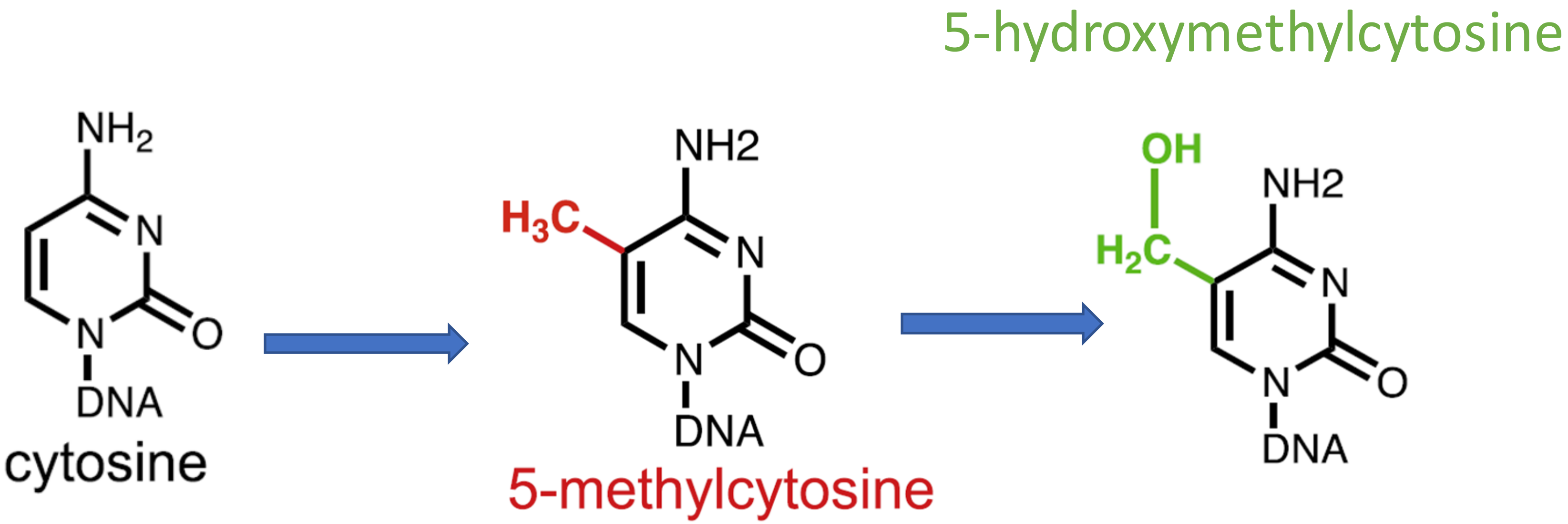
# An Introduction to the 5hmC Portal – PETCH-DB

**V1.0, 02-2023@Chicago, Illinois, USA**

# Cytosine Modifications

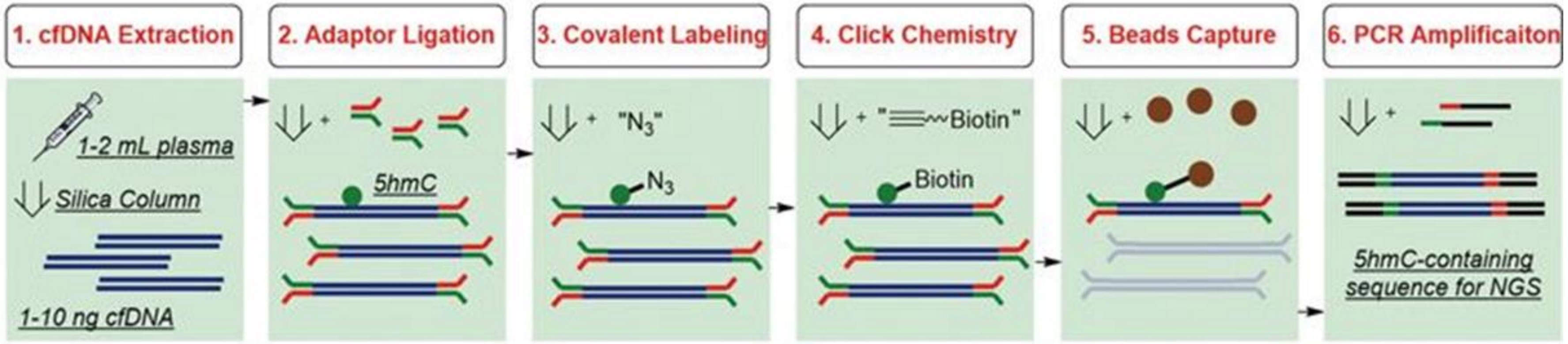


1. Cytosines can be methylated into 5-methylcytosines (5mC), which can be oxidized to 5-hydroxymethylcytosines (5hmC) via an active demethylation process.

2. The 5hmC are biochemically stable epigenetic marks in the human genome.

# The 5hmC-Seal Technology

– A highly sensitive chemical labeling technique for genome-wide profiling of 5hmC



Li et al. Cell Res., 2017

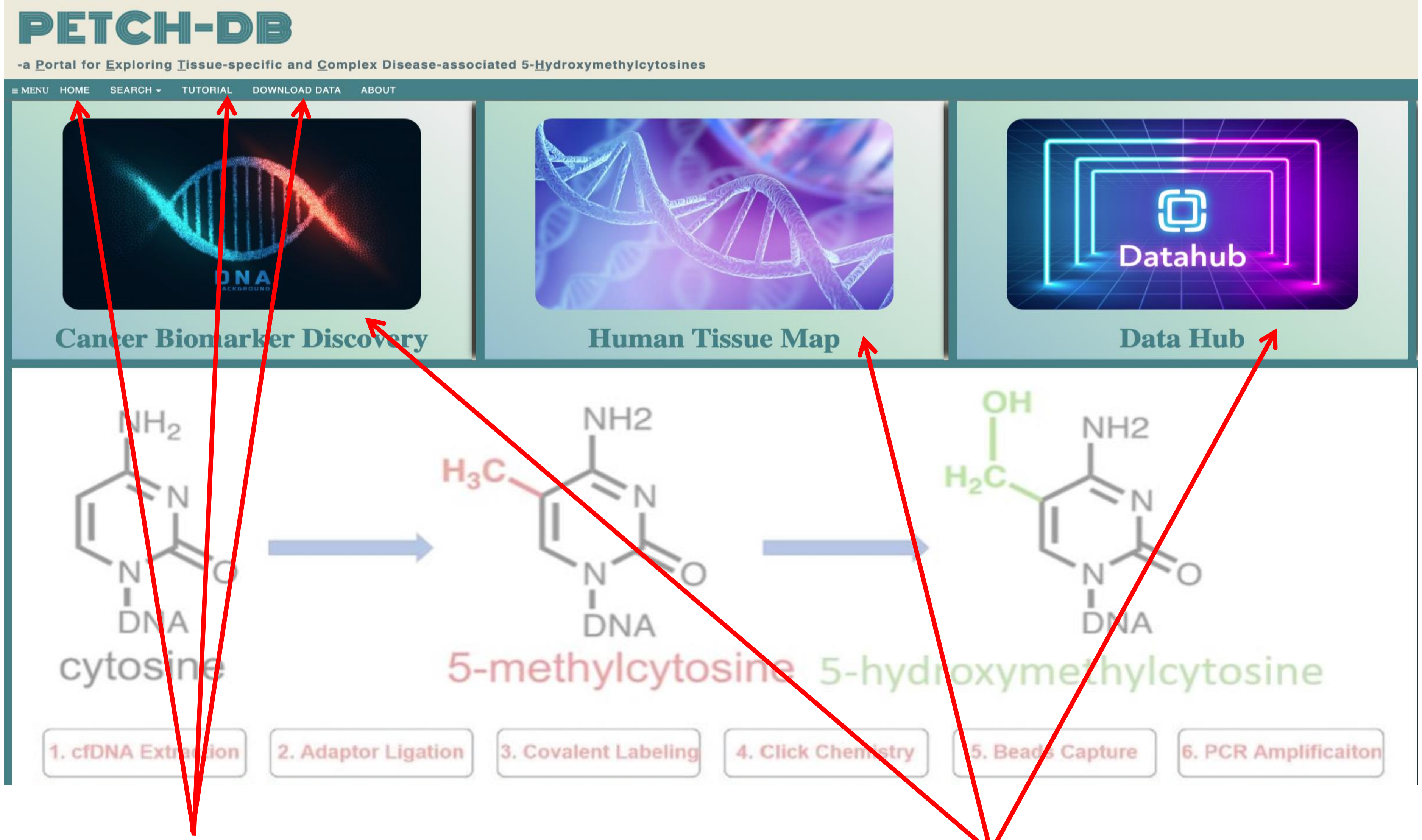
A brief description of the 5hmC-Seal profiling from cfDNA is shown. Purified cfDNA is ligated with standard sequencing adaptors. The 5hmC-containing cfDNA fragments are selectively labeled with a biotin group. The biotin-labeled fragments are captured on the avidin beads, followed by PCR amplification and next-generation sequencing (NGS). Genomic DNA after fragmentation can be profiled for genome-wide 5hmC using the 5hmC-Seal as well.

# Datasets Served in the PETCH-DB

**PETCH-DB**

- **The 5hmC Human Tissue Map** (Cui et al., Nat Commun, 2020)
- **Case-Control Biomarker Discovery Studies**
  - **Diagnosis**
    - ***Liver Cancer*** (Cai et al., Gut, 2019
    - ***Brain Cancer*** (Cai et al. Neurooncol Adv, 2021)
    - ***Colon Cancer*** (Li et al., Cell Res, 2017) – being processed
    - ***FUTURE UPDATES – TBN***
  - **Prognosis**
    - ***Lymphoma*** (Chiu et al., Blood Adv, 2019) – being processed
    - ***FUTURE UPDATES – TBN***

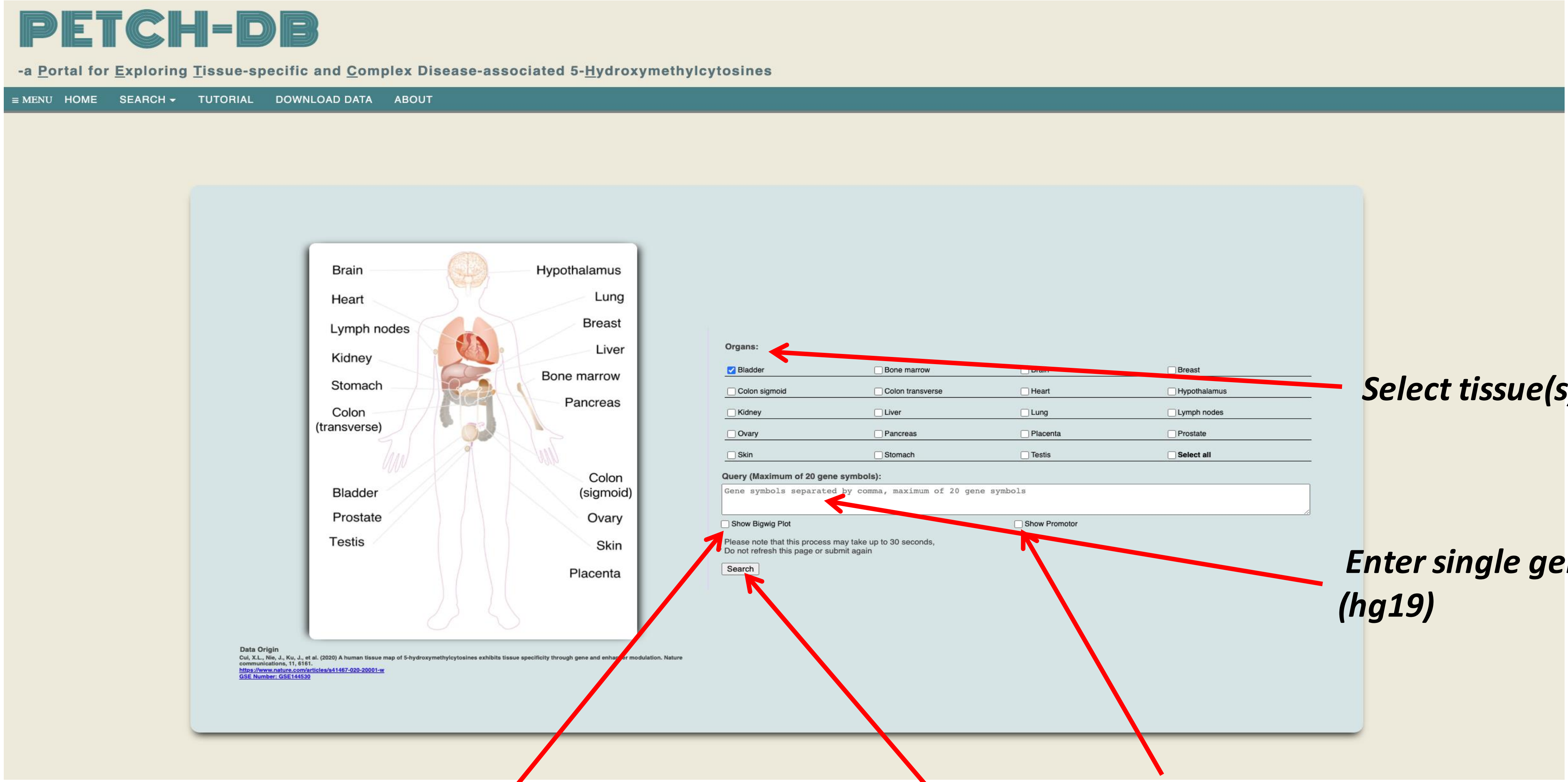
# Homepage – http://www.petcg-db.org/



*Main menu & support*

*Entry button*

# Main Tab – The 5hmC Human Tissue Map search for single gene symbol



**Organs:**

| | | | |
|---|---|---|---|
| ☑ Bladder | ☐ Bone marrow | ☐ Brain | ☐ Breast |
| ☐ Colon sigmoid | ☐ Colon transverse | ☐ Heart | ☐ Hypothalamus |
| ☐ Kidney | ☐ Liver | ☐ Lung | ☐ Lymph nodes |
| ☐ Ovary | ☐ Pancreas | ☐ Placenta | ☐ Prostate |
| ☐ Skin | ☐ Stomach | ☐ Testis | ☐ **Select all** |

**Query (Maximum of 20 gene symbols):**

Gene symbols separated by comma, maximum of 20 gene symbols

☐ Show Bigwig Plot ☐ Show Promotor

Please note that this process may take up to 30 seconds,
Do not refresh this page or submit again

Search

**Data Origin**

Cui, X.L., Nie, J., Ku, J., et al. (2020) A human tissue map of 5-hydroxymethylcytosines exhibits tissue specificity through gene and enhancer modulation. Nature communications, 11, 6161.

https://www.nature.com/articles/s41467-020-20001-w

GSE Number: GSE144530

***Select tissue(s)***

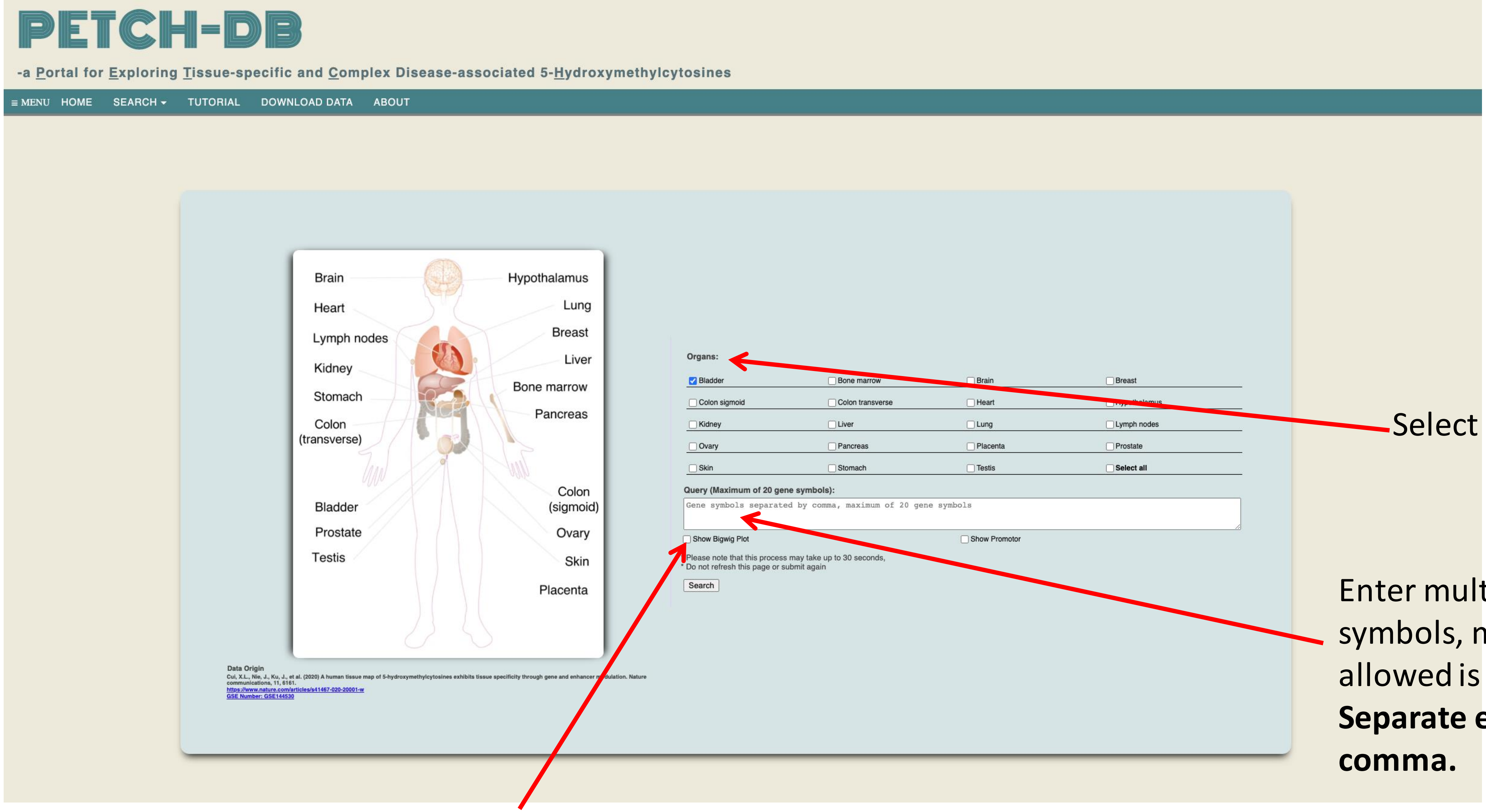
***Enter single gene symbol (hg19)***

***Select this to include "promoters"***

***Select "BigWig" to show read distribution***

***Run the search***

# Main Tab – The 5hmC Human Tissue Map search for multiple gene symbols (Batch search)



**Organs:**

| | | | |
|---|---|---|---|
| ☑ Bladder | ☐ Bone marrow | ☐ Brain | ☐ Breast |
| ☐ Colon sigmoid | ☐ Colon transverse | ☐ Heart | ☐ Hypothalamus |
| ☐ Kidney | ☐ Liver | ☐ Lung | ☐ Lymph nodes |
| ☐ Ovary | ☐ Pancreas | ☐ Placenta | ☐ Prostate |
| ☐ Skin | ☐ Stomach | ☐ Testis | ☐ **Select all** |

**Query (Maximum of 20 gene symbols):**

`Gene symbols separated by comma, maximum of 20 gene symbols`

☐ Show Bigwig Plot ☐ Show Promotor

Please note that this process may take up to 30 seconds,
* Do not refresh this page or submit again

Search

**Data Origin**

Cui, X.L., Nie, J., Ku, J., et al. (2020) A human tissue map of 5-hydroxymethylcytosines exhibits tissue specificity through gene and enhancer modulation. Nature communications, 11, 6161.
https://www.nature.com/articles/s41467-020-20001-w
GSE Number: GSE144530

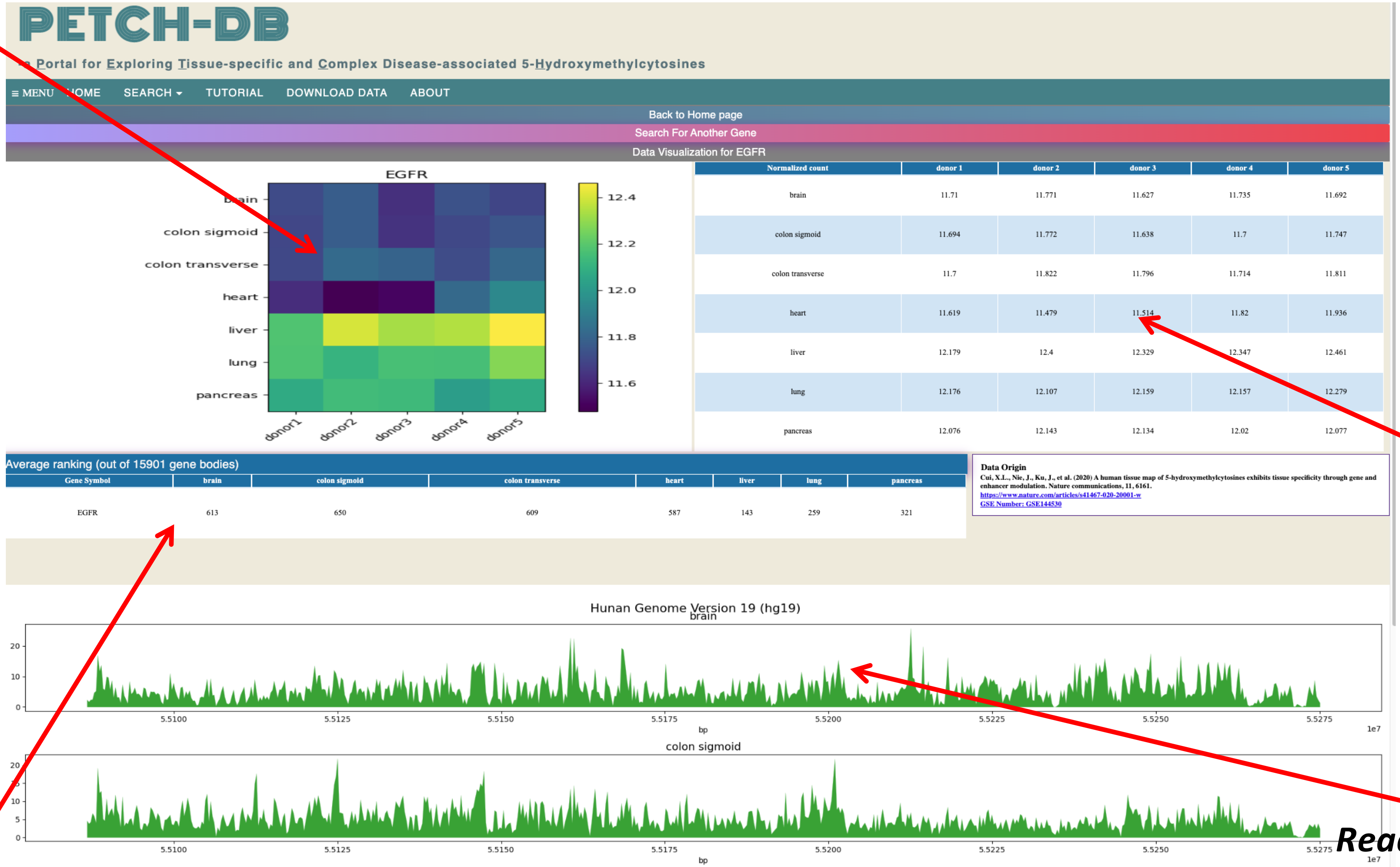
Select tissue(s)

Enter multiple gene symbols, maximum allowed is 20 per search. **Separate each gene with a comma.**

Batch search does not support showing distribution

# Output Example – The 5hmC Human Tissue Map

***A heatmap across the selected tissue types***



| Normalized count | donor 1 | donor 2 | donor 3 | donor 4 | donor 5 |
|---|---|---|---|---|---|
| brain | 11.71 | 11.771 | 11.627 | 11.735 | 11.692 |
| colon sigmoid | 11.694 | 11.772 | 11.638 | 11.7 | 11.747 |
| colon transverse | 11.7 | 11.822 | 11.796 | 11.714 | 11.811 |
| heart | 11.619 | 11.479 | 11.514 | 11.82 | 11.936 |
| liver | 12.179 | 12.4 | 12.329 | 12.347 | 12.461 |
| lung | 12.176 | 12.107 | 12.159 | 12.157 | 12.279 |
| pancreas | 12.076 | 12.143 | 12.134 | 12.02 | 12.077 |

Average ranking (out of 15901 gene bodies)

| Gene Symbol | brain | colon sigmoid | colon transverse | heart | liver | lung | pancreas |
|---|---|---|---|---|---|---|---|
| EGFR | 613 | 650 | 609 | 587 | 143 | 259 | 321 |

**Data Origin**

**Cui, X.L., Nie, J., Ku, J., et al. (2020) A human tissue map of 5-hydroxymethylcytosines exhibits tissue specificity through gene and enhancer modulation. Nature communications, 11, 6161.**

**https://www.nature.com/articles/s41467-020-20001-w**

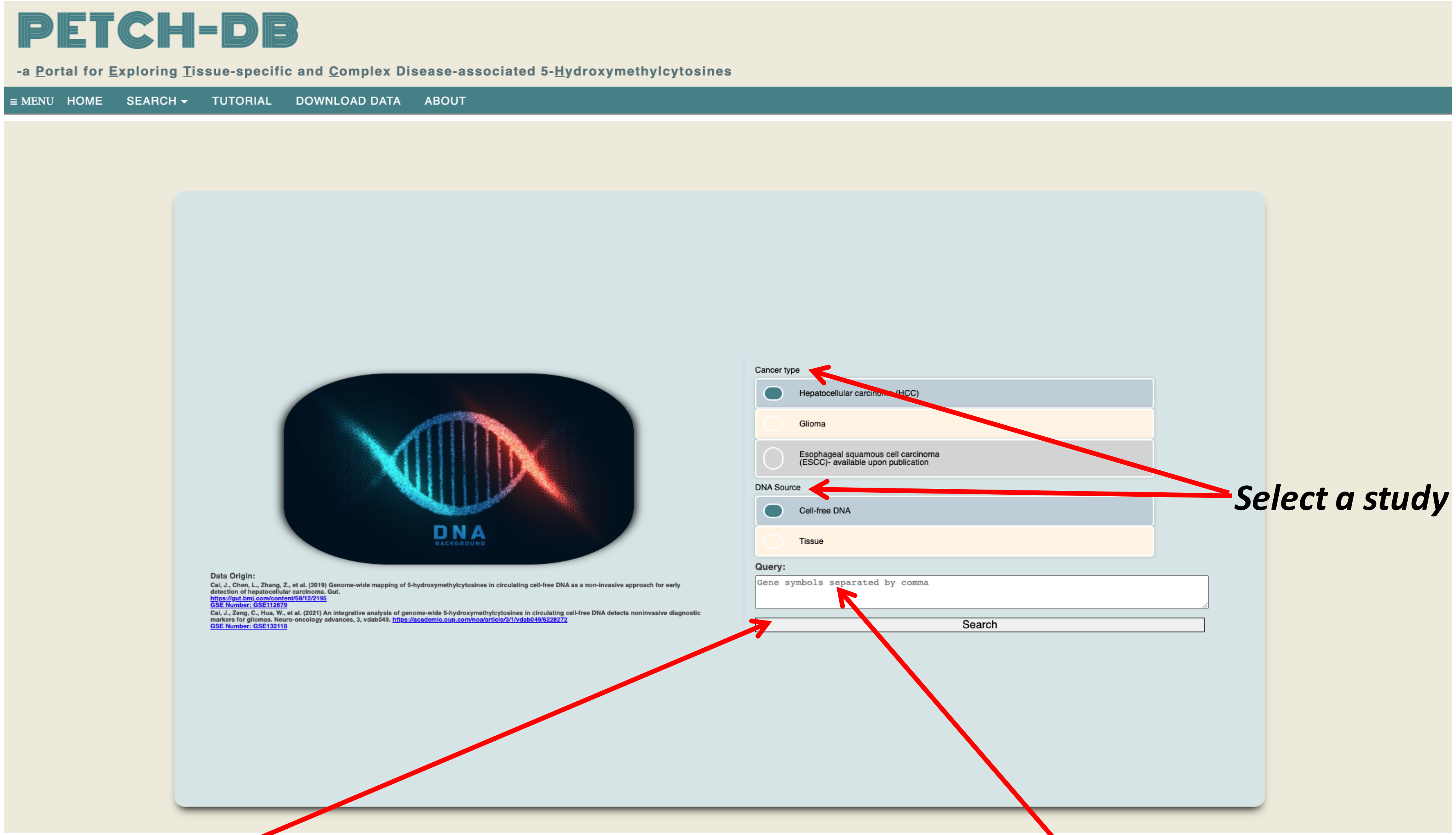
**GSE Number: GSE144530**

***5hmC by donor***

***Rank by tissue***

***Read distribution if "BigWig" is selected***

# Main Tab – The Case-Control Biomarker Discovery Studies



Cancer type

- ● Hepatocellular carcinoma (HCC)
- ○ Glioma
- ○ Esophageal squamous cell carcinoma (ESCC)- available upon publication

DNA Source

- ● Cell-free DNA
- ○ Tissue

Query:

Gene symbols separated by comma

**Data Origin:**

Cai, J., Chen, L., Zhang, Z., et al. (2019) Genome-wide mapping of 5-hydroxymethylcytosines in circulating cell-free DNA as a non-invasive approach for early detection of hepatocellular carcinoma. Gut.
https://gut.bmj.com/content/68/12/2195
GSE Number: GSE112679

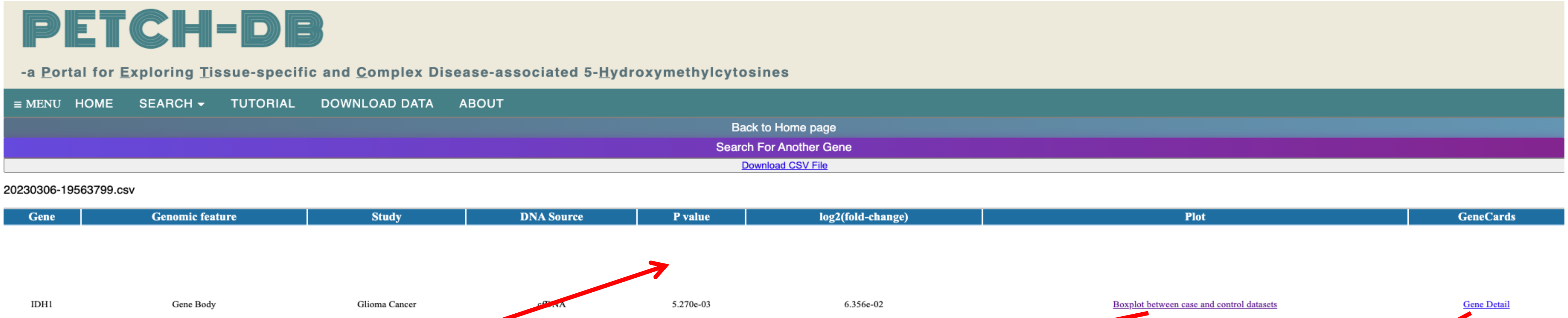
Cai, J., Zeng, C., Hua, W., et al. (2021) An integrative analysis of genome-wide 5-hydroxymethylcytosines in circulating cell-free DNA detects noninvasive diagnostic markers for gliomas. Neuro-oncology advances, 3, vdab049. https://academic.oup.com/noa/article/3/1/vdab049/6228272
GSE Number: GSE132118

*Select a study & DNA source*

*Run the search*

*Enter gene symbol(s) (hg19),*
*Separate by comma.*

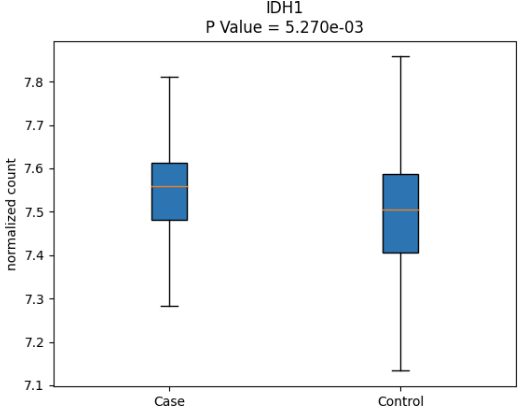
# Output Example – The Case-Control Biomarker Discovery Studies

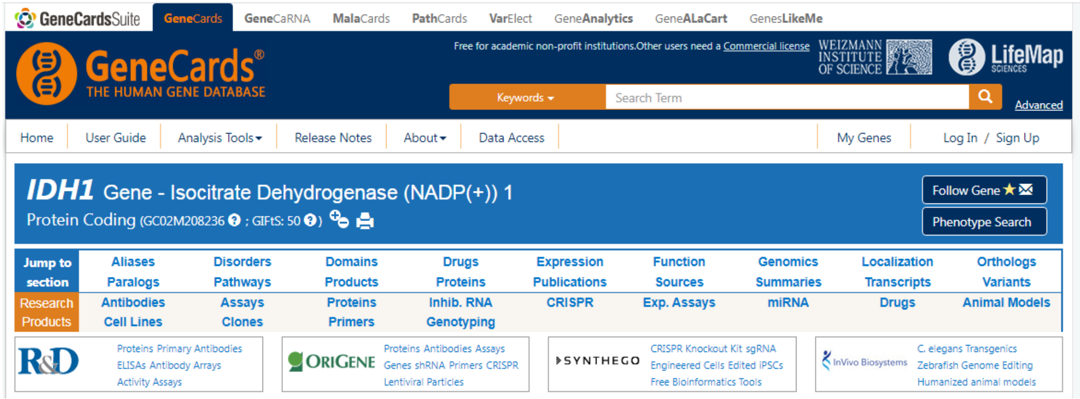


20230306-19563799.csv

| Gene | Genomic feature | Study | DNA Source | P value | log2(fold-change) | Plot | GeneCards |
|---|---|---|---|---|---|---|---|
| IDH1 | Gene Body | Glioma Cancer | cfDNA | 5.270e-03 | 6.356e-02 | Boxplot between case and control datasets | Gene Detail |

*P-value and fold change of the selected gene(s)*





**IDH1** Gene - Isocitrate Dehydrogenase (NADP(+)) 1

Protein Coding (GC02M208236 ; GIFtS: 50)

# Troubleshooting

Q: After pressing search, the results don't come out immediately.
A: Due to the size of our data, it takes maximum of 30 seconds to proceed. Please do not refresh the website or press search again. If the database hasn't responded for more than 1 min, please refresh the tab and try search again.

Q: Why would I get "gene doesn't exist in our database"
A: 1. The gene symbol we are using is hg19, please make sure the gene symbols you are using follow the hg19 manner.
2. If you did a batch search job (multiple gene search), please separate each gene symbol with a comma.

If you have further questions or suggestions on the database, please reach out to petch.db@gmail.com.

# References

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