



User manual

Arogya Sahyog

Clinical Decision Support System (CDSS)

Design and development of a clinical decision support system for community health workers to support early detection and management of non-communicable disease



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Background of the user manual

This project will help to identify whether Arogya Sahyog (A Hindi term meaning ‘Health Assistant’), a clinical decision support system (CDSS) based on a tablet device, can be used to screen and manage major non-communicable diseases (e.g., diseases not caused by infections). This user manual will guide you on how to operate the CDSS to screen people with NCDs. Later, we will teach you to deliver a lifestyle modification intervention to manage people with hypertension and with co-morbidities (pre-diabetes, diabetes, anaemia, hyperlipidaemia). In this manual, the term patient and participant are used interchangeably to refer the people who will be assessed for hypertension.

Concept of Arogya Sahyog designed to be used by ASHA

We have developed an initial version of a CDSS named ‘Arogya Sahyog’, and the app is programmed to an android operating system. Depending on the human-computer interaction, this Arogya Sahyog app can be used to undertake various functions in the process of decision-making (i.e., reminder, advisor, critic, or pilot as outlined below).

This application will integrate the four main features of a CDSS system:

- **Reminder:** CDSS will provide information and visualise relevant patient information according to traffic light colour (red, yellow, green), where red means urgent attention; yellow means the value of a test is outside the normal range; and green means the value is within the normal range.
- **Advisor:** CDSS will provide ASHAs with specific instructions for dealing with age- and sex-specific preventive measures. It will also help in the identification of emergency cases so that urgent referral can be initiated.
- **Critic:** It will provide specific instructions about what actions to take for the people whose blood pressure and blood glucose measurements are not controlled.
- **Guide:** It will act as an educational platform by providing intervention-specific information. For example, in the case of diabetes or high lipids in the blood, management-specific information will appear in the tablet and guide the provider regarding what health education should be delivered.

This CDSS will support you through a step by step process of assessment, classification, counselling, and referral of eligible clients according to standard guidelines. This CDSS will encourage you to provide health education in adherence to the instructions.

This CDSS has been integrated with the following screening tools:

- *Community-Based Assessment Checklist (CBAC):*

We use the CBAC for the early detection of hypertension and diabetes. A score above 4 indicates that the person may be at risk of developing NCDs, and should be prioritised for attending the weekly NCD day in the nearest sub-centre for further diagnosis and management.

- *Standardised clinical and laboratory assessments:*

We use standardised clinical or laboratory evaluation to identify people with hypertension, with or without diabetes.

- *Use of existing validated questionnaire-based assessments:*

We use an existing validated questionnaire to assess socio-demographic and lifestyle factors, quality of life, utilisation of health services, barriers to diagnosis and management, and knowledge of diabetes and its consequences.

Controls used in Arogya Sahyog application

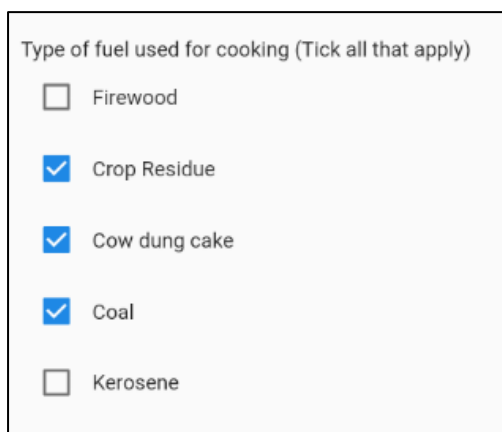
In the Arogya Sahyog, some input controls are used for data collection. You need to know about these input controls to be able to operate the functions in the app. These are described below:

Check-Box:

This control tool highlights the rectangle when checked. Therefore, if you select the box, a tick sign will appear in the box; otherwise, it will remain empty by default (Figure 1). If you change your mind and want to remove the tick, you need to touch the check-box again.

The check-box has the following features:

- Allows you to capture multiple responses
- Specifies the text which is displayed next to it (typically to the right of Check-Box)



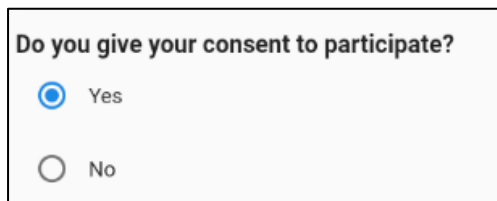
Type of fuel used for cooking (Tick all that apply)

- ☐ Firewood
- ☒ Crop Residue
- ☒ Cow dung cake
- ☒ Coal
- ☐ Kerosene

Figure 1: Example of check-box used in the app

Radio Button:

An element of the graphical user interface which allows you to select a single item from a predefined list of options (Figure 2). To select an answer, you have to touch the circle that appears on the left side of the answer.



Do you give your consent to participate?

☒ Yes

☐ No

Figure 2: Example of a radio button used in the app

Drop Down Menu/ List:

If you touch the Drop-Down icon, a list will be available from where you can select the answer/response. However, you would only be able to select the best option (Figure 3)

A drop-down menu has the following features:

- Provides multiple choice from a list of mutually exclusive values
- Contains choices that are limited according to the list



Do you have health insurance?

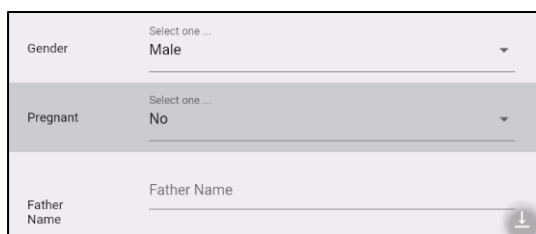
Yes

No

Figure 3: Example of a drop-down menu used in the app

Internal Validation:

You will find that some of the options, shown in grey, are not working (Figure 4). Do not worry about that. This CDSS was built in such a way that it can decide which options apply to a patient. It follows some internal validation, an algorithm to make the decision, in this regard. For example, if the gender of a participant is male, the app will not let you ask about his pregnancy status.



Gender Select one ... Male

Pregnant Select one ... No

Father Name Father Name

Figure 4: Example of internal validation used in the app

Text Box:

A text box appears in an on-screen rectangular frame that allows you to type text or values. To type anything, you need to click the Text Box; then, a keyboard will appear. In the console, the numeric values are located at the top, and the alphabetic values below this (Figure 5). You can type your information using this app keyboard. Finally, click the 'Done' button to save the details in the Text box.

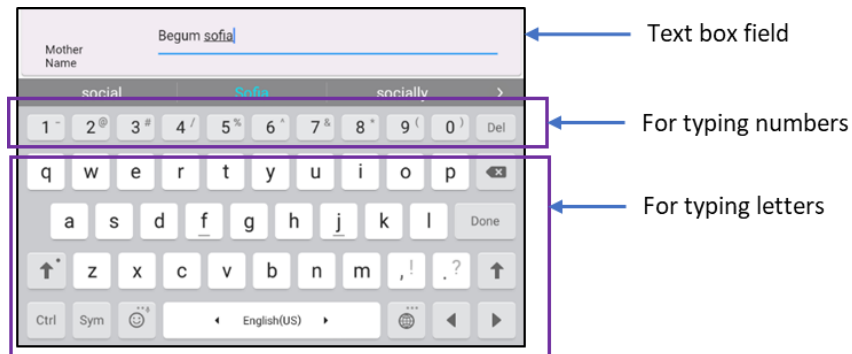


Figure 5: Inbuilt keyboard

Sometimes, instead of a keyboard appearing, you will find that a keypad has popped up. This keypad enables you to input data using the numeric keypad. For example, if you need to write a phone number, you need to use the number keypad (Figure 6). Finally, click the 'Done' button to save the numbers into the text box.

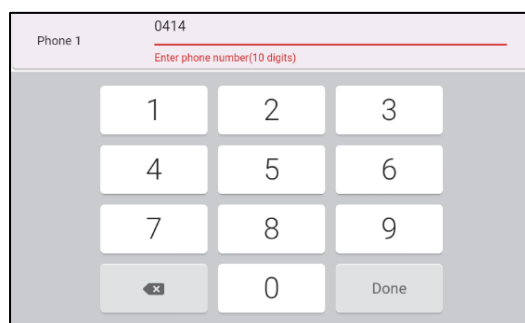


Figure 6: Inbuilt number keypad

Time Field:

After clicking the clock icon, a clock will appear in a 24 Hours and minute (HH: MM) format. You need to click on the Hour button to set the time. Then, you have to change the dial of the clock to set the time. After selecting the hour button, you need to click the minute button. Finally, click the 'OK' button to set the time into the Time field (Figure 7).

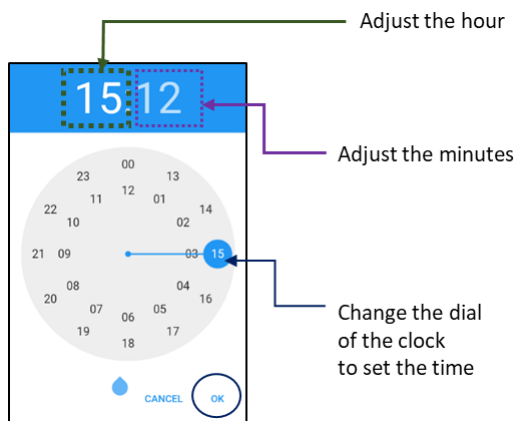


Figure 7: Inbuilt clock in the app

Date Field:

After clicking the date field icon, an inbuilt calendar will appear. You need to select a month, and year from the upper part of calendar (arrow marks) You also need to change the date using a circle (Figure 8). The upper section of the window shows the selected date.

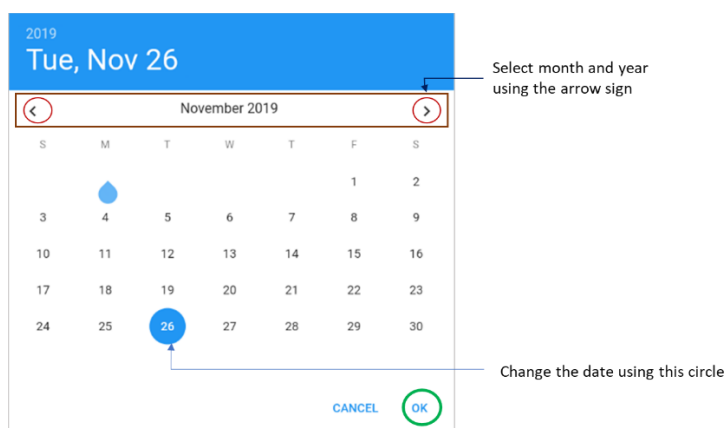


Figure 8: Inbuilt calendar in the app

When you are sure that you have entered the correct date, you need to click the OK button. By clicking the OK button, it will set the time in the app.

Registration of ASHAs

We have installed the Arogya Sahyog app on to some tablets. First, you need to find the location where the Arogya Sahyog app has been installed. There are two locations where it can be accessed. Usually, the shortcut of the app is visible in the 'primary app' on the home screen. You need to find the Arogya Sahyog icon and click on it. If the Arogya Sahyog is not found on the home screen, you have to click on the 'Apps' image to open a new page (Figure 9). On this new page, you will discover the Arogya Sahyog icon along with other installed apps.



Figure 9: Left screen shows the location of the Arogya Sahyog app on the home screen, and the right screen shows its position within the apps

After you click on the Arogya Sahyog app, a login page will open. You will be asked to enter your username and password. If you are a first-time user, you need a username and password to use the app. To do so, click on the 'Register' button (Figure 10a) of the app.

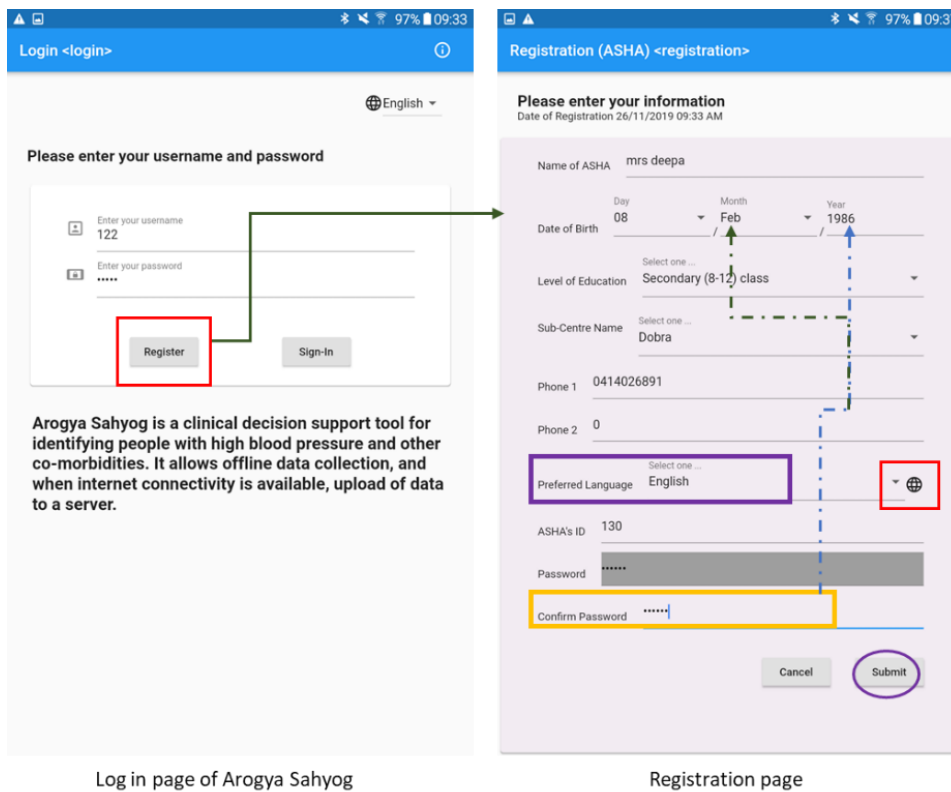


Figure 10a: Screens show the login page and registration page of Arogya Sahyog

You will find a screen where you need to enter your information for completing the registration. Firstly, you need to write your name in 'Name of the ASHA' space. To do so, you need to click the name field, and an in-built keyboard will appear on the screen (Figure 10b).

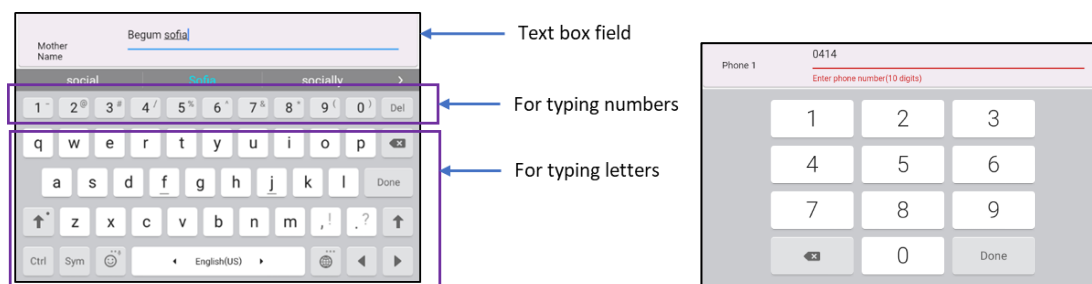


Figure 10b: In-app keyboard and keypad to write number and text in the text box field

Then, you need to enter your date of birth (DOB). Please select 'Day' and 'Month' of your DOB from the drop-down menu. To write the year of DOB, you need to tap on the 'Year' button. A numeric keypad will appear. You need to input the year using the keypad. It is also applicable to use the keypad to type the number in 'Phone 1' and 'Phone 2' in the app field.

You also need to select a response on 'Level of education', 'Sub-centre Name', and 'Preferred Language' from the drop-down menu. You need to use the keyboard to type your assigned ID in the field of 'ASHAs ID'.

Now you need to set your password to create your user profile (Figure 10). The app will automatically generate your six-digit password. The first two digits of the password will be the number of your 'Month' of birth, and the last four digits will be your 'Year' of birth. For example, if your date of birth is February 1986, the first two digits of your password will be 02, and the last four digits will be 1986 (therefore, the password will be 021986). Accordingly, you need to enter your six-digit password generated by the app in the 'Confirm Password' field. After that, you have to click the submit button. You will get a pop-up notification "Your profile has been created", and it will show your username and password again (Figure 11). Please write down your username and password in a book to save this information securely. Then you have to click Ok button.

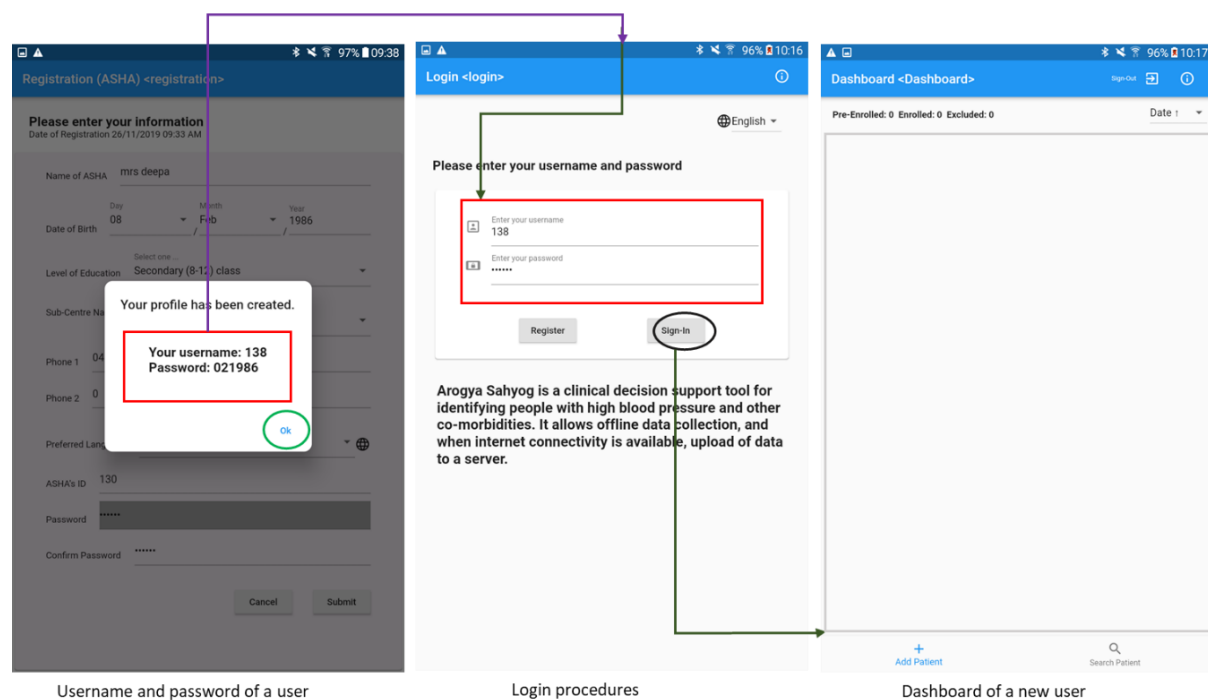


Figure 11: Screen shows the sign-in details and dashboard interphase

Then the login page will pop up. You need to enter your username and password and click 'sign in' to continue (Figure 11). A new page 'Dashboard' will open. Now your profile is ready to add/register a new participant.

Registration of a new participant

You need to follow some procedures to register a new participant.

- Click on the 'add patient' button at the bottom of the screen; a new screen will appear— select date and month of the birth of the participant from the drop-down menu
- Click on 'Year' to enter the date
- Use the number pad to type the appropriate numbers to enter the year of birth
- If a participant does not know the exact day and month of birth, select the checkbox "Don't know day and month of birth" button. It will automatically select '01' as day and 'Jul' as Month.
- After entering the year of birth, click on the 'Next' button (Figure 12)

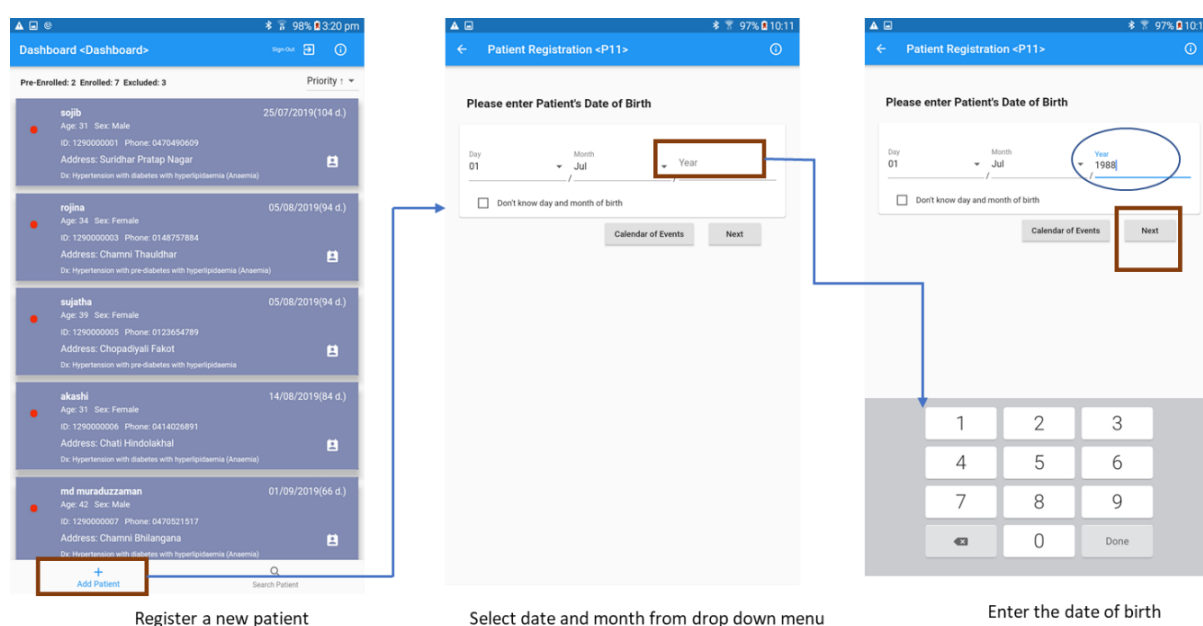


Figure 12: Registration of a new participant

- If a participant is at least 30 years, s/he will be eligible to participate in this screening. Use the paper-based consent form to obtain consent and to obtain a signature from the participant. Select 'Yes,' if the participant gives permission to participate and then click 'Submit.'
- A new registration page will open. You need to type the name, short name, father name, mother name of the participant each of the text fields (Figure 13).
- Please select the appropriate response from the drop-down menu for 'Gender', and 'Pregnant'. Enter your details such as 'Phone 1', 'Phone 2', 'Aadhar card', '12-digit unique identification (UID) number', and 'Voter ID' in the number field.

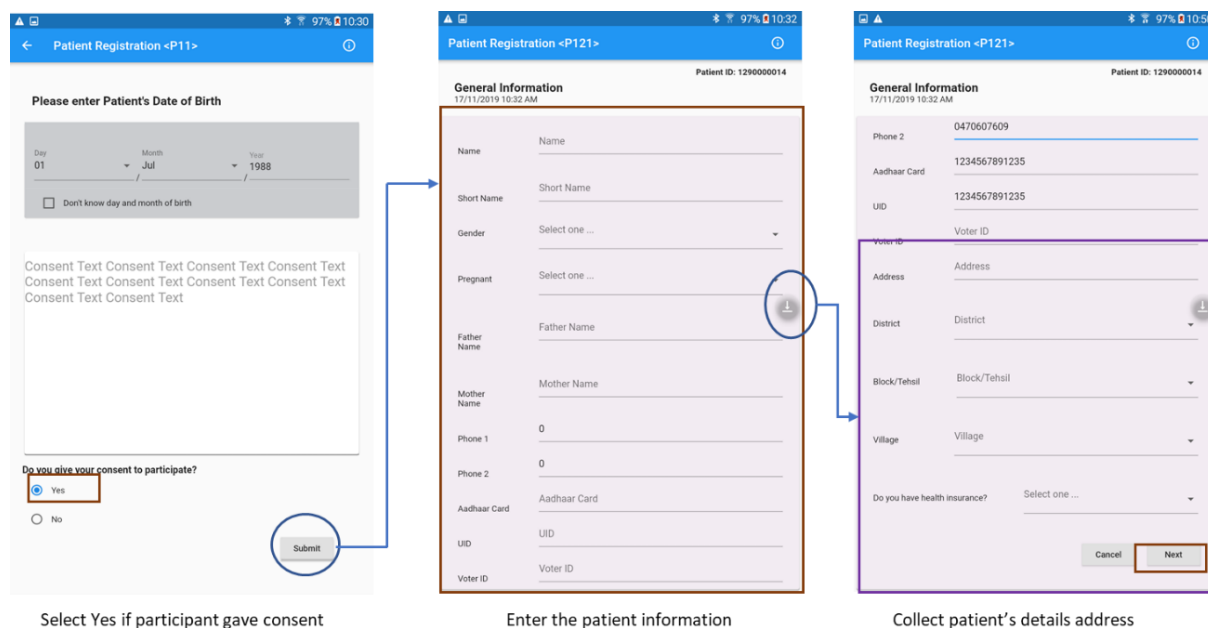


Figure 13: General information required for registering a participant

- Afterwards, click the down arrow button (place in the right middle) to view the rest of the page. Enter the address in detail and select the district, block/tehsil, village, and health insurance status from the drop-down menu. Then, select the 'Next' button to complete the patient registration.
- A window will appear as 'Please confirm the information'. If you are happy with the information you provided, click the submit button (Figure 14).
- If you want to make some changes, click on the 'Edit' button. The CDSS will allow you to edit information. If you don't need to change anything, you should click the 'Next' button. Then, you will find the 'Submit' button; and click on it. The dashboard will appear.

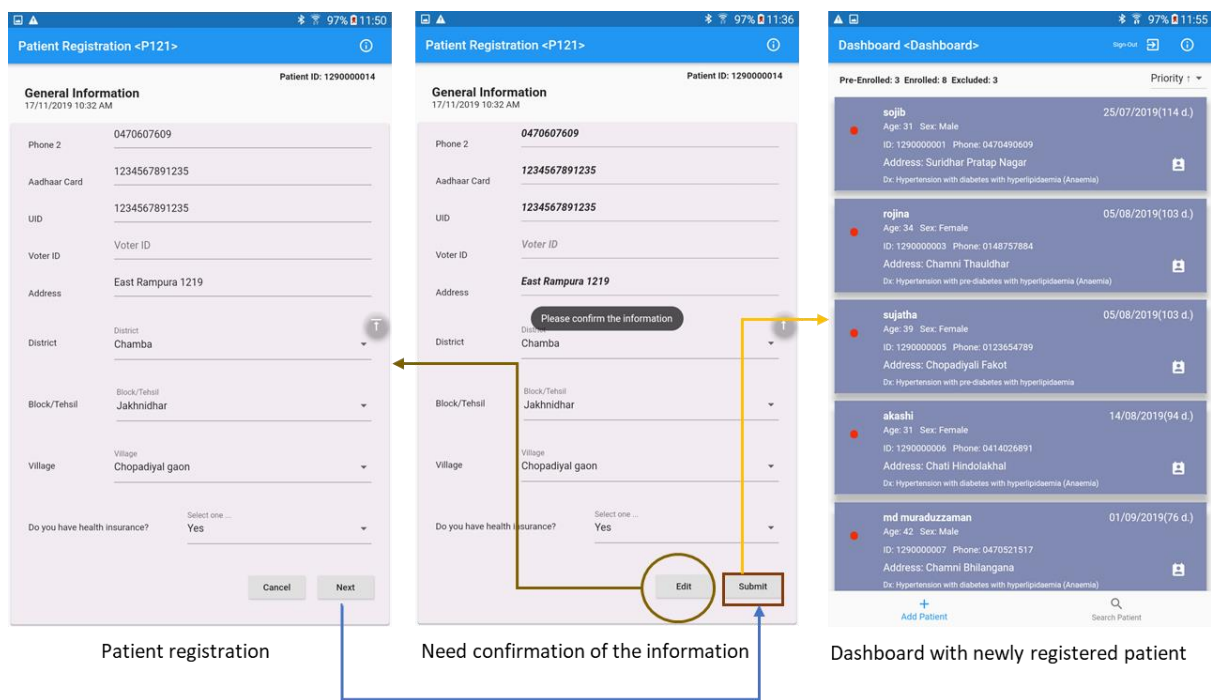
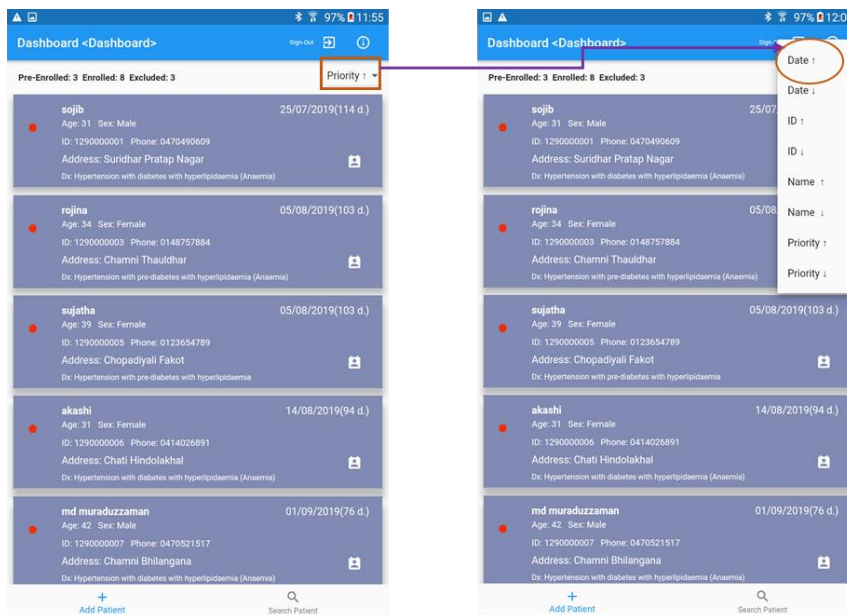


Figure 14: Successful patient registration

- Usually, the participant's name will appear at the top of the screen. Often, when you register many participants, the name of newly registered participants will go down the list. If you cannot find the name of the participants that you have registered, you will need to change the sorting option (priority) according to date. Click on the drop-down list below to the information and sign-out button. You have to choose the **Date ↑** option to sort it (Figure 15a).

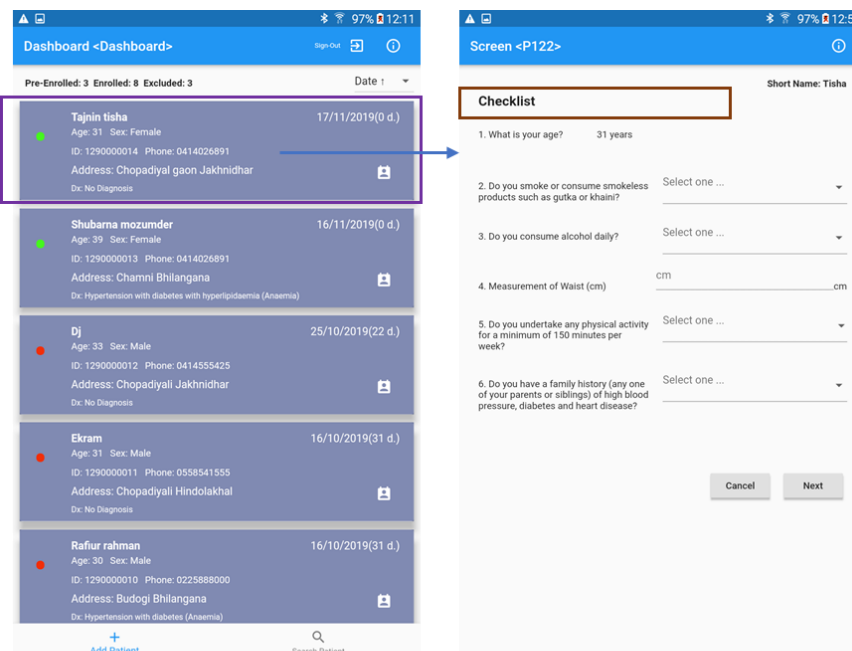


Select the drop down menu for sorting options

Select the option of latest date from drop down menu to get the newly registered patient

Figure 15a: Finding a newly registered participant

- After sorting according to a recent date, you will be able to see the newly registered patient.
- When you find the new patient that you registered, click on the patient box to continue the data collection (Figure 15b). Then a new page named 'Checklist' will appear.



Click on the patient box to go to the next page

Select the appropriate options from the drop down menu of each question

Figure 15b: Selecting a participant from the dashboard

Section 1A: Community based assessment checklist:

These questions are adopted from the community-based assessment checklist (CBAC) designed for you to collect information about participants who are aged at least 30 years.

- Select the appropriate option from the drop-down menu of each question. Then click next. If CBAC scores ≤ 4 , the app will show the total score.
- If the CBAC score is more than 4, an instruction 'Refer the patient to attend weekly NCD day' will appear in addition to the total score. This will be written in red (Figure 16).

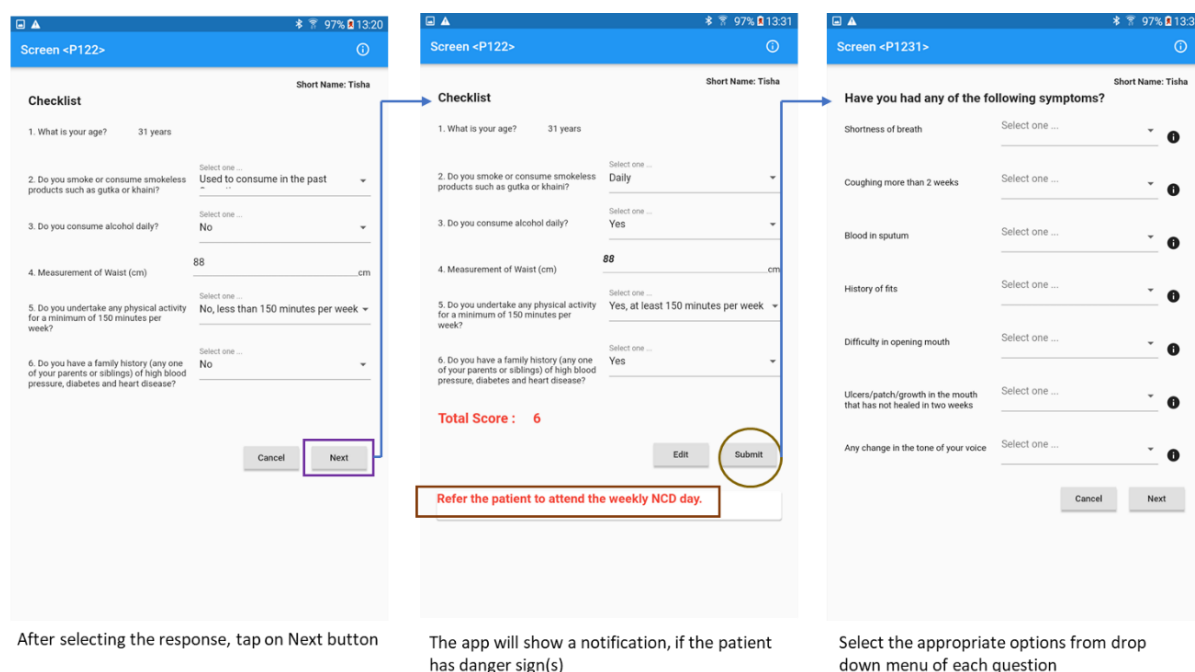


Figure 16: Details of the community-based assessment checklist

- After clicking on the 'submit' button, a series of questions will appear under the subject heading on, "have you had any of the following symptoms?" (Figure 17 & 18).

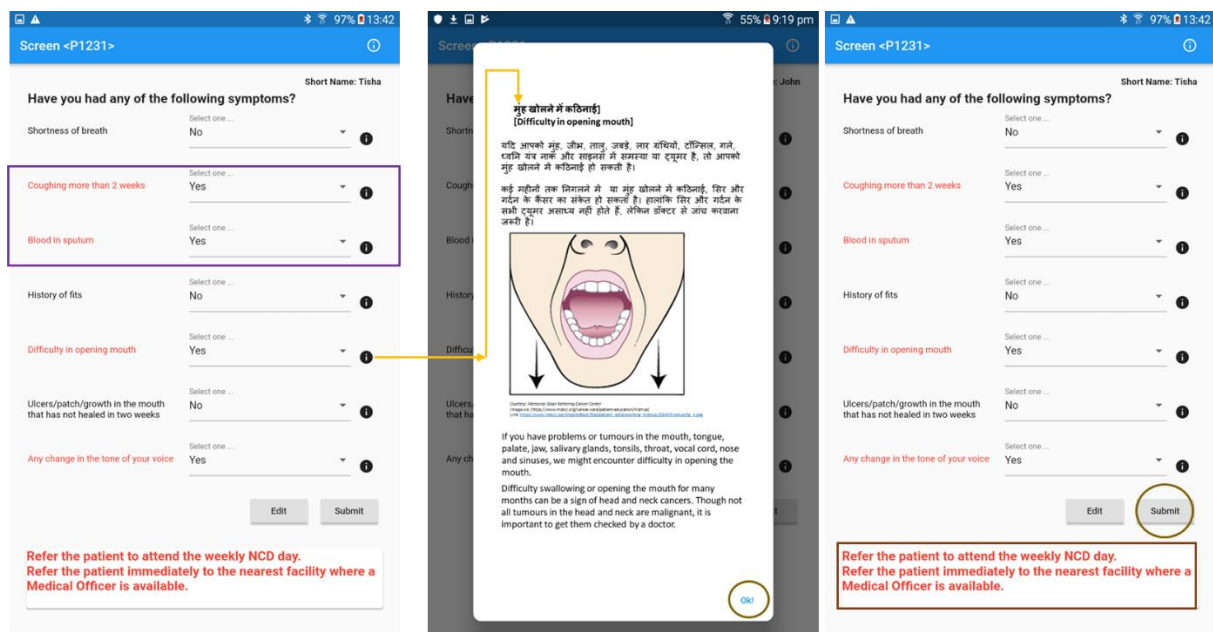


Figure 17: Screening of cancer-related symptoms

- You need to select either 'Yes' or 'No' as a response to these questions using the drop-down menu. If you choose any of these responses as 'Yes,' the item will turn red.
- If you do not understand any specific question, click on the information button next to that question. A window containing instructions will pop-up. You need to click the OK button to return in the question section.
- When you complete the responses of these questions, select the 'Next' button to proceed.
- Again, after you click on the submit button, another set of questions will appear.

Applicable for female participants

The next section is only appropriate if the current participant is female (Figure 18). These are the screening questions to detect breast and cervical cancer.

- You need to select either 'Yes' or 'No' response from the drop-down menu to complete these questions. Then click the 'Next' button to submit your responses

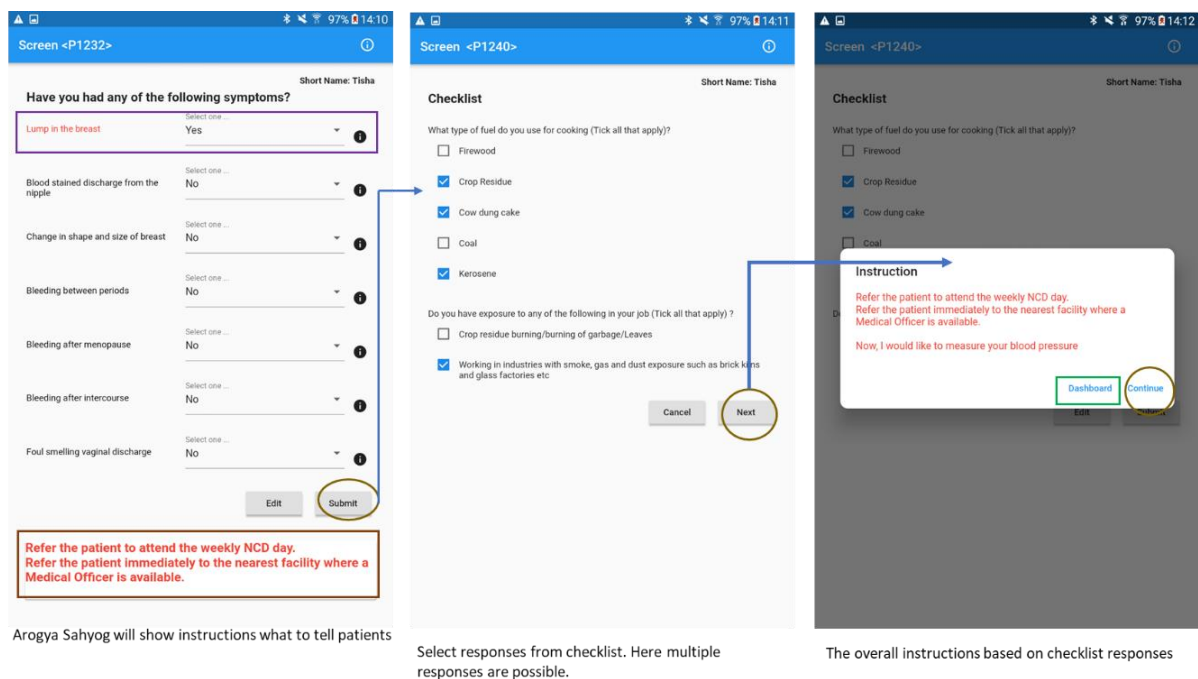


Figure 18: Screen showing the automated instruction, based on the risk of the participant

Applicable for all participants

- A checklist will appear to detect the cooking practices of the participants. You need to select appropriate responses. You will be able to choose multiple answers from the list according to the practices of the participant. Then, you should choose the 'Next' button to continue and then 'Submit'
- Arogya Sahyog will compute the results based on the responses provided and will show the instructions in a pop-up window. The CDSS will let you know what information you need to tell participants. You need to click on 'Continue' to get the next section. If you need a break for some time and want to continue the use of the app later, you can select the 'Dashboard' button to go back to the dashboard. Afterwards, you need to click on the participant's name in the dashboard to continue with his/her profile.

Section 1B: Measurement of blood pressure

The screen related to measurements of blood pressure (BP) will appear. You need to measure the blood pressure of the participants according to the instructions below:

- Measure BP three times for each participant and enter the values in the number field

- Select the Yes/No response for the follow-up questions on 'History of taking antihypertensive medications' from the participant (Figure 19a)

BP=Blood pressure

Average of systolic blood pressure (SBP) and diastolic blood pressure (DBP) will appear

Summary of blood pressure and next instruction

Figure 19a: Identification of high blood pressure

You need to write down the measurements of average BP in a register book. Based on the responses, the Arogya Sahyog will give you further instructions. If the BP of the participant is more than 140/90 mmHg or s/he has a positive history of taking antihypertensive medication, the participant will be selected for measuring her/his blood sugar.

However, if the participant does not fulfill the eligibility criteria, s/he will be excluded from the participant's list. The Arogya Sahyog will notify you of this in a pop-up screen.

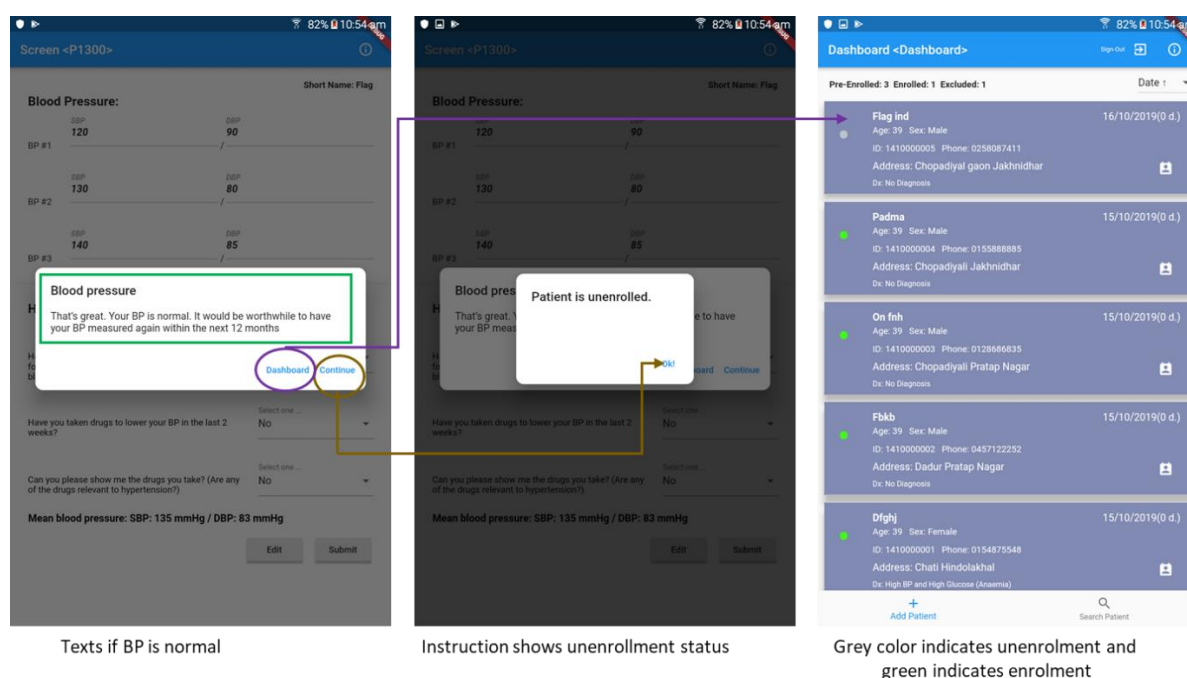


Figure 19b: Instructions for unenrolled participants

For participants with normal BP, you will get a notification that the patient is unenrolled. You need to provide the participants with some advice (see Figure 19b). Then, click the dashboard button. You will notice that unenrolled participants are marked with grey circle indicator on the dashboard.

Section 1C: Measurement of blood haemoglobin and blood glucose

You need to measure the blood haemoglobin, glycated haemoglobin (HbA1c), and blood glucose level of the participant. You will use point-of-care devices to measure the blood tests (Figure 20) and write them down in a register book.

Please follow the instructions below for participants with high BP:

- Input the value in the app after conducting these three tests in a row
- Tell the patient that you will measure blood pressure again after seven days

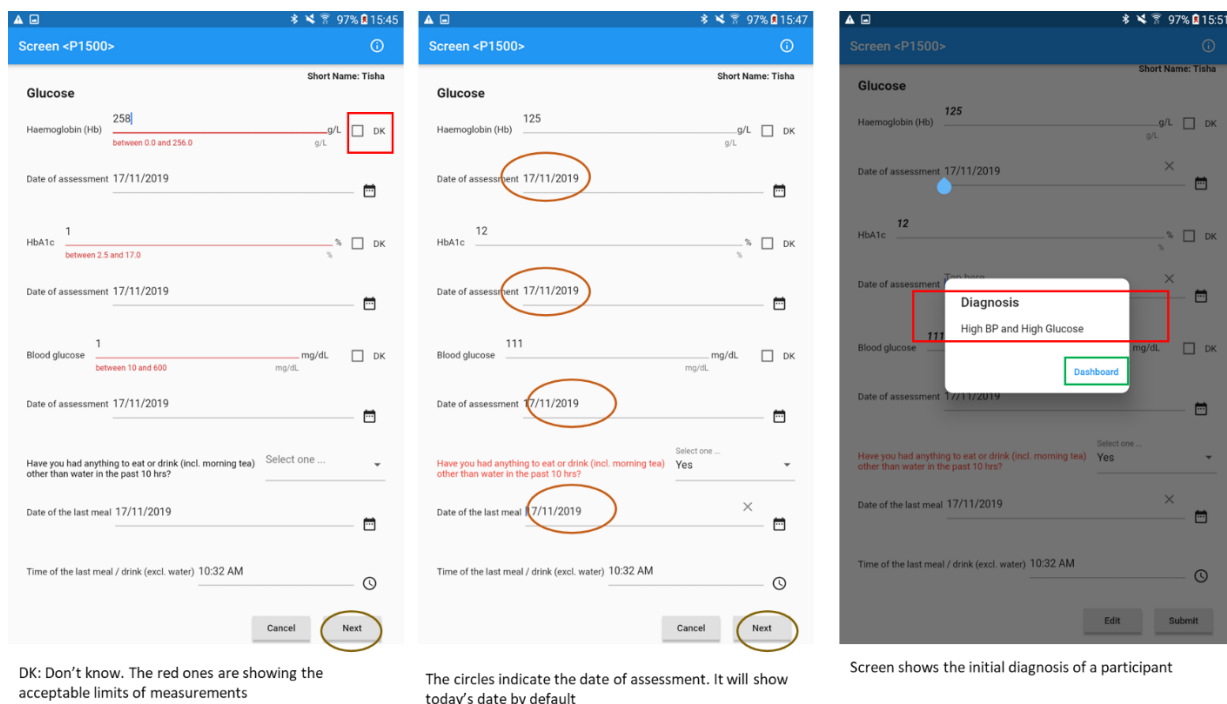
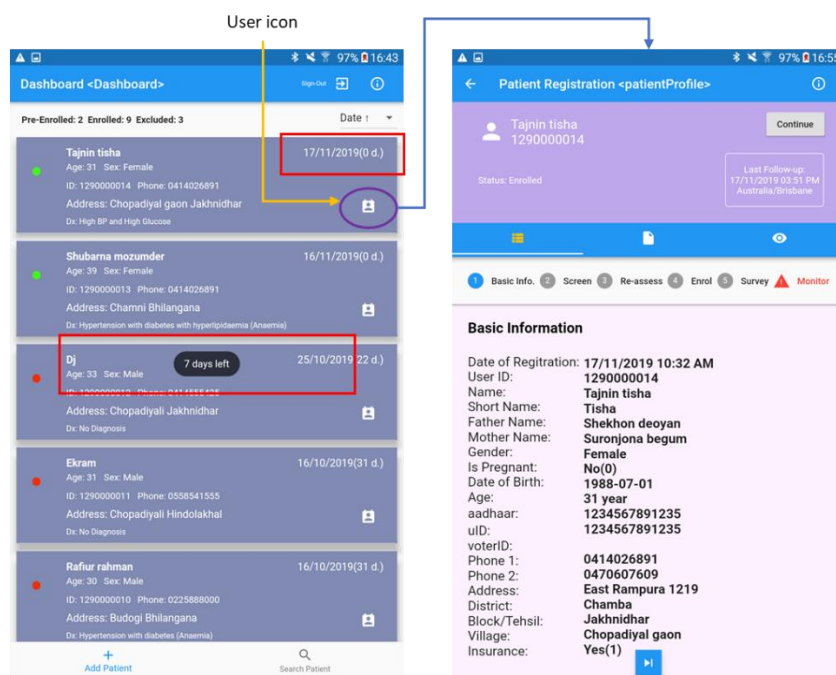


Figure 20: Recording of blood glucose, HbA1c, and blood haemoglobin

Section 2A: Confirmation of hypertension and enrollment of the patient

Certain time restrictions have been incorporated into the app to increase the likelihood of adherence to guidelines for hypertension. For example, you will not be able to enter the 2nd-day blood pressure measurement until seven days after the initial assessment of the participant (Figure 21). Hence, you will not be allowed to measure blood pressure on the same day.



The left sided screen shows how many days have passed (upper red box) since the first measurement. The lower red box shows how many days left before BP can be re-measured. The screen on the right shows the patient's profile

Figure 21: Access to the profile of a particular patient

Measurement of blood pressure on a 2nd occasion will enable you to determine whether the patient has hypertension. When you enter the information into the app, it will do all the calculations and instruct you on what health information you need to provide to each participant. You can also access his/her information from the 'Patient profile'. To do so, you need to click the 'User' icon (Figure 21) to get the details of the participant.

After seven days, the Arogya Sahyog will allow you to remeasure the blood pressure for the same participant. Again, you need to measure blood pressure three times using the digital blood pressure machine. Immediately after doing the measurements, you need to input the value to the register book and text field in the app. Then, Arogya Sahyog will calculate the blood pressure values and history of medication to let you know about the enrollment status of the participants. When a participant is hypertensive, the app will tell you that the participant is enrolled (Figure 22).

Reassess <P2000> Short Name: Tisha

Blood Pressure:

BP #1 SBP: 140 DBP: 90 mmHg

BP #2 SBP: 142 DBP: 152 mmHg

BP #3 SBP: 140 DBP: 80 mmHg

History of taking anti hypertensive medications

Have you ever been prescribed (chit) any medications for high blood pressure? (consider only drugs for high blood pressure) Select one ... No

Have you taken drugs to lower your BP in the last 2 weeks? Select one ... No

Can you please show me the drugs you take? (Are any of the drugs relevant to hypertension?) Select one ... No

Cancel Next

Re-measurement of the blood pressure

Reassess <P2000> Short Name: Tisha

Blood Pressure:

BP #1 SBP: 140 DBP: 90 mmHg

BP #2 SBP: 145 DBP: 150 mmHg

BP #3 SBP: 140 DBP: 80 mmHg

History of taking anti hypertensive medications

Have you ever been prescribed (chit) any medications for high blood pressure? (consider only drugs for high blood pressure) Select one ... No

Have you taken drugs to lower your BP in the last 2 weeks? Select one ... No

Can you please show me the drugs you take? (Are any of the drugs relevant to hypertension?) Select one ... No

Mean blood pressure: SBP: 143 mmHg / DBP: 115 mmHg

Edit Submit

Patient is enrolled to participate in this project

Figure 22: The CDSS shows a diagnosis of hypertension

Section 2B: Confirmation of diabetes

When the participant is enrolled, you need to conduct blood tests. If previously, the patient showed a high blood sugar level, then the app will let you know to measure the blood sugar again to confirm diabetes. This procedure is almost identical to the previous one (Figure 23).

If you fail to do a test on that day or you find that one of the point-of-care devices is not working, you can leave that field vacant and do the test on the following day. However, you need to mark the 'DK' box to do so. When you have done the tests, you can enter the value into the number field, but you need to uncheck the box and change the date accordingly (Figure 23).

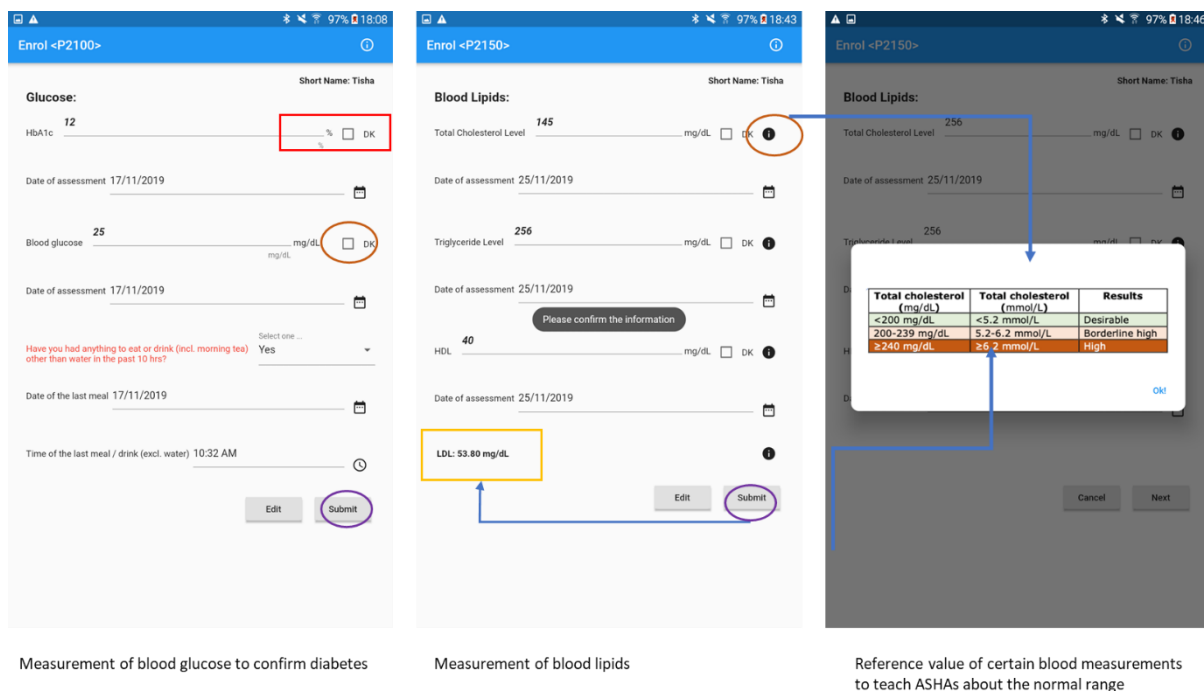


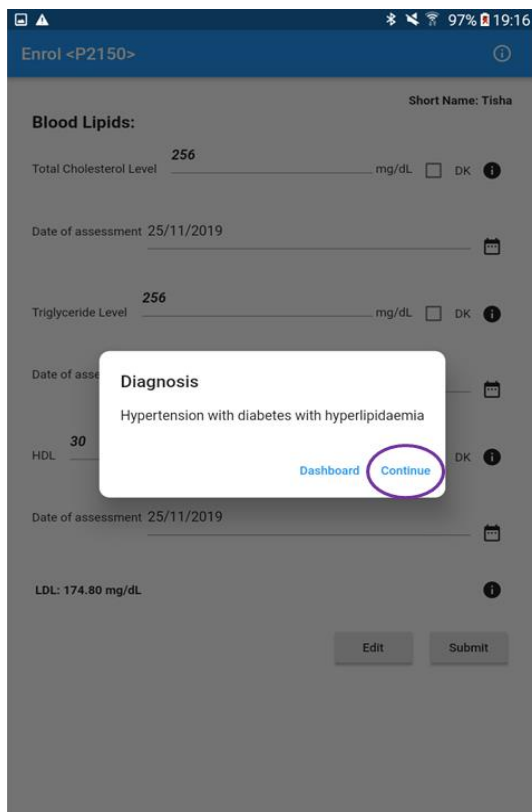
Figure 23: Measurements of blood glucose and blood lipids

Section 2C: Measurement of blood lipids

After clicking the submit button, you will be directed to a new page for lipids in blood:

- Measure the blood lipids using a point-of-care device and write down the values of tests in the register book
- Arogya Sahyog will show you the standard and high limit levels (risk) of blood lipids
- Click the information button for which lipid level you want to know. When you click the icon, a pop-up window will appear and show you the reference value
- Click on the 'DK' box, if you want to leave the field vacant and do the test on the following day

Finally, after computing the blood pressure, blood tests, and history, the Arogya Sahyog will let you know the patient's final diagnosis in a pop-up window (Figure 24).



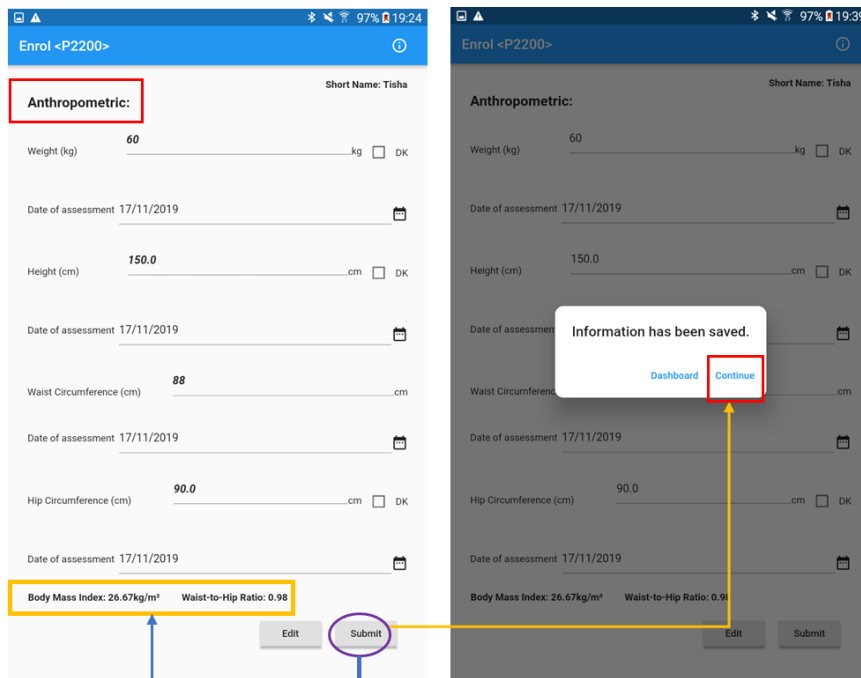
Arogya Sahyog shows the diagnosis of a participant

Figure 24: The CDSS shows the final diagnosis

Section 2C: Anthropometric measurement

The next step is to take a variety of anthropometric measurements (Figure 25). You need to follow the standard procedures to measure the weight, height, waist circumference, and hip circumference.

- You need to measure the weight and height of the participant. Then you need to record the value in the register book.
- You also need to measure the hip circumference of the patient following standard procedures. You need to record these measured values in the register book.
- Afterwards, you need to fill this information in the app. The Arogya Sahyog will automatically calculate the body mass index (BMI) and waist-to-height ratio for your participant (the details of BMI and waist to height ratio are been described later)



Body Mass Index (BMI) and Waist-to-Hip Ratio will be calculated automatically

Confirmation of the right way of saving details

Figure 25: The CDSS shows the automatic calculation of BMI and waist to hip ratio

- You need to click on the 'submit' button. At this stage, you will get a pop-up message showing that "information has been saved".
- You will need to click on the Dashboard button to continue data collection

Afterwards, a new screen 'Demographic' will appear. You have to select the drop-down menu, enter the numbers in the text field and click on the checkbox to collect appropriate responses from the participant (Figure 26).

Demographic: Short Name: Shubarna

1. Particulars and demographics of the patient

01. What is your religion?
Select one ... Hindu

02. What is your caste?
Select one ... General Caste

03. What is your marital status?
Select one ... Married

04. What is the highest level of education you have completed?
Select one ... Class 12 completed

05. In total, how many years have you spent at school and in full-time study (excluding pre-school)?
Year/s 10

06. Do you have a ration card?
Select one ... Yes

Green boxes indicate the drop down menu and the violet box indicates the text field (left screen); dummy entries of these fields (right screen)

Figure 26: The screen shows the demographic information

This demographic section consists of sub-sections such as particulars and demographics of the patient; health-seeking behaviour; health condition; diet; salt intake; tobacco use; alcohol exposure; household cooking habit; and physical activity. After entering all the details, you need to click the Next button. Usually, the next screen on 'Sanitation' should appear (Figure 27).

However, if you miss entering any required information of this section, the CDSS will give you a message in pop-up window as 'Please enter all required information!'. Then you need to click the ok button. Afterwards, you will need to search the missing text. Usually, the missing fields are marked in red. You need to fill in the required information and click the next and submit button again to proceed the next section 'Sanitation' (Figure 27).

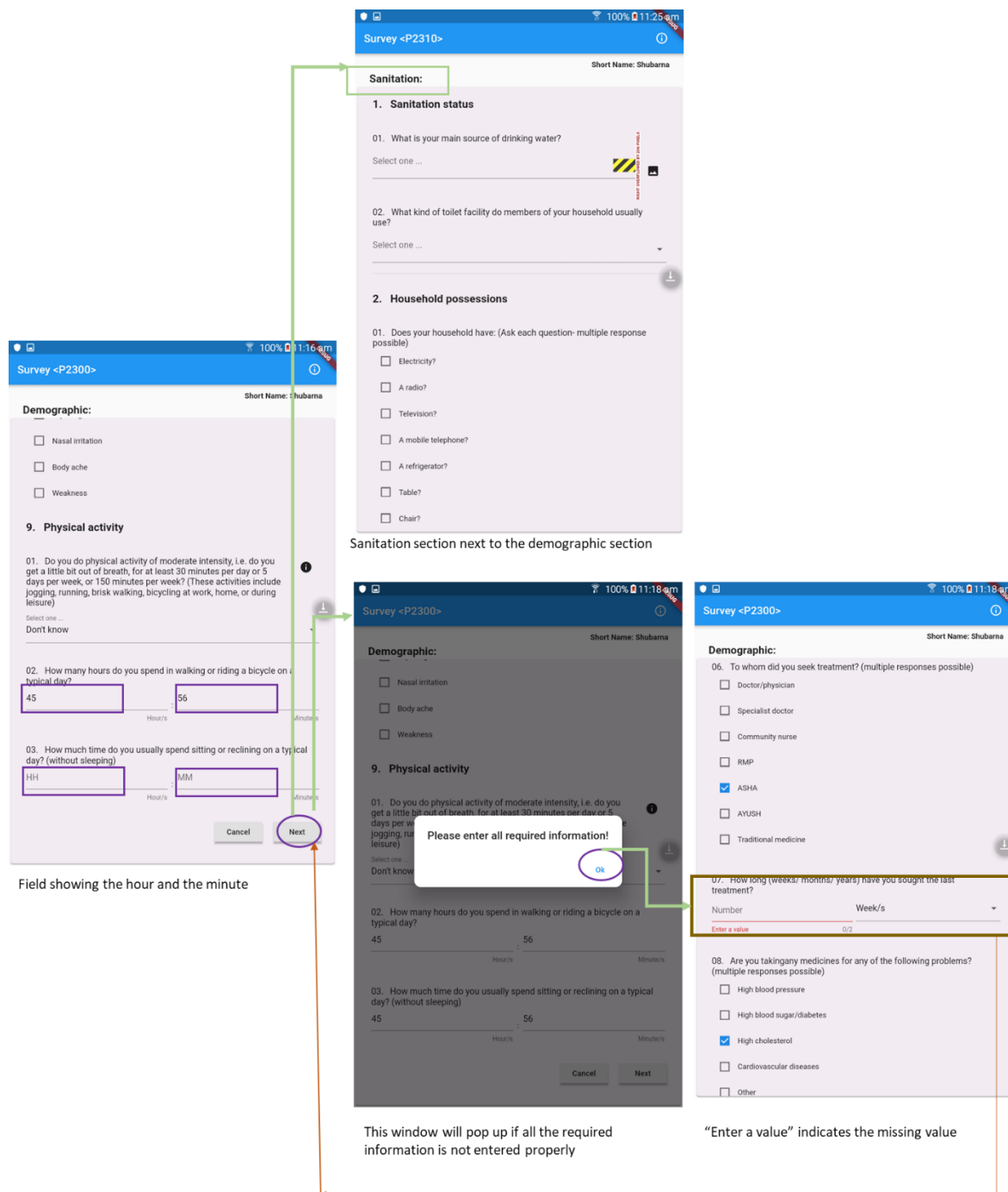


Figure 27: Steps to change the sections

The sanitation section consists of two sub-sections; as Sanitation status and Household Possessions (Figure 28). You need to select the responses from the drop-down menu and select the continue button to proceed to the next section.

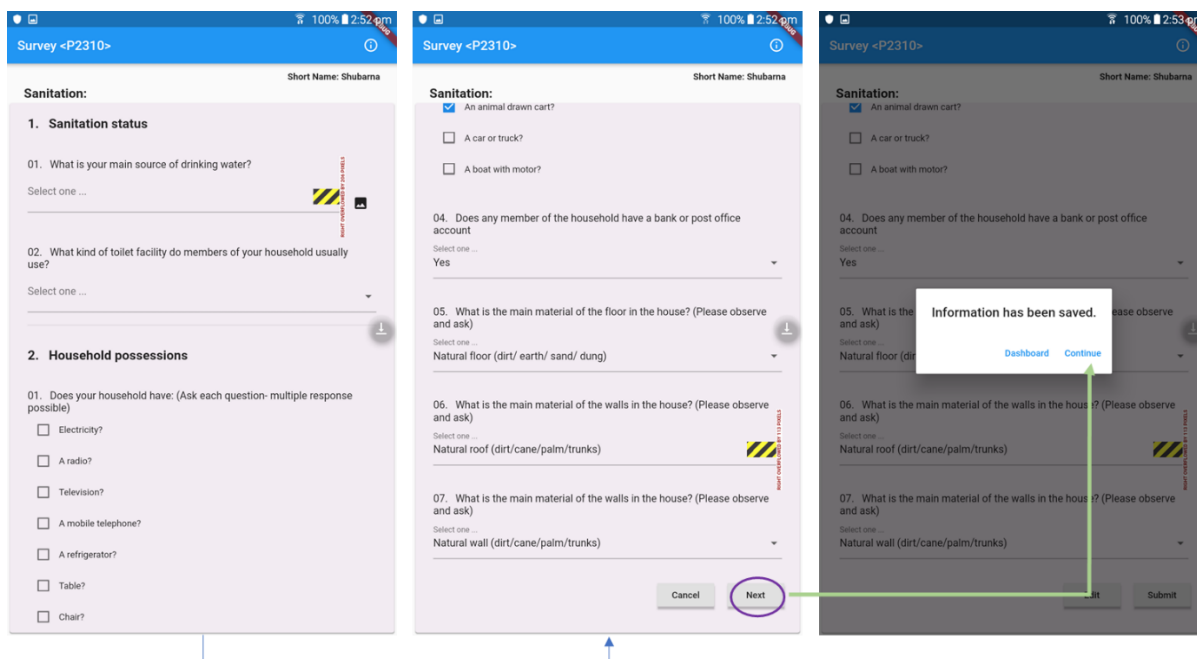


Figure 28: Section on sanitation and household possessions

The next section is the health literacy section. It consists of sub-sections such as assessing knowledge about hypertension, assessing knowledge about high blood sugar (diabetes), and assessing knowledge regarding high lipids in blood. You need to fill all the required information to proceed in next section (Figure 29).

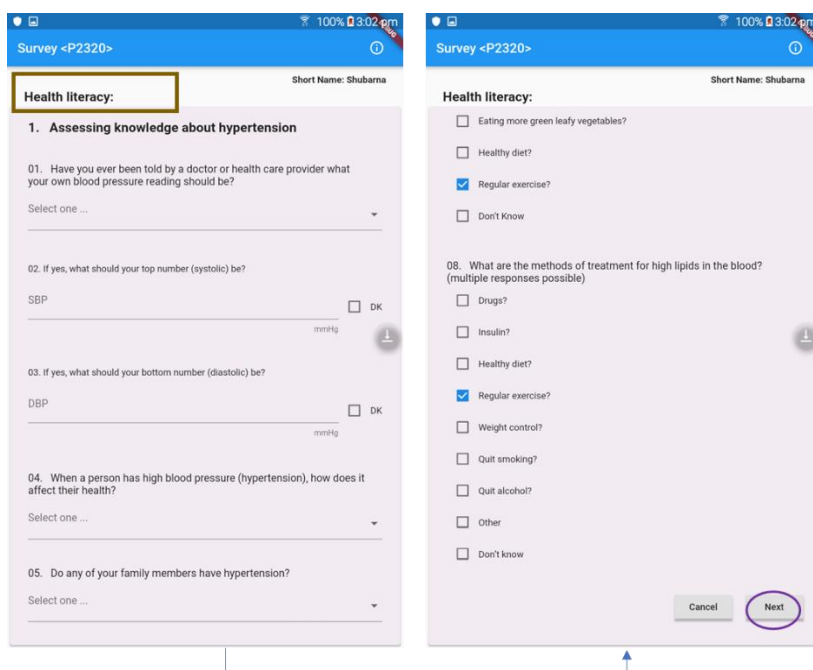


Figure 29: Section on the health literacy

Finally, you need to assess whether participants have any symptoms which require immediate attention. You will ask specific questions to screen the presence of symptoms related to urgent referral. You need to select the Yes/No response from the drop-down menu (Figure 30). The CDSS will also assist you in identifying whether the participants have a very high level of blood pressure or blood glucose. It will also instruct you which type of advice you are required to let them know.

The figure consists of two side-by-side screenshots of a mobile application interface. Both screenshots show a form titled "Have you had any of the following?:" with a timestamp of "16/10/2019 11:49 AM" and a patient name "Short Name: Tisha". The form contains several questions with "Select one ..." dropdown menus. The questions are: "New / Severe chest Pain", "Symptoms / signs of TIA or stroke", "Symptoms / signs of heart failure", "Foot ulcers", "Blood pressure > 180/110 mmHg", and "Blood glucose ≥ 324 mg/dL". In the left screenshot, the "Blood pressure > 180/110 mmHg" dropdown is set to "Yes (143/115 mmHg)". The "Next" button at the bottom right is circled in purple. In the right screenshot, an "Instruction" pop-up box is displayed over the form, containing the text: "Refer the patient immediately to the nearest facility where a medical officer is available." The "Next" button is still visible in the background.

Figure 30: Criteria of an urgent referral

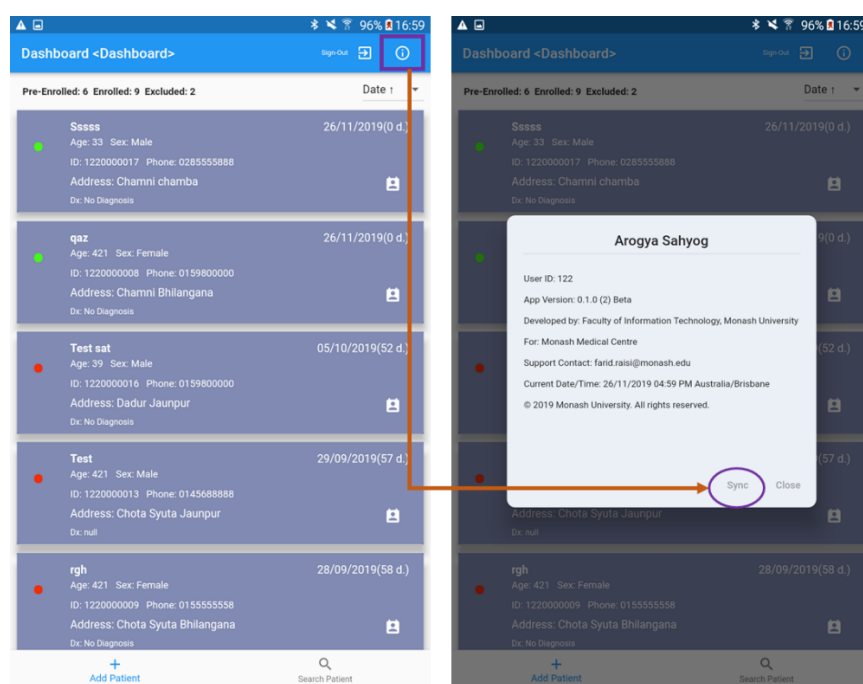
- That's the end of app entry training for this session.

Procedures to synchronise data

Arogya Sahyog saves the data collected from a participant. When you have finished the data collection for a day end, you will need to synchronise (sync) the data with the server. This sync is typically done by connecting the device with the internet (WiFi) using a wireless connection. If you don't know how to connect the device with the internet, please review the 'Connecting with Internet/ Wi-Fi' section in the user manual of 'How to use a tablet' to know details.

The following outline the procedures you will need to follow:

- Turn on the Wi-Fi connection in your tablet to communicate with the internet
- Go to the dashboard of the Arogya Sahyog app (Figure 31)
- Click on the information button (on the right top corner), and a pop-up window will appear
- Click the Sync button to start synchronisation



Location of the information button in dashboard and sync button in the app

Figure 31: Synchronisation of data from the CDSS

When you collect data from participants, the data will be stored on your tablet device. When you sync your tablet with the internet, it will transfer a copy to the server (Figure 32).

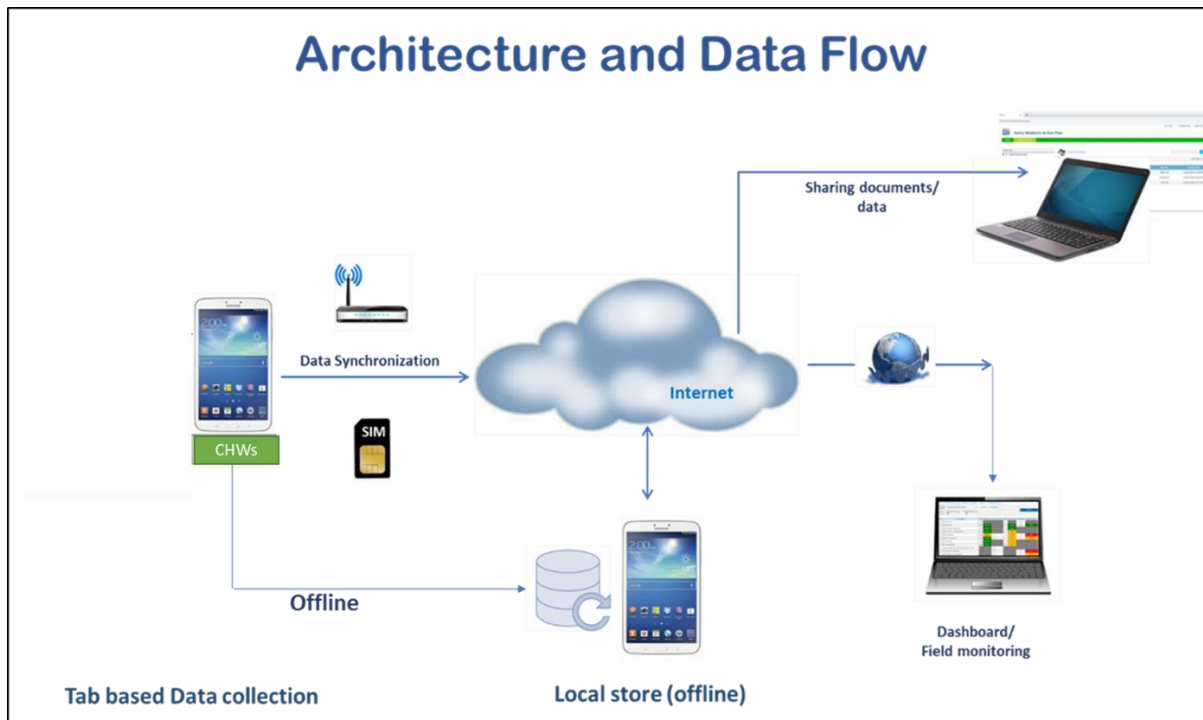


Figure 32: Data flow and visualisation system of the CDSS.

CHWs, Community Health Workers

We have also developed a web-based dashboard to visualise the data collection status. Your supervisors will use the web-based dashboard to monitor your progress regularly.

End.