

# cBioPortal Tutorial #1: Single Study Exploration

Explore all data in a dataset

# Tutorial Objectives

- Introduce cBioPortal main page
- Show two ways to select a study
  - From the Query box on the main page
  - From the Data Sets page
- Walk through the four possible tabs in the study view
  - Study Summary
  - Clinical Data
  - Heatmaps
  - CN Segments
- Show how to run a query from the study view

# cBioPortal Main Page

The screenshot shows the cBioPortal main page. At the top, there is a navigation bar with links: Data Sets, Web API, R/MATLAB, Tutorials/Webinars, FAQ, News, Visualize Your Data, About, and cBioPortal. A 'Login' button is in the top right. Below the navigation bar, there is a 'Query' section with 'Quick Search Beta!' and 'Download' links. A 'Please cite: Cerami et al., 2012; Gao et al., 2013' notice is present. The main content area is titled 'Select Studies for Visualization & Analysis:' and shows '0 studies selected (0 samples)'. On the left, a table lists various study categories and their counts. On the right, there are sections for 'PanCancer Studies' and 'Pediatric Cancer Studies', each with a list of studies and their sample counts. A 'Search...' input field is located at the top right of the main content area. On the far right, there is a 'What's New' section with a Twitter feed and a 'Local Installations' section with a world map.

**Search studies**

**Browse available datasets and select studies to explore or query**

**Number of studies for each tissue of origin (click to filter)**

**List of all studies, organized by organ system**

Category	Count
PanCancer Studies	7
Pediatric Cancer Studies	13
Immunogenomic Studies	8
Cell lines	3
Adrenal Gland	3
Ampulla of Vater	1
Biliary Tract	9
Bladder/Urinary Tract	16
Bone	2
Bowel	10
Breast	18
CNS/Brain	20
Cervix	2
Esophagus/Stomach	16

**PanCancer Studies**

- ☐ MSK-IMPACT Clinical Sequencing Cohort (MSKCC, Nat Med 2017)
- ☐ Metastatic Solid Cancers (UMich, Nature 2017)
- ☐ MSS Mixed Solid Tumors (Broad/Dana-Farber, Nat Genet 2018)
- ☐ SUMMIT - Neratinib Basket Study (Multi-Institute, Nature 2018)
- ☐ TMB and Immunotherapy (MSKCC, Nat Genet 2019)
- ☐ Tumors with TRK fusions (MSK, Clin Cancer Res 2020)
- ☐ Cancer Therapy and Clonal Hematopoiesis (MSK, Nat Genet 2020)

**Pediatric Cancer Studies**

- ☐ Pediatric Preclinical Testing Consortium (CHOP, Cell Rep 2019)
- ☐ Pediatric Acute Lymphoid Leukemia - Phase II (TARGET, 2018)
- ☐ Pediatric Rhabdoid Tumor (TARGET, 2018)
- ☐ Pediatric Wilms' Tumor (TARGET, 2018)
- ☐ Pediatric Acute Myeloid Leukemia (TARGET, 2018)
- ☐ Pediatric Neuroblastoma (TARGET, 2018)
- ☐ Pediatric Pan-Cancer (DKFZ, Nature 2017)
- ☐ Pediatric Pan-cancer (Columbia U, Genome Med 2016)
- ☐ Acute Lymphoblastic Leukemia (St Jude, Nat Genet 2016)
- ☐ Acute Lymphoblastic Leukemia (St Jude, Nat Genet 2015)
- ☐ Pediatric Ewing Sarcoma (DFCI, Cancer Discov 2014)
- ☐ Ewing Sarcoma (Institut Curie, Cancer Discov 2014)

**What's New**

**Local Installations**

# Selecting a study: from Query

**1. Filter the list of studies (optional)**

**2. Select the checkbox next to the study of interest and click "Explore Selected Studies"**

**3. Or click on "View study summary" button**

The screenshot shows the cBioPortal interface. At the top, there is a navigation bar with links like Data Sets, Web API, R/MATLAB, Tutorials/Webinars, FAQ, News, Visualize Your Data, and a Login button. Below the navigation bar, there is a search bar with the text "glioma" and a dropdown menu. The main content area is titled "Select Studies for Visualization & Analysis:" and shows a list of studies. The list is organized into categories: Immunogenomic Studies, CNS/Brain, and Soft Tissue. Under the CNS/Brain category, there is a sub-category "Diffuse Glioma" with a list of studies. The study "Brain Lower Grade Glioma (TCGA, Firehose Legacy)" is selected, indicated by a checked checkbox. To the right of the study list, there is a "What's New" section with a tweet from cBioPortal and a "Local Installations" section with a world map. At the bottom, there are two buttons: "Query By Gene" and "Explore Selected Studies".

# Selecting a study: from Data Sets page

1. Use search functionality to find datasets of interest

2. Or sort by number of samples with each data type

**cBioPortal**  
FOR CANCER GENOMICS

Data Sets Web API R/MATLAB Tutorials/Webinars FAQ News Visualize Your Data About cBioPortal Installations

### Datasets

The table below lists the number of available samples per cancer study and data type.

Name ▲	Reference	All	Mutations	CNA	RNA-Seq
<a href="#">Acinar Cell Carcinoma of the Pancreas (JHU, J Pathol 2014)</a>	<a href="#">Jial et al. J Pathol 2014</a>	23	23	0	0
<a href="#">Acral Melanoma (TCGA, Genome Res 2017)</a>	<a href="#">Liang et al. Genome Res 2017</a>	38	38	38	36
<a href="#">Acute Lymphoblastic Leukemia (St Jude, Nat Genet 2015)</a>	<a href="#">Andersson et al. Nat Genet 2015</a>	93	93	0	0
<a href="#">Acute Lymphoblastic Leukemia (St Jude, Nat Genet 2016)</a>	<a href="#">Zhang et al. Nat Genet 2016</a>	73	73	0	0
<a href="#">Acute Myeloid Leukemia (OHSU, Nature 2018)</a>	<a href="#">Tyner et al. Nature 2018</a>	672	622	0	451
<a href="#">Acute Myeloid Leukemia (TCGA, Firehose Legacy)</a>	<a href="#">TCGA, NEJM 2013</a>	200	197	191	173
<a href="#">Acute Myeloid Leukemia (TCGA, NEJM 2013)</a>	<a href="#">TCGA, NEJM 2013</a>	200	200	191	173
<a href="#">Acute Myeloid Leukemia (TCGA, PanCancer Atlas)</a>	<a href="#">TCGA, Cell 2018</a>	200	200	191	173
<a href="#">Acute myeloid leukemia or myelodysplastic syndromes (WashU, 2016)</a>	<a href="#">Welch et al. N Engl J Med. 2016</a>	136	136	0	0
<a href="#">Adenoid Cystic Carcinoma (FMI, Am J Surg Pathol. 2014)</a>	<a href="#">Ross et al. Am J Surg Pathol 2014</a>	28	28	28	0
<a href="#">Adenoid Cystic Carcinoma (JHU, Cancer Prev Res 2016)</a>	<a href="#">Rettig et al. Cancer Prev Res 2016</a>	25	25	0	0
<a href="#">Adenoid Cystic Carcinoma (MDA, Clin Cancer Res 2015)</a>	<a href="#">Mitali et al. Clin Cancer Res 2015</a>	102	65	0	0
<a href="#">Adenoid Cystic Carcinoma (MGH, Nat Gen 2016)</a>	<a href="#">Drier et al. Nature Genetics 2016</a>	10	10	0	0
<a href="#">Adenoid Cystic Carcinoma (MSKCC, Nat Genet 2013)</a>	<a href="#">Ho et al. Nat Genet 2013</a>	60	60	60	0
<a href="#">Adenoid Cystic Carcinoma (Sanger/MDA, JCI 2013)</a>	<a href="#">Stephens et al. JCI 2013</a>	24	24	0	0
<a href="#">Adenoid Cystic Carcinoma of the Breast (MSKCC, J Pathol. 2015)</a>	<a href="#">Martelotto et al. J Pathol 2015</a>	12	12	12	0
<a href="#">Adenoid Cystic Carcinoma Project (J Clin Invest 2019)</a>	<a href="#">Allen et al. J Clin Invest 2019</a>	1049	1049	928	0
<a href="#">Adrenocortical Carcinoma (TCGA, Firehose Legacy)</a>	<a href="#">TCGA, Cell 2018</a>	92	90	90	79
<a href="#">Adrenocortical Carcinoma (TCGA, PanCancer Atlas)</a>	<a href="#">TCGA, Cell 2018</a>	92	91	89	78
<a href="#">Adult Soft Tissue Sarcomas (TCGA, Cell 2017)</a>	<a href="#">TCGA, Cell 2017</a>	206	206	206	206
<a href="#">Ampullary Carcinoma (Baylor College of Medicine, Cell Reports 2016)</a>	<a href="#">Gingras et al. Cell Rep 2016</a>	160	160	0	0
<a href="#">Anaplastic Oligodendroglioma and Anaplastic Oligoastrocytoma (MSKCC, Neuro Oncol 2017)</a>	<a href="#">Thomas et al. Neuro Oncol 2017</a>	22	22	22	0
<a href="#">Basal Cell Carcinoma (UNIGE, Nat Genet 2016)</a>	<a href="#">Bonilla et al. Nat Genet 2016</a>	293	293	0	0
<a href="#">Bladder Cancer (MSK/TCGA, 2020)</a>	<a href="#">Kim et al. Eur Urol 2015</a>	476	474	442	296
<a href="#">Bladder Cancer (MSKCC, Eur Urol 2014)</a>	<a href="#">Kim et al. Eur Urol 2015</a>	109	109	109	0
<a href="#">Bladder Cancer (MSKCC, J Clin Oncol 2013)</a>	<a href="#">Iyer et al. J Clin Oncol 2013</a>	97	97	97	0
<a href="#">Bladder Cancer (MSKCC, Nat Genet 2016)</a>	<a href="#">Al-Ahmadie et al. Nat Genet 2016</a>	34	34	33	0
<a href="#">Bladder Cancer (TCGA, Cell 2017)</a>	<a href="#">Robertson et al. Cell 2017</a>	413	412	408	408
<a href="#">Bladder Urothelial Carcinoma (BGI, Nat Genet 2013)</a>	<a href="#">Guo et al. Nat Genet 2013</a>	99	99	0	0
<a href="#">Bladder Urothelial Carcinoma (DFCI/MSKCC, Cancer Discov 2014)</a>	<a href="#">Van Allen et al. Cancer Discov 2014</a>	50	50	0	0
<a href="#">Bladder Urothelial Carcinoma (TCGA, Firehose Legacy)</a>	<a href="#">TCGA, Cell 2017</a>	413	130	408	408
<a href="#">Bladder Urothelial Carcinoma (TCGA, Nature 2014)</a>	<a href="#">TCGA, Cell 2017</a>	131	130	128	129
<a href="#">Bladder Urothelial Carcinoma (TCGA, PanCancer Atlas)</a>	<a href="#">TCGA, Cell 2017</a>	411	410	408	407
<a href="#">Brain Lower Grade Glioma (TCGA, Firehose Legacy)</a>	<a href="#">TCGA, Cell 2017</a>	530	286	513	530
<a href="#">Brain Lower Grade Glioma (TCGA, PanCancer Atlas)</a>	<a href="#">TCGA, Cell 2017</a>	514	512	511	514
<a href="#">Brain Tumor PDXs (Mayo Clinic, 2019)</a>	<a href="#">TCGA, Cell 2017</a>	97	83	83	66

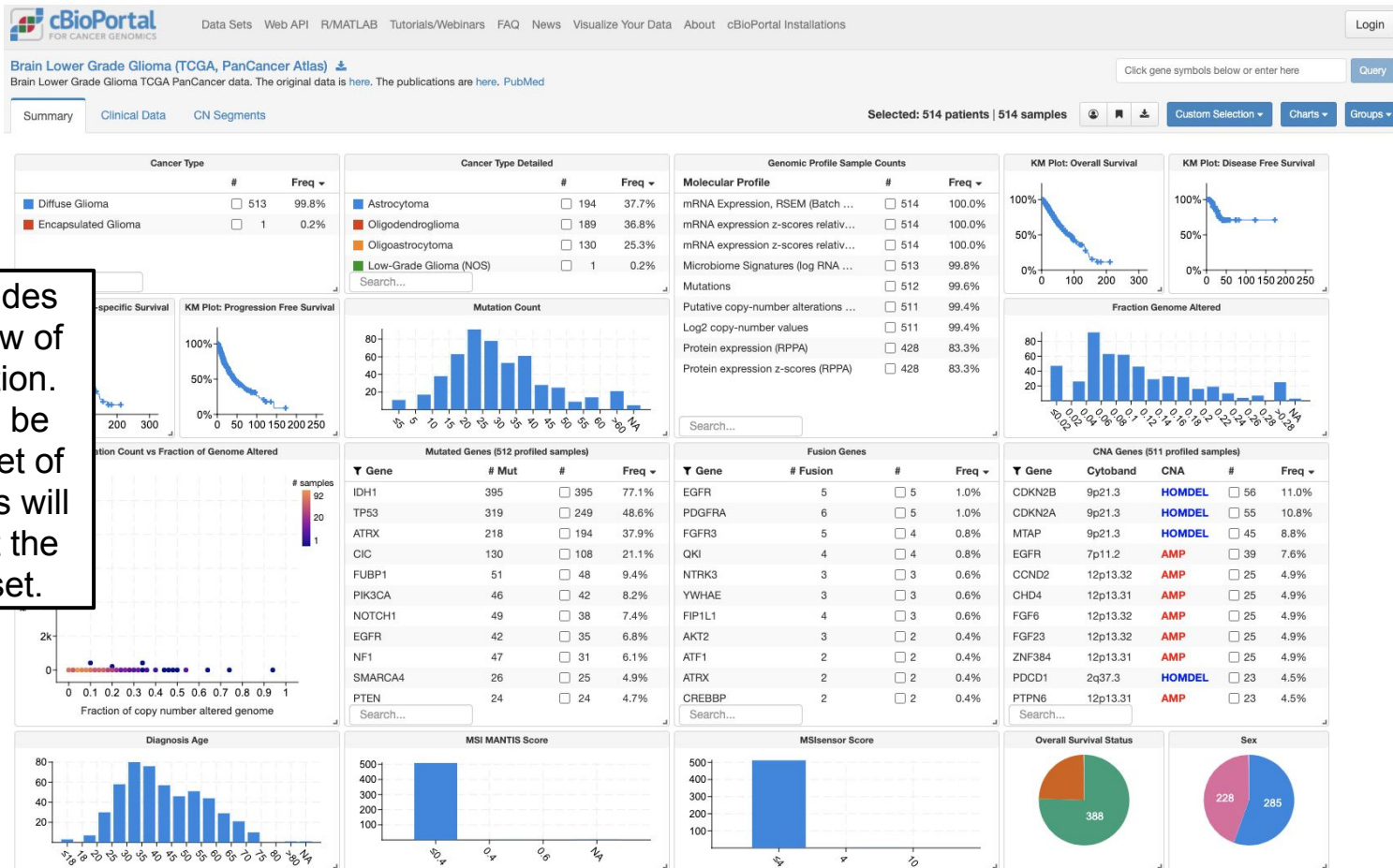
3. Click on data set of interest

Once you select a study by either method you land on the Study Summary Tab.

Here you can explore features (e.g. mutated genes or gender) of the samples in the study (or of a subset of samples in the study) or initiate a query.

The features available to explore will depend on the data available for the particular study selected.

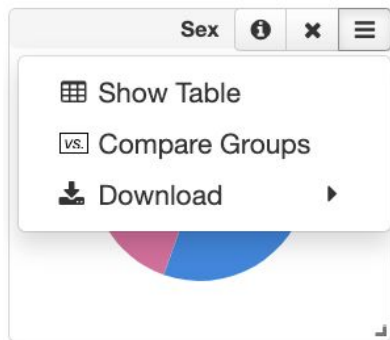
# Study Summary Tab: Overview



Study summary provides an interactive overview of the study for exploration. Individual charts can be used to select a subset of the samples. All charts will then update to reflect the features of that subset.

# Study Summary Tab: Charts


Hover over a chart to find these buttons





Click and drag to resize a chart





 Hover for a description of the data in this chart.

 Click to remove this chart from view.

 Hover over this button to bring up a menu with the options below:

 Click to convert the pie chart to a table. Note that hovering over the chart will also bring up a tooltip with tabular data.

 Click to go to a group comparison session with groups based on these values. See the [group comparison tutorial](#) for more details.

 Click to download data (text file) or plot (PDF or SVG).



# Study Summary Tab: Charts

Many studies have additional charts that can be added using this button.

Brain Lower Grade Glioma (TCGA, PanCancer Atlas)

Brain Lower Grade Glioma TCGA PanCancer data. The original data is [here](#). The publications are [here](#). [PubMed](#)

Summary Clinical Data CN Segments

Selected: 514 patients | 514 samples

Click gene symbols below or enter here

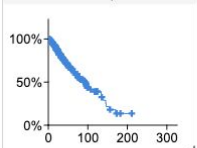
Custom Selection Charts Groups

Cancer Type

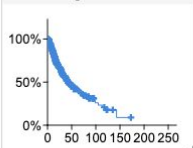
#	Freq
Diffuse Glioma	513 99.8%
Encapsulated Glioma	1 0.2%

Search...

KM Plot: Disease-specific Survival



KM Plot: Progression Free Survival

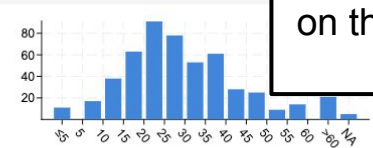


Cancer Type Detailed

#	Freq
Astrocytoma	194 37.7%
Oligodendroglioma	189 36.8%
Oligoastrocytoma	
Low-Grade Glioma (NOS)	

Search...

Mutation Count



Genomic Profile Sample Counts

#	Freq
mRNA Expression, RSEM (Batch ...	514 100.0%
mRNA expression z-scores relativ...	514 100.0%

Search...

Charts can always be reordered by dragging on the grey bar with the chart name.

Clinical Genomic Gene Specific Custom Data

Select all (100) Search...

Name	Freq
<input type="checkbox"/> BuPa Hypoxia Score	100.0%
<input type="checkbox"/> Cancer Studies	100.0%
<input checked="" type="checkbox"/> Cancer Type	100.0%
<input checked="" type="checkbox"/> Cancer Type Detailed	100.0%
<input type="checkbox"/> Case Lists	100.0%
<input type="checkbox"/> Center of sequencing	100.0%
<input type="checkbox"/> In PanCan Pathway Analysis	100.0%
<input checked="" type="checkbox"/> MSIsensor Score	100.0%
<input type="checkbox"/> Number of Samples Per Patient	100.0%
<input type="checkbox"/> Oncotree Code	100.0%
<input type="checkbox"/> Ragnum Hypoxia Score	100.0%
<input type="checkbox"/> Sample Type	100.0%
<input type="checkbox"/> Somatic Status	100.0%
<input type="checkbox"/> TCGA PanCanAtlas Cancer Type Acronym	100.0%

The Gene Specific subtab allows you to add charts for individual genes from any molecular profile with continuous data, e.g. mRNA expression. The data will be displayed as a histogram, which can be used like any other chart to filter or define groups for comparison.

Clinical Genomic Gene Specific Custom Data

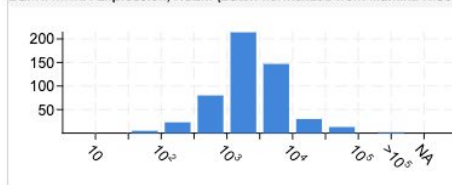
EGFR

All gene symbols are valid.

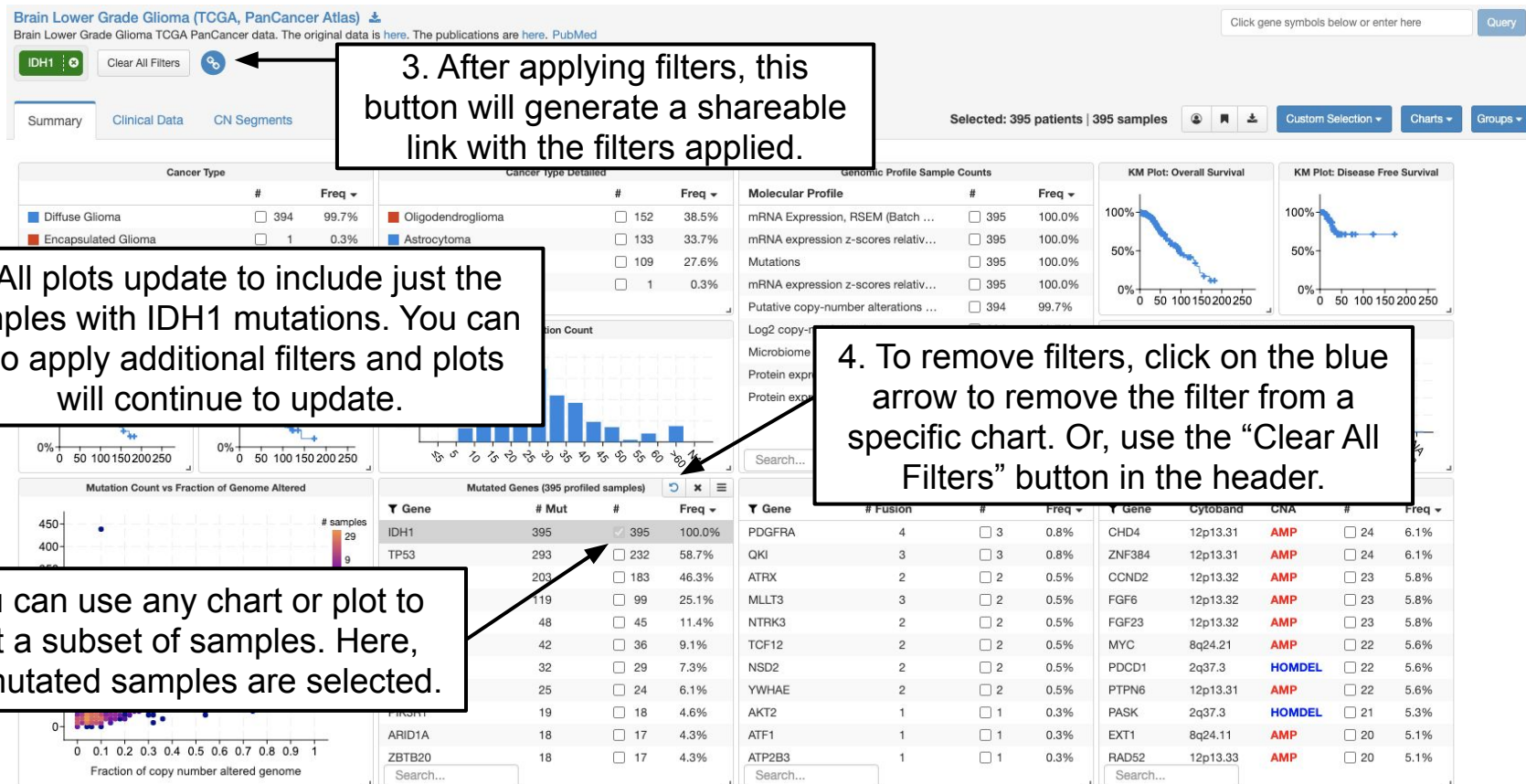
mRNA Expression, RSEM (Batch normalize...

Add Chart

EGFR: mRNA Expression, RSEM (Batch normalized from Illumina HiSeq...



[Link to this page](#)



# Clinical Data Tab

Brain Lower Grade Glioma (TCGA, PanCancer Atlas) [Download](#)

Brain Lower Grade Glioma TCGA PanCancer data. The original data is [here](#). The publications are [here](#). PubMed

IDH1

Clear filters

Filters applied in the Summary tab apply to this table

Download clinical data table

Show additional data (available data will vary based on the study)

Selected: 395 patients | 395 samples

Custom Selection

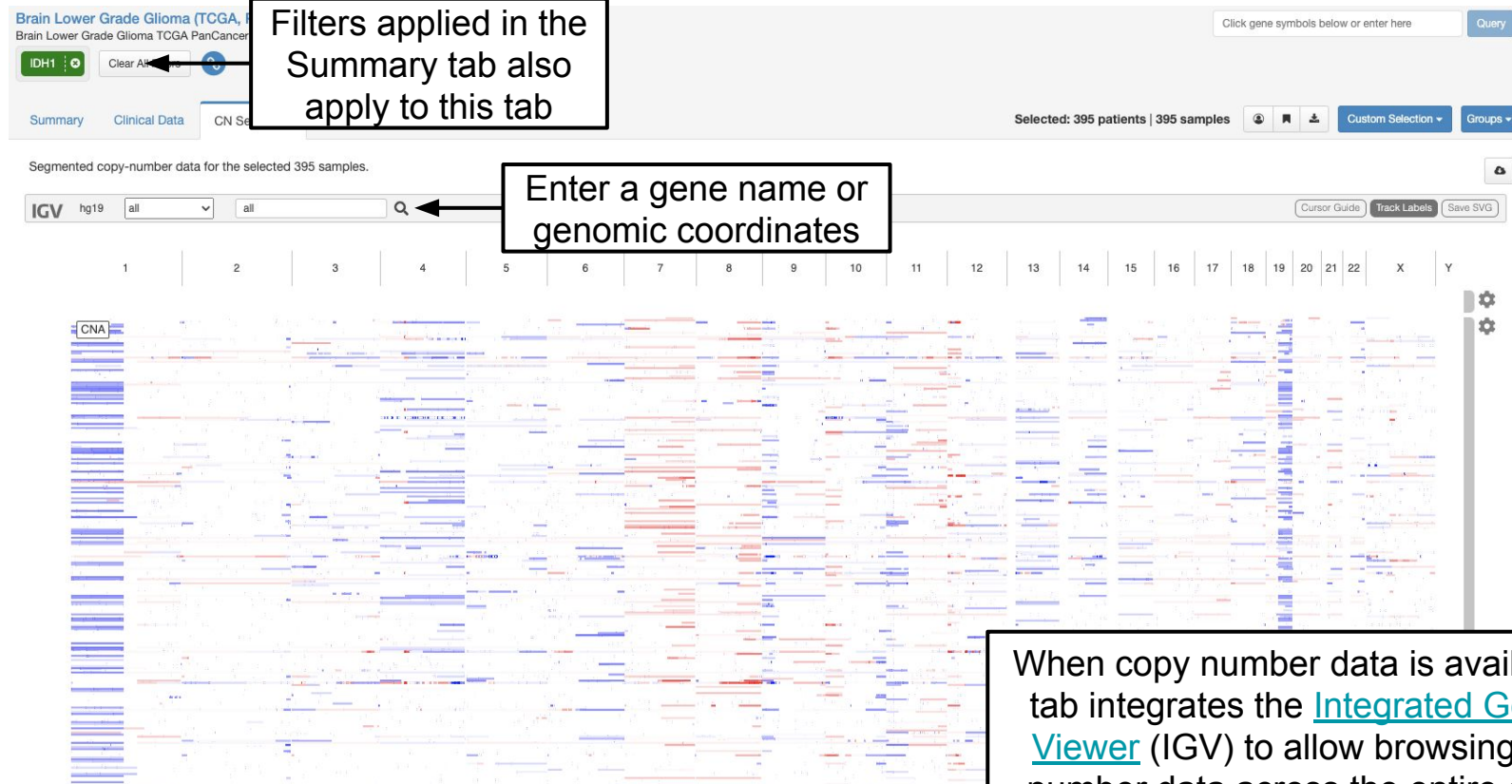
Columns

Groups

Patient ID	Sample ID	Cancer Type	Cancer Type Detailed	Mutation Count	Fraction Genome Altered	Diagnosis Age	MSI MANTIS Score	MSIsensor Score	Overall Survival Status	Sex	Ethnicity Category	Race Category	Subtype	Tumor Type	10p Status	10q Status	11p Status	11q Status	12p Status
TCGA-CS-4938	TCGA-CS-4938-01	Diffuse Glioma	Astrocytoma	14	0.0518	31.0	0.303	0	0:LIVING	Female	Not Hispanic Or Latino	White	LGG_IDHmut-non-codel	Astrocytoma	Not Called	Not Called	Not Called	Not Called	Not Called
TCGA-CS-4942	TCGA-CS-4942-01	Diffuse Glioma	Astrocytoma	25	0.0937	44.0	0.281	0.02	1:DECEASED	Female		Black or African American	LGG_IDHmut-non-codel	Astrocytoma	Not Called	Not Called	Not Called	Not Called	Not Called
TCGA-CS-4943	TCGA-CS-4943-01	Diffuse Glioma	Astrocytoma	24	0.1625	37.0	0.2751	0.25	1:DECEASED	Male		White	LGG_IDHmut-non-codel	Astrocytoma		Not Called		Not Called	Gained
TCGA-CS-4944	TCGA-CS-4944-01	Diffuse Glioma	Astrocytoma	21	0.0603	50.0	0.2697	0.04	0:LIVING	Male		White	LGG_IDHmut-non-codel	Astrocytoma	Not Called	Not Called	Not Called	Not Called	Not Called
TCGA-CS-5390	TCGA-CS-5390-01	Diffuse Glioma	Oligodendroglioma	44	0.0511	47.0	0.2623	0.1	0:LIVING	Female		White	LGG_IDHmut-codel	Oligodendroglioma	Not Called	Not Called	Not Called	Not Called	Not Called
TCGA-CS-5393	TCGA-CS-5393-01	Diffuse Glioma	Astrocytoma	24	0.0569	39.0	0.2715	0	0:LIVING	Male		White	LGG_IDHmut-non-codel	Astrocytoma	Not	Not	Not	Not	
TCGA-CS-5394	TCGA-CS-5394-01	Diffuse Glioma	Astrocytoma	22	0.0469	40.0	0.3295	0.16	0:LIVING	Male		White	LGG_IDHmut-non-codel	Astrocytoma					

Scroll to the right to see more columns. Each column can be sorted by clicking on the column header.

# CN Segments Tab



When copy number data is available, this tab integrates the [Integrated Genomics Viewer](#) (IGV) to allow browsing of copy number data across the entire genome. Each row is a single sample.



# Additional Tabs: Heatmaps

Colorectal Adenocarcinoma (TCGA, Firehose Legacy) 

TCGA Colorectal Adenocarcinoma. Source data from GDAC Firehose. Previously known as TCGA Provisional.

Summary Clinical Data **Heatmaps** CN Segments

This tab will only appear for some TCGA studies. It is an embedding of the [Next-Generation Clustered Heat Map](#) interactive heatmap tool.

THE UNIVERSITY OF TEXAS

MDAnderson  
Cancer Center

TCGA Next-Generation Clustered Heat Map (NG-CHM) Compendium

**Single Study Maps**

Choose one or more criteria:

**Cancer Type**

COAD - Colon adenocarcinoma

**Platform**

Select platform

**Heatmap Type**

Select heat map type

[See other Heat Map Collections](#)

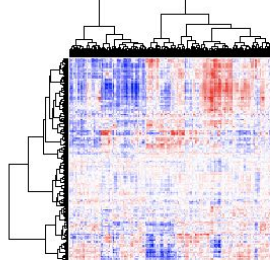
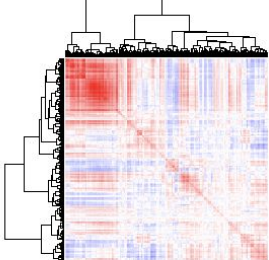
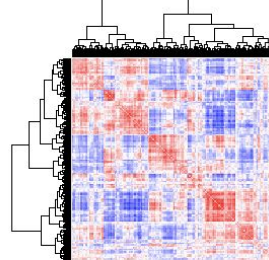
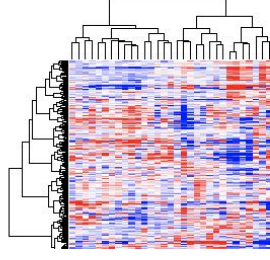
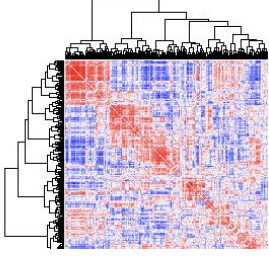
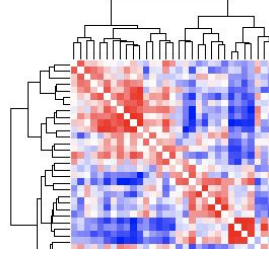
[Bookmark Link for Current View](#)

**NG-CHM Viewer Help**

[Quick User Guide \(Video\)](#)

[Other User Guides / Videos](#)

Click on any thumbnail image shown below to open in the NG-CHM viewer.

	Gene/Probe vs Sample	Gene/Probe vs Gene/Probe	Sample vs Sample
mRNA Expression	 tcga_rnaseqv2_coad_v2.0_gene_sample	 tcga_rnaseqv2_coad_v2.0_gene_gene	 tcga_rnaseqv2_coad_v2.0_sample_sample
Reverse Phase Protein Array			

# Study View: Additional Features

Brain Lower Grade Glioma (TCGA, PanCancer Atlas) [Download](#)

Brain Lower Grade Glioma TCGA PanCancer data. The original data is [here](#). The publications are [here](#). [PubMed](#)

Summary

Clinical Data

CN Segments

Selected: 514 patients | 514 samples

Click gene symbols below or enter here

Query

Click here to see all selected samples/patients in Patient View.  
See [tutorial](#).

Click here to create a virtual study of the selected samples/patients.  
See [tutorial](#).

Click here to enter a list of sample or patient IDs for a custom filter.

Click here for group comparison.  
See [tutorial](#).

# Study Summary Tab: Run a query

3. Then click here to run the query

Brain Lower Grade Glioma (TCGA, PanCancer Atlas) [📄](#)

Brain Lower Grade Glioma TCGA PanCancer data. The original data is [here](#). The publications are [here](#). PubMed

Putative copy-number alterations from GISTIC [🔍](#) and Mutations [🔍](#) Clear All Filters [🔄](#)

Summary Clinical Data CN Segments

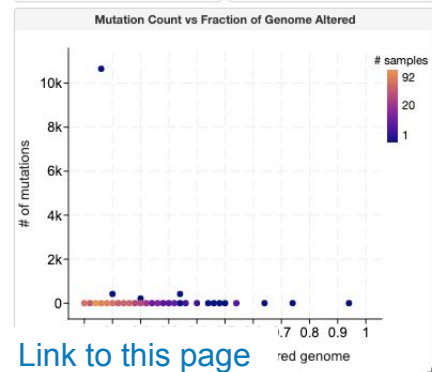
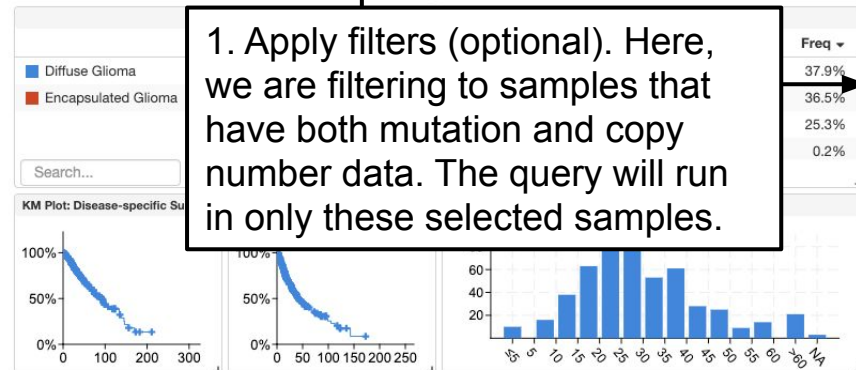
1. Apply filters (optional). Here, we are filtering to samples that have both mutation and copy number data. The query will run in only these selected samples.

2. Type a gene name here

IDH1

Query

3. Or click on a gene to add it to the query



Mutated Genes (509 profiled samples)			
Gene	# Mut	#	Freq
IDH1 <input checked="" type="checkbox"/>	394	394	77.4%
TP53	319	249	48.9%
ATRX	218	194	38.1%
CIC	130	108	21.2%
FUBP1	51	48	9.4%
PIK3CA	46	42	8.3%
NOTCH1	49	38	7.5%
EGFR	42	35	6.9%
NF1	47	31	6.1%
SMARCA4	26	25	4.9%
PTEN	24	24	4.7%

Fusion Genes			
Gene	# Fusion	#	Freq
EGFR	5	5	1.0%
PDGFRA	6	5	1.0%
FGFR3	1	1	0.2%
QKI	1	1	0.2%
NTRK3	1	1	0.2%
YWHAE	3	3	0.6%
FIP1L1	4	3	0.6%
AKT2	3	2	0.4%
ATF1	2	2	0.4%
ATRX	2	2	0.4%
CREBBP	2	2	0.4%

EGFR is included in the [OncoKB Cancer Gene List](#) as a oncogene.

CNA Genes (509 profiled samples)				
Gene	Cytoband	CNA	#	Freq
CDKN2B	9p21.3	HOMDEL	56	11.0%
CDKN2A	9p21.3	HOMDEL	55	10.8%
MDM1	9p21.3	HOMDEL	45	8.8%
EGFR	7p11.2	AMP	39	7.7%
CCND2	12p13.32	AMP	25	4.9%
CHD4	12p13.31	AMP	25	4.9%
FGF6	12p13.32	AMP	25	4.9%
FGF23	12p13.32	AMP	25	4.9%
ZNF384	12p13.31	AMP	25	4.9%
PDCD1	2q37.3	HOMDEL	23	4.5%
PTPN6	12p13.31	AMP	23	4.5%

[Link to this page](#)

See Tutorial #2: Single Study Query



Questions?

Check out our other tutorials  
or email us at:

[cbioportal@googlegroups.com](mailto:cbioportal@googlegroups.com)