



# Web3D Consortium Medical WG Update

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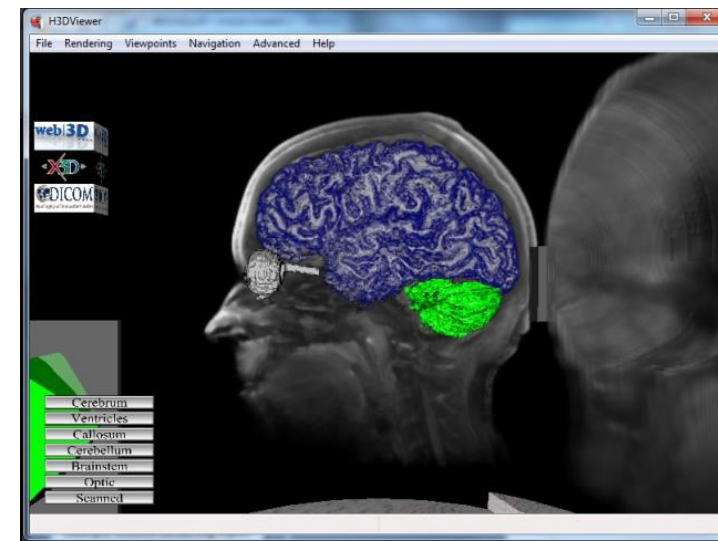
Virginia Tech

Web3D Consortium



# Topics

- Introduction
- Rendering
  - Volume Rendering
  - Extensions
  - Other Medical data
- 3D printing (NIH 3D Print Exchange)
- Informatics
  - HL7 (FHIR)
- Next Steps



# Web3D Medical WG

Funded by US Army to specify and standardize an X3D Volume Rendering Component (2006)

Notables:

- IEEE VR Workshop
- Web3D Conference workshops
- SIGGRAPH BOFS
- MOU with DICOM – n-Dimensional Presentation States
- SOU with HL7

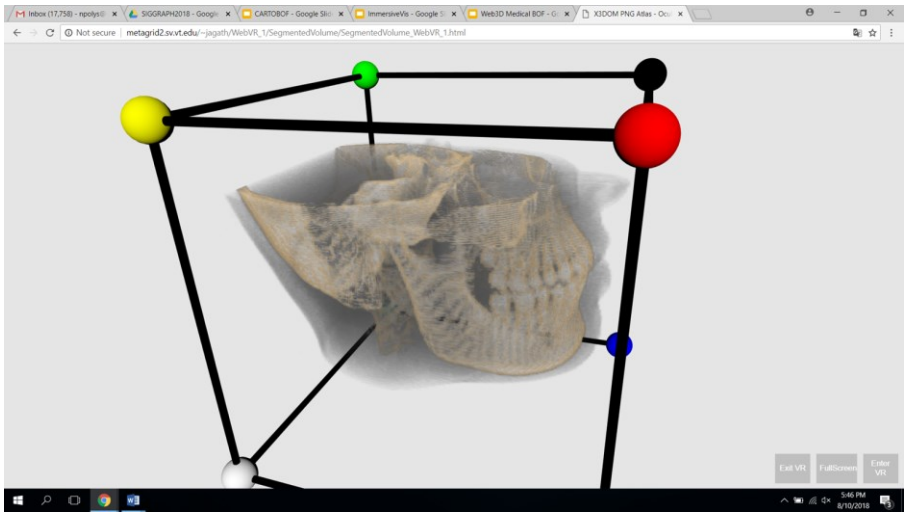
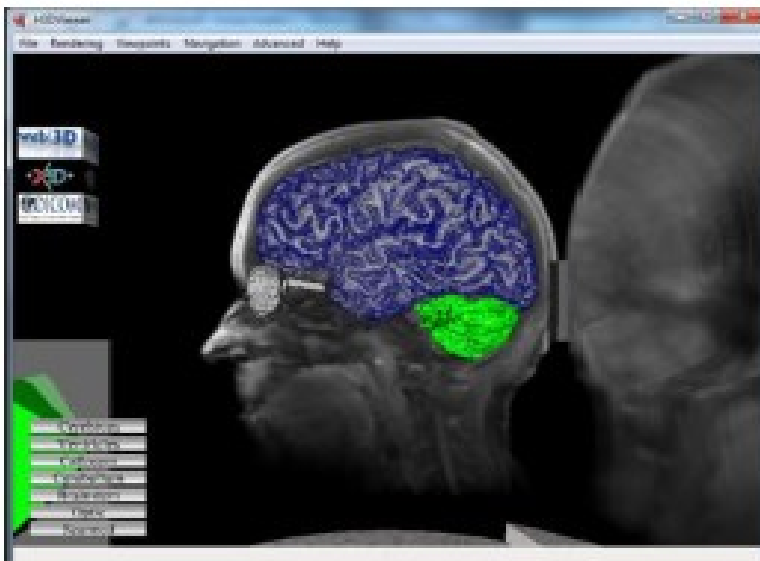
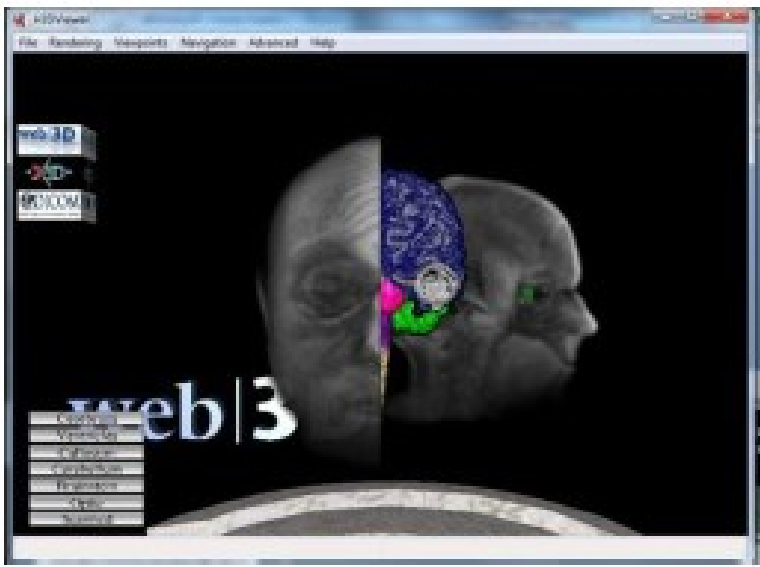
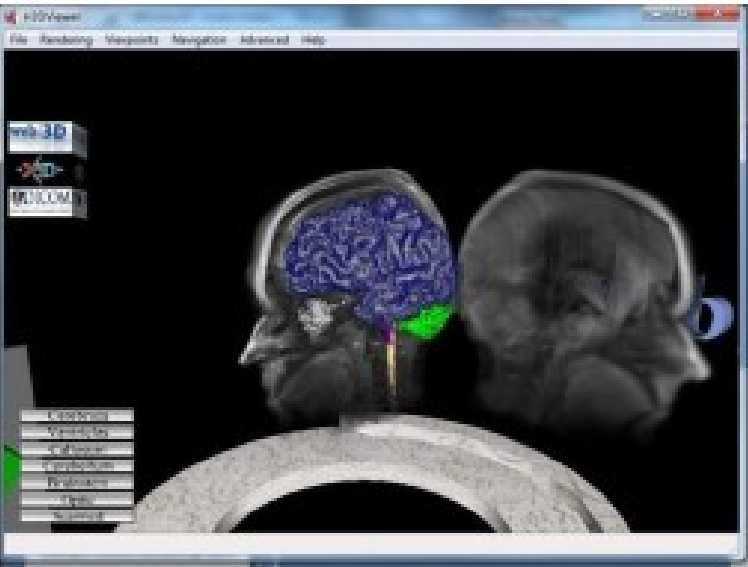
# Kinds of data, kinds of stakeholders

## Health and Medicine

- Exercise
- Therapy
- Simulation
- Surgery
- Genomics
- Analytics
- Networks
- ...

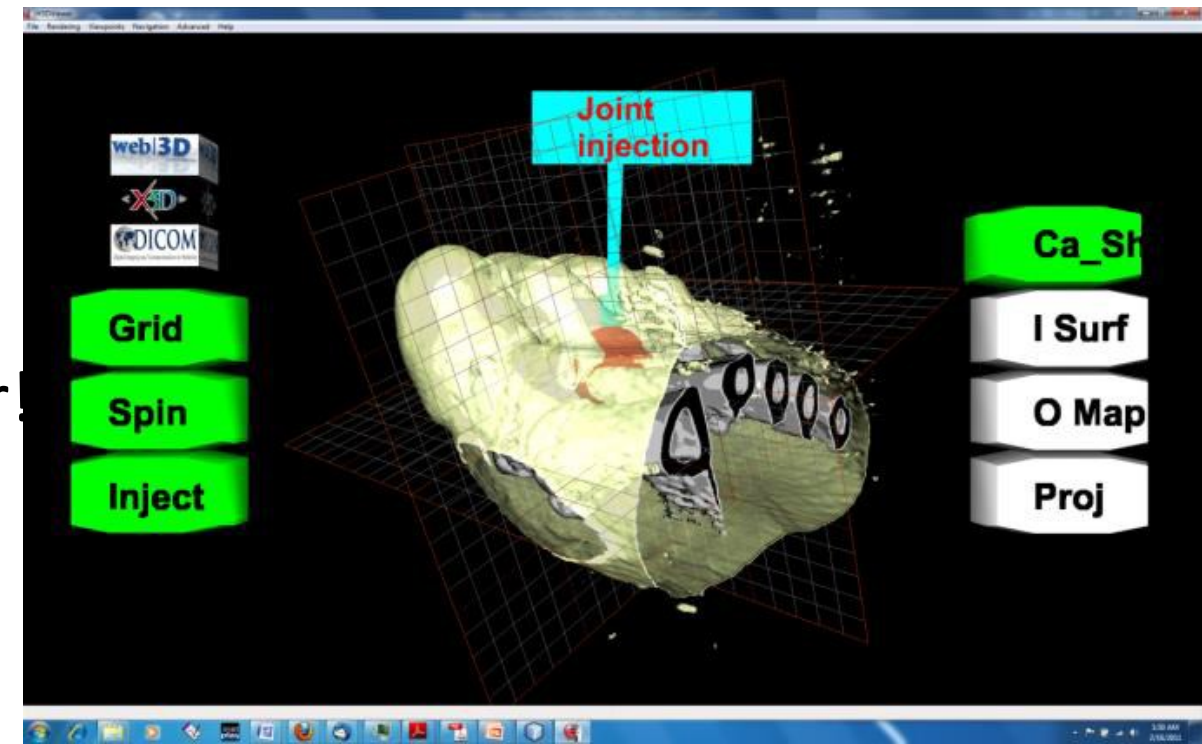
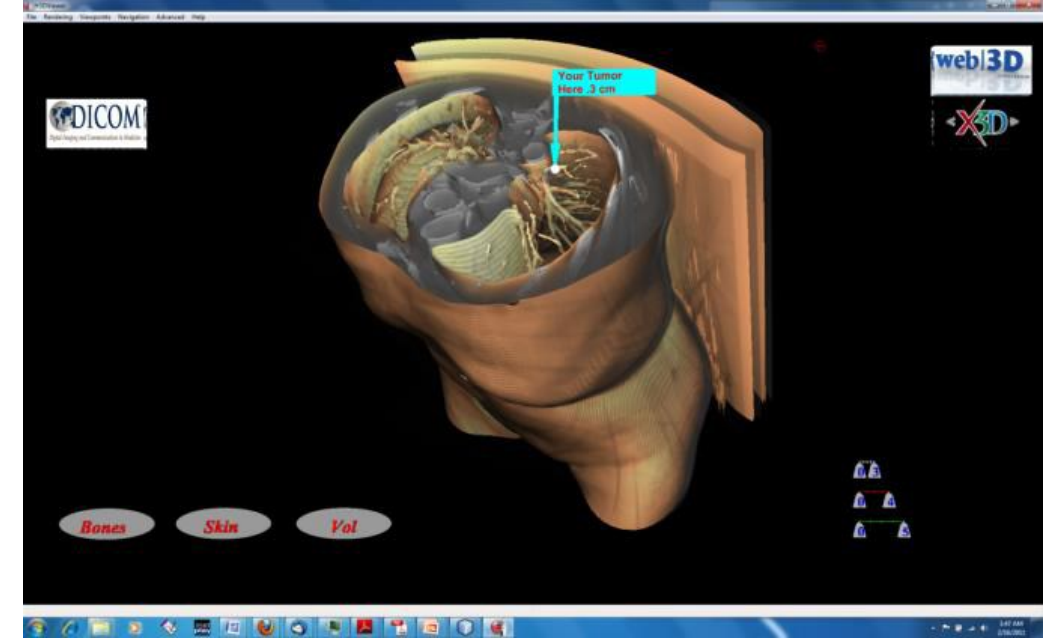


# X3D Volume Rendering



## Access: WWW and VR

- X3D: desktop, mobile, immersive VR/MR/AR
- Imaging
  - X3D Volume Rendering
  - TIFF stacks, DICOM, NRRD, PNG
  - Scripted automated conversions
- Molecular Visualization
- Immune Simulation
- Genomic alignment
- Polygons and volumes living together
- VR and 3D printing !!!



# Access: X3D Volume Rendering

- DICOM, NRRD, TIFF:
  - <https://www.youtube.com/watch?v=ml7zfrH6A9U&t=37s>
- Segmentations and Interaction Mashup:
  - <https://www.youtube.com/watch?v=ZO3jWjW9soE>
- Cell images with corresponding surfaces:
  - <https://www.youtube.com/watch?v=srpiEBvbG-Q&list=UUoQkIIQuVbdKEBqgefLbhzw>
- Many publications

# Extensions

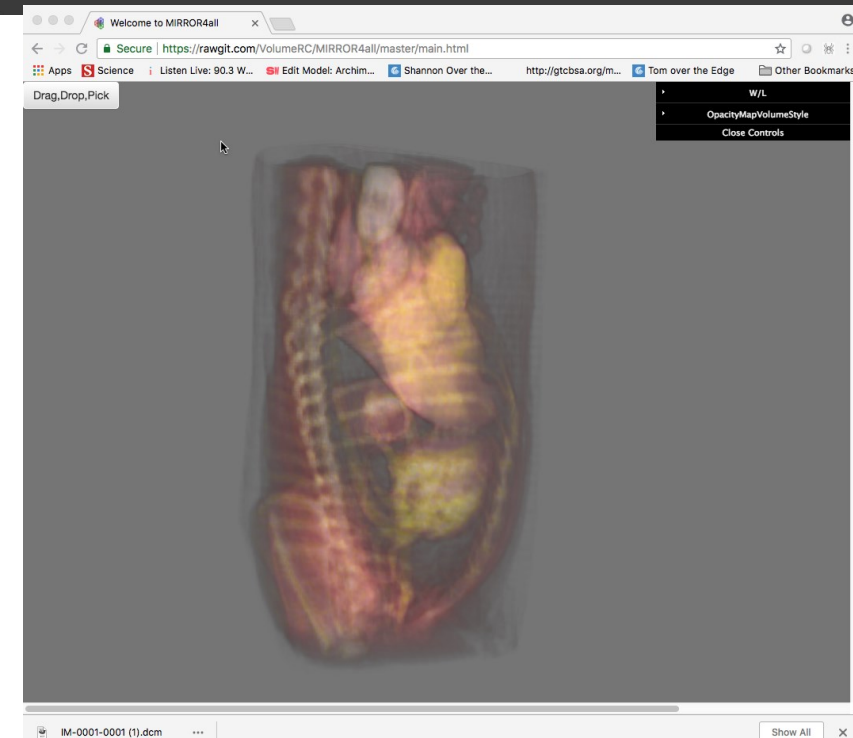
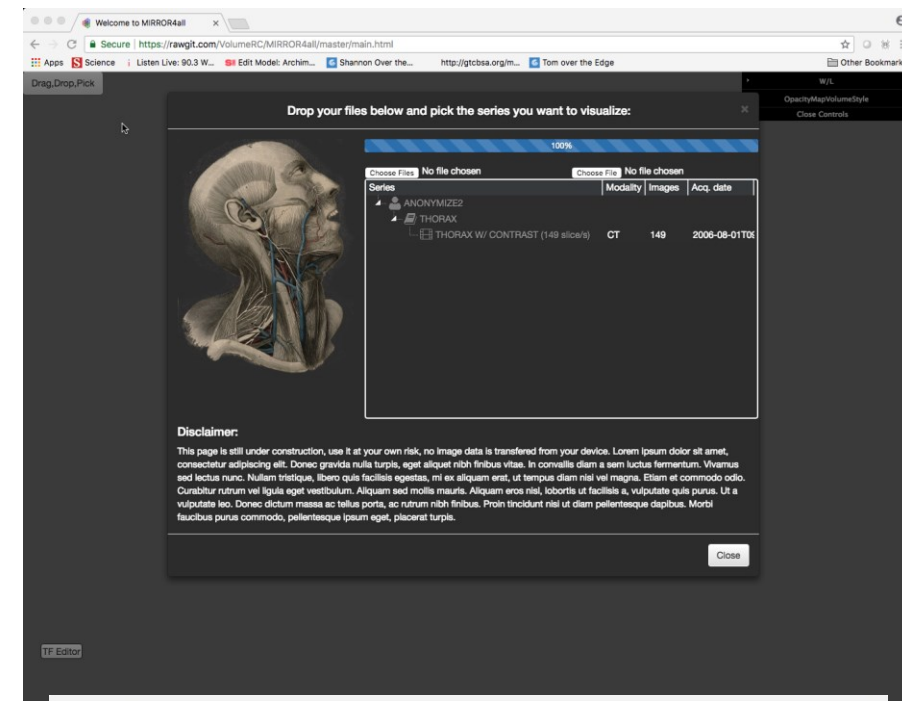
- ImageTextureAtlas
  - MovieTextureAtlas
  - VolumeData
  - MPRVolumeStyle
- 
- Ander Arbeláiz, Aitor Moreno, Luis Kabongo, Nicholas Polys, and Alejandro García-Alonso. 2017. Community-driven extensions to the X3D volume rendering component. In Proceedings of the 22nd International Conference on 3D Web Technology (Web3D '17). ACM, New York, NY, USA, Article 1, 9 pages. DOI: <https://doi-org.ezproxy.lib.vt.edu/10.1145/3055624.3075945>



# Access: Web Volume Rendering in X3DOM

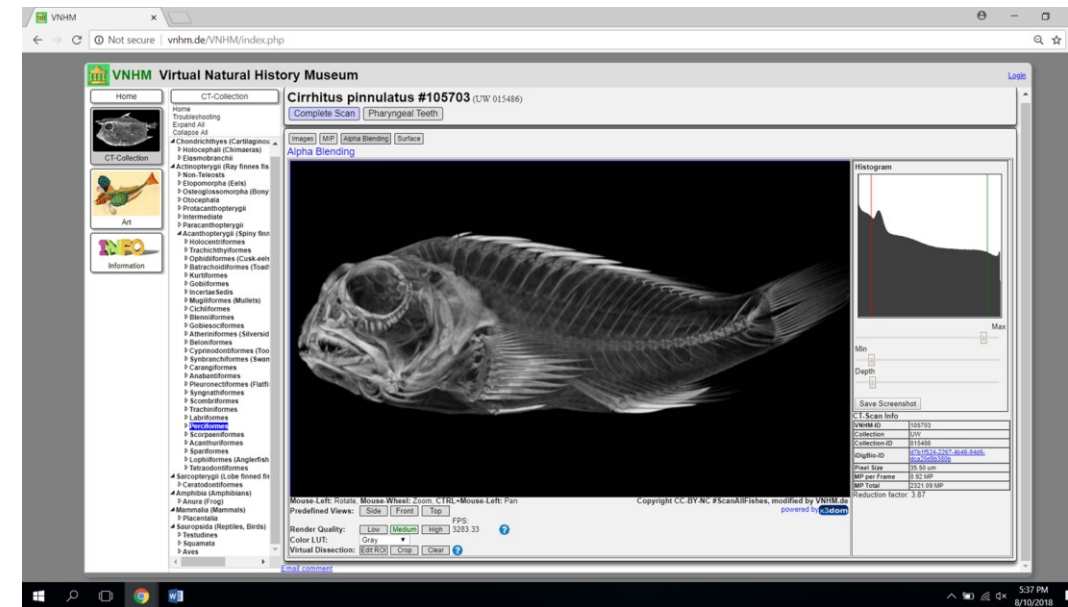
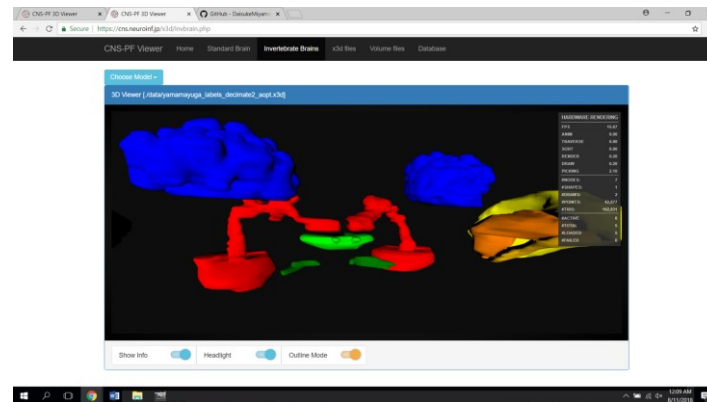
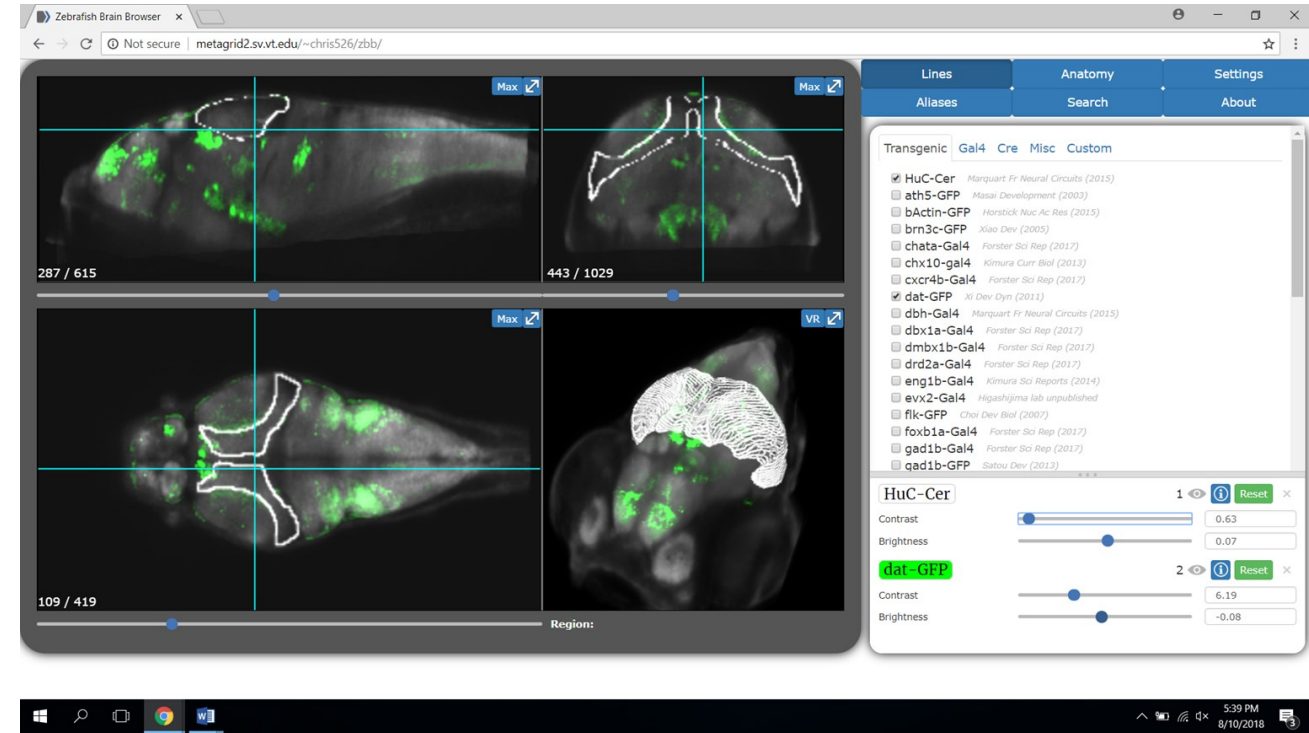
## HTML5 + WebGL + X3D

- [VICOMTech: Volumerc.org](https://www.vicomtech.org)
- Online drag-and-drop service for DICOM:
  - To HTML5/WebGL/X3DOM
  - [Mirror4All](https://www.mirror4all.com) by VICOMTECH and Kshell
  - Open source python processing scripts



# Access: WWW and VR

- **HTML5 + X3D Portals**
  - *Zebrafish genetic and neuro atlas: [zbbrowser.com](http://zbbrowser.com)*
  - *Virtual Natural History Museum: <http://vnhm.de>*
  - CNS-PF [neuron viewer](http://cns-pf.org)
  - Cell image library
  - NIH 3D Print Exchange

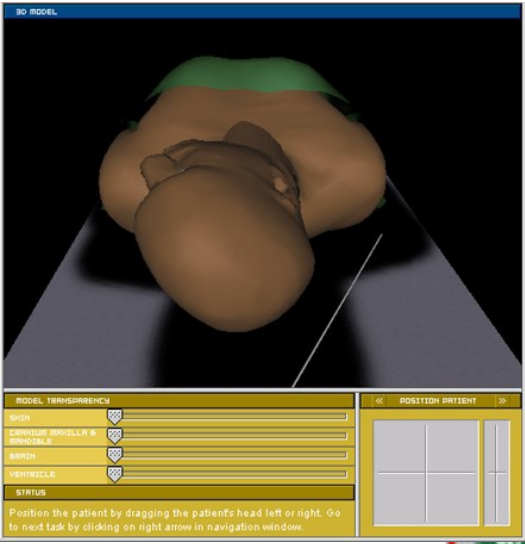


# Access: WebVR

- X3D and HTML5 files
- Uses the browser as the platform
- Many headsets



# Rehearsal; Consent



3D MODEL

MODEL TRANSPARENCY

SKIN	<input type="checkbox"/>
CERVICAL ARTERIES & VEINS	<input type="checkbox"/>
SPINAL	<input type="checkbox"/>
VENTRICLE	<input type="checkbox"/>
STATUS	<input type="checkbox"/>

POSITION ORIENT

Position the patient by dragging the patient's head left or right. Go to next task by clicking on right arrow in navigation window.

*Virtual Environment*



*Immersive Workbench*

Interspinous Ligament

L3

L4

FORCES

WEIGHING

SPINAL NEEDLE

ROTATION:

< / >

↑

↓

PRACTICE MODE

VSA

Tutorial Kit

A screenshot of a virtual environment. The central focus is a yellow, cylindrical virtual needle positioned between two vertebrae labeled L3 and L4. The needle is shown in a 3D perspective. The background is a light-colored, textured surface. The interface includes a control panel on the left with various buttons and a 'Tutorial Kit' label in the bottom right corner.

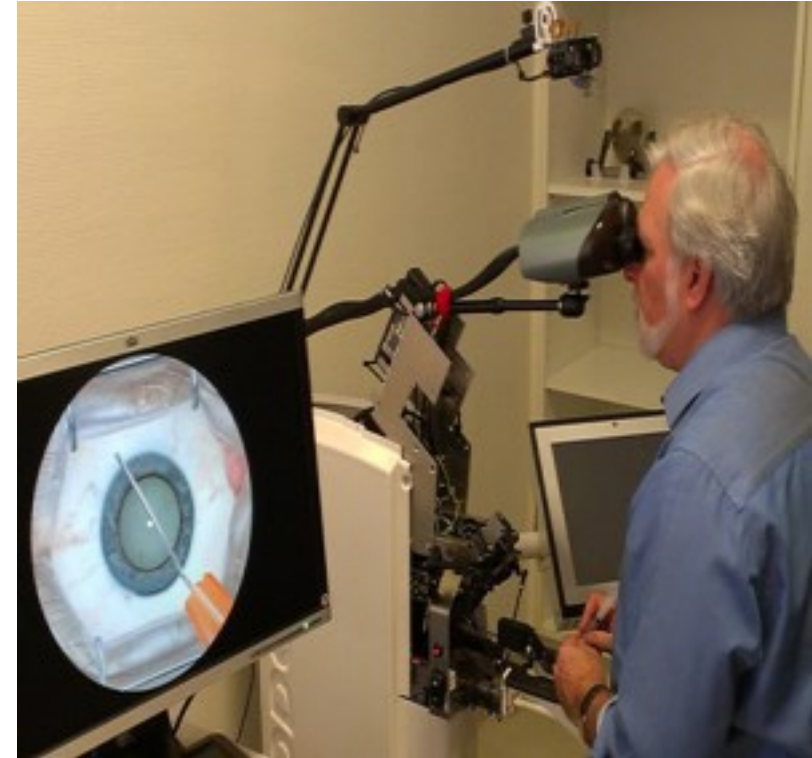
*Virtual Needle*



# Surgical Simulation

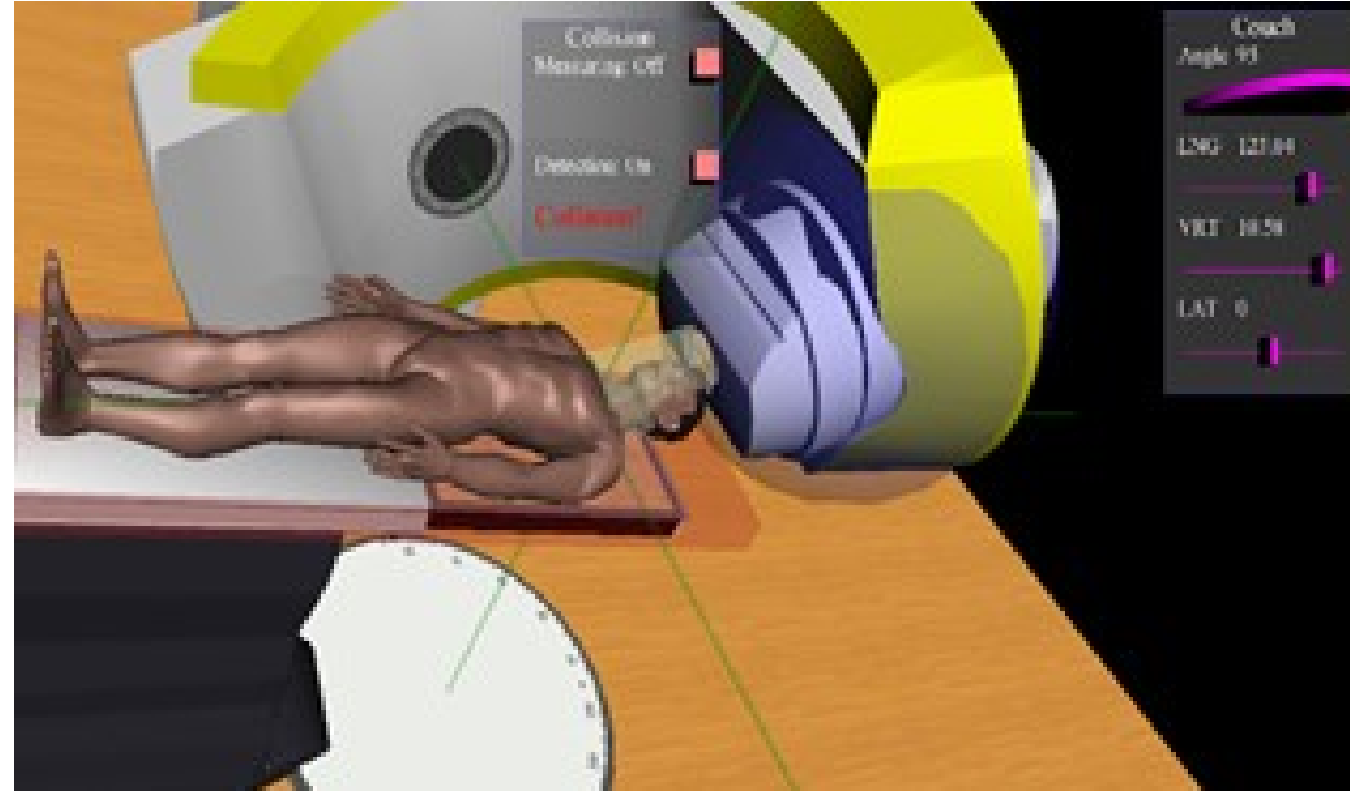
X3D as a platform for Haptic simulation and Medical training

- H3D.org
- Nigel John's trainers:
  - Eye surgery simulator
  - Ventricular catheterization training
- MMVR 2014 workshop
- "Quantizing the Void" paper



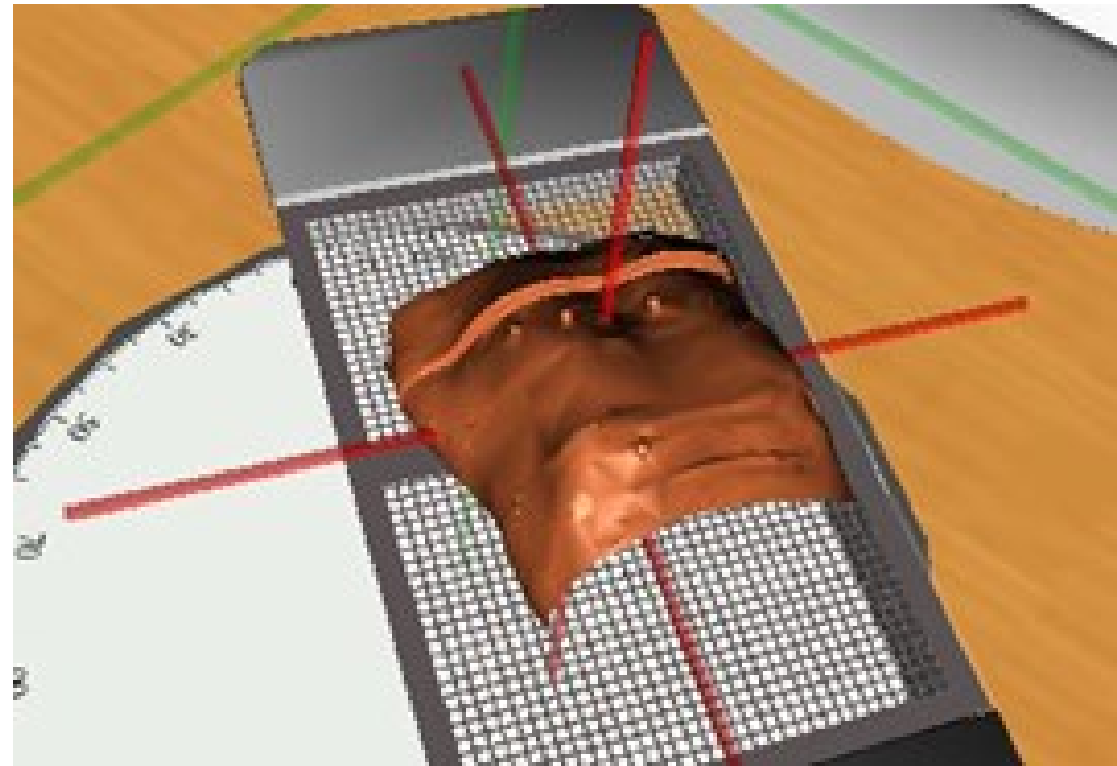
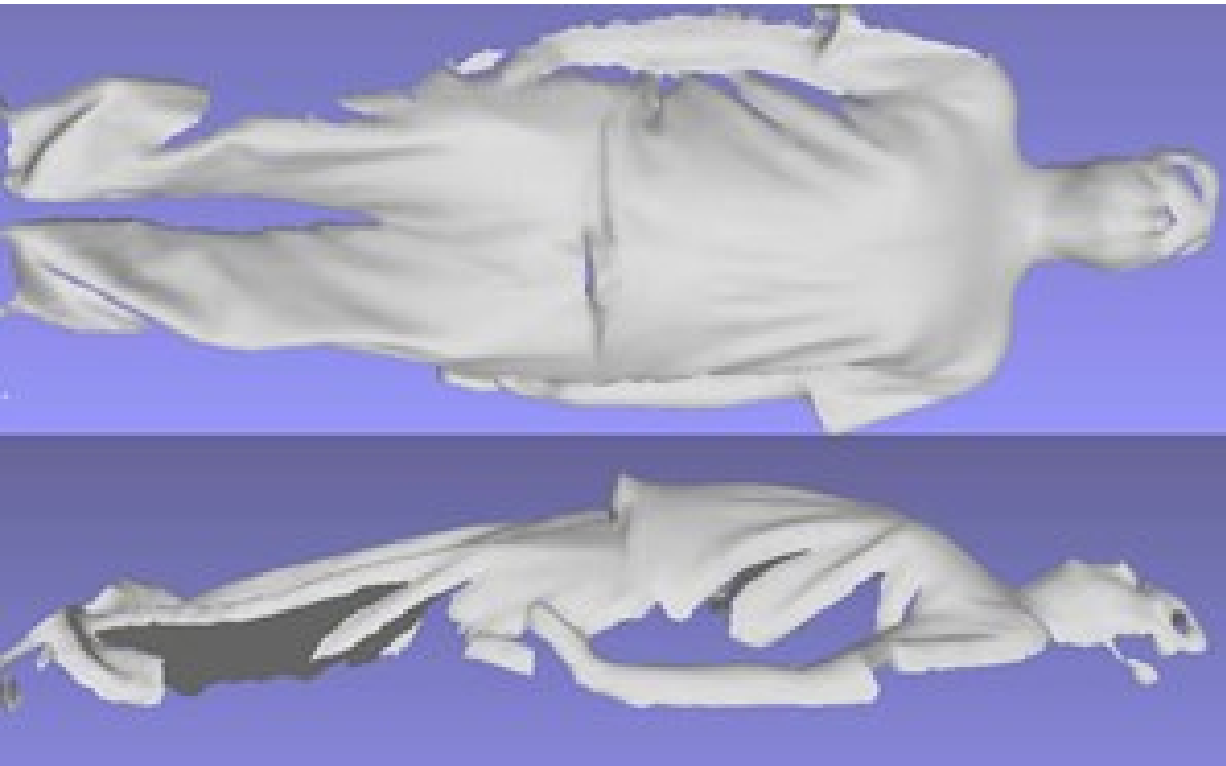
# Safety and Radiation Therapy

## X3D simulation of X-Ray therapy: Felix Hamza-Lup



# Safety and Radiation Therapy

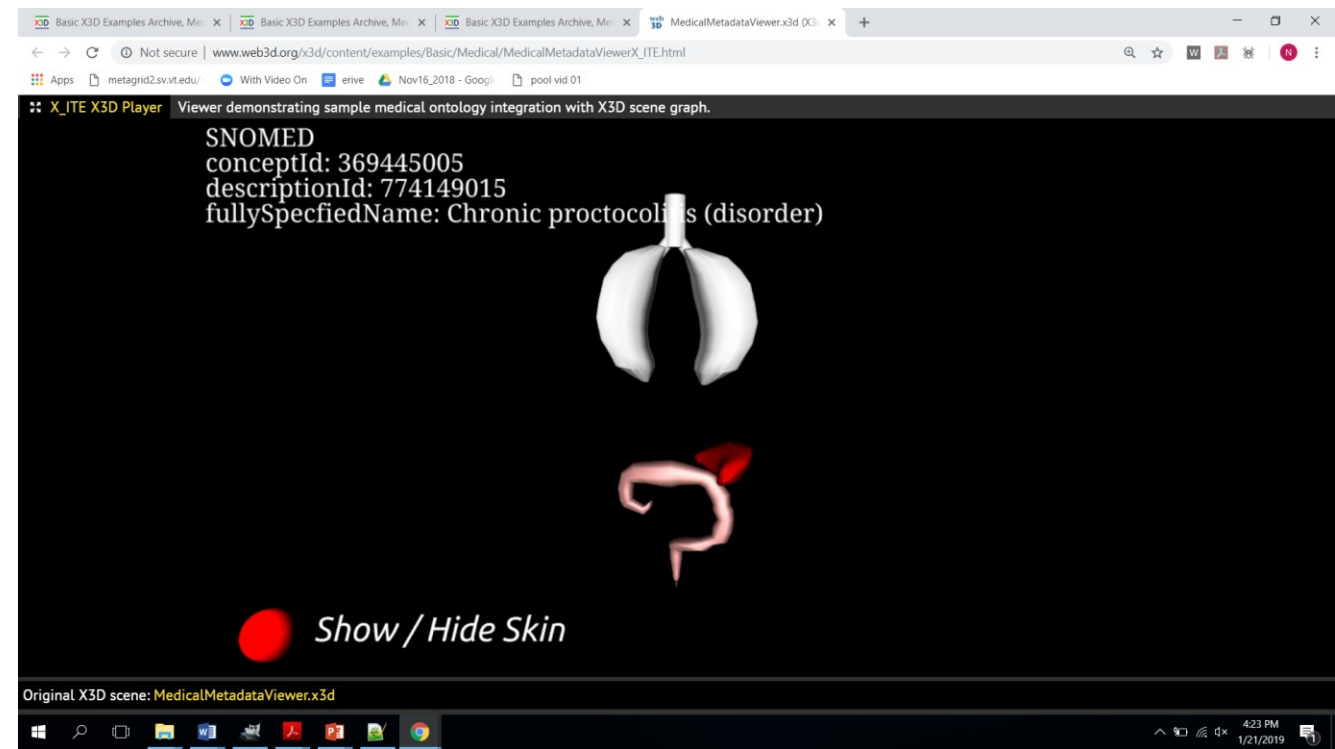
Patient CT data and real-time boundary representation for the 3DRTT simulator ([3DRTT.org](http://3DRTT.org))



# SNOMED and FMA in an X3D Scenegraph

- ***X3D Example Archives: Basic, Medical, Medical Metadata***
- MetadataSets demonstrating sample medical ontology integration with X3D scene graph.

<http://www.web3d.org/x3d/content/examples/Basic/Medical/index.html>







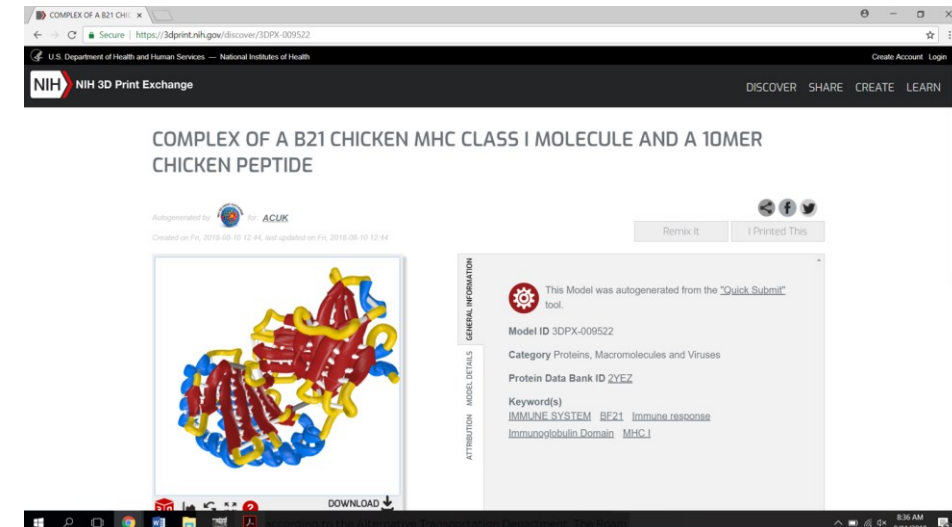
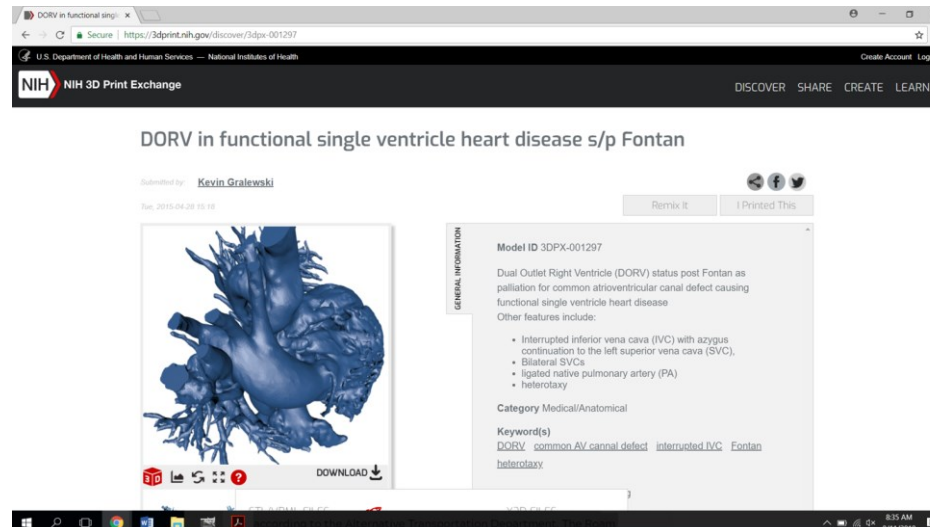
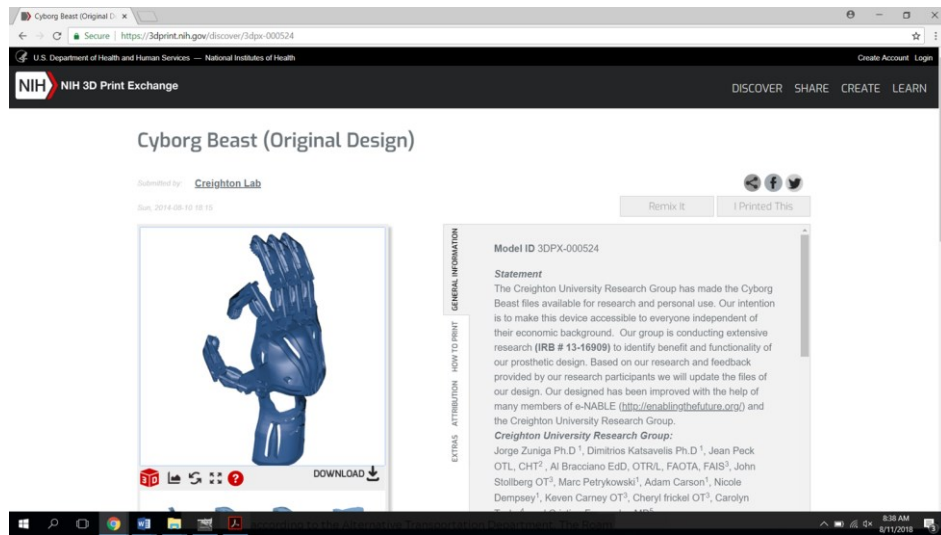
**High spatial and  
temporal resolution  
body scans**

**[www.3dmd.com](http://www.3dmd.com)**



# Access: NIH X3D Printing

# 3dprint.nih.gov



# Choosing X3D for Enterprise 3D printing services

- X3D is lossless for meshes, color, metadata (STL IS NOT)
- Supported by many tools in the field (biochemistry)
- Web Services for processing translation
- CURA open source slicing toolkit for native X3D printing:
  - Shapeways color printing
  - Ultimaker
  - NetFabb

# HL7

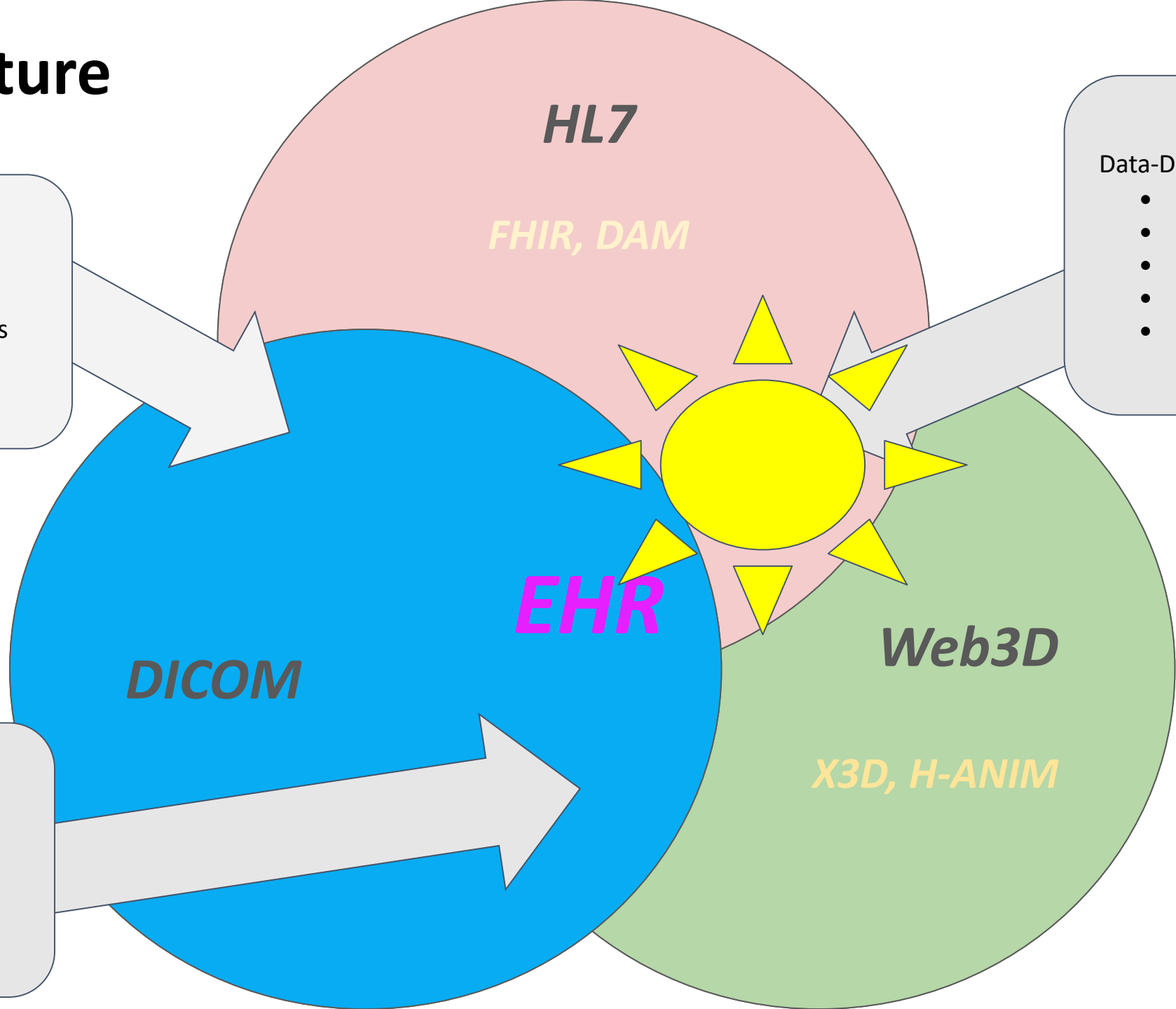
- FHIR <http://hl7.org/fhir/> (FHIR)
  - Example: <https://syntheticmass.mitre.org/api.html>
- Loinc.org LOINC is a common language (set of identifiers, names, and codes) for identifying health measurements, observations, and documents. If you think of an observation as a "question" and the observation result value as an "answer."
- Where needed, codes from other standards (e.g. SNOMED CT) represent the "answer."

# EHR Big Picture

- Patient Imaging
- Treatments
- ...

- Data-Driven Visualization:
- Scanning
  - Physical Therapy
  - Microscopy
  - Bioinformatics
  - Analytics

- Multimodal Patient Imaging
- Treatments
- n-D presentation
- Simulation
- ...



# Path Forward

## *X3D in HL7:*

- XML & JSON payloads of X3D content in FHIR
- DAM-specific integrations

## *HL7 in X3D:*

- Metadata vocabularies & reference practice
- Using 3D Semantic Interaction to explore high-dimensional HL7 information



# Pipelines to Exchange Views on the Patient

**HL7 FHIR Endpoint**

*Health Records:*

- DAMs
- DICOMs
- X3D as scene or url

**Use-case driven mappings**

*lossless ; cross-referenced*

- Codes -> Anatomy
- SampledData timeseries
- Surgical Planning
- X-Ray-Proton Therapy
- Body Scans
- Therapeutic VR
- Physical Therapy
  - Exercise data
  - Motivational VR
- ...

**Extensible 3D (X3D)**

- XML (dtd, ...)
- JSON
- Binary
- utf8
- ...
- ECMASCRIPT
- Java

**Display Modalities**

- Desktop - Mobile
  - Metadata, urls
- VR-MR-AR
  - Metadata, urls
- 3D Printing
  - Metadata, urls
- ...
- GIS
  - Metadata, urls
- Human Animation
  - Metadata, urls

# Next Steps

- X3D 3.4 and 4.0 spec updates
- Web3D Quickstart tutorial @ AMIA 2019
- Web3D 2019
- HL7 Atlanta (September)

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