

The logo for The Cancer Imaging Archive. It features the word "THE" in a small font above a stylized "C" that contains a circular graphic with a blue and red gradient. To the right of this graphic, the word "CANCER" is written in large, light blue, sans-serif capital letters. Below "CANCER", the words "IMAGING ARCHIVE" are written in white, sans-serif capital letters.

THE **CANCER**
IMAGING ARCHIVE

**Support for the Clinical Proteomic
Tumor Analysis Consortium**

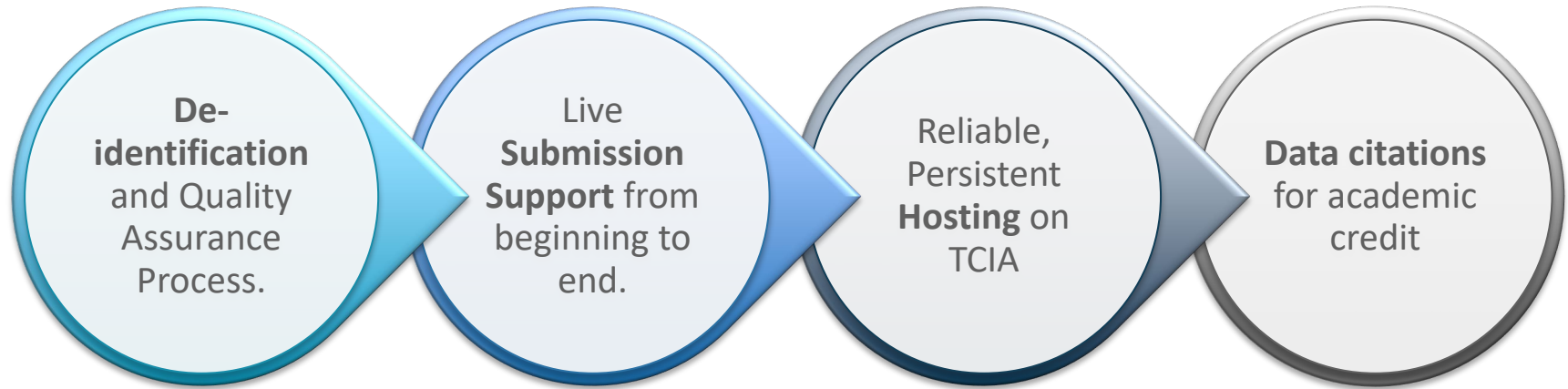
Justin Kirby (justin.kirby@nih.gov)

Technical Director, Cancer Imaging Informatics Lab

Frederick National Laboratory for Cancer Research

TCIA's Mission

Provide services to encourage data sharing
for cancer imaging research



TCIA components



Data Collection Centers

- Tools and staffing to support data collection, curation, and de-identification

Data Access Tools*

- Browse
- Filter/Search
- Visualize
- REST API

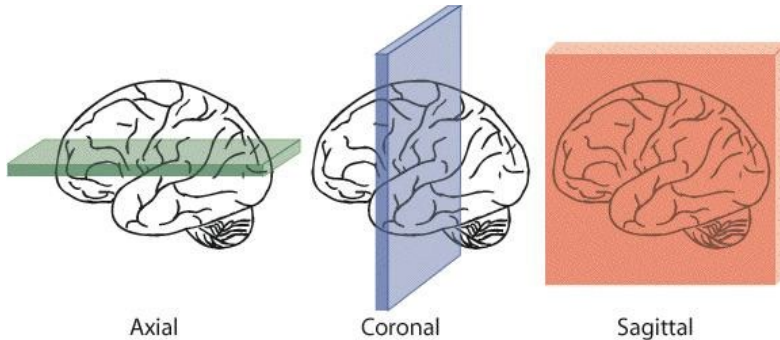
Data Analysis Centers

- 3rd party web sites or tools which use TCIA's API or mirror its data

Radiology Imaging Overview

➤ When a patient comes in for imaging studies it's common to use:

Different angles

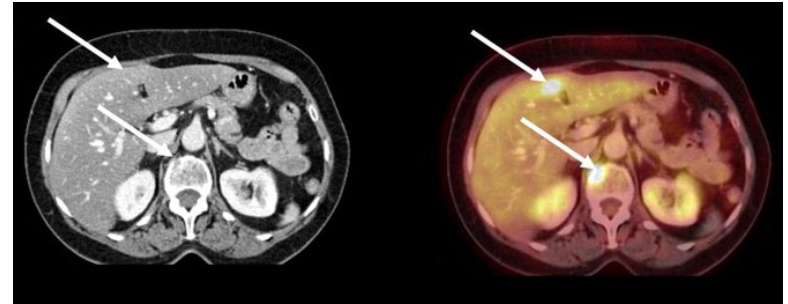


Top to bottom

Front to Back

Side to Side

Different modalities



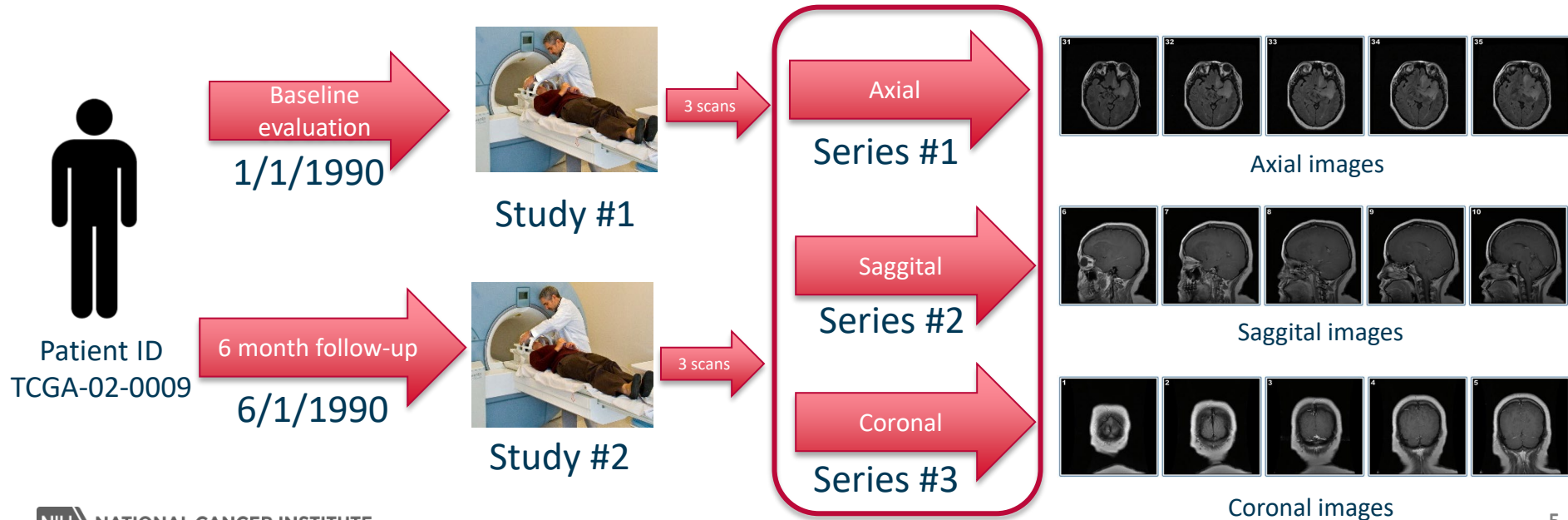
Computed Tomography
(CT)

Positron emission tomography
(PET)

Radiology Imaging Format: DICOM

➤ The DICOM data is hierarchical in its structure

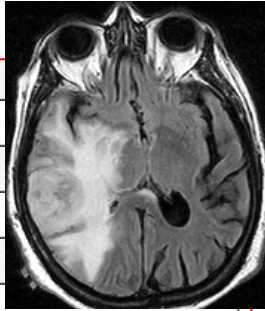
➤ Patient → Study (appointment) → Series (scans) → Images



Tackling the de-identification challenge

➤ PHI can appear in hundreds of places in DICOM

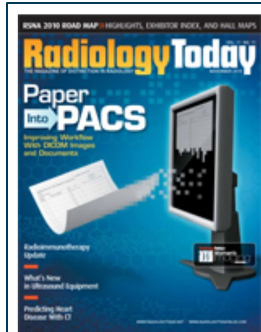
- Dates
- Identifiers
- Descriptions



(0008,0022)	Acquisition Date	19970614
(0008,0023)	Content Date	19970614
(0008,0024)	Study Time	073837
(0008,0031)	Series Time	074251
(0008,0032)	Acquisition Time	074252
(0008,0033)	Content Time	074252
(0008,0050)	Accession Number	2819497684894126
(0008,0061)	Modality	MR
(0008,0070)	Manufacturer	GE MEDICAL SYSTEMS
(0008,0090)	Referring Physician's Name	
(0008,1010)	Station Name	
(0008,1030)	Study Description	MRI, BRAIN W&W/O CONTRAMR
(0008,1032)	Procedure Code Sequence	
(0008,103E)	Series Description	AX FLAIR
(0008,1090)	Manufacturer's Model Name	GENESIS_SIGNA
(0010,0010)	Patient's Name	
(0010,0020)	Patient ID	TCGA-02-0009
(0010,0030)	Patient's Birth	

Tackling the de-identification challenge

Documents saved as images
(e.g. billing, patient records)

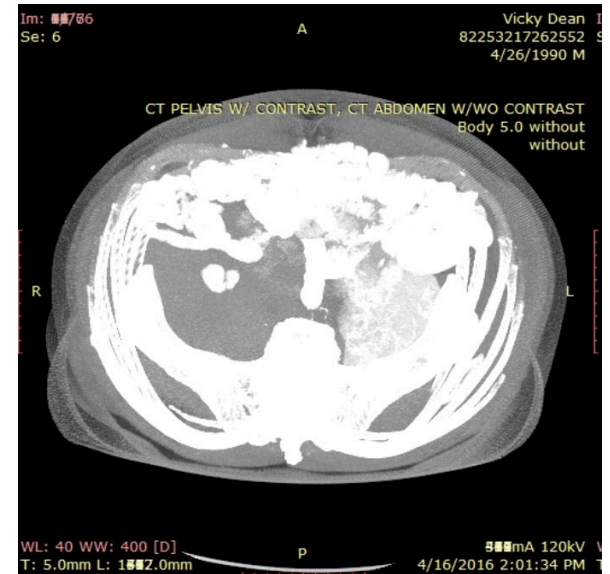


November 2010

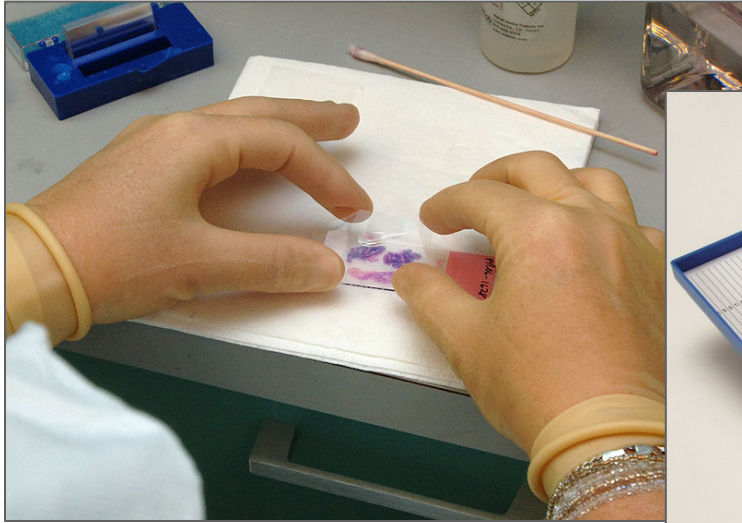
Paper Into PACS
By Dan Harvey
Radiology Today
Vol. 11 No. 11 P. 20

Converting paper documents into a format acceptable to store in a PACS is a widespread need. Imaging facilities use several approaches to solve this common problem, including using DICOM, RIS, or EMR document management.

PHI in the image pixels
(fake example)



Histopathology Imaging Overview



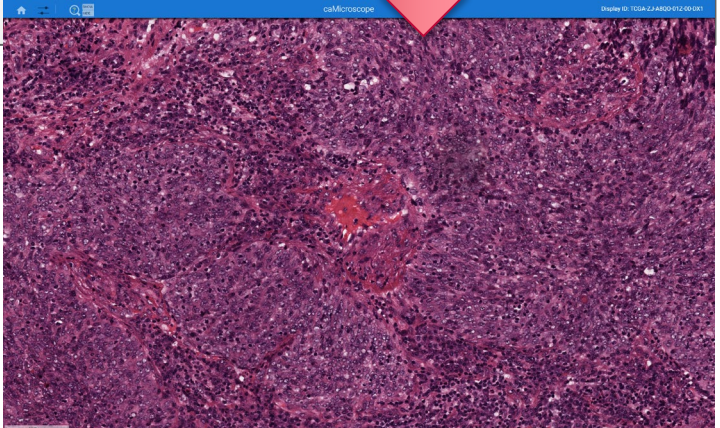
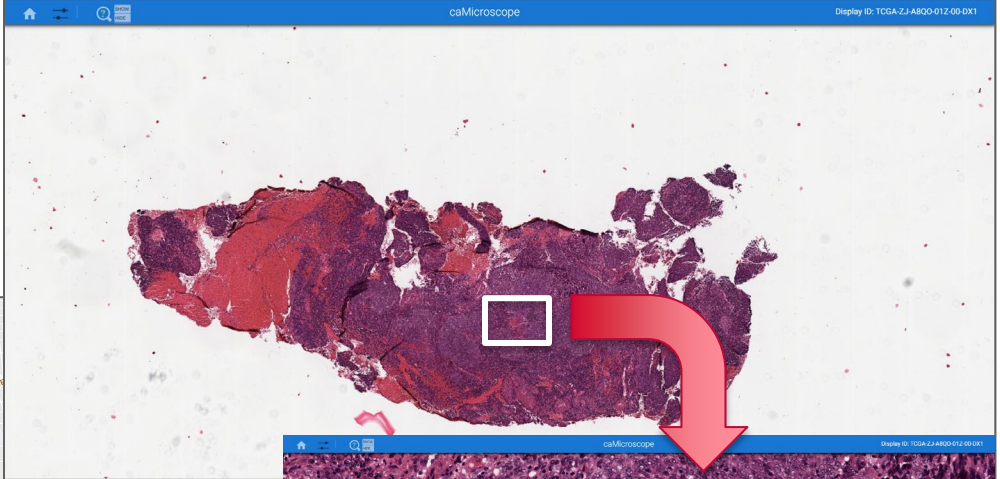
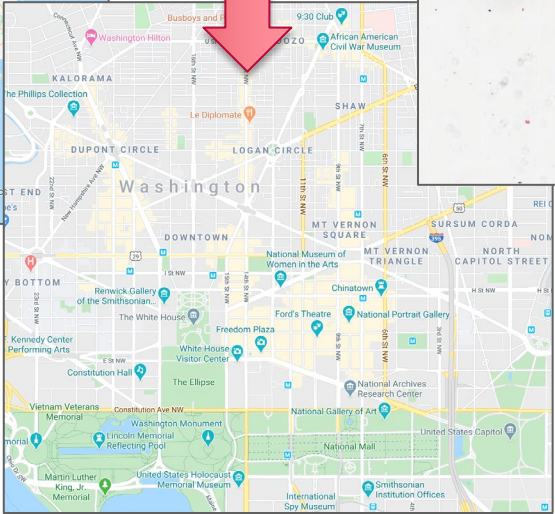
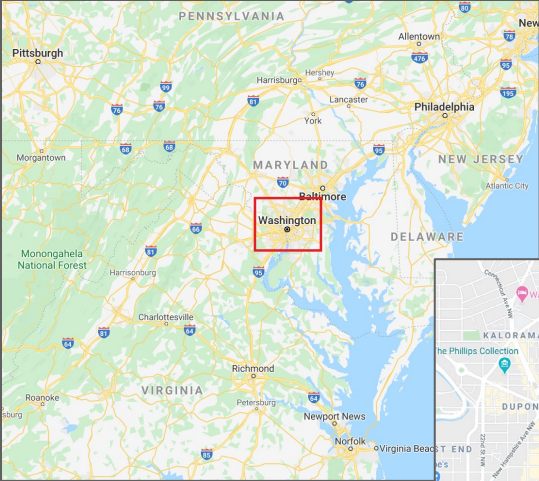
Stained tissue mounted
on glass slide



Slides being digitized



Histopathology Imaging Overview



Histopathology image de-identification

- Image metadata
- Image labels/barcodes
- Pixel data

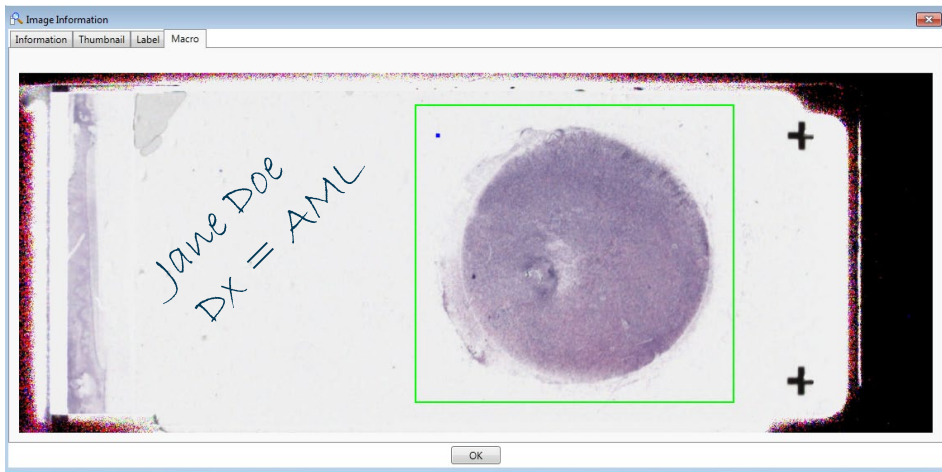
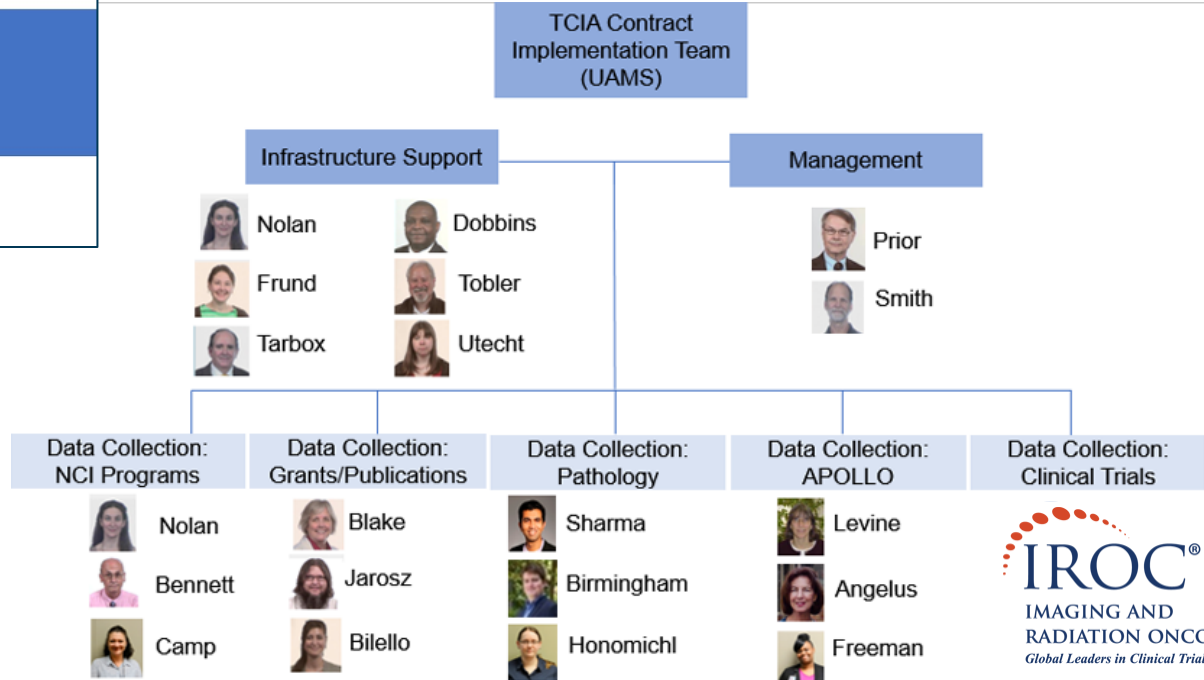


Image Information	
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Image Path	\\vmware-host\Shared Folders\Downloads\C3L-00452-41.sys
Description	Aperio Image Library v12.0.11 96224x85778 [0.100 92344x85678] (240x240) JPEG/RGB Q=70
Apparent Magnification	40X
StripeWidth	992
ScanScope ID	551553
Filename	104632
Date	01/25/17
Time	12:32:38
Time Zone	GMT-05:00
User	bd156663-fd1a-483b-a2be-9aa5f37aae07
MPP	0.2467
Left	28.078907
Top	23.057886
LineCameraSkew	0.001659
LineAreaXOffset	0.011789
LineAreaYOffset	-0.003588
Focus Offset	0.000000
DSR ID	aperio04
ImageID	104632
Exposure Time	109
Exposure Scale	0.000001
DisplayColor	0
OriginalWidth	96224
OriginalHeight	85778
ICC Profile	ScanScope v1
Image Type	SVS/JPEG 2
Image Width	92,344 pixels
Image Height	85,678 pixels
Image Depth	1 pixels
Image Channels	3
Image Bit Depth	8 bits
File Size	2,257,398,000 bytes
Compression Type	JPEG using libjpeg
Compression Quality	70
Compression Ratio	10.51
Organization	tilted
Tile Width	240 pixels
Pyramid	Width Height Ratio
Thumbnail	827 768 111:1
Level 3	2885 2677 32:1
Level 2	5771 5354 16:1
Level 1	23086 21419 4:1
Base	92344 85678

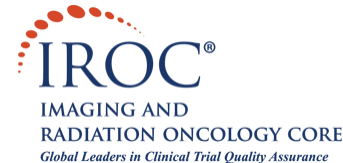
TCIA Staffing: De-id and curation is a major effort



CIP Informatics Lab
CANCER IMAGING ARCHIVE

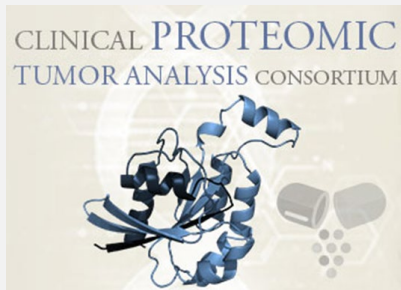


- 5 curation teams
- Infrastructure support
- Management



TCIA Data Sources

NCI data collection initiatives



“Community” proposals reviewed monthly



Data generated by NCI/NIH Grants



Challenge competitions

SCIENTIFIC DATA

Publication data sharing requests





Data Sources: Analyses of TCIA Collections

nature > scientific data > data descriptors > article

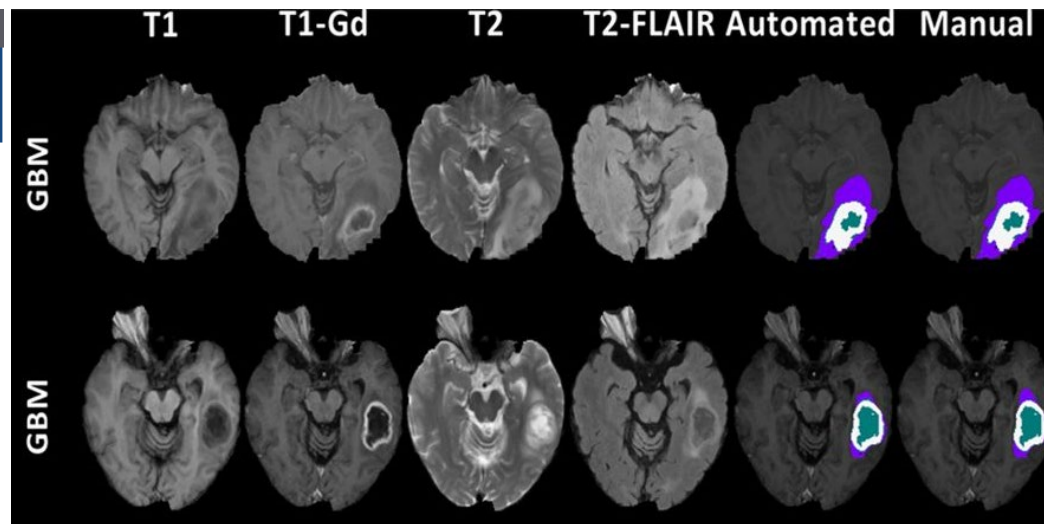
SCIENTIFIC DATA

Data Descriptor | OPEN | Published: 05 September 2017

Advancing The Cancer Genome Atlas glioma MRI collections with expert segmentation labels and radiomic features

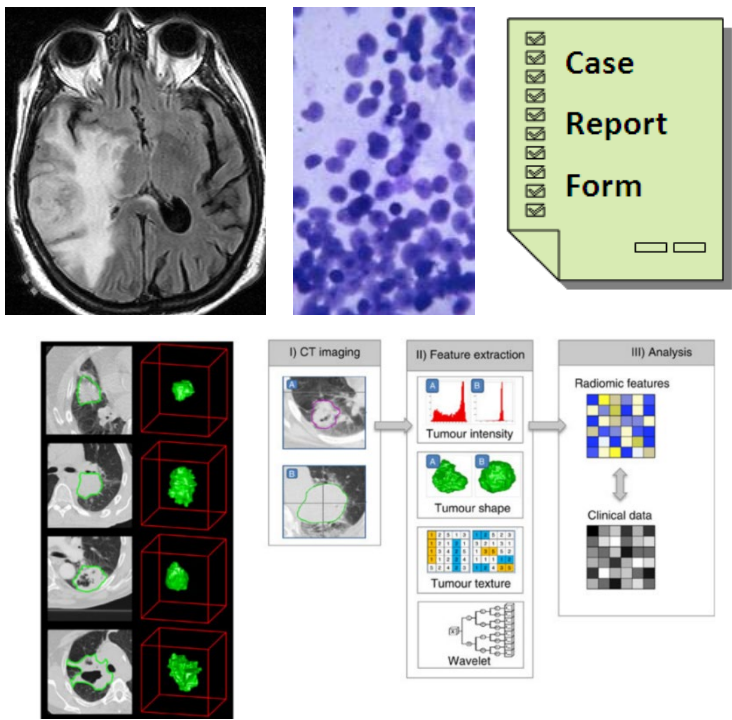
Spyridon Bakas , Hamed Akbari, Aristeidis Sotiras, Michel Bilello, Martin Rozycki, Justin S. Kirby, John B. Freymann, Keyvan Farahani & Christos Davatzikos 

Scientific Data 4, Article number: 170117 (2017) | [Download Citation](#)



Example analysis data derived from existing TCGA-GBM collection

TCIA Data Summary



- **New collection proposals** are reviewed by the TCIA Advisory Group for quality/utility
- **115 collections** consisting of ~47,300 subjects available for download
- Covers **radiology, radiation therapy, and pathology** image modalities
- Wide **variety** of cancers + phantoms
- Most have **associated supporting data**
 - Demographics/outcomes/therapy
 - Image analyses (annotations, segmentations, features)
 - Genomics/Proteomics

<http://www.cancerimagingarchive.net>

Citations and data usage policy

➤ Citations (credit for data sharing!)

- Dataset
- Scientific manuscript
- TCIA manuscript

➤ Data Usage Policy

- Generally 100% open (no login)
- 11 datasets require special access requests
- Creative Commons Attribution license

CT Lymph Nodes

Created by kclark01, last modified by kirbyju 11 minutes ago

Summary

This collection consists of Computed Tomography (CT) images of the mediastinum and abdomen in which lymph node p Center. Radiologists at the *Imaging Biomarkers and Computer-Aided Diagnosis Laboratory* labeled a total of 388 me abdominal lymph nodes in 86 patients.

The collection is aimed at the medical image computing community for developing and assessing computer-aided detect diagnostic tool but is very challenging due to the low contrast of surrounding structures in CT and to their varying sizes, p available to make direct comparison to other detection methods in order to advance the state of the art.

Acknowledgements

We would like to acknowledge the individuals and institutions that have provided data for this collection.:

National Institutes of Health, Bethesda MD. Special thanks to **Dr. Holger R. Roth** and **Dr. Ronald Summers**, *Imaging B Clinical Center*.

Data Access Detailed Description Citations & Data Usage Policy Versions

Citations & Data Usage Policy

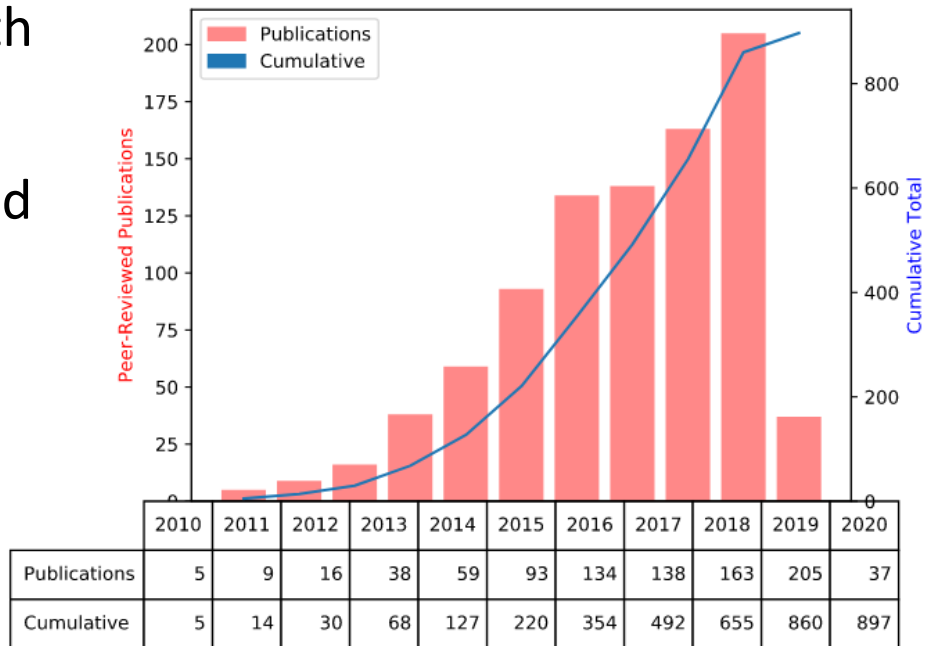
This collection is freely available to browse, download, and use for commercial, scientific and educational purposes as our [Data Usage Policies and Restrictions](#) for additional details. Questions may be directed to help@cancerimagingarchive.net

Please be sure to include the following citations in your work if you use this data set:

 **CT Lymph Nodes Citation**
The Cancer Imaging Archive Team. Data From CT Lymph Nodes. doi:[10.7937/K9/TCIA.2015.AQIIDCNM](https://doi.org/10.7937/K9/TCIA.2015.AQIIDCNM)

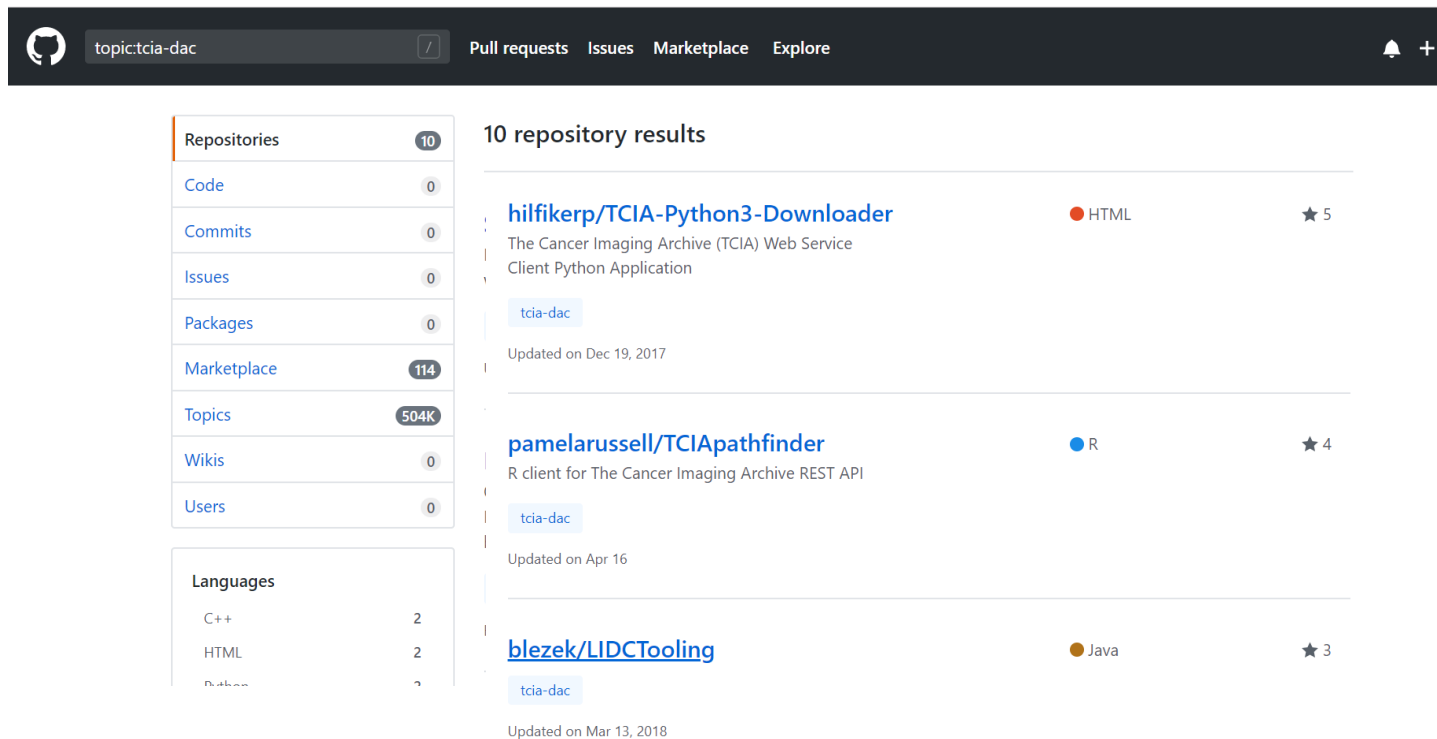
TCIA Metrics

- Over 20,000 active users per month
- Downloads of ~100TB per month
- 30 incoming data sets to be curated
- 897 peer reviewed publications based on TCIA
- Widely used by industry due to permissive Creative Commons licensing



TCIA community code sharing

Tag your Github repo with “tcia-dac” topic tag to appear in the list



The screenshot shows a GitHub search interface with the search term 'topic:tcia-dac' entered in the search bar. The navigation menu includes 'Pull requests', 'Issues', 'Marketplace', and 'Explore'. On the left sidebar, the 'Topics' filter is selected, showing 504K results. Below the sidebar, a list of repository results is displayed:

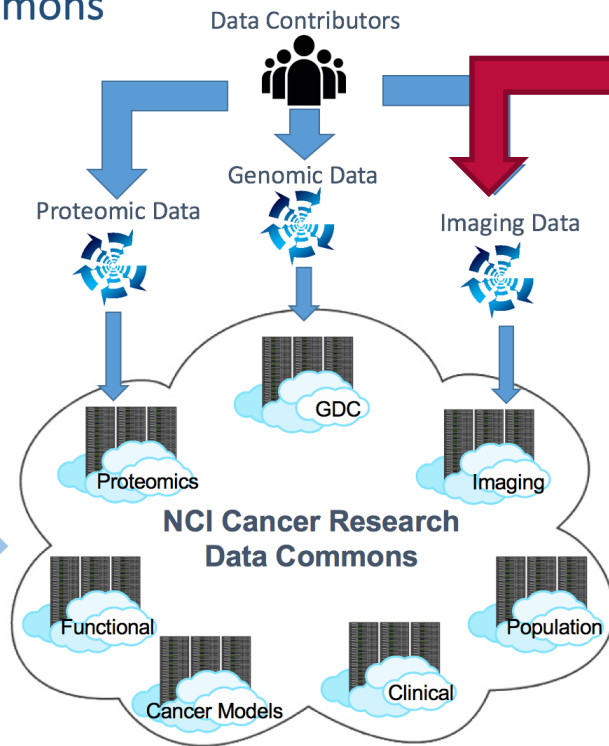
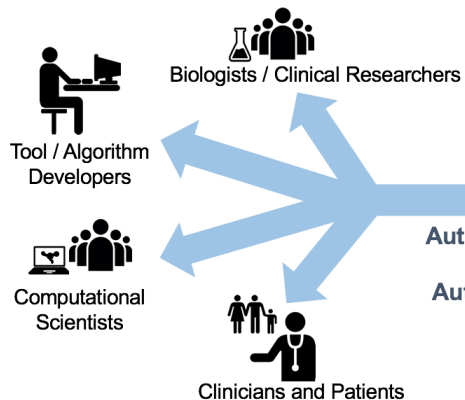
- hilfikerp/TCIA-Python3-Downloader** (HTML, 5 stars)
The Cancer Imaging Archive (TCIA) Web Service Client Python Application
Updated on Dec 19, 2017
- pamelarussell/TCIapathfinder** (R, 4 stars)
R client for The Cancer Imaging Archive REST API
Updated on Apr 16
- blezek/LIDCTooling** (Java, 3 stars)
Updated on Mar 13, 2018

TCIA data in the NCI Data Commons cloud

The NCI Cancer Research Data Commons A virtual, expandable infrastructure

- Standardized data submission and Q/C
- Controlled vocabularies
- Harmonization by subject matter experts

- Secure data access through API or web UI
- Query across data domains
- Analytics, elastic compute, visualization



TCIA Support for CPTAC: Project Summary

Dashboard / Wiki / Research Projects

Edit Save for later Watching Share

CPTAC Imaging Proteomics

Created by John Freymann, last modified by natasha.honovich on Feb 14, 2020

The National Cancer Institute's [Clinical Proteomic Tumor Analysis Consortium \(CPTAC\)](#) is a national effort to accelerate the understanding of the molecular basis of cancer through the application of large-scale proteome and genome analysis, or proteogenomics. Data (genomics, proteomics, imaging), assays, and reagents are made available to the public as a Community Resource to accelerate cancer research and advance patient care. CPTAC has been conducted in multiple phases. For the phase 3 prospective data collection activities TCIA has partnered with CPTAC to host both the radiology and pathology imaging data generated by the project. The other data types will be hosted in separate databases managed by the CPTAC program. TCIA will provide links to these resources as they become publicly available.

CPTAC Imaging Special Interest Group

You can [join the CPTAC Imaging Special Interest Group](#) to be notified of [webinars](#) & data releases, collaborate on common data wrangling tasks and seek out partners to explore research hypotheses!

CPTAC Phase 3 Histopathology and Radiology Imaging

CPTAC imaging data is being made available on a quarterly release schedule. Learn more about each cancer type by clicking on the collection names in the table below. Data currently available is listed below. Clicking on the number of subjects will take you to these data portals with that particular cancer type pre-selected. You can access the radiology and pathology data directly from the respective data portals.

- [Radiology Data Portal](#)
- [Pathology Data Portal](#)

Collection	Cancer Type	Location	Radiology Modalities	Radiology (Subjects)*	Pathology (Subjects)**
CPTAC-AML	Acute Myeloid Leukemia	Bone Marrow	--	--	56
CPTAC-CCRCC	Clear Cell Carcinoma	Kidney	CR, CT, DX, MR, SR	63	222
CPTAC-CM	Cutaneous Melanoma	Skin	CR, CT, MR	6	92
CPTAC-GBM	Glioblastoma Multiforme	Brain	CR, CT, DX, MR, NM, SC	63	189
CPTAC-HNSCC	Head and Neck Squamous Cell Carcinoma	Head-Neck	CT, SC, MR	55	112
CPTAC-LSCC	Lung Squamous Cell Carcinoma	Lung	CR, CT, DX, NM, PT	26	212
CPTAC-LUAD	Lung Adenocarcinoma	Lung	CT, MR, PT, CR, DX, NM	32	244
CPTAC-PDA	Ductal Adenocarcinoma	Pancreas	CT, MR, DX, CR, PT, XA	68	168
CPTAC-SAR	Sarcomas	Soft Tissue	CT, MR	22	88
CPTAC-UCEC	Corpus Endometrial Carcinoma	Uterus	CT, MR, PT, CR, DX	60	250

*links go to TCIA NBIA radiological search portal

** links go to TCIA CPTAC Pathology Portal

Quick links:

- Summary pages
- Radiology Portal
- Pathology Portal

Accessing the Data

Submit Your Data Access The Data Help

THE **CANCER**
IMAGING ARCHIVE

About Us Research Activities News

7281105
*506961
180080
11:53:08.97
4 MA 4
SEQ 23
SP 225.6

RAH

7281105
*506961
180080
11:53:08.97
4 MA 4
SEQ 23
SP 225.6

Welcome to The Cancer Imaging Archive

The Cancer Imaging Archive (TCIA) is a service which de-identifies and hosts a large archive of medical images of cancer accessible for public download.

[SUBMIT YOUR DATA](#) [ACCESS THE DATA](#)

Accessing the Data

The screenshot shows the 'Access the Data' page of the Cancer Imaging Archive. The header includes social media icons, navigation links for 'Submit Your Data', 'Access The Data', and 'Help', and the site logo. The main content area features six cards, each with an icon, a title, and a brief description of the service.

Browse Collections
Browse a list of all TCIA data. This is the best way to get a comprehensive picture of all data types associated with each Collection.

Search Radiology
Use the TCIA Radiology Portal to perform detailed searches across datasets and visualize images before you download them.

REST API
Our API enables software developers to directly query the public resources of TCIA and retrieve information into their applications.

Browse Analysis Results
Browse segmentations, annotations and other analyses of existing Collections contributed by others in the TCIA user community.

Search Histopathology
Use TCIA Histopathology Portal to perform detailed searches and visualize images before you download them. beta

Data Analysis Centers
Browse tools developed by the TCIA community to provide additional capabilities for downloading or analyzing our data.

Radiology Downloads & Data Portal

CPTAC-GBM

Created by Tracy Nolan, last modified by natasha.honochimi on Feb 14, 2020

Summary

This collection contains subjects from the National Cancer Institute's [Clinical Proteomic Tumor Analysis Consortium](#) Glioblastoma Multiforme (CPTAC-GBM) molecular basis of cancer through the application of large-scale proteome and genome analysis, or proteogenomics. Radiology and pathology images from by The Cancer Imaging Archive to enable researchers to investigate cancer phenotypes which may correlate to corresponding proteomic, genomic and clinical data.

CPTAC Phase 3 collects data from ten cancer types. In TCIA, imaging from each cancer type will be contained in its own TCIA Collection, with the collect available on TCIA each quarter as it is collected. A summary of CPTAC Phase 3 imaging efforts can be found on the [CPTAC Imaging Proteomics](#) page.

Radiology imaging is collected from standard of care imaging performed on patients immediately before the pathological diagnosis, and from follow-up heterogeneous in terms of scanner modalities, manufacturers and acquisition protocols. Pathology imaging is collected as part of the CPTAC qualifier

CPTAC Imaging Special Interest Group

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[Data Access](#) [Detailed Description](#) [Citations & Data Usage Policy](#) [Versions](#)

Data Access

Click the **Download** button to save a ".tcia" manifest file to your computer, which you must open with the [NBIA Data Retriever](#). Click the **Search** button to download a subset of its contents.

Data Type	Download all or Query/Filter
Images (DICOM, 39.4 GB)	Download Search
Tissue Slide Images (SVS, 87 GB)	Download Search
Clinical Data API (JSON - more info)	Download
Discovery Study Proteomics/Clinical Data (external)	<ul style="list-style-type: none">CPTAC Data Portal (Georgetown)Proteomic Data Commons
Genomics/Clinical Data (External)	Genomic Data Commons

The screenshot displays the Cancer Imaging Archive (TCIA) interface. At the top, there's a navigation bar with 'Home', 'News', 'About Us', 'Submit Your Data', 'Access The Data', 'Research Activities', and 'Help'. Below this is a search bar and a 'Simple Search' section. The 'Collections' filter is set to 'CPTAC-GBM'. The search results table shows a list of items with columns for 'Collection ID', 'Subject ID', 'Studies', and 'Series'. A red arrow points from the 'Download' button in the table above to the 'Download' button in the search results table. Below the search results, there is a viewer for a specific image (CIL-00016) showing an axial MRI brain scan with a yellow box highlighting a region of interest.

Pathology Downloads & Data Portal

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Created by Tracy Nolan, last modified by natasha.honochimi on Feb 14, 2020

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Discovery Study Proteomics/Clinical Data (external)	<ul style="list-style-type: none"> CPTAC Data Portal (Georgetown) Proteomic Data Commons
Genomics/Clinical Data (External)	Genomic Data Commons

The screenshot displays the TCIA CPTAC Pathology Portal. At the top, it indicates 'Selected: 910 slides, Total: 6121 slides' and 'Last Updated: Feb 13, 2020'. The main content area is divided into 'Specimen Data' and 'Slide Browser'. The 'Specimen Data' table lists various tumor specimens with their respective IDs and characteristics. The 'Slide Browser' section shows a list of slides with a 'Download' button. On the right side, there is a large histology image of a brain tumor section. The interface also includes a search bar, a 'Download' button, and a 'Search' button.

CPTAC Pathology Portal: Links to all data types

The image displays a comprehensive view of the CPTAC Pathology Portal interface. The central focus is a data table listing various cases and their associated data types. A red circle highlights the entry for Case ID C3L-00019, which is linked to a brain MRI image. Surrounding this are several other interface elements:

- Top Left:** A search and filter panel with options for 'CPTAC-GBM' and 'TCIA CPTAC Tumor'.
- Top Right:** A navigation menu for the 'NATIONAL CANCER INSTITUTE GDC Data Portal' with tabs for 'Cases', 'Clinical', 'Genes', and 'Mutations'.
- Bottom Left:** A 'Topographic_Site' dropdown menu listing various anatomical locations like 'Bone Marrow (0)', 'Brain (511)', 'Head, Neck (0)', etc.
- Bottom Center:** A brain MRI image showing a tumor in the brain, with a yellow arrow pointing to a specific region.
- Bottom Right:** A 'Proteomic Data Commons' panel showing filters and charts for 'CPTAC-GBM Discovery Study'.

The main data table is structured as follows:

Case ID	Primary Site	Gender	Files	Available Files per Data Category
C3L-00016	C3L-00016-23			
C3L-00016	C3L-00016-21			
C3L-00016	C3L-00016-24			
C3L-00016	C3L-00016-22			
C3L-00019	C3L-00019-23	40-50	White	
C3L-00019	C3L-00019-22	50-50	White	
C3L-00019	C3L-00019-21	60	White	
C3L-00019	C3L-00019-24	60-70	White	
C3L-00019	C3L-00019-22	60-70	White	
C3L-00025	C3L-00025-21	60-70	White	
C3L-00025	C3L-00025-22	60-70	White	
C3L-00025	C3L-00025-23	60-70	White	
C3L-00278	C3L-00278-22	60-70	White	
C3L-00278	C3L-00278-21	60-70	White	
C3L-00278	C3L-00278-22	60-70	White	
C3L-00349	C3L-00349-23	50-60	White	

Cancer-specific links to other CPTAC Resources

CPTAC-GBM

Created by Tracy Nolan, last modified by natasha.honouchi on Feb 14, 2020

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Genomics/Clinical Data (External)	Genomic Data Commons

Center for Strategic Scientific Initiatives
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CPTAC Glioblastoma (GBM) Discovery Study

Embargo release date: March 1, 2021

[Explore This Study at the NCI Proteomic Data Commons](#)

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Proteomic Data Commons

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Cases Clinical Genes Mutations

Case

TCGA-A5-A0G2_432fe4a9-2...

Upload Case Set


Primary Site

Program


Cases (108) Genes (0) Mutations (0) OncGrid

CPTAC Data Release Schedule

Monthly pathology updates



See What's New on
The Cancer Imaging Archive
CPTAC Pathology Portal



149 New Pathology Slides


28 New Cases

Lung Squamous Cell Carcinoma
Lung Adenocarcinoma
Glioblastoma Multiforme


wiki.cancerimagingarchive.net/display/Public/CPTAC+Imaging+Proteomics

CPTAC
Cancer Proteomics and Therapeutics

Quarterly radiology updates



See What's New on
The Cancer Imaging Archive
CPTAC Pathology Portal



10 New Pathology Slides
3 New Cases

44 New Radiology Cases

Cutaneous Melanoma
Glioblastoma Multiforme
Head & Neck Squamous Cell Carcinoma
Lung Squamous Cell Carcinoma
Lung Adenocarcinoma
Pancreatic Ductal Adenocarcinoma
Sarcomas

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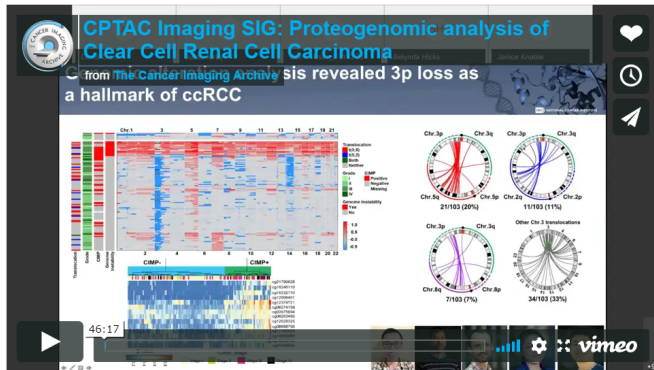
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CPTAC Imaging Special Interest Group

Join the [CPTAC Imaging Special Interest Group](#) to be notified of webinars & data releases, collaborate on common data wrangling tasks and seek out partners to explore research hypotheses!

Proteogenomic analysis of Clear Cell Renal Cell Carcinoma (February 4, 2020)



CPTAC Imaging Special Interest Group Shared privately

37 of 37 topics ✖

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- RE: CPTAC-CCRCC Proteogenomic Analyses Presentation
By me - 2 posts - 4 views Feb 11
- New CPTAC Pathology Data Now Available on TCIA!
By Brenda Fevter-Sullivan - 2 posts - 4 views Jan 30
- Fw: GDC Data Release 22 Includes New CPTAC Project!
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- Reminder! CPTAC Imaging SIG: Proteogenomic Analysis of UCEC
By me - 2 posts - 5 views Jan 16
- Do you have images for people who don't have tumors?
By Ahmed Hassan - 1 post - 2 views Jan 11
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By Brenda Fevter-S

Webinar schedule:

- [Proteogenomic analysis of Glioblastoma \(May 13, 2020\)](#)
- [POSTPONED – Proteogenomic analysis of Lung Adenocarcinoma \(March 3, 2020\)](#)
- [Proteogenomic analysis of Clear Cell Renal Cell Carcinoma \(February 4, 2020\)](#)
- [Proteogenomic analysis of Uterine Corpus Endometrial Carcinoma \(January 14, 2020\)](#)
- [Imaging-Omic correlation studies utilizing CPTAC data \(September 9, 2019\)](#)
- [Accessing CPTAC data via Jupyter Notebooks \(August 6, 2019\)](#)
- [Program overview & data access tutorials \(July 1, 2019\)](#)

Agenda & Slides

Dr. David Clarke presents the consortium's proteogenomic analyses of the [CPTAC Clear Cell Renal Cell Carcinoma \(CCRCC\)](#) cohort. This deep dive into the CCRCC genomic and proteomic datasets will help researchers better understand how these can be correlated with features derived from the imaging data. [Download the slides](#)

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