

# A Wayfarer's Guide to the Galaxy

LabKey Inside the NIHR Oxford Biomedical Research Centre



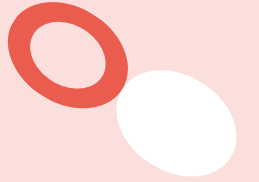
**DON'T**



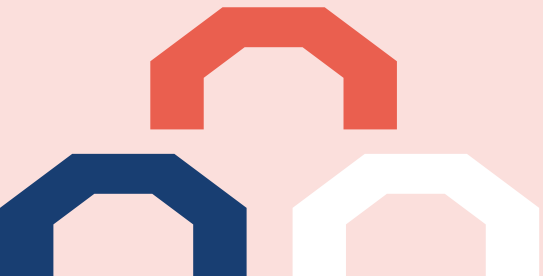
**PANIC**

# What is the NIHR BRC?

- NIHR
  - National Institute for Health Research
- BRC
  - Biomedical Research Centre
- Collaboration between
  - NHS Foundation Trust Oxford University Hospitals
  - University of Oxford
- Clinical Informatics Team



# Oxford Hepatology Research Project





# What is it?

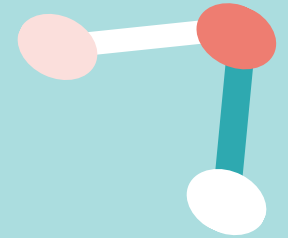
- Data collection for patient care and research
- Used by the Hepatitis Clinic in Oxford
- LabKey Study with 37 datasets across 6 cohorts
- Built in 2015 to use the Date/Visit style of Study
- In 2019 updated study to use the Continuous style

# What did we do?

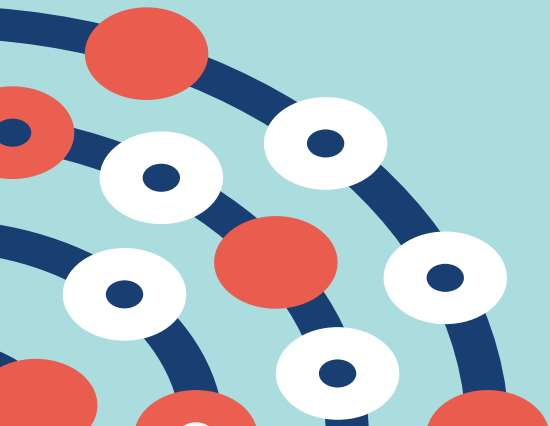
- Designed a custom JavaScript UI to sit on top of the LabKey UI
  - Designed in 2015 with the assistance of LabKey
  - Uses LabKey's JavaScript API
  - Originally built using JavaScript and jQuery
- 
- With the new LabKey UI we are currently rebuilding our interface using React to hopefully make it even smoother

# Why did we do it?

- Easier use for front-line medical staff as an EPR
- Allowed clear viewing of existing data
- Made it easier for adding/editing patient data
- Allows the researchers to use the inbuilt LabKey study functionality
  - Connections for R Studio
  - Searching
  - Charts & Reports



# Viewing Patient Data



# Standard LabKey UI

Data Views

Filter name, category, etc.

Name

Clinical Assessment

Risk Factors

Hepatitis C Risk Factors

Hepatitis B Risk Factors

Hepatitis D Risk Factors

Hepatitis E Risk Factors

Cirrhosis Staging

Social History

Pregnancy

Clinical Coding

Diagnosis

Hepatitis C Diagnosis

Hepatitis B Diagnosis

Hepatitis D Diagnosis

Hepatitis E Diagnosis

Autoimmune Hepatitis Diagnosis

HIV Diagnosis

HCV Re-Infection

Co-Morbidities

Manage Groups QC State View Specimens																		1 - 100 of 2,605	
Participant ID	Date	Date of data collection	Alcohol Use Status	Ever Been Heavy Drinker (i.e. Males > 21 units /week, Females > 14 units/week)	Current Weekly Alcohol Intake	Smoking Status	Smoker Start Year	Smoker End Year	Cigarettes Per Day	Lifetime Pack Years	Ever Injected Drugs	Year Of First Injection	Injected In Last Six Months	Cannabis Usage Status	Cannabis Start Year	Weight (kg)	Height (cm)		
HEP-0002	06-Oct-2016	01-Jun-2015									No					60.8			
HEP-0002	06-Oct-2016	03-Oct-2016														61.9			
HEP-0002	02-Feb-2017	16-Jan-2017	Current													63.3			
HEP-0005	08-Dec-2016	08-May-2015	Past/Former	No	0.0	C					Yes	2010	No						
HEP-0005	08-Dec-2016	11-Jan-2016	Current		6.0	C					Yes		No			78.0			
HEP-0009	08-Dec-2016	12-Aug-2013			0.0	N				0									
HEP-0012	08-Dec-2016	27-May-2015									Yes								
HEP-0013	01-Mar-2016	03-Dec-2014	Past/Former	Yes	0.0	C				10	Yes	1999	No	Current		61.9			

# Custom LabKey UI

LabKey Oxford Hepatology Research

Search Settings User Profile oliver.freeman

Hepatology ResearchData EntryData ViewsManage

LabKey Server 19.1.1 has been released and is ready for deployment. We recommend that you upgrade to the new version. Download it now.

Hepatitis Research Database Training

Subject Record

Cohorts All / None

- Autoimmune Hepatitis
- Hepatitis B
- Hepatitis B with Delta Co-Infection
- Hepatitis C
- Hepatitis E
- Other
- No Cohort

Participant Groups

Showing 2 of 2 participants

Search ParticipantId, NHSNumber, M

LabKey Id	NHS #	MRN #	Name	Date of Birth	Summary fields completed
HEP-0001	999999999	999999999	Donald Trump	14/06/1946	
HEP-0002	111111111	111111111	Barack Obama	04/08/1961	

+ Add Participant

Barack Obama

NHS #: 111111111  
MRN #: 111111111  
Date of birth: 04/08/1961

Clinical Assessment

Risk Factors

Diagnosis

Enrolment

Final Outcome

Imaging and Biopsy

Lab Tests

Treatment

Dataset:

Hepatitis C Diagnosis0

Hepatitis B Diagnosis0

Hepatitis D Diagnosis0

Hepatitis E Diagnosis0

Autoimmune Hepatitis Diagnosis0

HIV Diagnosis0

HCV Re-Infection0

Co-Morbidities0

No entries available

+ Add Entry

Enrolment			Lab Tests			Final Outcome			Diagnosis			Clinical Assessment			Risk Factors			Treatment			Imaging and Biopsy		
Dataset: Hospital Lab Tests 421																							
Date	Lab Obs Name	Lab Obs Num Result	Obs Units	Lab Obs Res String	Lab Obs Ref Range	Obs Ref	Batch ID	Lab Obs Context	Lab Obs Notes	Lab Obs Comment	Lab Obs Date	Obs Id	Di Transform Run Id	Di Row Version	Di Modified By	Di Modified	Di Created	Di Created By	Actions				
18/11/2013	ASSAY USED			CTC2		CAU	0EBD32A4-28FD-4DC7-803F-AF2F98B5F79D	NORM			18/11/2013	0EBD32A4-28FD-4DC7-803F-AF2F98B5F79D CAU	2546			03/12/2018			<div><div></div><div></div></div>				
18/11/2013	HCV RNA			DET		HCVR	0EBD32A4-28FD-4DC7-803F-AF2F98B5F79D	NORM			18/11/2013	0EBD32A4-28FD-4DC7-803F-AF2F98B5F79D HCVR	2546			03/12/2018			<div><div></div><div></div></div>				
18/11/2013	UNITS/ML	1213232				IPM	0EBD32A4-28FD-4DC7-803F-AF2F98B5F79D	NORM			18/11/2013	0EBD32A4-28FD-4DC7-803F-AF2F98B5F79D IPM	2546			03/12/2018			<div><div></div><div></div></div>				
18/11/2013	HEP C GENOTYPE/PCR			Full text report see note.		RHCG	15F5C754-5795-453B-90C2-7572FE9409EC	NORM			18/11/2013	15F5C754-5795-453B-90C2-7572FE9409EC RHCG	2546			03/12/2018			<div><div></div><div></div></div>				
18/11/2013	ALBUMIN	42	g/L		35-50	ALB	16A829AE-4565-4D23-A12A-AED2A03D95E5	NORM			18/11/2013	16A829AE-4565-4D23-A12A-AED2A03D95E5 ALB	2546			03/12/2018			<div><div></div><div></div></div>				
18/11/2013	ALT	159	IU/L		10-45	ALT	16A829AE-4565-4D23-A12A-AED2A03D95E5	NORM			18/11/2013	16A829AE-4565-4D23-A12A-AED2A03D95E5 ALT	2546			03/12/2018			<div><div></div><div></div></div>				
18/11/2013	AST	76	IU/L		15-42	AST	16A829AE-4565-4D23-A12A-AED2A03D95E5	NORM			18/11/2013	16A829AE-4565-4D23-A12A-AED2A03D95E5 AST	2546			03/12/2018			<div><div></div><div></div></div>				
18/11/2013	CALCIUM	2	mmol/L			BCA	16A829AE-4565-4D23-A12A-AED2A03D95E5	NORM			18/11/2013	16A829AE-4565-4D23-A12A-AED2A03D95E5 BCA	2546			03/12/2018			<div><div></div><div></div></div>				

Enrolment

Lab Tests

Final Outcome

Diagnosis

Clinical Assessment

Risk Factors

Treatment

Imaging and Biopsy

Dataset:

Fibroscan2

Ultrasound1

CT Scan0

MRI Scan0

Liver Biopsy0

Date	Fibroscan Date	Stiffness estimated in kPa	IQ	Success Rate	Probe Size	Actions
31/03/2016	18/11/2013	7.3	1.5	75		<div><div></div><div></div></div>
31/03/2016	21/03/2016	4.8	0.3	92	Medium	<div><div></div><div></div></div>

+ Add Entry

Enrolment

Lab Tests

Final Outcome

Diagnosis

Clinical Assessment

Risk Factors

Treatment

Imaging and Biopsy

Dataset:

Hepatitis C Diagnosis1

Hepatitis B Diagnosis0

Hepatitis D Diagnosis0

Hepatitis E Diagnosis0

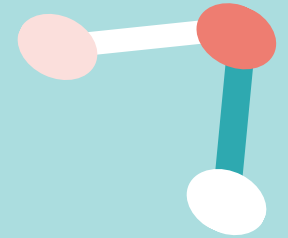
Autoimmune Hepatitis Diagnosis0

HIV Diagnosis1

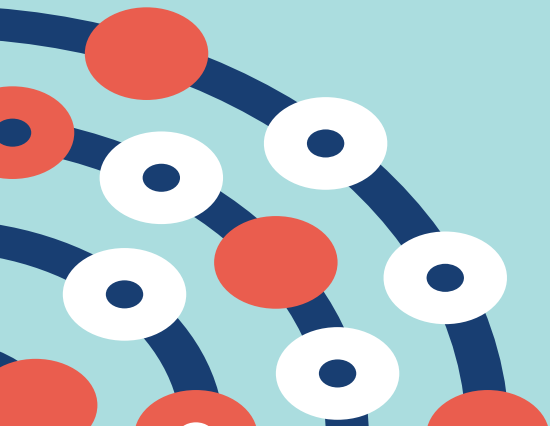
HCV Re-Infection0

Co-Morbidities1

Date	Date of First Attendance with Diagnosis of Hepatitis C	Date Of First Positive HCV Test	Date Of Last Negative HCV Test	Referral Source First Positive Sample	HCV Rna Status	Previous HCV Treatment At Baseline / Enrolment	Current HCV Treatment	HCV Genotype	HCV Genosubtype	Date of HCV Genotyping	Actions
31/03/2016	26/11/2013	01/10/2013		GP	Pos	No	No	3	a	26/11/2013	<div><div></div><div></div></div>
<div>+ Add Entry</div>											



# Adding/Editing Patient Data





to the new version. [Download](#) it now.

Search ParticipantId, NHSNumber, Iv

LabKey Id	NHS #		Date of Birth
HEP-0001	9999999999		14/06/1946
HEP-0002	1111111111		04/08/1961

Create Database Enrolment Record

Participant ID

HEP-0003

Date of Enrolment

Type of Hepatitis

-- not selected --

First Name

Last Name

NHS Number

MRN Number

Date of Birth

Data Collection Consent Withdrawn

-- not selected --

Date Consent Withdrawn

Cancel

Save

Edit Database Enrolment Record

Date of Enrolment

08/03/2019

Type of Hepatitis

Hepatitis B

First Name

Barack

Last Name

Obama

NHS Number

111111111

MRN Number

111111111

Date of Birth

04/08/1961

Data Collection Consent Withdrawn



-- not selected --

Date Consent Withdrawn

Cancel

Save






## Create Social History Record

Date	<input type="text"/>
	
Date of data collection	<input type="text"/>
	
Alcohol Use Status	-- not selected --
Ever Been Heavy Drinker (i.e. Male > 14 units/week)	-- not selected --
Current Weekly Alcohol Intake	Decimal places allowed
Smoking Status	<input type="text"/>
Smoker Start Year	Requires whole numbers
Smoker End Year	Requires whole numbers
Cigarettes Per Day	Requires whole numbers
Lifetime Pack Years	Requires whole numbers
Ever Injected Drugs	-- not selected --
Year Of First Injection	Requires whole numbers
Injected In Last Six Months	-- not selected --
Cannabis Usage Status	-- not selected --
Cannabis Start Year	Requires whole numbers
Weight (kg)	Decimal places allowed
Height (cm)	Decimal places allowed

Cancel

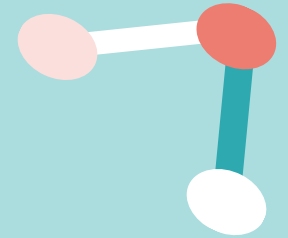
Save

## Create Hepatitis C Diagnosis Record

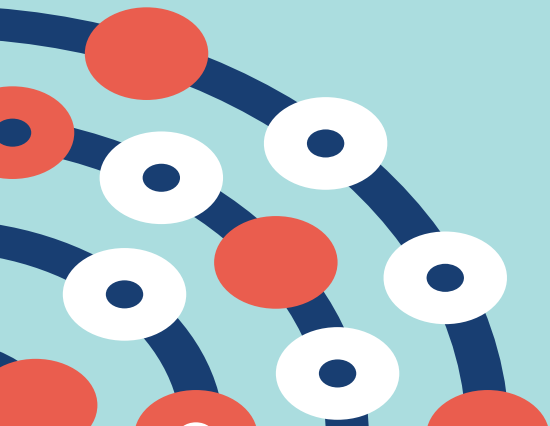
Date	<input type="text"/>
	
Date of First Attendance with Diagnosis	<input type="text"/>
	
Date Of First Postive HCV Test	<input type="text"/>
	
Date Of Last Negative HCV Test	<input type="text"/>
	
Referral Source First Positive Sample	-- not selected --
HCV Rna Status	-- not selected --
Previous HCV Treatment At Baseline	-- not selected --
Current HCV Treatment	-- not selected --
HCV Genotype	-- not selected --
HCV Genosubtype	-- not selected --
Date of HCV Genotyping	<input type="text"/>
	

Cancel

Save



# Laboratory Test Results



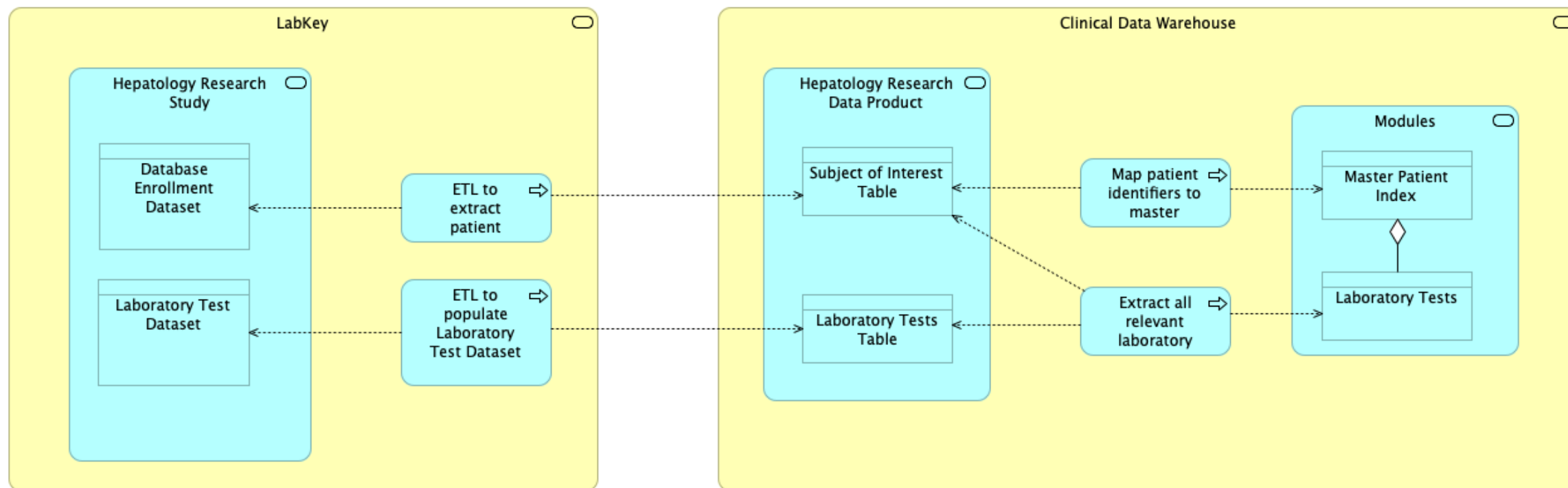
# The Problem...

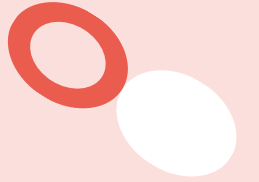
- A standard EPR will usually be connected to the laboratory test system/s
- LabKey is not...
- However it can be!!

# The Solution

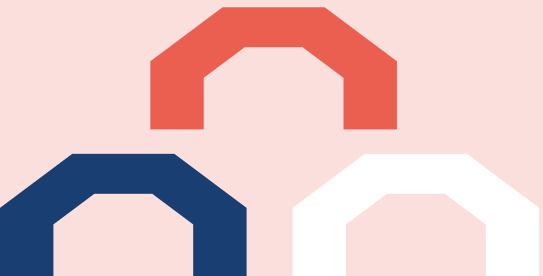
- Use of a LabKey ETL (Extraction, Transform & Load)
  - Extract all participants into a “Subject Of Interest” (SOI) table outside of LabKey
- Use our Clinical Data Warehouse
  - To provide master patient ids for each subject, updating the SOI table
  - To populate a laboratory test table with all laboratory tests for all the subjects
- Use of a LabKey ETL
  - Merge all the laboratory tests into the LabKey laboratory study dataset
- This is run automatically on a daily basis

# The Process





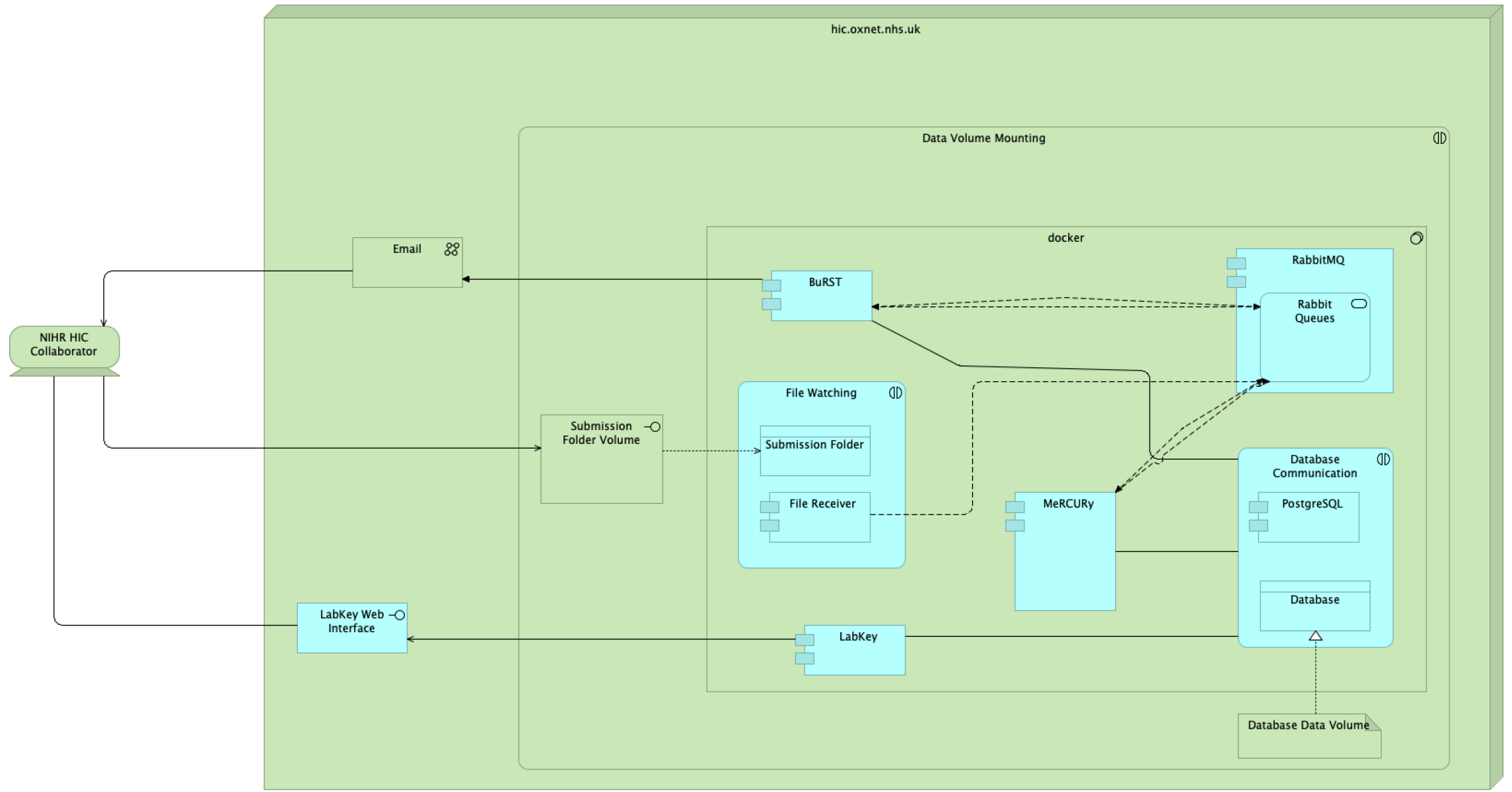
# Health Informatics Collaborative (HIC): Hepatitis Theme

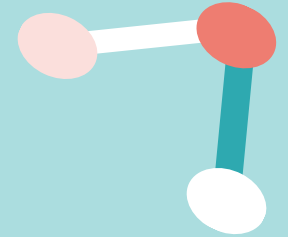


# What is happening?

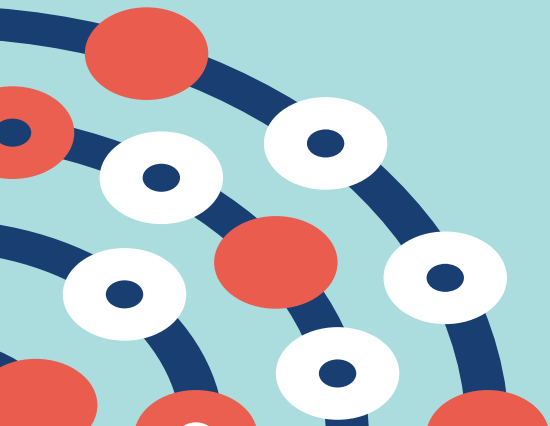
- Data sharing agreements in place between participating NHS Trusts
- Data from participating HIC centres is submitted by XML into the Oxford Data Acquisition & Management System
- Processed by Oxford's MeRCURy application which validates, dimensionalises and stores all submitted data
- All data stored in a custom designed database for the theme in question







# How are we using LabKey?



# Data Submission

- LabKey's “files”
- Allows users to “drop” files in for submission at any time
- Allows users to see any files submitted to review inconsistencies between stored data and submitted data

The screenshot displays the LabKey NIHR HIC LabKey Server interface. At the top, a teal header bar contains the LabKey logo and the text "NIHR HIC LabKey Server". Below this, a dark teal bar shows "NIHR HIC Submissions" with a dropdown arrow. A light gray message box states: "The deployed version of Java, 11.0.1, is not supported. We recommend installing Oracle OpenJDK 12. See the [Supported Technologies page](#) for more information."

### Welcome to the NIHR HIC Submissions Project

Please upload your file below into the appropriate theme folder.

**NOTE:** As the hepatitis theme data loading is automated please ensure you place your file into the 'inbox' folder, it will be moved into the 'processed' folder once it has been uploaded into the database.

Please ensure the file is named appropriately:

- Contains the programme name, ie NIHR HIC
- Contains the theme name
- Contains the collaborating trust's name
- Contains the date submitted in the format : YYYYMMDD

As an example a Hepatitis XML file submission from Oxford on 3 October 2018 would be named:

>> NIHRHIC\_hepatitis\_OXF\_20181003.xml

—

There is a message board below file submissions is, which can be used for relaying messages. Please note that anyone who has access to this project can see your messages.

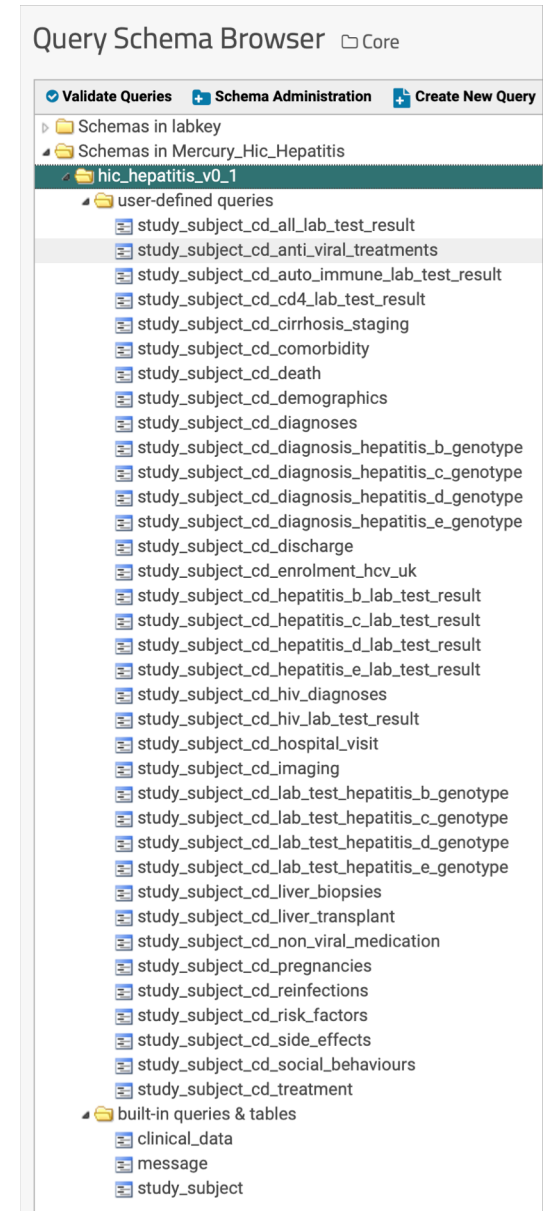
#### Files

Navigation bar: Upload Files | Import Data | Audit History | Admin

	Name	Last Modified	Size	Created By
<input type="checkbox"/>	inbox			
<input type="checkbox"/>	processed			

# Data Viewing

- LabKey's “external schemas”
- Read-Only connections to databases outside of the LabKey database
- Customisable grid/tabular views of tables
- Custom queries(finally) of these databases
- Connectivity using external analytics e.g. R
- Exporting custom data to common formats



The deployed version of Java, 11.0.1, is not supported. We recommend installing Oracle OpenJDK 12. See the [Supported Technologies page](#) for more information.

Core

# Welcome to the Hepatitis Core

All data can be seen using one of the tabs.

If all the tabs aren't visible please use the drop down in the first tab.

## Relationships

Please note that the following relationships exist.

### Study Subject

One to One

- Death
- Demographics
- Discharge
- Enrolment HCV UK
- Liver Transplant

Many to One

- Cirrhosis Stagings
- Comorbidities
- Diagnoses
- HIV Diagnoses
- Hospital Visits
- Imagings
- Liver Biopsies
- Pregnancies
- Reinfections
- Risk Factors
- Social Behaviours
- Non-Viral Medications (Found with Treatments)
- Treatments
- Laboratory Tests

## Treatments

Many to One

- Side Effects
- Anti-Viral Medication

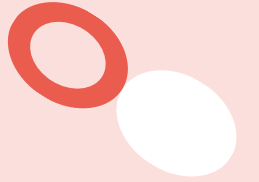
## Diagnoses

Many to One

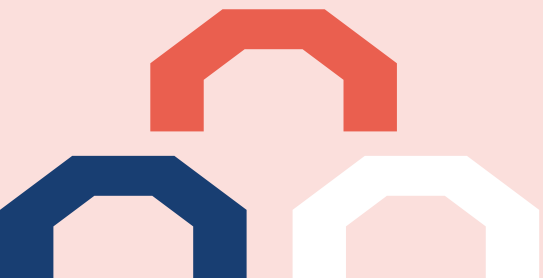
- Hepatitis B Genotypes
- Hepatitis C Genotypes
- Hepatitis D Genotypes
- Hepatitis E Genotypes

# Most Importantly!

- Everything is audited
- Everything is controlled by group level access
- No-one has direct access to the database
- This is accessible across the NHS N3 network allowing true data sharing between NHS Trusts without the data ever being available to the world



# Managing Multiple LabKey Deployments

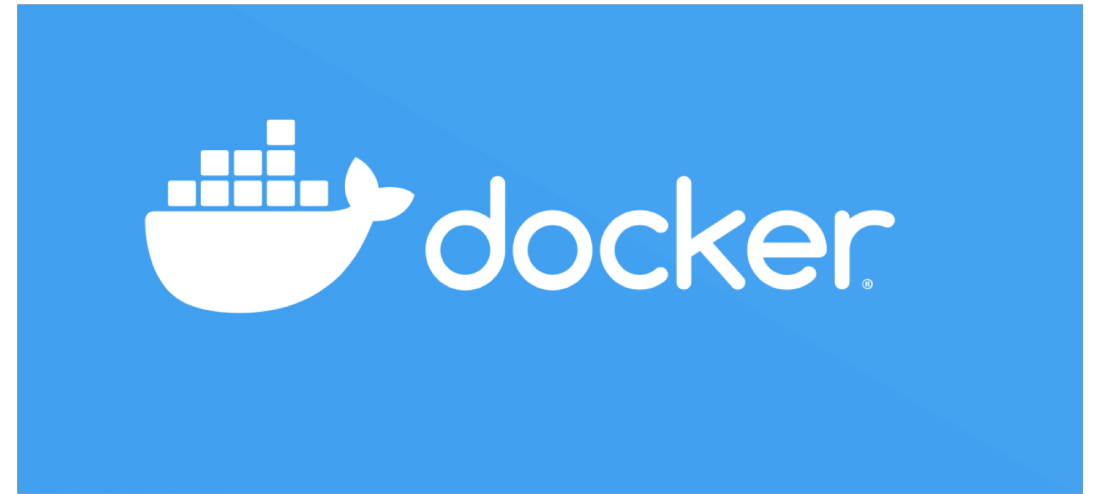


# Instances

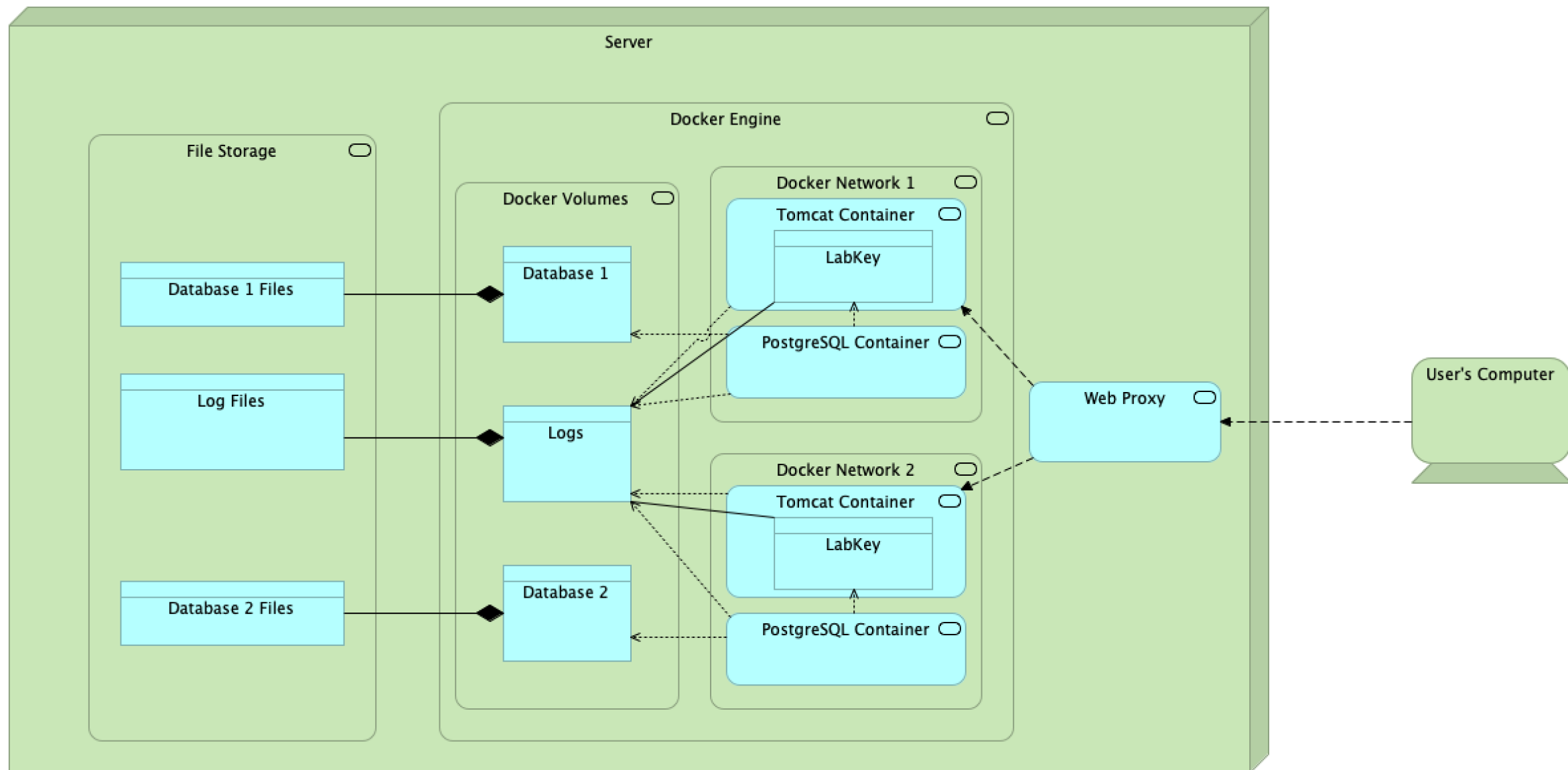
- Hepatology Research Project
- Health Informatics Collaborative
- Clinical Data Warehouse Data Products
- OUH Patient Safety System
- Ovarian Cancer Research
- OCCAMS ICGC Project
- And a few more ...



# Docker



- Container based & OS independent
- Deployed using docker-compose
- 2 Containers both built using Alpine OS
  - PostgreSQL
  - Tomcat/LabKey
- Internal network between containers so entirely secure
- Easily & quickly updateable
  - Change the version in the Dockerfile
  - Call `docker-compose up -d`





Thank You

