

# SMART DIAGNOSTICS FOR LOW RESOURCE SETTINGS

Appendix



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# B. Interview guide

## B-1 Introduction

My name is ..... from the department of Health Promotion and Education, College of Medicine, University of Ibadan. I am conducting a research on the Stakeholders perspective on Schistosomiasis control program in Oyo state. The purpose of this research is to assess the investigate the schistosomiasis control landscape in Oyo state and identify gaps and opportunities for improved schistosomiasis diagnostics within the state. The study is all stakeholders who can contribute to the success of the Schistosomiasis control program. The findings from this study will be helpful in understanding issues Schistosomiasis diagnostics and treatment. Moreover, I will like to find out your opinion on schistosomiasis, its' diagnosis, treatment, and factors that can aid diagnosis and treatment of the disease.

Your participation in this interview is voluntary and your answers to all the questions that I will ask you will be kept secret. There is no right or wrong answer so you are encouraged to make your contributions. I shall be grateful if you are honest in answering all the questions. Whatever information will get from you will be useful for planning purpose. The discussion will take about 30 minutes and you are free to terminate the discussion at any point you wish without any repercussion. I do not require your name for this interview but whatever information you supply will be kept confidential.

Thank you for your cooperation.

- a. Are you willing to participate in the study? 1. Yes o                      2. No o
- b. IF NO TO (a) above, STOP INTERVIEW and thank respondents.

LGA: .....

Address: .....

Respondent's Socio-demographic background

- 1. Facility/Location, LGA \_\_\_\_\_
- 2. Sex \_\_\_\_\_
- 3. Age \_\_\_\_\_
- 4. Religion \_\_\_\_\_
- 5. Educational background/ Qualifications \_\_\_\_\_
- 6. Ethnic group \_\_\_\_\_

## B-2 Guide for NTD officers, NGOs, academia

How long have you been working here?

What was your job/research/position before current position?

### Healthcare system

- 1. Are you familiar with schistosomiasis haematobium infection?
- 2. How common is Schistosomiasis infection within this LGA /state?
  - a. Where do you base your answer on? (Your experience, previous mapping..)
  - b. If any data is mentioned, ask if we can have access to it.
- 3. Please describe schistosomiasis control program/policy in the LGA/state?  
*Probe: components of program, awareness, objectives, strategies, coverage, diagnosis, treatment, data collection, others*
  - a. How is the process carried out?
  - b. What do you think of the current program?
  - c. What are the strengths and limitations?
  - d. Who are the stakeholders involved in the control programs?

4. What is your role in the schistosomiasis control program within the LGA/state?
  - a. Do you experience any challenges?
5. How do you think schistosomiasis should be addressed within the LGA/state?
 

*Probe: diagnostic, treatment, environmental modification, Water and sanitation practice*

  - a. What is the desired scenario from your perspective?
  - b. Where do you think the gap lies? How should we approach them?
  - c. Which population should we target with more priority and less priority?
  - d. What about adults? High risk group - fisherman, women, farmers.. How should we approach this group?

### **Diagnosis**

6. In your opinion, what role should diagnosis play in the Schistosoma control program in this state/local government?
7. Is there adequate diagnosis of Schistosoma haematobium being carried out within the LGA/ state?
  - a. If Yes, please describe more and its limitations and strengths.
  - b. If No, why do you think that? And what are the current challenge?
 

*Probe: why?*
8. What are the standard methods used for Schistosoma haematobium diagnosed within the state?
  - a. What laboratory equipment is being used to make a diagnosis of schistosomiasis?
  - b. What are the challenges in diagnosing Schistosoma haematobium infection in this LGA/ state?
 

*Probe:*

    - a) *Availability of tools, repairs, spares and replacement parts*
    - b) *Financing and funding*
    - c) *Reliance on donated equipment*
    - d) *Manpower skills*
9. Are you involved in decision-making/ organisation of the deworming day?
 

If yes, what is your role? What do you think about it? Strengths & limitations?
10. In terms of effectiveness and economic feasibility, what do you think Mass Drug Administration? What are the advantages and disadvantages?
  - a. Considering that, what do you think of conducting laboratory-based diagnosis before treatment?
 

What are the advantages and disadvantages?

*Probe: reason for choice*
10. Are you aware of research/program/NGOs that are geared to improving the control of schistosomiasis in Oyo state?
 

*Probe: Study location, results, and recommendations*
11. What do you think of government interest in the control of schistosomiasis?
  - a. What could be improved?
  - b. How should state/local government approach that?
12. How should state/local government improve the diagnosis of Schistosomiasis within local government?
  - a. point of intervention: community-based diagnosis, laboratory based, ...
  - b. Frequency of diagnosis
  - c. Cost of diagnosis
  - d. Any other measures
13. If we want to involve the lower level of HC worker (CHEW, PMVs, etc..), how should we encourage them? What kind of benefits should we provide? How can we ensure the quality?

14. What would be the ideal diagnostic test for the Schistosomiasis? What kind of qualities? Price? Sensitivity? Time? Users?

15. If people in the community are not actively seeking help for Schistosomiasis, what are the barriers?

16. How can we encourage people to seek early diagnosis and treatment for Schistosomiasis infection?  
Probe: Specific ways, How?

## B-3 Guide for informal healthcare providers and community influencers

1. What are the common health complaints that community members usually talk about?

2. Are you aware of schistosomiasis and its symptoms? Are you aware of its cause and dangers?  
Probe: *disease description and symptoms.*

3. Do community members complain of difficulty in passing urine or passing bloody urine?  
Probe: *age-group, frequency in last 1 year, number of persons with complaint.*  
If yes, what did you do when community members complained of these symptoms?  
Probe: *Diagnostic pathway (laboratory (private vs public), hospital (private vs public), pharmacy/ PMV, traditional healing, do nothing, others*

4. Did you consult anyone else when you received this complaint?  
Probe: *Diagnostic pathway (laboratory (private vs public), hospital (private vs public), pharmacy/ PMV, traditional healing, do nothing, others*  
How did you make the decision who to consult regarding diagnosis and treatment?

5. (in case of traditional healer) How did you do diagnosis and treatment?

6. (in case of PMV) Where in patient journey do people come to PMV?  
Probe: *Advice, diagnosis and/or treatment?*

7. Is there a way to improve your community members experience regarding the disease diagnosis and treatment?  
Probe:  
a) *level of diagnosis: community based diagnosis, hospital based.*  
b) *Frequency of diagnosis.*  
c) *cost of diagnosis.*  
d) *others*

8. What are some of the problems that can arise from failure to diagnose and treat Schistosomiasis?

9. (in case of community leader) How are you involved in control and elimination programmes of the government?

## B-4 Guide for formal healthcare providers

1. What are the common diseases you identify and or treat in your practice?

2. What are your qualifications (if hospital based)?  
Probe: *Clinical knowledge (skills and training level of providers)*

3. What are the qualifications of those who carry out your tests (if laboratory)?  
*Probe: Technical skills/ knowledge of staff*
4. What tests would you carry out if a patient complains of bloody urine?
5. What tests will you carry out if a patient complains of difficulty in passing urine?
6. What other questions would you ask if a patient complains of passage of bloody urine and or difficulty in passing urine.
7. Are you aware of schistosomiasis haematobium infection and its symptoms?  
*Probe: disease description and symptoms.*  
Are you aware of its cause and dangers?
8. Have you diagnosed or treated any patient for schistosomiasis in the last 3 years?  
*Probe: how diagnosis was made, number of diagnosis, treatment, notification of appropriate authority*
9. How common is schistosomiasis in your current location?
10. Do you prefer laboratory-based diagnosis before treatment, or you prefer to give medications?  
*Probe: reason for choice*
11. What is the procedure of diagnosis, providing results and treatment of schistosomiasis?  
*Probe: diagnostic method, result data*
12. What types of laboratory equipment can be used to make a diagnosis of schistosomiasis?
13. Are there any problems with the use of the mentioned equipment's in diagnosing schistosomiasis?  
*Probe:*
  - a) Availability of tools, repairs, spares and replacement parts
  - b) Affordability of devices
  - c) Financing and funding
  - d) Reliance on donated equipment
  - e) Manpower skills
14. What are your limitations in diagnosing schistosomiasis?  
*Probe: location, poor infrastructure, distance, power cuts, interest, cost, knowledge others.*
15. What is the best way to improve schistosomiasis diagnosis and treatment within your local government?  
*Probe:*
  - a) level of diagnosis: community-based diagnosis, laboratory-based.
  - b) Frequency of diagnosis.
  - c) Cost of diagnosis
  - d) Others
16. What are some of the problems that can arise from failure to diagnose and treat Schistosomiasis?
17. Have you heard of the Schistosomiasis control program?  
*Probe: program features, involvement in decision making*
18. In your opinion, is there a strong government interest in the control of schistosomiasis?

# B-5 Guide for teachers

## General

1. What is your name?
2. How long have you been working here? How many years of experience as teacher?
3. What is your role/ position?
4. How many students in your school?
5. Ratio between male and female?
6. Socio-cultural background of students?

## Schistosomiasis

1. What do students normally do when they get sick?
  - a. Do they talk to you? What do you advise them?
  - b. Do they go to Health centre? Which one do they go?
  - c. If they are not going to Health centre, why not?
2. Do you know about Schistosomiasis?
3. If yes, please describe it.
  - a. Do you know any case of Schistosomiasis?
  - b. Do you see it as a problem/ threat to your students/ community?
  - c. Do you teach children about Schistosomiasis? Any preventions?
    - i. Is there teaching material provided by government? NTD/ Schisto/..
  - d. What do you think is the awareness level among the students? Community?
4. Were you involved in any mapping (people came to collect the samples and test all the children)?
5. If yes, when was it? What happened? Who came?
  - a. What was your role?
  - b. Do you know about the results?
  - c. How did parents/ children react to this? Any complaints?
6. Was your school involved in deworming day?
  - a. When? How often? Since when?
  - b. Who did? What did you do?
  - c. What happened?
  - d. What happened for training? Who went to training?
  - e. How did you prepare your students/ parents for deworming day?
  - f. What did you measure from the children?
  - g. What information did you give to the children?
  - h. Any children who complained? Reacted? side-effect?
  - i. Any children/ parents who refused? Why?
  - j. Were the children who are not in school involved?
  - k. Did it improve the awareness among students/ parents?
    - i. Why do you think that?
7. Is there a toilet in the school?
  - a. Do you think children use it?
  - b. Where do you normally use it?



## B-6 Guide for community members and patients

1. What are the common illnesses within your community?
2. What do people in this community do when ill?  
*Probe: visit to PMVs, PHCs and traditional homes*
3. Have people heard about a health condition or disease called Schistosomiasis?  
*Probe: disease description*
4. Are community members aware of a disease or health condition which makes people to have difficulty in passing urine or passing bloody urine?
5. What type of symptoms are common among those infected with Schistosomiasis??  
*Probe: number of episodes, other symptoms.*
6. What type of people are consulted by those who have the disease?
7. Why do they consult these people?
8. Where do people infected by schistosomiasis go for diagnosis or treatment  
*Probe:*
  - a) *diagnostic pathway: laboratory, hospital, pharmacy/patient medicine vendor, traditional healing, do nothing).*
  - b) *reason for choosing/not choosing each option*
9. How long did it usually take people infected to decide on seeking a diagnosis and treatment?  
*Probe: reason for time period*
10. What usually determines the choice of seeking diagnosis by those infected by the disease?  
*Probe: reason for choice (cost, location, severity of disease, accessibility, others)*
11. Which diagnostic option are people in this community likely to choose and why?  
*Probe: satisfaction level, reason for satisfaction*
12. Is there a better way to improve diagnosis of schistosomiasis?  
*Probe:*
  - a) *level of diagnosis: community b-sed diagnosis, hospital based.*
  - b) *Frequency of diagnosis.*
  - c) *cost of diagnosis.*
  - d) *others*
13. What are some of the problems that can arise from failure to diagnose and treat Schistosomiasis?

## B-7 Guide for Evidence Action

1. What is your responsibility in the organization?
2. For how long have you been working there?
3. Who initiated the deworming day? Which other stakeholders were involved?
4. What is the goal of the program?
  - a. Do you see any challenges or limitations in the deworming program?
5. Why do you target only school children? Do you see other risk groups?
6. What data is used on prevalence of the diseases when making the deworming day plan?
  - a. Was Evidence Action involved in the school mapping in 2015? Do they use that data?
7. Until what level is Evidence Action involved in the organization of the deworming days at schools?
  - a. Training of teachers? Date? Providing drugs?
  - b. Who decides when the deworming day happens + how often it happens?
  - c. What other stakeholders are involved?
8. What is the coverage rate of the program in Nigeria? How many children are treated?
9. What is the cost of deworming per child?
  - a. How much of this amount is cost of PZQ?
  - b. Who pays for the medicine? What if donation stops?
10. What are the plans for the future of the program?
11. How do you assess the impact of the deworm the world initiative in Nigeria?
  - a. How often is monitoring done? How? Method? Who? Where?
  - b. When will the program stop?
12. In your opinion; in an ideal situation, what role should diagnostics play in the control & elimination program?

Introduce schistoscope

13. If the cost of diagnosis is similar to treatment, do you see a place for this device in the control program? If yes, where?

# C. Field research templates

## C-1 Observation sheet health facilities

### General

Facility name .....

Facility type .....

Date ..... / ..... / 2019

Location .....

Observer Adeola / G-Young / Merlijn / .....

### Patients

Number of patients diagnosed at facility ..... per week/month

Number of patients suspected with Schistosomiasis ..... per week/month

Number of patients diagnosed with Schistosomiasis ..... per week/month

### Facility

Distance to next facility ..... km

*What does the facility look like? How clean? What size? Daylight?*

*What resources are available? (Water, Electricity/Generator, 3G, wifi)*

### Environment

Temperature inside ..... °C

Temperature outside ..... °C

Humidity ..... %

*What does the surrounding environment look like? How dusty? What infrastructure is available?*

## Equipment

Number of working microscopes .....	Frequency of use .....	<i>times a day</i>
Number of broken microscopes .....	Frequency of use for urine microscopy .....	<i>times a day/week</i>

*What other equipment is available? What does the equipment look like? (cleanliness, modern, maintained)*

## Staff

*How many people work at the facility? Who are present? What are their main practices? Who does diagnosis?*

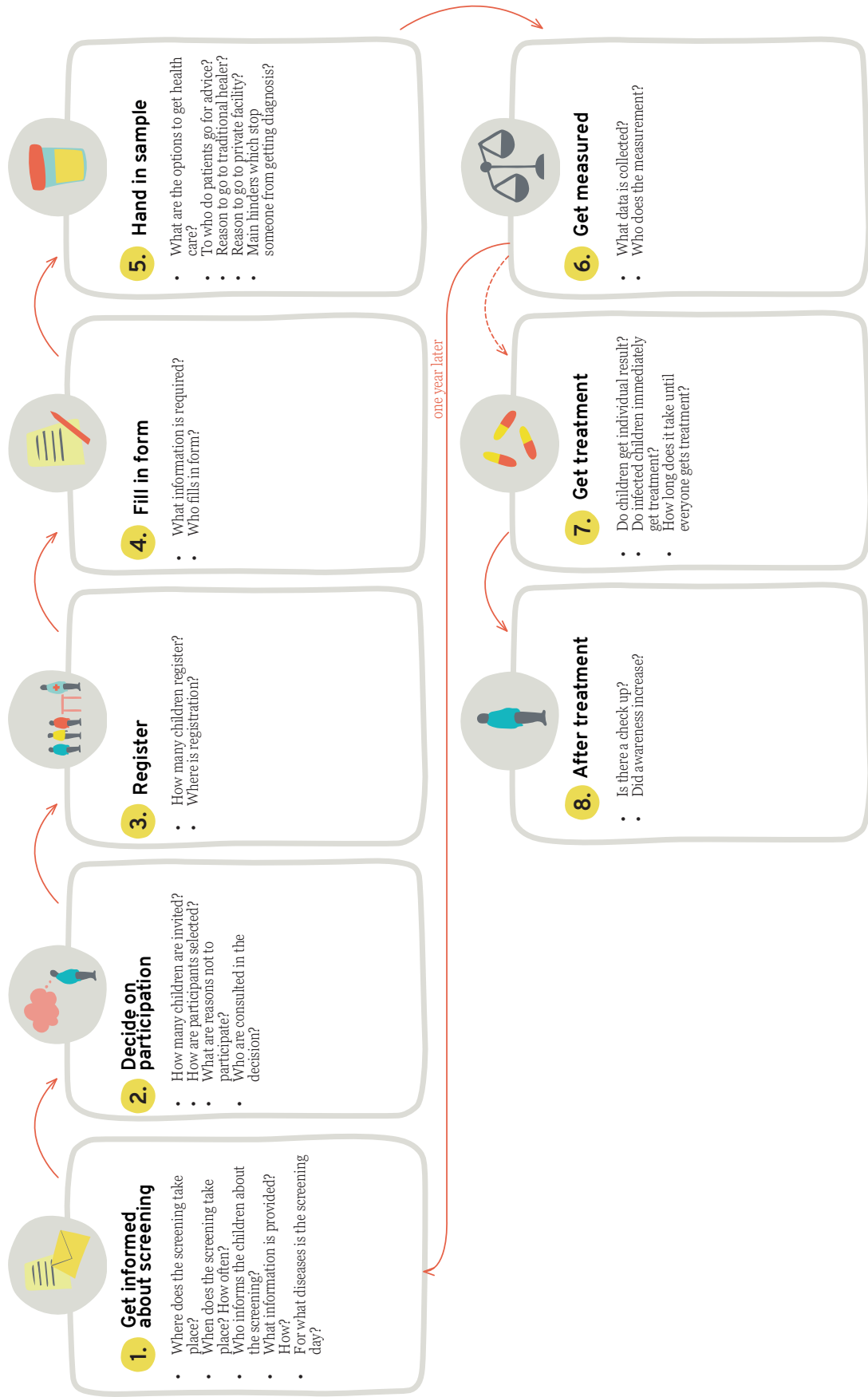
## Notes

# C-2 Patient journeys

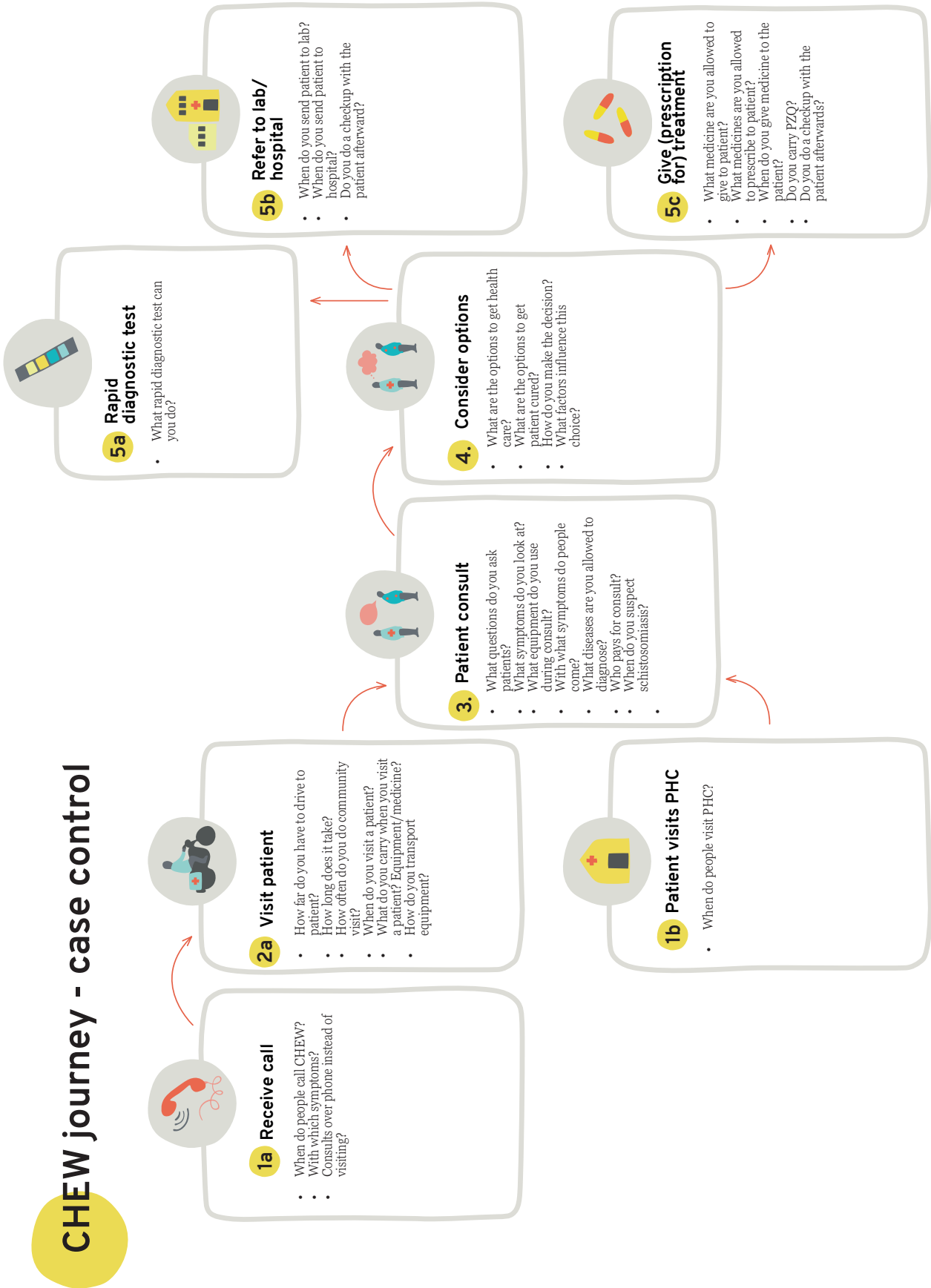
## Patient journey - case control



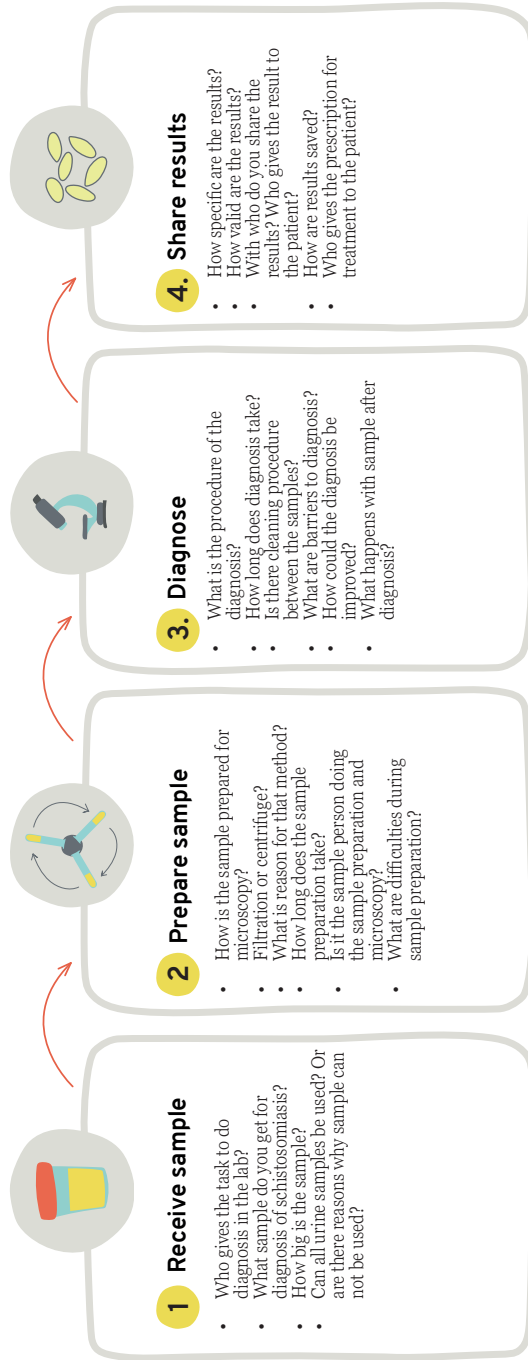
# Patient journey - control & elimination program



# C-3 Health worker journey

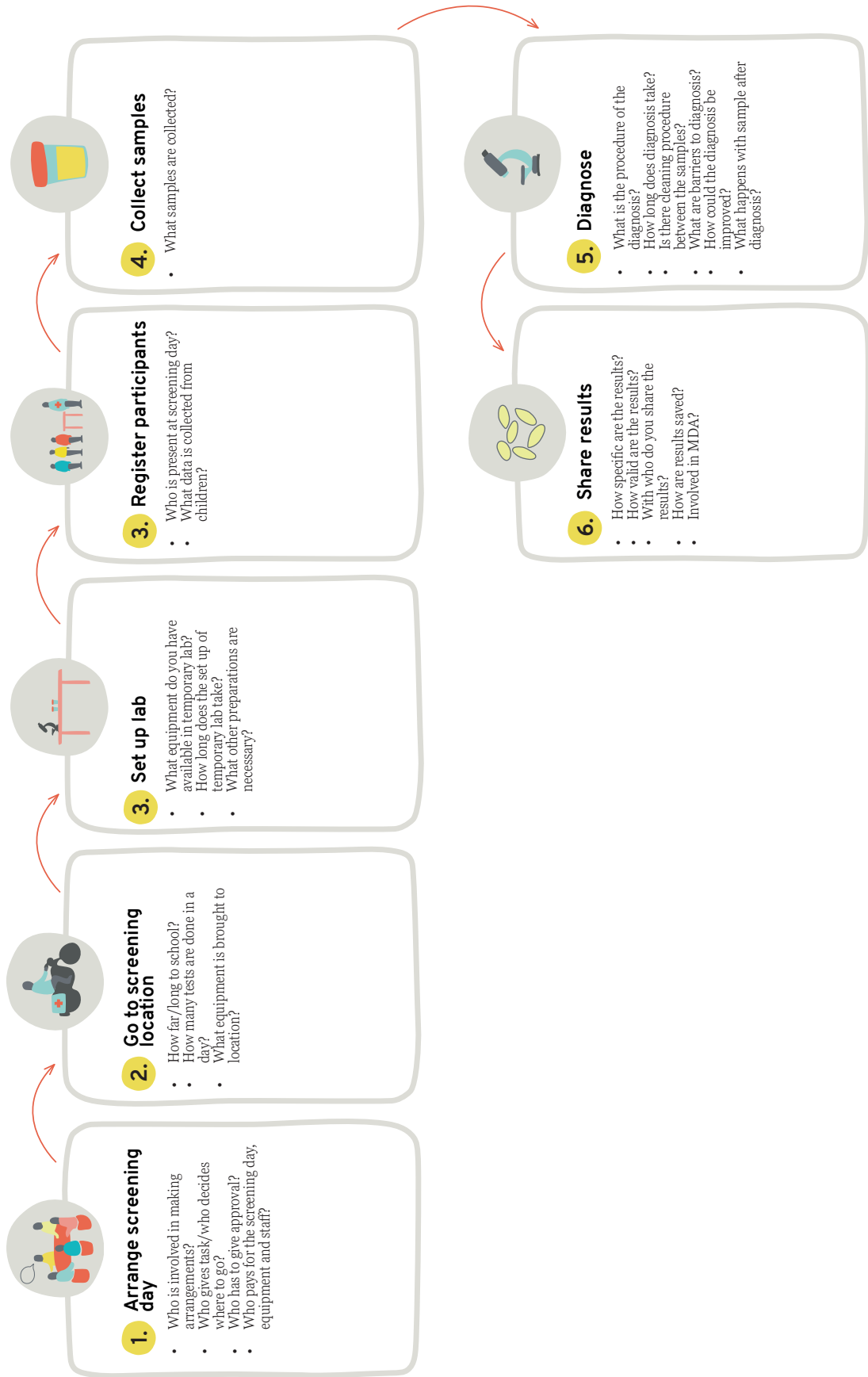


# Lab technician journey - case control





# Lab technician journey - control & elimination program



# C-4 Equipment journey

## Equipment journey - Microscope

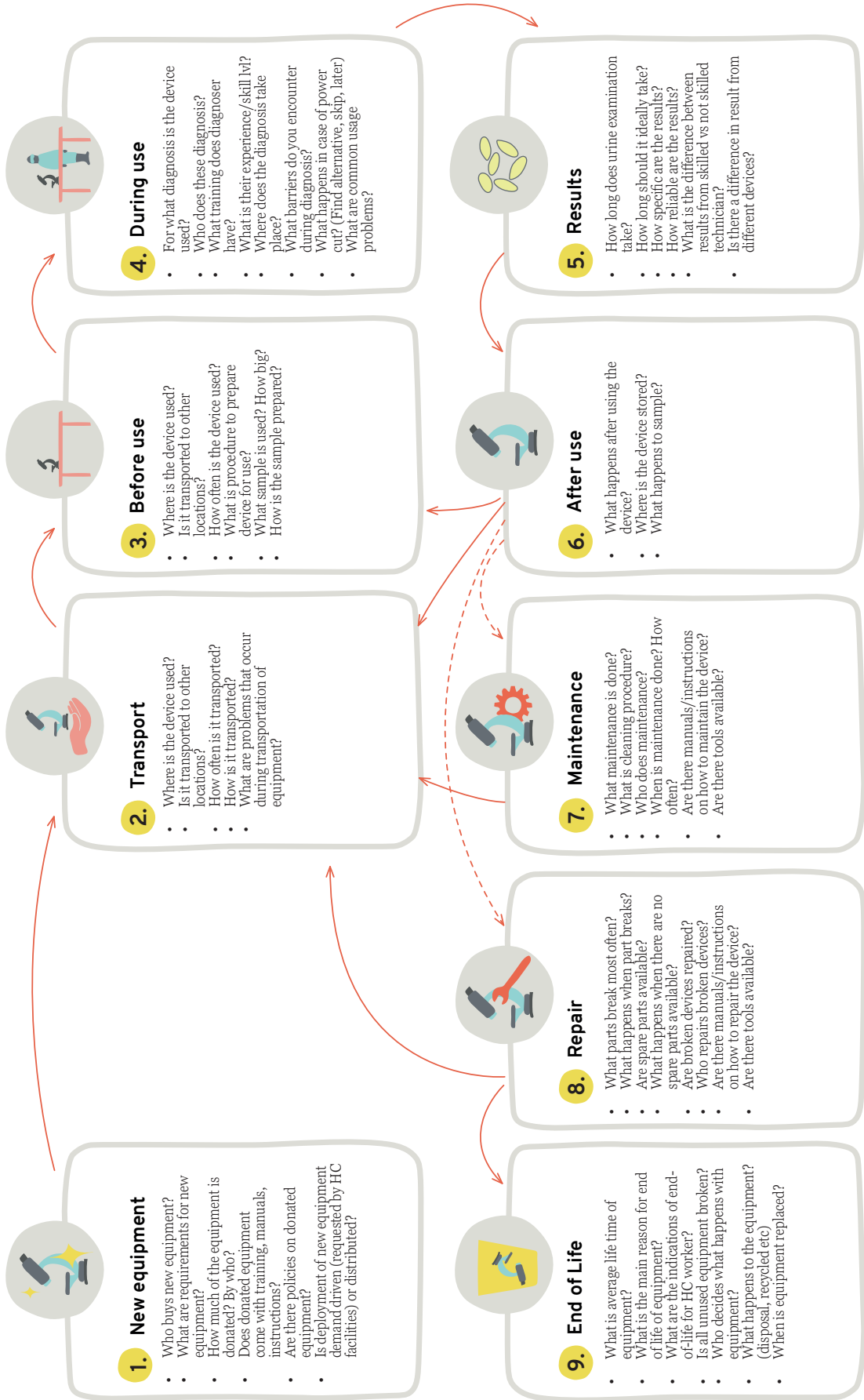




Image C1. Cards with steps in journey

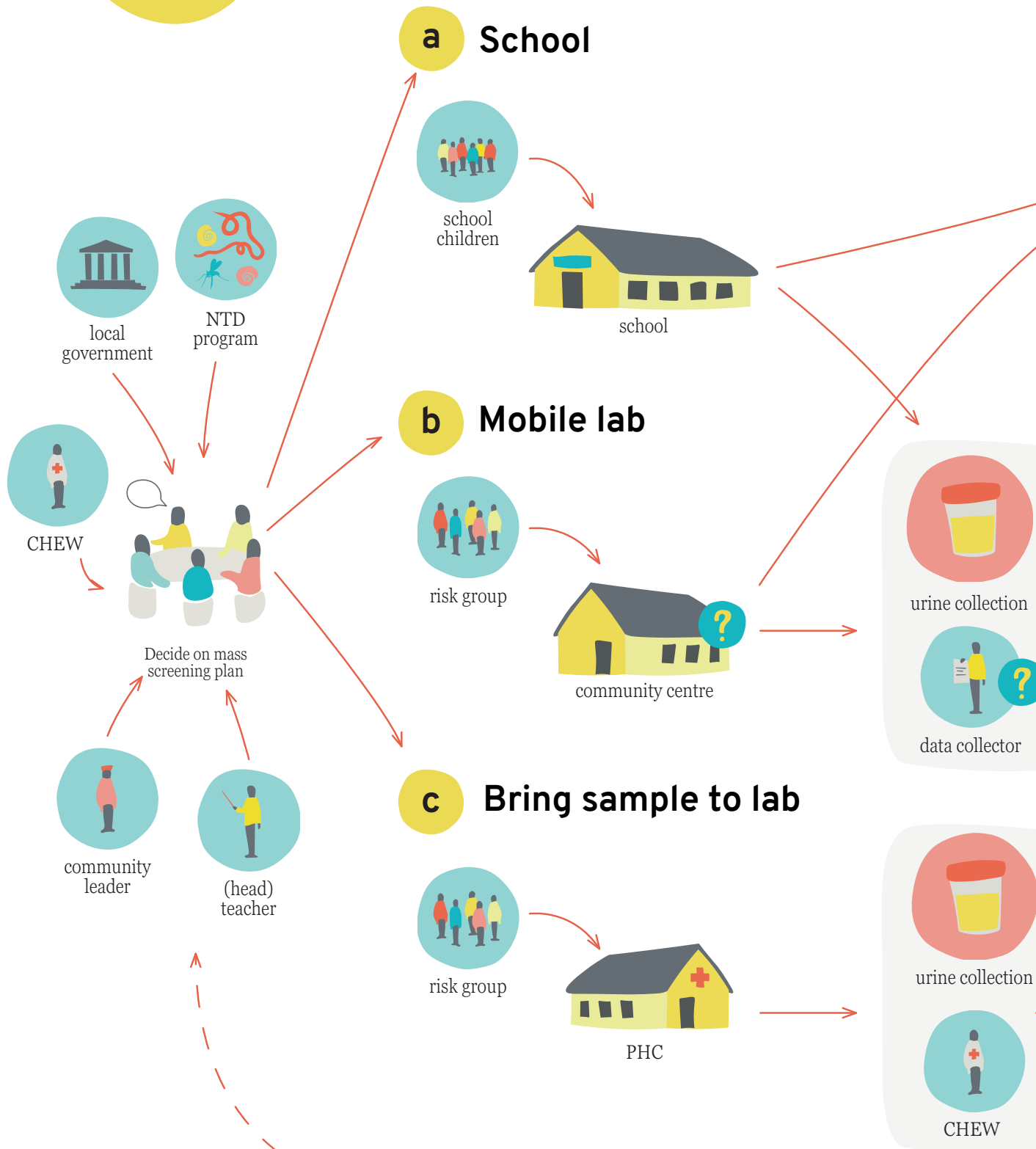


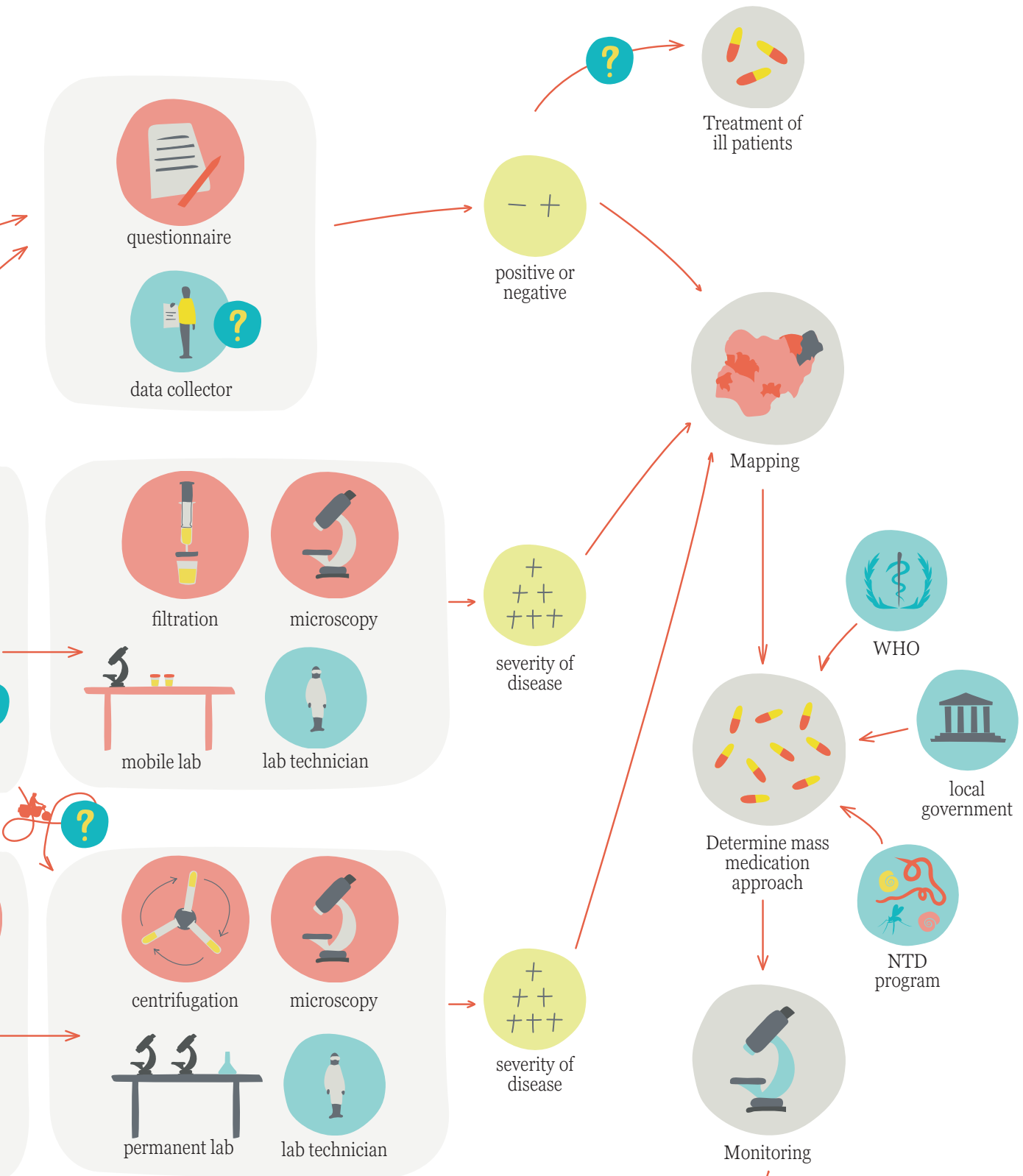
Image C2. Use of templates in the field

# C-5 Diagnostic landscapes

## 1.

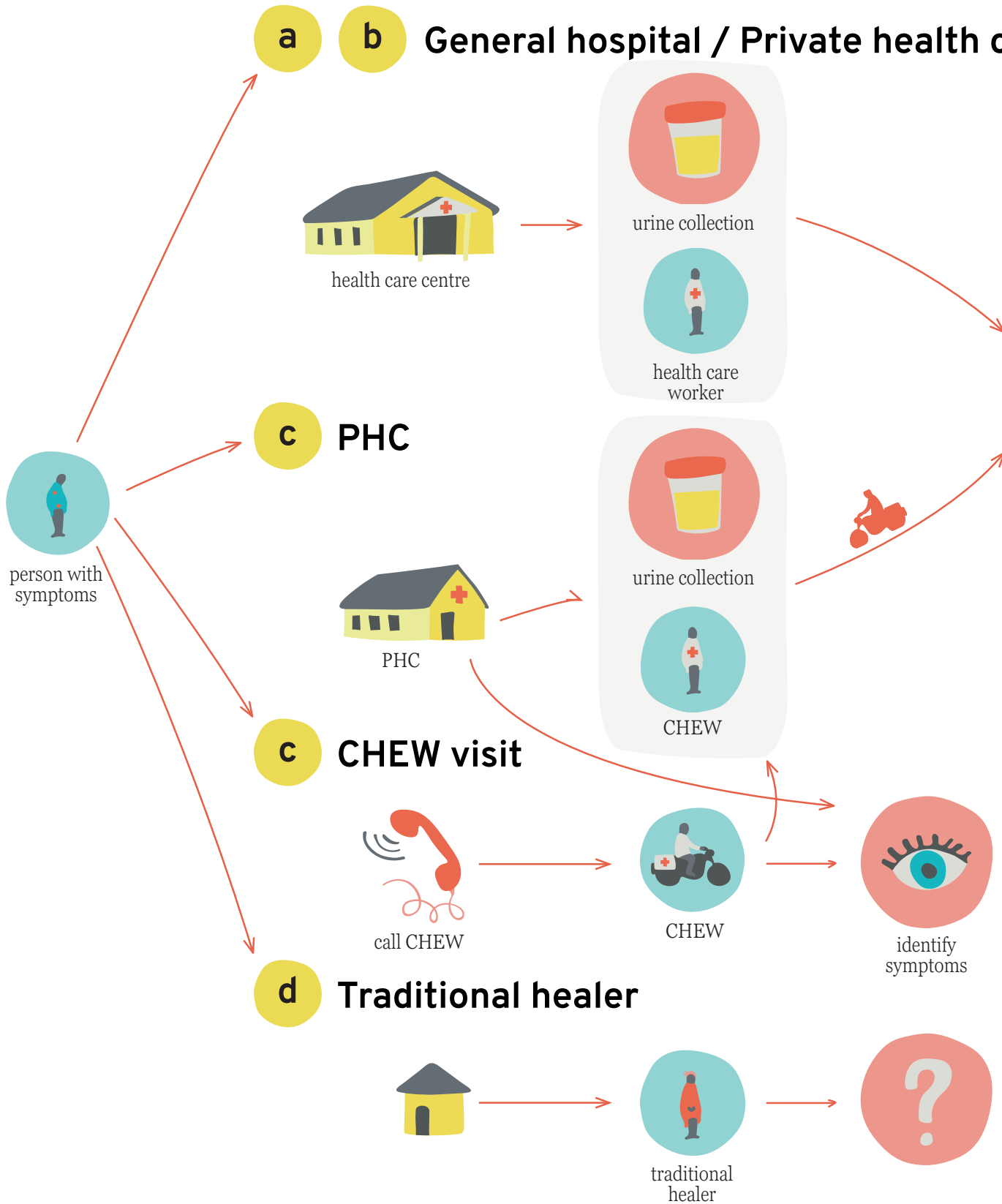
## Control and elimination program



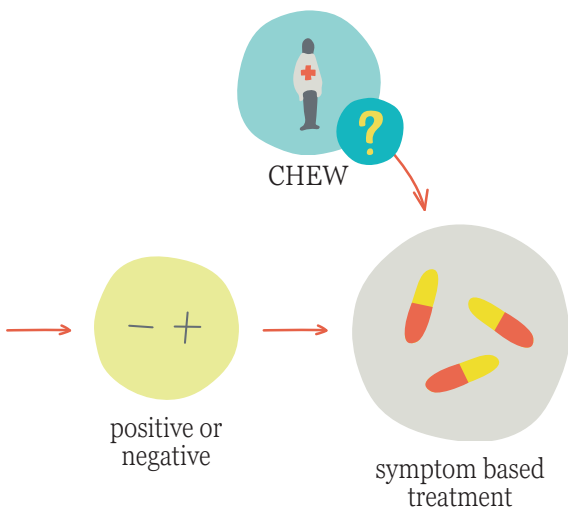
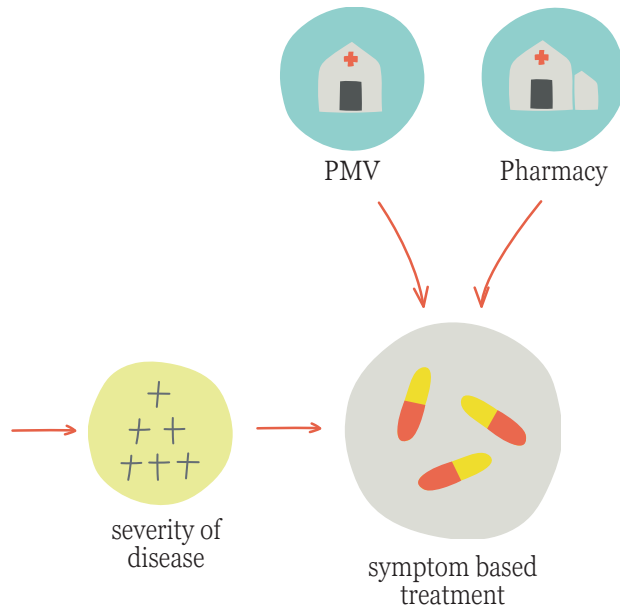
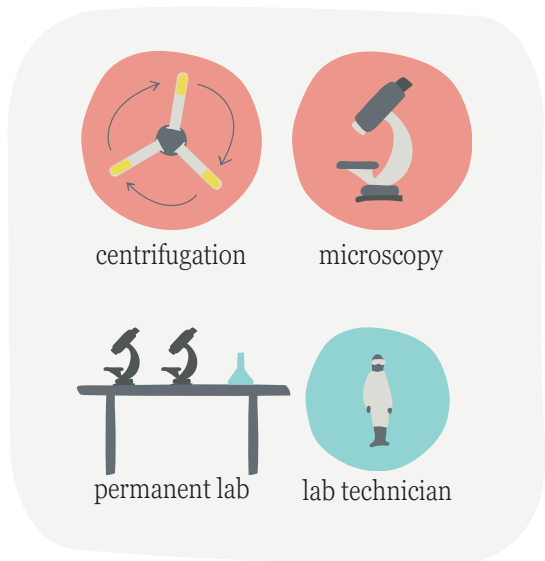


# 2.

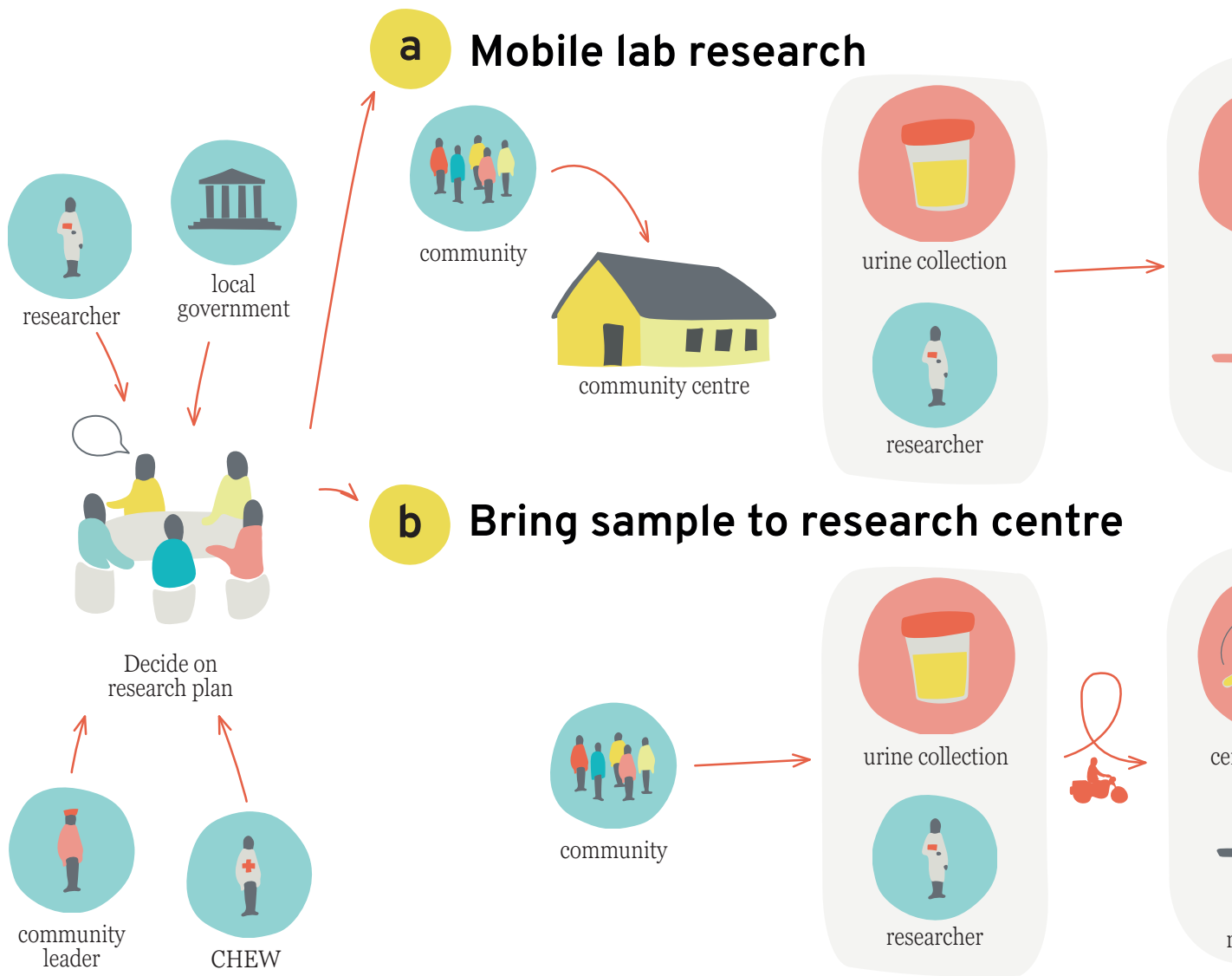
## Case management



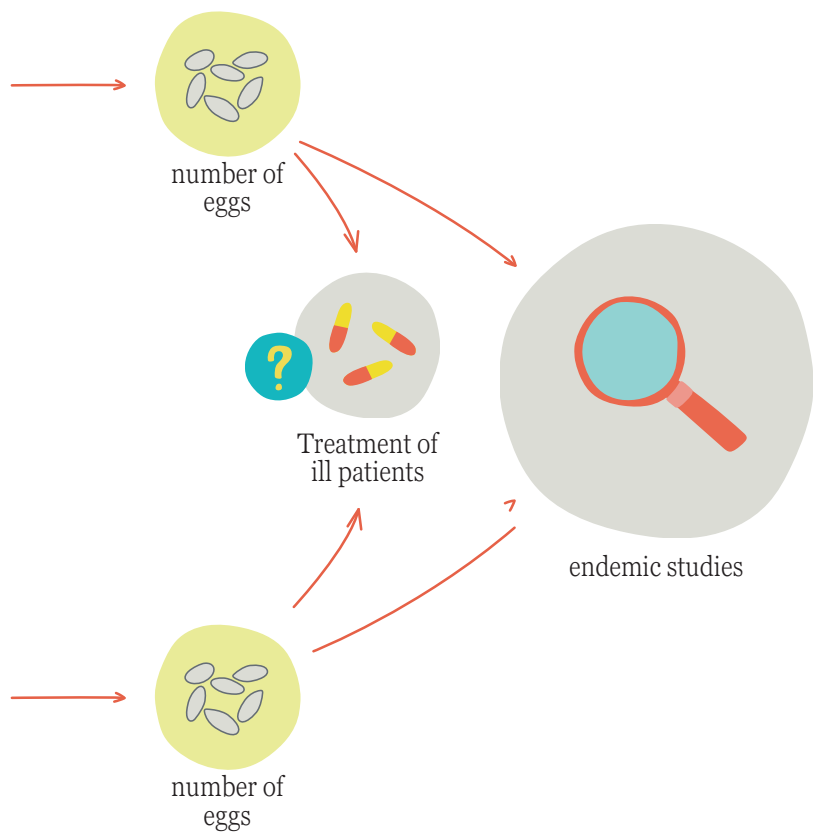
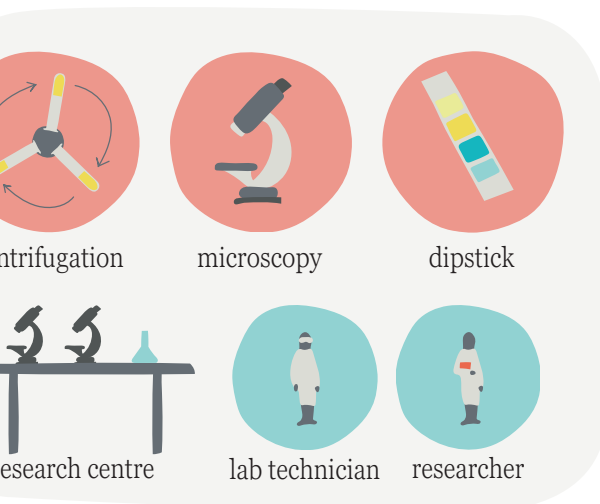
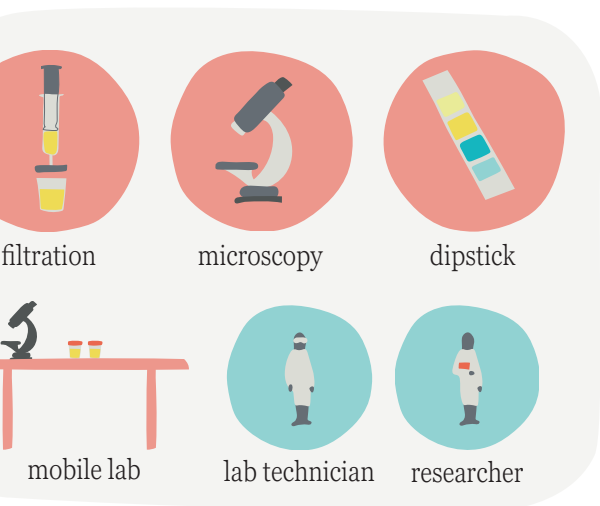
# care centre



# 3. Research







## D. Field trip itinerary

Date	Location	LGA	Interviewees
3-12-2019	ARFH private facility	Ibadan North	<ul style="list-style-type: none"> <li>Lab assistant</li> <li>Lab scientist</li> </ul>
4-12-2019	DSNO	Ibadan North West	<ul style="list-style-type: none"> <li>DSNO</li> <li>Assistant in charge of deworming day</li> </ul>
6-12-2019	<ul style="list-style-type: none"> <li>4 primary schools</li> <li>1 secondary school</li> </ul>	Ibadan North	<ul style="list-style-type: none"> <li>3 teachers</li> <li>6 vice principals</li> <li>3 principals</li> <li>2 primary school children</li> <li>6 secondary school students</li> </ul>
	University of Ibadan		<ul style="list-style-type: none"> <li>Researcher</li> </ul>
9-12-2019	Ibadan North local government	Ibadan North	<ul style="list-style-type: none"> <li>Medical doctor/PHC coordinator</li> <li>CHO/DSNO</li> </ul>
	PHC centre	Ibadan North	<ul style="list-style-type: none"> <li>Head of facility/CHEW</li> <li>Lab technician</li> <li>LGA NTD officer</li> </ul>
10-12-2019	Community visit Ibadan North	Ibadan North	<ul style="list-style-type: none"> <li>Community chairman</li> <li>2 Community mobilizers</li> <li>Community members</li> <li>PMV</li> <li>Traditional healer</li> </ul>
	Oyo state government		<ul style="list-style-type: none"> <li>Oyo state NTD officer</li> </ul>
11-12-2019	<i>Phone interview</i>		<ul style="list-style-type: none"> <li>WHO Oyo state TB coordinator</li> </ul>
	Akinyele local government	Akinyele	<ul style="list-style-type: none"> <li>DSNO</li> <li>PHC coordinator</li> <li>LGA NTD officer</li> </ul>
	PHC centre	Akinyele	<ul style="list-style-type: none"> <li>Lab assistant</li> </ul>
12-12-2019	Community visit Camp David	Akinyele	<ul style="list-style-type: none"> <li>Community mobilizer/CHEW</li> <li>Community members</li> </ul>
	Health clinic	Akinyele	<ul style="list-style-type: none"> <li>JCHEW</li> </ul>
13-12-2019	University of Ibadan		<ul style="list-style-type: none"> <li>Researcher</li> <li>Lab scientist/researcher</li> </ul>
	Giftrilab private lab	Ibadan North	<ul style="list-style-type: none"> <li>Lab director/lab scientist</li> </ul>
16-12-2019	KDF		<ul style="list-style-type: none"> <li>Lab scientist</li> </ul>
17-12-2019	Cocreation sessions		
18-12-2019	KDF		<ul style="list-style-type: none"> <li>Medical doctor</li> </ul>
19-12-2019	Schistoscope review + discussion		
10-1-2020	<i>Phone interview</i>		<ul style="list-style-type: none"> <li>Evidence Action national coordinator Nigeria</li> </ul>

Table D. Field trip itinerary

## E. Visited health facilities

Name of facility	Type of facility	LGA	Environment	No of lab scientists	No of lab technicians	No of lab assistants	No of CHEWs
KDF	Private PHC centre	Ibadan North West	Urban	2	0	1	?
Akinyele PHC	PHC centre	Akinyele	Peri-urban	1	2	1	?
IDI Ogungun	PHC centre	Ibadan North	Urban	0	1	1	?
Akinyele clinic	PHC clinic	Akinyele	Rural	-	-	-	3
ARFH	Private lab	Ibadan North	Urban	2	0	2	-
Giftrolab	Private lab	Ibadan North West	Urban	2	2	2	-

Table E1. Visited facilities and staff availability

Name of facility	No of microscopes in use	No of microscopes out of use	No of centrifuges in use	No of centrifuges out of use
KDF	1	0	2	0
Akinyele PHC	1	0	1	0
IDI Ogungun	1	0	0	1
Akinyele clinic	-	-	-	-
ARFH	1	3	2	0
Giftrolab	2	4	2	0

Table E2. Equipment availability

Name of facility	Number of patients at the facility	Number of suspected schistosomiasis cases
KDF	40-50/day	2 in last months
Akinyele PHC	?	?
IDI Ogungun	?	2-3 last year
Akinyele clinic	10/day	few times a year
ARFH	20/day	few times a year
Giftrolab	20/day	once a month

Table E3. Number of patients at facility

Disease surveillance and notification officer, Local government area	Number of reported schistosomiasis cases
DSNO Akinyele	2 cases last year
DSNO Ibadan North West	No cases last 5 years
DSNO Ibadan North	One case, three years ago

Table E4. Number of reported schistosomiasis cases at LGA DSNO

## KDF



Image E1. Microscope in KDF laboratory



Image E2. Centrifuge in KDF laboratory

## Akinyele PHC



Image E3. Laboratory in Akinyele PHC



Image E4. Centrifuge



Image E5. Microscope

## Akinyele clinic



Image E6. Akinyele clinic



Image E7. Akinyele clinic

## IDI Odugun



Image E8. Laboratory in IDI Odugun PHC



Image E9. Microscope in IDI Odugun laboratory

## ARFH



Image E10. Laboratory in ARFH with two lab assistants



Image E11. Centrifuges in ARFH laboratory

## Giftrolab



Image E12. Microscope in giftrolab



Image E13. Giftrolab with lab director/scientist

# F. CHW guidelines

Age patient	Complaint	Findings on examination	Clinical judgment	CHW	Action
1-5 years old	Blood in last stream of urine with or without pain, fever or discharge	Blood in urine, schistosoma ova may be detected in urine	Severe condition Suspect urinary schistosomiasis	CHO or CHEW	If painful urination; 1. Give cotrimoxazole a. 2-12 months -> ½ tab (240 mg) bd x 5/7 b. 1-5 years -> 1 tab (480 mg) bd x 5/7 2. Encourage fluid intake 3. Review in 3 days, if no improvement, check for bilharzia ova, if positive, give metriphonate a. 100mg (1tab) every 2 weeks x 6weeks -> 3-5 years b. If negative and no improvement, refer for further investigations
				JCHEW	Refer immediately
6-12 years old	Blood in last stream of urine with or without pain, fever or discharge. History of swimming in stream/river	Blood in urine, terminal haematuria	Moderate condition Suspect schistosomiasis	CHO or CHEW	1. Encourage liberal fluid intake 2. Give Metriphonate 200 mg (2 tablets) every 2 weeks x 6 weeks or praziquantel 1.2 g stat (2 tablets) 3. If no improvement, refer to hospital for further investigation
				JCHEW	Refer
Adolescent >12 years old	Blood in urine (terminal) may or may not have painful micturition	Blood in urine	Moderate condition Suspect Schistosomiasis	CHO or CHEW	Refer for bilharzia test 1. If Schistosomiasis test is negative, refer 2. If positive and staff trained, give praziquantel 60 mg/kg/day in 3 divided doses or metrifonate 4 mg tab every 2 weeks for 6 weeks 3. If no improvement, refer
				JCHEW	Refer
	Blood in urine	Blood in urine (terminal)	Moderate condition Suspect schistosomiasis	CHO or CHEW	Conduct test 1. If negative, refer 2. If positive, give praziquantel 2400 mg or 4 tabs stat 3. Review in 2 weeks 4. If no improvement, refer to the hospital
Adults	Blood in urine	General appearance: normal or ill looking and pale Abdomen: hard lower abdominal mass which may or may not be tender Urine: total blood in urine or terminal blood in urine	Severe condition Suspect bladder cancer or schistosomiasis	CHO or CHEW	1. For bladder cancer, refer 2. For schistosomiasis, give praziquantel 1200 mg stat then 600 mg daily x 5 days
				JCHEW	1. Refer immediately

Table F CHW guidelines for urinary problems

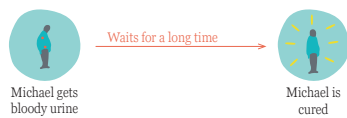
# G. Patient stories

## Patient 1 - Michael

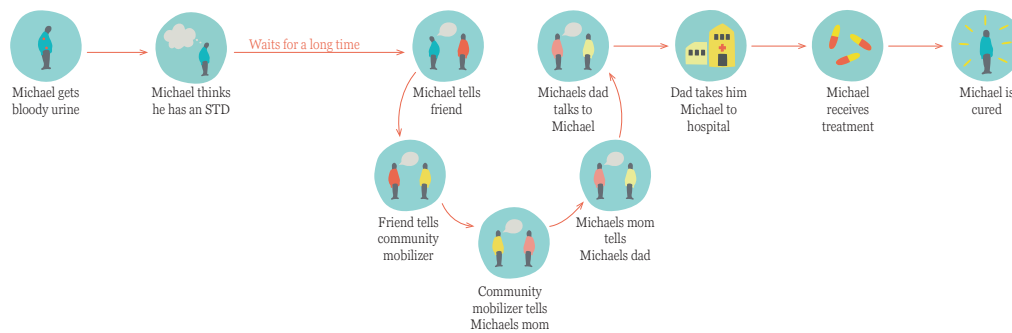
Michael is 15 years old. He lives in Gbinla area in Ibadan North. He is described as a rebellious child. He was expelled from school and he had sex with a promiscuous girl. The first time he got infected, the symptoms stopped without treatment. When the bloody urine returned, he thought the symptoms were caused by having sex. He waited a long time before he told a friend. Once he did, that friend told the community mobilizer. The community mobilizer saw blood in his underwear and he told Michaels mother. Michaels mother told it to Michaels father, who talked to Michael and took him to the hospital. In the hospital Michael received treatment and he was cured.

Barrier: Patient felt shame to tell anyone about his bloody urine, since he thought it was caused by sex.

### First time

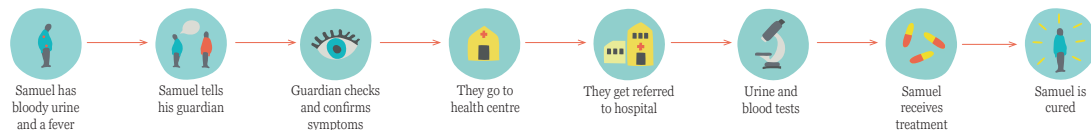


### Second time



## Patient 2 - Samuel

Samuel is 6 years old and lives in Ibadan North. He contracted schistosomiasis March 2019. He did not bathe or play in a river, but he did bathe in the rain. When he urinated blood, he told his guardian. He had a fever and his guardian made him urinate and store it so she could take a look at it. She took him to the health centre, where they referred him to Adeoyo hospital. In the hospital blood and urine tests were done in the morning and they received the results in the afternoon. The tests cost 700 naira. He was given drip, asked to drink a lot of water and prescribed him drugs. His treatment in the hospital took three days, he used drugs for five days. When he was cured, he was not taken back to the clinic for a checkup.



### Patient 3 - Baby

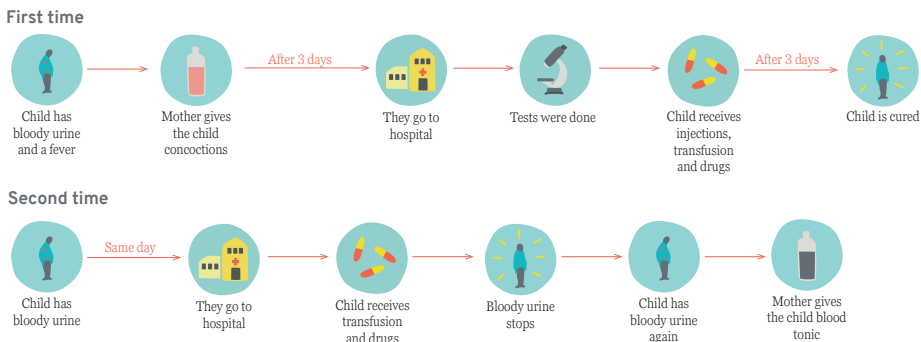
This patient is one year old and lives in Akinyele local government. The child could not urinate and when he finally could, it was bloody. After five days, his mother took him to the chemist, where they prescribed drugs. The child used the drugs twice and he recovered.



### Patient 4

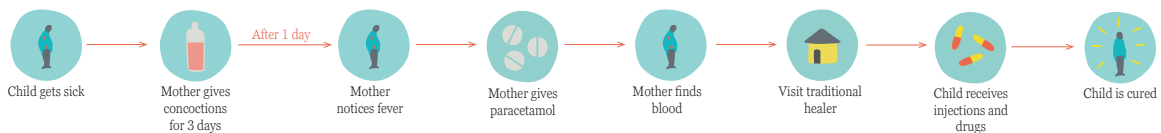
This child does not go to the stream alone, but follows his mother when she is doing laundry. Last year, the child had a fever and his mother noticed blood in his urine. The mother gave the child herbal concoctions from a vendor for three days. It did not work, so the mother took her child to the hospital. In the hospital they carried out tests, the child received blood transfusions, injections and drugs. The child spend three days in the hospital and got better.

Two days ago, the child had bloody urine again. That same day, the mother took the child to the health centre where he was referred to another hospital. In the hospital they gave the child blood and drugs. The bloody urine stopped in the hospital but it happened again. The mother is now giving her child blood tonic.



### Patient 5

This patient is three years old and lives in the rural community Camp David in Akinyele Local Government. Water is fetched from the river to bathe the child. When the child got sick the mother made herbal concoctions and gave it to the child for three days, but there was no sign of improvement. The first day, he had a fever and got paracetamol, but the situation did not improve. The mother discovered blood around the child and the child did not urinate. When she found out the blood was from her child, she alarmed a friend. The child was taken to the traditional healer and received some infections and drugs. Afterwards the child got better. The parents do not know the disease or its name.





# H. Creative session Nigeria

## H-1 Session set up

At the end of the field trip, a creative session was held with 14 master students from public health faculty of University of Ibadan.

The aim of this creative session was to **verify and enrich the gaps** that were identified and explore **new and promising opportunities**. Furthermore the aim was to define requirements for **specific opportunities from the perspective of end users**.

The session was kicked off with a presentation with a short summary of the field research, the aim of the session and the preliminary gaps that we identified during the interviews. During a group discussion we received feedback on these gaps. We explained the new diagnostic technology as an automatic microscope. We presented the device a white box with paper screen – so they would not be biased by the prototype of the Schistoscope - and we explained the potential benefits. The gaps were translated into opportunities for new diagnostic scenarios with the device and put on a matrix with on one axis 'effort', and 'impact' on the other axis.

Afterwards, the students were divided into pairs and picked one of the opportunities. They were asked to define the end users, and fill in one patient persona and one health worker persona with position, needs, wishes and barriers.

With these personas in mind, they described or drew a scenario of that the use case will look like. In the last step they added some product requirements that fit the end users and the use case, in the categories device requirements and usability requirements. At the end of the session, the students shared their results with the other pairs.

The results were used to get a better insight in the gaps. The opportunities that were formulated were used as inspiration for developing use case scenarios. Some of the requirements were used as input for the development of TPP later in the process. The results can be found in appendix H-3.

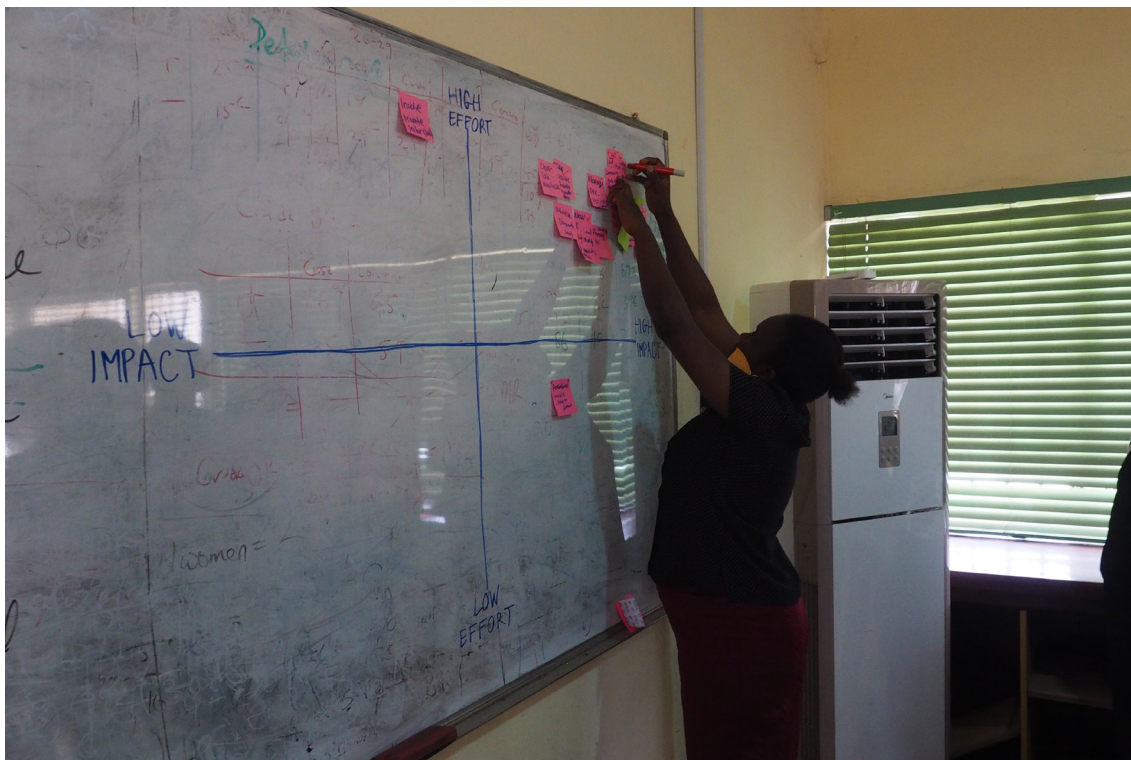


Image H1. Post its on axis during co-creation session



*Image H2. Participants of co-creation session*



*Image H3. Brainstorming during cocreation session*

# H-2 Presentation slides

## Co-creation session

Diagnostic device for Schistosomiasis

17-12-2019  
G-young, Adeola, Ope, Merlijn





### Today

1. Presentation
  - Field research overview
  - Identified gaps in current context
2. Discussion on gaps
3. Define end-users, scenario and requirements
4. Reflect on prototype

### Field research

**Aim**

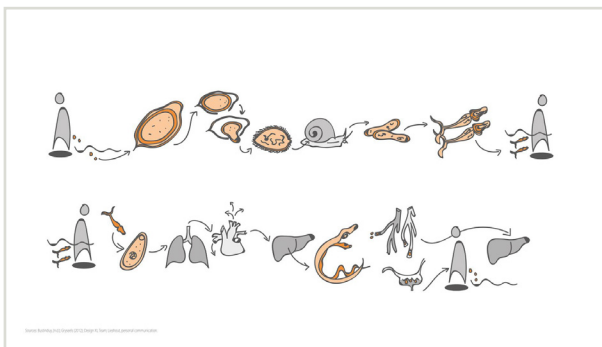
- Understand the current diagnostic context of urinary Schistosomiasis
- Identify gaps and opportunities for new diagnostic device

**Method**

- Community visit Akinyele & Ibadan North
- Interviews with stakeholders on different levels
- Interviews with researchers
- Co-creation session

### Schistosomiasis





### Current diagnosis

- Done in hospitals and laboratories


**Method**



Urine collection




Centrifugation




Microscopic egg count

### Context



**Case control**

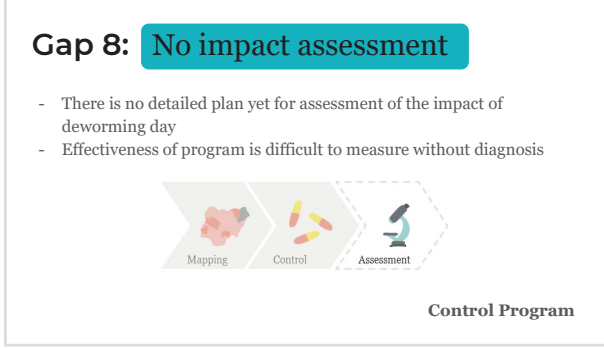
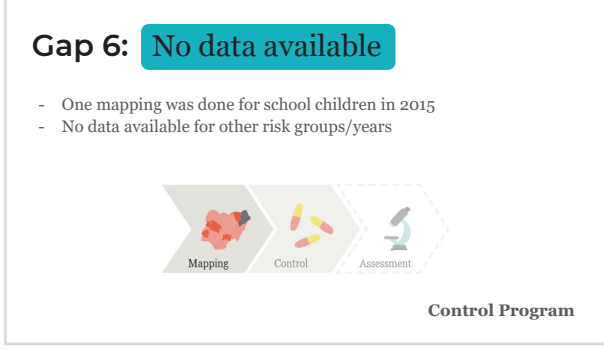
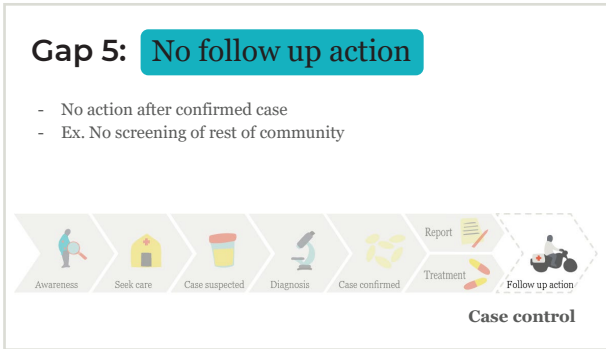
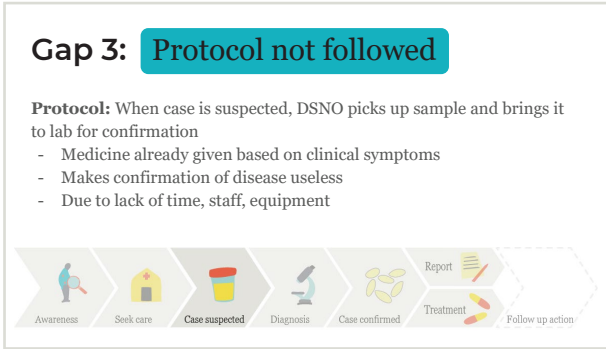
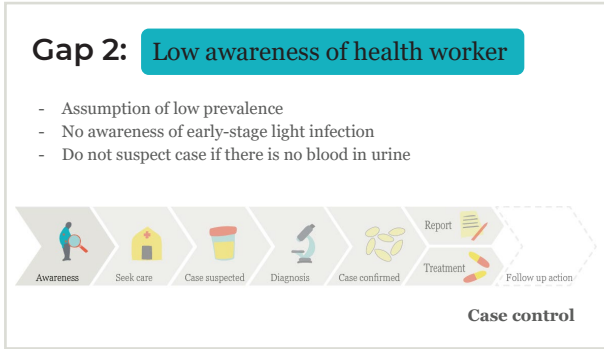
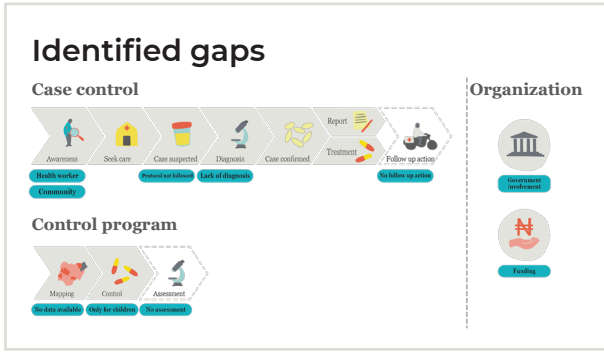


**Control program**



**Organization**



## Gap 10: Not enough funding

- Schistosomiasis is “Neglected” disease by sponsors
- Funding is not consistent and unpredictable in long term.



Organization

## Identified gaps

### Case control



### Out of scope



Government involvement

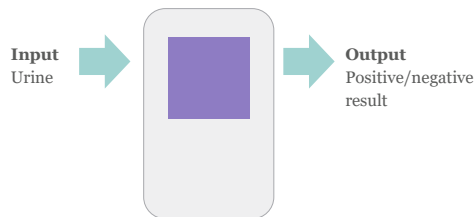


Funding

### Control program



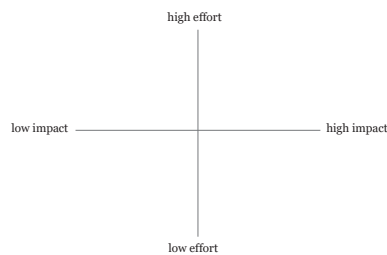
## Diagnostic device



## Come up with opportunities

1. Low awareness among community
2. Low awareness of healthcare worker
3. Protocol is not followed
4. Lack of diagnosis
5. No follow up actions
6. No data available
7. Only control program for school children
8. No impact assessment for Deworming day

## Prioritize the opportunities



## Make pairs

- Each pair works on one opportunity
- One will be **'the community'** (the diagnosed)
- The other one will be **'the healthworker'** (the diagnoser)

1. Define the end users + fill in the template
2. Develop scenario with template (you can use cards)

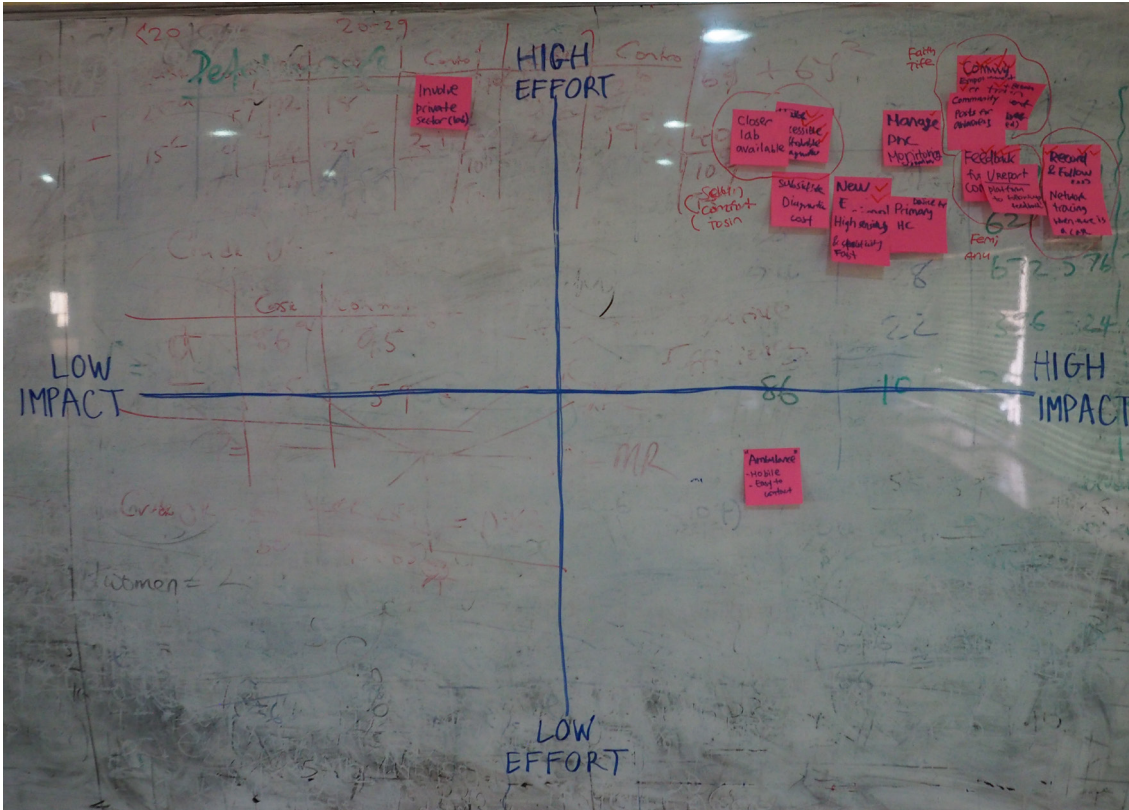
## Scenario

1. **Draw diagnostic scenario**
  - What are the steps?
  - Cards can be used as inspiration
1. **Describe for every step**
  - Who is involved?
  - Where does it take place?
  - What happens?
  - How does it happen?
  - What is the outcome?

## Scenario

3. **What are the implications for the diagnostic device?**  
Write down requirements:
  - **Device requirements:** size, time to process, specificity & sensitivity of result, power supply etc
  - **Usability requirements:** easiness of use, understanding, intuitiveness etc.

# H-3 Results





Group	Category	Who	Daily jobs	Needs/ wishes	Barriers	Key challenges
1	Community	Everyone especially those that have direct contact with community water	Fisherman, farmers, domestic workers, laundry men	To live a healthy life, for early detection and quick treatment, not to be sick ones in the community and avoid bad tags	Finance, attitude of health worker, accessibility to the health facility, low education status	Too busy to multitask
2	Community	Entire population	The use of the community water for lots of purposes like fishing and cooking	To get diagnosed early and get treated, to also get the awareness	Low coverage of advertisement to the community	
3	Community	all age group	make use of community water for various purpose ranging from economic activities, domestic, etc.	Have a sustainable health and access to health care	A proper communication mean is not enough due to the difference in age group, level of education, exposure in different channels of communication.	
4	Community	children and women	petty traders	Affordable and accessible health care service	Cost and distance to Health centre	Low income
5	Community	Women and children	Domestic activities like laundry and cooking	Good health	No potable water, low knowledge of the disease, financial constraints	Language
6	Community	Parents and community leaders	Monitoring signs and symptoms in the home and community	Moderate working hours and proper education	Illiteracy, lack of knowledge and information, Engagement with jobs	Lack of support from key decision makers in the community, poor attitudes from health information officers
2	Healthworker	CHEWs	patient visit, supervision	Want less patients to attend to for treatment	Supply, no fund, haven't used such device before	
3	Health worker	Community health volunteers	To carry out diagnosis of people within his/ her community and make referrals when needed	To detect early occurrence of disease	Limited coverage of advertisement, low educational status of people affect understanding of the device	inability to reach and create awareness
4	Health worker	Nurses, laboratory scientists	Attending to patients	For patients to get quality services	lack of qualified staff, High cost of equipment	Malfunctioning of the device, inadequate supply of equipment
5	Health worker	Frontline Health Facility worker	Educate case and control, identify and report the case	Provide adequate treatment	Low knowledge of equipment	attitude, resistance to health education idea
6	Health worker	Health information officers	Collection of feedback from community members	Should be supported with transportation stipends for ease of movement, private office where community can engage with them	Lack of funds for data collection, long working hour, non challant attitudes of community members	No channel to give feedback, poor attitudes from community members

Group	Scenario	Design requirements	opportunities			
1	Screening	Set-up	Screening	Diagnosis	Result	
	Use device for screening	The screening day should not coincide with working day		Cost diagnosis is affordable for the community members	Combine with other contextual information (awareness, how long they had symptoms), see the stage and prevalence of disease.	
		Information should be shared about the screening activities.				
2	Case management	Prepare	Consult	Diagnosis	Result	Treatment
		Good attitude of Health worker is critical on the service delivery		Multi-task device		
		Accessibility and affordability of Health service		Easy-to-use		
				High sensitivity	Data transferred to the server	
				Accurate results including the severity and light infection		
2	Screening	Set-up	Screening	Diagnosis	Result	
		Awareness video on the device (video includes a familiar person from Nigeria)	video or audio introduction of disease, symptom, prevention, treatment	instruction on how to use and how to conduct screening	Provide alert on follow-up action Provide suggestion on which healthcare centre to go	
3	Awareness campaign	Promotion				
	Community members become aware of the symptoms and relate to themselves and come to get diagnosis	Emphasize on immediate result		Give result immediately		
		Explain the device and show its efficiency				
4	Case management	Should be used by skilled and qualified health workers (nurses, lab scientist staff)		Safe to use for children		
		Sustainable supply and support		Minimized malfunction, or give instruction for that		
5	Case management/ Monitoring	Device include the information that provide adequate and relevant information to improve knowledge of health worker			Use device to open a new channel for feedback on healthworker's training and monitoring the disease	
		Feedback to/from the community on training and impacts				



# I. Product qualities

## I-1 Interview results

Product quality	Respondent	Respondent 1 Researcher UI	Respondent 2 Medical doctor KDF	Respondent 3 MOH + PHC coordinator	Respondent 4 Head of PHC centre + CHEW	Respondent 5 LGA NTD coordinator	Respondent 6 WHO State TB coordinator	Respondent 7 PHC coordinator	Respondent 8 Community mobilizer + CHEW	Respondent 9 LGA NTD coordinator	Respondent 10 Researcher UI	Total
Portable		■										1
Ease of use		■	■	■	■	■	■			■	■	8
Automatic reading without human involvement		■		■								2
No skilled operator required, can be operated by low level healthworker			■							■	■	2
Not observer subjective							■					1
Can not be manipulated							■					1
Easy sample preparation		■		■								2
Quantified result to know the severity		■	■									2
Option to share results		■										1
Option to get second opinion		■										1
Storage of result		■					■					2
GPS location		■										1
Ability to take pictures of water source		■										1
Fast, making diagnosis while patient is still present			■						■		■	2
High level of sensitivity			■				■		■			3
Specificity			■				■					2
Power source, not too dependent on electricity				■			■			■	■	4
Should come with training that fits level of knowledge of operator				■		■				■		3
Affordable		■	■	■			■		■	■	■	7
Can detect multiple diseases				■								1
Should come with treatment					■							1
Detect asymptomatic cases								■				1
Price that patients will pay for test		Ideally free, max 300 naira	Free for patients	Ideally free, max 1000 naira	max 800 naira	Free	Acceptable; 200-500 naira, max 1000 naira		Around 200 Naira		Ideally free, max 100 naira	

## I-2 Creative session results

Groups of 2 or 3 students developed a diagnostic scenario, based on the opportunities that were developed from the presented gaps during the co-creative session. After writing down the steps in the diagnostic scenario, the participants had to come up with matching product qualities. The table below shows the results from five groups. Two groups developed a scenario for case management, two for control & elimination screening and one for an awareness campaign.

Product quality	Scenario	Case management	Control & Elimination	Awareness campaign	Total
Affordable for community members		1	1		2
Multiple diseases		1			1
Easy to use		1			1
High sensitivity		1			1
Transfer data to the server		1			1
Results include severity of disease		1			1
Detect light infection		1			1
Show awareness video on device from familiar person			1		1
Video or audio introduction of disease, symptoms, prevention and treatment			1		1
Include instructions on use			1		1
Provide alert on follow up			1		1
Provide suggestion which health centre to go to			1		1
Immediate results				1	1
Sustainable supply and support		1			1
Safe to use on children		1			1
Minimized malfunction, or give instruction for that		1			1
Includes information to improve knowledge for health worker		1			1

## I-3 PhD session results

During a session with 6 PhD students from the public health faculty of University of Ibadan, feedback was received on the embodiment of Schistoscope 2B. The prototype was used to start a discussion about desired product qualities.

Overall, they were very impressed by the prototype and they believe it could make a big difference in making diagnosis.

### End users

They pointed out the importance of **simplicity**. It will improve the diagnosis as long as the operator will not have an attitude problem and refuses to automate tasks. Sample preparation might be challenging for a CHEW, operating the device is not. We should not rule out anybody yet as end users, especially not doctors. Furthermore, anybody should be able to get tested when they are interested.

If the device is used to outreach to communities, it is important that **experiences of former patients are shared**, so they will trust the procedure. These stories do not necessarily have to be shown on the device itself.

### Sample preparation

There is a risk of **leaking during filtration**. Preferably, the filter holder should be **reusable**, if it is cheap and there is a way to disinfect the holder. An autoclave cannot take plastics, so it should be good to **use glass slides** if possible, since cleaning is easy and they are widely available.

The participants discussed the possibilities of sample disposal. It might be interesting to look into gels that might absorb urine for disposal

### Device

The device should **not be too light**, otherwise it might easily fall. It would be good to have a **carrier** for the device, like a camera bag with protective foam and extra space for accessories. However, when the device is packed in a bag, it might be forgotten since it is only used a few times a year.

They pointed out the importance of an **off grid power supply**. We discussed several options for solar panels. External solar panel on the roof might be a possibility, however chances are high that it will be stolen. An internal solar panel can be placed on top or on the side of the device. The heat and light might affect parts of the device when it is out in the sun for a long time. It is possible to have a detachable solar panel, but this will most likely be used for other purposes like charging phones. An other option is to have a solar panel on the bag, but there is a risk that the bag might become weak and decolours after time.

The participants agreed that it would be ideal if the device takes **10 minutes to result**. As one of the participants said 'Any device that will give results in 5 seconds I will not trust'. If it takes a long time, patients might not be willing to wait for the results.

### Data sharing

The options of sharing results was discussed. **Internet access** would be good for data sharing, but there are lots of areas without internet connection. The idea of **printing the results** was discussed and considered an interesting idea by some. The results can be taken to a physician which diminishes the chance of miscommunication, but the ink might fade over time and Nigerians will probably not keep a paper slip. Currently there are problems with papers and files. There are often no patient records available. The other idea is to **send the results to patients phone** via SMS or WhatsApp. This might be interesting since it is easier to keep patient records. The problem with a text message is that it might be deleted. It is better for physician if there is a paper with the results instead of a text.

## UI

The interaction with the device should be as simple as possible. *'As simple or simpler than using WhatsApp'* A laboratory technician might be fluent in English, but other end users might not. They recommended a voice prompt in different languages.

It is important that distractions should be limited, so a smartphone might not be the right option. Operators will use the phone for other purposes instead of doing tests.

Product quality	Specification
Simplicity of sample preparation	
Trustworthy procedure for community	Share experiences of former patients
Reusable filtration material	Reusable filter holder, glass slides
Weight	Not too light, it might fall
Carrier for device	Bag with protective foam and space for accessories
Off grid power supply	Solar panel; external or internal on the device/bag, detachable
Rapid	10 minutes to result
Data sharing	Printing results or send results to phone
Voice prompt in different languages	Not everyone can read (English)
Simplicity of device interaction	<i>'As simple or simpler than using whatsapp'</i> , limited distractions

Table 11 Desired product qualities from PhD discussion

# K. Survey results

				Case management 1 - Sensitization tool				
Respondent	Category	Occupation	Feedback	Desirability [healthworker]	Desirability [patient]	Organizational feasibility	Technical feasibility	Potential Impact
1	Interviewee Nigeria	PhD researcher	Is promising. But technical know how of the official will be questionable.	5	6	5		5
2	Interviewee Nigeria	Laboratory scientist	Highly promising. Same as the earlier post	7	7	7		7
3	Interviewee Nigeria	Community mobilizer / CHW	Very innovative	7	7	7		7
4	Interviewee Nigeria	Medical doctor	Quite promising	3	5	6		7
5	Interviewee Nigeria	Researcher	Promising	7	7	7		6
6	Interviewee Nigeria	Researcher	quite promising	4	4	5		3
7	INSPIRED team	Professor	Promising. Pros: Community is part of intervention; Increased accessibility to diagnosis using the tool; cost effective. Cons: Poor acceptability unless the community mobilizer gets the consent of the community leaders, If community mobilizer is not a trained health staff, will require technical skills in using the device	7	7	5		7
8	INSPIRED team	Product developer	Based on my experience in Ivory Coast, an infected community can have a lot of asymptomatic, logically without any awareness. Visiting health facilities is often not possible due to practical and financial reasons. When including treatment, this seems desirable to the patients, but may be undesirable for healthworkers/organization due to the increased work demands and additional costs for logistics and accommodations which may not always be compensated. Technically speaking the conditions for performing the tests are less predictable and controllable. Still, it has a high potential impact.	3	7	3	3	6
9	INSPIRED team	PhD researcher	It is a very promising scenario which would help raise the awareness of the diseases in rural communities. The device would be cheap and easy for a layman to operate however the specificity of such device may be low. There might be more cost-effective alternatives to increase awareness instead of using a testing device. Testing is something private. As such one test on one person will not increase the awareness of the community. Only when a lot of people would be tested and outcomes would be discussed in the community it might have some impact.	6	6	6	6	3
10	INSPIRED team	Associate professor		6	3	2	2	6
11	INSPIRED team	Professor	I do not agree with your definition of case management, which is to test and treat confirmed cases. based in this definition, which is different from surveillance or others so we can give purpose to value-for-money? There are evidence about the disease that guides current interventions. The absence of rapid tests has limited the level of monitoring that could be done. Technically, lets differentiate case management from surveillance and other activities. Of course, outreaches could be organized with testing incorporated but we must look at the strategies of intervention as we put our lens on diagnostics.	1	2	3	3	1
12	INSPIRED team	PhD researcher	Impact of sensitization will be very good by this method but some citizens may shy away from doing test in public as others may think he/she is infected.	4	6	5	5	7
13	INSPIRED team	Medical doctor	Very promising. There will be more uptake in testing and treatment when there is improved community awareness. Community gatekeepers will need to have advocacy before hand	7	6	6	6	7

Case management 2 - Test at PHC consultation					Case management 3 - Test at community visit						
Feedback	Desirability [healthworker]	Desirability [patient]	Organizational feasibility	Technical feasibility	Potential Impact	Feedback	Desirability [healthworker]	Desirability [patient]	Organizational feasibility	Technical feasibility	Potential Impact
Highly promising and ensure proper data capturing. The training required by the health workers will be minimal and also reliable result is certain.	7	7	7		7	Is less promising because the screening is conducted only when the community members are sick.	6	6	6		5
Same as earlier post	7	7	7		7	Highly promising. Same as earlier post	7	7	7		7
Very interesting	6	6	6		6	Very innovative	6	6	6		6
Very promising	7	7	7		7	The test has the potential of improving this stage of the disease control	7	7	4		6
Promising	7	6	7		7	Very promising	7	7	6		7
quite promising. Patients will have a sense of trust in the process.	5	6	6		6	Not too promising. The community may not trust the process	3	3	3		3
Very promising. Pros: improved and timely case management since patients don't have to go the hospital. Cons: Attitude of health workers to patient overload. Long distance of facility is a potential barrier ; may not be sustainable if enough equipment is not purchased and serviced	5	5	5		7	Promising. Pros:Ensures early diagnosis as the service is brought to their doorsteps. Community extension worker are easily trainable to use device based on their previous training. Cons; Low number of community extension workers in PHC settings. Accessibility of villages may be difficult for community extension workers due to difficult terrain and transportation challenges	7	7	6		7
Seems to be a promising addition to PHCs. Especially if this does not require a lot of time & expertise from the healthworker. Impact on case management is more difficult to assess, as the source of the problem is not addressed and reinfection might quickly occur.	5	6	4	5	4	Depending on which scale the tests will be done and asymptomatic patients will be found, it might have a larger impact than the first scenario. This, as it is likely that infected people will be present. The request for medical assistance assures people are willing to accept help. Technical demands are similar to the first scenario.	4	7	4	4	6
I think this scenario is not so promising to improve case management because patients may not go to the PHCs until their condition is severe.	5	3	5	6	3	This scenario will improve case management , however it doesn't solve the problem of raising awareness of the disease	6	6	6	6	6
Sounds promising. The PHC is relative close to the patient. This will provide access to diagnostics. And above all it can be done directly. All at te same place ... Point of need / point of care.. May be in the beginning when new not much people use it.But once people know they might come more frequent	6	6	6	5	5	The good thing it brings it close to the patient. But.. the device has to be carried all the time by the healthcare worker. And might not be used that frequently. That will make it challenging... make it robust enough to be always on the road, and convince healthcare worker to carry everyday....	4	6	4	4	6
Schistosomiasis does not present as an acute disease that takes people to the facility. It is a community disease with everyone being able to still carry on with life. Schisto may be diagnosed along with other ailment at presentation but typically, except in some typical cases, patients will not present in facilities. Lets also remember the cultural underpinnings of the disease and how adults look at haematuria. There is need for rapid tests and has to aligned with current interventions such as mass drug administration to monitor effect and impact of interventions and map communities more accurately.	3	3	4	3	4	At a much later part of the control to elimination phase, case confirmation will have to be strengthened and expanded at every levels. This will be evaluated as progress is made. Health workers are of several categories. There are platforms and strategies that currently does not fully advance testing and treatment given that it takes several years of mass treatment for the desired impact to be felt in communities. This is community disease where coverage of intervention is critical in crashing transmission, alongside with other interventions. We may have to go back in reformulating our questions.	2	3	3	3	3
Not very promising as only those who feel sick will tested	7	5	7	7	5	Test will be performed only when someone feels sick and calls, meaning impact will not include asymptomatic cases	5	7	6	6	5
Quite promising. It will help in early case detection and treatment, boost the morale of the PHC CHEW and it is cost effective for the patients	6	7	6	5	7	Promising. Though testing an individual patient in the house may require payment of some stipend to the CHEW, cost-effectiveness for the patient	4	5	4	4	6

Case management 4 - Test in PHC laboratory					Case management 5 - DSNO brings device						
Feedback	Desirability [healthworker]	Desirability [patient]	Organizational feasibility	Technical feasibility	Potential impact	Feedback	Desirability [healthworker]	Desirability [patient]	Organizational feasibility	Technical feasibility	Potential impact
Is promising but this is a long process for the case management. The result will take a while and long while.	5	5	5		5	This is a long process. The purpose of the case management will be forfeited.	5	5	4		4
Same	7	7	7		7	Same	7	7	7		7
It will reduce long waiting hours in clinic	7	7	6		6	Very innovative	6	6	6		6
Very promising	7	7	6		7	It si quite promising	7	7	5		6
Not promising	3	5	4		1	Not promising	5	4	3		3
not promising. Follow up of patient may be hard to achieve	2	2	4		2	Not promising. Except the DSNO is based in the PHC	2	2	2		2
Fairly promising; Pros: Test conducted by a trained personnel ; Cons: ratio of health workers to patients might be low	7	7	7		6	Less promising . Pros: The DSNO is a trained officer who has greater skills in performing accurate diagnosis and record keeping. Cons; Non-constant availability of DSNO ; Long Patient waiting time. Communication problems in notifying the DSNO . ; Urine sample may disintegrate if kept for a long time	5	2	2		1
It is limited in terms of the potential impact, as needing to visit the PHC introduces practical and financial limitations for the patient. Little healthworker/organizational effort is required.  In Ivory Coast, the practice was to collect urine of potentially infected people and only send the urine to the PHC where we had a temporary lab set up. After performing diagnosis via microscopy for all potentially infected people, we made a list of all infected people and returned to the village to hand out medication in the correct doses.	6	3	6	6	2	As logistics can be difficult in these areas, introducing a large logistical network introduces hurdles for everyone involved. Depending on the practicalities and cost of this system I think little people will come to the PHC in order to wait for the DSNO to come and perform a diagnosis. As the device needs to be portable, it will have more demands than the one at the PHC, but the conditions are more controllable than in the village, resulting in less demands.	5	3	5	6	2
This scenario is promising it reduces the obstacles required for the patient to get more accurate diagnosis but it doesn't solve the awareness problem which I think is important.	6	6	6	6	6	This scenario doesn't suit the context due to high prevalence of the disease	3	3	3	3	3
promising. Every PHC lab should have such a device. The question is if it should be like scenario 2 at the PHC consultation or this scenario at lab. Preferably at consultation. What would be exactly the difference? It will be in the same building, but other person is operating	6	5	5	5	5	May be from a healthcare and policy system perspective this might fit the best. DSNO will take the responsibility of the diagnostics and administration. Con., makes it less accessible for patient	5	4	6	5	3
Disease is a community disease with community approaches for intervention at the control to pre-elimination phases. Persons do not have presentations since the disease is insidious. At a later stage, expanded testing with feedback mechanisms may be helpful. This strategy will also have to ensure that medicines are available to appropriately manage cases that may be challenging especially if the patient had taken the dose for that round.	2	3	3	3	4	The basics has been stated. The disease and current strategies are help full at the control to elimination phase.	3	3	3	3	3
community health worker still has to send suspected cases to the lab. what if he could do the test for confirmation that would be better.	6	5	6	6	6	not promising as the device is a bit far away from the patient to be tested.	4	3	4	5	4
Very promising. It will improve intake by patients, reducing visits to referral centres and the cost implications, and makes work easier for the laboratory staff.	6	7	6	6	7	Good. DSNO administers relevant questionnaires while the CHEWs or Laboratory technicians carry out the testing.	5	6	6	6	6

Case management 6 - Community screening after case						Case management 7 - Check up after treatment					
Feedback	Desirability [healthworker]	Desirability [patient]	Organizational feasibility	Technical feasibility	Potential Impact	Feedback	Desirability [healthworker]	Desirability [patient]	Organizational feasibility	Technical feasibility	Potential Impact
Is promising and cost effective.	5	5	5		5	This is also appropriate to ascertain the effectiveness of the device.	6	6	6		5
Same Help quick diagnosis May be too costly	7	7	7		7	Same as earlier post	7	7	7		7
	6	6	6		6	Fantastic	6	6	6		6
It is very promising since it is will be very easy to use	7	6	6		7	May be a bit helpful	4	6	4		4
Very promising	7	7	7		7	Very promising	7	7	7		7
The victim may have been infected from another environment. This may result in waste of resources	2	2	3		1	I don't think this will be feasible. What happens when the health worker meets the absence of the patient on several visits?	1	2	5		2
very promising. Pros: large coverage. Cost effective. fast-tracks case management of the disease	6	7	6		7	Very promising. Pros: improved treatment ensures healthier community. Complete treatment lowers risk for diseases transmission	7	7	7		7
Can have a large impact on a community if proper treatment can also be provided for all. I think it introduces similar limitations and requirements as the first scenario in the community.	3	7	3	4	7	Might have an impact, but patients can have a positive diagnosis for a long period after treatment due to SH eggs being retained by tissues and only slowly being released. This is also to be taken into account when detecting very light infections (eggs might be calcified after some time, indicating that the patient is not actually infected, but this is often difficult to assess and introduces high product requirements). Reinfection might also occur after treatment and the second test, as water sources can remain infected several weeks (up to 6 weeks if I remember correctly).	3	2	3	2	3
How do we get that one case confirmed in a community without awareness of the disease or PHC?	5	5	5	5	5	Yeah! it is very promising to improve case management but it would be difficult in the context we are considering	5	4	5	5	6
In my perspective it makes more sense to bring a device to community to do multiple test at the same time than just one. In this case you will multiple tests. The device could be faster... better administration, etc.	6	5	6	6	6	important but has less priority..	4	5	4	4	3
As stated for others. However, we talk about democratizing tests but we must look at this chronic disease and how community responds to community and mass interventions	3	3	3	3	3	This is critical in surveillance at the community level alongside other monitoring strategies. We can look at coverage data and current disease data. This is the opportunity. The emphasis has always been on coverage. So, what if coverage is 90% in last 3-4 years? what's the burden of the disease? how does this correlate with intervention? A cheaper an easier test will support larger sample monitoring unlike the proximate sampling that is done currently. strong follow up mapping to guide other strategies like vector control and when data will support messaging for awareness are critical. Diagnosis will be critical here and data can be obtained from school where teachers can be trained to perform and report testing results appropriately. Note that treatment is currently done at the community level.	4	4	3	3	3
This is also great	6	7	7	6	7	This is very promising as it will provide info about success.	6	7	7	6	7
Very promising. Community diagnosis and treatment. Source of infection can be mapped	6	7	6	6	6	Good	6	5	5	5	7



<b>Most promising case management scenario</b>	<b>Why?</b>
Test to sensitize the community	High coverage
Test in PHC laboratory	Technical know how is important
Test at health worker's community visit	They are at door steps
Test in PHC laboratory	A patient at the PHC will not only have access to the test but will also have access to treatment
Community screening after confirmed case	Prevent outbreak
Test at PHC consultation	
Test to sensitize the community	A well sensitised community will benefit from both diagnosis and taking preventive measures to discourage transmission
Community screening after confirmed case	Best ratio between required resources and the resulting impact
Test to sensitize the community	The reason is that the awareness of the diseases and patronage of Health care centres is very low in endemic region of Nigeria
Test at PHC consultation	If a patient goes to PHC there should be way to test directly a patient. The device does not have to be carried around all the time as such can be less robust. My second favorite would be community screening
Community screening after confirmed case	People do not present in facility per say. Current strategies are community-based
Community screening after confirmed case	This will provide rapidly infos about infectious status and measures will be taken rapidly to solve it It would help sensitize them to uptake testing and treatment.
Test to sensitize the community	The screening help to achieve all the other scenerios as it would serve to create awareness in the community and improve the health seeking behaviour

Control & Elimination 1 - Mapping of other risk groups				Control & Elimination 2 - Impact assessment of deworming day					
	Desirability [FMoH]	Organizational feasibility	Technical feasibility	Potential Impact		Desirability [FMoH]	Organizational feasibility	Technical feasibility	Potential Impact
<b>Feedback</b>					<b>Feedback</b>				
The scenario presented above will much more appropriate with the new device. It will help in cost reduction on the part of government and mapping at high coverage and ensuring hard to reach areas are covered. This scenario will be very promising because it will improve and aid in rapid and quick diagnosis of the diseased condition among the infected subjects. Also, it will reduce the infection spread if placed at every point of care in different health facilities (primary, secondary and tertiary) and treatment will be prompt because it will be a rapid diagnostic kit or tool. Some of the pros are: high sensitivity, high specificity, short turn around time, be able to proffer the solution to problems or challenges of the older diagnostics test etc. But the cons are: acceptability, capacity building in terms of man power, method of handling based on different facilities e.g storage, technical know how, political will etc.	7	6	7	7	This is also desirable, but this will only target school pupils, not community at large.	6	6	4	4
	7	7	7	7	Very promising. Same as above	7	7	7	7
It will early diagnosis and treatment	5	6	6	6	Help in early diagnosis and prompt treatment	6	6	6	6
It will improve disease detection	3	6	7	7	This is a welcome idea but the attrition should be considered because a number of students would have graduated in 4 years!	3	6	6	6
Promising	6	7	6	6	Promising	6	5	7	7
quite promising	4	4	4	4	not so promising	2	4	2	2
Very promising. Pros: Reaching other subpopulations at risk increases opportunity for control and elimination. COns; Expensive in terms cost and human resources; Sustainability is an issue.	7	4	7	7	Promising. Pros: Ease of use of device allowing test to be done at location. Cons: Oly targeted at school children excluding adults. Ambiguity about whether this would be done appropriately in the absence of a plan	7	7	3	3
It is often found that children have the highest risk of being infected due to their increased contact with infected water sources. This was also confirmed during my study in Ivory Coast. In addition, they are more likely of having a high infection load (also confirmed). Due to this, it is possible to gather more quantitative data (infection load over time) rather than qualitative data. In addition, children have the most noticeable symptoms. With the limited resources available, I think it is best to keep the focus on children, but if the available resources are increased, it is good to also include other age groups.  Note: People in the village in Ivory Coast were upset that only the children were always being tested and they were being ignored. Therefore, it was decided with the village elders that we would not have any requirements on the participants' age.	4	6	6	3	Having a higher throughput might be difficult to achieve on a technical and organizational point of view (experts are very fast, the sample preparation kits are often not available for large scale testing). Still, this could be a good indication for the effectiveness of the program and identify factors influencing the effectiveness.	5	3	4	5
This scenario is very promising	6	6	6	6	Yes it will be very promising for control and elimination program	6	6	6	3
May be connected to specific professions like farmers or fishermen. As part of their working circumstances. As such might not be ministry of health. But more big faming cooperation who want to have healthy workers. If we really want to eliminate then we have to kill worms also in adults	4	6	6	5	yes like the idea a lot. With direct digital data connection with NTD modelling group at erasmus MC for example	6	6	6	6
Excellent for mapping as against case management	7	7	7	7	very promising and helpful. The truth is that more tests will be in the hands of more people who will have to monitor and report nicely. There is a business case here as well as a strong public health case	7	7	7	7
will be easier to do screening for very rural areas	7	7	6	7	Drug efficacy may be evaluated by this strategy	7	7	6	7
Good. Identify community burden and formulate policy for screening and treatment implementation.	5	6	6	7	Very promising	5	6	6	7

Control & Elimination 3 - Test and treatment at deworming day				Control & Elimination 4 - Monitoring in low transmission areas					
	Desirability [FMoH]	Organizational feasibility	Technical feasibility	Potential impact		Desirability [FMoH]	Organizational feasibility	Technical feasibility	Potential impact
<b>Feedback</b> It is promising, this will also reduce cost and also ensure strict adherence to the programme compliance since the teachers are also involved. The teachers expertise will have to be ascertain before the screening exercise.	6	6		5	<b>Feedback</b> The communities will be at disadvantage because the screening will be focusing school children alone. However, it will be cost effective because is only concentrating on a smaller population.	5	5		5
Same as earlier post/ comments	7	7		7	Same as earlier post	7	7		7
Early treatment and prompt treatment	6	6		6	It will reduce long waiting time	4	5		5
It is will improve the disease control	3	6		7	It is promising but leaving out other identified at risk groups may be a con	3	6		7
Promising	6	7		5	Promising	7	6		6
a bit promising	4	4		4	fairly promising	4	4		4
Promising. Pros: Point of care treatment immediately after diagnosis. More cooperation by the children if the test is to be conducted by teachers. Cons: excludes adults and out of school children. Possible stigmatisation of those diagnosed and treated	7	7		3	Not promising. Pros: None. Cons: the government not likely to invest much in this scenario.	3	3		2
Very promising and eventually we will come to this stage, also due to the decreased prevalence and the potential side effects of the medication. In order to make it cheaper than medication, the preparation procedure should be adapted whilst remaining simple enough that a teacher can assist.	5	4	4	5	if the prevalence is so low that microscope can no longer detect it and there are no symptoms, it might be worth considering whether it is worth the cost and organizational strain. Besides this, the technical requirements for achieving this level of sensitivity are high.	3	3	3	2
This scenario is promising but it will only affect the control and elimination of the disease among children	4	4	4	4	it is very promising	5	5	5	5
also nice. Could save drugs and reduce resistance. Just cure those infected. May recreates also more awareness then just giving everybody a pill	5	6	6	6	interesting for elimination...but in many cases not yet there, Also need high sensitivity. May be good solution for the mid term	4	5	4	4
There are many opportunities so far records are kept and aggregated. For example the school, the community coordinators and special programmes for out-of-school and special community targets	7	7	7	7	Schools and other strategic platforms	7	7	7	7
since only those who test positive receive treatment, this will reduce the fear of resistance development	6	7	6	7	not sure	4	4	4	4
Good. It would reduce the cost of deworming and development of drug resistance	6	6	6	7	Very promising	6	6	6	7

Control & Elimination 5 - Assessment of elimination of disease						
Feedback	Desirability [F/MoH]	Organizational feasibility	Technical feasibility	Potential Impact	Most promising scenario	Why?
Not promising. The world is revolving, another device with higher specificity might have come on board.	4	4		4	Mapping of other risk groups	It ensures the coverage of other groups at risk.
Same as above post	7	7		7	Test and treatment at deworming day	For specificity purposes
Fantastic	2	3		3	Impact assessment of deworming day	Will help to know the impact of deworming program in the state identification of the other at risk group will ensure complete elimination and not just the elimination among school age children
The scenario is promising. However, if the new test is just comparable to microscopy (my understanding of the schema) then it may not be the needed test	3	6		5	Mapping of other risk groups	
Slightly promising	5	6		5	Mapping of other risk groups	Holistic
Promising	3	4		4	Assessment of elimination of disease	
Not promising. Pros: Nil . Cons; The effort for elimination should be based on high and sustained level of community awareness and destruction of the cercariae.	7	5		5	Mapping of other risk groups	Covers larger group of people
Same as previous scenario. And if it is completely asymptomatic, is it still considered a public health problem?  Note: With the amount of people still being infected and limited sanitarian facilities in Africa up to now, I don't think the WHO goal will be met within 5 years.	3	3		2	Test and treatment at deworming day	On the road towards the elimination of Schistosomiasis, I consider the transition to this approach as being essential.
It is very promising	6	6		6	Mapping of other risk groups	
least important on the short term..	3	3		4	Impact assessment of deworming day	direct monitoring of impact drugs. only interesting if data are directly used
Every strategic platforms. Case detection will have to be activated at several levels using the natural history of the disease and the performance of the tests. It is important that tests that are flag current infections would be relevant here as well.	7	7		7	Monitoring in low transmission areas	Monitoring is critical and same applies to assessment of elimination or mapping of risk groups especially in hot spot areas
not sure	6	6		5	Test and treatment at deworming day	Treatment is more specific in this case and rapid given that we have a fast device for diagnoses in the community It will help to prevent reinfection of the already treated cases, and is key to the other scenerios
Very good. Ease of use, sensitivity and portability	6	6		7	Mapping of other risk groups	

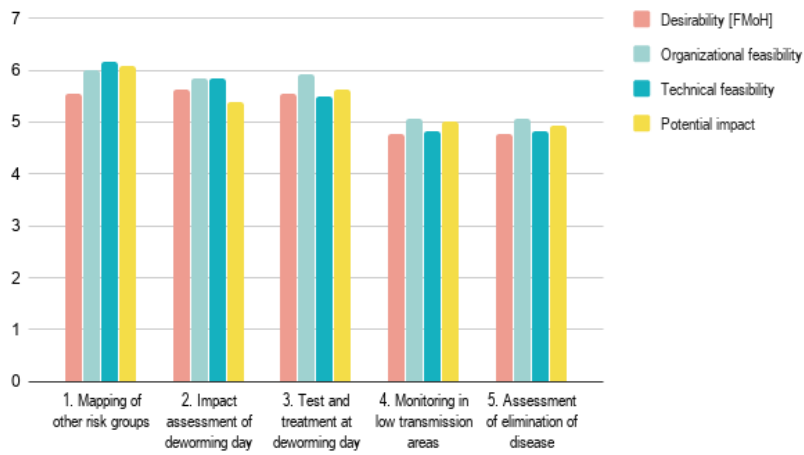


Figure K1. Ratings on desirability, feasibility and impact for case management scenarios

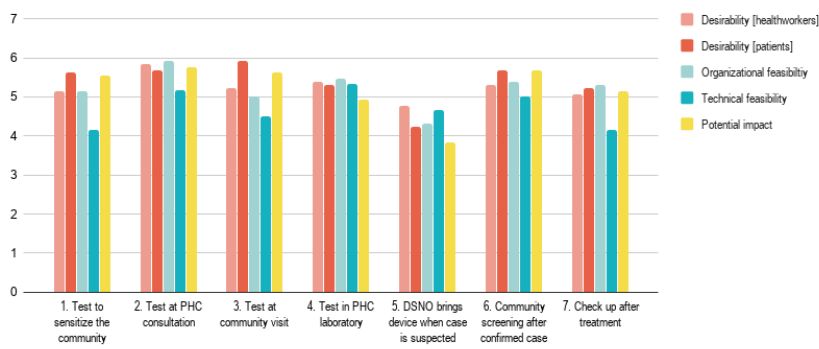


Figure K2. Ratings on desirability, feasibility and impact for control & elimination scenarios

# L. Scenario feedback

Respondent	Occupation	Most promising scenario case management	Most promising scenario control & elimination
Mirte Vendel	COO AidX Medical from TU Delft	Test to sensitize the community	Test and treatment at deworming day
Adeola Onasanya	Medical doctor + PhD student from TU Delft/Nigeria	Test to sensitize the community	Impact assessment of deworming day
G-Young Van	Researcher from TU Delft	Community screening after confirmed case	Mapping of other risk groups
Maryam Keshinro	Medical doctor from LUMC/ Nigeria	Test to sensitize the community	Mapping of other risk groups

Table XX Respondents for scenario feedback

## 1. Sensitization tool

This scenario is desirable for patients on the long term. They do not immediately get a results, but it will increase their knowledge and awareness which might improve their health on the long term. Actual visual evidence - photos or videos - instead of the regular verbal health education makes a bigger impact on the community.

According to Mirte it is promising to target schools, where the test can be part of their health education. However, according to Maryam it is better to target other people in the community; they will sensitize the children. Targeting the most important people – the gatekeepers; imams, men, grandmothers, chiefs, teachers has the biggest effect on the long term since they have influence in the community.

People in the community might be suspicious at first, especially when it is free. It is important that they see what your intentions are. Showing that the test works on yourself or arrange urine from patients (with help of CHEWs) will convince the community and they might want to get tested too.

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Community mobilizers do not have technical background, but they have experience with health education and RDTs. This scenario might not directly be desirable for healthworkers, since they need extra training but it will give them a helpful tool to improve health education practices. The device should be part of a health education program; including promotional material like reflector jackets, tshirts, face caps and banners. Media can be involved to spread the message; towncriers can spread messages or jingles on the radio.

Organisational feasibility depends on the state government. Implementation should start with the SMoH – LGA has some independency, but

there is more chance of success when SMOH is involved. The state government can be convinced to sponsor if there is proof. There is a high level of suspicion by the government, they feel threatened that they will be exposed. It might be difficult to prove evidence that this scenario has impact – since increased awareness is not directly measurable- to higher level stakeholders. However, Health Education is in their strategy, which might convince them.

When organizing a meeting, it is important to involve the PHC coordinator from the beginning. She or he will inform the LGA chairman, who will be the link to village and ward heads. They are closest to the community and if they give consent, they can link to other CBO's for further organization.

Potential impact is very big, since awareness proved to be the biggest barrier for patients to seek care. More people know the risk and might change their water related behaviour and will go to health facilities once they show symptoms.

Overall, this scenario is highly promising.

## 2. Test at PHC consultation

Desirability for patient, is high for the patient, since case management will be improved and timely. Patients will not be referred, and usually do not have to travel far to the closest health facility. Patients will have more trust in the test with device than in symptom diagnosis of the community health worker.

This scenario is desirable for healthworkers since it requires minimal training and it will ensure a reliable result, instead of symptom based treatment or referral. It reduces the burden on lab staff, since the patient will not be referred. It improves the trust of the community in primary level healthcare.

There are multiple reasons why urine turns reddish, healthworker should ask whether the patient has taken medicine that discolors urine or has eaten beetroots. Healthworker should have a card with different colors of red urine colors.

Organizational feasibility depends on policy of FMOH. The feasibility is low in terms of sample preparation, since that is usually done by trained lab staff. Mirte argues that this scenario will be more feasible once an organization like healthy entrepreneurs is involved. They will ensure proper training and data capturing.

Impact depends on endemicity of the area. In low endemic regions, when one case is confirmed, other people can come and get screened. The frequency of use might be too low frequency of use, so the community first needs to be sensitized. In high endemic regions the impact can be way bigger, since there are more people infected.

Overall, this scenario is promising.

### 3. Test at community visit

Desirability for patients is high, since it reduces the amount of steps to get cured. The barrier is lower to seek care when they do not have to visit a facility and service is brought to their doorsteps. However, the community members might not trust the process. Furthermore, it costs money to call the CHEW to come to your house, so only happens when they are severely ill or in case of emergency, unless it is cheaper than transport to facility.

This scenario is not desirable for health workers, since they are already understaffed. Villages might be difficult to access, due to difficult terrain and transportation challenges.

Organizational feasibility is low, due to shortage of staff. JCHEWs and CHEWs barely visit communities since they do not have time for that. Only when a patient has a life threatening illness, CHEWs will visit patients, otherwise they will advise to visit facility or consult over the phone. It is easy to train CHEWs to use the device based on their previous training. Furthermore, it might not be technically feasible to do the sample preparation and testing in any environment.

Need input from state government, PHC coordinator, then CHEWs will do what they are asked. Only when there is no lab available in the neighbourhood.

Mirte argues that it might be promising when combined with an NGO like healthy entrepreneurs, they carry a backpack and already have tablet

Impact is low because it will barely be used – community members will only get screened when they are sick. Since the frequency of use is low, there is an increased risk of redundancy.

This scenario is slightly promising

### 4. Test in PHC laboratory

Desirability for healthworkers is high because it will reduce and distribute workload (Adeola). Desired by healthworkers in rural areas, since they have the equipment and desired training to do testing themselves, instead of refer patients to far away hospitals. Laboratory staff might be hesitant at first, since the device will be a threat to their work. When showing the difference in cost and time to result between current microscopy and the new test, they will accept it – since it makes their job easier.

Desirability for patients is high because patient does not have to be referred somewhere else, reduces load from hospitals. Furthermore it will reduce long waiting hours in the clinic, if they do perform diagnostic tests there.

Organization feasibility is high, since primary health care centres already have a lab and equipment for sample preparation. Lab staff – even the assistants – are already trained to do sample preparation. However, SMOH needs to be convinced that device is important for primary level, since they are the ones who procure and distribute medical devices.

Potential impact is high endemic areas, makes it easier to access health for sick people, Less chance of patients not going to the referral. Not very interesting for PHC labs in low endemic areas, since there are so little cases. Interesting when in hospitals at high endemicity where the lab technicians are very busy with diagnoses all day.



## 5. DSNO brings device

Healthworker desirability is low. It makes it easier for the DSNO to stick to the protocol of FMoH, where the case needs to be confirmed. However, the DSNO is too busy to visit everyone, especially when they live far away in the rural areas. It will give extra work to the DSNO. Usually the DSNO is a trained officer with greater skills in performing accurate diagnosis and record keeping, however, the DSNO is not constantly available. DSNO is needed for elimination of the disease, so it becomes more interesting scenario once elimination is close.

Patient desirability is low, because there might be long waiting times before the DSNO arrives and conducts the test.

Organization feasibility This scenario is easy to implement when DSNO is located in the PHC. In rural areas, however, it might be difficult and time consuming to visit health facilities. LGAs can be very big and there is usually only one DSNO per LGA. There might be communication problems in notifying the DSNO, since this is usually done via phone but there is not always phone reception in rural areas. Urine sample may disintegrate if kept for a long time.

Impact is very low, because it might not reach any new people. Since there are not very frequent cases. It does not reach more people and requires a whole system change, which might be challenging to implement

Overall, this scenario is not promising.

## 6. Community screening after case

Desirability for patients is high. They do not have to go somewhere to get screened. Once they are infected they will immediately receive treatment.

Desirability for healthworkers is low since it will increase the workload for the staff. It will add an extra task to their work.

Organization feasibility is high in terms of applicability, it can be integrated into the current journey. Depends on whether drugs are available. Feasibility is low in terms of organizational on policy level. It does not directly fit into the strategy of the government. Costs might be high, so might be difficult to convince government. Must be organized top-down, since it is an extra procedure. Interesting, but outside scope of product developers.

Impact can be big since there is a large coverage.

## 7. Check up after treatment

Desirability for healthworkers is low. In general, healthworker does not really care, since the general belief is that praziquantel works. Visiting the community for check-ups will take extra time from staff. However, it is nice for healthworkers to validate that they have treated the right thing (since there could have been a misdiagnosis or co-infection with another disease) and that the patient is now cured.

Desirability for patient is high when a CHEW visits them, since it ensures effective treatment. Monitor their therapeutic process by telling them if the number of eggs has reduced. Desirability is also dependent on costs of check-up, since most people are not willing to pay extra for a check-up. However it is double trouble if they have to go back to PHC.

Organizational feasibility is quite low. It will take extra time from staff. There is already a shortage of staff, and this scenario requires them to do more community visits. It will be too costly, especially since there is a chance that the patient is absent during visits.

According to Maryam, check up should happen 3-6 months after treatment.

Impact is low, since PZQ is in general effective. It will only impact the patients whose treatment was not effective or who did not take the medicine. There are very few patients, so this scenario has too little impact as a standalone scenario, but can be combined with other case management scenarios. However, it does increase awareness in the disease for the patient, since they will be reminded through a check up.

Overall promisingness is low

## 1. Mapping of other risk groups

Technical feasibility might be challenging when testing adults. There are not that many eggs excreted by adults according to Mirte, so it will not be recognized by the algorithm. This scenario might not be very relevant since it will give a lot of false negatives. However, according to Maryam, this reduction is caused by a change in water related behaviour or very old infections where ova are stuck in tissue.

Organizational feasibility is high when mapping is done at occupational groups. It is possible to gather workers together from occupational groups structure. However, it is not feasible for sex based screening. When only womens' urine is screened – since they do domestic chores in the water – there are associations with STD's. It arises suspicion about their sexual activities. Furthermore, Merck only supplies drugs for children, so as long as there is no medicine donor, this scenario is not very useful.

Governmental desirability depends on the available funding. Data gathered by the device can be used as leverage for a new control program. At the moment there is nothing for adults since nothing is in their strategy/policy at the moment, so it is only possible when a NGO provides sufficient funding for a new control program. WHO guidelines state that there should be a control program for high risk groups as well. According to Maryam, there is a responsibility for the government. Merck, WHO and Evidence Action focus on children, government should take care of adults.

Impact can be high, since it can leverage a control program for more risk groups which are now not included. It will help cost reduction for the government and reaching high coverage mapping. Especially if drugs are given afterwards, it can prevent drug wastage and reduces adverse effects (NTD officer Ibadan North). The device will enable coverage in hard to reach areas. Other subpopulation at risk will be reached which increases the opportunity for control and elimination. However, it can be expensive in terms of cost and human resources. On the long term, it will decrease the disease burden and loss of man hours, which is beneficial for the Nigerian economy.

Overall, this scenario is highly promising.

## 2. Impact assessment of deworming day

Technical feasibility of this scenario is low – microscope can not be replaced at this moment yet. It is difficult to compare the results when the diagnostic method is different, since the baseline information was measured with microscopy. So in practice, this would mean that this can be used as research to proof that the device is good enough and all samples are tested with microscope as well, since this method was used during the mapping. Very interesting opportunity for proof of concept.

Organizational Feasibility is moderate in a sense that it will happen sure, but it might be difficult on such short terms. However, since there is no plan yet, it is possible to get involved from an early stage. The scenario is promising; however, it only targets SAC, not community at large.

Governmental desirability is high, since there is a need for impact assessment soon. The ease of use of the device allows the test to be done at location, which makes it cheaper and thus more desirable

Impact can be high. However, mentioned ambiguity whether this would be done appropriately in the absence of a plan.

## 3. Test and treatment at deworming day

Organizational feasibility is very low when teachers do the test, it is too difficult for them to do the test. However, there would be more corporation by the children if the test is to be conducted by teachers. Someone with technical skills is required at the deworming day, which makes organization more difficult.

Governmental desirability on short term is low, since treating is cheap. However, they are depending on medicine donor Merck for donations. Merck eventually wants to go towards targeted treatment, so this might be an interesting scenario when they are involved. Since they are the ones donating the medicine, they can put some pressure on the government.

Impact is high. More efficient medicine use increases the chance of getting treatment. However, it excludes adults and out of school children. It potentially may result in stigmatization of those diagnosed and treated.

Technical feasibility is low. Diagnosing will never be cheaper than drugs according to Adeola as long as there is high prevalence. This scenario only becomes interesting when the donations stop, when there is resistance to PZQ or when the side effects are too extreme for children at certain point. At a very low prevalence, a more sensitive test is required – at least 90% sensitivity – which needs to be able to pick up even only one egg. Specificity is less important, because those who are infected can be treated.

The scenario is promising

#### **4. Monitoring is low transmission areas**

Organizational feasibility is low, since costs a lot of money.

Technical feasibility is low. Certification for a device like this is very difficult and it is unlikely that a sufficient sensitivity can be reached with the algorithm.

Governmental desirability is high, since there is no device like this available yet. However, the focus on the short term is not on this yet since prevalence is still very high. As long as the focus is on morbidity control, it is highly unlikely that the government is interested and willing to invest in a device for this scenario. It can be cost effective, because it concentrates on a smaller population.

Impact can be high, since there is no device available yet for this purpose and the data can help to identify infection hotspots.

At this moment, this scenario is not promising.

#### **5. Assessment of elimination of disease**

Organizational feasibility is low, costs a lot of money.

Technical feasibility is low. Certification for a device like this is very difficult and it is unlikely that a sufficient sensitivity can be reached with the algorithm.

Desirability by government will be high in the future. However, at the moment the effort for elimination should be based on high and sustained level of community awareness and the destruction of cercariae.

Impact can be high, since there is no device available yet that fulfils this function.

This scenario is not promising.

# M. TPP motivation

## M-1 Test at PHC consult

	Attribute	Acceptable	Ideal	Explanation
	Scope			
1.1	Need (value proposition)	Affordable and easy to use diagnostics		
		Enables diagnosis at primary healthcare level and sharing of data; referral to hospital labs is no longer required		
1.2	Use case	Case management at primary healthcare level		
1.3	Target population	Sick people in endemic communities		
1.4	Target community	Communities in areas with high prevalence of <i>S. haematobium</i> in Nigeria		
1.5	Target user of test	Community health workers (CHEWs and JCHEWs) with minimal training		
1.6	Location of test	Primary health facilities without laboratories		
		Inside facilities without windows or with open windows, in a dusty, humid and hot environment		
	Operational characteristics			
2.1	Diagnostic marker	Schistosoma ova		Determined by smart diagnostic technology
2.2	Sample type	Urine	Urine and stool	Enabling the device to process both urine and stool and diagnosing both urinary and intestinal schistosomiasis will bring great added value. Since data is shared with WHO and FMoH it gives them more accurate numbers on schistosomiasis. Furthermore, detection of multiple diseases was mentioned during the interviews with experts and the co-creative session.
2.3	Sample volume	10 ml urine	> 10 ml urine	10 ml is the recommended volume by WHO, but a bigger urine sample will increase the sensitivity
2.4	Sample preparation	Minimal sample preparation with as little ancillary supplies as possible	Integrated sample preparation	User has no experience with sample preparation. In the field there were mixed responses to filtration by CHWs. Some people mentioned that it is too difficult, while others said that it is possible in case there is sufficient training. The sample preparation method should be tested with the users to determine if they can do it. Another option that should be considered is sample sedimentation by gravity. This is easier than filtration, but takes a lot of time and requires fixation of the sample. Since there are few cases, this sedimentation method is an option.
		Precise timing and measuring should not be required		
2.5	Sample stability	Time that is necessary to collect, prepare and analyze sample		Sample should be stable until the results are available. To prevent the ova from hatching, the sample can be fixed with formaldehyde and/or kept in the dark

2.6	Steps performed by operator between sample preparation and result	Test should be easy to use	None	User has limited experience with tests
		Less operator steps than microscopy, none of which are timed or labour intensive		
2.7	Result display and result interpretation	Instrument should have integrated screen, a simple keypad or touchscreen (compatible with protective gloves)	None	Results should be understandable for both the CHW and the health worker. Interpretation should not depend on level of knowledge. Results should be saved to send to DSNO at the end of the week.
		Ability to save results		
		Result should be understandable by healthworkers as well as patients who have no prior knowledge of diagnostic tests and might be illiterate or non English speaking		
		Result and interpretation should not depend on level of knowledge		
2.8	Nature of result	Presence and intensity of infection (low or high)	Number of eggs, infection intensity and treatment that should be prescribed	For the patient it is most important to know the presence of infection and the intensity, so she or he will receive the right dose of medicine. For the healthworker, it is ideal if she or he knows how many tablets to prescribe. The number of eggs can be used by the DSNO to determine the size of the schistosomiasis problem in the area.
2.9	Time to result	Same day result, including sample preparation time	Between 5 - 30 minutes, including sample preparation time	The result should be available the same day. Ideally, the result is available within 30 minutes, to fit the ASSURED criteria. The time in between can be used to educate the patient
2.10	Throughput	1 sample per day	>1 samples per user per day	There are very few cases, so if the device has a throughput of 1 sample per day that is enough. However, in areas with high prevalence or after awareness campaigns; the device can ideally test multiple samples per day
2.11	Training required	Test should be easy to perform after one training, for an operator with some medical training, but no experience in tests	No training, textual and visual instructions should be sufficient to operate the device	Training should be available to train CHWs on how to operate the device. However, since there are so many PHC facilities, it is preferred that the CHWs understand the test without formal training.
2.12	Device size and weight	Table-top device		Test is done inside a facility, where a table is available to put the device on
2.13	Power requirements	Battery power with minimal 8 hour operation between charges		Based on opening hours of PHC facilities  Often, there is no electricity available it is important that the battery can be powered by a generator or solar power. Since that requires planning - the device should indicate when the battery is running low.
		Show battery level		
		Battery charged by generator	Battery charged by solar power	
			Give indication when battery is almost empty	
2.14	Ancillary supplies	Ancillary equipment for sample preparation which is not available in standard PHC	None	There is some ancillary equipment that should be available in PHC facilities, see minimum standards for PHC in Nigeria. [78] Other material should be included in the test kit.
		Standardized, locally available and reusable parts where possible		

2.15	Test kit	Should include all materials for test procedure		The test kit should include everything that is needed for the test procedure and instructions. Furthermore, preferably it includes urine reagent strips for a more sensitive test result, it should include health education material to teach patients about health risks and lastly, a urine color card, to identify the color of the urine. Depending on the color, it might indicate schistosomiasis, otherwise the patient should be tested on other diseases, like malaria.
		Should include instructions on test procedure, administration of medicine, maintenance and cleaning of the device		
			Should include urine reagent strips	
			Should include material for health education	
			Should include urine color card	
2.16	Operating conditions	Withstand temperature fluctuations between 20-40 degrees and 60-100% humidity		Environmental circumstances in Oyo state
2.17	Environmental tolerance of packaged test kit	Should protect device and ancillary supplies against dust		Even though the kit is not transported, it should be protected against dust since it can be dusty inside the health facilities.
2.18	Cold chain requirements	No cold chain required		Not all PHC facilities have a fridge.
2.19	Cleaning	Device and reusable ancillary supplies should be easy to clean without running water		Cleaning method should not require running water, since that is often not available in PHC facilities. It is recommended that ancillary materials are cleaned with bleach, methylated spirit, medicated soap and disinfectant wipes are used to wash all reusable equipment. [27]
2.20	Maintenance & Calibration	Calibration is not required		The CHW has no technical education, so calibration should not be required. Furthermore, the device should indicate when something goes wrong.
		Should give indication when unstable, in case of inadequate sample or incorrect procedure		
2.21	Data acquisition and storage	Able to add patient ID, operator ID, age, facility, location of patients house, sample quality and color	Able to add patient ID, operator ID, weight or height, date, age, location of patients house, sample quality and color, result of reagent strip	According to the IDSR guidelines, the facility level the following data needs to be collected; patients ID number, date of onset of illness, date of presentation at facility, village/location, age, sex, diagnosis, treatment and outcome [34]. The data should be shared with the DSNO weekly. Since not all patients will live close to the health facilities, the location of the patients house should be collected. Due to privacy reasons, this data should not be available to anyone but the CHW and DSNO. Preferable the results should be printed.
			Able to print results + medicine prescription	
		Able to store patient results for at least a week		
2.22	Connectivity	N/A	Device is connected with mobile phone network	The device does not require GPS, since it used inside the facility and will not be moved. Ideally the device is connected to the mobile network, so it is easier to share data with the DSNO.
2.23	Data export	Data is shared on paper to disease surveillance and notification officer	Should export data automatically to LGA disease surveillance and notification officer via mobile network	It is acceptable when the data is shared on paper, since that is the way the IDSR forms work. Ideally, it is possible to share data via USB or mobile network. Besides, it is ideal if the device allows a second opinion from a laboratory from a distance.
			Should have ability to export data on USB	
			Should allow for a second opinion from laboratory on a distance	
Performance characteristics				

3.1	Limit of detection	Should be able to detect light infections (<10 ova) and asymptomatic cases (without haematuria)	Should be able to detect the number of eggs in sample (even if there is only one)	Should be able to detect light infections as well, to be able to compete with a microscope. However, since the exact number of eggs is not required, it is acceptable if the device only distinguishes between light and heavy infections.
		Should be able to distinguish between light and heavy infection		
3.2	Analytical specificity	Detects <i>S. haematobium</i>	Detects <i>S. haematobium</i> and <i>S. mansoni</i>	Preferably, it can detect <i>S. mansoni</i> too, since that gives a more realistic image of the size of the schistosomiasis problem in the community to the government
3.3	Diagnostic sensitivity	Same as microscopy (≈80%)	Higher than microscopy	It should be approved as a standard laboratory (to confirm the case officially according to the IDSR guidelines), so needs to have at least the same sensitivity and specificity as microscopy. Ideally, accuracy is higher.
3.4	Diagnostic specificity	Same as microscopy (≈90%)	Higher than microscopy	
Price				
4.1	Price of individual test	Max 800 Naira (including sample preparation)	Max 300 Naira (including sample preparation)	This price is based on indications from interviewees. However, it was not a
4.2	Price of device	Depends on SPHCDA (indication is max 30,000 naira)	Depends on SPHCDA (indication is max 10,000 naira)	We did not speak to anyone from state primary healthcare development agency. This price indication is based on insights from an interview with a researcher.



## M-2 Mapping of populations at risk

	Attribute	Acceptable	Ideal	Explanation
	Scope			
1.1	Need (value proposition)	Field deployable, cheaper diagnostic test than microscopy so risk groups can be mapped and treated immediately		
1.2	Use case	Mapping of prevalence amongst adults to initiate control program for risk groups other than school children		
1.3	Target population	High risk occupational groups: fishermen, irrigation farmers, etc.		
1.4	Target community	Communities at risk of <i>S. haematobium</i> infection in Nigeria		
1.5	Target user of test	Laboratory assistants for sample preparation (if necessary), community health workers for operating the device		
	Location of test	At occupational group meetings		
1.6		Either inside or outside in dusty, hot and humid environment		
	Operational characteristics			
2.1	Diagnostic marker	Schistosoma ova		Determined by diagnostic technology
2.2	Sample type	Urine	Urine and stool	WHO recommends mapping for schistosomiasis and STH at the same time. Even if mapping is only for schistosomiasis, it should ideally be able to detect intestinal schistosomiasis as well.
2.3	Sample volume	10 ml urine	> 10 ml urine, but can detect ova in smaller samples as well	WHO standards recommend a sample volume of at least 10 ml. The bigger the sample, the higher the sensitivity. However, during epidemiological surveys, not all participants delivered a sample of 10 ml - the device should be able to detect ova in smaller samples as well to deliver results to the patient, but not take the results into account in mapping
2.4	Sample preparation	Fast sample preparation with as little ancillary supplies as possible Easy to perform for someone with laboratory training	Integrated sample preparation	The laboratory assistant has experience with sample preparation, but amount of ancillary supplies should be limited. Ideally, this lab assistant would not be required since sample preparation is integrated. This will save labour costs and reduces the chance of human error in sample preparation, and thereby increase the sensitivity of the procedure. High throughput is more important than simplicity, since the person preparing the sample is experienced.

2.5	Sample stability	Time that is necessary to collect, prepare and analyze 50 samples		Per community, ideally 50 samples should be collected and tested. The time that that will take depends on the organization of the mapping exercise. To prevent the ova from hatching, the sample should be fixed with formaldehyde and/or kept in the dark
			10% of samples should be stored for quality control	Depending on requirements of the FMoH. Storing samples can be done by covering the filter of the glass slide with a piece of hydrophilic cellophane soaked in glycerol [99]
2.6	Steps performed by operator between sample preparation and result	Test should be easy to use	None	Community health workers have no experience with diagnostic devices, so the steps that they need to perform should be limited to a minimum. It should be easy and feel intuitive.
		Less operator steps than microscopy, none of which are timed or labour intensive		
2.7	Result display and result interpretation	Test must be simple to navigate		Device is used by community health workers, who have limited experience with tests.
		Device should have integrated screen, simple keypad or touchscreen (compatible with protective gloves) which functions in various lighting conditions (from direct sunlight to ambient light)		To insert patient information and read results, it is required to have a screen. Since the device is used outside, it should function in various lighting conditions
		Saves results automatically		Saving the results automatically makes the job of the test user easier and saves time. Furthermore, reduces the risk of manipulation or losing result
			Presence and intensity of infection is given, so drugs can be administered immediately if available	To determine whether the goals of morbidity control or elimination as a public health problem have been reached, the results should indicate the infection intensity class. In case there sample is bigger than 10 ml, the device should automatically calculate the amount of eggs per 10 ml, since that data is requested from WHO and data that determines treatment dose.
2.8	Nature of result	Infection intensity, classify in light or heavy infection and number of eggs/10 ml		Mapping requires both qualitative and quantitative data from each individual sampled, in order to generate information about the prevalence and intensity of infection. [32] Since the device might measure a sample bigger than 10 ml, the number of eggs in the whole sample should be calculated to average number of eggs per 10 ml
2.9	Time to result	Same day result	30 minutes, including sample preparation time	The device is required to give a same day result, so the target population can come back for the results and/or treatment in the evening. According to the ASSURED criteria, it is ideal to have a result within 30 minutes.
2.10	Throughput	>50 samples per user per day	>100 samples per user per day	Preferably, 50 samples are collected per community and two communities are visited per day.
2.11	Training required	Test should be easy to perform after one training by an operator with some medical training, but no experience in tests		The test user(s) should be trained in how to perform the procedure, and should be able to operate the test independently afterwards.
2.12	Device size and weight	Small, portable table-top or hand-held device		Since the device is transported by motorbike and used in the community, it is important that the device is small and portable.

2.13	Power requirements	Battery power with at least 8 hour operation between charges		The battery should at least function a whole day without charging. Field trips can take up to a few days before returning to the facility. Charging should be done by a generator and ideally by solar power, since electricity is limited.
			Battery level should be visible and device gives indication when battery is running low	
		Battery charged by generator	Battery charged by solar power	
2.14	Ancillary supplies	Ancillary supplies packaged as a kit	None	There are no supplies available at the test location, so it is required to bring all ancillary supplies for the test procedure. Preferably, these materials are reusable and locally available. Filters are not commonly available in Nigeria, this should be kept in mind when determining the sample preparation method. WHO has standard filters of 14 mm or 25 mm that should be used in case of filtration.
		As little ancillary equipment as possible for sample preparation		
		WHO approved, standardized, locally available and reusable parts where possible		
2.15	Test kit	Should include all materials for test procedure	Should include all materials for test procedure and a spare battery	All material should be included since there is nothing available in the community. Furthermore it should include instructions.
		Should include instructions on sample preparation, how to operate the device and cleaning instructions		
2.16	Operating conditions	Withstand temperature fluctuations 20-40 degrees and 60-100% humidity		Environmental circumstances in Oyo State.
2.17	Environmental tolerance of packaged test kit	Should be able to tolerate transport stress (motorbike or car) and exposures between 20-40 degrees		The device is taken to the communities for tests and transported by motorbike or car. The test might be performed outside, so the test kit should be able to withstand environmental influences.
		Should protect device and ancillary supplies against sunlight, dust and rain		
2.18	Cold chain requirements	No cold chain required		Mapping is done in communities where there is no electricity to support a cold chain.
2.19	Cleaning	Device and reusable ancillary supplies should be easy to clean without running water;	Device and reusable ancillary supplies should be easy to clean without running water	Cleaning method should not require running water, since that is often not available in communities. It is recommended that ancillary materials are cleaned with bleach, methylated spirit, medicated soap and disinfectant wipes are used to wash all reusable equipment. [27]
			Cleaning of the device is not necessary during screening day	
			In case of filtration, there should be an option to check if a cleaned filter is free from ova	
2.20	Maintenance & Calibration	Device should give indication when unstable, in case of an inadequate sample or incorrect procedure		The test user(s) have no technical background, so calibration should not be required during the screening day. Furthermore, the device should indicate when it does not function properly.
		Calibration should not be required during screening day	Calibration is not required	
2.21	Data acquisition and storage	Able to add patient ID, operator ID, date, age, location of sample collection		Data that is required for mapping according to WHO.
		Able to store data and results from at least 50 patients	Able to store data and results from at least 100 patients	Ideally, the field team will visit two communities per day. At the end of the day, the data can be transferred to an USB or to the cloud via mobile network.
2.22	Connectivity	Device has an integrated GPS module	Device has integrated GPS module and connected with mobile phone network	An integrated GPS module allows collection of location data, which can be used for more specific mapping than calculating the prevalence per LGA.

2.23	Data export	Should have ability to store data of mapping in device; number of eggs/10ml, number of cases, location		Data that is required for mapping according to WHO.
		Option to share through USB or mobile network	Share data automatically if there is mobile network, option to share through USB	Data should be shared with government. Mobile network is not always available, so sometimes data should be shared via USB
Performance characteristics				
3.1	Limit of detection	Should be able to detect the number of eggs in sample (detect infections with $\leq 10$ eggs)	Should be able to detect the number of eggs in sample (detect infections with $\leq 5$ eggs)	To detect light infections, it is required to have a limit of detection $\leq 10$ eggs. Ideally, it detects infections $\leq 5$ eggs, so it can be used in the future when the prevalence of infection is lower. [99]
3.2	Analytical specificity	Detects <i>S. haematobium</i>	Detects <i>S. haematobium</i> , <i>S. mansoni</i> and STH; distinguishes between them	WHO recommends mapping for schistosomiasis and STH at the same time. Even if mapping is only for schistosomiasis, it should ideally be able to detect intestinal schistosomiasis as well.
3.3	Diagnostic sensitivity	Same as microscopy ( $\approx 80\%$ )	Higher than microscopy	Should at least have the same accuracy as microscope. Since the device will be used for mapping in areas with a high prevalence, high throughput, simplicity and low price are more important than increased sensitivity and specificity.
3.4	Diagnostic specificity	Same as microscopy ( $\approx 90\%$ )	Higher than microscopy	
Price				
4.1	Price of individual test	Cheaper than filtration + microscopy (approximately \$1)	To be determined, dependent on mapping initiator/financial sponsor	Depends on the financial sponsor, but they can only be convinced if there is a financial benefit for them. Since the sponsor has not been determined, it is not possible to determine the ideal price.
4.2	Price of device	Cheaper than a microscope (approximately 100,000 Naira $\approx$ €250 )	To be determined, dependent on mapping initiator/financial sponsor	

## M-3 Test as sensitization tool

	Attribute	Acceptable	Ideal	Explanation
	Scope			
1.1	Need (value proposition)	Use diagnosis as a tool for health education, to create awareness in the community about the disease		
1.2	Use case	At sensitization meetings		
1.3	Target population	Important people in communities; chiefs, traditional healers, PMVs, teachers, elderly, religious leaders etc.		
1.4	Target community	Communities in endemic areas for urinary schistosomiasis in Nigeria		
1.5	Target user of test	Community resource persons, like community mobilizers or LGA NTD program officers, with minimal training		
1.6	Location of test	At Community meetings		
		Inside or outside in a dusty, humid and hot environment		
	Operational characteristics			
2.1	Diagnostic marker	Schistosoma ova		Determined by smart diagnostic technology
2.2	Sample type	Urine		Determined by smart diagnostic technology
2.3	Sample volume	10 ml	>10 ml	Standard volume - not a hard requirement since the result does not have to comply with WHO standards, but since the test requires a certain sensitivity it is recommended to use at least ml urine
2.4	Sample preparation	Minimal sample preparation with as few operator steps as possible	Integrated sample preparation	CORP has no experience with sample preparation at all and there are no materials available in the community. It should be determined whether it is possible to train CORPs for filtration, otherwise it is required to have integrated sample preparation.
		Requires as little ancillary supplies as possible		
		Precise timing and measuring should not be required		
2.5	Sample stability	Time that is necessary to collect, prepare and analyze sample	> 6 hours	It is acceptable that the sample is stable from the time from collection to results, since the sample will be tested immediately during the sensitization meeting. However, in an ideal situation; it would also be possible to collect a sample prior to the meeting, to know for sure that the urine sample is infected. In that case, the sample should tolerate stress from transport on a motorbike.
			Should be able to tolerate transport stress	
2.6	Steps performed by operator between sample preparation and result	Test should be easy to use for someone with no test experience, except for RDT	None	The user of the test - a CORP - has no test experience except for RDT, so there should be limited and easy operator steps. Ideally, none.
		Less operator steps than microscopy, none of which are timed, require precision or are labour intensive		
2.7	Result display and result interpretation	Result should be visual		To make an impact on the community and increase their awareness, it is important that the community members understand the results. Since the majority of people in rural areas do not speak English and some are illiterate, the result should be visual and available in local language
		Results should be understandable by a user who has no prior knowledge of diagnostic tests. people who are illiterate and in English and local language		

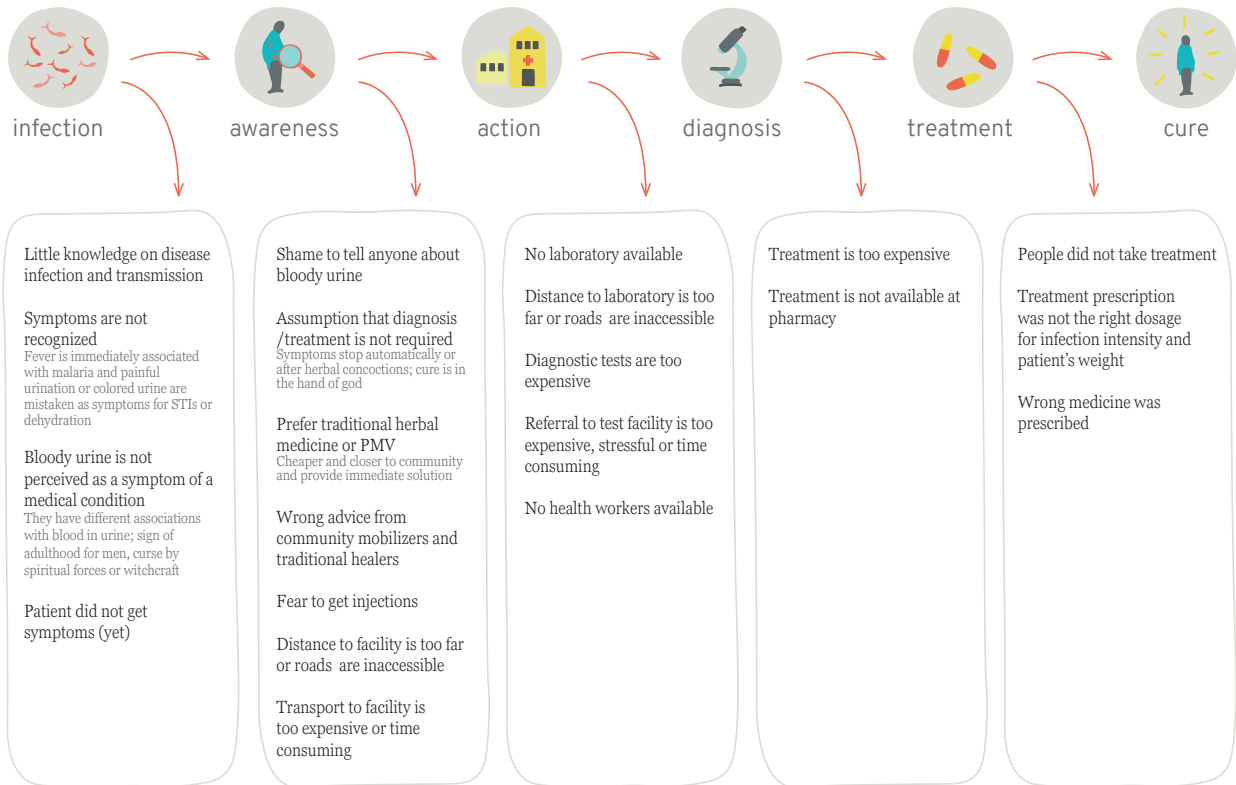
2.8	Nature of result	Presence of infection	Number of eggs, infection intensity and instructions for next steps	The result should show whether a person is infected or not. Ideally it would give some more detail, and gives instructions where the tested person can go for an official diagnosis and/or treatment
2.9	Time to result	Before the end of the sensitization meeting	<30 minutes, including sample preparation time	The result should be available before the end of the sensitization meeting. The time in between can be used for health education. Ideally, the time to result is <30 min to fit ASSURED criteria.
2.10	Throughput	>5 sample per day	Able to test all people at sensitization meeting (around >30 samples per user per sensitization meeting)	To make an impact on the community, it is required to show at least results of a few urine samples. Ideally everyone should get tested.
2.11	Training required	Test should be easy to operate after one training for an operator without medical training or experience in tests		There should be a training for test users to teach them the test procedure. One training should be enough for them to understand how to operate the device.
2.12	Device size and weight	Small, portable table-top or hand-held device		Since the device is transported by motorbike and used in the community, it is important that the device is small and portable.
2.13	Power requirements	Battery power with at least 8 hour operation between charges		The battery should at least function for a whole day without charging. Charging should be done by a generator and ideally by solar power, since electricity is limited.
			Show battery level and give reminder to charge the battery	
		Battery charged by generator	Battery charged by solar power	
2.14	Ancillary supplies	Ancillary supplies packaged as a kit	None	There are no supplies available at the test location, so it is required to bring all ancillary supplies for the test procedure. Preferably, these materials are reusable and locally available. Filters are not commonly available in Nigeria, this should be kept in mind when determining the sample preparation method.
		As little ancillary equipment as possible for sample preparation		
		Standardized, locally available and reusable parts where possible		
2.15	Test kit	Should include all materials for test procedure		Next to all materials and instructions for the test procedure, the test kit should contain referral instruction. Since the CORP can not make official diagnosis to confirm the case, the patient should visit a health centre afterwards.
		Should include instructions on test procedure, maintenance and cleaning of the device		
		Should contain referral instruction		
2.16	Operating conditions	Withstand temperature fluctuations between 20-40 degrees and 60-100% humidity		Environmental circumstances in Oyo state
2.17	Environmental tolerance of packaged test kit	Should be able to tolerate transport stress (motorbike on dirt roads)		The CORP will travel to communities with a motorbike. The test kit should protect the device and materials against this transport stress.
		Should tolerate temperature exposures between 20-40 degrees		
		Should protect device and ancillary supplies against sunlight, dust and rain		
2.18	Cold chain requirements	No cold chain required		There is no electricity for cold chain.
2.19	Cleaning	Device and reusable ancillary supplies should be easy to clean without running water		Often, there is no running water available in communities.
2.20	Maintenance & Calibration	Calibration should not be required	Should give indication when unstable, in case of inadequate sample or incorrect procedure	The CORP has limited technical knowledge, so calibration should not be required. Ideally, the device gives an indication when something goes wrong.

2.21	Data acquisition and storage		Able to print the result and/or a referral to health facility	It is not necessary to collect data. Since CORPs are not official health workers, the privacy details should be protected. The names of people that are tested are not collected. Ideally, some data should be acquired so infected water bodies can be identified. Ideally a result and/or referral should be printed.
		N/A	Able to add operator ID, date, location, age	
			Able to store results	
2.22	Connectivity	N/A	Device has integrated GPS module and connected with mobile phone network	Ideally, GPS data can be collected and shared to DSNO/health facility to identify infected water bodies and communities which require attention.
2.23	Data export	N/A	Should be able to export data via USB or mobile network to health facility	Can communicate to health facility or DSNO where there are suspected cases.
Performance characteristics				
3.1	Limit of detection	Should be able to detect light infections (<10 eggs) and asymptomatic cases (without haematuria)	Should be able to detect number of eggs (even if there is only one)	Part of awareness creation for schistosomiasis is showing that asymptomatic individuals can be infected. To achieve this, light infections should be detected.
3.2	Analytical specificity	Detects <i>S. haematobium</i>		Determined by smart diagnostic technology
3.3	Diagnostic sensitivity	To be determined	Higher than microscopy (>80%)	Sensitivity and specificity are not very important for this device, since it does not make an official diagnosis. Minimal values are still to be determined, since they depend on the goal of the health education program.
3.4	Diagnostic specificity	To be determined	Higher than microscopy (>90%)	
Pricing				
4.1	Price of individual test	To be determined, but free for community members	To be determined, but free for community members	Depends on financial sponsor, but the test should be free for the community members
4.2	Price of device	To be determined, depends on financial sponsor	To be determined, depends on financial sponsor	Depends on financial sponsor

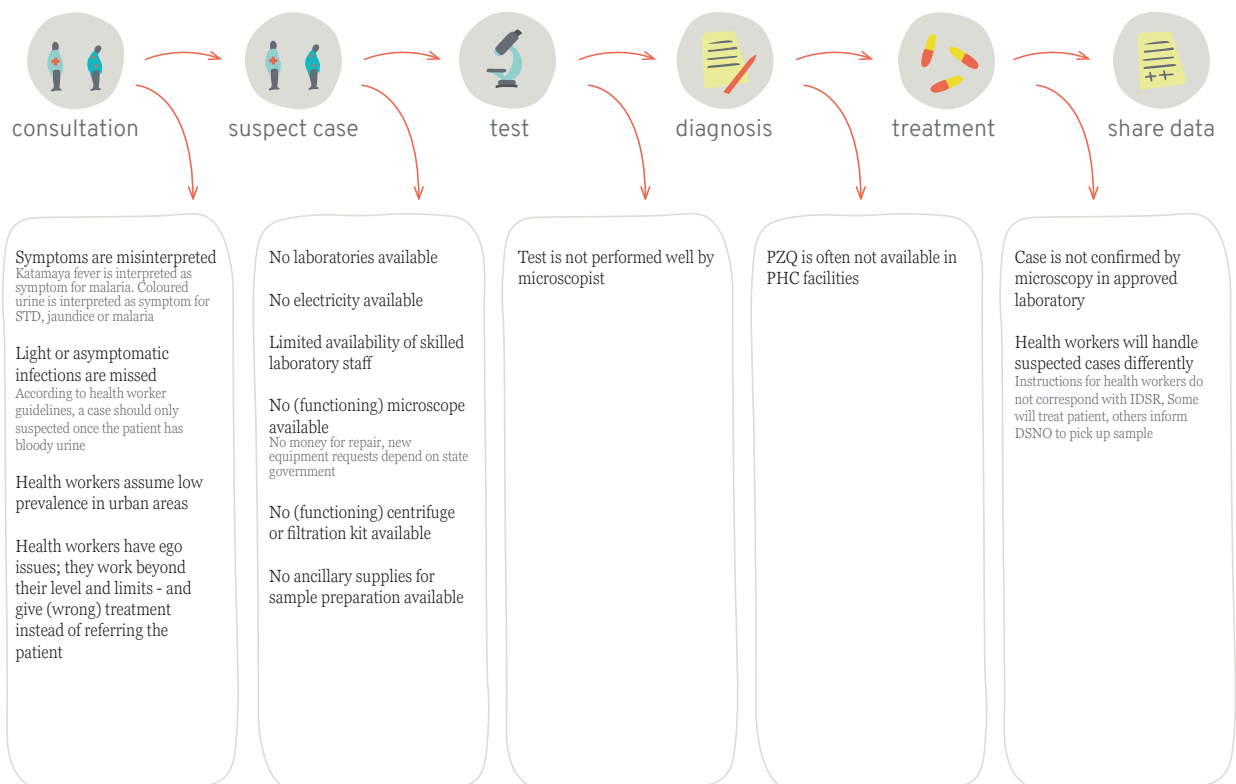
# N. Creative session TPP

## N-1 Input creative session

### Patient barriers in case management

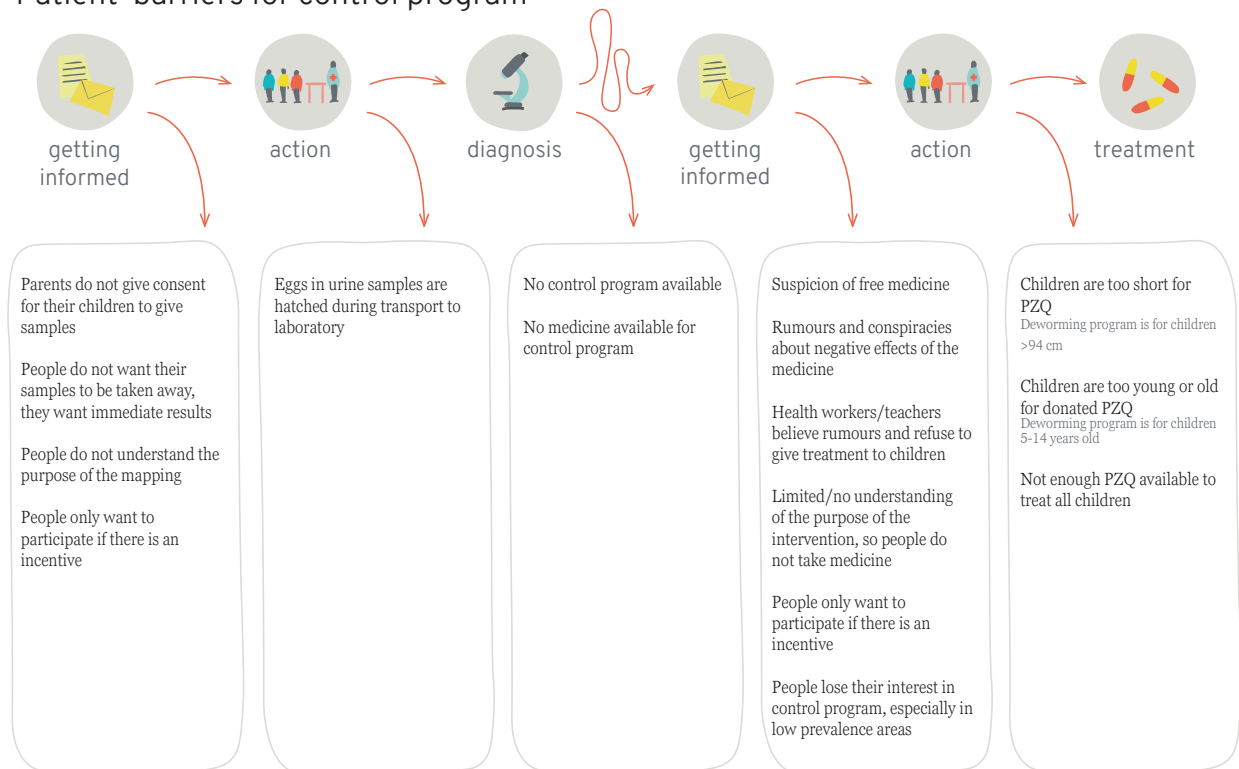


### Healthworker barriers in case management

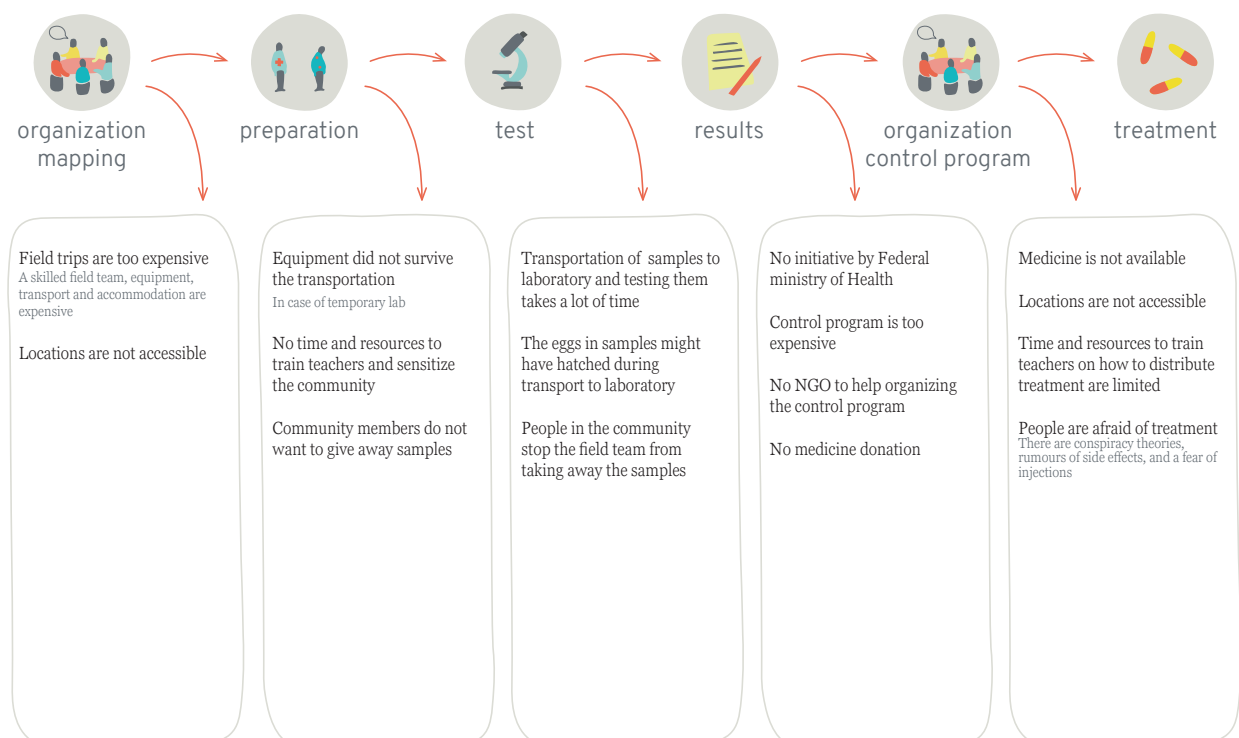




## 'Patient' barriers for control program



## Organizational barriers in control program



# SESSION SURVEY

Team number:

What are your general thoughts on this session?

What did you think about the input you received? Did you miss any information?

Did you experience a difference in the design process between the two sessions?

## List of barriers

What do you think about the lists barriers as design input? (Indicate a point the scale)

Useless ————— Useful

Why?

## Target product profile

What do you think about the TPP as design input?

Useless ————— Useful

Why?

What do you think about the criteria on the TPP?

General ————— Specific

Why?

Where there aspects on the TPP that you did not understand? If yes, indicate which.

Did you miss any criteria/requirements on the TPP? If yes, indicate which.

Any last comments or recommendations?

Thank you very much for your participation!

# N-2 Observations creative session

## 1. Case management group B

After reading the TPP and the barrier lists, they discussed whether they wanted to aim for the acceptable or ideal result. They decided to aim for the highest and focus on ideal characteristics for the device. They started with the sample preparation for both urine and stool samples and looked at options to integrate sample preparation. After 10 minutes they decided that integrated sample preparation was not technically feasible if they wanted to include both urine and stool samples. In the meantime, one of the students made a cost estimation for the device. They went through the target product profile in chronological order. They asked questions whose answers were in the target product profile. After 30 minutes one of the students realized that the device would only be used a few times a day. They changed the design from multiple samples at the same time to one sample at the time.

The group used the list of barriers to extract user needs from, e.g. 'The healthworker wants to feel competent'.

Not all aspects were read well. Their design is portable, while the TPP states that the device does not require to be transported from one place to another. They did not think about charging at all.

## 2. Control & Elimination group B

The second part of the session → focus on procedure and how to scan multiple samples at the same time, to increase the throughput of the device. They discussed how to match the sample with the slide and result. Compared to first session, focussed more on the data that needed to be collected. They decided to keep the design and the procedure low tech. They spend a lot of time to decide on a fitting method. They ended up with a procedure with preprinted QR codes on stickers. Focussed on the workflow, and who is going to do which step and how long it takes so the workflow is as smooth as possible.

## 3. Control & Elimination group A

Group A started with a different approach. They started with going through the barrier list and translating them into user needs for the patient and the test operator. They used a timer for listing the barriers. They took two minutes for each user. After writing down the lists they started from the price.

They decided to go for a replaceable battery, since that will make the device less heavy and the spare batteries can be changed in the meantime.

They did ask some questions about meaning of some of the attributes on the list; e.g. sample stability, cold chain. Furthermore, they questioned some of the values of the attributes, since they did not know where they came from. 'Why does the battery needs to last for 8 hours?'

They did not read all attributes on the TPP well. When listing the health worker needs, they were discussing that the device should be easy to operate 'Oh that is already on the list'

## 4. Case management group A

The students again started from the barrier list. They looked at the needs they formulated for control & elimination stakeholders and added and removed some needs to the lists. They discussed difference in health worker needs, since this health worker is not an experienced in testing. They decided the device has to be very easy to use. They considered using the same device as control & elimination, but then with integrated sample preparation. They discussed the option for an extension kit for the scenario, but using the same device, until they discovered the acceptable price for the device.

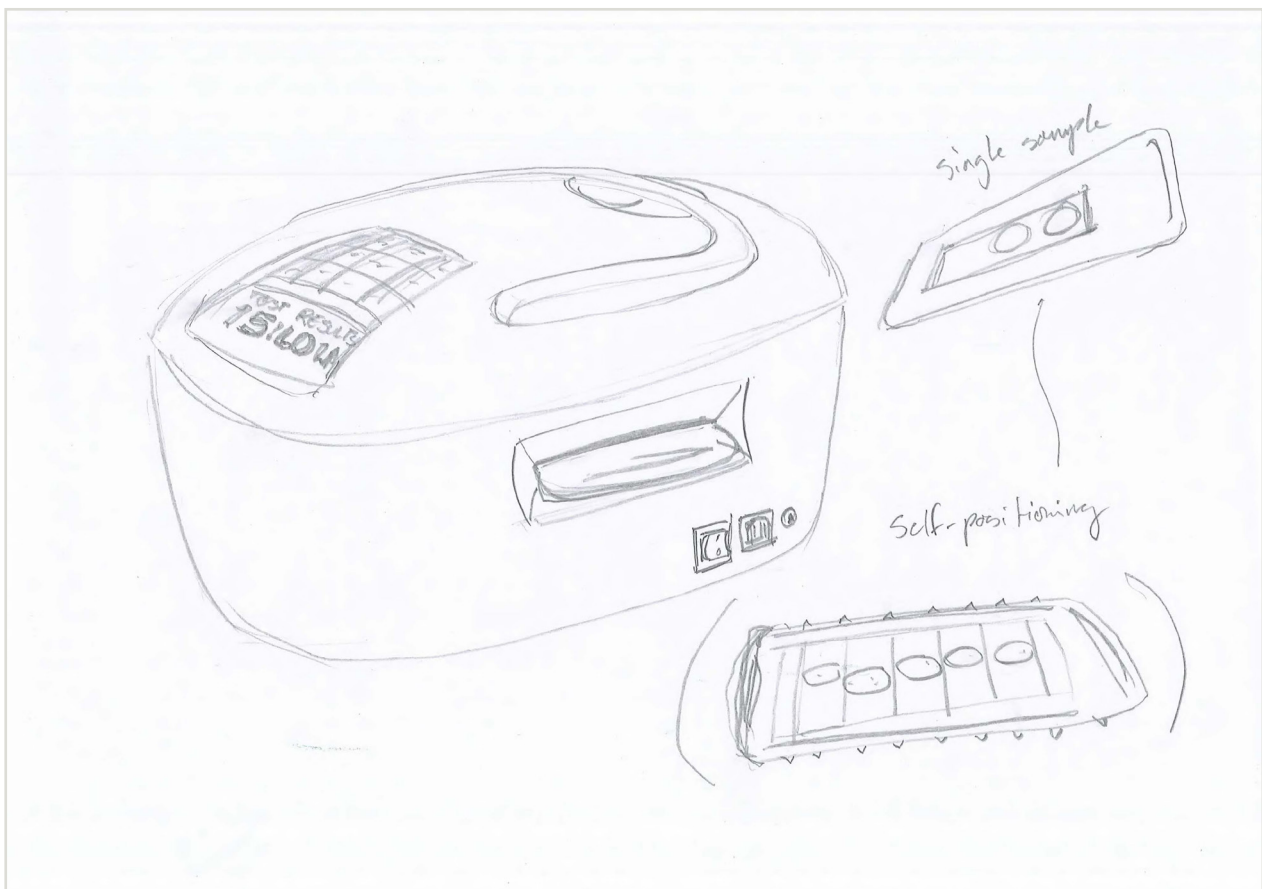
They immediately decided to keep the test as simple as possible to keep the price low. They discussed which product features can fit the acceptable requirements. They decided to go for LEDs to show the result, but questioned whether it gives enough information to convince the patient to trust the diagnosis. They did not only try to keep the device itself as simple as possible – they also tried to reduce the price for ancillary supplies. They decided to go for jam

jars for sample collection and log book to reduce price of the device and the supplies. The extra effort of writing down the results weighs up to the lower cost of no digital data storage.

Overall, the group was thinking from the user perspective, and made decisions based on that.

## N-3 Results creative session

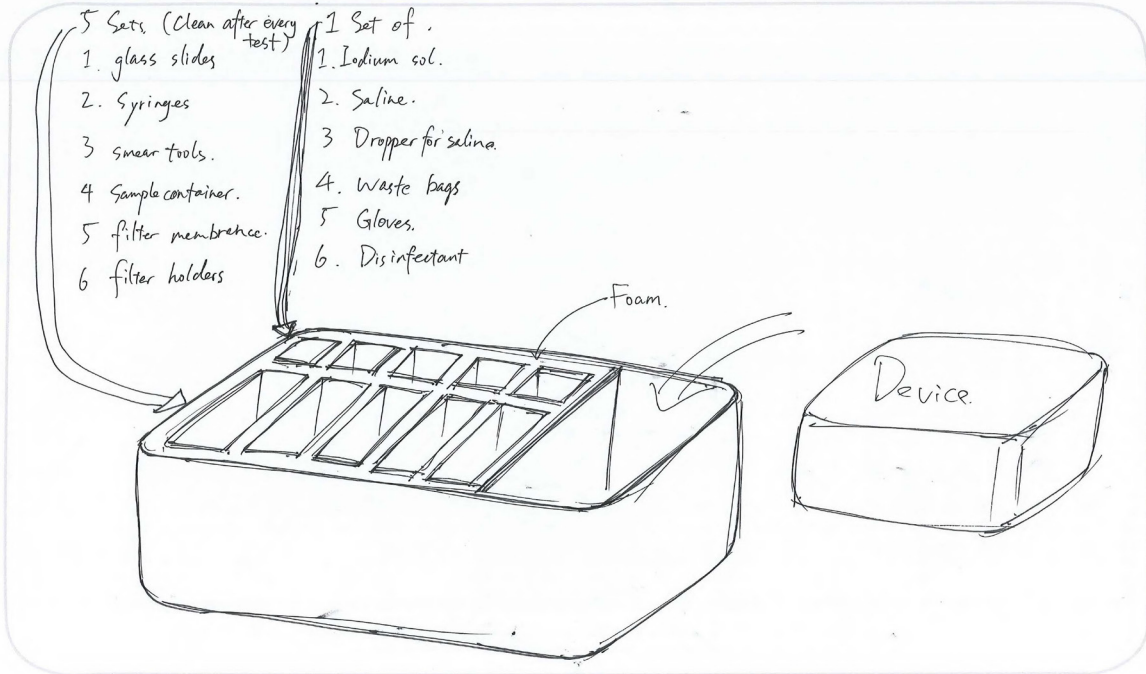
### 1. Case management group B



# TEST KIT

What does the test kit look like?

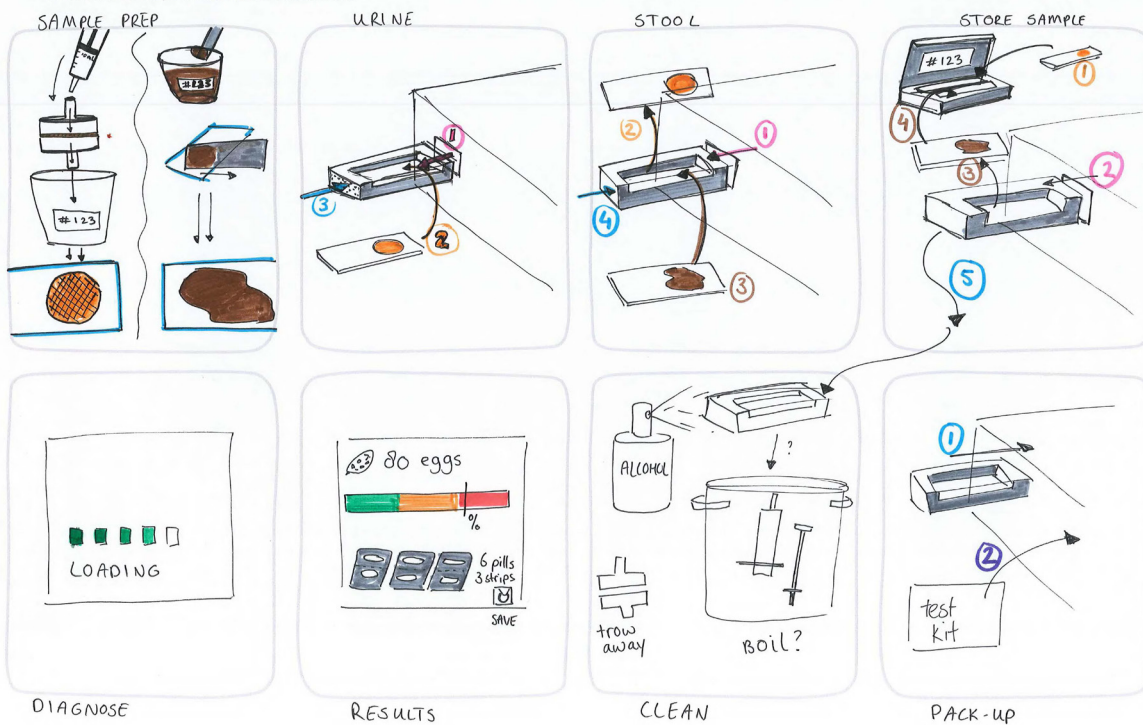
Team number: 17B  
Scenario: Case management



# PROCEDURE

What are the steps in the use of the device?

Team number: 17B  
Scenario: Case management

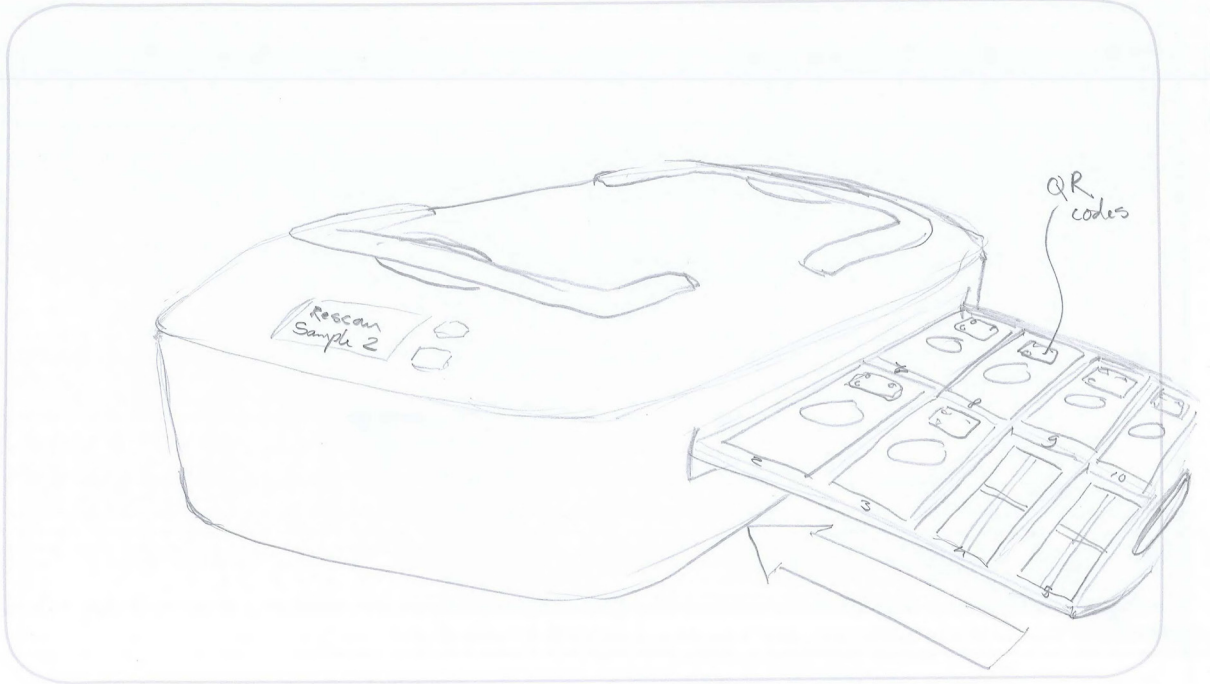


## 2. Control & Elimination group B

### DIAGNOSTIC DEVICE

What does the device look like?

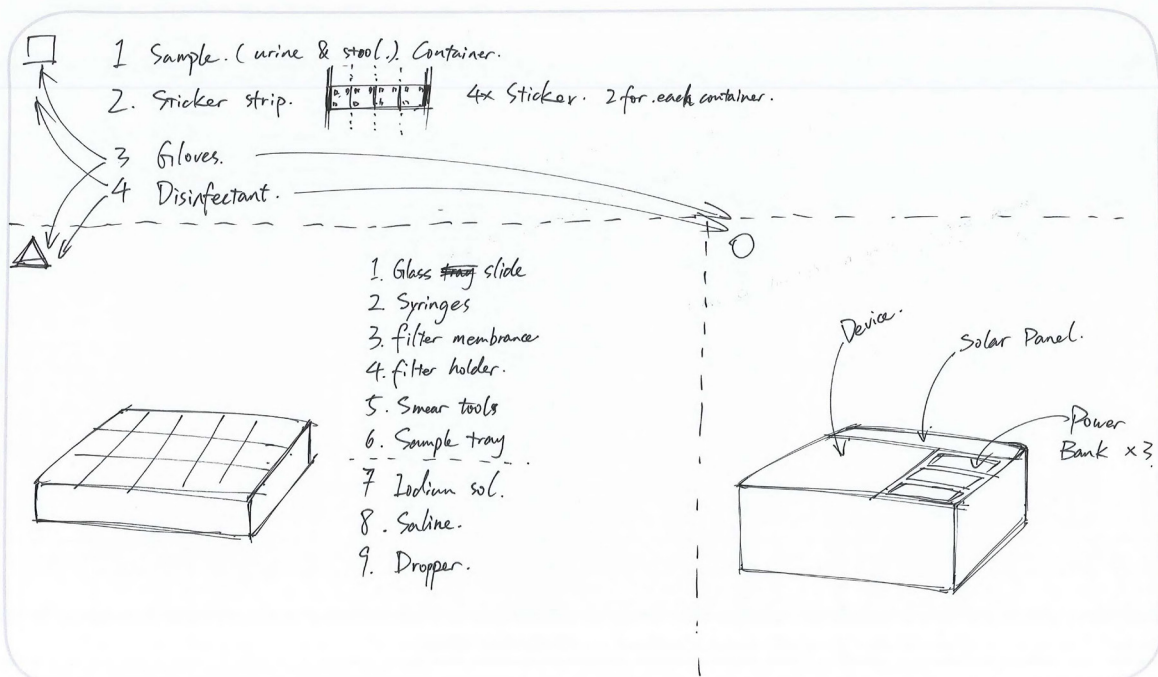
Team number: 17 B  
Scenario: Control & Elimination



### TEST KIT

What does the test kit look like?

Team number: 17 B  
Scenario: Control & Elimination

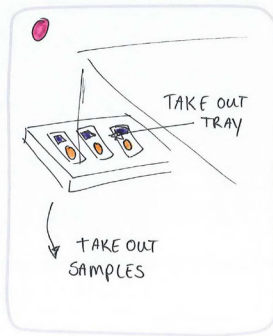
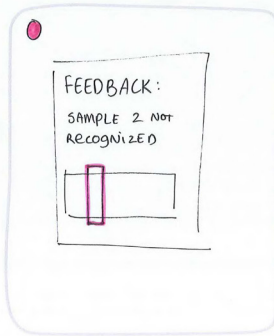
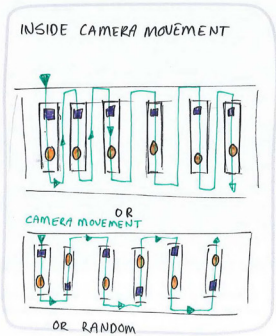
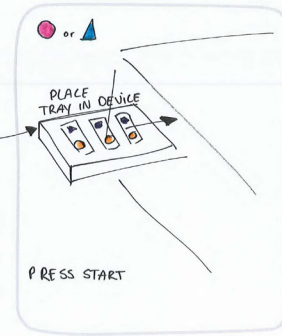
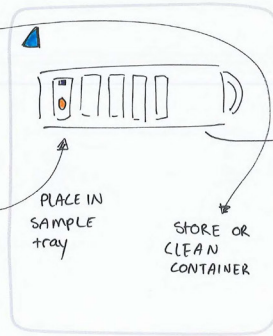


# PROCEDURE (for urine)

What are the steps in the use of the device?

Team number: 17B

Scenario: Control & Elimination





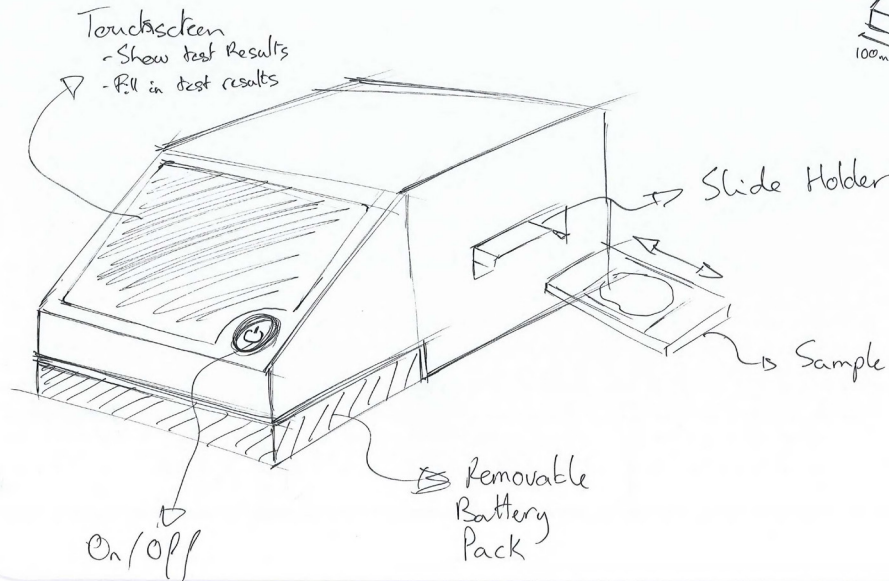
### 3. Control & Elimination group A

## DIAGNOSTIC DEVICE

What does the device look like?

Team number: RA  
Scenario: CPE

Touchscreen - On/Off Switch - Battery Pack - Slide Holder



## TEST KIT

What does the test kit look like?

Team number: RA  
Scenario: CPE

### 1. Slide PREPARATION

#### ① Sample collection:

1. Urine cup
2. Pipette
3. Glass slide
4. Filter
5. Gloves
6. Box
7. Trash cans (plastic)
8. Cleaning (alcohol)

#### ② Medication:

1. Medicines
- 2.

#### ③ ~~Diagnostic~~ Device

1. Hard casing - pill box
2. Device
3. Spare parts
4. Solar charger (for battery)
5. Spare battery
6. Extra storage
8. Scale + measuring tape
9. Scale + weight

#### ④ Info Pack

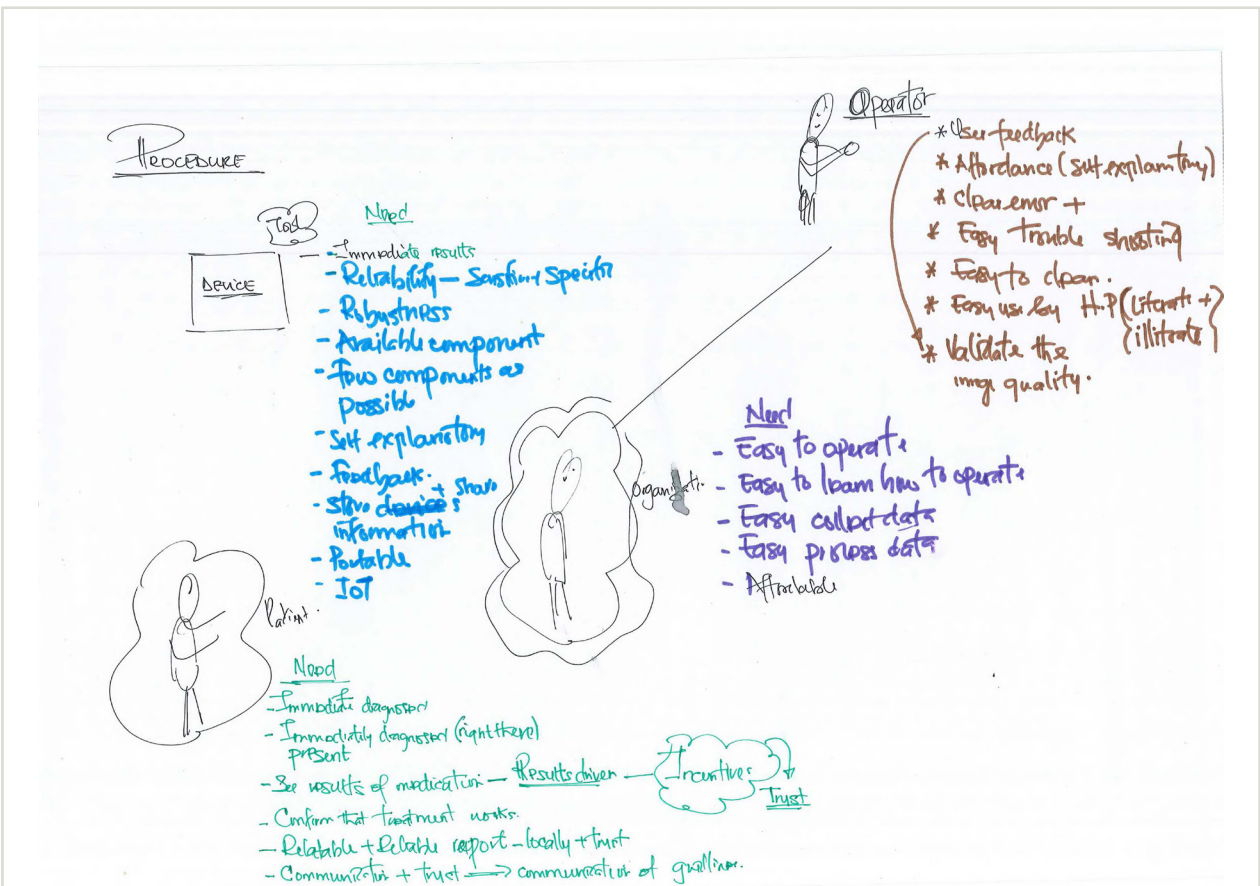
- \* Flyers + information pack

# PROCEDURE

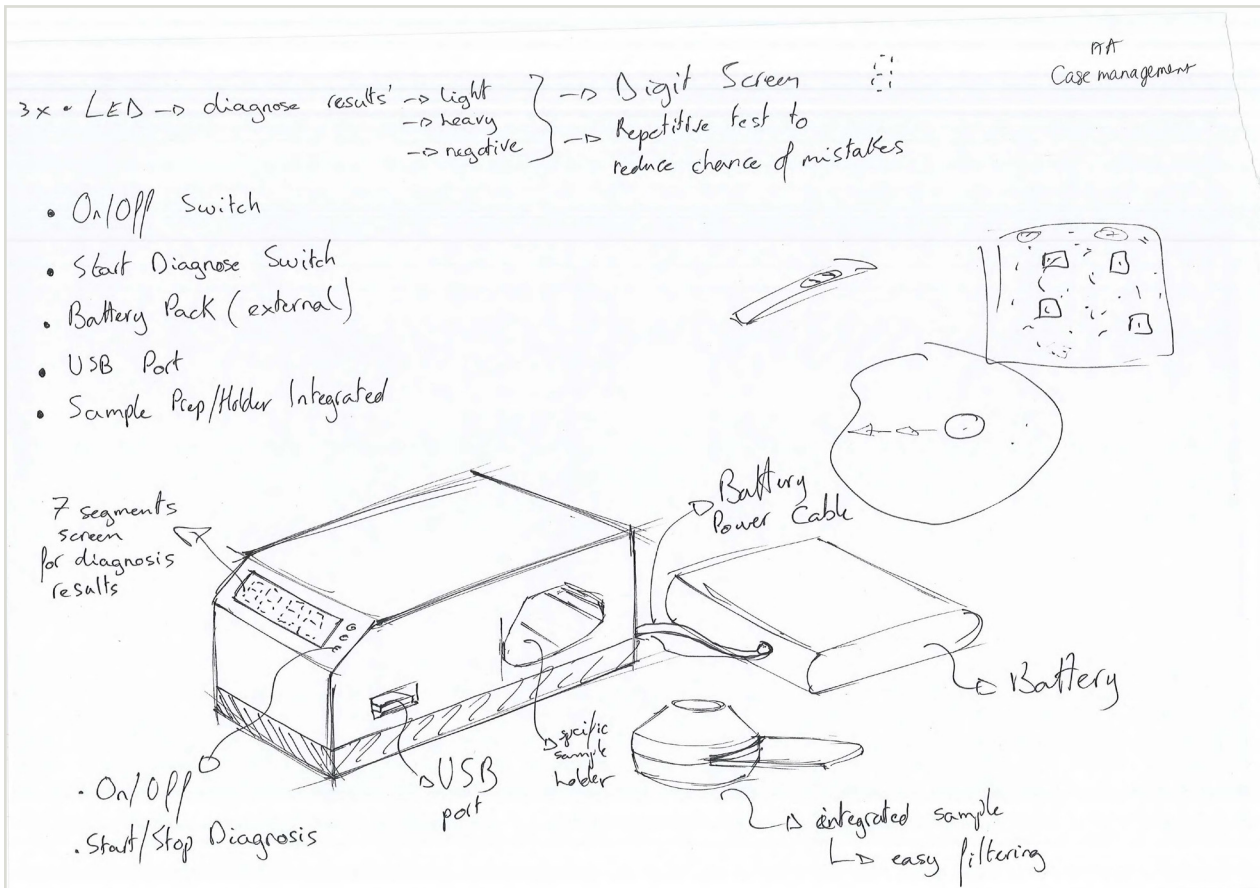
What are the steps in the use of the device?

Team number: 19A

Scenario: CFE



## 4. Case management group A



## TEST KIT

What does the test kit look like?




Team number: 17A  
Scenario: Case management

### Sample collection

- 50 7am-7pm

Replacement parts (frequently, breaking down parts)

### Sample prep

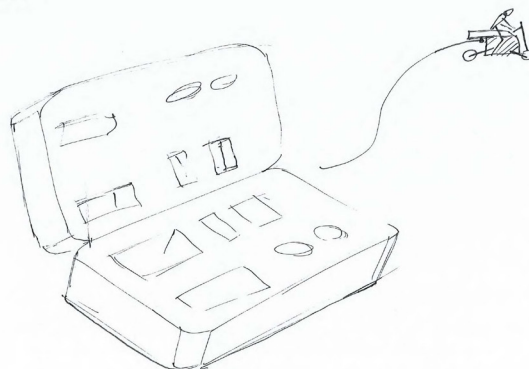
- filter holders  gloves
- filters 
- syringe 
- iodine (coloring)
- cleaning equipment

### Sample Analysis

- Device
- Batteries
- Book (logbook)

### Cleaning

- cleaning agents
- small brush
- piece of cloth



# PROCEDURE

What are the steps in the use of the device?

Team number: 17 A

Scenario: Case management

