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🌐 INSPECT sample tracking system

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Coronavirus Method De...



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External link: <https://github.com/SEARCH-Alliance/inspect.git>

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Protocol status: Working

We have successfully deployed INSPECT for a real-time qPCR-based workflow for Covid19 testing from nasopharyngeal swab samples.

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Protocol Integer ID: 39488

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Abstract

A specimen to data tracking tool for SEARCH SARS-CoV-2 tests. The application is used by SEARCH technicians to track samples as they proceed through each step within the RT-qPCR testing workflow. The app is currently hosted here: http://inspect-covid.com/qpcr_records/

Safety warnings

- ❗ INSPECT makes certain assumptions about plate format and automation at each step of the workflow :
 - 1) INSPECT expects 96-well plates for the Sample and RNA extraction steps and 384-well plates for the RT-qPCR reaction steps.
 - 2) Sample plating is not automated and performed manually. Technicians must follow the prompted order of sample plating to maintain data integrity within INSPECT
 - 3) RNA Extraction, RNA plate compression and RT-qPCR reaction plate preparation are automated using Kingfisher, EpMotion and Mosquito robots / machines. This permits INSPECT to transition well IDs from one plate to another in specific orders as followed by the machines.
 - 4) Only 1 decision review is permitted per plate.

Before Starting

- 1 Before starting ensure that the INSPECT system is publicly accessible and that you are registered on the INSPECT user list.

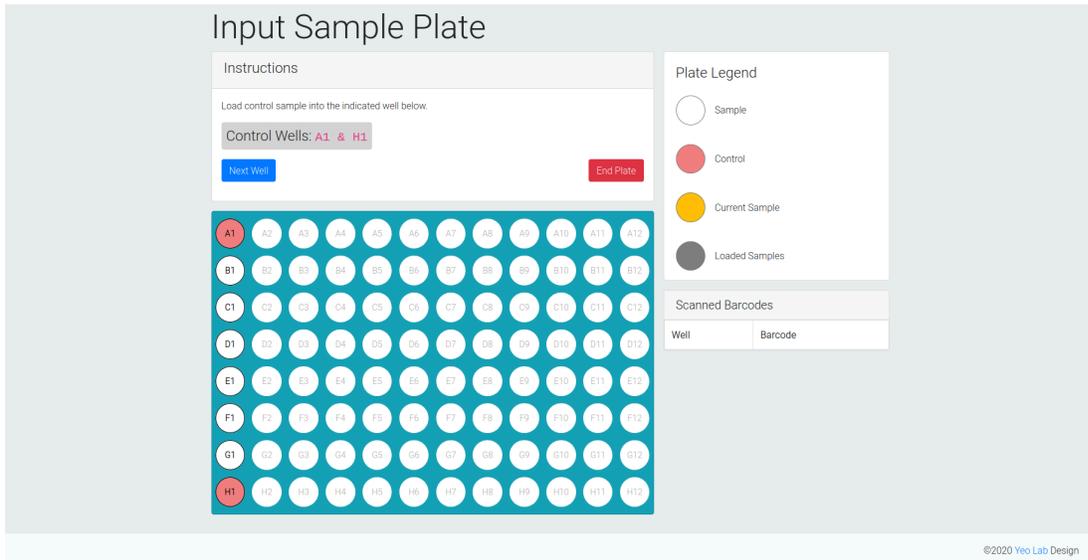
Sample Extraction and Plating

- 2 Freshly received samples can be registered into INSPECT by scanning the 2D sample tube barcode into the system. This is performed in conjunction to the sample extraction and plating step.
- 3 Enter the Lot # of the RNA Lysis buffer being used. The Lot # can also be scanned into the app.
Enter the name of the assisting technician (if any).

The screenshot shows the INSPECT web interface. At the top, there is a navigation bar with 'INSPECT', 'Home', 'Search', and 'Dashboard'. The main content area is titled 'Perform Safety Checks'. It contains a list of safety items: 'Facemask', 'Hood', and 'Gloves', each with a red square checkbox. Below this list are several input fields: 'Lysis Reagent Lot #' (with a value of 'M62461XXXXX'), 'Lysis Reagent Lot #', 'Assisting Technician Name*' (with a value of 'Gene Yeo'), and 'Name of Assisting Technician'. A blue 'Start' button is located at the bottom left of the form. In the bottom right corner, there is a copyright notice: '©2020 Yeo Lab Design'.

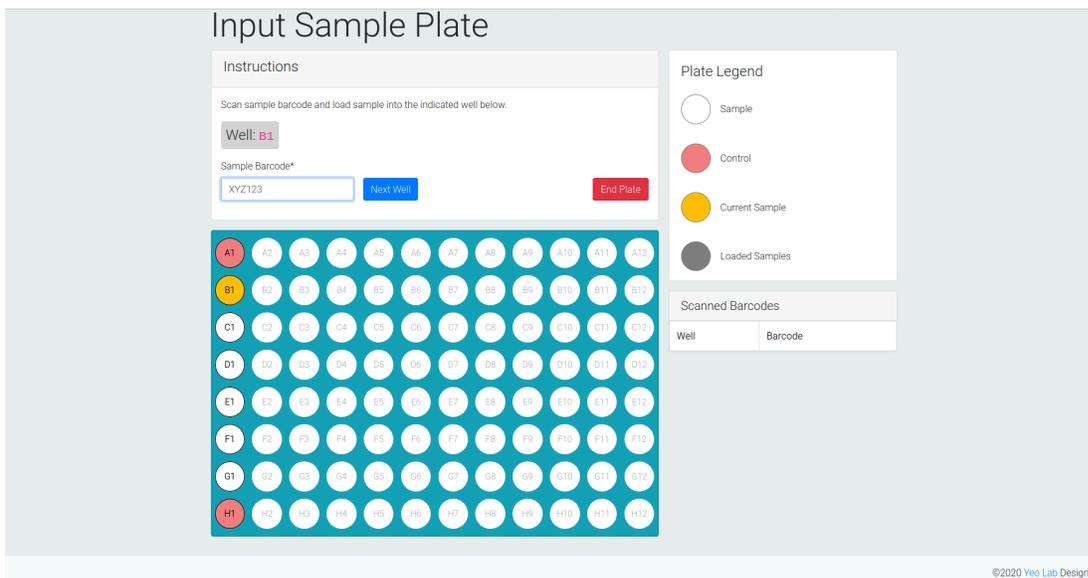
Submission form for recording the RNA lysis buffer lot #

- 4 Start sample plating by using the platemap guides provided by INSPECT.
- 4.1 Load control samples first. INSPECT assumes that the control samples are being loaded in well A1 and H1.

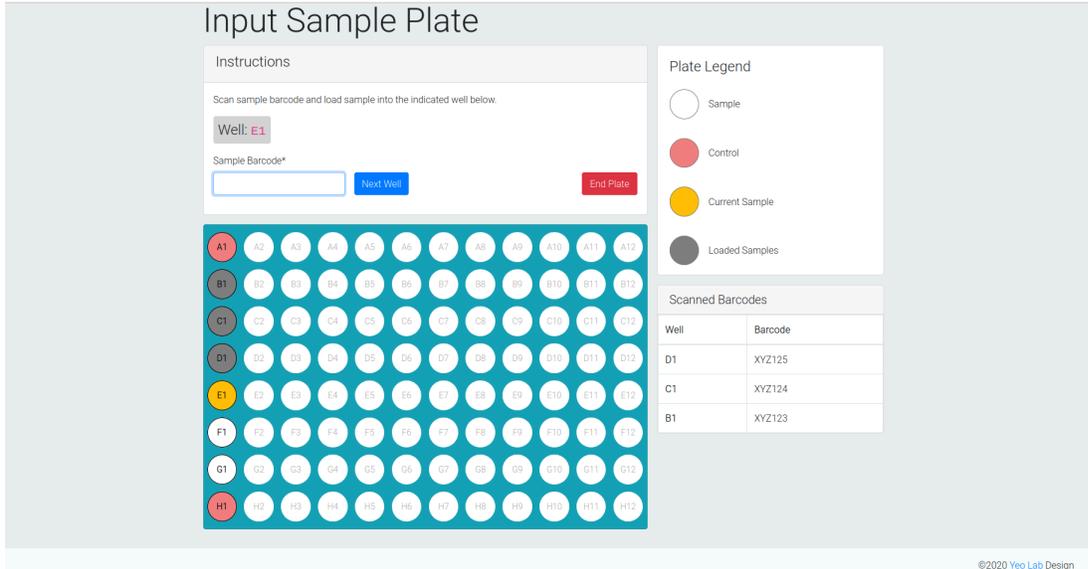


Initial sample plating window. INSPECT prompts user to load the control samples first into wells A1 and H1.

4.2 Scan sample barcode into the provided text area and load sample into the assigned well.

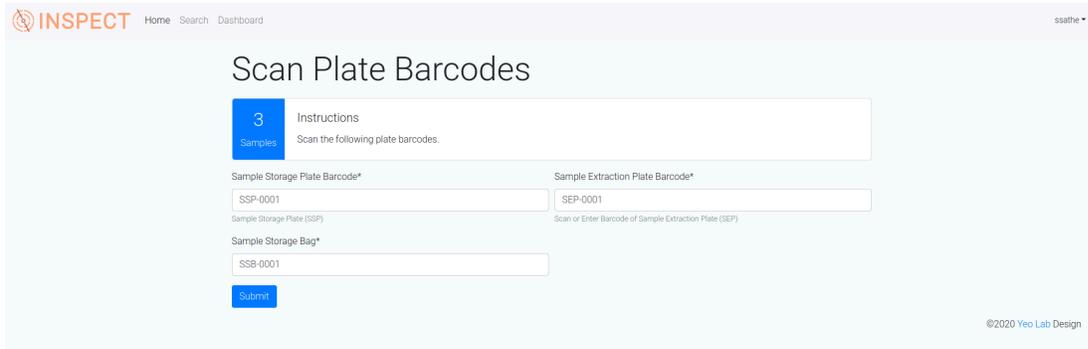


Scan sample barcode and load sample into assigned well (B1, in this case)



Scan and load samples as guided by INSPECT. If you do not have 94 samples, you can end the sample plating step by clicking on "End Plate". INSPECT will proceed with the scanned barcodes only.

- Once all samples have been plated, end the sample plating step and proceed to the plate barcode scanning step. INSPECT requires the user to enter the Sample Extraction Plate (SEP) barcode. Additionally, if present, users can enter the Sample Storage Plate (SSP) and Sample Storage Bag (SSB) barcodes as well.



SSP, SEP and SSB barcode submission form

-

Expected result

The screenshot shows the INSPECT dashboard with a navigation menu on the left and a main content area. The main content area features the INSPECT logo and the text "Instant Service Platform for Emergency COVID Tests". Below this is an "Overall Testing Summary" table and a "Sample Tracker" table.

Number of Samples	Number of Positives	Number of Negatives	Number of Undetermined
12105	1410 (11.65%)	9858 (81.44%)	567 (4.68%)

Step Name	Number of Samples in Step	Number of Plates Already Evaluated	Evaluated Plate IDs
Unprocessed Samples	0	-	-
Sample Extraction Plate (SEP)	3	1	SEP-0001
RNA Elution Plate (REP)	0	0	
RNA Working Plate (RWP)	0	0	
Running qPCR Plate (QRP)	0	0	
Recorded qPCR Plate (QRP)	0	-	-
Processed qPCR Plate (QRP)	0	-	-

INSPECT will display the number of samples successfully scanned. The live counter will also be updated to reflect the appropriate number of samples in the sample extraction steps.

6.1

The screenshot shows the "Search Results" page in INSPECT. It includes a "Download All Results" link and a table with the following data:

Barcode	Sampling date	Ssp id	Ssp well	Sep id	Sep well	Sample bag id	Sampling plate csv	Rep id	Rep well	Rsp id	Rsp well	Rwp id	Rwp well	Qrp id	Qrp well	Ms2 ct value	N ct value	Orf1ab ct value	S ct value	D rt
XYZ123	07/20/2020	SSP-0001	B1	SEP-0001	B1	SSB-0001	https://covidtest2.s3-us-west-2.amazonaws.com/SEP-0001_20-07-20.csv	-	B1	-	B1	-	-	-	-	-1.0	-1.0	-1.0	-1.0	U

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RNA Extraction

- INSPECT assumes that the RNA extraction from SEPs is an automated process, performed using Kingfisher or similar robotic machines. Thus, sample barcode scanning is not required. Users must enter the origin SEP and the destination RNA Extraction Plate (REP) barcodes. Only upon entering both will the samples be successfully linked between sample extraction and RNA extraction steps.

7.1 Enter Lot #s of the reagents being used in the RNA Extraction step

7.2 Enter the barcode of the SEP and the barcode of the new REP and proceed with extracting RNA from the samples.

The screenshot shows the INSPECT web application interface. At the top, there is a navigation bar with 'Home', 'Search', and 'Dashboard' links, and a user profile 'ssathe'. Below the navigation bar, there are two reminder boxes: 'Reminder: Add MS2 PHAGE.' and 'Reminder: RNA Elution Plate ID will be recorded as the RNA Storage Plate ID.' The form contains several input fields for lot numbers and barcodes. The 'MS2 Phage Lot #' field contains '2003001', 'KingFisher ID*' contains 'KF001', 'RNA Extraction Kit Lot #' contains 'XYZ001', and 'Mag-bind Particles CNR Lot #' contains 'XYZ002'. There are also fields for 'Carrier RNA Lot #' and 'Enter Carrier RNA Lot #'. At the bottom of the form, there is a blue button labeled 'Assign Plates'.

Submission Form to assign REP to an existing SEP

7.3

The screenshot shows the INSPECT web application interface. At the top, there is a navigation bar with 'Home', 'Search', and 'Dashboard' links, and a user profile 'ssathe'. Below the navigation bar, there is a green notification bar that says 'RNA plates added successfully.' The main content area features the INSPECT logo and the text 'Instant Service Platform for Emergency COVID Tests'. Below the logo, there is an 'Overall Testing Summary' section with a table showing the number of samples, positives, negatives, and undetermined results. The table has the following data:

Number of Samples	Number of Positives	Number of Negatives	Number of Undetermined
12105	1410 (11.65%)	9858 (81.44%)	567 (4.68%)

Below the summary, there is a 'Sample Tracker' section with a table showing the number of samples in each step, the number of plates already evaluated, and the evaluated plate IDs. The table has the following data:

Step Name	Number of Samples in Step	Number of Plates Already Evaluated	Evaluated Plate IDs
Unprocessed Samples	0	-	-
Sample Extraction Plate (SEP)	0	0	SEP-0001
RNA Elution Plate (REP)	3	1	REP-0001
RNA Working Plate (RWP)	0	0	-
Running qPCR Plate (QRP)	0	0	-
Recorded qPCR Plate (QRP)	0	-	-
Processed qPCR Plate (QRP)	0	-	-

Provided with valid barcodes, INSPECT will link the given REP with the corresponding SEP entered in the form

7.4 INSPECT assumes that the RT-qPCR test is performed on a 384-well plate format. For this purpose, 4× 96-well plates are compressed into a single 384-well plate. Thus, each 384-well RNA Working Plate (RWP) must be linked with 4× 96-well REPs, and the well ID for each sample must be transformed into a 384-well plate format. This process is automated by INSPECT and can be achieved by simply scanning the new RWP and the associated REPs

The screenshot shows the INSPECT web interface with the following fields and values:

- EpMotion ID*: EPM-0001
- First 96-Well Plate in Array Position B2*: REP-0001
- Second 96-Well Plate in Array Position B3: (empty)
- Third 96-Well Plate in Array Position B4: (empty)
- Fourth 96-Well Plate in Array Position B5: (empty)
- RNA Working Plate Barcode*: RWP-0001

At the bottom of the form is a blue button labeled "Assign Plates". The footer of the interface reads "©2020 Yeo Lab Design".

7.5

Expected result

The screenshot shows the INSPECT dashboard with a navigation bar (Home, Search, Dashboard) and a user profile (ssathe). A notification at the top states "RNA working plate added successfully". The main content area features the INSPECT logo and the text "Instant Service Platform for Emergency COVID Tests".

Overall Testing Summary

Number of Samples	Number of Positives	Number of Negatives	Number of Undetermined
12105	1410 (11.65%)	9858 (81.44%)	567 (4.68%)

Sample Tracker

Step Name	Number of Samples in Step	Number of Plates Already Evaluated	Evaluated Plate IDs
Unprocessed Samples	0	-	-
Sample Extraction Plate (SEP)	0	0	SEP-0001
RNA Elution Plate (REP)	0	0	REP-0001
RNA Working Plate (RWP)	3	1	RWP-0001
Running qPCR Plate (QRP)	0	0	-
Recorded qPCR Plate (QRP)	0	-	-
Processed qPCR Plate (QRP)	0	-	-

The screenshot shows the INSPECT Search Results page with a navigation bar (Home, Search, Dashboard) and a user profile (ssathe). A "Download All Results" link is visible above the table.

Barcode	Sampling date	Ssp id	Ssp well	Sep id	Sep well	Sample bag id	Sampling plate csv	Rep id	Rep well	Rsp id	Rsp well	Rwp id	Rwp well	Qrp id	Qrp well	Ms2 ct value	N ct value	Drf ct. val
XYZ123	07/20/2020	SSP-0001	B1	SEP-0001	B1	SSB-0001	https://covidtest2.s3-us-west-2.amazonaws.com/SEP-0001_20-07-20.csv	REP-0001	B1	REP-0001	C1	RWP-0001	C1	-	C1	-1.0	-1.0	-1.0

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Viral Gene Expression Test

- 8 Similar to previous steps, each qPCR Reaction Plate (QRP) must be linked to an existing RWP. Since the RWP and the QRP have the same platemap format, the well ID for each sample is carried over from the previous assignment.
- 8.1 Enter a valid RWP barcode and the new QRP barcode

8.2

Expected result

qRT-PCR plate added successfully

- Upload PlateMap
- Sample Plating
- Update Existing Records
- Advanced Search

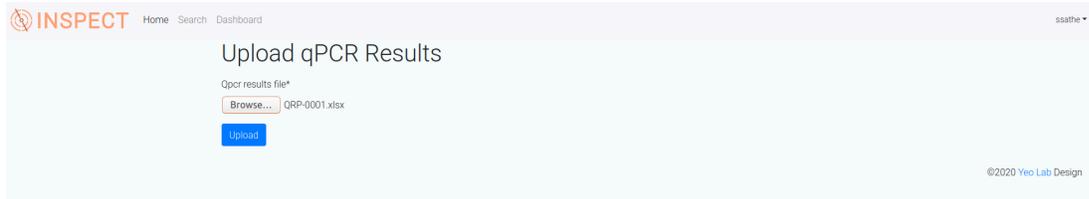
Overall Testing Summary

Number of Samples	Number of Positives	Number of Negatives	Number of Undetermined
12105	1410 (11.65%)	9858 (81.44%)	567 (4.68%)

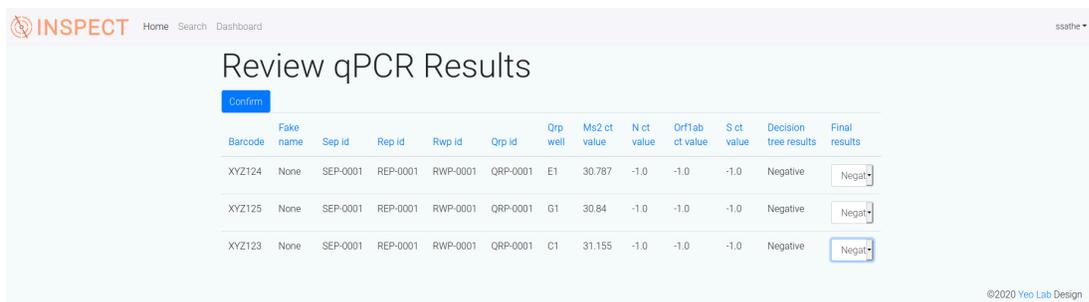
Sample Tracker

Step Name	Number of Samples in Step	Number of Plates Already Evaluated	Evaluated Plate IDs
Unprocessed Samples	0	-	-
Sample Extraction Plate (SEP)	0	0	SEP-0001
RNA Elution Plate (REP)	0	0	REP-0001
RNA Working Plate (RWP)	0	0	RWP-0001
Running qPCR Plate (QRP)	3	1	QRP-0001
Recorded qPCR Plate (QRP)	0	-	-
Processed qPCR Plate (QRP)	0	-	-

8.3 After the qPCR reaction has completed, the technician is required to upload the qPCR results file. This can be done using the results submission page. The filename for the results file must be the same as the QRP barcode.



8.4 Once the results are successfully uploaded, INSPECT will make decision calls on each sample (during file upload). These decisions have to be reviewed by a qualified technician. On the Review Results page, enter the barcode of the QRP for which you would like to review the results.



Default results are the same as the decisions made by INSPECT. To change the decisions, use the dropdown menu to select 1 of 4 options : Negative, Positive, Invalid and Inconclusive.

Result Reporting

9 Once the results for a QRP have been reviewed, the RT-qPCR testing workflow is complete. Users can search for samples and corresponding results through the SEARCH tab.

INSPECT Home Search Dashboard ssathe

Record Search Form

Sample Barcode

Sampling date

(MM/DD/YYYY)

Plate id

Enter a Plate Barcode

Technician

Final Result

Sample bag id

Enter a Sample Bag Barcode

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Expected result

Search Results ssathe

[Download All Results](#)

Barcode	Sampling date	Sep id	Sep well	Sep id	Sep well	Sample bag id	Sampling plate csv	Rep id	Rep well	Qrp well	Ms2 ct value	N ct value	Orf1ab ct value	S ct value	Decision tree results	Final results	Qcqr results file	Sample release						
XYZ124	07/20/2020	SSP-0001	C1	SEP-0001	C1	SSB-0001	https://covidtest2.s3-us-west-2.amazonaws.com/SEP-0001_20-07-20.csv	REP-0001	C1	REP-0001	E1	RWP-0001	E1	QRP-0001	E1	30.787	-1.0	-1.0	-1.0	Negative	Negative	https://covidtest2.s3-us-west-2.amazonaws.com/QRP-0001.xlsx	✕	
XYZ125	07/20/2020	SSP-0001	D1	SEP-0001	D1	SSB-0001	https://covidtest2.s3-us-west-2.amazonaws.com/SEP-0001_20-07-20.csv	REP-0001	D1	REP-0001	G1	RWP-0001	G1	QRP-0001	G1	30.84	-1.0	-1.0	-1.0	Negative	Negative	https://covidtest2.s3-us-west-2.amazonaws.com/QRP-0001.xlsx	✕	
XYZ123	07/20/2020	SSP-0001	B1	SEP-0001	B1	SSB-0001	https://covidtest2.s3-us-west-2.amazonaws.com/SEP-0001_20-07-20.csv	REP-0001	B1	REP-0001	C1	RWP-0001	C1	QRP-0001	C1	31.155	-1.0	-1.0	-1.0	Negative	Negative	https://covidtest2.s3-us-west-2.amazonaws.com/QRP-0001.xlsx	✕	

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Users can download the results table from the Download link at top-left of the results table