A QUALITATIVE STUDY ON THE ACCEPTABILITY/EASE OF USE AND INTERPRETATION OF GLUCOSE-6 PHOSPHATE-DEHYDROGENASE RAPID DIAGNOSTIC TEST

CONTENTS

1 INTRODUCTION

Glucose-6-phosphate dehydrogenase (G6PD) deficiency is an inherited disorder that affects red blood cells by causing haemolysis which can lead to haemolytic anaemia. There are certain factors that trigger haemolysis in G6PD-deficient patients. These triggering factors include oxidative foods and drugs such as primaquine (1-3). Primaquine, an 8-aminoquinoline drug has the potential to induce haemolysis in G6PD-deficient patients when they are exposed to it in high dose(4). Primaquine is currently the most widely used radical cure for liver stage *Plasmodium vivax (P. vivax)* and gametocyte stage of *Plasmodium falciparum (P. falciparum)*. In order to eliminate *P. vivax*, primaquine has to be administered at its most effective dosage which is 0.75mg/kg. However, lack of field-deployable, sensitive and affordable G6PD testing tools is a setback in many *P. vivax* endemic countries (5, 6).

Papua New Guinea (PNG) National Malaria Control Program has recommended Primaquine as a radical cure for *P. vivax* infections which has been used since 2009. Due to no G6PD deficiency testing in PNG, patients with vivax malaria are administered primaquine at a lower dose of 0.25kg/g for 14 days after 3 days of artemether-lumefantrine (AL). However, a reviewed paper by John et al. (7) indicated that this course of treatment is less effective compared to 7 days of primaquine at a dose of 0.75kg/g. As PNG goes into malaria elimination in the near future, we will be faced with the challenge of eliminating *P. vivax*. Health workers at the primary health care facilities have to be equipped with the necessary knowledge and tools to manage *P. vivax* malaria. Having an awareness on the importance of G6PD testing and the availability of point-of-care G6PD test will enable health workers to identify G6PD-deficient patients and administer primaquine safely and effectively.

1.1 Aim of the Study

This study aimed to:

1. Generate G6PD prevalence data from four regions of PNG using the CareStart G6PD point-of-care test in order to add to the national and regional prevalence data of severe and intermediate G6PD deficiency in PNG.
2. Assess health worker perceptions on point of care G6PD testing and primaquine treatment.

2 METHODOLOGY

2.1 Study sites and participants

2.1.1 Training of health workers at the sentinel sites

Between the months of July and October 2018, health workers in the four sentinel sites were trained on the use of G6PD test. Health workers trained included research nurses and other interested health workers at the sentinel health centers. Health workers in Sausi, Lemakot and the East Cape sentinel sites were trained on-site while the research nurse from Karimui sentinel site was trained in Goroka.

During the training sessions, health workers were taught how to perform the test and interpret the test results using the manufacturer's instruction. Health workers were informed that there would be a follow-up interview to assess the health workers perception on the use of the test kit after two-months of using the test kits.

2.2 CareStart G6PD Test

The CareStart G6PD rapid diagnostic test used was a qualitative enzyme chromatographic test. It is a visual screening test that identifies G6PD deficient patients using blood sample. This point-of-care test does not require additional equipment or expertise and is easy to train staff on how to use it. Two microliters (2µl) of whole blood from a finger-prick and two drops of buffer were added into the buffer well. Results were read after 10 minutes. Samples with normal G6PD activity produce a distinct purple colour background in the result

window while no colour change was observed for samples with deficient G6PD activity (Figure 1).

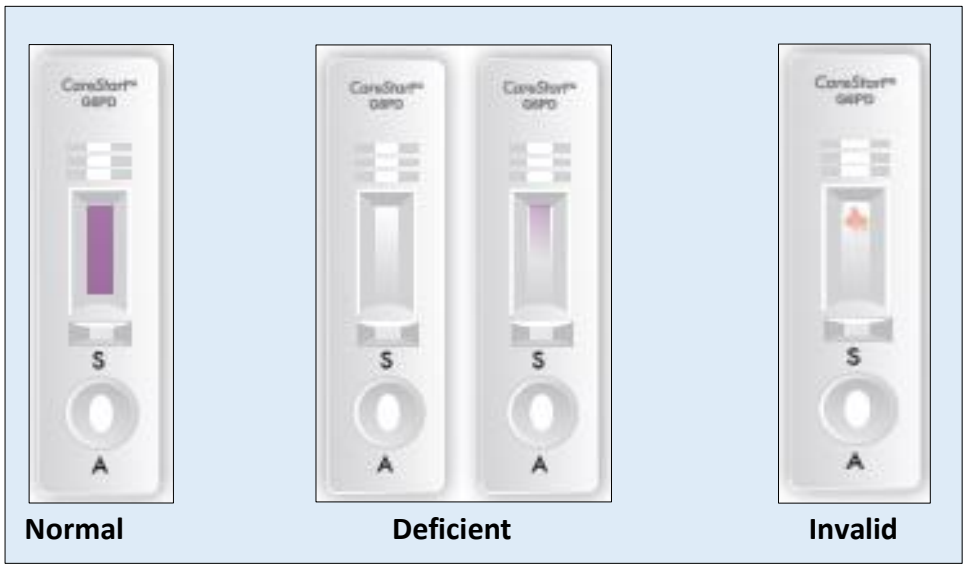

Figure 1 shows CareStart G6PD test with different results

2.3 G6PD Register and Questionnaires

A G6PD register was designed to capture date of testing, demography information of the patients and G6PD test results. An in-depth interview questionnaire was designed to capture responses of health workers related to their perception regarding the use of the G6PD test and primaquine treatment as well as its ease of use and acceptability. Also, the questionnaire captured demographic information of the health workers, years of work experience and level of education. The G6PD register and the questionnaires were all paper based.

2.4 Data Collection

For the prevalence of G6PD deficiency, 180 consented febrile patients in each sentinel sites were tested by research nurses for G6PD deficiency. Research nurses were told to record G6PD test results in a G6PD register book. After two months of introducing the G6PD tests, health workers who have used the G6PD test were invited to take part in an in-depth interview.

2.5 Ethical Considerations

This study was granted ethical clearance by the Medical Research Advisory Council (MRAC Protocol Number 10.12). Oral informed consents were obtained from both febrile patients and health workers prior to conducting the tests and the in-depth interviews.

3 Results

3.1 Aim 1 - G6PD Prevalence

During the survey, a total of 975 febrile individuals were screened for G6PD deficiency of which, 400 records are available. Of the 400 participants tested, 1.25% (n=5) were tested positive for G6PD deficient. Prevalence across the four sites was 0.01% (Table 2).
Records for 575 participants were not available.

Table 1: Shows information on the number of participants who were tested for G6PD deficient

	Sausi (n=265)	**Lemakot (n=48)**	**East Cape (n = 103)**	**Karimui (n = 32)**	**All Sites (n=400)**
Date tests implemented in each Site & completed POC	June 2018 – March 2019	April 2018 – March 2019	August	October	June 2018 - March 2019
G6PD positive	2	1	1	1	**5**
G6PD positive rate (%)	0.75	2.08	0.97	3.13	**1.25**
G6PD prevalence (%)	0.03	0.01	0.01	0.01	**0.01**

n = Total number of febrile patients tested for G6PD

3.2 Aim 2 - Health workers acceptability and perception of G6PD test

3.2.1 Participation and demography Information of health workers

Only staff who have used the CareStart G6PD test were interviewed regarding the use and acceptability of the test kit. A total of 8 health workers including sentinel site research nurses were interviewed. The cadre of health workers that used G6PD tests at the sentinel sites comprised of three nursing officers and five community health workers, aged between 27 to 51 years. The health workers had an average of 10 years of work experience as a health worker.

3.2.2 Utilization of G6PD tests by health workers

At the sentinel sites, screening of febrile individuals commenced immediately after health workers were trained on the use of the G6PD point of care testing. A total of eight health workers including the four sentinel site research nurses used the G6PD test. Health workers at each sentinel site screened more than 180 febrile patients with the G6PD test.

3.2.3 Ease of use and acceptability of G6PD Test

Performing the test

Seven health workers read the manufacturer's instructions during training. They mentioned that they remembered the instructions on how to perform the test and interpreted the results from the training they received and from practicing it every day. One health worker mentioned that it was time consuming to read the lengthy manufacturer's instructions when they were with patients.

"On training, I read the manuals but when actually performing the test I do not use the manuals. I remember from what was thought and I do the test and interpretation. Time consuming to read the manual and performing the test. It's much easier to see and do things." (Nursing Officer 2, East Cape Sentinel Site)

All health workers mentioned that the steps involved in performing the test were similar to malaria RDT. However, two health workers did not mention the right amount of buffer drops and waiting time. All health workers except one mentioned that the instructions were easy to understand and were not confusing due to the training they received. One health worker did not read the instructions and had problems performing the test and interpreting the results.

Interpreting the results

G6PD test was well received by all the health workers who had used the G6PD test. The health workers reported that they found it easy to perform the test because they were familiar with using the current CareStart *pf*/Pan test for malaria and were able to use the test with little or no difficulty at all.

During the interview, seven out of eight health workers were able to interpret the G6PD results (Figure 2).

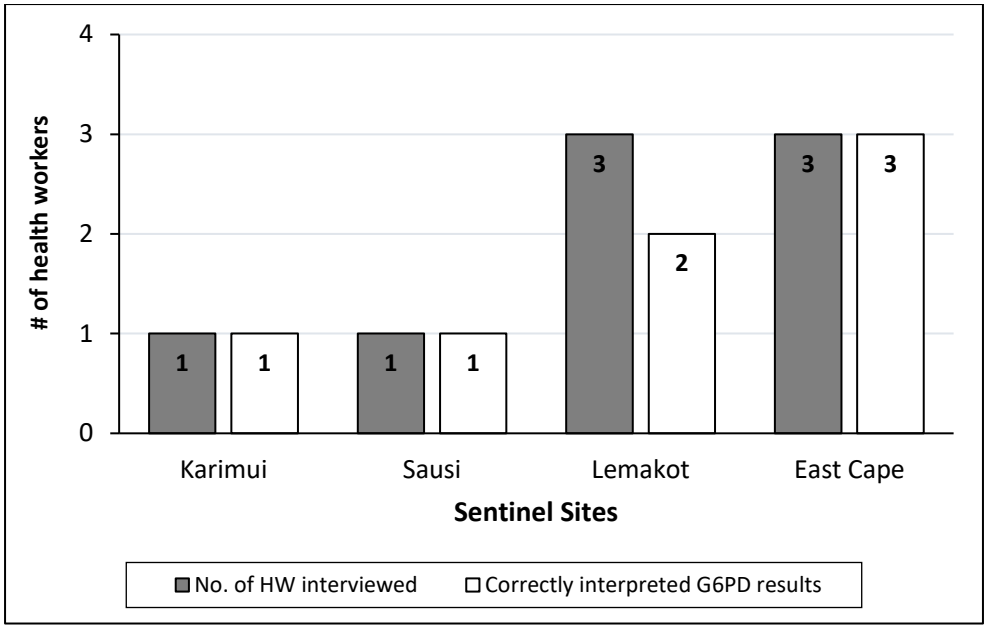

Figure 2 shows number of health workers who correctly interpreted G6PD results

3.2.4 Perception of G6PD tests

All health workers reported that the test had improved their patient management skills. Knowing the G6PD status of a patient gave the health workers confidence to administrator appropriate doses of primaquine to patients who were infected with mixed and/or non-pf infections. They also mentioned that, it was a vital test for a rural setting and the test was a benefit for the patients as they were able to know their G6PD status.

"Having the result of the CareStart G6PD test gives an idea about which patients can be given primaquine unlike before when the G6PD status was unknown, primaquine was given to patients who had mixed infection which probably led to some patients being anaemic after treatment or they developed weakness after 3 days of malaria treatment. The importance in conducting the G6PD test is that it is helpful to nurses, giving them an idea of which patient is able to take primaquine. If only the government introduced the G6PD RDT to health facilities in the country at the rural setting, it would be very good. Like us in the villages, fever patients do not have to take PMV into the town to provincial hospitals to be checked there at the laboratories. This rapid test is very vital for a setting such as East Cape" (Nursing Officer 1, East Cape Sentinel Site)

The health workers recommended that training should be provided by the national department of health prior to using any rapid diagnostics tests and followed by supervisory visits for quality assurance purposes.

4 Discussion and Conclusion

This study shows that the CareStart G6PD point-of-care test documented an overall low prevalence of G6PD deficiency of 1.25% in the four sentinel sites combined. Although initial studies show that this point-of-care test used could detect enzyme activity level at less than 30% which would make it a suitable field-deployable test to guide safe administration of primaquine (8), patients with enzyme activity greater than 30% may be missed. Therefore, a study comparing this qualitative G6PD test to a quantitative G6PD test would be needed to compare the prevalence of G6PD deficiency in these settings.

From the in-depth interviews, health workers expressed support for the availability and use of the G6PD test. It was a first-time experience for the health workers to use G6PD test, especially in a primary health care setting, to guide treatment decisions. However, this study also showed that health workers when conducting point-of-care tests, do not read manufacturer's instructions. A high proportion of them stated that the instructions are very lengthy and time consuming. They learn from trainings/watching fellow health workers performing the tests. Health workers learn more from listening and seeing others performing point-of-care test rather than reading manufacturer's instruction manual.

In conclusion, the CareStart G6PD test documented a very low prevalence of G6PD deficiency across the four sentinel sites studied. Nevertheless, the test was well received by health workers and it was seen as an aid that can improve the management of vivax malaria in PNG.

5 References

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