

1 Introduction

1.1 Abbreviations

ACORN	A Clinically Oriented Antimicrobial Resistance Network
AMR	Antimicrobial Resistance
AST	Antimicrobial Susceptibility Test
AWS	Amazon Web Service
BSI	Bloodstream Infection
CAI	Community-Acquired Infection
CLSI	Clinical and Laboratory Standards Institute
CRF	Case Record Form
EUCAST	European Committee on Antimicrobial Susceptibility Testing
GDPR	General Data Protection Regulations
HAI	Hospital-Acquired Infection
IT	Information Technology
LIMS	Laboratory Information Management System
MORU	Mahidol-Oxford Tropical Medicine Research Unit
ODK	Open Data Kit
PIN	Personal Identification Number
PPS	Point Prevalence Survey
QR	Quick Response
REDCap	Research Electronic Data Capture
SOP	Standard Operating Procedure
URL	Uniform Resource Locator

1.2 Purpose

This document provides a summary of information technology (IT) procedures for ACORN surveillance, covering electronic data collection, clinical data error checking and correction, clinical-laboratory data linkage, and data visualisation.

1.3 Hardware and software requirements

1.3.1 Laptop or Desktop computer

- Windows 10 operating system.
- Internet connection.
- Internet browser (e.g. Chrome or Firefox) for REDCap.
- ACORN app.

1.3.2 Android tablet

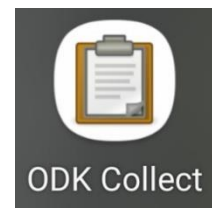
- Internet connection (WiFi or 3/4G).
- ODK Collect app.

2 Data entry using ODK Collect

2.1 Purpose and Scope

To describe collection of clinical data for ACORN surveillance using the ODK Collect app.

ODK Collect is an Android app for filling out forms. It allows data collection using Android mobile devices (smartphones or tablets) and data submission to an online server. This can be done even without an internet connection or mobile carrier service at the time of data collection. The data is synced when a connection is found.

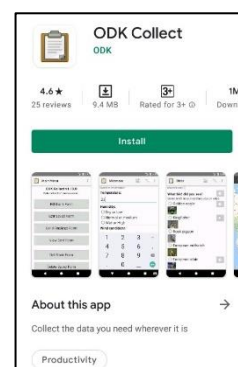


The ACORN ODK database is hosted on a secure server at MORU (Bangkok, Thailand) and managed according to MORU's data policies.

2.2 Set up

Note on devices: we suggest dedicated project devices be used for the ACORN project. Any recent Android device should work but we have tested extensively on Samsung Tab A (8-inch screen) devices running Android 10. It is recommended to PIN or password protect the device, turn off backup, and to keep app installations to a minimum. Project specific device wallpaper is available for download [here](#), if desired.

- You must have an internet connection to do the app setup.
- Download and install the ODK Collect app from the Google Play Store.
- Grant the app all permissions.
- Make sure you have been assigned a unique username and password and have the set-up details for the ODK server. This will have been set up and provided by the ACORN IT team as either a QR code or URL address. If you do not have one or it does not work please contact ACORN admin (acorn@tropmedres.ac) or the ACORN IT team (ACORN IT Helpdesk TEAMS channel).



2.2.1 Configure Server

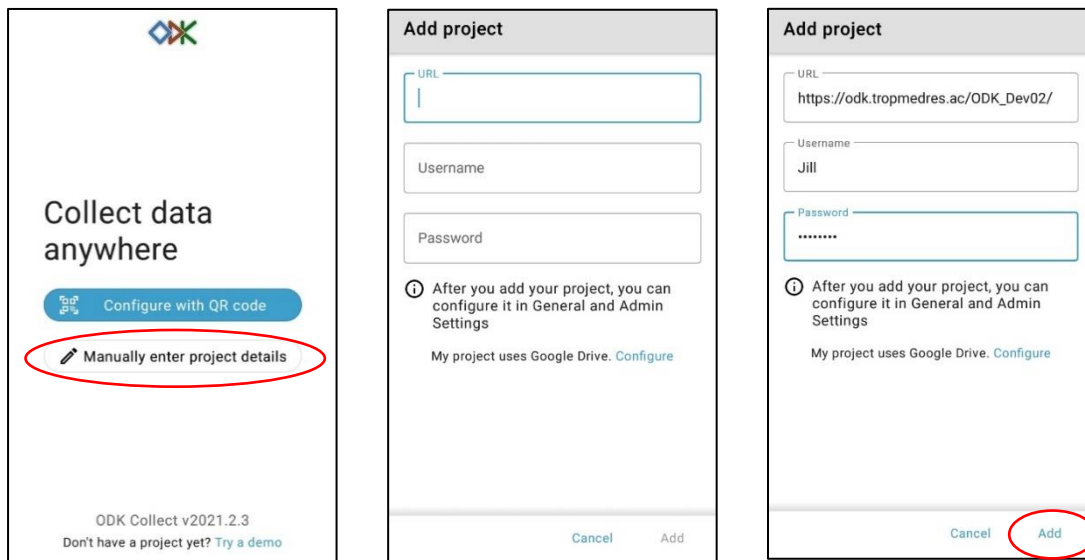
- Open the ODK Collect App and you will see the Setup screen.

Set up can be done two ways:

1. QR Code: the ACORN IT team will provide an ODK Collect QR code for set-up. Select the blue "Configure with QR code" on the set-up screen and scan the QR code. The app will be configured automatically, and the project forms will download automatically. The app is then ready for use/data entry.
2. Enter the supplied server URL and your Username and Password (see below) and then download the project forms

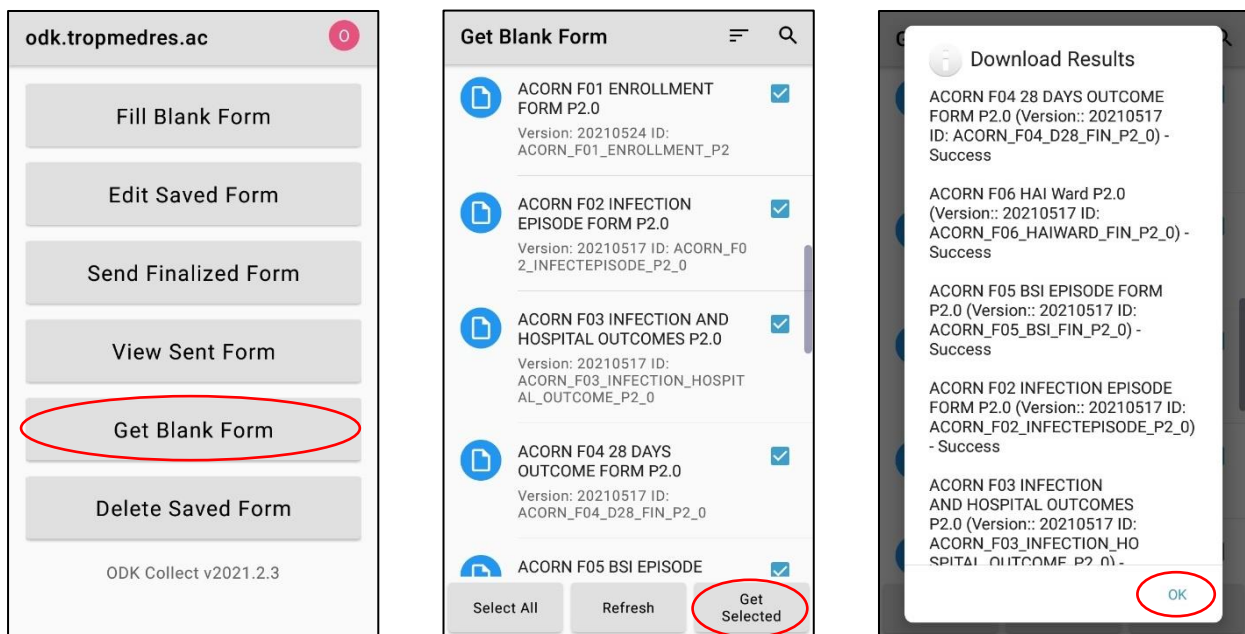


Important note: you must set up the "production" version of the project before beginning live data capture. You will be given access to a "test" project during training: this should be deleted from ODK Collect prior to the start of surveillance.



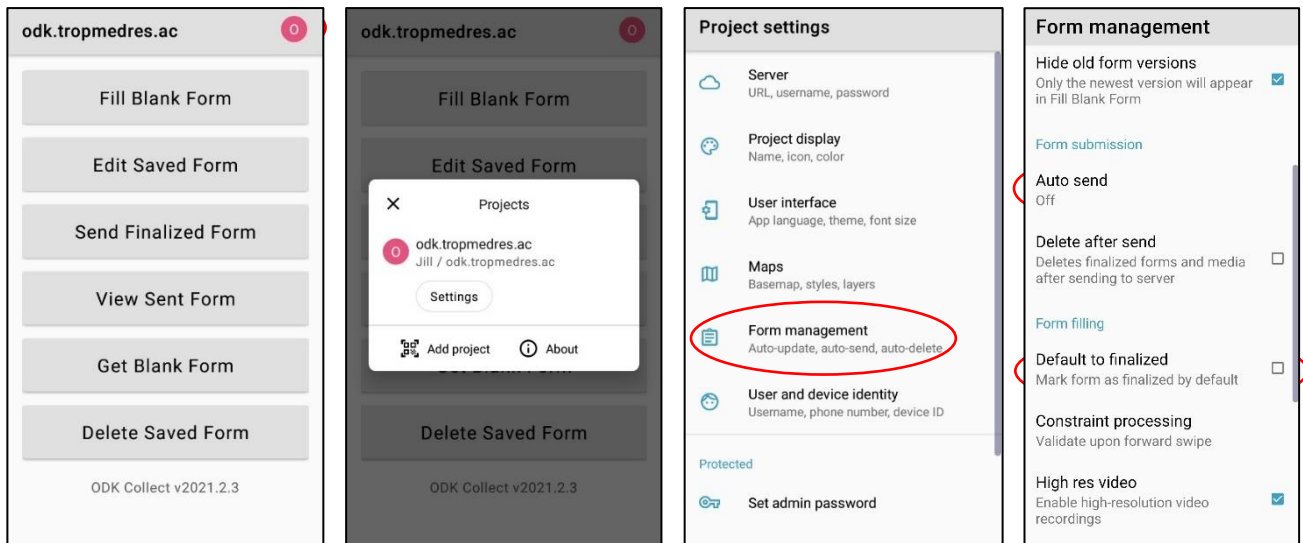
2.2.2 Download Project Forms

- Note: this is done automatically if you use the QR code set-up option.
- From the Main Page choose Get Blank Forms.
- Select all the ACORN Forms and touch Get Selected.
- The Forms will then be downloaded.

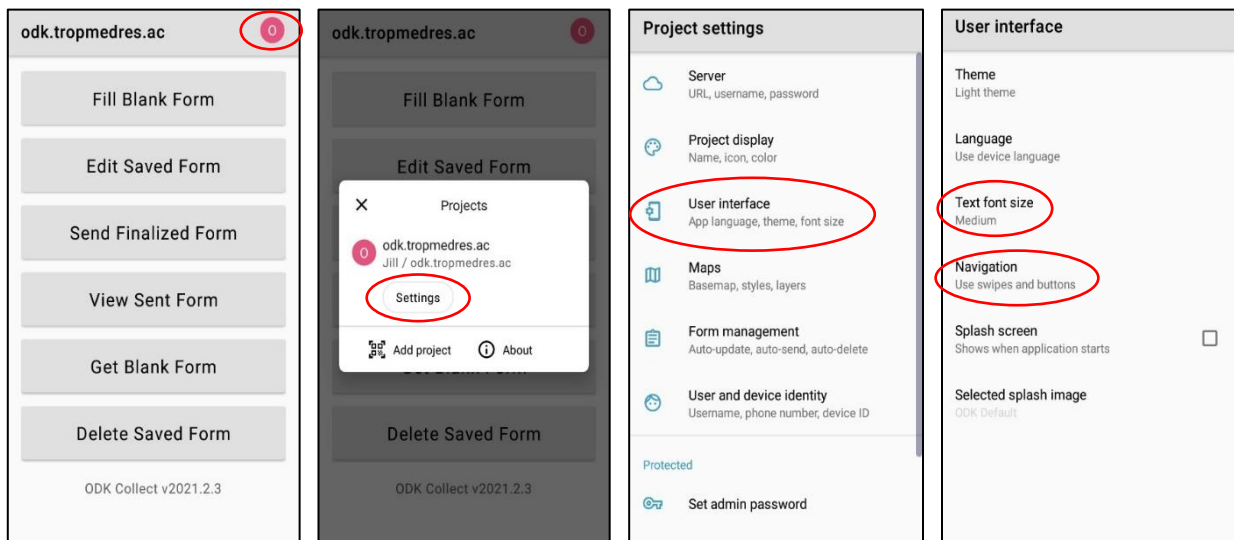


2.2.3 Additional Settings

In the Setting menu -> Form management you can adjust other Form management settings such as turning auto send off and unchecking Default to finalized. Both of these options will prevent the forms being sent to the server automatically upon saving and will allow forms to be edited if needed before sending – we recommend that these settings are updated.



In the Setting menu -> User interface you can adjust other user settings such as Text font size and type of Navigation (swipes or forward and backward buttons) for your preference.



The App is set up and ready for Data Entry.

2.3 Data Entry

- Log in to the tablet computer.
- Open the ODK Collect app.
- From the main menu select Fill Blank Form.
- Choose the Form to complete from the ones listed.
- Use the Next and Back Buttons or Swipe Left and Right to move through the form.

odk.tropmedres.ac

Fill Blank Form

Edit Saved Form

Send Finalized Form

View Sent Form

Get Blank Form

Delete Saved Form

ODK Collect v2021.2.3

Fill Blank Form

ACORN F01 ENROLLMENT FORM P2.0
Version: 20210524
Added on Fri, Aug 13, 2021 at 03:55

ACORN F02 INFECTION EPISODE FORM P2.0
Version: 20210517
Added on Fri, Aug 13, 2021 at 03:55

ACORN F03 INFECTION AND HOSPITAL OUTCOMES P2.0
Version: 20210517
Added on Fri, Aug 13, 2021 at 03:55

ACORN F04 28 DAYS OUTCOME FORM P2.0
Version: 20210517
Added on Fri, Aug 13, 2021 at 03:55

ACORN F05 BSI EPISODE FORM P2.0
Version: 20210517

ACORN F01 ENROL...

ACORN

ACORN Enrolment Form

Thanks for taking the time to fill this form. The form has a total of 23 questions and takes usually 3 minutes for completion. Please make sure to have the patient record information on hand before proceeding. Should you need any assistance with this form, please contact contact@acornmr.net.

NEXT >

- Enter data using the select boxes, keypad, scroll wheel etc.
- Some questions require double entry (either directly or the same data in different formats) or entered in a specific format to reduce data entry errors (examples below).

ACORN F01 ENR...

* Q01. Hospital code

☒ KH001

☐ GH001

☐ GH002

☐ ID001

☐ ID002

☐ ID003

☐ KE001

☐ KE002

☐ LA001

☐ LA002

☐ MW001

☐ NP001

☐ NP002

☐ NP003

< BACK NEXT >

ACORN F01 ENR...

* Q02. Hospital name

☒ Cambodia - Angkor Hospital for Children

☐ Ghana - Korle-Bu Teaching Hospital

☐ Ghana - 37 Military Hospital

☐ Indonesia - Peln Hospital

☐ Indonesia - RSCM national referral hospital

☐ Indonesia - RSUI teaching hospital of UI

☐ Kenya - Kitale County Referral Hospital

☐ Kenya - Bungoma County Referral Hospital

☐ Laos - Mahosot Hospital

☐ Laos - Settathirath Hospital

☐ Malawi - Queen Elizabeth Central Hospital

< BACK NEXT >

Same data in different formats – hospital code and hospital name must “match”



ACORN F01 ENR...   

* Q04. Patient ID
(This ID must be present in the hospital microbiology lab database / LIMS.)

1001

< BACK NEXT >

!#1 , English(CA) . ↵

ACORN F01 ENR...   




* Q05. Patient ID (Double Entry)

1001

< BACK NEXT >

!#1 , English(CA) . ↵

Direct double entry – data must be entered twice and entries must match

ACORN F01 ENR...   




* Q06. ACORN ID

A112355

ACORN ID should be in the format of Axnnnn where x is a dedicated ward number and nnnn is the 4 digit running number within the ward.

OK

!#1 , English(CA) . ↵

ACORN F01 ENR...   

* Q07. ACORN ID (Double Entry)

A11234

ACORN ID and ACORN ID (Double Entry) should be the same.

OK

!#1 , English(CA) . ↵

Example of a specific format required (for ACORN ID) and direct double entry and their associated warnings if incorrect

ACORN F01 ENR...

Q20. Comorbidities
Several comorbidities can be selected.

- ☐ None
- ☒ AIDS
- ☐ Cancer / leukaemia
- ☒ Chronic pulmonary disease
- ☐ Congestive heart failure
- ☐ Connective tissue / rheumatologic disease
- ☐ Dementia
- ☐ Diabetes
- ☐ Diabetes with end organ damage
- ☐ Hemi- or paraplegia
- ☐ HIV on ART
- ☐ HIV without ART
- ☐ Malaria

< BACK NEXT >

Multiple selections
are allowed in
some questions

ACORN F01 ENROL...

*** Q03. Date of enrolment**

Select date

Select date

May	06	2019
Jun	07	2020
Jul	08	2021

CANCEL OK

< BACK NEXT >

Example of a
scroll wheel data
entry for dates

- At the end of the Form you will get to review the key information.
- Check that the details are correct (and match your entries in the enrolment logbook):
 - If errors are suspected, right swipe back through the form to the appropriate questions and make corrections.
- You can then save the form.
- Select "Save Form and Exit" (and ensure "Mark form as finalized" is selected):
 - If you cannot complete data collection, uncheck "Mark form as finalized" before saving. You will be able to complete data entry later by selecting the correct form from "Edit Saved Form".
 - You can rename the form if you wish to something more memorable as a reminder (e.g. add the patient ID) if you are leaving the form unfinalized for later editing.
 - Then save the form.

2.3.1 Editing and Deleting Saved Forms

- If you need to edit or delete a saved form you can do so from the main menu.
- Forms can be edited or deleted only if they have NOT been sent to the server.

2.3.1.1 Edit

- Select Edit Saved Form from the main menu.
- Select the form to edit.
- Scroll through the questions and recorded answers and select the question you wish to edit.

- Edit the data as required.
- Touch the Save icon to save the edit.
- You can use the Go To End button to jump to the end of the form and Save Form and Exit.

ACORN F01 ENROL...

* Q12. Gender

☐ Female

☒ Male

☐ Other

☐ Unknown

< BACK NEXT >

Form successfully saved!

ACORN F01 ENROLLMENT FORM...

ACORN Enrolment Form

* Q01. Hospital code
KH001

* Q02. Hospital code (Double Entry)
KH001

* Q03. Date of enrolment
Aug 13, 2021

* Q04. Patient ID
12345

* Q05. Patient ID (Double Entry)
12345

* Q06. ACORN ID
A12345

Go To Start Go To End

2.3.1.2 Delete Saved Form

- Select Delete Saved Form from the main menu.
- Select the form to delete.
- Confirm deletion.

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Fill Blank Form

Edit Saved Form (1)

Send Finalized Form (1)

View Sent Form

Get Blank Form

Delete Saved Form

ODK Collect v2021.2.3

Delete Saved Form

SAVED FORMS BLANK FORMS

ACORN F01 ENROLLMENT FORM P2.0

Finalized on Fri, Aug 13, 2021 at 04:56

Delete Selected

Delete 1 form(s)?

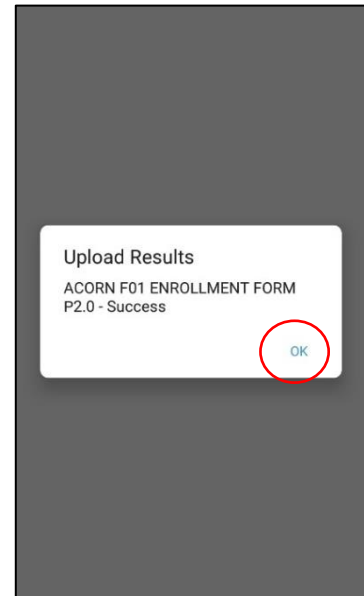
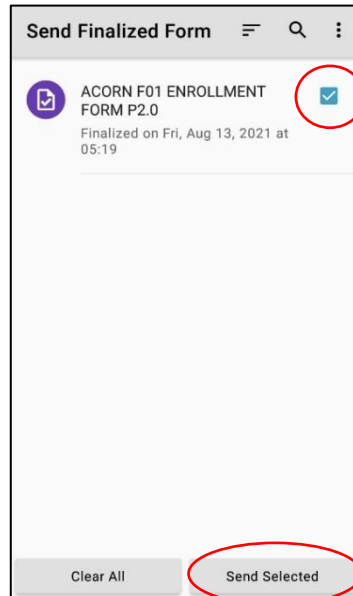
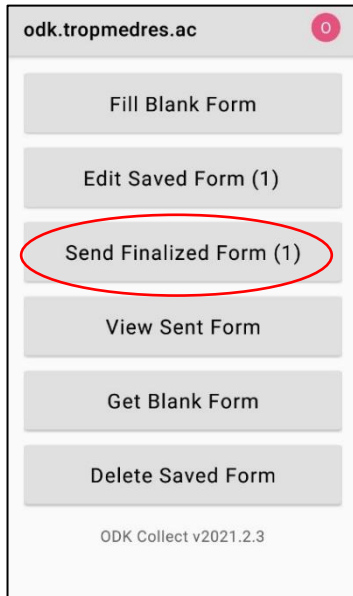
DO NOT DELETE DELETE FORMS

Nothing available to display.

1 form(s) successfully deleted!

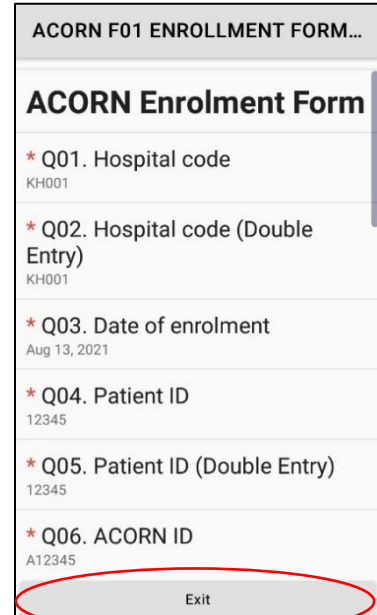
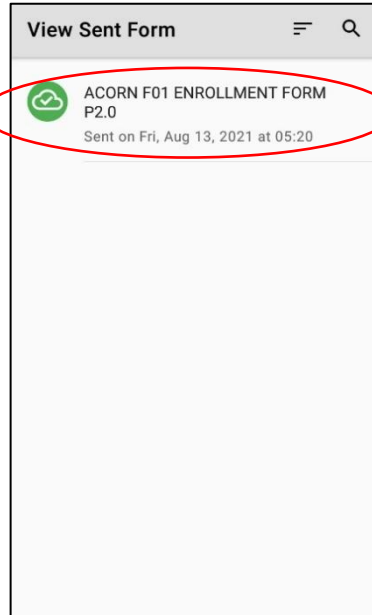
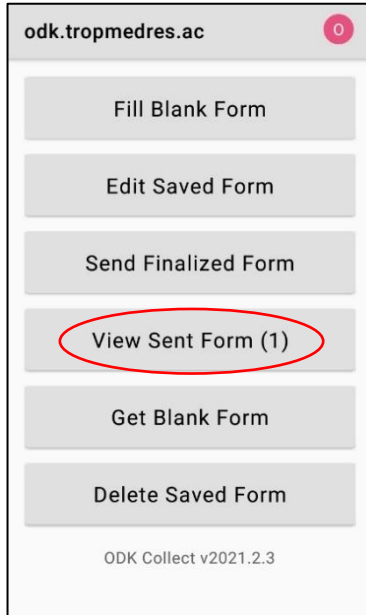
2.3.2 Send Finalized Form

- Once data entry is complete the forms need to be sent to the server.
- Select Send Finalized Forms from the main menu.
- Select the forms to send and select Send Selected.



2.3.3 View Sent Form

- You can view a sent form (but not edit it) if you want to check something in the form.
- Select View Sent Form in the main menu.
- Select the form you want to view.
- Scroll through to view the data.
- Exit when finished.



2.4 Data Entry Errors

- Once a form has been sent to the server it cannot be edited.
- If errors are suspected or found after sending, the data can be accessed and edited in the REDCap database (see REDCap section [3](#)).

2.5 ODK Data Error Checking

- The only user data error checks in ODK are the double entry validation rules: the double entry inputs must match.
- When the data from ODK is imported into REDCap, the ACORN Data Manager will identify any incorrectly imported records.

3 Data entry using REDCap

3.1 Purpose and Scope

REDCap is a secure web application for building and managing online surveys and databases. The ACORN IT team has set up a database in REDCap to enter ACORN clinical surveillance data. The ACORN REDCap database is hosted on a secure server at MORU (Bangkok, Thailand) and managed according to MORU's data policies.



3.2 Accessing the ACORN REDCap Database

Make sure you have been assigned a unique username. This will have been set up by the ACORN IT team. If you do not have one or it does not work please contact ACORN admin (acorn@tropmedres.ac) or the ACORN IT team (ACORN IT Helpdesk TEAMS channel).

When your user account is set up, you will receive an email with the subject "REDCap access granted" which contains your username. Click on the link 'Set your new REDCap password' in the email. This will take you to the password setup page in REDCap.

Set Your Password

Your password has not been set yet or has been reset. You will need to set your password here to whatever value you wish. Please enter your desired password below and click the 'Submit' button. Once your password has been set, you may use it with your username whenever you log in to REDCap. Please make sure that you write down or remember your new password for future use. **The new password entered must be AT LEAST 9 CHARACTERS IN LENGTH and must consist of AT LEAST one lower-case letter, one upper-case letter, and one number.**

Username:

Password:

Re-type password:

REDCap Software - Version 8.8.1 - © 2015 Vanderbilt University

You will see your username in the dialog box. Click in the 'password' field to set your password. The password should be AT LEAST 9 CHARACTERS IN LENGTH and must consist of AT LEAST one lower-case letter, one upper-case letter, and one number.

Open any browser (it has been tested with the most common browsers including Safari, Chrome, Firefox, Edge) and go to the ACORN REDCap production database (https://redcap.tropmedres.ac/REDCap_Prod01/).

Bookmark this page in your browser.

Important note: you must verify that you are logged into the correct database for data entry (as you will have access to a test database during training).



Log In



Please log in with your user name and password. If you are having trouble logging in, please contact [REDCap support team](#).

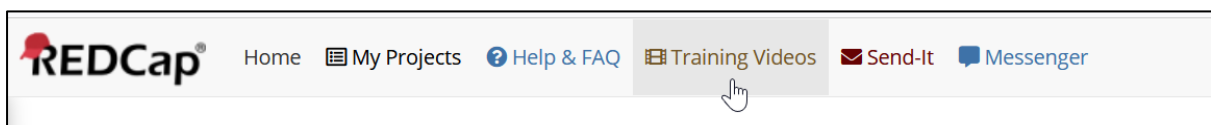
Username:

Password:

[Forgot your password?](#)




Enter your login details.

Once logged in the “Training Videos” section gives 3 short videos to help you quickly get started with REDCap if you have never used it before.

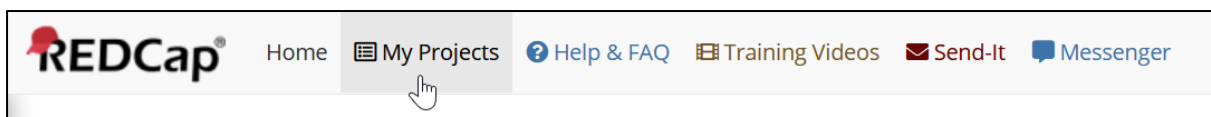


REDCap Training Videos

Just Getting Started?
Explore these overviews of fundamental concepts and features.

Title	Description	Watch Video
Brief Overview	A quick summary of what REDCap is and what it can do.	 4 minutes
Detailed Overview	This video provides an overview of basic functions and features within a REDCap project. It will serve as a starting point for learning about the basic concepts of REDCap, what REDCap projects are, how to create them, and how to use them.	 14 minutes
Data Entry Overview	A focused exploration of basic data entry workflow. Suitable for training data entry staff.	 19 minutes

Once comfortable with the basics, click on “My Projects”



You will see a list of the ACORN projects you have access to:

My Projects Organize					
Filter projects by title					
Project Title	Records	Fields	Instrument	Type	Status
ACORN2	1,408	167	5 forms		✓
ACORN2 HAI ward	143	13	1 form		✓

- **ACORN2 [SITE CODE]** (e.g. ACORN2 KH001) is for clinical data.
- **ACORN2 HAI ward** is for HAI point prevalence survey ward data.
- **ACORN2 Site Information** is for site level data.
- **ACORN2 Laboratory Assessment** is for site laboratory quality assessment and monitoring data.

To access a project, click on the project title. You will then see the Project Homepage:

Logged in as jill | Log out

My Projects

REDCap Messenger

Project Home and Design

Project Home · Codebook

Project status: **Production**

Data Collection

Record Status Dashboard

Add / Edit Records

Show data collection instruments

Applications

Help & Information

Help & FAQ

Video Tutorials

Suggest a New Feature

Contact REDCap administrator

ACORN2 PID 19

Project Home

The tables below provide general dashboard information, such as a list of all users with access to this project, general project statistics, and upcoming calendar events (if any).

Current Users (7)

User	Expires
jill (Jill Hopkins)	never
naomi (Naomi Waithira)	never
olivier (Olivier Celhay)	never
pault (Paul Turner)	never
prapass (Prapass Wannapini)	never
testrole (TestRole TestRole)	never
testsite_1 (testsite_1 user)	never

Project Statistics

Records in project	1,410
Most recent activity	12-08-2021 01:03
Space usage for docs	0.18 MB

Upcoming Calendar Events (next 7 days)

Time	Date	Description
		No upcoming events

3.3 Data Entry

Go to Data Collection -> Record Status Dashboard

Data Collection

Record Status Dashboard

Add / Edit Records

There you can see all the current records and their status based on your user settings.

In the section below, the process for data entry for clinical data is summarised. The procedure is identical for entry, and correction, of HAI PPS ward data, site-level data, and laboratory assessment data.

3.3.1 Clinical Data Entry from Paper CRFs

If you are recording ACORN data manually onto paper CRFs (NOT using ODK) and need to enter that data into the database you will need to create a New Record for each Patient. The flow of data entry in REDCap follows the same as the paper CRFs.

F01 Enrolment – Complete 1 for each and every patient

F02 Infection Episode – Complete 1 for each and every patient. Some patients will have more than 1.

F03 Infection Hospital Outcome - Complete 1 for each and every patient

F04 D28 - Complete 1 for each and every patient (except death)






F05 BSI Episode – Complete 1 only for some patients

In REDCap All 5 forms are linked in 1 record. 1 record is equivalent to a single hospital admission: if the patient is readmitted, another F01 is completed etc.

Click the Green “Add New Record” Button on the Record Status Dashboard page

+ Add new record

You will see the Record Home Page with the list of Forms and their Status

NEW Record ID 10	
Data Collection Instrument	Status
F01 Enrolment	
F02 Infection Episode	
F03 Infection Hospital Outcome	
F04 D28	
F05 BSI Episode	

Click on the Status Icon to access the form

- Enter the data from the paper CRF into the REDCap form.
- The database questions are the same as in the CRFs (and ODK) however there are some logic rules in REDCap which means that some questions and/or answers may be hidden based on answers to previous questions.
- Below each question in red text are requirements and/or information for the question for clarity and help.
- You can use the Reset button on the right of each question to clear answers to re-enter.

The last question on every form is:

Is marked as delete record.	<input type="radio"/> Yes <input checked="" type="radio"/> No	reset
-----------------------------	--	-------

Make sure to click No to this question (it is used only by the central ACORN data management team).

Form Status	
Complete?	<input type="radio"/> Incomplete <input checked="" type="radio"/> Complete

When you complete all questions on this form, select the ‘Complete’ status from the drop down menu above. If some values are unavailable, select the ‘Incomplete’ status and save the form.

3.3.2 Finishing the Form

<input type="button" value="Save & Exit Form"/> <input type="button" value="Save & Go To Next Form"/>
<input type="button" value="-- Cancel --"/>

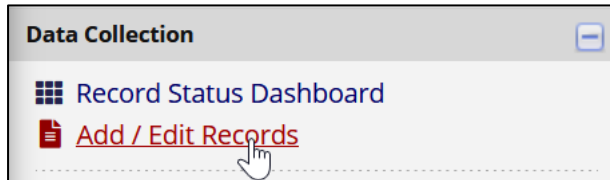
You can “Save & Exit” if you are finished with the data entry or you can “Save & Go To Next Form” to continue with the data entry.

3.3.3 Searching For and Finding Records

You most likely will not have all the data for each patient at one time and will need to go back and fill in more later (such as discharge data or second infection episode).

To search for a record you need a unique identifier such as the **ACORN ID**.

Go to Data Collection -> Add / Edit Records



In the Data Search Field, choose a field to search (ACORN ID) and enter the ACORN ID in the search query.

 A screenshot of the "Data Search" form. It has a yellow header bar. Below it, there are two sections. The first section, "Choose a field to search", has a dropdown menu showing "acornid (Q06. ACORN ID)". The second section, "Search query", has a text input field that is currently empty.

The search and result will appear automatically.

 A screenshot of the "Data Search" form after a search. The "Search query" field now contains the text "8a". Below the input field, a search result is displayed: "\"KH001-8a\" in Record ID 61: KH001-8a". A mouse cursor is pointing at the result.

Click on the search result to go to that record.

It will take you to F01 first, you can navigate to different forms in the record using the "Save and Go To Next Form" button on the bottom of the form (the button is also on the top right). Or you can use the forms menu on the left.

Save & Go To Next Form

To add an additional F02 Infection Episode, click the small + sign to the right of the form name

3.4 Data Edit/Correction from ODK entry

It is not possible to edit data in ODK once a form has been sent. However as all forms from ODK get imported into REDCap it is possible to edit the data via REDCap.

Notes on ODK to REDCap import:

- The import from ODK to REDCap happens approximately once every 24 hours (early in the morning, Thailand time [UTC +7]). So if you are searching for a recent record from ODK and are not able to find it, it might take some time to appear. Please check again after 24 hours.
- All the REDCap records will be available for the entire project, so if an error in ODK is noticed at any time (even months later) it can be accessed and corrected in REDCap.

If you notice a data entry error in ODK follow these steps:

1. Record it in the site "Data Entry Error Log". It is important to keep an error log with details including the ACORN ID, details of the error (field or question number and what was wrong, for example "wrong birthdate in F01, question 8") and details of the resolution (for example "entered correct birthdate via REDCap"), and the date and signature of the person who made the change. See example below.
2. Find the correct record using the REDCap search function (see Searching For and Finding Records section above).
3. Edit data as required (record details in Data Entry Error Log).
4. Save updated form in REDCap.

Example of Data Entry Error Log:

ACORN Data Entry Error Logbook				
Date logged	ACORN ID	Description of problem	Outcome / Action	Sign/Initial
			<input type="checkbox"/> Resolved	
			<input type="checkbox"/> Resolved	

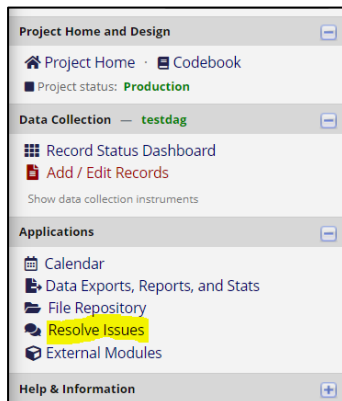
3.5 Data Error Checking

The ACORN Data Manager will identify incorrectly imported records in REDCap.

REDCap has some built in and default checks in the database such as validation rules. The data manager will provide regular reports and highlight records requiring manual review. These will be notified to the site data manager by email.

3.5.1 Resolving REDCap data queries [Site users]

1. A summary of assigned queries is accessible on the left hand pane of the home page or by clicking 'Resolve Issues' as in the image below.



2. In the 'Resolve Issues' tab, the user will see a summary of all queries. The 'First update' column tells what error needs fixing. Open the participant's record by clicking on the participant's ID in the 'Record' column. You may update the incorrect or blank data based on the source documents, if available. Save the changes.

Filters:		Open / unresolved issues (2)				
All fields and rules						
All data access groups						
User assigned (all users) or not assigned						
Click button to view data query	Record (Sorted by DAG)	Data Quality rule and/or Field	User Assigned	Days Open	First Update	Last Update
1 comment	A12345_210813	Rule #30: F03-Check3 (Infection episode diagnosis) : Evaluate = True.	-	0	Naomi (11-10-2021 13:02): "Final diagnosis is blank"	[same as first update]
1 comment	import-acorn1b-100 ACORN-100	Rule #28: F01- Check1 (Age, Admission type, reason, comorbidity) : Evaluate = True	-	0	Naomi (11-10-2021 13:08): "Comorbidity is blank"	[same as first update]

Click here to update query status

Click here to update participant's data

Tells you the error in the data

3. Return to the 'Resolve Issues' tab to update the query status by clicking on the 'Comment bubble' in the first box of the image above. A pop-up box will appear as below. Click 'Reply with response', select the applicable response from the drop down list, type OK in the comment box, and click Respond to Query.

Record ID : A12345_210813
 Rule: **Rule #30: F03-Check3** (Infection episode diagnosis) : Evaluate = True.
 Status: **Open / Unresolved** (unresponded)

Date/Time	User	Comments and Details
11-10-2021 13:02		Action: Opened query Comment: "Final diagnosis is blank"
11-10-2021 13:08		<input checked="" type="radio"/> Reply with response: -- choose response -- Upload file (optional): Upload file OR <input type="radio"/> Close the query Comment: <input type="text"/>

Respond to query Cancel

-Corrected-Data missing
 -Corrected-Typographical error
 -Corrected-Wrong source used
 -Verified-Confirmed correct (no error)

3.5.2 Resolving REDCap data queries [Data manager]

The data manager will review updated responses from the Data resolution dashboard. If the proposed resolution is satisfactory, the query will be closed, otherwise the query will be reissued ('Sent back for further attention').

Record ID : A12345_210813
 Rule: **Rule #30: F03-Check3** (Infection episode diagnosis) : Evaluate = True.
 Status: **Open / Unresolved** (responded)

Date/Time	User	Comments and Details
11-10-2021 13:02		Action: Opened query Comment: "Final diagnosis is blank"
11-10-2021 15:19		Response: Corrected - Wrong source used Comment: "no data update"
11-10-2021 15:19		<input type="radio"/> Close the query <input checked="" type="radio"/> Send back for further attention Comment: <input type="text"/>

Send back for further attention Cancel

3.5.3 Monitoring query status

1. Site users, project managers and the data manager may monitor query status from the Data Resolution Dashboard. Summaries of queries can be viewed by using the filtering options (by query status, days open, assigned use). Queries may be exported in Excel format for further reporting, basic metrics can be viewed in the 'Resolution Metrics' tab.
2. The data manager will generate data query summaries for review in periodic team meetings or with sites on request.
3. If queries are open for more than 14days, the data manager will send the site an email reminder to resolve the queries.

3.5.4 Data error log in ACORN dashboard/app

Data can be checked at any time in the dashboard and an error log downloaded for action in REDCap.

See Section 4.1.4 (Creating the .acorn file). The second tab of the downloaded EXCEL enrolment log is the error log which contains the issue found, the REDCap ID and the ACORN ID so the record can be found in REDCap and the issue corrected.

4 Clinical and laboratory data linkage

To utilize and visualize ACORN data users will generate an anonymized ACORN dataset in the form of an .acorn file by using the ACORN app to merge the clinical and laboratory data. This requires clinical data in REDCap (see above sections) and a microbiology laboratory datafile. To set up the microbiology laboratory datafile see Section 8 below.

4.1 ACORN App

The ACORN app has two versions, a stand-alone local version and a web-based version:

- We recommend the stand alone local version for generation of .acorn files and for accessing, visualising, and analysing ACORN data.

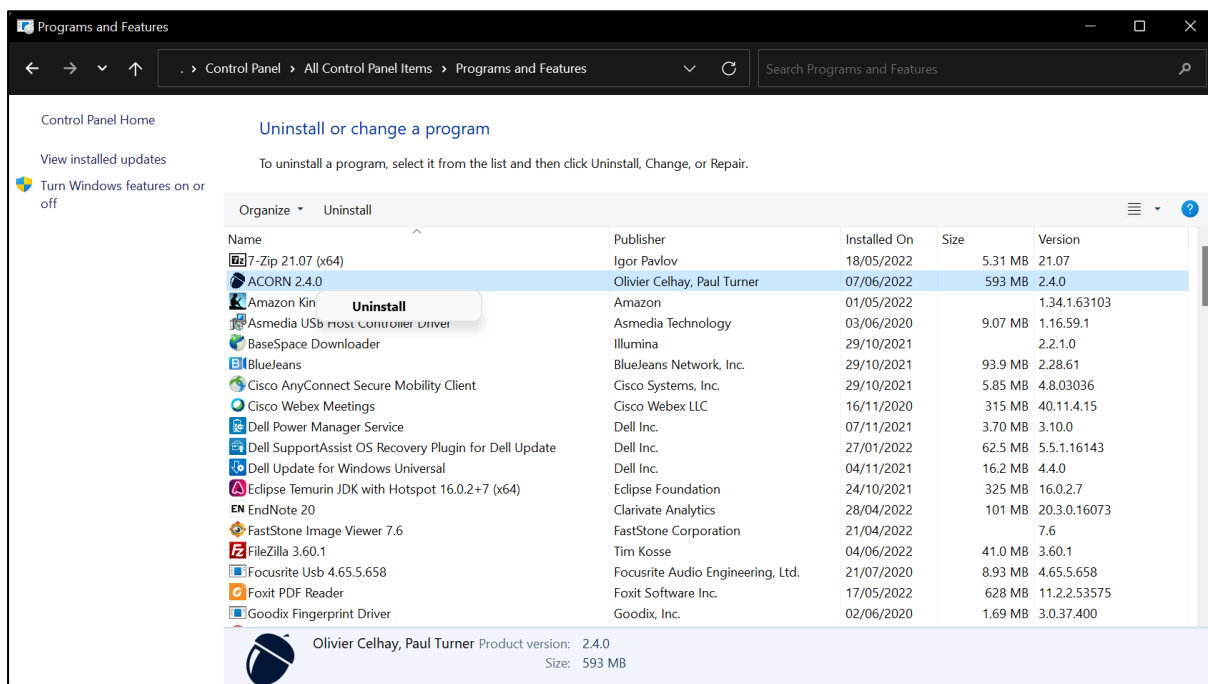
The web version is available here: <https://moru.shinyapps.io/acorn2/>

- We recommend this web-based version for accessing, visualising, and analysing ACORN data.

4.1.1 Installing the local ACORN App

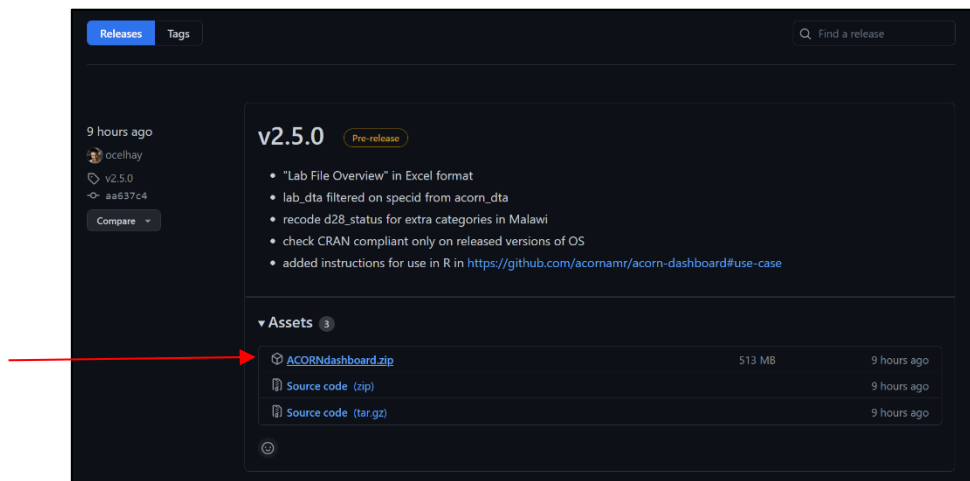
4.1.1.1 *Uninstall any old versions of the ACORN app, if any*

- Open Windows control panel – Programs and Features
- Select “ACORN” – if there is no “ACORN”, then proceed to the download step below (i.e. there is no old version to uninstall)
- Right click and select “Uninstall”
- Click “OK” on the next dialog box to start the uninstall



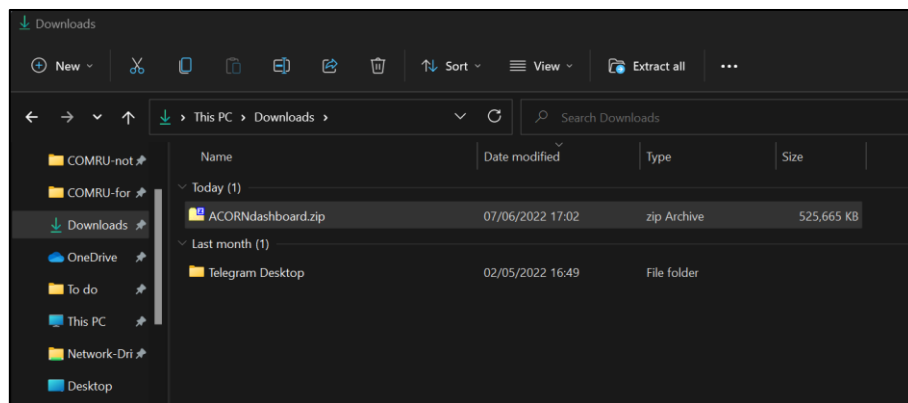
4.1.1.2 *Download the zipped installation folder from GitHub – version 2.5.0*

- Open a web browser
- Navigate to the app URL:
<https://github.com/acornamr/acorn-dashboard/releases/v2.5.0/>
- Download the .zip file from the 2.5.0 version of the app (**you must install the 2.5.0 version first and then update to the latest version**). Click on “ACORNdashboards.zip” to start the download.

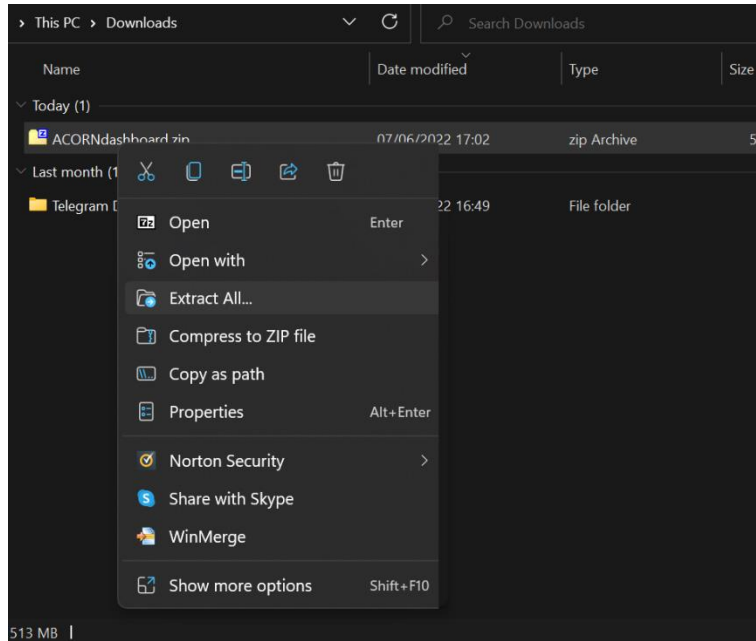


- The file may take a little while to download as it is >500Mb:
 - However, **this only needs to be done once** – all further version updates are managed from the app folder and will be much smaller and faster to download.

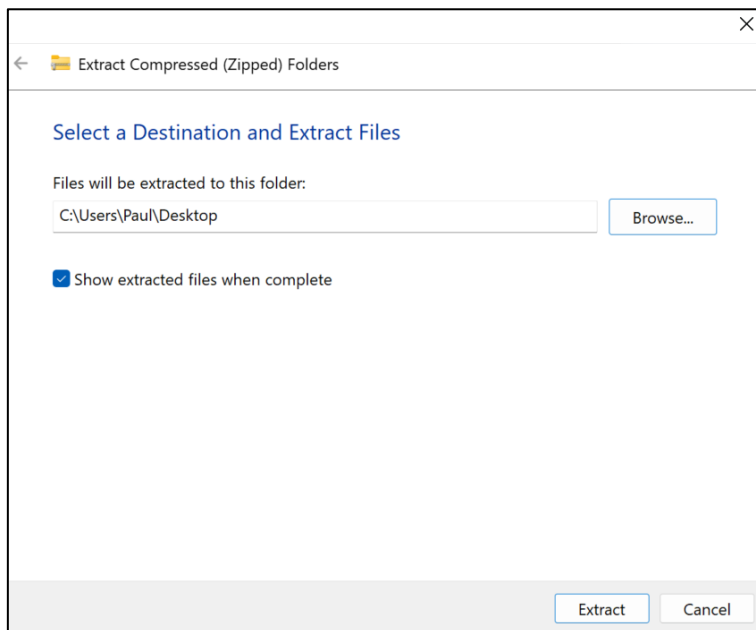
Locate the downloaded ACORNdashboards.zip file in the “Downloads” folder



- Right click on the ACORNdashboards.zip file and select “Extract all”



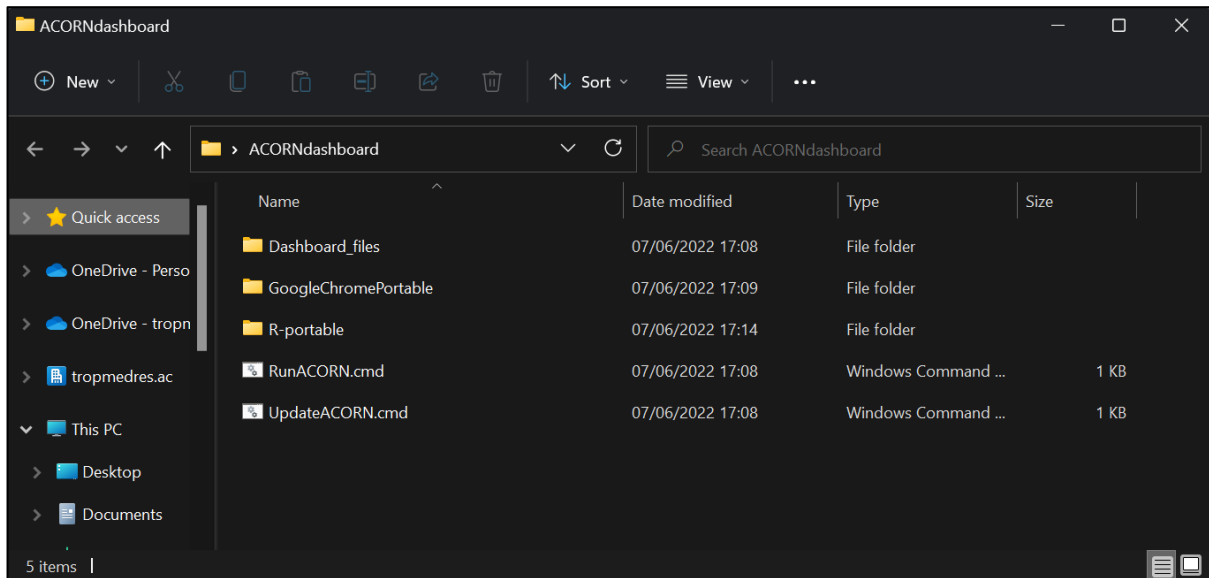
- Select a location to extract the ACORNdashboar.zip zip file to (e.g. user desktop):



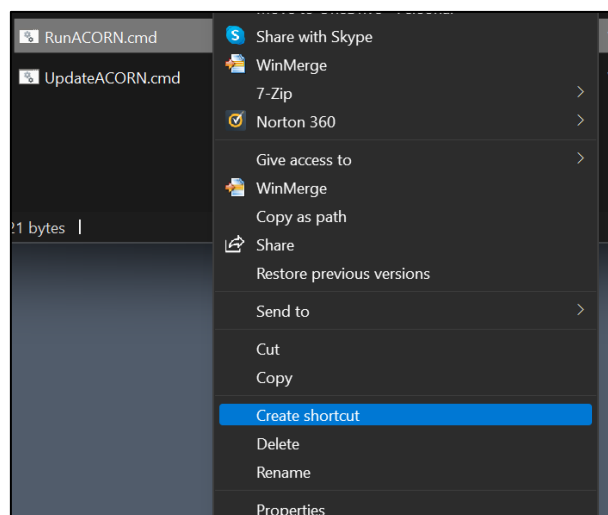
- It will take a few minutes to extract.
- Once extracted, move the “ACORNdashboar” folder to wherever you would like to keep it:
 - A suggestion would be “C:/ACORNdashboar” but it is ok to leave on the user desktop
 - You could even move it to a removable USB drive and run it from there
 - **DO NOT rename the folder or move any of the files / sub-folders within it**

4.1.1.3 Running the ACORN app

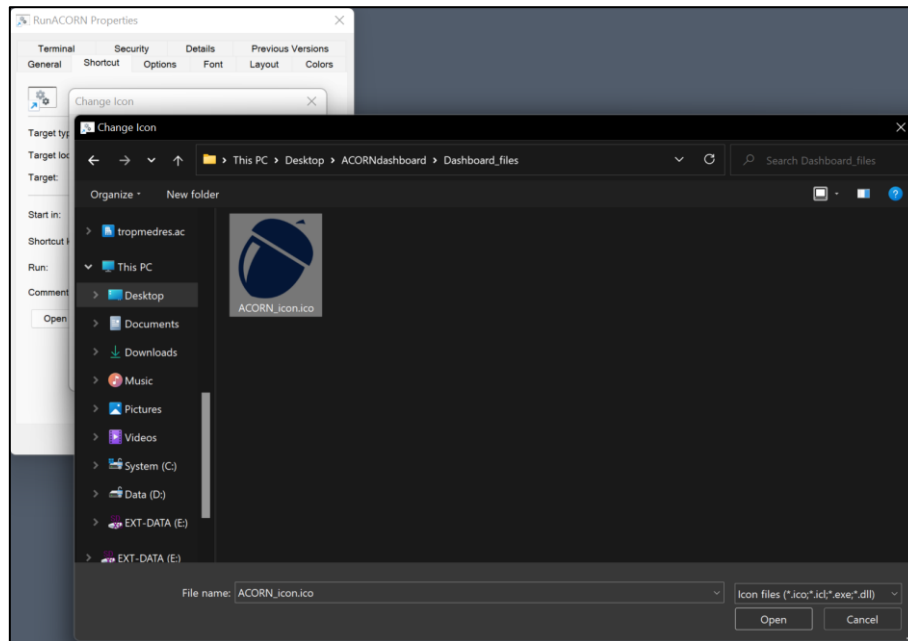
- Open the “ACORNdashboar” folder



- Optional step: create an app shortcut for user desktop
 - Right click on “RunACORN.cmd” and select “Create shortcut” (if using Windows 11 will need to select “Show more options” first):



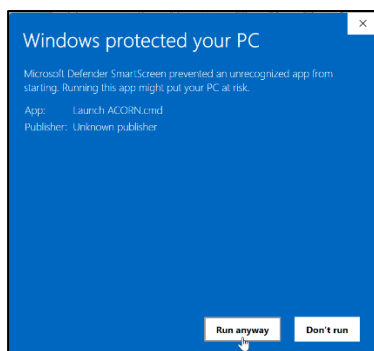
- You may like to rename this short cut “Run ACORN”
- Copy or drag the shortcut to the user desktop
- Change the icon to the ACORN icon
 - Right click on the shortcut and select “Properties”
 - Click “Change icon...”
 - Click “OK”
 - From the “Change Icon” dialog click “Browse...” and navigate to the “Dashboard_files” folder within the “ACORNdashboard” folder
 - Select “ACORN_icon.ico” and click “Open”



- Click “OK” and “OK” to complete.

4.1.1.4 Launching the app

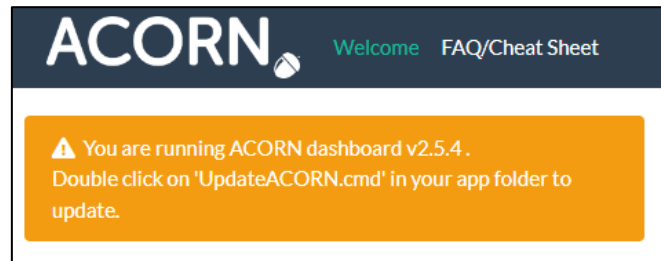
- To launch the ACORN app, double click “RunACORN.cmd” or the “Run ACORN” shortcut created above
- The first time the app is run you may get a windows pop-up security warning.
 - If so click on “More Info” and then “Run anyway”



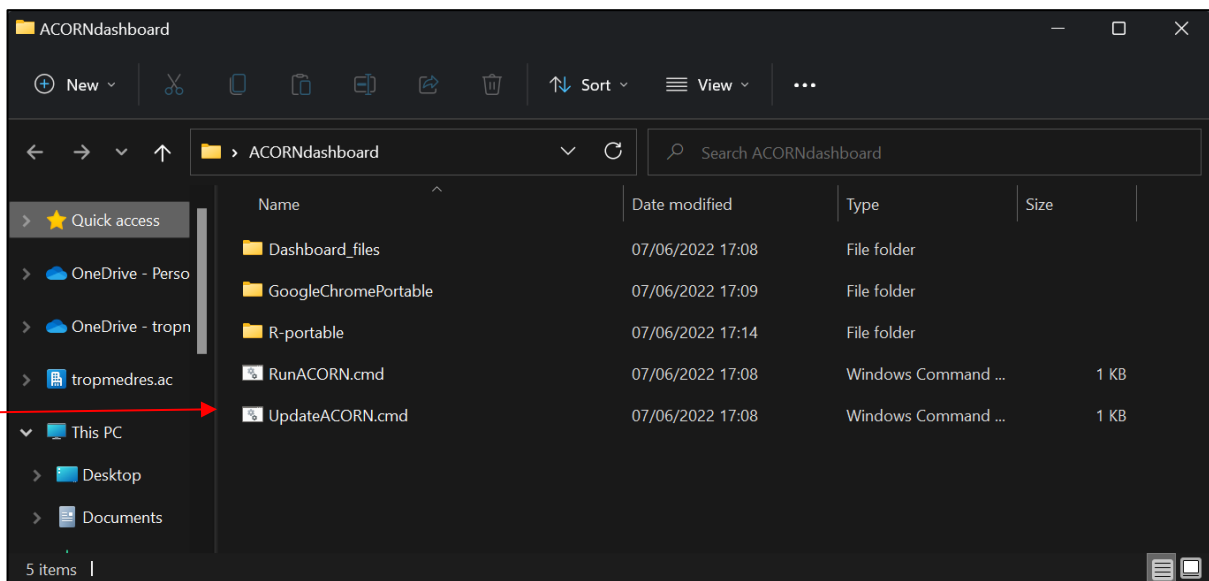
- The app will open in a Google Chrome Browser window (running offline). Functionality is exactly the same as the older version of the app, so go ahead and use it as normal
- There will be a Windows command window open in the background (labelled “ACORN”): do not close this or the app will stop working and you will need to re-launch the app. It will close automatically when you close the browser window.

4.1.2 Updates to local ACORN app

- When you are prompted by the following orange warning message on the app home page, it is time to update the app



- Open the “ACORNdashboard” folder and double click “UpdateACORN.cmd”



- You can create a desktop shortcut for this as well. Follow the optional instructions in section 4.1.1.3 to create an “Update ACORN” shortcut.
- The update process just renews components of the “ACORNdashboard” folder so you can continue using the app immediately following the update.
- This update process is much faster (and a smaller download) than the first installation of the app.

4.1.3 Data security

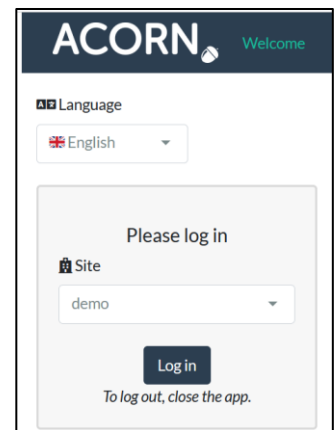
If you are using the online data tools provided you can be assured that they are in compliance with the General Data Protection Regulations (GDPR). If you choose to store your ACORN data locally this might not be the case. However, the .acorn file is fully anonymized meaning that it is not possible to identify a participant or site from the data.

Note: using the web version of the app to generate .acorn files requires upload of the non-anonymised lab data file to a remote server and this may not meet local site data security requirements. We recommend using the Windows app to generate .acorn files as the lab file does not leave the local computer this way.

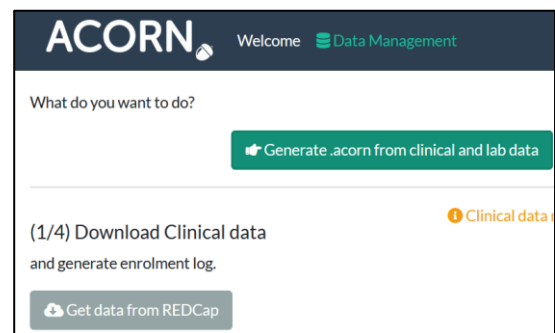
4.1.4 Creating the .acorn file

Make sure you have been assigned a unique username and password. This will have been set up by the ACORN IT team. If you don't have one or it doesn't work please contact ACORN admin (acorn@tropmedres.ac) or the ACORN IT team (ACORN IT Helpdesk TEAMS channel).

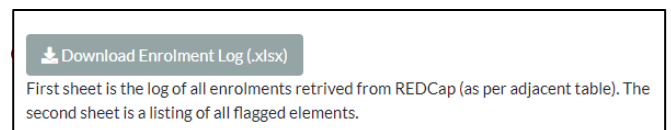
- Login using your username and password. You will be redirected to the "Data Management" tab.



- Click Generate .acorn file from clinical data tab.
- Then click Get data from REDCap.
- The clinical data will be retrieved from the ACORN REDCap database.

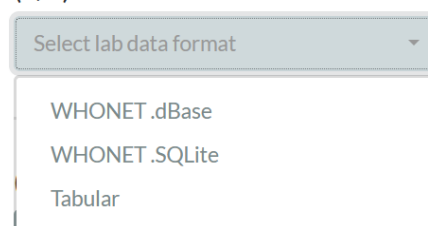


- At this stage it is possible to review any error messages and download an enrolment log, which summarises in an Excel file the clinical data (sheet 1) and any technical errors encountered (sheet 2).

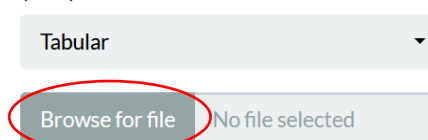


- Select the lab data format.
- Then select the microbiology laboratory datafile.

(2/4) Provide Lab data

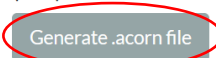


(2/4) Provide Lab data



- Click Generate .acorn file
- The .acorn file will be created
- Then save the .acorn file either locally or on the server.

(3/4) Combine Clinical and Lab data



(4/4) Save .acorn file

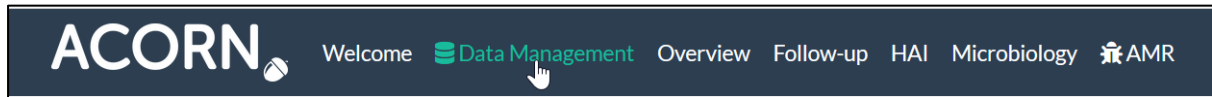
Local ☒ Server ☐



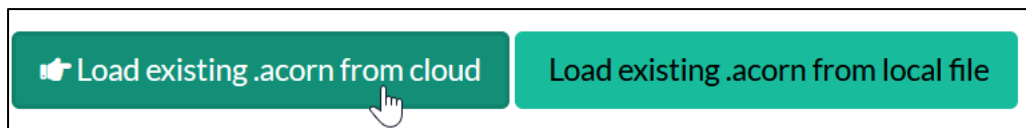
5 Data visualisation and reporting using the ACORN App

Upload the .acorn file to the dashboard via the ACORN app (same as used to generate .acorn file in the previous section). You can load an existing .acorn file from cloud or local storage.

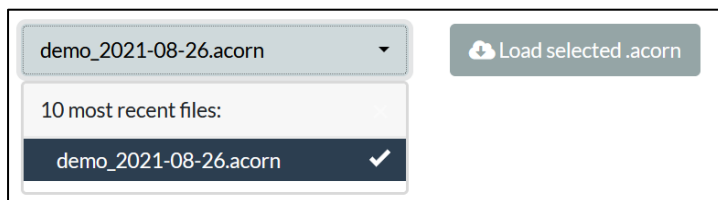
Go back to the Data Management Section in the ACORN app. (Note that you can also access this section directly when opening the app).



Choose either “Load existing .acorn file from cloud” or “Load existing .acorn from local file”.



Select the .acorn file and click load or upload a local .acorn file. The file will be loaded in the dashboard and the data displayed.



- Once the data is loaded it can be interacted with in multiple ways
- The broad categories are shown in the top menu



- There are many drop box menus, sliders, check boxes, and other data options to help manipulate the data visualization.
- Charts and data can be downloaded individually to aid in reporting or for further data use.
- The dashboard will automatically update every time a new .acorn file is uploaded and every time a new option is selected.



6 Backup and access to .acorn data files

If you are using the online data tools provided and storing and uploading the .acorn files to the cloud they will automatically be backed up. This is the default save location and is preferred for data security and ease of access from the ACORN app / dashboard.

ACORN uses AWS (Amazon Web Service) to securely backup .acorn files that the user chooses to add to the server, and all files are kept for the duration of the project.

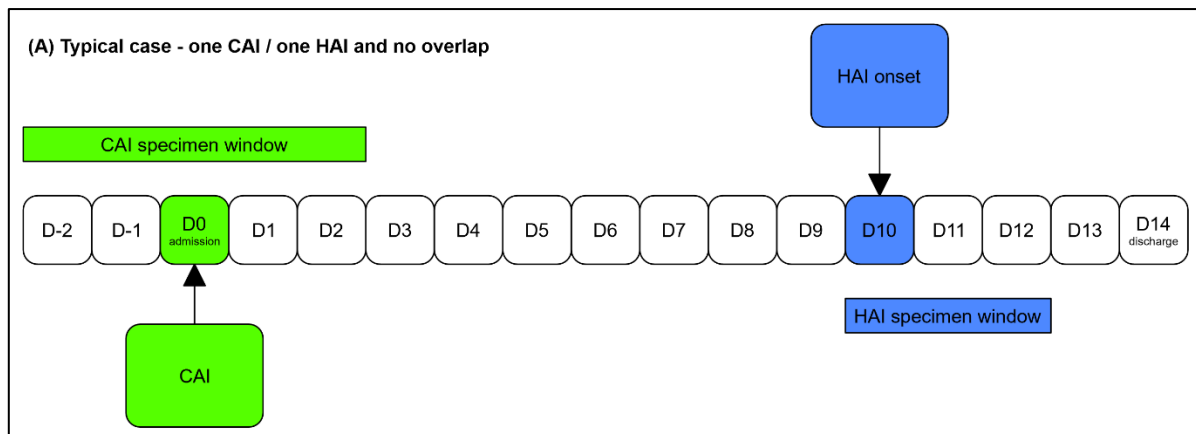
Sites will always retain access to all their ACORN data and can retrieve it at any time.

Contact the ACORN data manager (acorn@tropmedres.ac) or the ACORN IT team (ACORN IT Helpdesk TEAMS channel) if you require access to your site's AWS back-ups for further instructions and guidance.

7 Laboratory data file types and structure

In order to link with clinical data, local laboratory data is processed by the ACORN app into a standard format. The app will filter the provided text file (exported from a LIMS or other laboratory database) or WHONET data file to keep only cultures from ACORN participants. Local laboratory codes are mapped to ACORN codes as described below. To be compatible with the ACORN app, laboratory data files need to meet the following specifications:

- Data in wide format: one culture / isolate per row with antimicrobial susceptibility test (AST) results on the same row:
 - A WHONET file is completely compatible: either old (dBase) or new (SQLite) format.
 - A text file (csv or txt) or Excel (xls orxlsx) will also be compatible.
- Include a specimen number and a patient identification number:
 - The patient identification number MUST be the same as captured in the ACORN clinical CRF (either the local hospital ID or the ACORN ID).
 - Automated linkage between clinical and laboratory data is done by patient identifier, hospital admission date (for CAI) or symptom onset date (HAI), and specimen date – the linkage windows are shown in the diagram below.



- Include all culture data, even no growth and non-target organisms (including contaminants if possible).
- The data file should include cultures for all patients during the surveillance period and including any ward / clinical area that cultures could have been done on a patient admitted to a surveillance ward:
 - As noted above, the ACORN app will filter out and discard any data on patients not included in the ACORN clinical data, so the laboratory data file does not need to be pre-filtered before processing.
- Note that whilst raw antimicrobial susceptibility testing (AST) data are preferred (i.e. zone diameters in mm and/or MIC values), the app can process categorical "S", "I", "R" data or a mixture of the two.
- The names and ordering of columns in the lab data file does not matter, but it should be consistent throughout the project.

An example of an appropriately formatted laboratory datafile is shown here:

patid	specid	specdate	specty	orgnum	org.local	blac	ind.cli	cpm	esbl	mrsa	vre	AMC_NM	AMP_NM	ATM_NM	AZM_NE
2020-44585548	BC20-78085	12-Oct-20	BC	1	No growth at 5 days										
2020-78950180	BC20-12809	12-Oct-20	BC	1	Staphylococcus aureus (MRSA)		NEGATIVE								
2018-79584328	BC20-28451	16-Oct-20	BC	1	Escherichia coli				NEGATIVE			4	32	1	
2018-79584328	BC20-28451	16-Oct-20	BC	2	Staphylococcus haemolyticus										
2020-99886747	OMS20-53459	06-Apr-20	UR	1	Mixed growth of >2 organisms										

Specimen details

Organism ID

Misc results

AST results

The image shows three specimens, for clarity each specimen is highlighted in a different colour:

- A blood culture (spectype = BC) yielding no growth [blue]
- A blood culture with a pure growth of *Staphylococcus aureus* [white]
- A blood culture with growth of *Escherichia coli* and *S. haemolyticus* [orange]
- A urine culture (spectype = UR) with a mixed growth [green]

A single result is present on each row, with the organism ID and AST tests recorded according to the column headings.

8 Laboratory data dictionary set up

Each ACORN surveillance site must complete a laboratory data dictionary to ensure that local laboratory data can be linked successfully to clinical data (as described in section 4). The data dictionary is a codebook, used to map local laboratory variables, test result text, specimen types, and organism names to the standard ACORN format.

8.1 Purpose and Scope

To describe completion of the ACORN laboratory data dictionary.

8.2 Requirements

- Computer with Microsoft Excel (or appropriate third-party software capable of opening, editing, and saving Excel files).
- The ACORN laboratory data dictionary Excel file (download here: [ACORN2_data_dictionary.xlsx](#)).
- A microbiology laboratory datafile: either an export from the hospital microbiology laboratory information management system (text, csv, or Excel file) or a WHONET software file.

8.3 Procedure

The Excel file is completed once at the start of ACORN surveillance, during the laboratory assessment, and updated only if the laboratory data export is changed in any way.

- The completed file should be emailed to acorn@tropmedres.ac.
 - The file will be stored in the site AWS bucket and accessed automatically by the ACORN app.
- Do not rename the file or change the file extension (.xlsx).

The Excel sheet contains several tabs, select each one to complete variable mapping. Only cells with a white background can be edited.

8.3.1 variables

This tab maps column names from the laboratory file into those required by ACORN: there are variables for the patient, specimen, organism, and AST variables.

Fill in the **local.code** column (column F) with the corresponding variable names from the laboratory data file. The must be specified **exactly** as they are written in the laboratory file (e.g. correct case, no extra spaces etc.).

- For AST codes, each antibiotic is specified three times for each of the major guidelines (CLSI and EUCAST): for a disk testing variable, an Etest variable, and a MIC variable (e.g. VITEK, Phoenix, or broth microdilution).
 - If more than one method is used in the laboratory (e.g. vancomycin is tested by both disk and Etest, depending on the organism), complete for all relevant methods.
 - If a single category result (susceptible [S], intermediate [I], resistant [R]) is saved for an antibiotic regardless of the methodology, then enter this variable name in the appropriate "disk test" row (e.g. for vancomycin / CLSI, this would be "VAN_ND30").
- If a variable is not in use, leave it blank.

Notes:

- If using ACORN LIMS, then the variable names will be the same as the **acorn.code** (row B): the appropriate codes can be copied from row B to row F (**local.code**).
- If using WHONET, by default the variable names will be the same as the **whonet.code** (row C): the appropriate codes can be copied from row B to row F (**local.code**).

8.3.2 test.results

- For each of the tests listed (in **test** [column B]), enter the laboratory code for "Positive" and "Negative" results in **local.result.code** (column D).

- E.g. if the laboratory codes ESBL results as “+” (positive) or “-” (negative), enter “+” in cell D8 and “-” in cell D9.
- If a variable / test is not in use, leave it blank.

8.3.3 spec.types

- For each of the specimen types listed, enter the local laboratory terminology in the appropriate cell(s). These should be the terms that appear in the “Specimen type” (ACORN code: **spectype.local**) column of the data file [row 6 of the **variables** tab].
 - Include all possible variants in use, e.g. for urine “Midstream urine”, “Catheter urine”, etc.
- If a variable / specimen type is not in use, leave it blank.

8.3.4 organisms

- For each of the organisms listed, enter the local laboratory terminology in the appropriate cell(s). These should be the terms that appear in the “Organism name” (ACORN code: **org.local**) column of the data file [row 9 of the **variables** tab].
 - E.g. if the laboratory records *Escherichia coli* as “E. coli”, enter “E. coli” into cell C3.
- Do the same for the terms used for “No growth”, “No growth (specific organism)”, “No significant growth”, and “Mixed growth”.
 - Include all possible variants in use, e.g. “No growth”, “No growth at 48 hours”, “No growth at 7 days”.
 - For “No growth (specific organism)”, the intention is to capture coding for any pathogen directed cultures that can either be a final result for an entire specimen or an additional result, e.g. “No growth of Group B Streptococcus”, “No growth of Salmonella or Shigella”, “No growth of Burkholderia pseudomallei”.
- Do the same for terms used if a specimen is not cultured (“Not cultured”).
 - Include all possible variants in use, e.g. “Not cultured”, “Not processed”.

If a variable / organism/ culture result is not in use, leave it blank.

8.3.5 notes

- Record the version (1 if the first time this is completed), date of completion, site code (provided by the central ACORN team) and expected lab file type (either a WHONET file “whonet” or a tabular text file “tabular”).

9 Update history

Version	Date	Summary of changes
1.0	9 th September 2021	Document created
2.0	22 nd October 2021	Added section on resolving REDCap data queries Updated AWS backup section
2.1	24 th February 2022	Updated section on ODK data entry
2.2	21 st March 2022	Added sections on app update and app data error log
2.3	12 th Oct 2022	Updated installation, running and updating of ACORN stand-alone local app