

A Sustainable Solution for Tracking NGS Workflows

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Kentucky Division of Laboratory Services

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Conflicts of interest

 I have no conflicts of interest to disclose.

The need for data modernization



Images: dreamstime.com and alamy.com

The search for a commercial LIMS product



**Next-Generation
Sequencing (NGS)
LIMS**

illumina

Clarity LIMS software

A highly customizable laboratory information management system that allows genomics labs to track samples and manage workflows efficiently and securely.

NucleoLIS - [Result Manager-CLIN2021-000142 Doe, John]

File Operations Window Printer New All Display Patient ID Specimen Karyotype Ancillary Environmental Virology DNA Seq Culture Plate Quality Review

LISTS: All Active NAME: NEEDS RESULTS, NEEDS PRELIMINARY, NEEDS SIGN... Overdue IReview Quality Archives

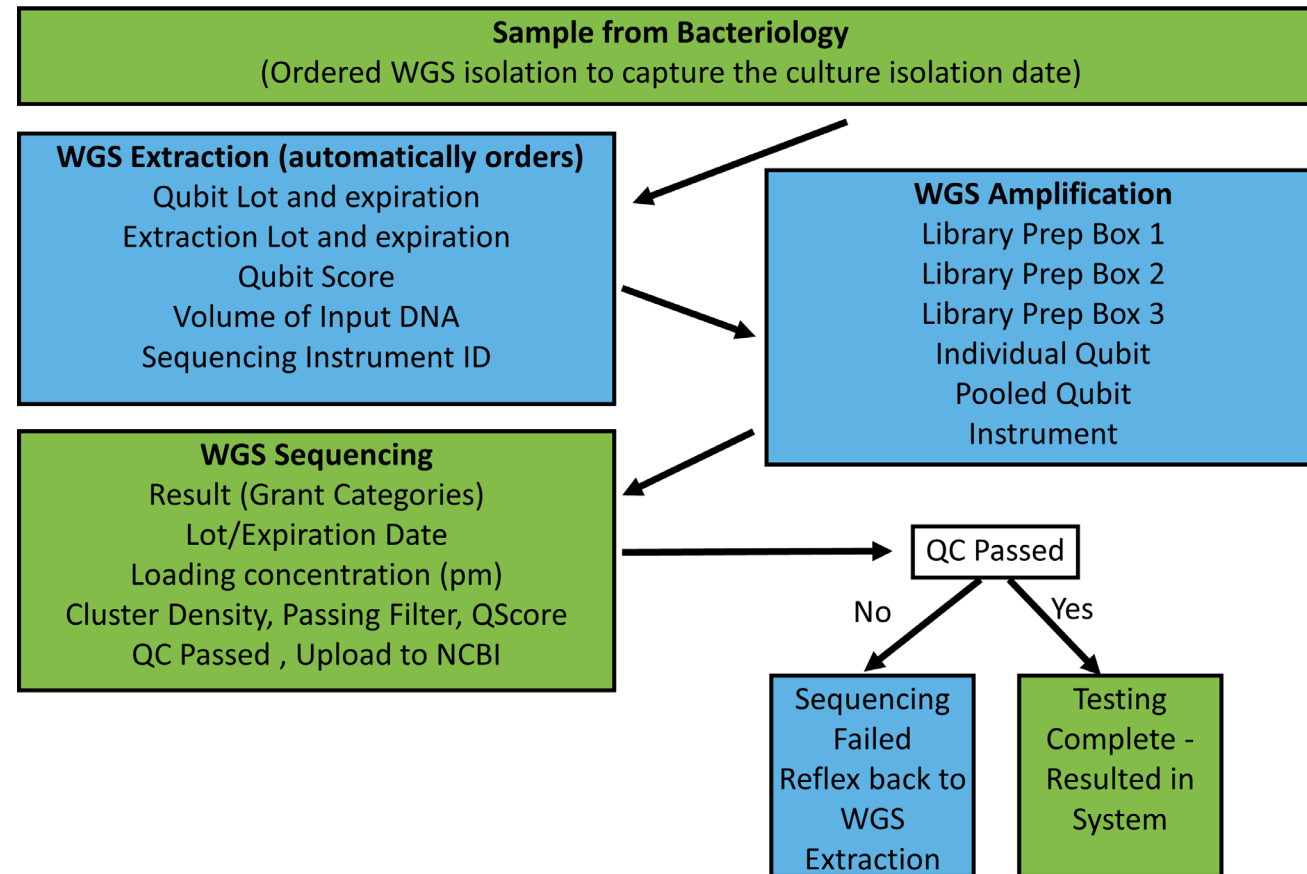
Name	Medical REQ #	DOB	Visit Code	ID Number	Submitter	Submitter Group	Req Number	Case Type	Report Status	Case Status	PMSG	Order Date
Doe, Dmitrii	3675-EZMOBILE	1985-01-01	3626	CLIN2023-000164			3626-EZMOBILE	Clinical	PENDING	NEEDS RESULTS		2023-03-10
Doe, John	104196376	2021-05-17	104196377	CLIN2021-000142	ANDERSON CO ...		104196378	Clinical	PRELIMINARY	NEEDS RESULTS		2021-08-24
Doe, John	197109229	2024-01-01	197109263	CLIN2024-000155	TRAINING ENVI...		197109264	Clinical	PENDING	NEEDS RESULTS		2024-06-24

SEARCH: ID Number [Full Search]



Psychē Systems Corporation. (2025) *NucleoLIS*. <https://psychesystems.com/enterprise-laboratory-information-software/nucleolis-molecular-lab-testing-software/>

Understanding our workflow



New LIS workflow

- [-] CLIN2021-000142 Doe, John
 - [-] [SPEC] - Stool
 - ECO / E. COLI: Order Panel
 - [+] ECO MEDIA / E. COLI MEDIA AND SCREEN:
 - [+] EHEC SWEEP & PK 1-6 / EHEC SWEEP & PK 1-6:
 - [+] ECO SERO / E. COLI SEROTYPING:
 - ECO STX PCR / SHIGATOXIN PCR:
 - [+] WGS / WGS Comp:
 - [+] SALM SEROTYP / Salmonella Serotyping: serotype enteritidis
 - WGS ISO / Date isolated for WGS testing (mm-dd-yy): 01-30-2025
 - WGS Extract / WGS Extraction:
 - WGS Amp / WGS Amplification:
 - WGS Seq / WGS Sequencing: Resequence- extract
 - WGS Extract / WGS Extraction:
 - WGS Amp / WGS Amplification:
 - WGS Seq / WGS Sequencing: Non-O157 STEC

Extraction

CLIN2021-000142 Doe, John

[SPEC] - Stool

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- ECO SERO / E. COLI SEROTYPING:
- ECO STX PCR / SHIGATOXIN PCR:
- WGS / WGS Comp:
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- WGS Extract / WGS Extraction:
- WGS Amp / WGS Amplification:
- WGS Seq / WGS Sequencing: Resequencing- extract
- WGS Extract / WGS Extraction:
- WGS Amp / WGS Amplification:
- WGS Seq / WGS Sequencing: Non-O157 STEC

▼ Ancillary	
Number	197113158
Panel Definition	WGS Extract / WGS Extraction:
Description#	
Order Date	1/30/2025
Order Time	11:34
Ordered By	KSLPRESTONS
Status	PENDING
▼ Result	
Q- Lot\Expiration Date	Qubit lot 1253 2/25/26
E- Lot\Expiration Date	Extraction Lot: 123456 2/11/25
Qubit Score >=4	2
Volume of Input DNA	18
Run ID	KY_123456-1234567
Instrument	EZ-2
Abnormal Flag	False
Reportable	True
▼ Completion	
Completed By	
Complete Date	
Complete Time	
▼ Image	
Images#	No Images on File
▼ PARENT	
Specimen	[SPEC] - Stool



Records extraction instrument used



Qubit score



Starts to link to the Run ID for the sequencer used

Library prep



Library prep information



Additional Qubit information

CLIN2021-000142 Doe, John
[SPEC] - Stool
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ECO MEDIA / E. COLI MEDIA AND SCREEN:
EHEC SWEEP & PK 1-6 / EHEC SWEEP & PK 1-6:
ECO SERO / E. COLI SEROTYPING:
ECO STX PCR / SHIGATOXIN PCR:
WGS / WGS Comp:
SALM SEROTYP / Salmonella Serotyping: serotype enteritidis
WGS ISO / Date isolated for WGS testing (mm-dd-yy): 01-30-2025
WGS Extract / WGS Extraction:
WGS Amp / WGS Amplification:
WGS Seq / WGS Sequencing: Resequencing- extract
WGS Extract / WGS Extraction:
WGS Amp / WGS Amplification:
WGS Seq / WGS Sequencing: Non-O157 STEC

Ancillary	
Number	197113159
Panel Definition	WGS Amp / WGS Amplification:
Description#	
Order Date	1/30/2025
Order Time	11:34
Ordered By	KSLPRESTONS
Status	PENDING
Result	
LP Box 1	678905/ 11-5-26
LP Box 2	123456
LP Box 3	123456
Individual Qubit	2
Pooled Qubit	3
Instrument	Hamilton
Abnormal Flag	False
Reportable	False
Completion	
Completed By	
Complete Date	
Complete Time	
Image	
Images#	No Images on File
PARENT	
Specimen	[SPEC] - Stool

Final results



Any failures can be sent back to any step of the workflow



Passing results are identified by the organism as required by grant metrics

CLIN2021-000142 Doe, John
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WGS ISO / Date isolated for WGS testing (mm-dd-yy): 01-30-2025
WGS Extract / WGS Extraction:
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WGS Seq / WGS Sequencing: Resequencing- extract
WGS Extract / WGS Extraction:
WGS Amp / WGS Amplification:
WGS Seq / WGS Sequencing: Non-O157 STEC

Ancillary	
Number	197113162
Panel Definition	WGS Seq / WGS Sequencing:
Description#	
Order Date	1/30/2025
Order Time	11:41
Ordered By	KSLPRESTONS
Status	PENDING
Result	
Result	Resequencing- extract
Lot/Expiration Date	987531 / 2-9-27
Loading Concentration (pm)	18
Cluster density	1455
Passing Filter	471
QSCORE	80.2
QC passed, Upload to NCB	No, all metrics failed
Abnormal Flag	False
Reportable	False
Completion	
Completed By	
Complete Date	
Complete Time	
Image	
Images#	No Images on File
PARENT	
Specimen	[SPEC] - Stool

Data stored together

NucleoLIS - [Result Manager-WGS Seq / WGS Sequencing: Resequencing- extract]

File Operations Window Printer New All Display Patient ID Specimen Karyotype Ancillary Environmental Virology DN

LISTS: All Active NAME: NEEDS RESULTS, NEEDS PRELIMINARY, NEEDS SIGN...

Name	Medical REQ #	DOB	Visit Code	ID Number	Submit
Doe, Dmitri	3675-EZMOBILE	1985-01-01	3626	CLIN2023-000164	
Doe, John	104196376	2021-05-17	104196377	CLIN2021-000142	ANDER
Doe, John	197109229	2024-01-01	197109263	CLIN2024-000155	TRAIN

SEARCH: ID Number

CLIN2021-000142 Doe, John

- [SPEC] - Stool
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 - EHEC SWEEP & PK 1-6 / EHEC SWEEP & PK 1-6:
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 - ECO STX PCR / SHIGATOXIN PCR:
 - WGS / WGS Comp:
 - SALM SEROTYP / Salmonella Serotyping: serotype enteritidis
 - Comment:-
 - Notes:
 - WGS ISO / Date isolated for WGS testing (mm-dd-yy): 01-30-2025
 - WGS Extract / WGS Extraction:
 - WGS Amp / WGS Amplification:
 - WGS Seq / WGS Sequencing: Resequencing- extract
 - WGS Extract / WGS Extraction:
 - WGS Amp / WGS Amplification:
 - WGS Seq / WGS Sequencing: Non-O157 STEC

Ancillary

Number	197113162
Panel Definition	WGS Seq / WGS Sequencing:
Description#	
Order Date	1/30/2025
Order Time	11:41
Ordered By	KSLPRESTONS
Status	PENDING

Result

Result	Resequencing- extract
Lot/Expiration Date	987531 / 2-9-27
Loading Concentration (pm)	18
Cluster density	1455
Passing Filter	471
QSCORE	80.2
QC passed, Upload to NCBI	No_all metrics failed
Abnormal Flag	False
Reportable	False

Completion

Completed By	
Complete Date	
Complete Time	

Image

Images#	No Images on File
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PARENT

Specimen	[SPEC] - Stool
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Run reports

NCOV WGS Pending			Tuesday, March 18, 2025			5:22	
ID Number	Specimen Number	Patient Name	Submitter			Collection Date	Date Received
CLIN2021-000115	100011316	Test Group	LINCOLN TRAIL DISTRICT			2020-12-29	2021-09-22
CLIN2022-000020	110397913	NCOV, Rachel	DIVISION OF LABORATORY SERVICES			2022-01-18	2022-01-19
CLIN2022-000049	110994990	Test Req	DIVISION OF LABORATORY SERVICES			2022-01-30	2022-01-31
CLIN2022-000101	111755082	test, katelyn	ANDERSON CO HEALTH DEPT			2022-02-14	2022-02-15
CLIN2022-000224	124882267	clark, lewis	DIVISION OF LABORATORY SERVICES			2022-11-06	2022-11-07
CLIN2022-000225	124882426	Retting, Kailey	DIVISION OF LABORATORY SERVICES			2022-11-04	2022-11-07
CLIN2022-000226	124883464	Strange, Stephen	DIVISION OF LABORATORY SERVICES			2022-11-06	2022-11-07
CLIN2023-000079	182884912	Grooms, Will	DIVISION OF LABORATORY SERVICES			2023-05-14	2023-05-16
CLIN2023-000084	182882309	Rucker, Kalvin	DIVISION OF LABORATORY SERVICES			2023-05-15	2023-05-16
CLIN2023-000094	183307084	Hookensmith, Ryli	DIVISION OF LABORATORY SERVICES			2023-05-08	2023-05-17
CLIN2023-000109	197065033	TEST, PATIENT S	LOUISVILLE DEPARTMENT	METRO	HEALTH	2023-10-04	2023-10-06
CLIN2023-000109	197065033	TEST, PATIENT S	LOUISVILLE DEPARTMENT	METRO	HEALTH	2023-10-04	2023-10-06
CLIN2024-000120	197108230	FLUCOV, TEST	DIVISION OF LABORATORY SERVICES			2024-03-17	2024-03-18
CLIN2024-000294	197112327	Patrol, Rocky	DIVISION OF LABORATORY SERVICES			2024-12-03	2024-12-05
						Total	14

Adding automation

PulseNet 2.0 Export

Key	ReceivedDate	IsolatDate	SourceType	SourceSite	SourceCity	SourceCounty	SourceState	SourceCountry	PatientSex	PATIENTAGEDAY	PATIENTAGEMON	PATIENTAGEYEA
2025-000220-222762407	2025-01-28	2024-12-26	Human	Stool	Nicholasville	Jessamine	KY	USA	Female		23	ECO
2025-001840-222535189	2025-01-30	2025-01-14	Human	Stool		Jefferson	KY	USA	Male		1	ECO
2025-000985-222510536	2025-01-22	2025-01-10	Human	Stool	Springfield	Washington	KY	USA	Male		9	ECO
2025-001839-222636926	2025-01-30	2025-01-17	Human	Stool	Murray	Breathitt	KY	USA	Male		78	ECO
2025-000638-223794124	2025-01-22	2025-01-03	Human	Blood	Frankfort	Franklin	KY	USA	Male		50	MC:
2025-000885-222821762	2025-01-22	2025-01-04	Human		Frankfort	Franklin	KY	USA	Male		50	MC:
2025-001070-222821070	2025-01-22	2025-01-10	Human	Stool	Lagrange	Oldham	KY	USA	Female		8 Months	SGT:
2025-001169-222833247	2025-01-30	2025-01-07	Human	Stool	Lagrange	Oldham	KY	USA	Female		4 Months	SGT:
2025-001291-222833284	2025-01-30	2025-01-15	Human	Stool	Shelbyville	Shelby	KY	USA	Female		39	SGT:
2025-001834-222848925	2025-01-30	2025-01-16	Human	Urine	Lawrenceburg	Anderson	KY	USA	Female		71	SGT:
2025-001880-222807571	2025-01-22	2025-01-08	Human	Stool	Georgetown	Scott	KY	USA	Male		73	SGT:
2025-001833-222848984	2025-01-30	2025-01-18	Human	Stool		FAYETTE	KY	USA	Female		42	SGT:
2025-001835-222857732	2025-01-30	2025-01-13	Human	Stool	Richmond	Madison	KY	USA	Female		16	SGT:

System benefits

- Additional costs are minimal since the system is already in use across the lab and an administrator was already trained
- Allows for real-time tracking on the status of samples in the WGS process, potentially allowing for staff to pick up after each other or for management to track status
- Lot numbers, completion dates and quality control metrics can be tracked for each sample

System benefits

- 🛡️ Flexible reports are issued for quality assurance
- 🛡️ Demographic data can be autogenerated for Bionumerics/PulseNet 2.0 upload
- 🛡️ While this was started for PulseNet organisms, it can easily be adapted to other organisms
- 🛡️ The system utilizes HL7 messaging allowing for communication across systems

System drawbacks

- ⚠ The system is not as versatile as other commercial systems
- ⚠ The LIS cannot directly link to sequencing instrumentation which is similar to the commercial platform
- ⚠ Scientists experienced a learning curve in the use of the system
- ⚠ Scientists cannot directly update drop-down menu for lot information (LIS Administrator completes this task), although it can be manually entered

Future expansion

-  Virology extractions and PCR
-  Bacteriology
-  Media
-  Plus many other functions currently performed on paper

Questions?

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