

The Tools of TCIA

Standardizing Zero-Tolerance De-identification



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Introduction

TCIA Collections



Data Collection

Specialized de-identification processes and tools support data collection, curation, and de-identification

Specialized Teams

Data Hosting and Query

Research-focused website GUI and programmatic interfaces

• Radiology

- 70,420 subjects
- 169,567 studies
- 79,682,647 images
- 31.4 TB of data
- Modalities
 - (CT / MR / PET / MG / US / SR / RT)
- File types:
 - (DICOM / NIFTI / NRRD)
- 250 TB downloads / month

• Pathology

- 7,147 subjects
- 219,526 images
- 12.38 TB of data
- Modalities:
 - (WSI / microarray / IFC photomicrograph / raster)
- File types:
 - (SVS / TIFF / NDPI / MRXS / JPG, HDF5, BMP)
- 25 TB download / month

TCIA Workflow

- **Submission**

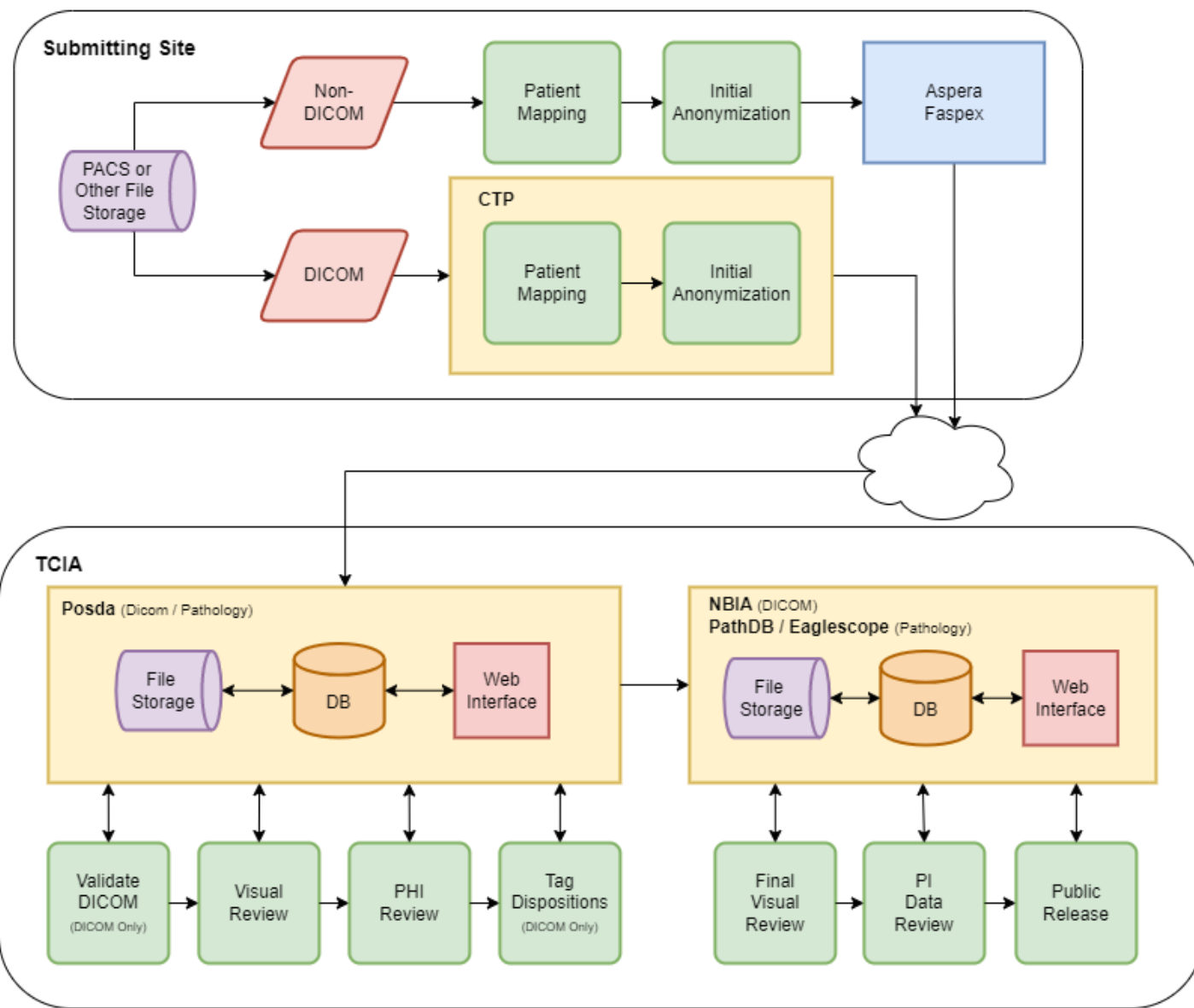
- CTP
- Aspera Faspex

- **Curation**

- Posda

- **Publication**

- NBIA
- PathDB / Eaglescope





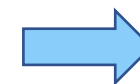
Submission

Submission

Submit **Proposal**



Monthly review by
TCIA **Advisory Group**



TCIA **Submission**
and **Curation** Support

TCIA New Collection Proposal

Please answer the questions below to allow the TCIA Advisory Group to review your proposal. The group meets monthly to review new proposals. You will be invited to the next upcoming meeting to review your proposal and answer any questions. Contact help@cancerimagingarchive.net with any questions.

Not shared

* Indicates required question

Dataset Publication
TCIA publishes datasets in the same way that journals publish manuscripts. Each dataset is assigned a title, author list, abstract, and digital object identifier.

Suggest a descriptive title for your dataset. *

The title should be similar to one you would use for the title of a manuscript.

Your answer

Suggest a shorter nickname for your dataset. *

E.g. "Segmentation of Vestibular Schwannoma from Magnetic Resonance Open Annotated Dataset and Baseline Algorithm" has a shorter nickname "Schwannoma-SEG".

Your answer

Submit Your Data Access The Data Help

CANCER IMAGING ARCHIVE

About Us Research Activities News

Confluence Spaces

Advisory Group Charter

Created by Justin Kirby, last modified by John Freymann on Jan 18, 2023

The Cancer Imaging Archive (TCIA) is intended to be a resource to the research community. As such, the archive is one that would be of value to our target audiences. Researchers are encouraged to submit data to the archive that meets the following criteria:

- Meeting the data sharing requirements set forth by an NCI grant or contract award
- Sharing data for analyzing imaging features to be used as biomarkers
- Sharing data for comparing image features to other data types such as genetics, pathology, or biomarkers
- Sharing data for the creation of automated or semi-automated algorithms for detection of cancer
- Sharing data as a reference collection for testing and validating quantitative analysis techniques
- Sharing data with unique characteristics for clinical training

The TCIA Advisory Group reviews each candidate collection based on the criteria above and the availability of resources. The Advisory Group may request clarifications for each candidate collection. Preference is given to data sets which can be fully shared. Proposals which contain supporting non-image data (e.g. patient outcomes, training data) are preferred over those which lack these characteristics. The Advisory Group is composed of staff from the National Cancer Institute (NCI) and the National Cancer Research (FNLCR) who are experts in cancer imaging, informatics and related technologies. The

TCIA SUBMISSION TOOL

TCIA Help Desk CTP Status

Import Confirm Configure Anonymize Transfer

Import Your Data

Browse your computer and locate the directory containing the DICOM data you would like to submit. All sub-directories will be included in the import.

NOTE: The act of importing creates a copy of your data. Please ensure you have enough free space. You currently have 227 GB available on D:\.

Or
[Confirm your PACS Import](#)

D:\VIMAGINGFILES

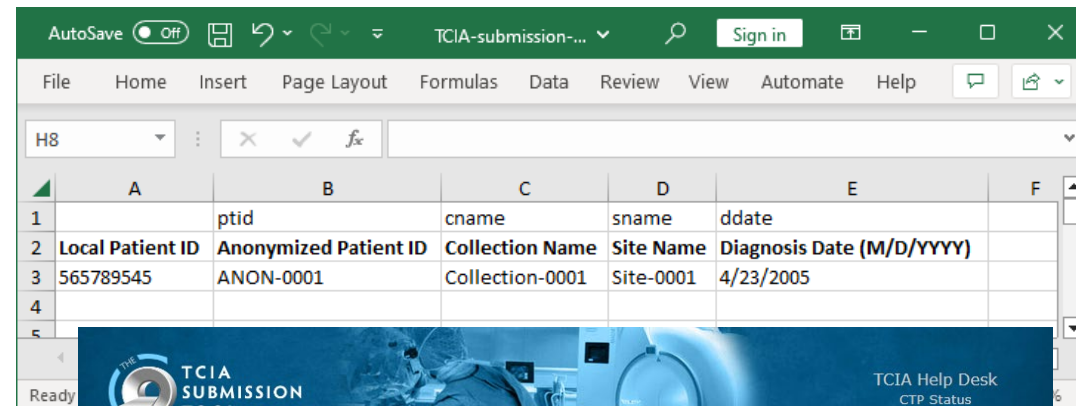
- deidentified
- final
- log
- Projects
- stage

Import Data

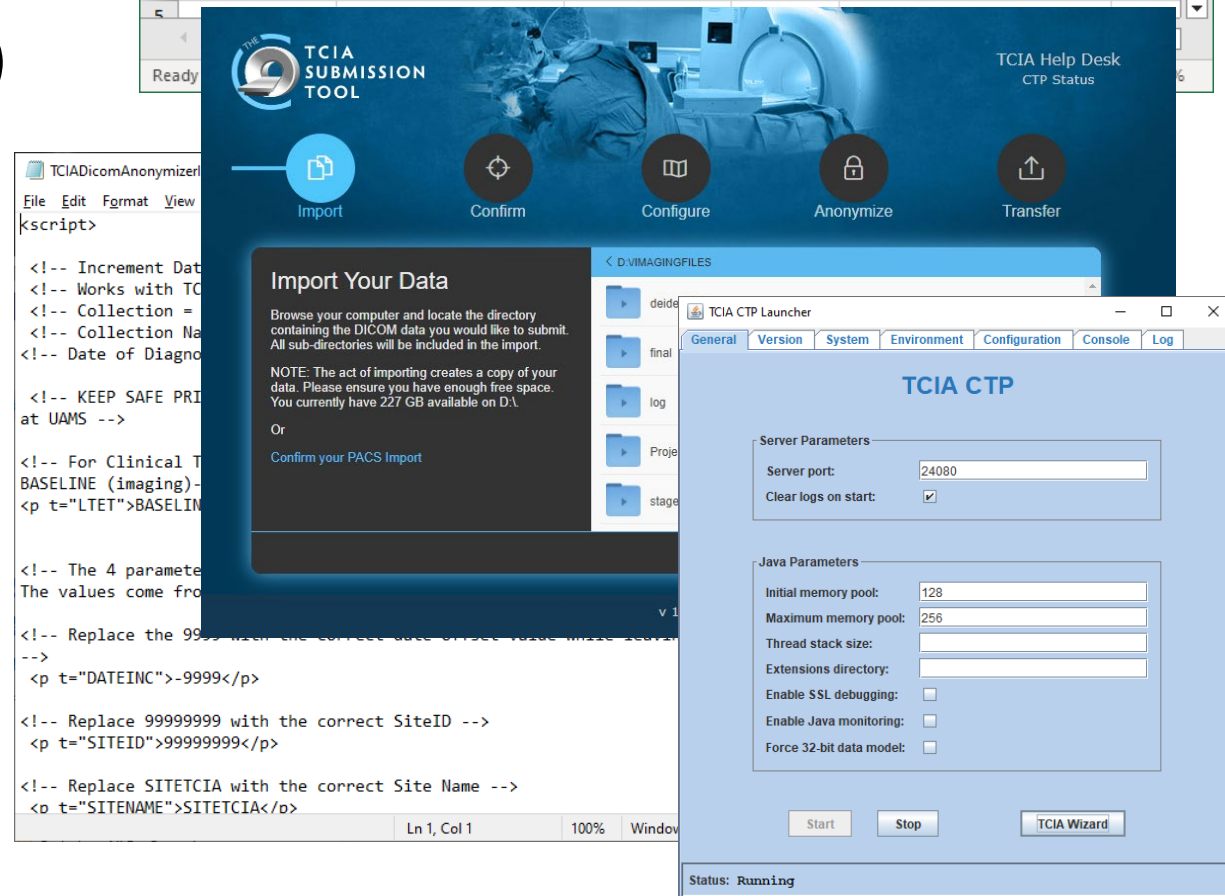
v 1.5

Submission Tools

- **Clinical Trials Processor (CTP)**
 - TCIA Submission Wizard
 - Import Files
 - Map Patients
 - Anonymize Files
 - Transfer Files
- **Aspera Faspex**
- **Box**



| | A | B | C | D | E | F |
|---|-------------------------|------------------------------|------------------------|------------------|----------------------------------|---|
| 1 | | ptid | cname | sname | ddate | |
| 2 | Local Patient ID | Anonymized Patient ID | Collection Name | Site Name | Diagnosis Date (M/D/YYYY) | |
| 3 | 565789545 | ANON-0001 | Collection-0001 | Site-0001 | 4/23/2005 | |
| 4 | | | | | | |
| 5 | | | | | | |



The screenshot displays the TCIA Submission Wizard interface. At the top, there are navigation buttons: Import, Confirm, Configure, Anonymize, and Transfer. The 'Import Your Data' window is active, showing instructions to browse for DICOM data. Below this, the 'TCIA CTP Launcher' window is visible, containing configuration options for Server Parameters (Server port: 24080, Clear logs on start: checked) and Java Parameters (Initial memory pool: 128, Maximum memory pool: 256, Thread stack size, Extensions directory, Enable SSL debugging, Enable Java monitoring, Force 32-bit data model). The status at the bottom indicates 'Status: Running'.

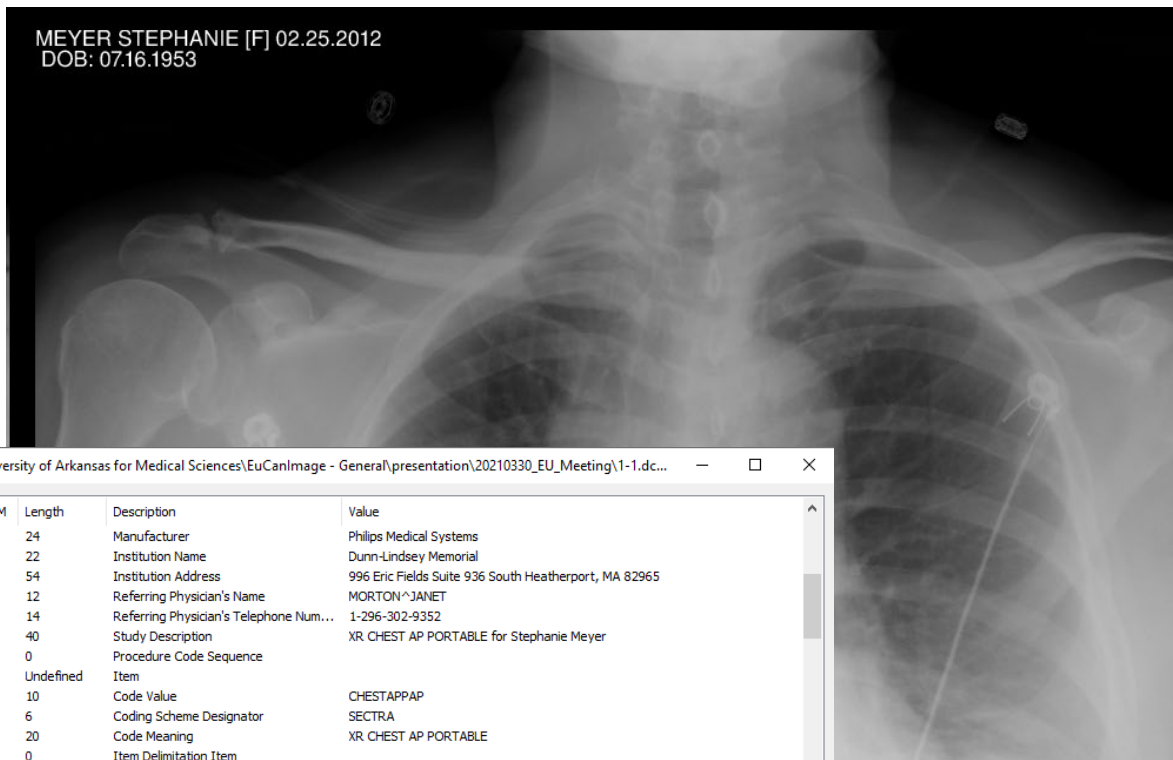
Curation

Medical Imaging

- **DICOM**

(Digital Imaging and Communications in Medicine)

- Metadata (Header)
- Pixel Data
 - Content
 - Implants
 - Recognizable Features
 - Faces
 - Embedded
 - Burned-in Text
 - Watermark



DICOM Tags (D:\Cloud\University of Arkansas for Medical Sciences\EuCanImage - General\presentation\20210330_EU_Meeting\1-1.dc...

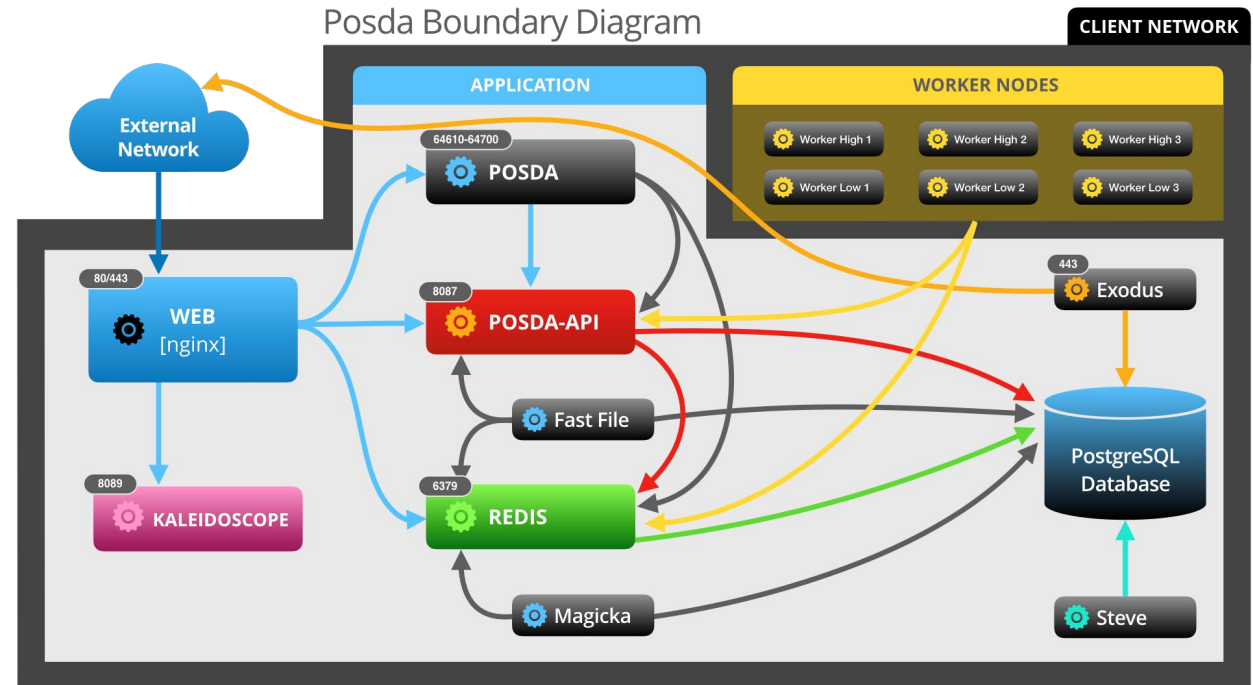
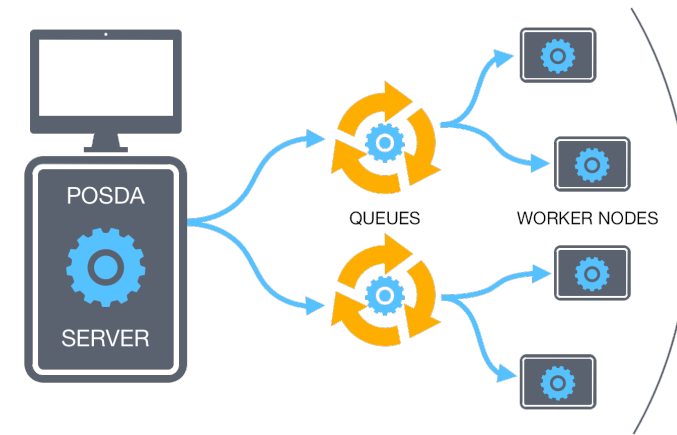
| Tag ID | VR | VM | Length | Description | Value |
|-------------|----|----|-----------|--|--|
| (0008,0070) | LO | 1 | 24 | Manufacturer | Philips Medical Systems |
| (0008,0080) | LO | 1 | 22 | Institution Name | Dunn-Lindsey Memorial |
| (0008,0081) | ST | 1 | 54 | Institution Address | 996 Eric Fields Suite 936 South Heatherport, MA 82965 |
| (0008,0090) | PN | 1 | 12 | Referring Physician's Name | MORTON^JANET |
| (0008,0094) | SH | 1 | 14 | Referring Physician's Telephone Num... | 1-296-302-9352 |
| (0008,1030) | LO | 1 | 40 | Study Description | XR CHEST AP PORTABLE for Stephanie Meyer |
| (0008,1032) | SQ | 0 | 0 | Procedure Code Sequence | |
| (FFFF,E000) | | 1 | Undefined | Item | |
| (0008,0100) | SH | 1 | 10 | Code Value | CHESTAPPAP |
| (0008,0102) | SH | 1 | 6 | Coding Scheme Designator | SECTRA |
| (0008,0104) | LO | 1 | 20 | Code Meaning | XR CHEST AP PORTABLE |
| (FFFF,E00D) | | 0 | 0 | Item Delimitation Item | |
| (FFFF,E0DD) | | 0 | 0 | Sequence Delimitation Item | |
| (0008,103E) | LO | 1 | 2 | Series Description | AP |
| (0008,1050) | PN | 1 | 16 | Performing Physician's Name | COPELAND^MELISSA |
| (0008,1090) | LO | 1 | 18 | Manufacturer's Model Name | MobileDiagnost wDR |
| (0008,1111) | SQ | 0 | 0 | Referenced Performed Procedure St... | |
| (FFFF,E000) | | 1 | Undefined | Item | |
| (0008,1150) | UI | 1 | 24 | Referenced SOP Class UID | 1.2.840.10008.3.1.2.3.3 |
| (0008,1155) | UI | 1 | 44 | Referenced SOP Instance UID | 2.25.160539642186938793107880005813476638198 |
| (FFFF,E00D) | | 0 | 0 | Item Delimitation Item | |
| (FFFF,E0DD) | | 0 | 0 | Sequence Delimitation Item | |
| (0008,3010) | UI | 1 | 64 | Irradiation Event UID | 1.3.6.1.4.1.14519.5.2.1.9999.103.2159801235948285747498355820028 |
| (0010,0010) | PN | 1 | 16 | Patient's Name | MEYER^STEPHANIE |
| (0010,0020) | LO | 1 | 10 | Patient ID | 8548156246 |

Find text... Close

Rutherford M, Mun SK, Levine B, Bennett W, Smith K, Farmer P, Jarosz Q, Wagner U, Freyman J, Blake G, Tarbox L, Farahani K, Prior F. **A DICOM dataset for evaluation of medical image de-identification**. Sci Data. 2021 Jul 16;8(1):183.

Posda

- Timepoint Architecture
- Worker Nodes
- Activity Workflows
- Visualization Tools
- Multi-format
- Multi-language



DICOM Conformance

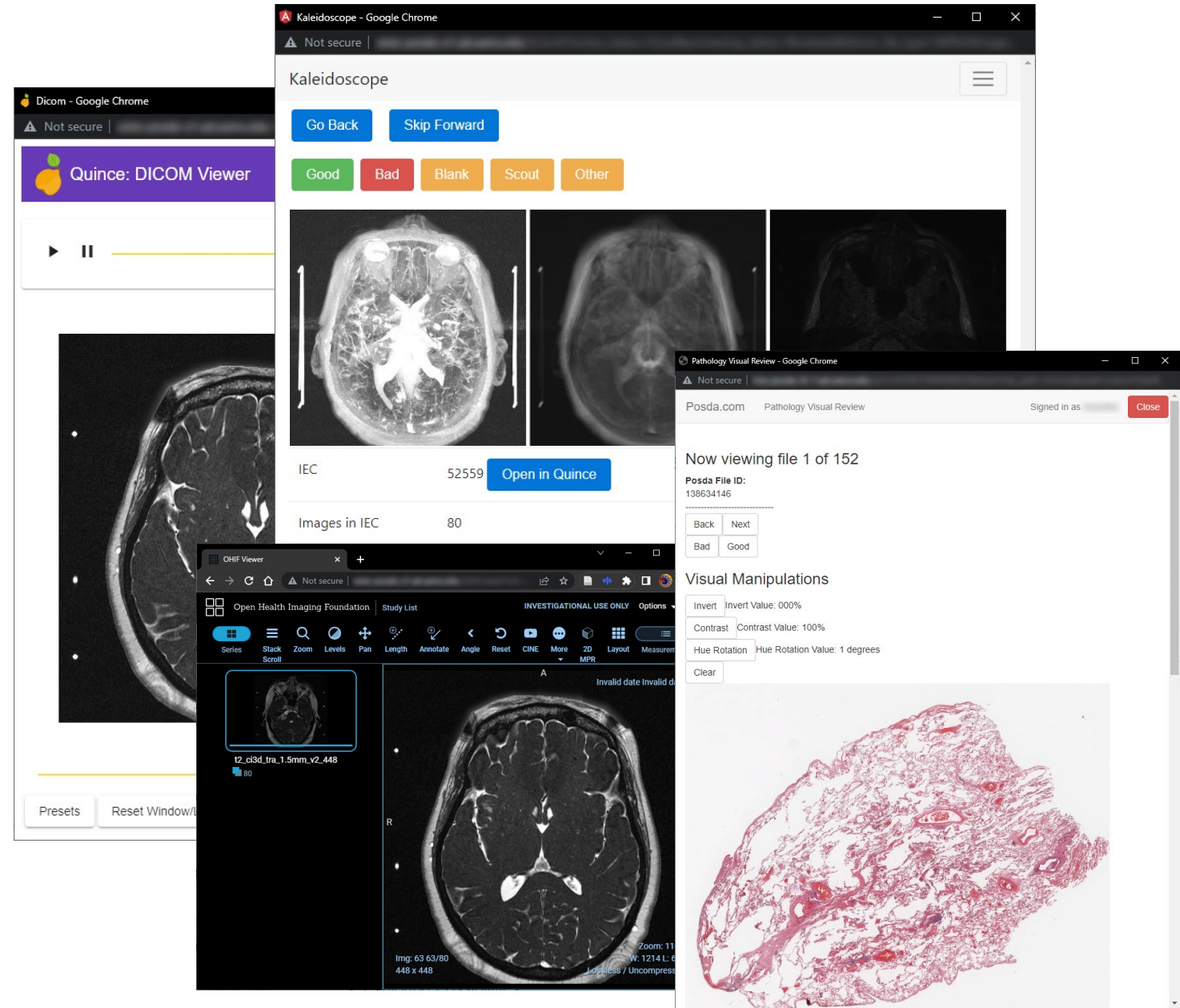
- DICOM Validator (DCIODVIFY)
- DICOM Std. PS3.15 E.1
- **Basic Confidentiality Profile**
 - Retain **Safe Private**
 - Retain **UIDs**
 - Retain **Device Identity**
 - Retain **Institution Identity**
 - Retain **Patient Characteristics**
 - Retain **Longitudinal With Full Dates**
 - Retain **Longitudinal With Modified Dates**
 - Clean **Descriptors**
 - Clean **Structured Content.**
 - Clean **Graphics**
 - Clean **Pixel Data**
 - Clean **Recognizable Visual Features**

| | |
|--------|---|
| D | replace with a non-zero length value that may be a dummy value and consistent with the VR |
| Z | replace with a zero length value, or a non-zero length value that may be a dummy value and consistent with the VR |
| X | remove |
| K | keep (unchanged for non-sequence attributes, cleaned for sequences) |
| C | clean, that is replace with values of similar meaning known not to contain identifying information and consistent with the VR |
| U | replace with a non-zero length UID that is internally consistent within a set of Instances |
| Z/D | Z unless D is required to maintain IOD conformance (Type 2 versus Type 1) |
| X/Z | X unless Z is required to maintain IOD conformance (Type 3 versus Type 2) |
| X/D | X unless D is required to maintain IOD conformance (Type 3 versus Type 1) |
| X/Z/D | X unless Z or D is required to maintain IOD conformance (Type 3 versus Type 2 versus Type 1) |
| X/Z/U* | X unless Z or replacement of contained instance UIDs (U) is required to maintain IOD conformance (Type 3 versus Type 2 versus Type 1 sequences containing UID references) |

| attribute | tag | basic | priv | uid | dev | inst | pat | full | dates | desc | str | graph |
|------------------------------------|------------------------------------|-------|------|-----|-----|------|-----|------|-------|------|-----|-------|
| Accession Number | <(0008,0050)> | Z | | | | | | | | | | |
| Admitting Diagnoses Description | <(0008,1080)> | X | | | | | | | | C | | |
| Allergies | <(0010,2110)> | X | | | | | C | | | C | | |
| Curve Data | <(50xx,xxxx)> | X | | | | | | | | | | C |
| Institution Address | <(0008,0081)> | X | | | | K | | | | | | |
| Institution Name | <(0008,0080)> | X/Z/D | | | | K | | | | | | |
| Overlay Data | <(60xx,3000)> | X | | | | | | | | | | C |
| Patient's Age | <(0010,1010)> | X | | | | | K | | | | | |
| Patient's Birth Date | <(0010,0030)> | Z | | | | | | | | | | |
| Patient's Name | <(0010,0010)> | Z | | | | | | | | | | |
| Patient's Sex | <(0010,0040)> | Z | | | | | K | | | | | |
| Patient's Size | <(0010,1020)> | X | | | | | K | | | | | |
| Patient's Weight | <(0010,1030)> | X | | | | | K | | | | | |
| Private attributes | <(gggg,eeee)> where gggg is odd | X | C | | | | | | | | | |
| Radiopharmaceutical Start DateTime | <(0018,1078)> | X | | | | | | K | C | | | |
| Radiopharmaceutical Start Time | <(0018,1072)> | X | | | | | | K | C | | | |
| Series Date | <(0008,0021)> | X/D | | | | | | K | C | | | |
| Series Description | <(0008,103E)> | X | | | | | | | | C | | |
| SOP Instance UID | <(0008,0018)> | U | | K | | | | | | | | |
| Study Date | <(0008,0020)> | Z | | | | | | K | C | | | |
| Study Description | <(0008,1030)> | X | | | | | | | | C | | |

Visual Review

- **Kaleidoscope**
 - Mark viability (good/bad).
 - Review series holistically (all images at same time)
 - Max, Avg, Min projections
- **Pathology Visual Reviewer**
 - Invert, Contrast, Hue Rotation
- **Other viewers** (for deeper review and cleaning)
 - Quince, OHIF (ohif.org)
 - We use various external viewers as needed for testing purposes.



PHI Review

| element | vr | q_value | description | disp_num_series |
|---|----|---|--|-----------------|
| <(0010,1010)> | AS | <019Y> | Patient's Age | 8 |
| <(0010,1010)> | AS | <020Y> | Patient's Age | 2 |
| <(0010,1010)> | AS | <021Y> | Patient's Age | 12 |
| <(0008,0050)> | SH | <<empty>> | Accession Number | 1936 |
| <(0008,0022)> | DA | <20061225> | Acquisition Date | 2 |
| <(0008,0022)> | DA | <20070117> | Acquisition Date | 2 |
| <(0008,0022)> | DA | <20070130> | Acquisition Date | 2 |
| <(0008,1080)> | LO | <Vestibular schwannoma> | Admitting Diagnoses Description | 1936 |
| <(0018,0025)> | CS | <N> | Angio Flag | 484 |
| <(300e,0002)> | CS | <APPROVED> | Approval Status | 438 |
| <(300a,00b0)[<0>]{300a,00c3}> | ST | <A1 20120726> | Beam Sequence:Beam Description | 1 |
| <(300a,00b0)[<0>]{300a,00c3}> | ST | <A1 at MBAFCH> | Beam Sequence:Beam Description | 1 |
| <(300a,00b0)[<0>]{300a,00c3}> | ST | <A21> | Beam Sequence:Beam Description | 19 |
| <(300a,00b0)[<0>]{300a,00b6}[<1>]{300a,00b8}> | CS | <X> | Beam Sequence:Beam Limiting Device Sequence:RT Beam Limiting Device Type | 483 |
| <(300a,00b0)[<0>]{300a,00b6}[<1>]{300a,00b8}> | CS | <Y> | Beam Sequence:Beam Limiting Device Sequence:RT Beam Limiting Device Type | 483 |
| <(0012,0010)> | LO | <NIH> | Clinical Trial Sponsor Name | 1936 |
| <(0012,0020)> | LO | <11270449> | Clinical Trial Protocol ID | 2 |
| <(0040,0280)> | ST | <Admitted to Patterson General on 20120114> | Comments on the Performed Procedure Step | 1 |
| <(0040,0280)> | ST | <Ordered for 726701374 by JK> | Comments on the Performed Procedure Step | 1 |
| <(3004,0006)> | LO | <Dose algorithm: TMR 10 20190914> | Dose Comment | 1 |
| <(3004,0006)> | LO | <Dose algorithm: TMR 10 at BHARG> | Dose Comment | 1 |
| <(300a,0010)[<0>]{300a,0020}> | CS | <TARGET> | Dose Reference Sequence:Dose Reference Type | 484 |
| <(300a,0010)[<0>]{300a,0016}> | LO | <A:AN 20120222> | Dose Reference Sequence:Dose Reference Description | 1 |

Scan report:

- Very large (thousands to >1M rows)
- Easily sortable
- Easily scanned by curators
- Suspicious items highlighted

Edit template:

- Blue is supplied by PHI script
- Yellow is cut/pasted from report
- Green is supplied by Curation Mgr.
- Uploaded, ran, and changed confirmed

| element | vr | q_value | num_series | p_op | q_arg1 | q_arg2 | Operation | activity_id | scan_id | notify | sep_char |
|-------------------------------|----|---|------------|------|----------------|----------------------|-----------|----------------|---------|--------|---------------|
| <(300a,00b0)[<0>]{300a,00c3}> | ST | <A12 20100416> | | 1 | string_replace | <20100416> | <> | ProposeEditsTp | 108 | 110 | mrutherford % |
| <(300a,0004)> | ST | <627-81-0637> | | 1 | empty_tag | <> | <> | | | | |
| <(300a,0010)[<0>]{300a,0016}> | LO | <A:AN 20120222> | | 1 | string_replace | <20120222> | <> | | | | |
| <(300a,0010)[<0>]{300a,0016}> | LO | <A:TV 20101022> | | 1 | string_replace | <20101022> | <> | | | | |
| <(300a,0010)[<0>]{300a,0016}> | LO | <A:TV 20140311> | | 1 | string_replace | <20140311> | <> | | | | |
| <(300a,00b0)[<0>]{300a,00c3}> | ST | <A1 20120726> | | 1 | string_replace | <20120726> | <> | | | | |
| <(300a,00b0)[<0>]{300a,00c3}> | ST | <A11 20130426> | | 1 | string_replace | <20130426> | <> | | | | |
| <(300e,0080)[<0>]{300e,00a6}> | PN | <ADKINS^JOHN> | | 2 | empty_tag | <> | <> | | | | |
| <(0040,0280)> | ST | <Admitted to Patterson General on 20120114> | | 1 | delete_tag | <> | <> | | | | |
| <(300e,0080)[<0>]{300e,00a6}> | PN | <ARMSTRONG^DOUGLAS> | | 2 | empty_tag | <> | <> | | | | |
| <(300e,0080)[<0>]{300e,00a6}> | PN | <ARNOLD^BILLY> | | 2 | empty_tag | <> | <> | | | | |
| <(0008,1030)> | LO | <Avanto RoutineHead 20100628> | | 2 | string_replace | <20100628> | <> | | | | |
| <(0008,1030)> | LO | <Avanto RoutineHead 20100714> | | 2 | string_replace | <20100714> | <> | | | | |
| <(300a,0004)> | ST | <Correct PD 20131002> | | 1 | string_replace | <20131002> | <> | | | | |
| <(3004,0006)> | LO | <Dose algorithm: TMR 10 20101122> | | 1 | string_replace | <20101122> | <> | | | | |
| <(3004,0006)> | LO | <Dose algorithm: TMR 10 20111005> | | 1 | string_replace | <20111005> | <> | | | | |
| <(0032,1060)> | LO | <MRI Head at GGM> | | 2 | string_replace | <at GGM> | <> | | | | |
| <(0032,1060)> | LO | <MRI Head at JDACC> | | 2 | string_replace | <at JDACC> | <> | | | | |
| <(0040,0254)> | LO | <MRI Head for Jennifer Baker> | | 2 | string_replace | <for Jennifer Baker> | <> | | | | |
| <(0040,0254)> | LO | <MRI Stereo Gamma Knife 20180413> | | 2 | string_replace | <20180413> | <> | | | | |
| <(0040,0254)> | LO | <MRI Stereo Gamma Knife at MBM> | | 2 | string_replace | <at MBM> | <> | | | | |
| <(0032,1060)> | LO | <MRI Stereo Gamma Knife gad 20150926> | | 2 | string_replace | <20150926> | <> | | | | |
| <(300e,0006)> | ST | <Ordered for 014-28-2961 by Dr. Nolan> | | 1 | delete_tag | <> | <> | | | | |

Future Posda Development

- Improved **File Format** Support (Both radiology and pathology)
- Enhanced **Defacing** Tools
- Improved **Pathology Curation** Tools
- Enhanced **Visualization** Tools
- Improved **Clinical Data Curation** with **Semantic Integration**
- Improved **Object Store** Support
- Improved **HPC** Support

Publication

NBIA (National Biomedical Imaging Archive)

The image displays two browser windows from the National Biomedical Imaging Archive (NBIA). The left window shows the search results page for the query "Image Modality (MR) AND Anatomical (ABDOMEN)". The search results table lists subjects and series:

| Collection ID | Subject ID | Series |
|---------------|-------------------|--------|
| CMB-CRC | CMB-CRC-MSB-01262 | 1 |
| CMB-LCA | CMB-LCA-MSB-09027 | 1 |

The right window shows the OHIF DICOM Viewer interface for the study "CMB-LCA-MSB-09027". It displays an axial MRI slice of the abdomen with technical details:

- Series: 10001.00000
- Image: 1 (1/32)
- Dimensions: 512 x 448
- Thick: 7.00 mm Spacing: 8.00 mm
- Zoom: 138%
- Lossless / Uncompressed

PathDB / Eaglescope / caMicroscope

TCIA Biobank Pathology Portal

pathdb.cancerimagingarchive.net/eaglescope/dist/?configurl=%2Fsystem%2Ffiles%2Fcollectionm...

TCIA Biobank Pathology Portal

3185

Search

Collection | TCIA_Collection = CMB-CRC | Clear All Filters

Biobank Data Table

| Patient ID | Slide ID | Collect... | Timepo... | Topogr... | Tumor ... | Tumor ... | Percent... | Percent... | Is Enric... | Days Fr... | Gender | Age | Ethnicity | Ra |
|------------|-----------|------------|-----------|------------|----------------|-----------|------------|------------|-------------|------------|--------|-----|--------------|----|
| MSB-01262 | MSB-01262 | CMB-CRC | PROGRES | Colorectal | Adenocarci... | Y | 5 | 20% - 49% | N | 202 | M | 67 | NOT HISPA... | WH |
| MSB-01262 | MSB-01262 | CMB-CRC | BASELINE | Colorectal | Adenocarci... | N | 0 | 0 - 9% | N | 8 | M | 67 | NOT HISPA... | WH |
| MSB-01262 | MSB-01262 | CMB-CRC | ARCHIVAL | Colorectal | Adenocarci... | N | 5 | 10% - 19% | N | -993 | M | 67 | NOT HISPA... | WH |
| MSB-01262 | MSB-01262 | CMB-CRC | ARCHIVAL | Colorectal | Adenocarci... | N | 0 | 0 - 9% | N | 8 | M | 67 | NOT HISPA... | WH |
| MSB-01262 | MSB-01262 | CMB-CRC | PROGRES | Colorectal | Adenocarci... | Y | 10 | 20% - 49% | N | 202 | M | 67 | NOT HISPA... | WH |
| MSB-01262 | MSB-01262 | CMB-CRC | PROGRES | Colorectal | Adenocarci... | Y | 10 | 20% - 49% | N | 202 | M | 67 | NOT HISPA... | WH |
| MSB-02381 | MSB-02381 | CMB-CRC | ARCHIVAL | Colorectal | Colorectal | N | 0 | 0 - 9% | Y | -370 | F | 71 | NOT HISPA... | WH |
| MSB-02381 | MSB-02381 | CMB-CRC | ARCHIVAL | Colorectal | Colorectal | N | 0 | 0 - 9% | Y | -370 | F | 71 | NOT HISPA... | WH |
| MSB-03032 | MSB-03032 | CMB-CRC | ARCHIVAL | Colorectal | Colorectal | N | 10 | 20% - 49% | N | -27 | M | 67 | NOT HISPA... | WH |
| MSB-03258 | MSB-03258 | CMB-CRC | BASELINE | Colorectal | Unknown | Y | 10 | 10% - 19% | N | 0 | F | 76 | NOT HISPA... | WH |
| MSB-03258 | MSB-03258 | CMB-CRC | BASELINE | Colorectal | Unknown | Y | 40 | 20% - 49% | N | 0 | F | 76 | NOT HISPA... | WH |
| MSB-03258 | MSB-03258 | CMB-CRC | BASELINE | Colorectal | Unknown | Y | 50 | 20% - 49% | Y | 0 | F | 76 | NOT HISPA... | WH |
| MSB-03808 | MSB-03808 | CMB-CRC | ARCHIVAL | Colorectal | Invasive Ad... | Y | NA | 50% - 59% | N | -511 | M | 63 | NOT HISPA... | NA |
| MSB-08170 | MSB-08170 | CMB-CRC | PROGRES | Colorectal | Colon Cancer | Y | 10 | 10% - 19% | N | 0 | F | 53 | NOT HISPA... | WH |
| MSB-08170 | MSB-08170 | CMB-CRC | PROGRES | Colorectal | Colon Cancer | Y | 5 | 50% - 59% | N | 0 | F | 53 | NOT HISPA... | WH |
| MSB-08170 | MSB-08170 | CMB-CRC | PROGRES | Colorectal | Colon Cancer | Y | 10 | 10% - 19% | N | 0 | F | 53 | NOT HISPA... | WH |
| MSB-08170 | MSB-08170 | CMB-CRC | ARCHIVAL | Colorectal | Colon Cancer | Y | 20 | 10% - 19% | N | -78 | F | 53 | NOT HISPA... | WH |
| MSB-08583 | MSB-08583 | CMB-CRC | ARCHIVAL | Colorectal | Invasive Ad... | Y | 5 | 50% - 59% | N | -92 | M | 51 | NOT HISPA... | BL |

Ethnicity

Race

Age

Gender

Percent Tumor Nuclei

Percent Necrosis

caMicroscope

pathdb.cancerimagingarchive.net/caMicroscope/apps/viewer/view...

Slide: CMB_CRC | MSB-01262 | MSB-01262-10-02



Thank you!