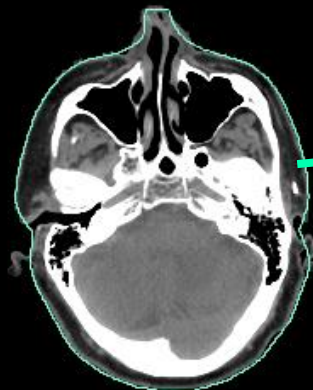
Particle type  
Beam energy  
Patient position  
Dose  
Fractions

### Text Template

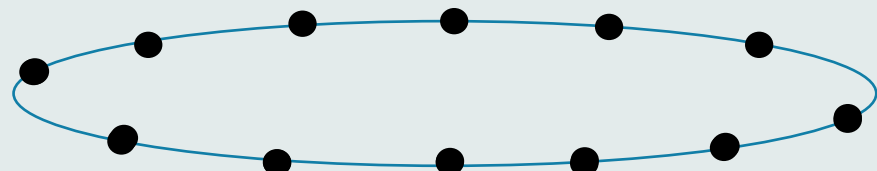
You will be treated with **electron** beams, which are used when the tumour is very close to the surface or on the skin. This is because...

## 3D Visuals

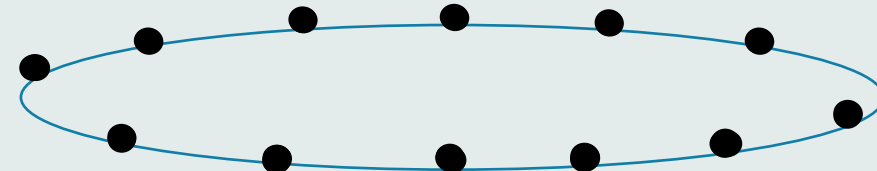
### DICOM RT STRUCT



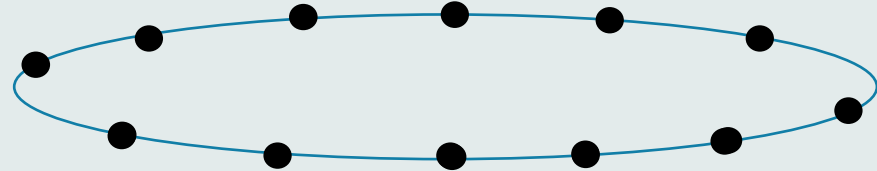
Slice 1:



Slice 2:



Slice 3:



# Creating Pre-Treatment Plans

## Explanatory Text

### DICOM RT-PLAN

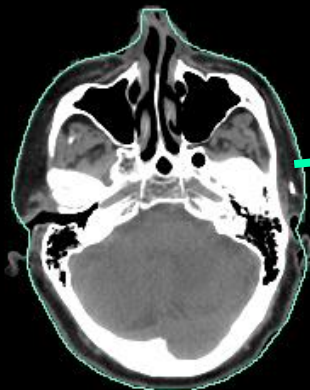
Particle type  
Beam energy  
Patient position  
Dose  
Fractions

### Text Template

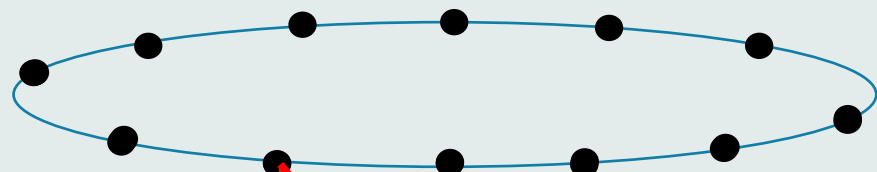
You will be treated with **electron** beams, which are used when the tumour is very close to the surface or on the skin. This is because...

## 3D Visuals

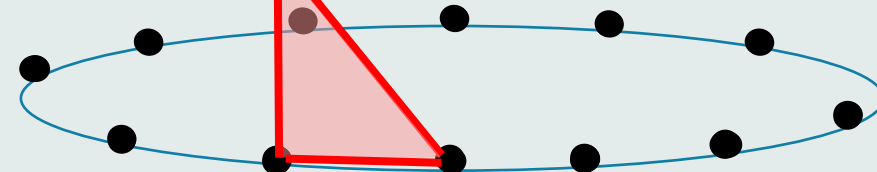
### DICOM RT STRUCT



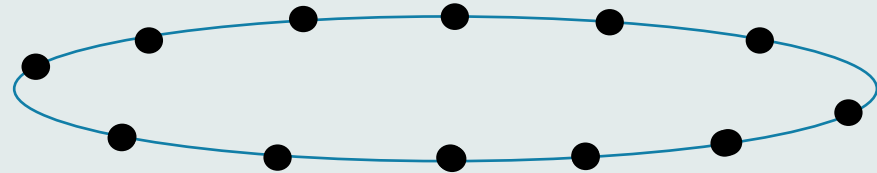
Slice 1:



Slice 2:



Slice 3:



# Creating Pre-Treatment Plans

## Explanatory Text

### DICOM RT-PLAN

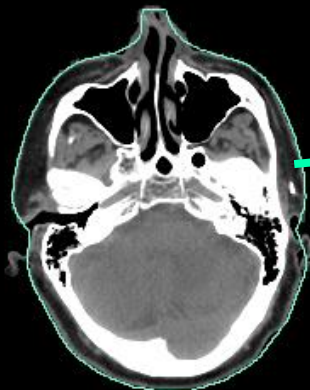
Particle type  
Beam energy  
Patient position  
Dose  
Fractions

### Text Template

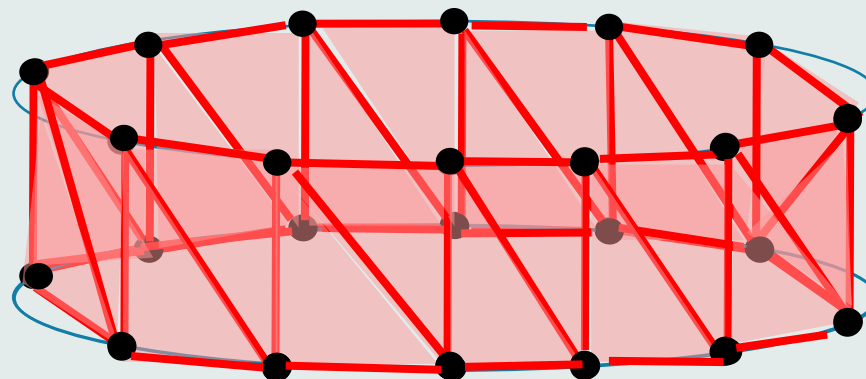
You will be treated with **electron** beams, which are used when the tumour is very close to the surface or on the skin. This is because...

## 3D Visuals

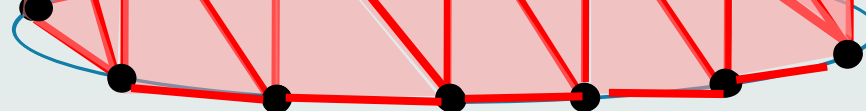
### DICOM RT STRUCT



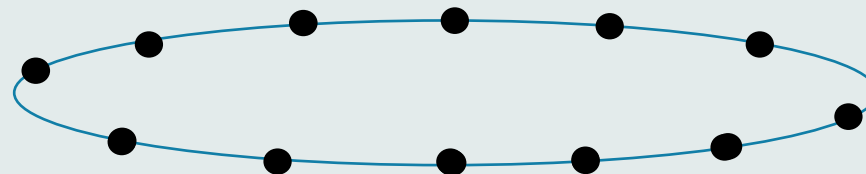
Slice 1:



Slice 2:



Slice 3:





# Creating Pre-Treatment Plans

## Explanatory Text

### DICOM RT-PLAN

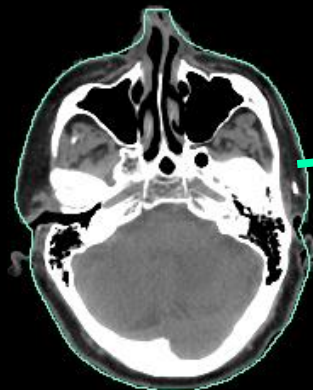
Particle type  
Beam energy  
Patient position  
Dose  
Fractions

### Text Template

You will be treated with **electron** beams, which are used when the tumour is very close to the surface or on the skin. This is because...

## 3D Visuals

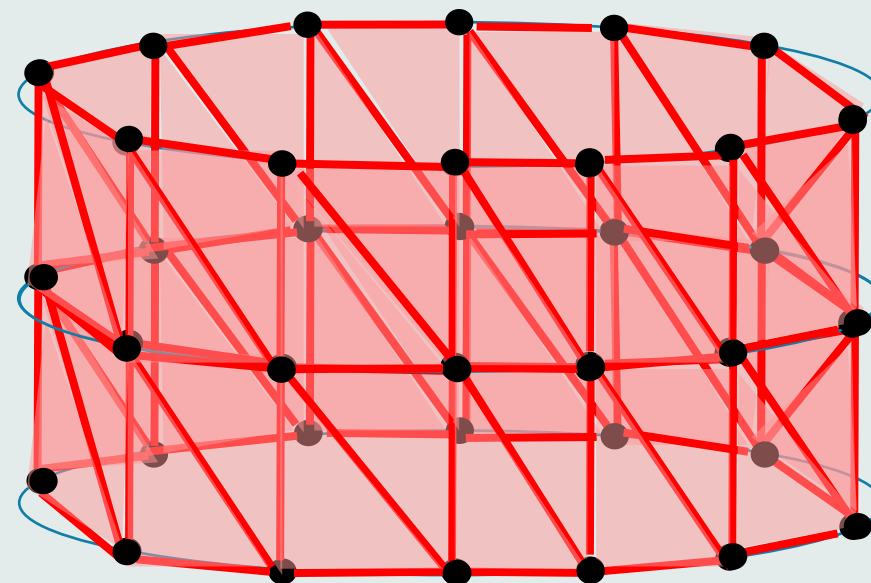
### DICOM RT STRUCT

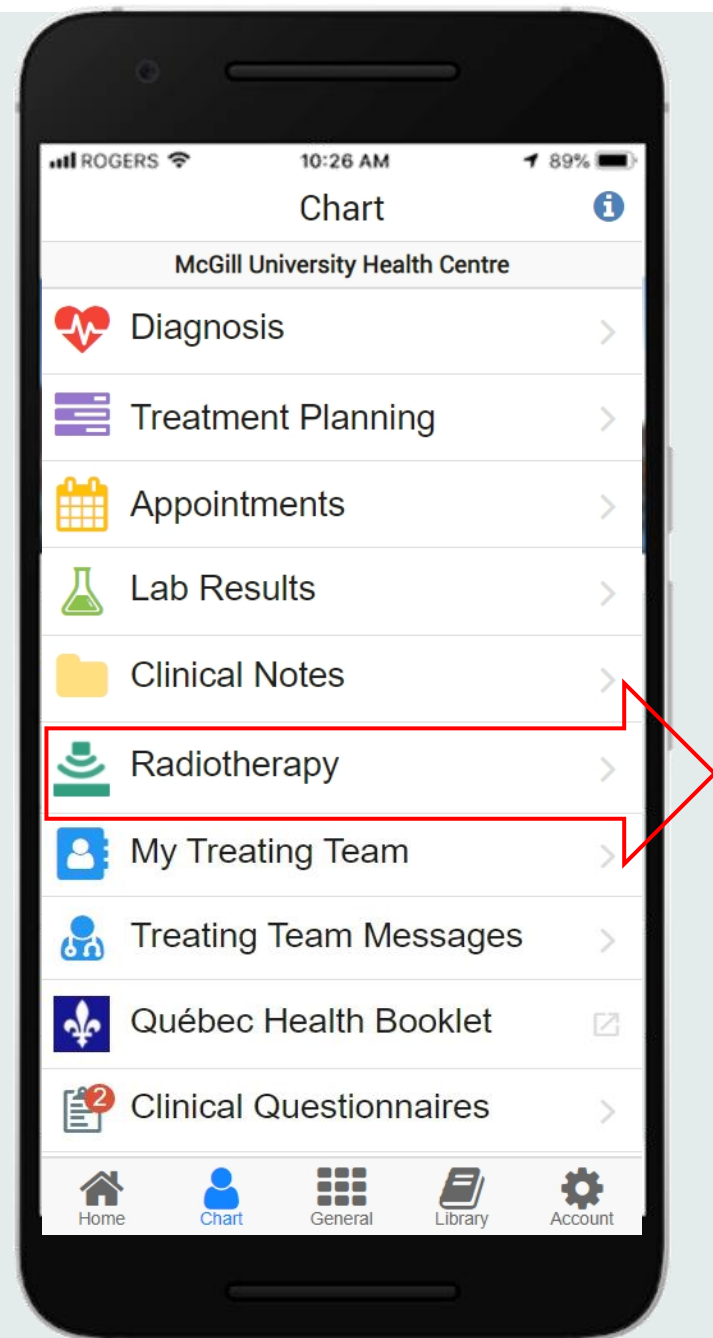


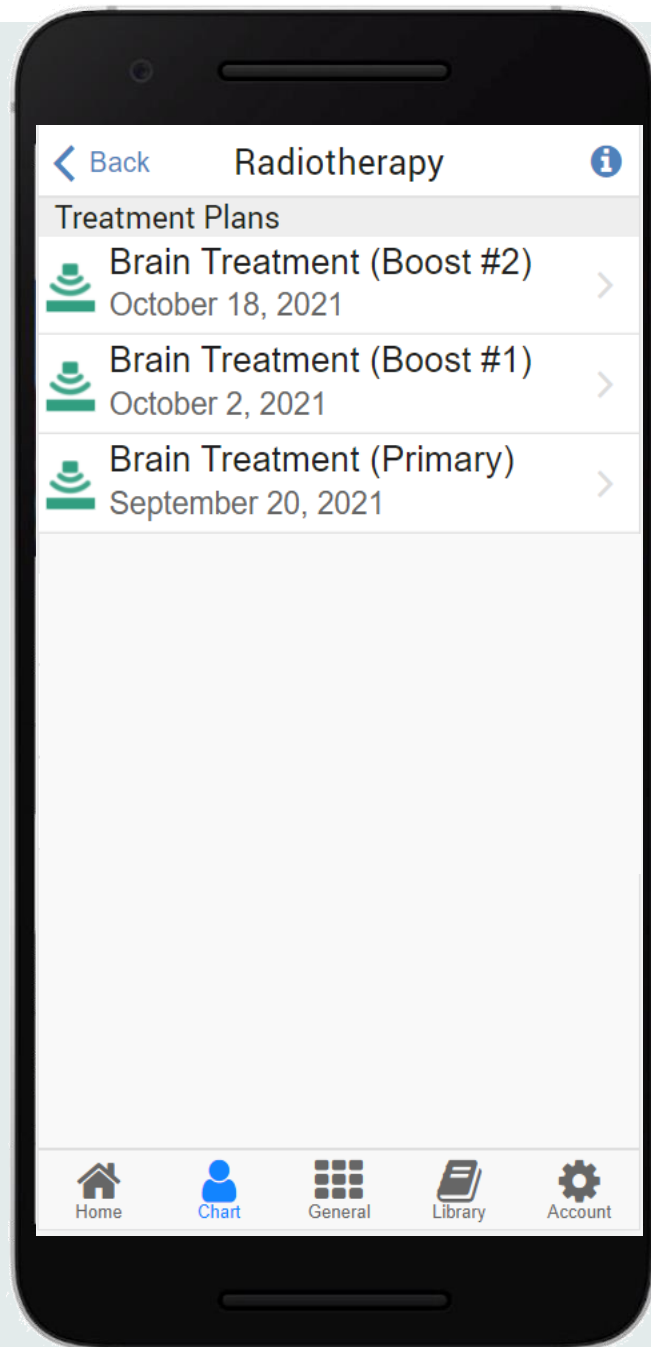
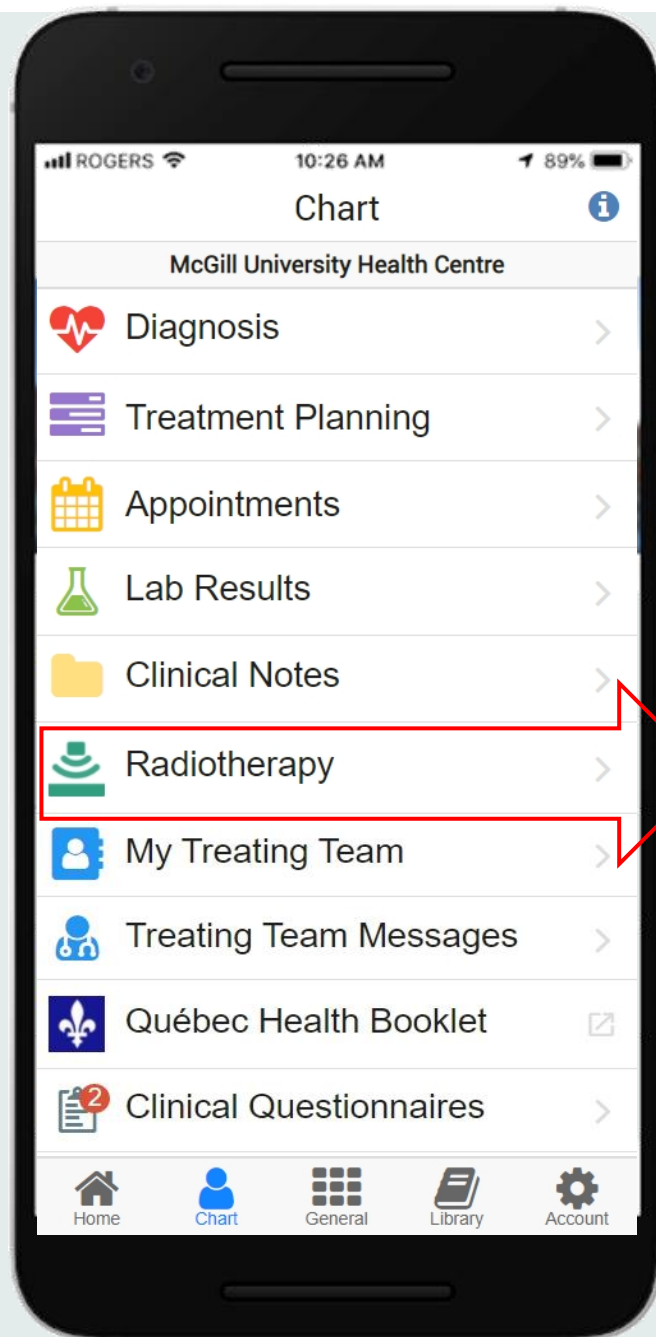
Slice 1:

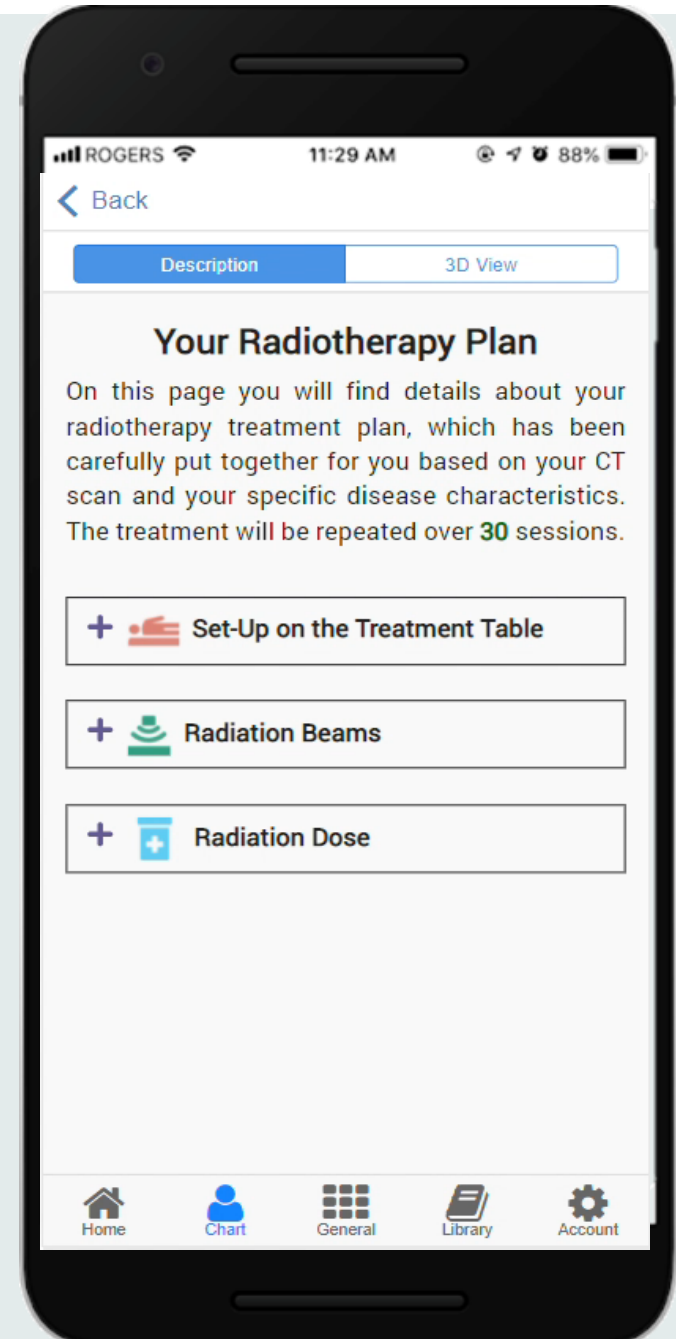
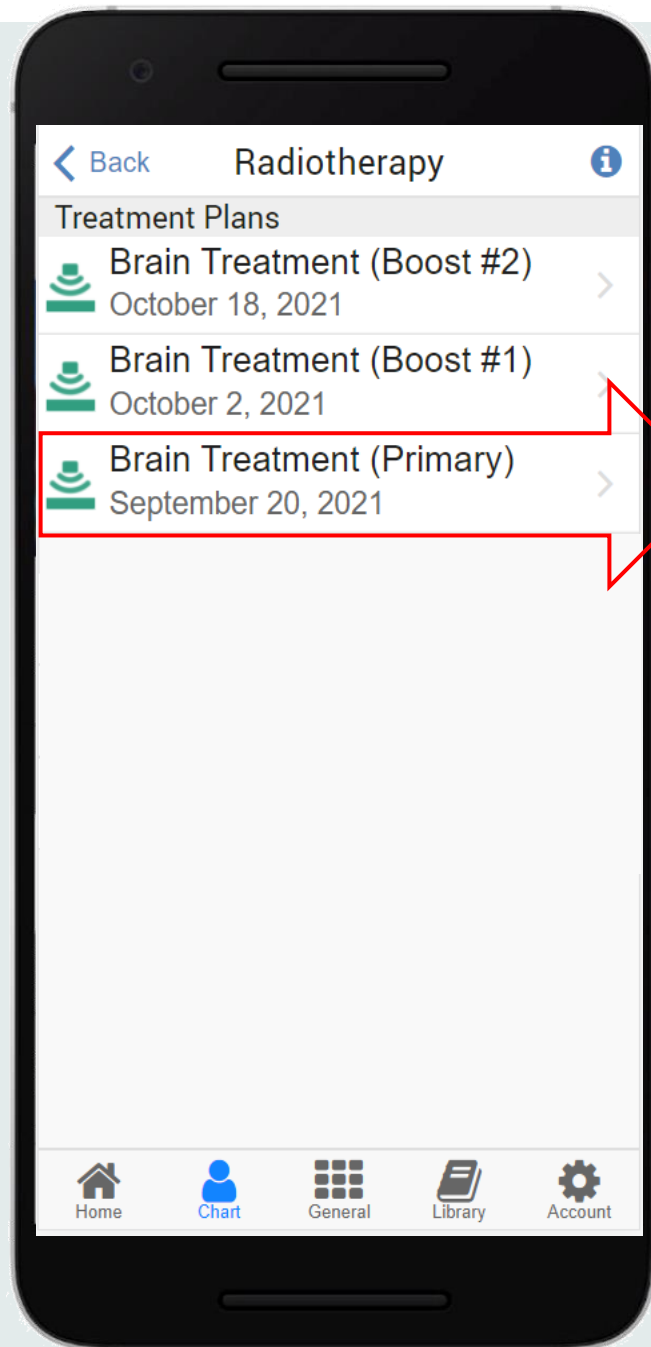
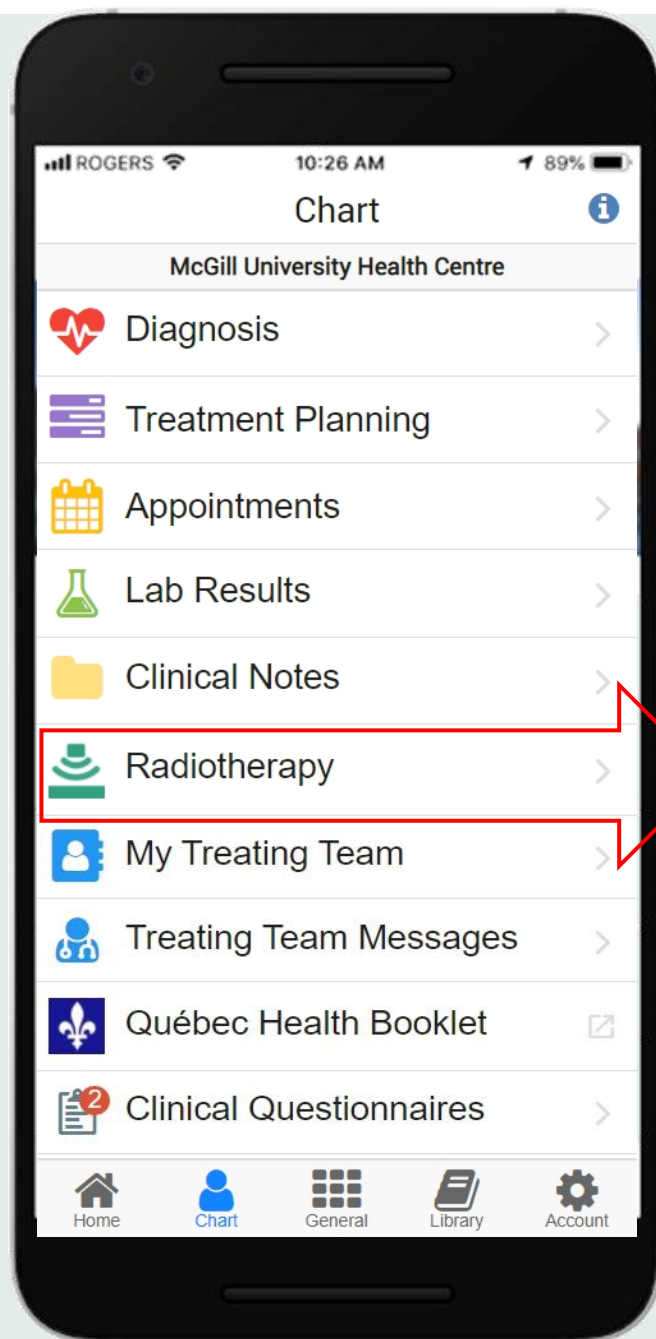
Slice 2:

Slice 3:





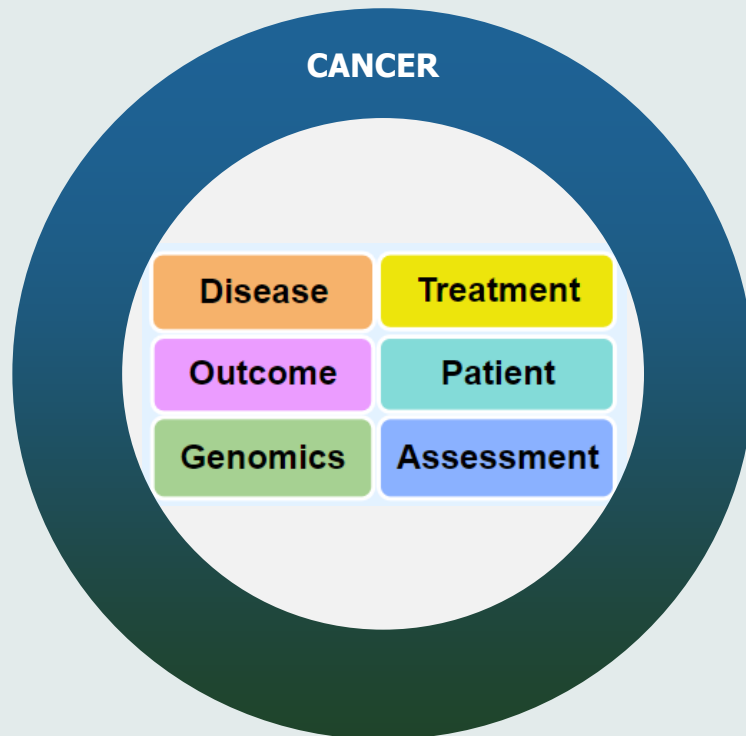




## **2) Post-Treatment Summaries**

# mCODE<sup>TM</sup>

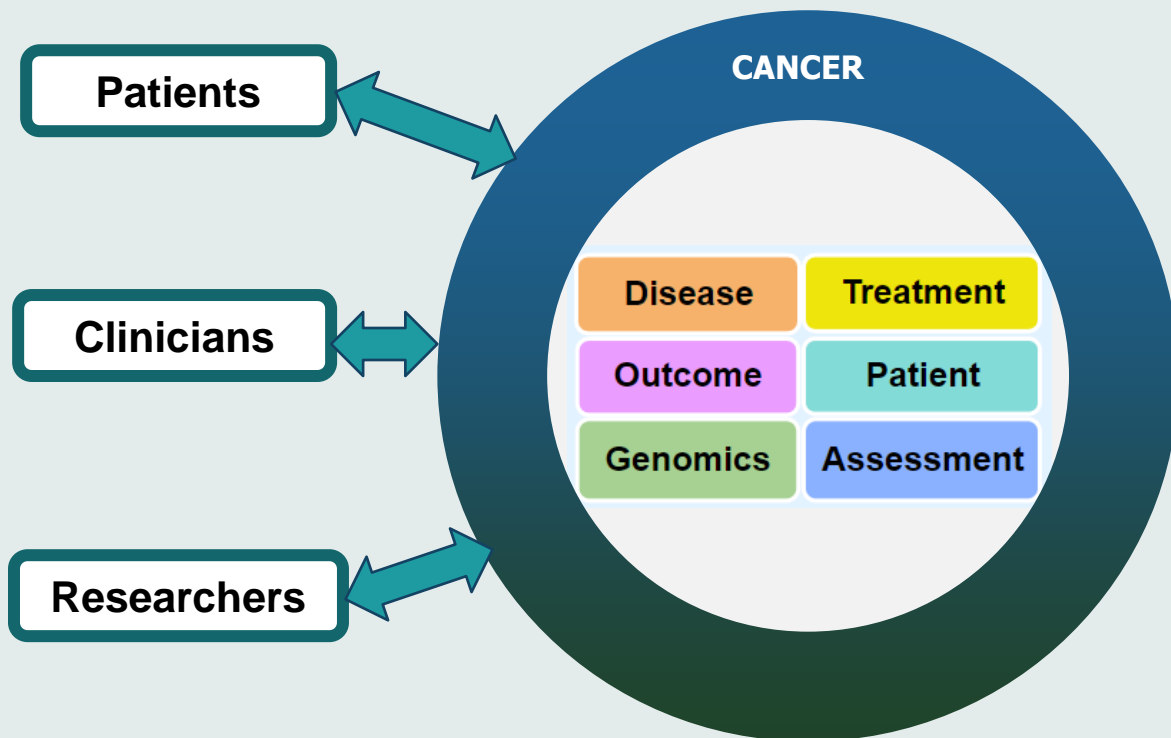
minimal Common Oncology Data Elements



- The minimal set of data elements **applicable to all cancers**
- A **standard health record** for oncology

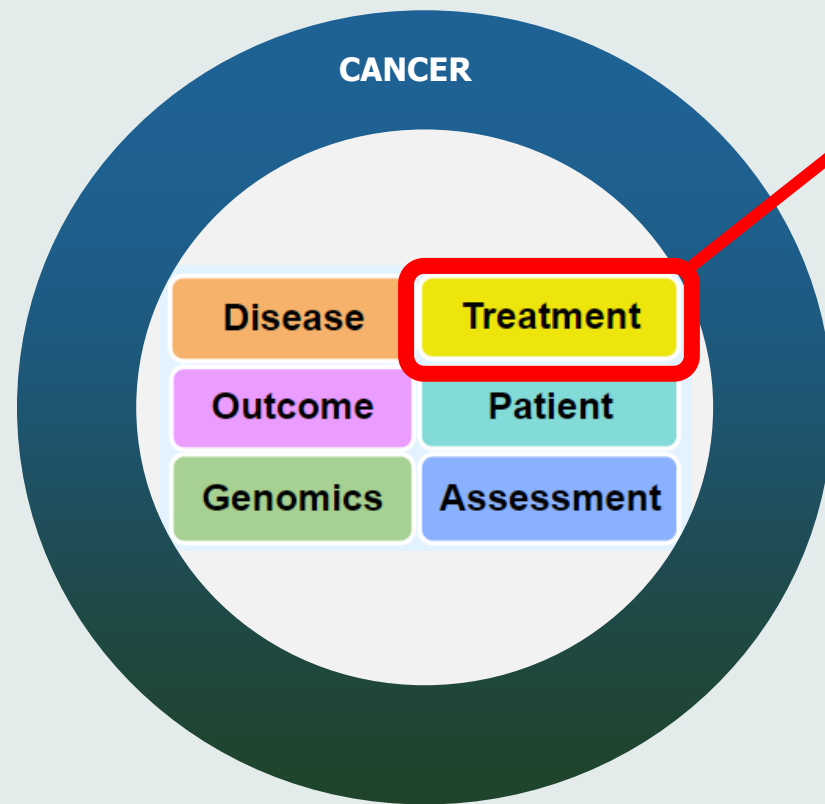
# mCODE<sup>TM</sup>

minimal Common Oncology Data Elements



- The minimal set of data elements **applicable to all cancers**
- A **standard health record** for oncology
- Easily **shareable**

# mCODE<sup>TM</sup>



## Radiotherapy Course Summary

*Procedure (US Core)*

No. Sessions

Modality/Technique

Modality

Technique

Doses Delivered

Total Dose

No. Fractions

Body Volume

## Radiotherapy Volume

*BodyStructure*

Volume Type

Location

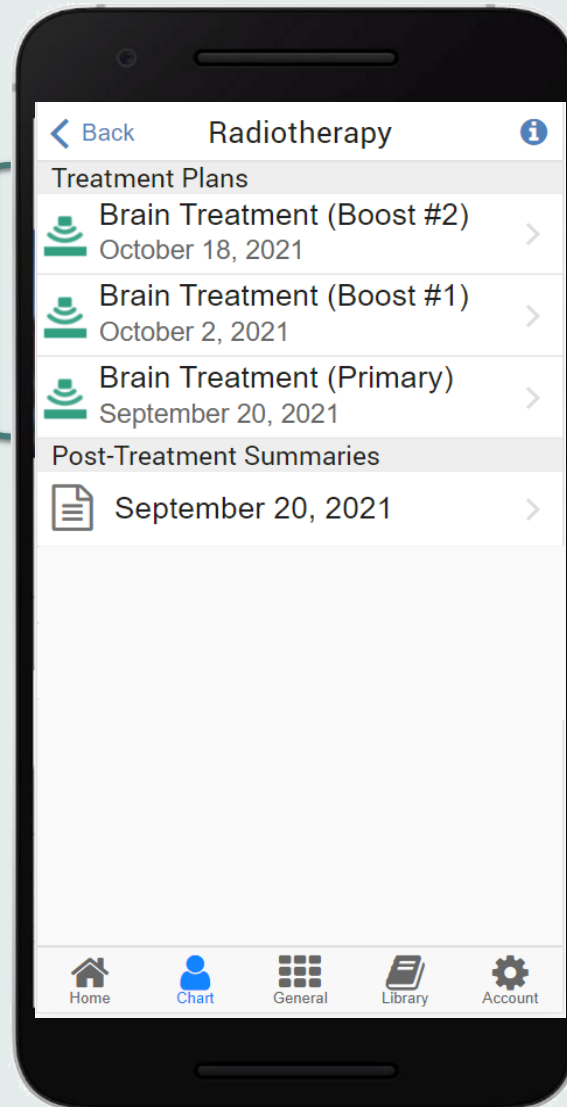
Location Qualifier

**End of treatment  
summary**



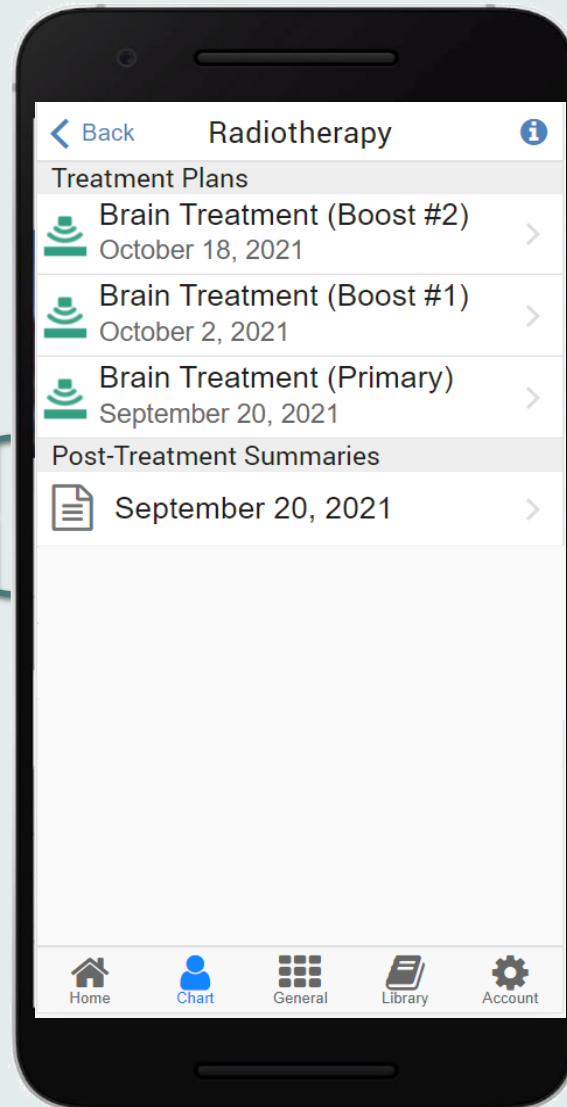
# Radiotherapy Menu Revisited

**Pre-Treatment  
Plans**



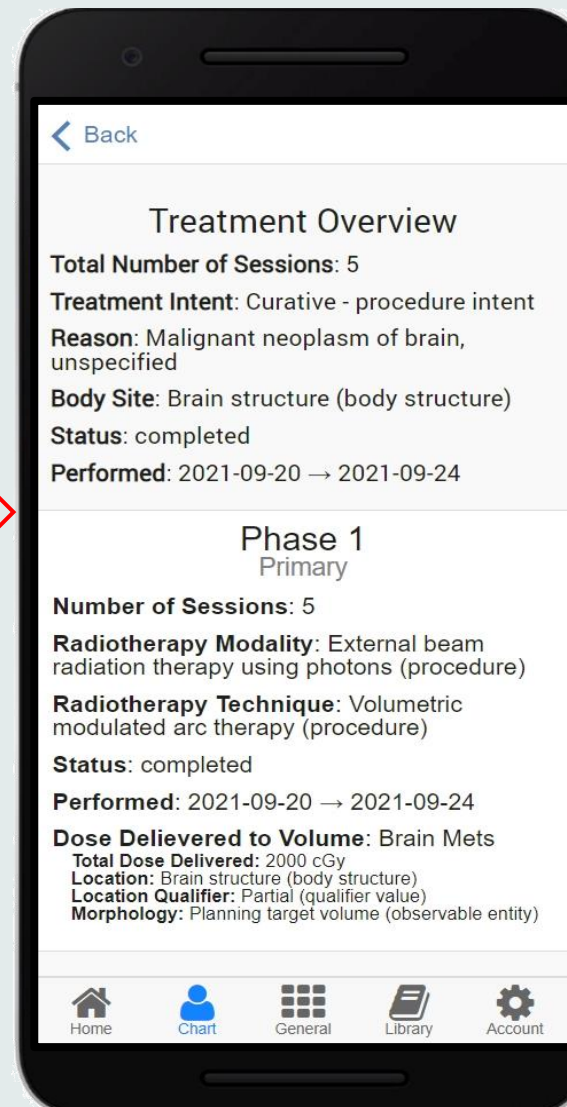
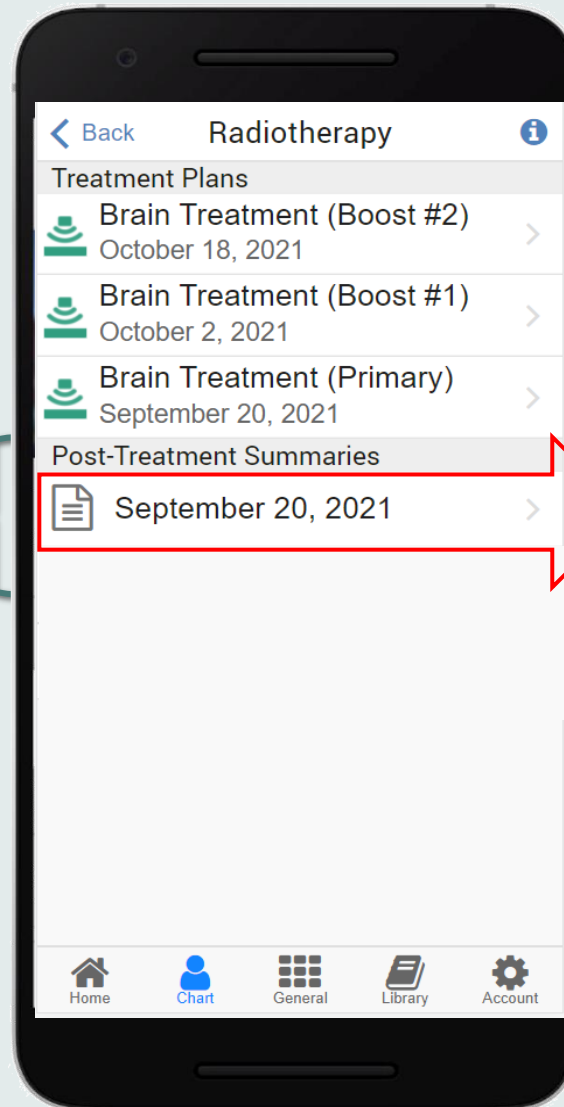
# Radiotherapy Menu Revisited

Post-Treatment  
Summaries



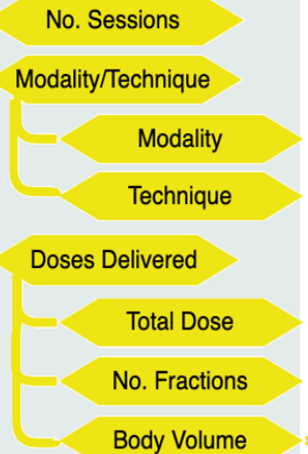
# Radiotherapy Menu Revisited

## Post-Treatment Summaries



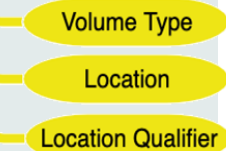
### Radiotherapy Course Summary

Procedure (US Core)



### Radiotherapy Volume

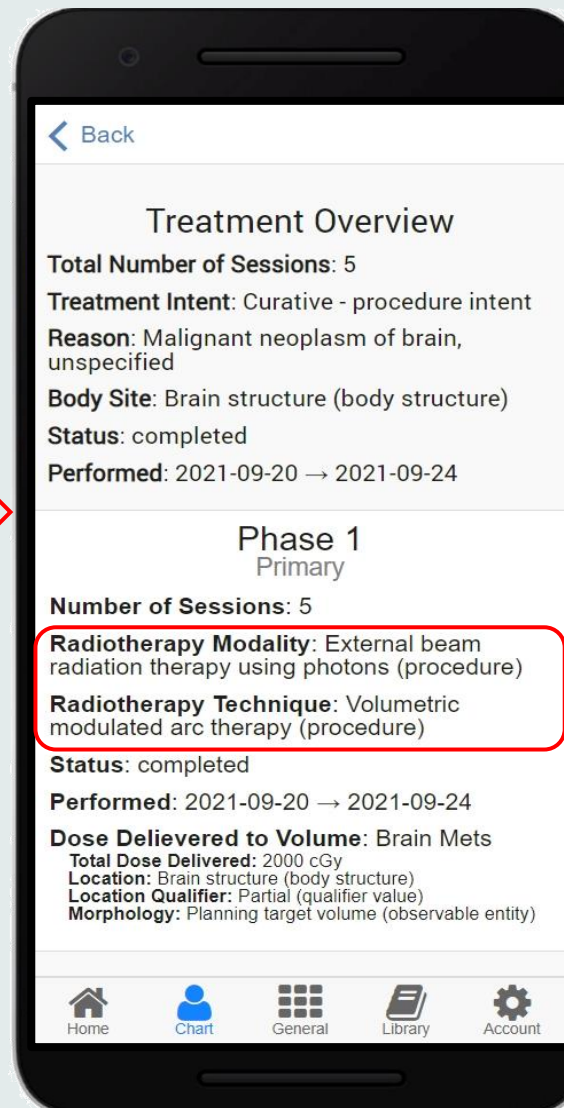
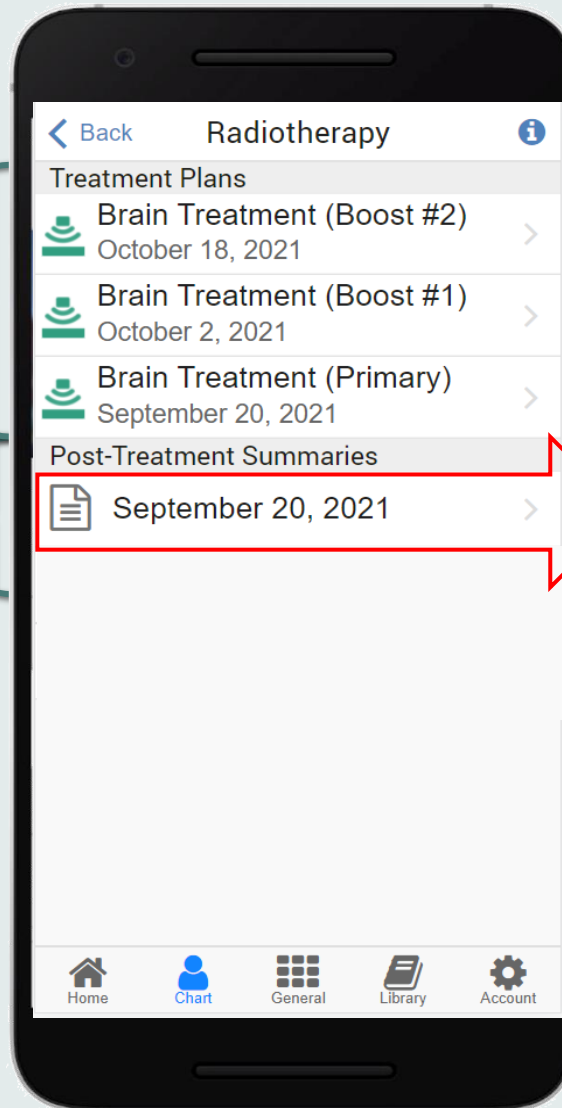
BodyStructure



# Radiotherapy Menu Revisited

Pre-Treatment  
Plans

Post-Treatment  
Summaries



## Radiotherapy Course Summary

Procedure (US Core)

No. Sessions

Modality/Technique

Modality

Technique

Doses Delivered

Total Dose

No. Fractions

Body Volume

## Radiotherapy Volume

BodyStructure

Volume Type

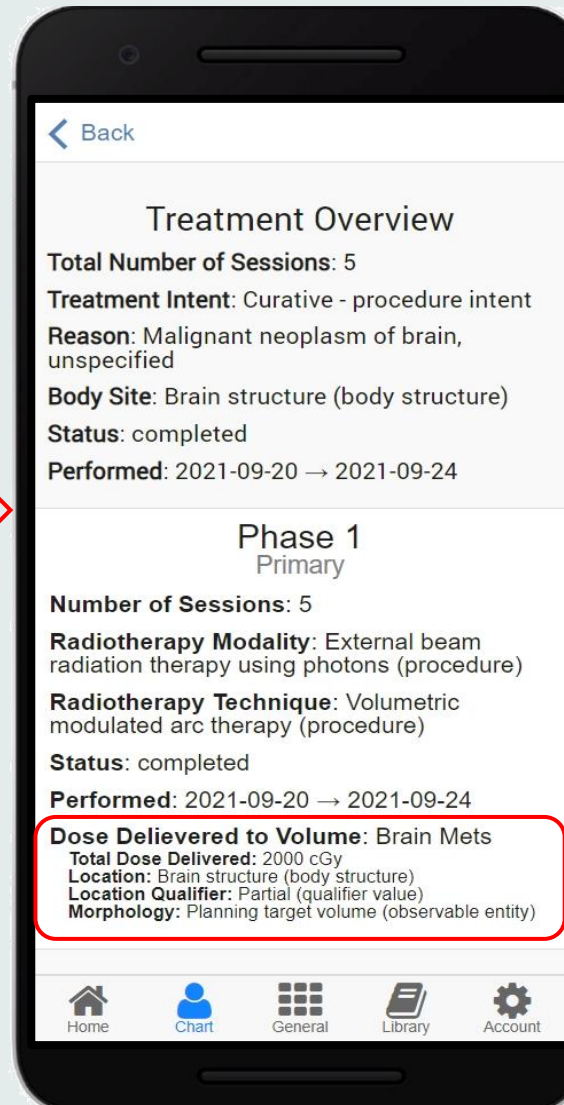
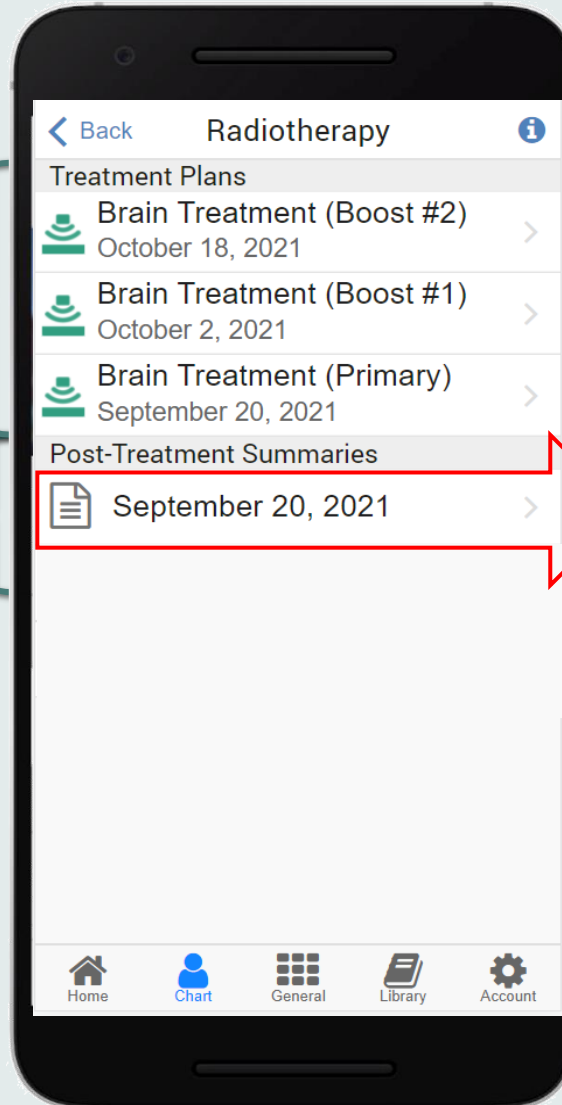
Location

Location Qualifier

# Radiotherapy Menu Revisited

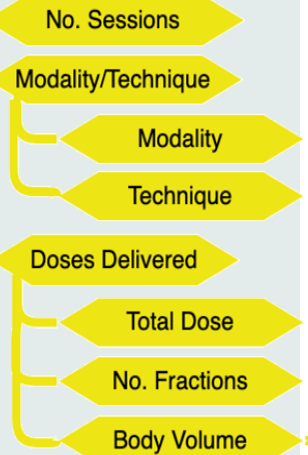
Pre-Treatment  
Plans

Post-Treatment  
Summaries



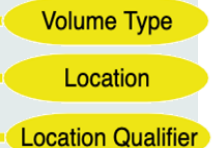
## Radiotherapy Course Summary

*Procedure (US Core)*



## Radiotherapy Volume

*BodyStructure*



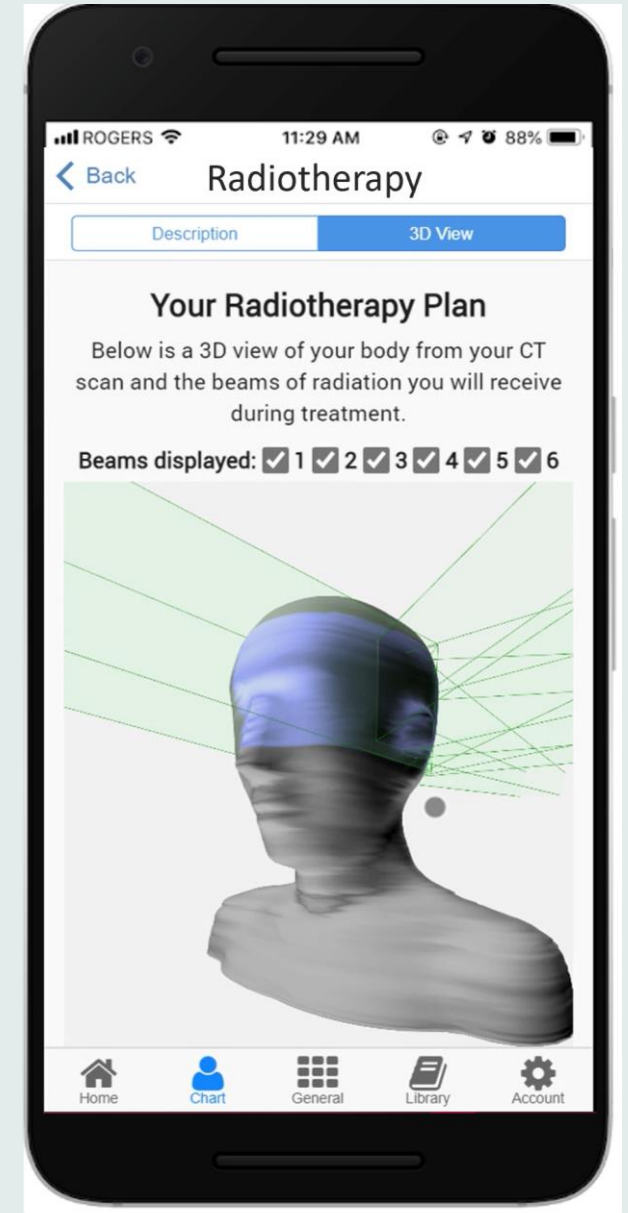
# Patient Feedback

# Focus group feedback

“We would have loved to have this!”

“[My anxiety] would have been decreased, for sure.”

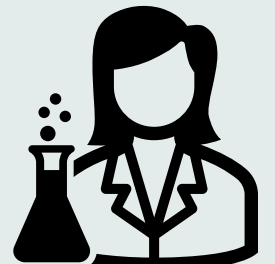
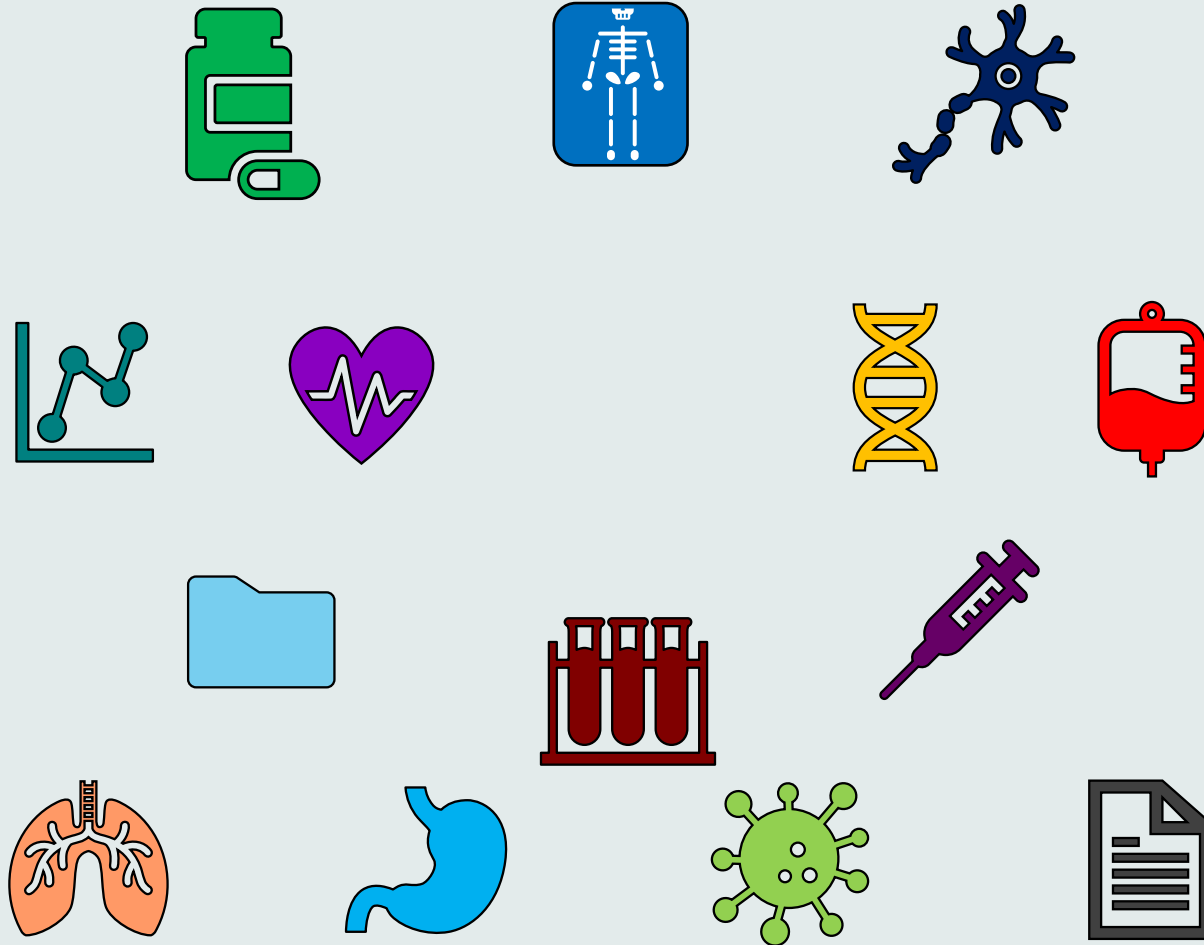
“You take away a lot of the unknowns.”



# Health Data



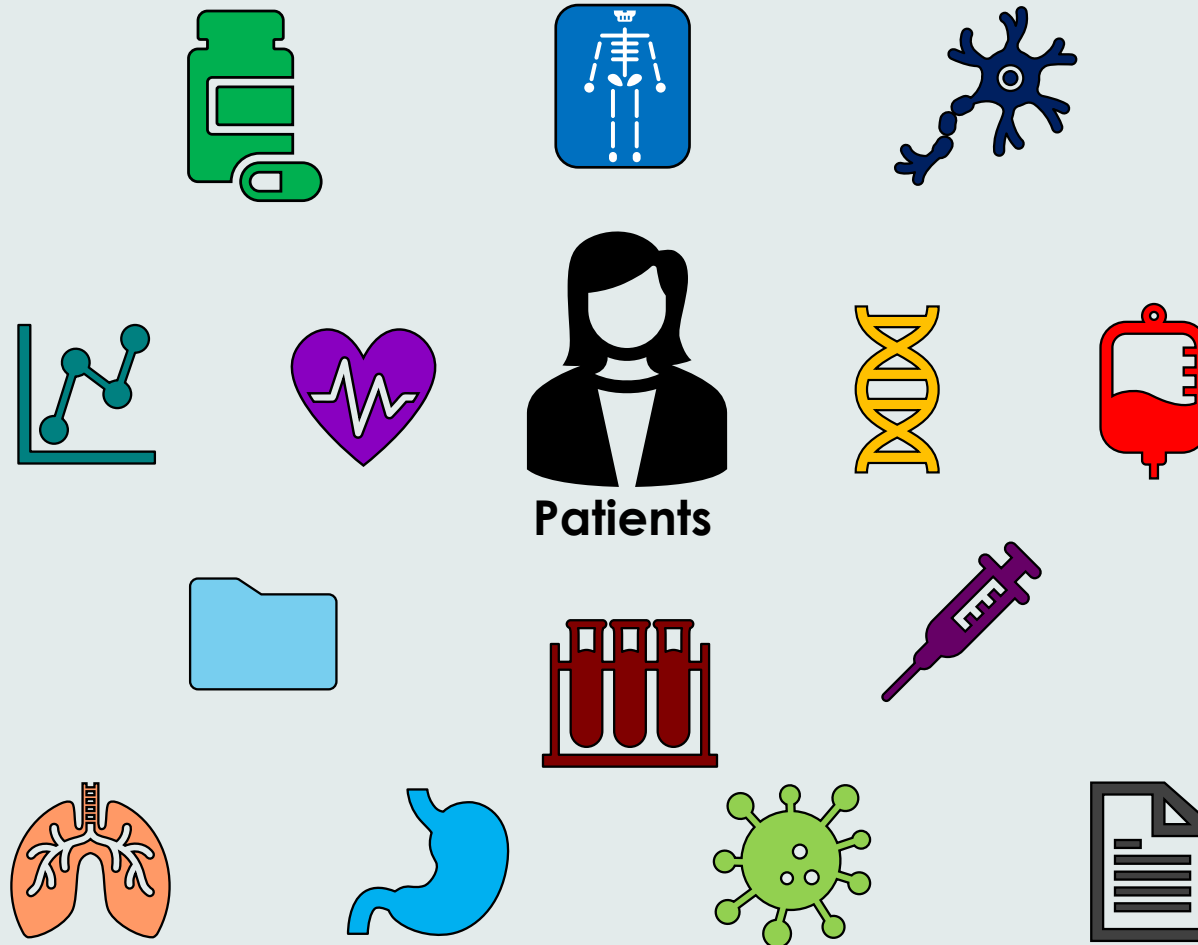
Patients



Researchers



# Health Data

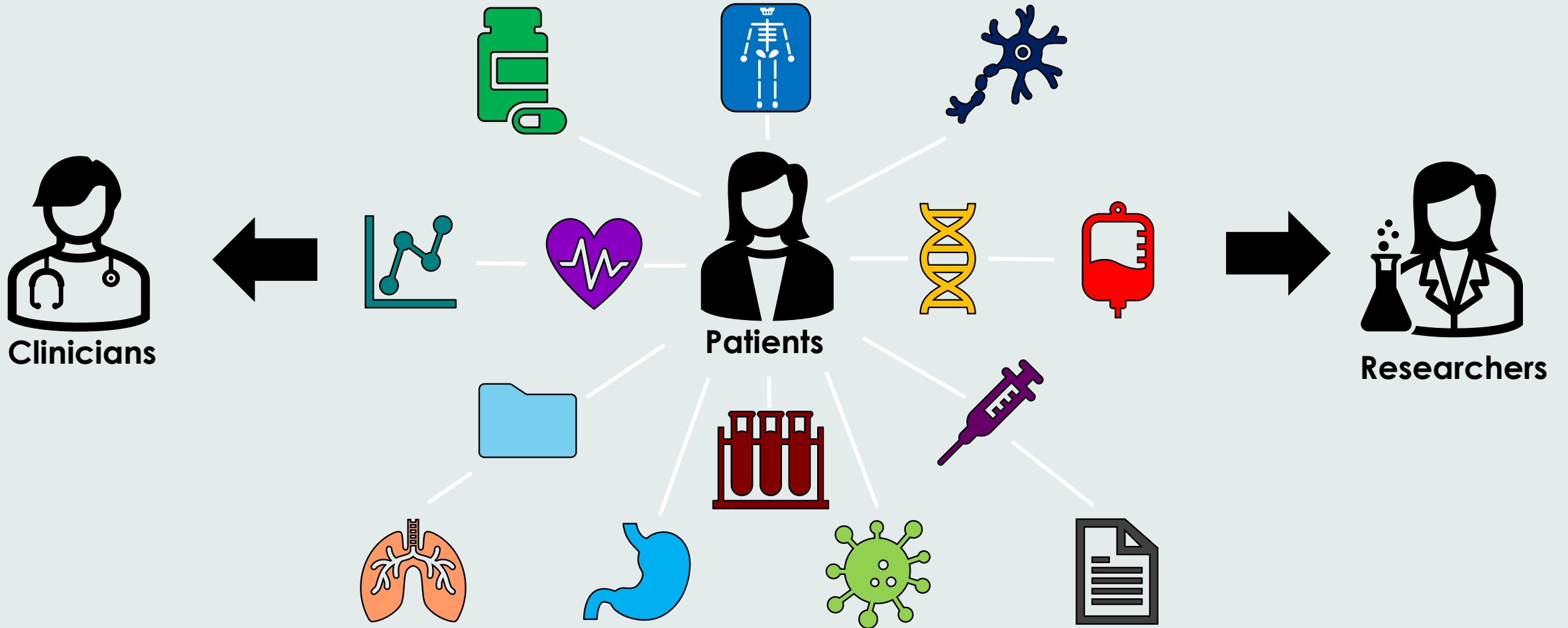


Patients



Researchers

# Health Data



# Acknowledgements

- Dr. John Kildea
- PARTAGE Team
- Opal Development Team
- CodeX Community



McGill University  
Health Centre  
Foundation

Santé  
et Services sociaux  
Québec

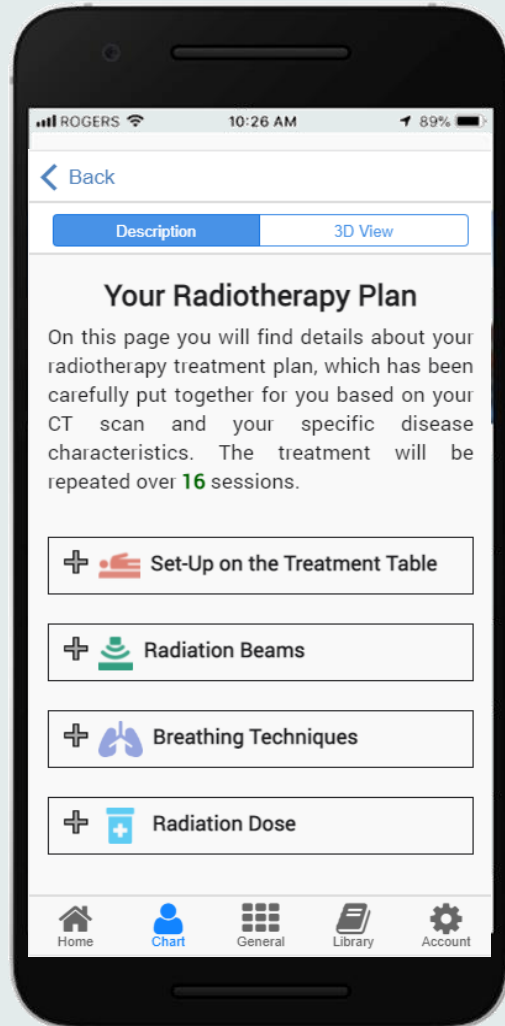


Fonds de recherche  
Nature et  
technologies  
Québec



<https://kildealab.com/>

# Personalized Text



## Set-Up on the Treatment Table

The radiation treatment itself will only last a couple of minutes, however, the entire session may take 10-30 minutes. The majority of this time is spent making adjustments to ensure that you are set up exactly as you were during your CT simulation. This is important because the radiation is delivered very precisely based on your CT scan.

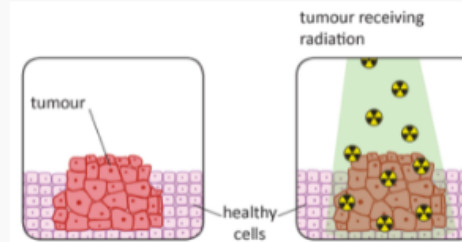


On the treatment table, you will lie on your **back with your head towards the machine**.

For breast treatment, you will typically need to hold your arms above your head so that they are not in contact with the radiation. This may be uncomfortable or painful for some

## Radiation Beams

Once positioned, your treatment will begin. The machine will rotate around you to deliver **2** beams of radiation at different angles. You can visualize these beams on the next page.



You will be treated with **photon** beams, which are beams of high energy x-rays and the most common type of radiotherapy.

The beams will have an energy value of **6 MV** (Mega-volts). The energy determines how far the radiation penetrates in your body. Higher energies can travel further inside the body and are used for deeper tumours. Typical photon beam energies range from 4 MV to 25 MV.

The widths of the beams delivered are chosen so that they are just large

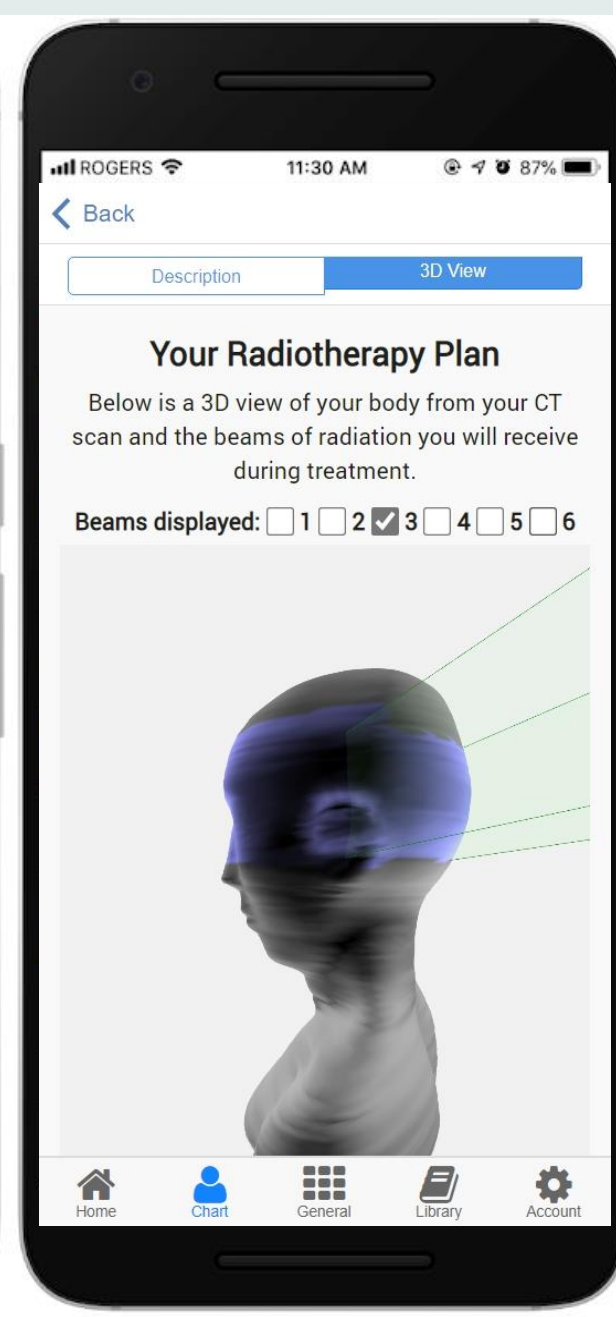
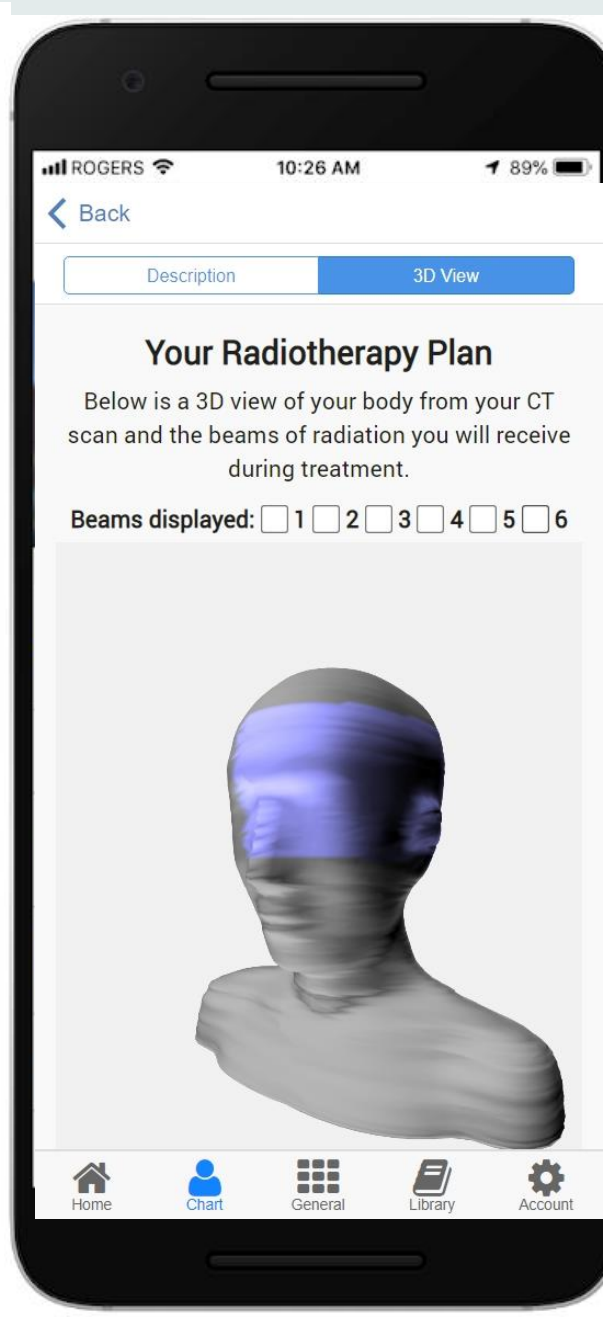
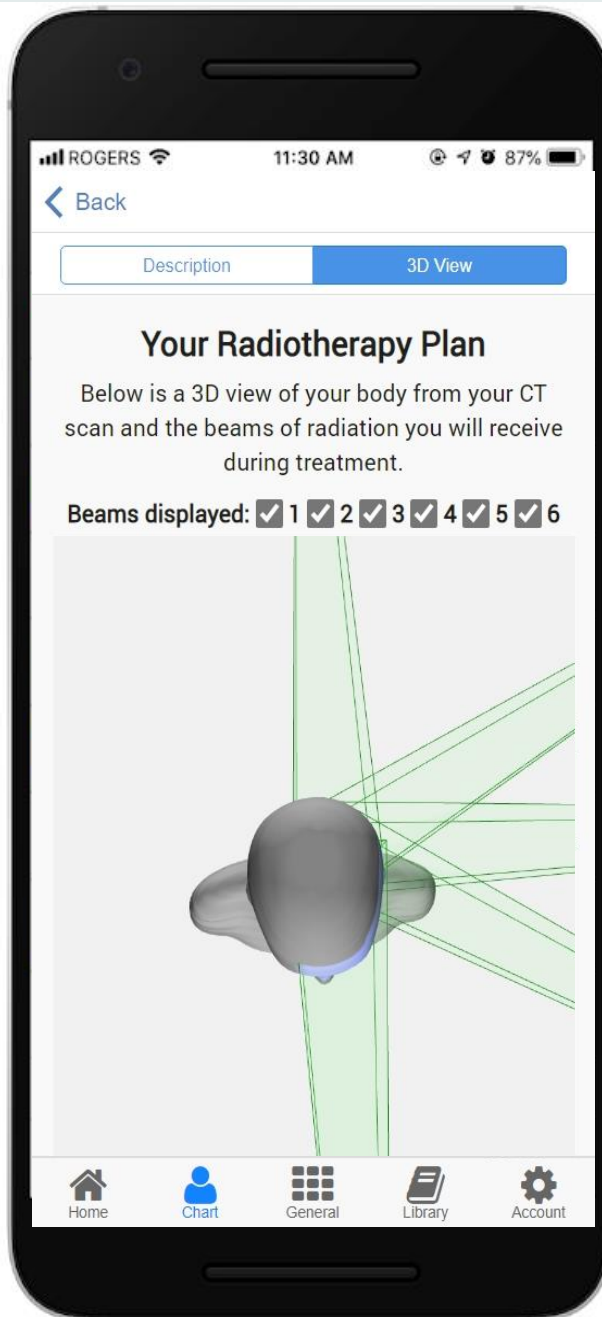
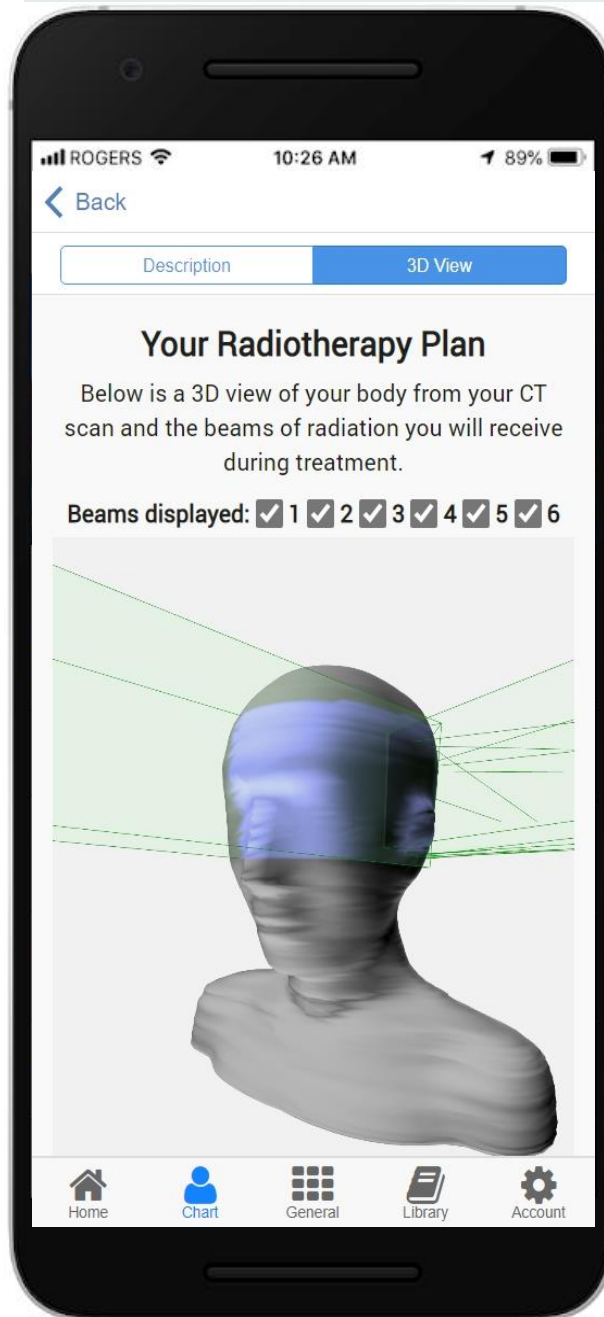
## Radiation Dose

The prescribed radiation dose to the targeted tumour is **40 Gy** (Gray). This number indicates the amount of radiation energy to be deposited in this area.

You will not receive the full dose at once. Rather, it will be split up into **16** "fractions" (sessions). There are many reasons for splitting up treatment into smaller fractions. Mostly, it maximizes the chances of killing the tumour cells while also leaving your healthy cells enough time to repair in between sessions.

The radiation beam type, energy, angle and shape are all chosen so that the tumour receives this prescribed dose, while the surrounding healthy tissues and organs receive the least amount of radiation possible. Our goal is first to effectively remove the tumour, but also to reduce the side effects you may experience.

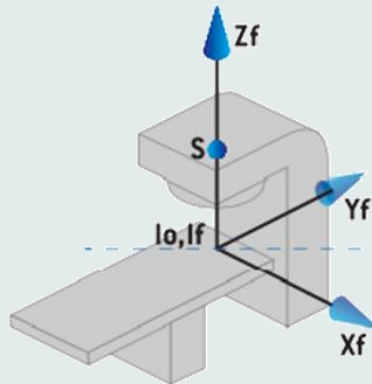




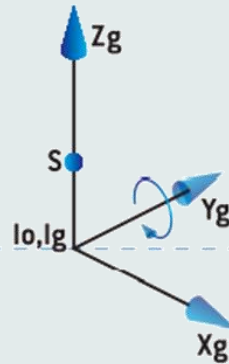
# Methods – Beam Visualization

## RT PLAN Data

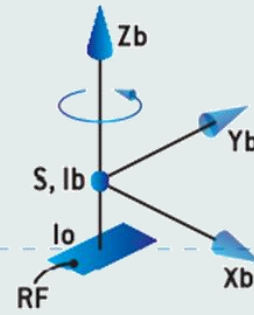
- Isocenter
- SAD
- XY Collimators Jaws



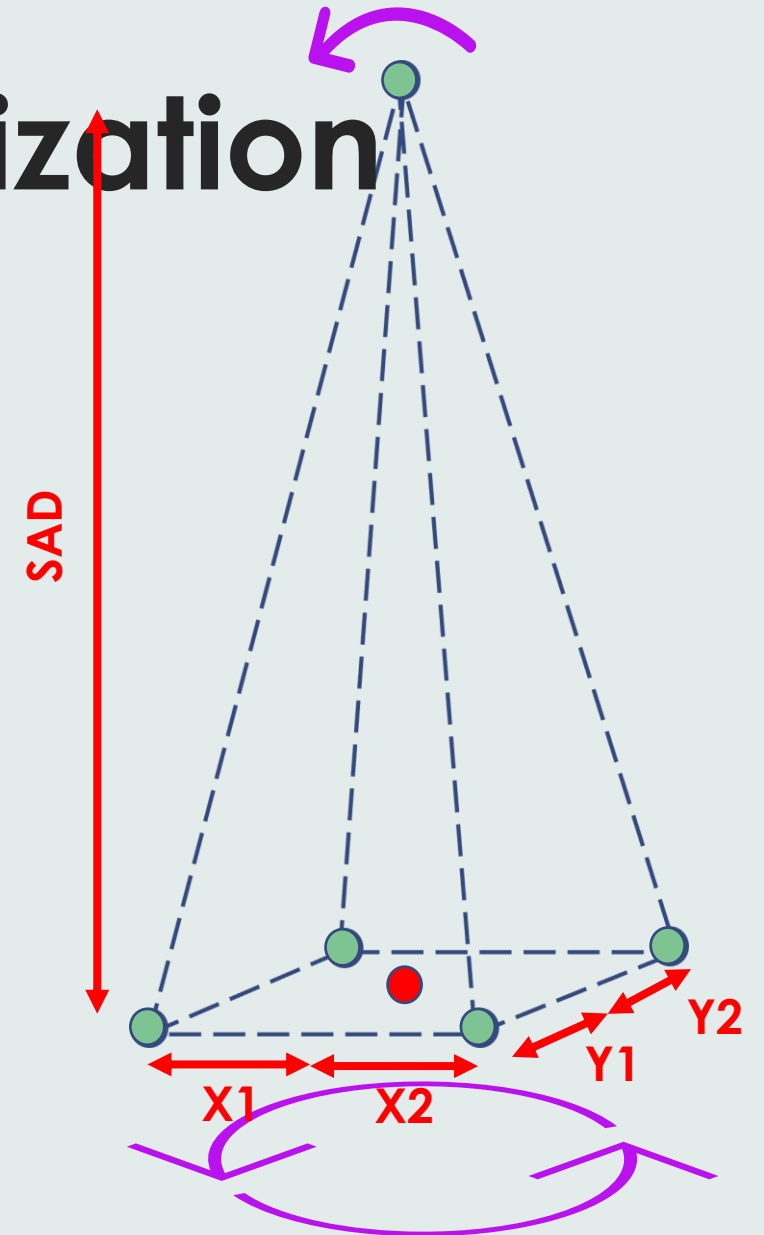
Fixed system



Gantry system



Beam limiting  
device system



# 1) Data Elements Standards

## mCODE Members

Founders



### PREMIER



### PRINCIPAL



### BENEFACTOR



### GOVERNMENT AGENCY



### SPONSORED MEMBER



### DEVELOPER/IMPLEMENTER



# Building an **Engaged** Network of Health System Solutions

IC IC ICAREdata  
TM TM Trial Matching

RR RR Registry Reporting  
RT RT Radiation Therapy Treatment Data

● **Active** – Committed or actively participating in planning, design, development, piloting

○ **Engaged & Previously Expressed Interest** – Engaged in multiple conversations and/or in the process of being Active

Brigham and Women's Hospital IC

City of Hope IC

Dana Farber Cancer Institute IC

Duke University IC

Heartland Cancer Research IC

Massachusetts General Hospital IC

Mayo Clinic IC

McGill University RT

MD Anderson Cancer Center IC

Metro-Minnesota Community Oncology IC

Missouri Baptist IC

Northwell Health RT

Rush University Medical Center IC

Saint Joseph Mercy Health System IC

The Ohio State University IC RT

The University of Chicago Medicine IC

ThedaCare IC

Trinity Health IC

UNC Lineberger Comprehensive Cancer Center IC

University of California San Francisco IC TM RR RT

University of Michigan RT

University of Pennsylvania IC RT

University of Texas Southwestern TM

Veterans Health Administration RT

Virginia Commonwealth University RT

Washington University in St Louis IC

Oncoclinicas ●

Taiwan Cancer Registry ○

Netherlands Cancer Registry ●

UC Los Angeles ●

## Scaling through Industry Implementations

CancerInsights ●

Cerner ○

Clinical Pipe ○

Elekta ●

Elsevier ○

Epic ●

Flatiron ○

IQVIA ●

Jitterbit ○

MassiveBio ●

Mettle Solutions ●

Microsoft ○

NeuralFrame ●

Nuance ●

PatientLink ●

Pfizer ●

Roche ○

Smedy ●

Syntropy ●

Trial Scope ●

TrialJectory ●

Varian ●

Wemedoo ●



### 3) Communication Standards



Fast Healthcare Interoperability Resources

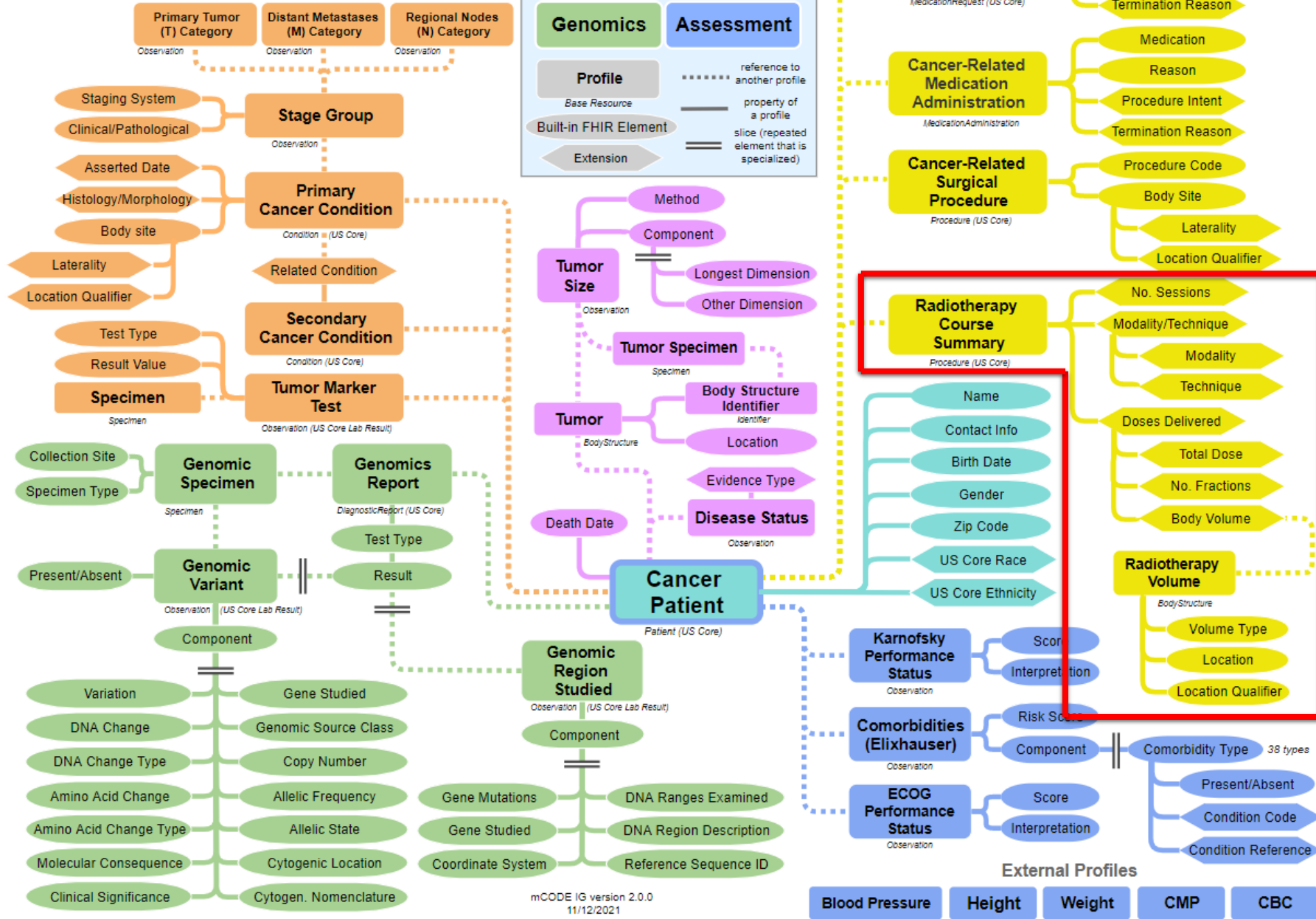
- HL7 standard that defines **how data is shared between systems**
- Fast, efficient and easy
- Built using latest **web standards** (e.g. API, JSON)



# mCODE STU 2

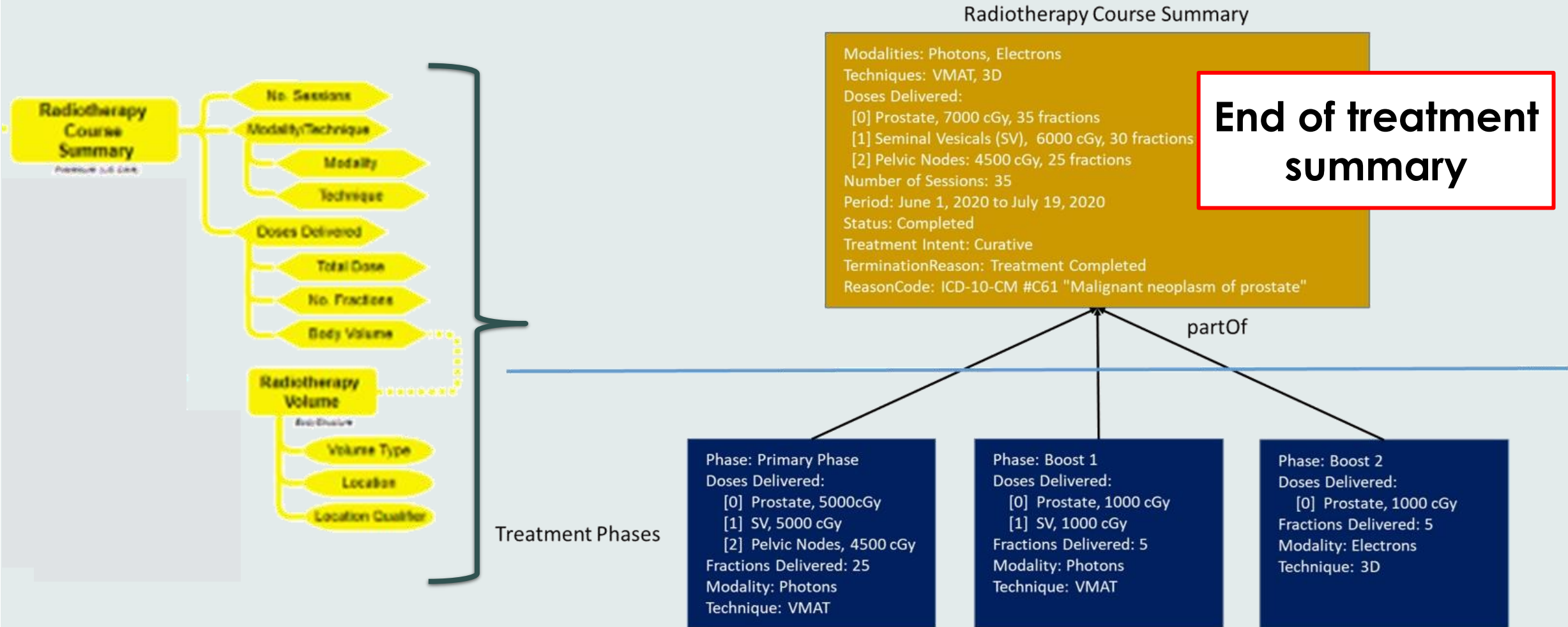
Click embedded links to see  
FHIR artifact definitions

This illustration is not a formal part  
of the mCODE specification. For  
brevity and clarity, names and  
structural relationships shown here  
may deviate from the specification.

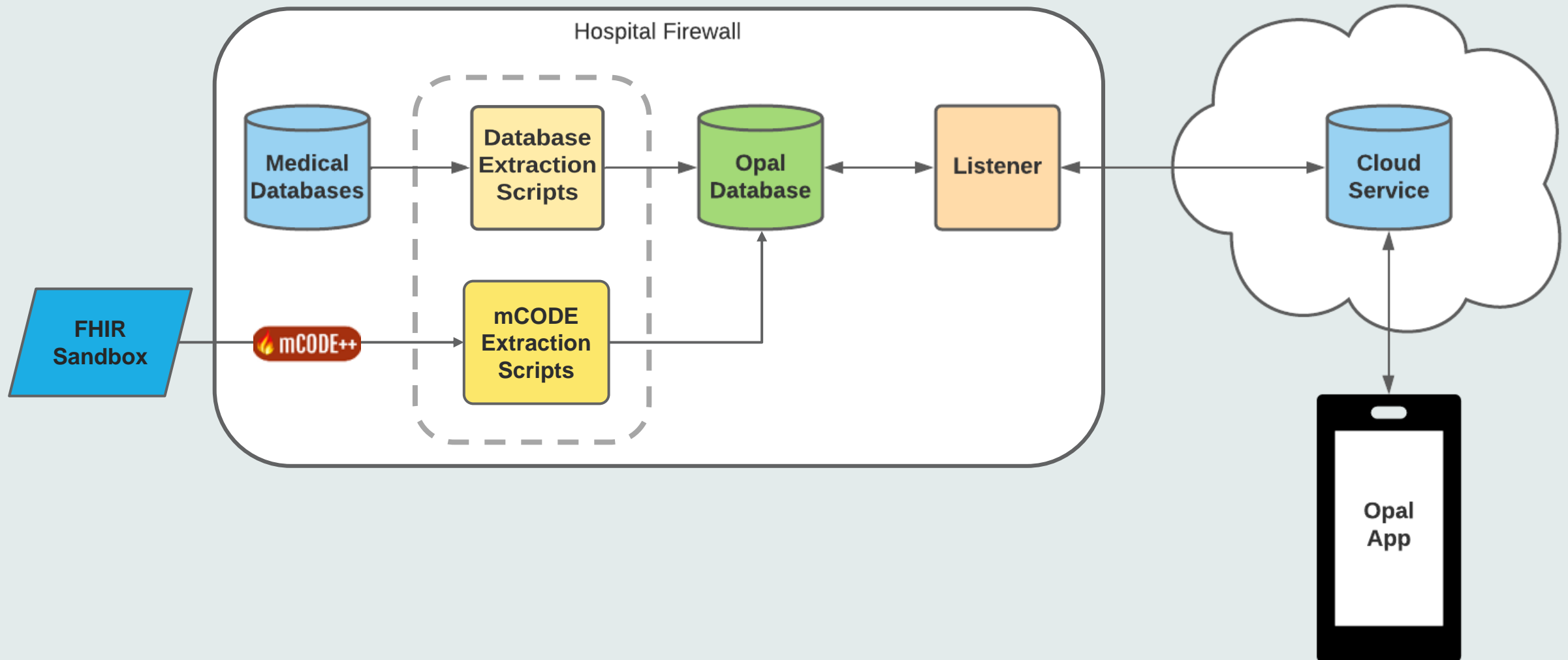


<http://hl7.org/fhir/us/mcode/>

# mCODE Radiotherapy Summary



# Opal Architecture

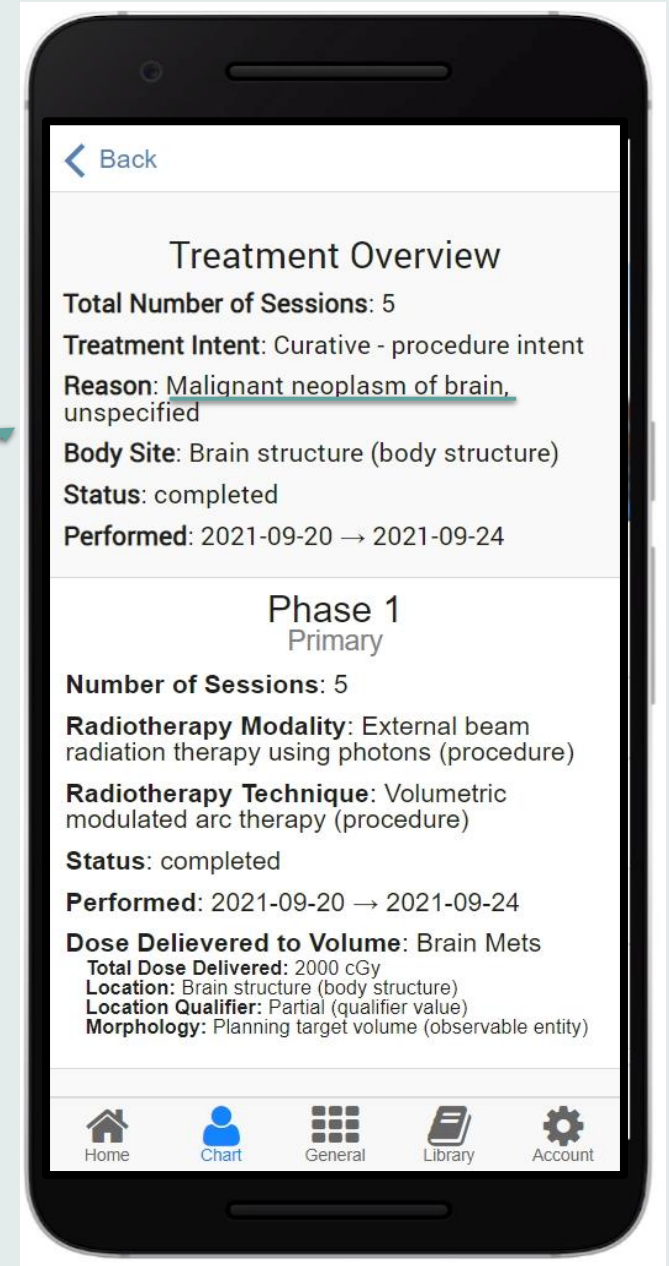
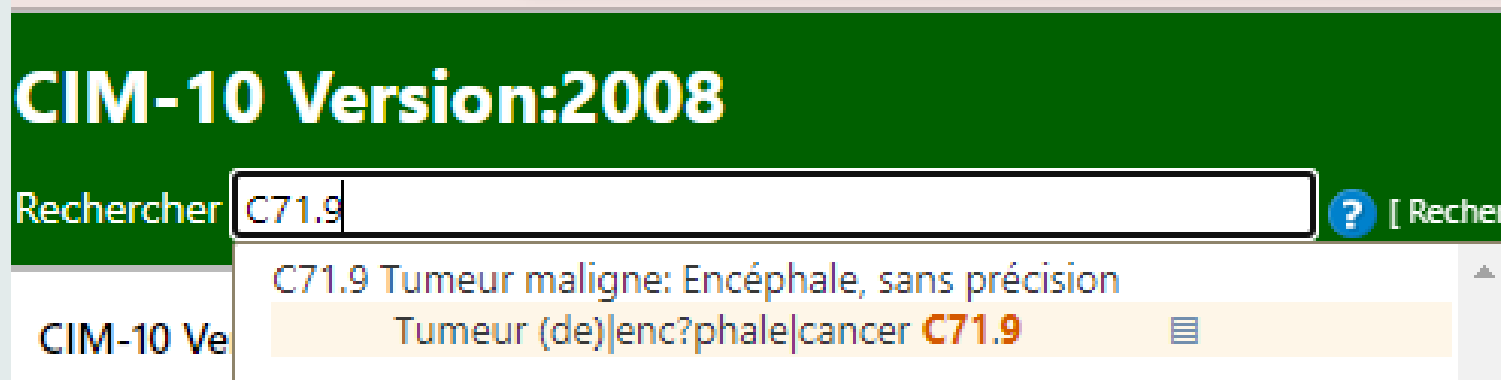


# Et en français?

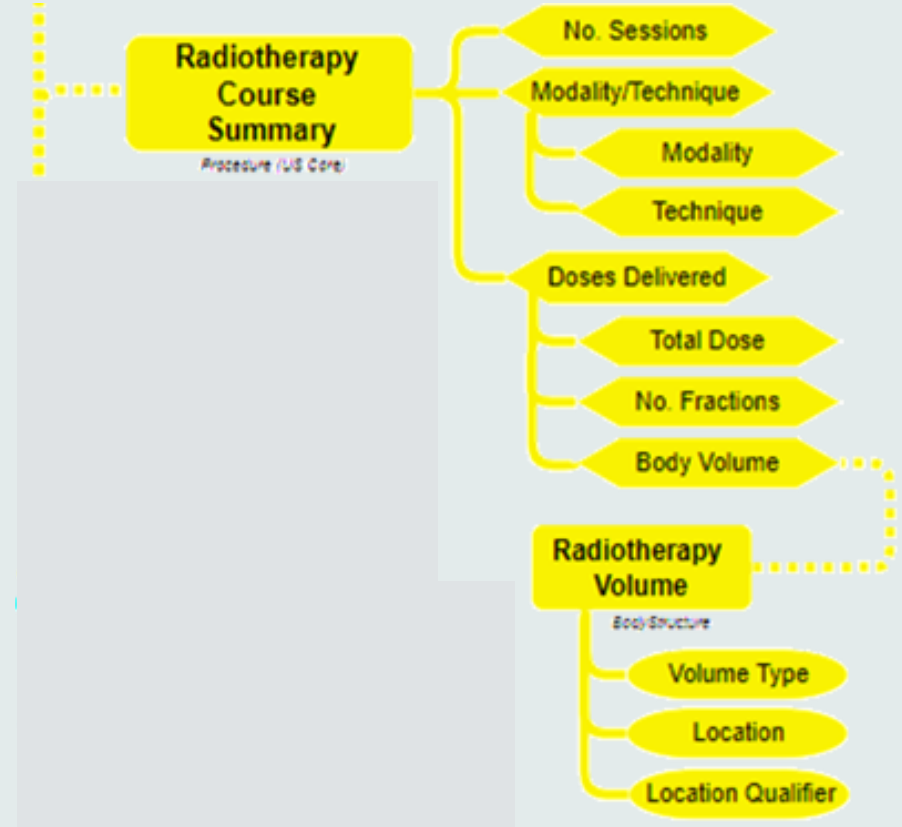
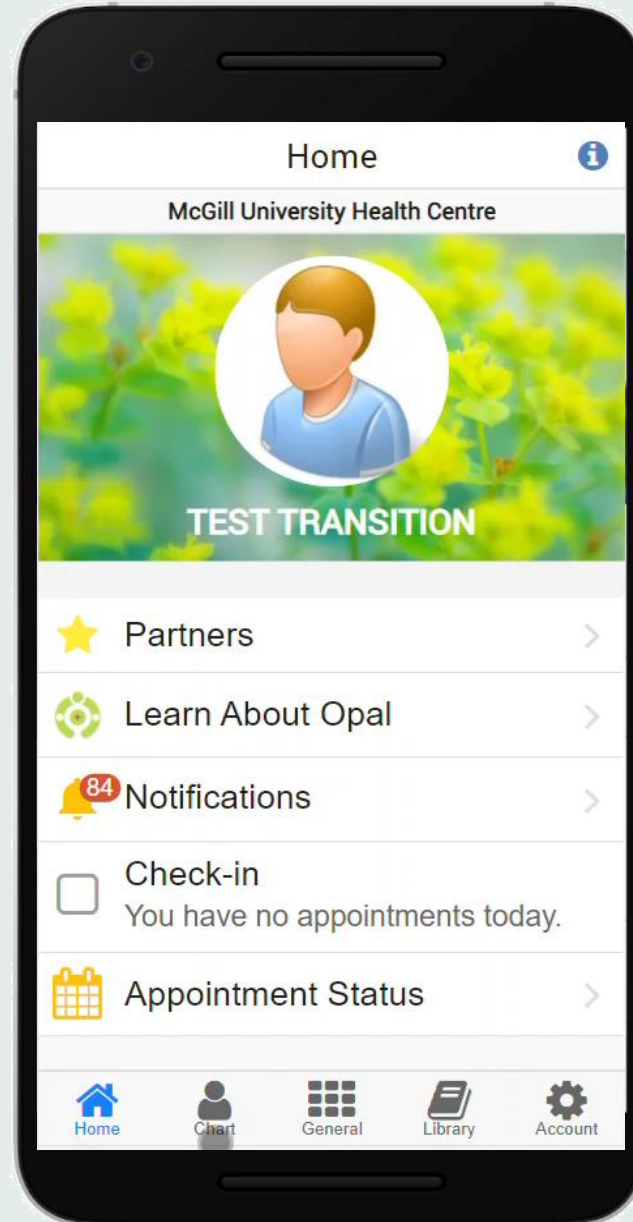
- The text elements are stored as a **coding system**

```
→ {  
  coding system: ICD-10,  
  code: C71.9  
  value: Malignant neoplasm of brain  
}
```

- Use coding systems' APIs to get translations

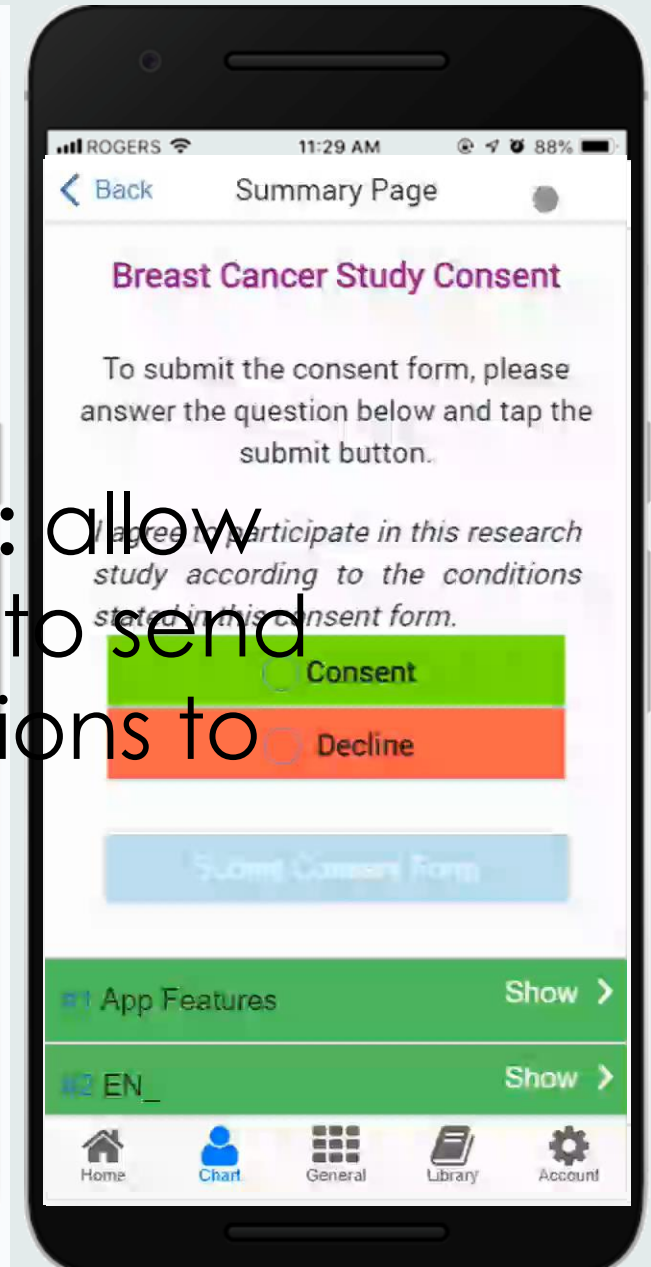
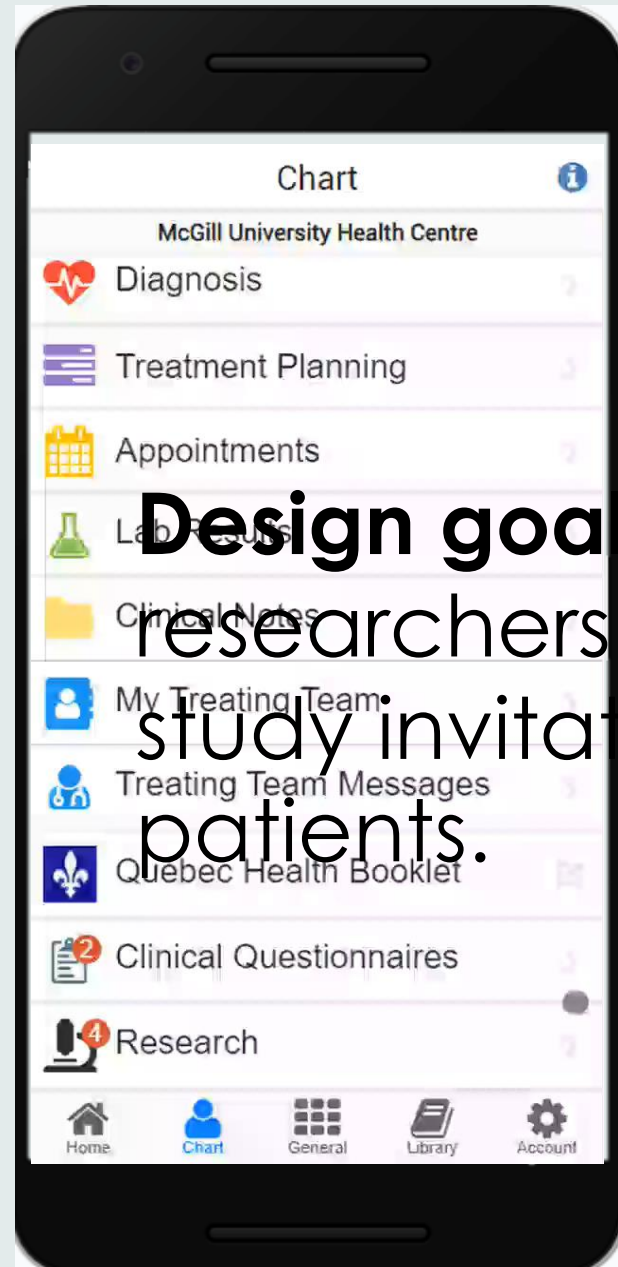
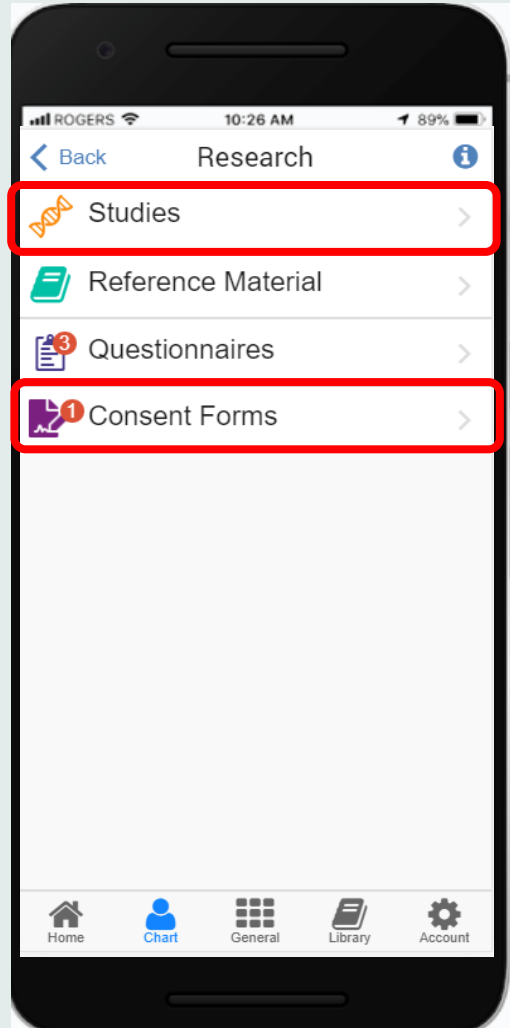


# Demo



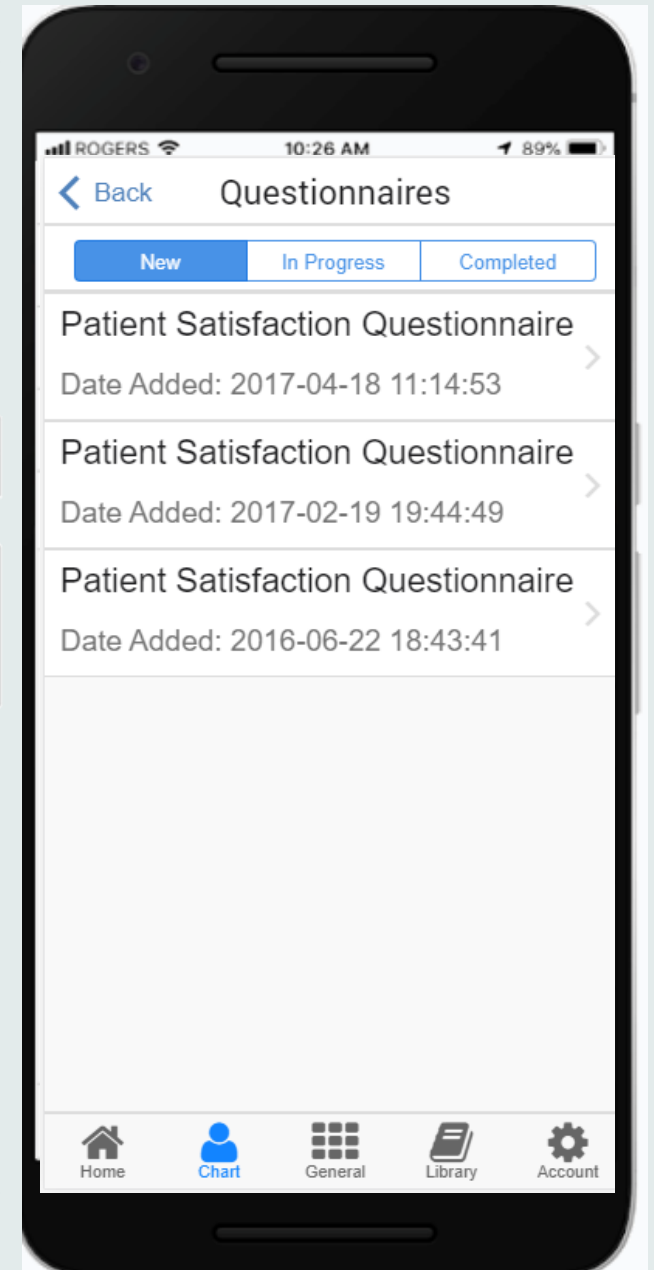
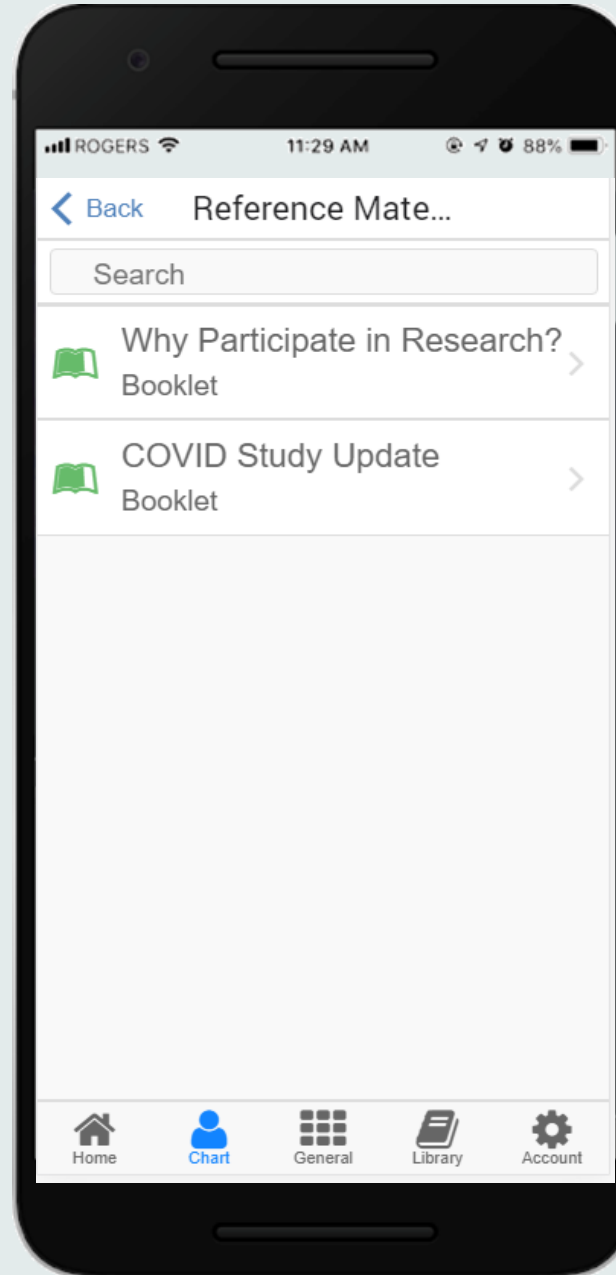
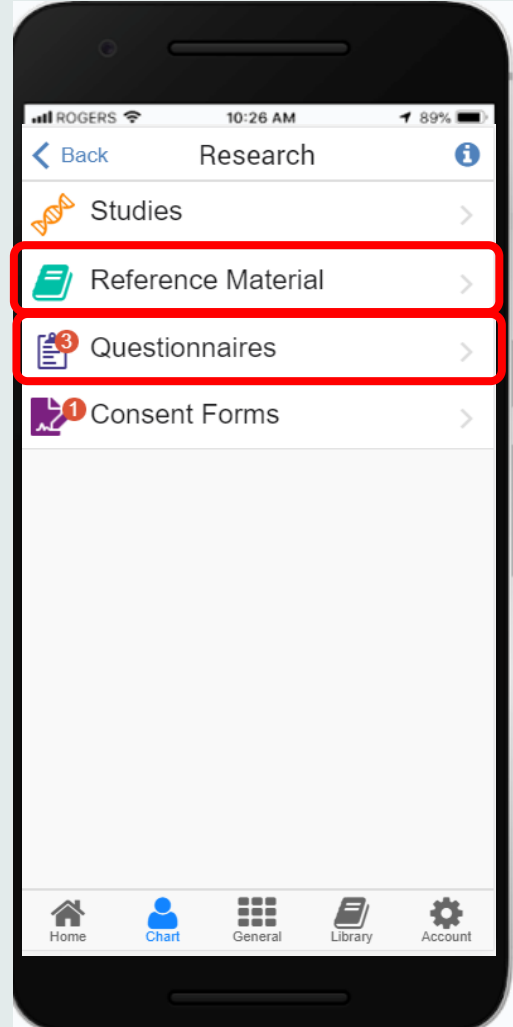


# Research Menu



Design goal: allow researchers to send study invitations to patients.

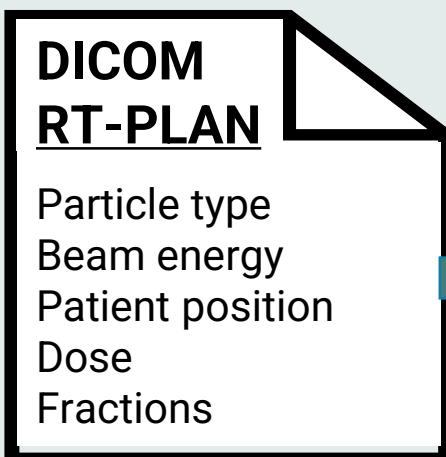
# Research Menu





# Creating Pre-Treatment Plans

Explanatory  
Text



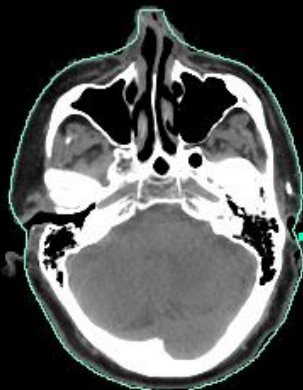
## Text Template

You will be treated with **electron** beams, which are used when the tumour is very close to the surface or on the skin. This is because...

# Creating Pre-Treatment Plans

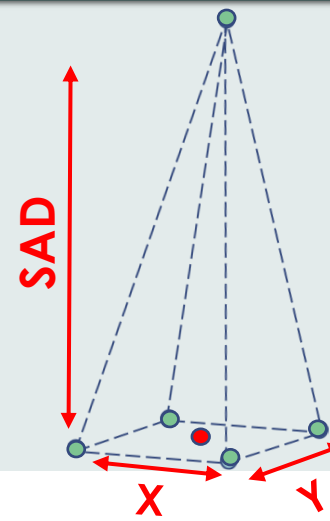
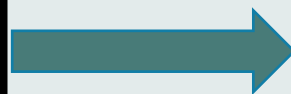
## 3D Visuals

DICOM  
RT STRUCT

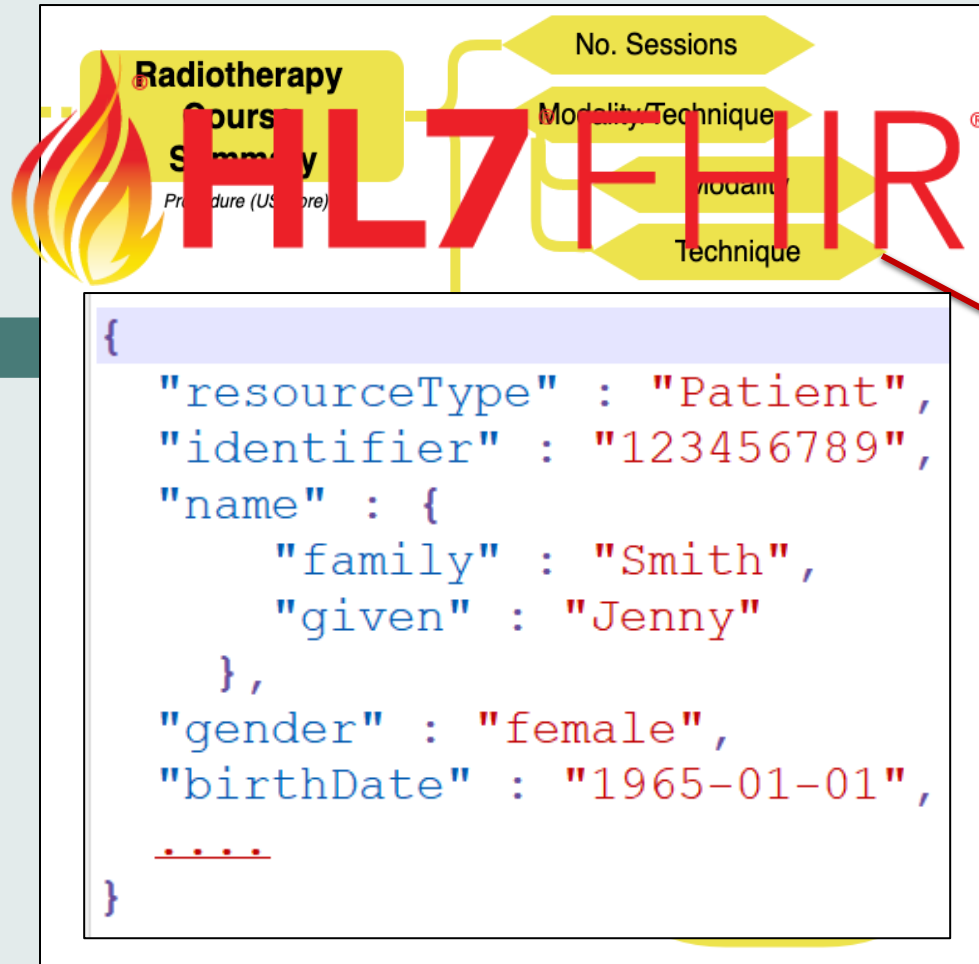
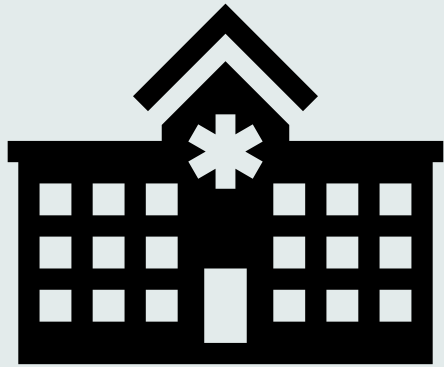


DICOM  
RT-PLAN

SAD  
Isocentre  
XY-Jaws  
Angles



# mCODE in Practice



**coding system:** SNOMED-CT  
**code:** 1156530009  
**value:** VMAT

