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REASSURED evaluation of the Bioline HCV point-of-care testing for diagnosing hepatitis C virus infection in primary healthcare settings of Ghana: a study protocol

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ABSTRACT

Introduction Hepatitis C virus (HCV) infection is a silent epidemic that needs a comprehensive and contextualised approach to manage. Access to readily available, affordable and acceptable HCV point-of-care (POC) in vitro diagnostics (IVDs) is equally required to meet the global HCV goals. However, most guidelines for evaluating these IVDs such as the WHO prequalification process and country-specific standards disproportionately focus on diagnostic performance. The real-time connectivity, ease of specimen collection, affordability, sensitivity, specificity, user-friendliness, rapidity and robustness, equipment-free or simplicity and deliverability to end-users (REASSURED) criteria provide a holistic and user-oriented evaluation of the IVDs in the populations they are meant to be used. Therefore, as part of a multinational study in sub-Saharan Africa, we will conduct an evaluation of the Bioline HCV POC test for diagnosing HCV infection in primary healthcare settings of Ghana using the REASSURED criteria.

Methods and analysis This field evaluation will be conducted in three phases. The first phase will use a cross-sectional field evaluation study design to evaluate the diagnostic performance of the Bioline HCV POC test. The second phase will use mixed methods to ascertain operational characteristics and users' perceptions. In the third phase, a cross-sectional survey will be used to estimate the costs of accessing HCV diagnostics services using three proposed HCV testing models to inform the affordability of the testing pathways and linkage to care in the primary healthcare clinics. This phase will run concurrently with the second phase of the study. Thematic content analysis and quantitative data analysis will be performed using ATLAS.ti V.23.0.6 and StataCorp LLC's Stata statistical software V.16.0, respectively.

Ethics and dissemination The study protocol has been reviewed and fully approved by the Faculty of Health Sciences Research Ethics Committee, University of Pretoria (281/2023) and the Ghana Health Service Ethics Review Committee (GHS-ERC013/08/23). This diagnostic trial has also been registered in the Pan African Clinical Trial Registry (PACTR202410837698664). The findings of the study will be presented in relevant peer-reviewed journals, at local and international conferences, and to all stakeholders involved.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ A systematic and multiphase approach using both laboratory-led and user-oriented field evaluations will demonstrate holistic evaluation of the Bioline hepatitis C virus point-of-care (HCV POC) test.
⇒ The minimum required sample size will be used as demonstrated by respective sample size formulae.
⇒ The deployment of mixed methods in the second phase will ensure robust data collection to adequately ascertain operational characteristics and users' perceptions of the Bioline HCV POC test.
⇒ As the study is designed purposely to evaluate the Bioline HCV POC test in sub-Saharan African population, the researchers do not intend to generalise the study outcomes. However, the study outcomes will be comparable to similar outputs in the subregion as part of a multicountry study.
⇒ Similarly, the researchers do not intend to generalise the HCV prevalence to be generated from the study as the target populations will be used for test evaluation purposes only.

INTRODUCTION

Hepatitis C virus (HCV) infection remains a public health menace and contributes significantly to the global burden of liver disease and complications including hepatocellular carcinomas.[1–5] Known as a silent epidemic in most global settings, 50%–80% of people living with HCV infection are oblivious to their status.[6 7] Annually, 1.5 million new cases are reported with more than 290 000 deaths.[8] Of the 130–150 million cases of HCV recorded worldwide in 2017,[9 10] over 58 million people progressed to chronic HCV and 13% treated as of 2019.[8 11] Existing literature highlights specific vulnerable groups to HCV infection

due to their circumstances of sharing spaces and potentially sharing sharp objects like razor blades and needles. These groups include incarcerated individuals, people who use or inject drugs, those who engage in unsafe tattoo practices, as well as men who have sex with men.[12–14] HCV infection traverses most WHO member regions with 12 million recorded cases each in the Eastern Mediterranean and European regions, 10 million each in South-East Asia and the Western Pacific regions, and 5 million in the Americas as of 2021.[8] However, sub-Saharan Africa (SSA) contributes 2%–5% of the global HCV burden with over 200 000 deaths annually.[4 15 16] This is substantially associated with inadequate testing and linkage to care due to poor or no access to cheaper diagnostics particularly in hard-to-reach and resource-limited communities.[17 18]

The global narrative around medical diagnosis is progressively shifting towards rapid diagnostics testing at point-of-care (POC).[19–24] This was heightened during the peak of COVID-19, which met high advocacies for the implementation of self-testing and near-bedside testing.[25–30] Similarly, the WHO's goal is to make HCV diagnosis closer and more accessible to hard-to-reach communities using POC diagnostic assays,[11] thus linking most viral hepatitis cases to care to reduce viral hepatitis deaths by 65%, and new viral hepatitis infections by 90% by 2030.[8]

Ghana, like most SSA countries, battles with HCV infection with seroprevalence ranging between 1% and 3%.[5 31 32] Arguably, this burden is expected to be disproportionately higher if expanded community-based HCV testing is implemented at POC. This will improve HCV awareness, and boost test uptake and coverage amidst the sizeable hard-to-reach communities that lack access to simple, robust, affordable and user-oriented HCV diagnostic services. Unlike HIV and hepatitis B, HCV diagnosis in Ghana is founded on the over-reliance on screening tests using rapid in vitro diagnostics (IVDs) with little or no attention paid to confirmatory testing.[5 33 34] Moreover, these screening tests have been relegated to blood donors due to poor public awareness.[35] Confirmatory testing may be outsourced to private-owned laboratories and research institutions since no public health facility in Ghana is equipped to reliably offer confirmatory testing for HCV.[5] This development comes with huge cost implications that promote health inequalities among the poor and hard-to-reach communities who solely rely on primary healthcare (PHC) clinics.[17 18 36] To meet the HCV POC diagnostic needs of Ghana's Health system and to improve the HCV diagnosis in the country, there is the need for a reliable diagnostic that can serve its intended purposes.

Several HCV POC IVDs have received different regulatory approvals notably the WHO prequalification (PQ) process and others are 'Conformité Européenne' (CE) marked.[34] However, the majority of these tests' clinical trials did not include African populations, disproportionated in high-income settings and easy-to-reach communities and were largely evaluated on laboratory-based clinical performance.[34] The Bioline HCV test, manufactured by Abbott Diagnostics, includes products (02FK10, 02FK16, 02FK17) that have met the WHO Prequalification process (PQDx 0257-012-00), are CE marked and are registered for use in Ghana by the Food and Drugs Authority (FDA) (FDA/D.21–11702).[37 38] Using the Bioline HCV POC IVD as a case test, this study seeks to evaluate the test based on quality indicators within the Ghanaian health system, particularly in PHC clinics and among the Ghanaian population. The multiphased evaluation will be conducted using the real-time connectivity, ease of specimen collection, affordability, sensitivity, specificity, user-friendliness, rapidity and robustness, equipment-free or simplicity and deliverability to end-users (REASSURED) criteria. This criteria is a revised version of the affordable, sensitive, specific, user-friendly, rapid and robust, equipment-free or simple and deliverable to end-users (ASSURED) criteria adopted by the WHO/Tropical Diseases Research in 2006.[39 40] The update was made to incorporate technological advancements in POC diagnostics after a decade of implementing the original ASSURED criteria.

METHODS

Study design

This study will employ varying study designs to evaluate the Bioline HCV test based on specific components of the REASSURED criteria. In a three-phased approach, the study will be rolled out to address three specific study objectives with each phase addressing each objective. The first phase will use a cross-sectional field evaluation study design to evaluate the diagnostic performance of the Bioline HCV POC test. A mixed method study approach will be employed to ascertain users' perceptions of the Bioline HCV POC test in terms of real-time connectivity, ease of specimen collection, equipment-free or simplicity and user-friendliness in the second phase of the study. To be run concurrently with phase 2, the final phase will use a cross-sectional survey to estimate the costs of accessing HCV diagnostics services using three proposed HCV testing models to inform the affordability of the testing pathways including Bioline HCV POC test and linkage to care in the PHC clinics. Laying foundation for this work, a comprehensive narrative review, was conducted and published elsewhere to shape the study objectives in this protocol.[34] This review summarised the standard regulatory requirements and quality assurance for HCV POC testing in SSA including Ghana. Recommendations for future studies towards evaluating the accessibility, affordability and user-oriented application were made.

Study setting

The study will be conducted in Ghana. More specifically, the study will be conducted in the Central region, one of the 16 administrative regions of Ghana.[41] The Central region is considered one of the smallest regions in Ghana with a land area of about 9826 square kilometres.[42] Specifically, in phase 1 of the study, three HCV target populations will be recruited from two study settings, including the

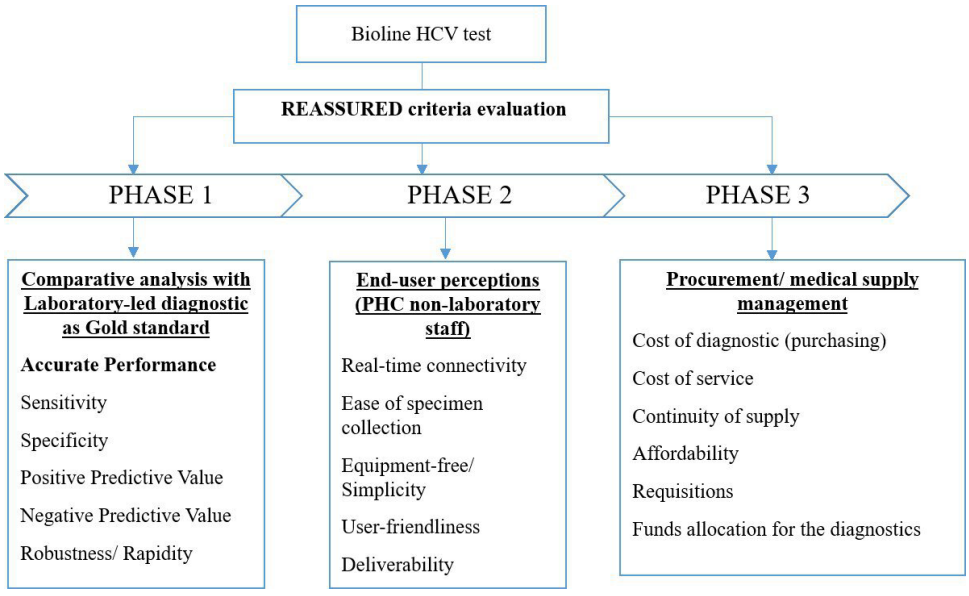

Figure 1 Conceptual framework for evaluating the Bioline HCV point-of-care testing using the REASSURED criteria. HCV, hepatitis C virus; PHC, primary healthcare; REASSURED, real-time connectivity, ease of specimen collection, affordability, sensitivity, specificity, user-friendliness, rapidity and robustness, equipment-free or simplicity and deliverability to end-users.

Ankarful prison, and the Cape Coast Teaching Hospital both in the Cape Coast Metropolis. During phases 2 and 3, data will be drawn from a total of 70 PHC clinics in three districts, thus Komenda-Edina-Eguafo-Abirem, Cape Coast, and Mfantseman out of the 414 PHC clinics in the Central region.[43 44] The selection of the prison was informed by the existing literature that underscores the risk factors associated with confined environments and the sharing of sharp objects. This includes incarcerated individuals, people who use or inject drugs, and those involved in unsafe tattoo practices.[12 45 46] The PHC clinics play a crucial role as the first point of contact for local communities, providing essential medical services such as preventive care, treatment for common illnesses, vaccinations, chronic disease management and health education. In contrast, the teaching hospital serves as a referral tertiary facility for smaller health facilities within and outside the Central region of Ghana, providing emergency services, special clinics, and blood banking facilities.

Conceptual framework

Figure 1 gives a framework that describes the relational connection between key concepts and variables towards evaluating the Bioline HCV test using the REASSURED criteria.[39] This framework guides the three-phased evaluation study under the broader building blocks of performance evaluation, user perceptions and cost-effectiveness indicators in a unidirectional flow. The first phase of the study will address the first research objective, thus evaluating the diagnostic performance of the Bioline HCV test against a laboratory-led HCV reference test (the Fortress Diagnostics qualitative HCV kit, using the sandwich ELISA test principle and to be run on the ChemWell Fusion Automatic Immunoassay Analyzer). This objective will use standard statistical indicators for evaluating the accurate diagnostic performance of POC tests.[47] This includes estimating the sensitivity, specificity, positive predictive value, negative predictive value and robustness or rapidity of the tests involved. The second phase seeks to assess the perceptions of the non-laboratory staff in the PHC clinics in using the Bioline HCV test. This objective will, through in-depth interviews, collect data on user perceptions concerning real-time connectivity, ease of specimen collection, equipment-free or simplicity, and user-friendliness. Finally, the third phase will follow the step-by-step guidelines for disease-specific costing, payments, affordability and linkage to care metrics in low and middle-income countries.[48 49]

Phase 1: comparative analysis

Objective 1: to evaluate the diagnostic performance of the Bioline HCV POC test

Design: Cross-sectional field evaluation study.

Study population: incarcerated individuals, patients with a Clinician's request for HCV test and voluntary blood donors with a request for predonation screening.

Sampling: a sample of the study population calculated by Buderer's formula for diagnostic studies will be obtained using the convenience sampling technique.[50] A total required minimum sample size of 433 will be used for the study, thus 399 and 34 for sensitivity and specificity analysis, respectively assuming a 10% non-response rate.

Sensitivity

$$n_{Se} \geq \frac{z^2_{\frac{\alpha}{2}}\, Se(1-Se)}{d^2 \times Prev}$$

n_{Se}=minimum sample size for estimating sensitivity,[50]

Z= standard normal deviate for a given level of significance (α), here α=5%, Z=1.96,

S= predetermined sensitivity of Bioline HCV=99.3%,[38]
d=level of precision or marginal of error for the sensitivity=5%,
Prev=predetermined prevalence of HCV in Ghana=3%[5]

$$n_{Se} \geq \frac{1.96^2 \times 0.993(1-0.993)}{0.05^2 \times 0.03}$$
$$n_{Se} \geq 359$$

Assuming a 10% non-response rate

$$n_{Se} \geq \frac{359}{1-0.1}$$
$$n_{Se} \geq 399$$

Specificity

$$n_{Sp} \geq \frac{z^2_{\frac{\alpha}{2}} Sp(1-Sp)}{d^2 \times (1-Prev)}$$

n_{Sp}=minimum sample size for estimating specificity
Z=standard normal deviate for a given level of significance (α), here α=5%, Z=1.96
Sp=predetermined specificity of Bioline HCV=98.1%[38]
d=level of precision or marginal of error for the specificity=5%
Prev=predetermined prevalence of HCV in Ghana=3%[5]

$$n_{Sp} \geq \frac{1.96^2 \text{x } 0.981(1-0.981)}{0.05^2 \text{x } 0.97}$$
$$n_{Sp} \geq 30$$

At a 10% non-response rate

$$n_{Sp} \geq \frac{30}{1-0.1}$$
$$n_{Sp} \geq 34$$

The convenience sampling technique will be used to obtain a sample of the study population. This non-probability sampling technique will permit all consenting participants to be included in the study.

Data collection and testing: at the Ankarful prison, a medical screening programme will be rolled out by the principal investigator (PI) and research assistants, including a team consisting of a medical doctor, two medical laboratory professionals, a disease control officer, and a nurse. This will also include pretest counselling, post-test counselling and linking all positive cases to care at the Cape Coast Teaching Hospital. A paper-based structured questionnaire will be administered by the PI and the research assistants to collect non-identifiable demographic information (online supplemental file S1). A study-specific venous blood sample will be collected in a 5 mL gel separator tube and a 4 mL EDTA tube by the medical laboratory professionals. The study-specific blood collection tubes will be processed according to the study work instructions and standard operating procedures at the Cape Coast Teaching Hospital Laboratory. The medical laboratory professionals will use the whole blood sample in the EDTA tube for the Bioline HCV POC testing, while the serum sample obtained by centrifuging the gel separator tube will be used for the reference testing. Additionally, at the Cape Coast Teaching Hospital Laboratory, freshly collected whole blood and serum samples from patients with a clinician's request for HCV testing, as well as from voluntary blood donors requiring predonation screening, will be obtained by the medical laboratory professionals. These blood samples, along with non-identifiable demographic information of the patients and donors (online supplemental file S1), will be catalogued, provided informed consent (online supplemental file S2) is obtained. Whole blood samples will be tested using the Bioline HCV POC test. Reference testing will be performed using the Fortress Diagnostics qualitative HCV kit on the ChemWell Fusion Automatic Immunoassay Analyzer. This kit detects serum HCV antibodies (Anti-HCV) using a microplate qualitative chemiluminescence immunoassay based on the sandwich ELISA principle.

Inclusion criteria

- At the Ankarful Prison, all incarcerated individuals who consent to be screened will be included in the study.
- At the Cape Coast Teaching Hospital, all patients with a Clinician's request for HCV test and voluntary blood donors with a request for predonation screening who give informed consent will be included in the study.

Exclusion criteria

- At the Ankarful Prison, a participant will be considered ineligible for this study if:

Participant withdraws consent for study participation.

Inadequate venous whole blood samples are obtained.

- Participants who are ineligible will be withdrawn from the study and may be replaced at the discretion of the sponsor and PI.

Data analysis: the paper-based data will be manually entered into an Excel spreadsheet, cleaned and imported into StataCorp LLC's Stata statistical software V.16.0[51] for further statistical analysis. Descriptive statistics will be performed for the general distribution of data followed by performance analysis for diagnostic tests. This will estimate the sensitivity, specificity, positive predictive value, negative predictive value, positive likelihood ratio, negative likelihood ratio, Youden index and test efficiency of the Bioline HCV POC test with corresponding 95% CI as defined in table 1. In addition, the Kappa coefficient of concordance between the Bioline HCV POC test and the ELISA test will be estimated.

$$Sensitivity\ (Se) = \frac{A}{A+C} \times 100$$
$$Specificity\ (Sp) = \frac{D}{B+D} \times 100$$
$$Positive\ predictive\ value\ (PPV) = \frac{A}{A+B} \times 100$$
$$Negative\ predictive\ value\ (NPV) = \frac{D}{C+D} \times 100$$
$$Test\ efficiency\ (TE) = \frac{A+D}{A+B+C+D} \times 100$$

Table 1 A 2×2 contingency table for evaluating diagnostic performance

	ELISA positive	ELISA negative	
Bioline HCV positive	A	B	A+B
Bioline HCV negative	C	D	C+D
	A+C	B+D	

HCV, hepatitis C virus.

$$Youden\ index\ (J) = Se + Sp - 1$$
$$Positive\ likelihood\ ratio\ (LR+) = \frac{Se}{1-Sp}$$
$$Negative\ likelihood\ ratio\ (LR-) = \frac{1-Se}{Sp}$$

Outcome measures: diagnostic performance of the Bioline HCV POC test.

Phase 2: end-user perceptions

Objective 2: to ascertain users' perceptions of the Bioline HCV POC test in terms of real-time connectivity, ease of specimen collection, equipment-free or simplicity and user-friendliness

Design: Mixed methods study

Study population: all non-laboratory clinical staff of PHC clinics in the Komenda-Edina-Eguafo-Abirem, Cape Coast, and Mfantseman districts.

Sampling: a representative sample of the study population will be obtained using simple random sampling technique guided by the Cochrane sample size formula.[52] However, the PHC clinics will be selected conveniently until the minimum required sample size is obtained. A minimum required sample size of 428 will be used for the quantitative study assuming a 10% non-response rate.

$$n \geq \frac{z^2_{\frac{\alpha}{2}} P(1-P)}{d^2}$$

n=minimum sample size[52]

Z=Standard normal deviate for a given level of significance (α), here α=5%, Z=1.96

P=Predetermined user perception. A 50% good perception of the usability and acceptability of the Bioline HCV test is assumed since there are no published data on this subject in Ghana.

d=level of precision or marginal of error for the specificity=5%

$$n \geq \frac{1.96^2 x\ 0.5(1-0.5)}{0.05^2}$$
$$n \geq 385$$

Assuming a 10% non-response rate

$$n \geq \frac{385}{1-0.1}$$
$$n \geq 428$$

Also, the minimum required sample size for the qualitative component will be set at 20 in-depth interviews until data saturation is reached. These study participants will be selected purposively from the 428 non-laboratory clinical staff for the qualitative study.

Data collection: in the quantitative study, the PI and research assistants made up of two medical laboratory professionals will train the study participants on how to use the Bioline HCV POC test, guided by the manufacturer's instruction for use. The PI and research assistants will demonstrate how the test is used while observing all required safety protocols including wearing of a pair of gloves. The study participants will be observed and evaluated by the PI and research assistants with a paper-based standardised checklist (online supplemental file S1) while performing the test on each other in pairs in private rooms and results documented. The checklist will document errors and difficulties faced by the study participants and also indicate where assistance will be requested while performing the test. This checklist will cover the pretesting (preanalytical) processes, analytical processes (performing the test) and postanalytical processes (reading, reporting interpreting results). These will include pretesting: (1) reading the test instruction on the information sheet or test leaflet, (2) removing the test device from the foil pouch, (3) placing the test material on a flat surface and opening all pouches and caps and (4) washing hands in warm water, drying and wearing gloves. Testing: (5) correctly choosing the ring or middle finger, (6) massaging and warming the finger, (7) cleaning the finger with an alcohol swab and letting it dry, (8) pressing down firmly to prick the skin, (9) safely discarding the lancet, (10) wiping away the first drop of blood with tissue and rubbing it to create a second large drop of blood, (11) collecting the drop of blood with the specimen dropper, (12) dispensing the whole blood into the round specimen well (marked S'), (13) applying plaster, (14) twisting and pulling the cap to open the assay diluent, (15) dispensing all the assay diluent tube into the square well of the device and (16) timekeeping for results. Post-testing: (17) reading and interpreting the results, (18) safely discarding the used test kit and (19) retesting/attempting to retest if invalid results are obtained. The tests will be repeated and equally documented by a research assistant to determine the interoperator and inter-reader concordance of the tests. Additionally, the participants will be randomly given one of two known standard samples labelled A or B, which will be blinded from the study participants, to perform the Bioline HCV test. Similarly, the results will be documented and compared with the standard results to assess the interoperator and inter-reader concordance of the tests.

Concurrently, the study will explore the users' experiences and acceptability of the Bioline HCV test using qualitative methods. In-depth interviews will be conducted with 20 study participants purposively sampled, using a semistructured interview guide (online supplemental file S1). The interview guide consists of questions that seek to explore participants' personal experiences and perceptions about the use of the test. These include questions about their overall hands-on experience, confidence, usability and reliability of the manufacturer's test

instructions; challenges, ease of sample collection, quality assurance, real-time connectivity, simplicity or equipment-free, deliverability, improvement areas and recommendations. The interviews will be conducted in English and are anticipated to last 45 min per participant. The interviews will be audio-recorded, and field notes will be taken to supplement the recorded interviews.

Inclusion criteria

- Non-laboratory consenting personnel of the targeted PHC clinics will be allowed an opportunity to participate in the study.

Exclusion criteria

- A participant who withdraws consent (online supplemental file S2) for study participation will be excluded from the study.
- Laboratory personnel will be excluded from the study.

Data analysis: the audio-recorded files will be transcribed into Word documents, and thematic analysis will be performed on the qualitative data to identify relevant themes from the end-user perception evaluation. This analysis will be conducted by importing the Word documents into ATLAS.ti qualitative data analysis software, V.23.0.6.[53] The paper-based quantitative data will be manually entered into an Excel spreadsheet, cleaned and imported into StataCorp LLC's Stata statistical software V.16.0[51] for statistical analysis. The general distribution of the data will be established by descriptive measures. The usability or user-friendliness of the Bioline HCV POC test will be measured by the observed errors recorded and difficulties faced by the study participants when using the POC test as recorded on the study checklist. These will be computed and presented in absolute frequencies and percentages as proportion with 95% CI. Interoperator and inter-reader concordance of the test will be estimated as percentage agreement between the test results as reported and interpreted by the participants and the research assistants. Cohen's kappa coefficient will be estimated. Statistical significance exists at $p<0.05$. Results will be presented in tables, graphs and quotes.

Outcome measures: usability or user-friendliness of the Bioline HCV POC test as well as interoperator and inter-reader agreement results of the test.

Phase 3: comparative cost evaluation

Objective 3: to estimate the costs of accessing HCV diagnostic services using proposed HCV testing models to inform the affordability of the testing pathways

Design: cross-sectional survey

Study population: financial units of the PHC clinics and referral laboratories in the Komenda-Edina-Eguafo-Abirem, Cape Coast and Mfantseman districts.

Sampling: using Yamane's sample size formula, a minimum required number of 60 PHC clinics will be sampled simple randomly from the 70 profiled PHC clinics in the three districts.[52]

$$n \geq N/(1+Ne^2)$$

where:

N=the total number of PHC clinics in the districts under study is 70.[52]

e=margin of error=5% =0.05 at 95% CI.

$$n \geq N/(1+Ne^2)$$

$$n \geq 70/\left(1+70\left(0.05\right)^2\right)$$

$$n \geq 60$$

Data collection: a decision tree approach will be used to test three HCV testing models in the selected districts (figure 2). The testing models are made up of phases that represent varying testing strategies and algorithms. The PI and trained research assistants will use a paper-based questionnaire to collect data on the cost composition of various phases of testing decisions in each testing model thus:

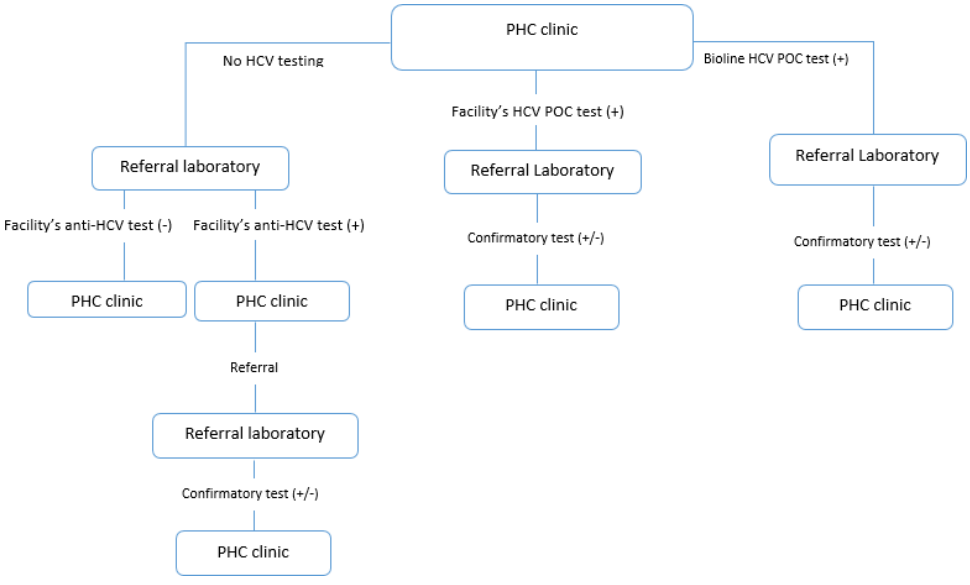

Figure 2 HCV testing models (decision tree). HCV, hepatitis C virus; PHC, primary healthcare.

1. Using no HCV testing algorithm at the PHC clinic hence resorting to referrals.
2. Using PHC clinic's (brand withheld) HCV POC test and referring for confirmatory testing.
3. Using the Bioline HCV POC test at the PHC clinic and referring for confirmatory testing.

The cost of service chart at each PHC clinic and referral laboratory will be requested. The cost implications of the Bioline HCV POC test will be compared with that of the available testing algorithms in the testing models.

Model 1 will establish the cost of transport to the referral laboratory for the HCV test+the cost of anti-HCV testing at the referral laboratory+cost of transport back to the PHC clinic+cost of transport to the Central Laboratory for confirmatory test+type and cost of confirmatory test+cost of returning to the PHC clinic with confirmatory test results.

Model 2 will determine the cost of the anti-HCV test at the PHC clinic+the cost of transport to the Central Laboratory for confirmatory testing+the type and cost of the confirmatory test+the cost of returning the confirmatory test results to the PHC clinic.

Model 3 will inform the proposed cost of Bioline HCV POC test at the PHC clinic+type and cost of confirmatory test+cost of returning confirmatory test results to the PHC clinic. PHC clinics that have laboratories and laboratory staff will be excluded from the study.

In addition, the PI and research assistants will collect data on estimated distance to the referral and central laboratories; and payment methods will be accepted by the referral facilities (out-of-pocket or insured).

Inclusion criteria

The following will be included in the study:

- PHC clinics within the three districts under study.
- Referral laboratories provided by specific PHC clinics (if any).

Exclusion criteria

PHC clinics that have laboratories and all laboratory professionals will be excluded from the study.

Data analysis: the paper-based data will be manually entered into an Excel spreadsheet, cleaned and imported into StataCorp LLC's Stata statistical software V.16.0[51] for statistical analysis. Descriptive analysis will be performed to demonstrate the general distribution of data such as the cost distribution among the testing algorithms and models under study. Mean and its associated standard deviation (SD) and median and its associated interquartile range (IQR), whichever appropriate will be used to summarise the data. The cost composition comparing the three testing models will be established by calculating the total cost for each model. All statistical results will be presented in tables and graphs.

Outcome measures: cost implications of the Bioline HCV POC test.

Patient and public involvement

It was not appropriate or possible to involve patients or the public in the design of this study. However, study participants will be actively involved in the conduct of the study, reporting and dissemination of the study outcomes. Participants will be engaged in data collection processes, including using the Bioline HCV POC test and providing feedback on their experiences. Regular feedback sessions will be organised to discuss preliminary findings and gather input on data interpretation. Participants will have the opportunity to review study results during facility visits before finalisation and publication, ensuring their perspectives are considered. Workshops will be held for participants to share their experiences, and findings will be disseminated accordingly. Participants will be acknowledged in the acknowledgement section of all three publications for their contributions to the study.

Study timeline

Data collection is anticipated to be carried out between September 2024 and February 2025. The objective 1 is set to begin in September 2024 and the objectives 2 and 3 will run side-by-side starting in October 2024. The entire study is projected to be completed within 1 year.

ETHICS APPROVAL

This diagnostics trial has been registered in the Pan African Clinical Trial Registry (PACTR202410837698664). The study has received full approval from the Faculty of Health Sciences Research Ethics Committee, University of Pretoria, South Africa (Reference number: 281/2023). Additional full approval has been given in Ghana by the Ghana Health Service Ethics Review Committee (Reference number: GHS-ERC013/08/23). Written permission has been obtained from the Ghana Prison Service's Headquarters for data collection at the Ankarful Prison. Similarly, written permission has been obtained from the laboratory management of the Cape Coast Teaching Hospital for the performance evaluation phase.

Contributors Conceptualisation: ED, EMM, TPM-T. Methodology: ED, EMM, TPM-T. Project administration: ED. Supervision: RKDE, EMM, TPM-T. Validation: TPM-T. Writing—original draft: ED. Writing—review and editing: ED, RKDE, EMM, TPM-T. Guarantor: ED.

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Competing interests EMM declares that he is employed by Abbott Rapid Diagnostics as a Scientific Affairs Manager for Africa and a co-supervisor to Evans Duah. He, therefore, acknowledges that he is aware of his responsibility to take the necessary steps to take reasonable steps to avoid any potential or perceived conflict of interest during his co-supervision duties in this study. Moreover, as a co-supervisor, his contribution and decisions will be reviewed and approved by TPM-T, the main supervisor of the study. All authors declare no other conflict of interest.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer-reviewed.

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S1 file: Questionnaires

1. **Questionnaire for data collection at the Ankarful Prison**

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

To evaluate the performance of the Bioline™ HCV POC test

Unique identifier	
Ward/ Block	
Cell Number	
Date	

A. Socio-demographic information
Age (years):
Sex: Male [ ] Female [ ]
Employment status before incarceration: Unemployed [ ] Employed [ ]
Occupation before incarceration:
Education status: No formal education [ ] Basic [ ] Secondary [ ] Tertiary [ ]
Year of incarceration:

B. Behavioural characteristics
Sexual preference/ orientation: Men [ ] Women [ ]
History of drug use: Yes [ ] No [ ]
Drug snorting: Yes [ ] No [ ]
Drug injection: Yes [ ] No [ ]
Tattoo: Yes [ ] No [ ]
Piercing: Yes [ ] No [ ]
Sharing toiletries: Yes [ ] No [ ]

C. Medical history
Known history of HCV infection: Yes [ ] No [ ] NA [ ]
Known history of HCV infection in a sexual partner: Yes [ ] No [ ] NA: [ ]

D. POC Test Results
HCV:
HIV:

Thank you for taking the time to respond to this questionnaire.

2. Data collection tool for the Cape Coast Teaching Hospital Laboratory

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

To evaluate the performance of the Bioline™ HCV POC test

Date					
Unique identifiers	**Age**	**Sex**	**Patient/Donor**	**Bioline™ HCV POC results**	**ELISA results**

3. Audit checklist for ascertaining the usability and user perceptions of the Bioline™ HCV POC test

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

To ascertain users' perceptions of the Bioline™ HCV POC test in terms of real-time connectivity, ease of specimen collection, equipment-free or simplicity, and user-friendliness.

Unique identifier	
Name of PHC clinic	
Name of District	
Name of sub-district	
Name of Community	
Condition or road network	Non-pliable road [ ] Poor road but pliable [ ] Good road [ ]
Availability of air-conditioned storage room	Yes [ ] No [ ]
Date	

A. Socio-demographic information
Age (years):
Sex: Male [ ] Female [ ]
Level of education: Certificate [ ] Diploma [ ] Degree [ ] Masters [ ] Ph.D. [ ]
Occupation/ profession:
Professional rank/cadre:
Total years of working experience:
Years of working in this clinic:
Leadership position (if any):

B. Audit 1 (hands-on)	**Yes**	**No**	**N/A**	**Comment**
1. Did the study participant read/use the information sheet or test insert?				

2. Was it difficult for the study participant to remove the test device from the foil pouch?				
3. Did the study participant successfully place material on a flat surface and open all pouches and caps?				
4. Did the study participant wash hands in warm water, dry and wear gloves?				
5. Did the study participant correctly choose the ring or middle finger?				
6. Did the study participant massage and warm their hands?				
7. Did the study participant clean the finger with an alcohol swab and let it dry?				
8. Did the study participant successfully press down firmly to prick their skin?				
9. Did the study participant safely discard the lancet?				
10. Did the study participant successfully wipe away the first drop of blood with tissue and then rub it to create a second large drop of blood?				
11. Did the study participant use the specimen dropper to collect the drop of blood?				
12. Did the study participant successfully dispense the whole blood into the round specimen well (marked S') of the device?				
13. Did the study participant successfully apply plaster?				
14. Was the study participant able to twist and pull the cap to open the assay diluent?				
15. Did the study participant dispense all the assay diluent tube into the square well of the device?				
16. Did the study participant read the test results within the stipulated time?				
17. Did the study participant interpret the results correctly?				
18. Did the study participant safely discard the used test kit?				
19. If invalid results were obtained, did the study participant attempt to retest?				

C. Audit 2 (User-perception)	**Very easy**	**Easy**	**Not easy**

1. Reading/using the information sheet or test insert			
2. Removing the test device from the foil pouch			
3. Sample collection using finger prick			
4. Collecting the drop of blood with the specimen dropper			
5. Dispensing the whole blood into the round specimen well (marked S') of the device			
6. Twisting and pulling the cap to open the assay diluent			
7. Dispensing all the assay diluent tubes into the square well of the device?			
8. Timing the test			
9. Reading/interpreting the test results			

D. Acceptability-Quantitative	**Yes**	**No**
1. Are you willing to use this test in this facility and in future?		
2. Would you recommend this test for use in other PHC clinics?		

E. User-perception (Interview guide)-Qualitative
1. Please share your general experience of using the Bioline™ HCV test kit
2. How did you find the instructions sheet, was it useful to you?
3. Did you experience any difficulty or challenges while using the Bioline™ HCV test kit?
4. Please share your experience of sample collection procedure for HCV test using the Bioline™ HCV test kit?
5. What steps did you take to ensure reliability of results of the test conducted?
6. Does the stipulated time for reading the results match the time on the test instructions?
7. How confident were you when performing the test? Rate your confidence as "very confident", "confident" and "not confident" and explain
8. How easy was it for you to interpret the test results? Rate as "very easy", "easy" and "not easy" and explain
9. In your experience, how do you think the simplicity of the test in terms of equipment required for the Bioline™ HCV test makes it easier to use?
10. How does the simplicity of the Bioline™ HCV test affect its usability, especially in terms of storage infrastructure or space available in your facility?
11. What challenges are you likely to face with storage of the test kit?

12. What factors will you and your facility consider before using the Bioline™ HCV test in your facility?
13. Are you willing to use this test in this facility and in future? Explain
14. Would you recommend this test for use in other PHC clinics? Explain
15. What feature about this test would you recommend to be changed by the manufacturer?
16. What feature about the test would you prefer to be added in subsequent models by the manufacturer?

F. Inter-reader concordance (Test on each other)		
Participant's HCV POC test result	**Researcher's HCV POC test results**	**Comment**
Inter-operator concordance		
Participant's HCV POC test result	**Researcher's HCV POC test results**	**Comment**

G. Inter-reader concordance (Random standard blood sample)		
Participant's HCV POC test result	**Researcher's HCV POC test results**	**Comment**
Inter-operator concordance		
Participant's HCV POC test result	**Researcher's HCV POC test results**	**Comment**

Thank you for taking the time to respond to this questionnaire.

4. Questionnaire for assessing the cost composition of the testing pathways

A. PHC clinic

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

To estimate the costs of accessing HCV diagnostic services using proposed HCV testing models to inform the affordability of the testing pathways

Unique identifier	
Name of PHC clinic	
Name of District	
Name of sub-district	
Name of Community	
Date	

Item	**Yes**	**No**	**N/A**	**Comment**
Do you perform HCV POC testing here?				
If Yes, which test kit do you use?				
How often do you do testing?				
Do you currently have test kits?				
How often do you run out of test kits?				
Have you received training to test				
If Yes, what is the cost of testing? (if testing is free, please state)				
If not free, are patients able to afford (pay)?				
Which payment method do you accept?	Out-of-pocket [ ] NHIS [ ]			
If NHIS, do you take top-up payment?				
What is the cost of the test kit?				
What other consumables are required to conduct the test, aside from the test kit? Please list them, including their cost and the number of tests each consumable can perform (if you test)				
If you don't test here, do you refer?				
If you refer, to which facility?				
Do you request confirmatory testing?				
If yes, which central laboratory/health facility do you refer patients to for confirmatory testing?				

Which confirmatory test do you request?	NAT [ ] EIA [ ]
How long does it take patients to return test results?	
If no, why are you not testing? Have you ever performed testing here? (qualitative) **record**	
How will it affect healthcare delivery if you begin testing here? **record**	
Do you treat HCV here? How do you treat it? **record**	

Thank you for taking the time to respond to this questionnaire.

B. Referral Laboratory for Anti-HCV test

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

To estimate the costs of accessing HCV diagnostic services using proposed HCV testing models to inform the affordability of the testing pathways

Unique identifier	
Name of District	
Name of sub-district	
Name of Community	
Type of facility	Private [ ] Public [ ] (CHAG[ ] GHS[ ])
Date	

Item	**Yes**	**No**	**N/A**	**Comment**
Do you perform HCV POC testing here?				
If Yes, which test kit do you use?				
If Yes, what is the cost of testing?				
Which payment method do you accept?	Out-of-pocket [ ] Insured [ ] (NHIS[ ] Private[ ])			
If Yes, what is the cost of the test kit?				
What other consumables are required to conduct the test, aside from the test kit? Please list them, including their cost and the number of tests each consumable can perform				
Are patients able to afford (pay)?				
How many Anti-HCV tests do you run in a month?				
Estimated distance to the referral laboratory				
Cost of transport to the referral laboratory and back				

Thank you for taking the time to respond to this questionnaire.

C. Confirmatory testing laboratory

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

To estimate the costs of accessing HCV diagnostic services using proposed HCV testing models to inform the affordability of the testing pathways

Unique identifier	
Name of District	
Name of sub-district	
Name of Community	
Type of facility	Private [ ] Public [ ] (CHAG[ ] GHS[ ])
Date	

Item	**Yes**	**No**	**N/A**	**Comment**
Estimated distance to the central laboratory from the PHC clinic				
Do you perform HCV confirmatory testing here?				
Cost of transport to the central laboratory for confirmatory testing and back				
Type of confirmatory testing	NAT [ ] EIA [ ]			
Brand/Cost of equipment used				
Brand/cost of assay/reagent				
What other consumables are required to conduct the test, aside from equipment and reagent/assay? Please list them, including their cost and the number of tests each consumable can perform				
Cost of confirmatory testing				
Which payment method do you accept?	Out-of-pocket [ ] Insured [ ] (NHIS[ ] Private[ ])			
Are patients able to afford (pay)				
How many HCV confirmatory tests do you run in a month?				

Thank you for taking the time to respond to this questionnaire.

Participant Information for Incarcerated Individuals (objective 1/phase 1)

STUDY TITLE: REASSURED evaluation of the Bioline™ HCV Point-of-care testing for diagnosing HCV infection in primary healthcare settings of Ghana
Supervisor: Prof. Tivani Mashamba-Thompson
Principal Investigators: Evans Duah
Institution: School of Health Systems and Public Health, University of Pretoria, South Africa

DAYTIME AND AFTER HOURS TELEPHONE NUMBER(S):
Daytime number/s: +233209067278
Afterhours number: +233209067278

Dear Prospective Participant
Dear Mr. / Mrs. .....

1) INTRODUCTION

You are invited to volunteer for a research study. I am doing research for a PhD Degree purpose at the University of Pretoria, South Africa. The information in this document is to help you to decide if you would like to participate in the current study. Before you agree to take part in this study you should fully understand what is involved. If you have any questions, which are not fully explained in this document, do not hesitate to ask the researcher. You should not agree to take part unless you are completely happy about all the procedures involved.

2) THE NATURE AND PURPOSE OF THIS STUDY

This study aims to evaluate the Bioline™ HCV Point-of-care testing for diagnosing hepatitis C viral infection in primary healthcare settings of the Central region of Ghana. As part of this, we seek to evaluate the clinical performance (sensitivity and specificity) of the test. By doing so we wish to learn more about the diagnostics of Hepatitis C virus (HCV) disease and to identify a test kit that is more sensitive and specific towards diagnosing HCV infection. HCV is considered a silent epidemic. Late linkage to care may lead to full-blown liver disease and complications such as hepatitis, cirrhosis, and hepatocellular carcinoma. Globally, about 58 million HCV cases have been recorded with 1.5 million new cases annually and 290000 deaths. The HCV seroprevalence in Sub-Saharan Africa stands between 2% and 3% with over 200000 deaths annually. In Ghana, the national HCV prevalence ranges from 1-3%. The infection spreads through blood commonly through sharing of sharp objects and blood transfusion.

3) EXPLANATION OF PROCEDURES AND WHAT WILL BE EXPECTED FROM PARTICIPANTS.

As part of this medical screening being conducted today, we will require that you answer some questions regarding HCV infection. A pre-counseling session will be conducted for you before the start of the study. Similarly, a post-counseling session will be arranged for you after the issuance of your test results.

Duah E, *et al. BMJ Open* 2024; 14:e082416. doi: 10.1136/bmjopen-2023-082416

4) POSSIBLE RISKS AND DISCOMFORTS INVOLVED

There are no medical risks associated with the study. The only possible risk and discomfort involved is the taking of blood from a vein which can result in bruising and bleeding from the puncture site. To identify and link positive cases to medical care, we will require your personal information specifically, your name and ward or prison cell number. We will ensure strict confidentiality.

5) POSSIBLE BENEFITS OF THIS STUDY

You will benefit from this study since it will help you to know your HCV status and if positive, you will be linked to care/ treatment through consultation with the prison warden. If negative, you will be provided with some measures to help you prevent HCV infection. Also, the study results may help us to improve the accessibility, affordability, and performance of the Bioline™ HCV test in Primary Healthcare settings of Ghana.

6) COMPENSATION

You will not be paid to take part in the study. There are no costs involved for you to be part of the study.

7) YOUR RIGHTS AS A RESEARCH PARTICIPANT

We understand that research on the incarcerated population raises ethical concerns due to the confinement of incarcerated individuals and the limitations on their rights. We will respect your rights as a citizen of Ghana and as an inmate as ethics requires. The prison warden is not requiring or forcing you to participate in the study hence you have the free will to refuse to take part in this study or redraw from the study at any point in time without affecting you in any way. Some questions may be sensitive; however, you do not have to answer them if you do not want to. You are assured that there will be no punishment for refusing to participate, redrawing from the study, or refusing to answer some questions. You will only be allowed to participate in this study when you consent to take part. Your information will be kept under strict confidentiality. Only the PI or personnel assigned by the PI may have restricted access to this information.

8) ETHICS APPROVAL

This Protocol was submitted to the Faculty of Health Sciences Research Ethics Committee, University of Pretoria, telephone numbers (+27) 012 356 3084 / (+27) 012 356 3085, and written approval has been granted by that committee (Ethics reference number: 281/2023). Also, Ethical approval has been granted by the Ghana Health Service Ethics Review Committee (GHS-ERC013/08/23). The study has been structured following the Helsinki Declaration (last update: October 2013), which deals with the recommendations guiding doctors in biomedical research

involving human/subjects. A copy of the Declaration may be obtained from the investigator should you wish to review it.

9) INFORMATION

If I have any questions concerning this study, I should contact the PI

Evans Duah. Cell: 0209067278

If I have any questions concerning ethics approval, I should contact:

The Ghana Health Service Ethics Review Committee
The ERC Administrator
Nana Abena Apatu
Ghana Health Service
P.O. Box MB 190
Accra
Tel: 0503539896 Email: ethics.research@ghs.gov.gh

10) CONFIDENTIALITY

All information obtained during the course of this study will be regarded as confidential. Each participant that is taking part will be provided with an alphanumeric coded number e.g. A001. This will ensure confidentiality of the information so collected. Only the researcher will be able to identify you as participant. Results will be published or presented in such a fashion that patients remain unidentifiable. The hard copies of all your records will be kept in a locked facility at the School of Health Systems and Public Health, The University of Pretoria.

11) DECLARATION OF CONFLICT OF INTEREST

The researchers declare no conflict of interests

12) FUNDING

The study will be self-funded by Evans Duah with product support from Abbot Diagnostics, Johannesburg, South Africa

Participant Information for patients and blood donors (objective 1/phase 1)

STUDY TITLE: REASSURED evaluation of the Bioline™ HCV Point-of-care testing for diagnosing HCV infection in primary healthcare settings of Ghana
Supervisor: Prof. Tivani Mashamba-Thompson
Principal Investigators: Evans Duah
Institution: School of Health Systems and Public Health, University of Pretoria, South Africa

DAYTIME AND AFTER HOURS TELEPHONE NUMBER(S):
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Dear Mr. / Mrs. .....

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2) THE NATURE AND PURPOSE OF THIS STUDY

The aim of this study is to evaluate the Bioline™ HCV Point-of-care testing for diagnosing hepatitis C viral infection in primary healthcare settings of the Central region of Ghana. As part of this, we seek to evaluate the clinical performance (sensitivity and specificity) of the test. By doing so we wish to learn more about the diagnostics of Hepatitis C virus (HCV) disease and to identify a test kit that is more sensitive and specific towards diagnosing HCV infection. HCV is considered a silent epidemic. Late linkage to care may lead to full-blown liver disease and complications such as hepatitis, cirrhosis, and hepatocellular carcinoma. Globally, about 58 million HCV cases have been recorded with 1.5 million new cases annually and 290000 deaths. The HCV seroprevalence in Sub-Saharan Africa stands between 2% and 3% with over 200000 deaths annually. In Ghana, the national HCV prevalence ranges from 1-3%. The infection spreads through blood commonly through sharing of sharp objects and blood transfusion.

3) EXPLANATION OF PROCEDURES AND WHAT WILL BE EXPECTED FROM PARTICIPANTS.

As part of the tests requested by the Doctor or the blood organizer, we will take 4mls of your blood and dispense equally into a gel separator tube and an EDTA tube (2ml each). The sample will be sent to the laboratory and HCV test performed using the Bioline™ HCV Point-of-care test and the ELISA as a confirmatory test. Your results will be communicated to you as soon as possible.

Study duration
The study will be carried out between September 2024 and February 2025. However, it will take about 30 minutes to participate in this study.

4) POSSIBLE RISKS AND DISCOMFORTS INVOLVED

A venous blood sample will be taken which will cause some discomfort and pain in your arm due to the needle prick. However, we have engaged the service of a professional phlebotomist to prevent any adverse effects or outcomes. The phlebotomist will be quick with the sample collection procedure, avoid multiple punctures, apply a tourniquet, and gently massage the arm to mitigate the pain from the venipuncture. Also, the site of the venipuncture will be disinfected with rubbing alcohol to prevent infection at the site of blood collection. Sterile cotton and phlebotomy plasters will be used to prevent infections.

5) POSSIBLE BENEFITS OF THIS STUDY

The study results will help us identify the test or clinical performance of the Bioline™ HCV test using Ghanaian populations. This will help us make recommendations to manufacturers of point-of-care test kits to consider evaluating the test kits using the very populations meant to use them. Also, this will help you know your HCV status.

6) COMPENSATION

You will not be paid to take part in the study. There are no costs involved for you to be part of the study.

7) YOUR RIGHTS AS A RESEARCH PARTICIPANT

Your participation in this study is entirely voluntary and you can refuse to participate or stop at any time without stating any reason. Your withdrawal will not affect your carreer or profession in any way.

8) ETHICS APPROVAL

This Protocol was submitted to the Faculty of Health Sciences Research Ethics Committee, University of Pretoria, telephone numbers (+27) 012 356 3084 / (+27) 012 356 3085, and written approval has been granted by that committee (Ethics reference number: 281/2023). Also, Ethical approval has been granted by the Ghana Health Service Ethics Review Committee (GHS-ERC013/08/23). The study has been structured in accordance with the Declaration of Helsinki (last update: October 2013), which deals with the recommendations guiding doctors in biomedical research involving human/subjects. A copy of the Declaration may be obtained from the investigator should you wish to review it.

9) INFORMATION

If I have any questions concerning this study, I should contact the PI

Evans Duah. Cell: 0209067278

If I have any questions concerning ethics approval, I should contact:

The Ghana Health Service Ethics Review Committee
The ERC Administrator
Nana Abena Apatu
Ghana Health Service
P.O. Box MB 190
Accra
Tel: 0503539896 Email: ethics.research@ghs.gov.gh

10) CONFIDENTIALITY

All information obtained during the course of this study will be regarded as confidential. Each participant that is taking part will be provided with an alphanumeric coded number e.g. A001. This will ensure confidentiality of the information so collected. Only the researcher will be able to identify you as participant. Results will be published or presented in such a fashion that patients remain unidentifiable. The hard copies of all your records will be kept in a locked facility at the School of Health Systems and Public Health, The University of Pretoria.

11) DECLARATION OF CONFLICT OF INTEREST

The researchers declare no conflict of interests

12) FUNDING

The study will be self-funded by Evans Duah with product support from Abbot Diagnostics, Johannesburg, South Africa

Participant Information for health staff (objective 2/phase 2)

STUDY TITLE: REASSURED evaluation of the Bioline™ HCV Point-of-care testing for diagnosing HCV infection in primary healthcare settings of Ghana
Supervisor: Prof. Tivani Mashamba-Thompson
Principal Investigators: Evans Duah
Institution: School of Health Systems and Public Health, University of Pretoria, South Africa

DAYTIME AND AFTER HOURS TELEPHONE NUMBER(S):
Daytime number/s: +233209067278
Afterhours number: +233209067278

Dear Prospective Participant
Dear Mr. / Mrs. .....

1) INTRODUCTION

You are invited to volunteer for a research study. I am doing research for a PhD Degree purpose at the University of Pretoria, South Africa. The information in this document is to help you to decide if you would like to participate in the current study. Before you agree to take part in this study you

should fully understand what is involved. If you have any questions, which are not fully explained in this document, do not hesitate to ask the researcher. You should not agree to take part unless you are completely happy about all the procedures involved.

2) THE NATURE AND PURPOSE OF THIS STUDY

The aim of this study is to evaluate the Bioline™ HCV Point-of-care testing for diagnosing hepatitis C viral infection in primary health care settings of the Central region of Ghana. As part of this, we seek to understand your perceptions as you use the Bioline™ HCV test presented to you. By doing so we wish to learn more about the diagnostics of Hepatitis C virus (HCV) disease. HCV infection is a viral infection that is increasingly affecting populations in the world. Late linkage to care may lead to full-blown liver disease and complications such as hepatitis, cirrhosis, and hepatocellular carcinoma. Globally, about 58 million HCV cases have been recorded with 1.5 million new cases annually and 290000 deaths. The HCV seroprevalence in Sub-Saharan Africa stands between 2% and 3% with over 200000 deaths annually. In Ghana, the national HCV prevalence ranges from 1-3%. The infection spreads through blood commonly through sharing of sharp objects and blood transfusion. Existing literature identifies incarcerated individuals as a vulnerable group to Hepatitis C virus (HCV) infection largely among people who share sharp objects (e.g. Razor blades and needles), people with tattoos, people who use or inject drugs, and men who have sex with men (MSM).

3) EXPLANATION OF PROCEDURES AND WHAT WILL BE EXPECTED FROM PARTICIPANTS.

This study involves receiving some training on how to use the Bioline™ HCV test for diagnosing HCV in your facility. You will also be observed by a research assistant whilst using the Bioline™ HCV test. This will be followed by answering some questions about your experience and perceptions about the use of the Bioline™ HCV test through interviews and paper questionnaires. The interview session will be recorded on tape.

Study duration
The study will be carried out between September 2024 and February 2025. However, it will take about 30 minutes to participate in this study.

4) POSSIBLE RISKS AND DISCOMFORTS INVOLVED

As part of the evaluation of the test, you will be required to perform the test whilst the researchers observe. This will require that you prick the finger of your paired colleague whilst he or she does the same to you. You may feel a little pain at the site of prick. A regulated lancet holder will be used to mitigate the pain you may feel.

5) POSSIBLE BENEFITS OF THIS STUDY

Duah E, *et al. BMJ Open* 2024; 14:e082416. doi: 10.1136/bmjopen-2023-082416

The study results may help us to improve the accessibility, affordability, and performance of the Bioline™ HCV test in Primary Healthcare settings of Ghana. Similarly, you may benefit from the availability and use of an evaluated test that meets your expectations and helps to diagnose HCV at POC. Also, this will help you know your HCV status.

6) COMPENSATION

You will not be paid to take part in the study. There are no costs involved for you to be part of the study.

7) YOUR RIGHTS AS A RESEARCH PARTICIPANT

Your participation in this study is entirely voluntary and you can refuse to participate or stop at any time without stating any reason. Your withdrawal will not affect your career or profession in any way.

8) ETHICS APPROVAL

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Duah E, *et al. BMJ Open* 2024; 14:e082416. doi: 10.1136/bmjopen-2023-082416

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11)DECLARATION OF CONFLICT OF INTEREST
The researchers declare no conflict of interests

12)FUNDING
The study will be self-funded by Evans Duah with product support from Abbot Diagnostics, Johannesburg, South Africa

Participant Information for health staff (objective 3/phase 3)

STUDY TITLE: REASSURED evaluation of the Bioline™ HCV Point-of-care testing for diagnosing HCV infection in primary healthcare settings of Ghana
Supervisor: Prof. Tivani Mashamba-Thompson
Principal Investigators: Evans Duah
Institution: School of Health Systems and Public Health, University of Pretoria, South Africa

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2) THE NATURE AND PURPOSE OF THIS STUDY

The aim of this study is to evaluate the Bioline™ HCV Point-of-care testing for diagnosing hepatitis C viral infection in primary health care settings of the Central region of Ghana. As part of this, we seek to compare the cost composition of the available HCV test in your facility and that of using the Bioline™ HCV test. HCV infection is a viral infection that is increasingly affecting populations in the world. Late linkage to care may lead to full-blown liver disease and complications such as

hepatitis, cirrhosis, and hepatocellular carcinoma. Globally, about 58 million HCV cases have been recorded with 1.5 million new cases annually and 290000 deaths. The HCV seroprevalence in Sub-Saharan Africa stands between 2% and 3% with over 200000 deaths annually. In Ghana, the national HCV prevalence ranges from 1-3%. The infection spreads through blood commonly through sharing of sharp objects and blood transfusion. Existing literature identifies incarcerated individuals as a vulnerable group to Hepatitis C virus (HCV) infection largely among people who share sharp objects (e.g. Razor blades and needles), people with tattoos, people who use or inject drugs, and men who have sex with men (MSM).

3) EXPLANATION OF PROCEDURES AND WHAT WILL BE EXPECTED FROM PARTICIPANTS.

This study involves answering some questions about the cost implications and compositions of the current test algorithms available in your facility for testing HCV. For example: how much it cost a patient to perform HCV test in your facility.

Study duration
The study will be carried out between September 2024 and February 2025. However, it will take about 30 minutes to participate in this study.

4) POSSIBLE RISKS AND DISCOMFORTS INVOLVED

There are no medical risks associated with the study.

5) POSSIBLE BENEFITS OF THIS STUDY

The study results may help us to improve the accessibility, affordability, and performance of the Bioline™ HCV test in Primary Healthcare settings of Ghana. Similarly, you may benefit from the availability and use of an evaluated test that meets your expectations and helps to diagnose HCV at POC.

6) COMPENSATION

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