

Dengue rapid diagnostic tests: Health professionals' practices and challenges in Burkina Faso

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Sylvie Zongo¹, Mabel Carabali², Marie Munoz³ and Valéry Ridde⁴ 

Abstract

Objectives: Dengue fever remains unrecognized and under-reported in Africa due to several factors, including health professionals' lack of awareness, important prevalence of other febrile illnesses, most of which are treated presumptively as malaria, and the absence of surveillance systems. In Burkina Faso, health centers have no diagnostic tools to identify and manage dengue, which remains ignored, despite the evidence of seasonal outbreaks in recent years. A qualitative study was conducted to analyze the use of rapid diagnostic tests in six health and social promotion centers (i.e. health-care centers, from the French Centers de Santé et de Promotion Sociale) of Ouagadougou (Burkina Faso) in an exploratory research context.

Methods: Dengue rapid diagnostic tests were introduced into fever-related consultations from December 2013 to January 2014. In-depth individual interviews were conducted in May and June 2014 with 32 health professionals.

Results: Prior to the introduction of the tests, dengue was not well known or diagnosed by health professionals during consultations. Most febrile cases were routinely presumed to be malaria and treated accordingly. With training and routine use of rapid diagnostic tests, health professionals became more knowledgeable about dengue, improving the diagnosis of non-malaria febrile cases and its management, and better prescription practices.

Conclusions: In a context of dengue re-emergence and high prevalence of other febrile illnesses, having rapid diagnostic tools available, especially during epidemics reinforces health professionals' diagnostic and prescribing capacities, allowing an opportune and accurate case management and facilitates diseases surveillance.

Keywords

Dengue fever, rapid diagnostic tests, health professionals' practices, qualitative study, Ouagadougou, Burkina Faso

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Introduction

The use of reliable and affordable rapid diagnostic tests (RDTs) has appeared to pose a daunting challenge for access to healthcare in developing countries due to the prevalence of many infectious diseases and the difficulties in accessing laboratory testing.¹ Several RDTs have been developed and tested to diagnose malaria, HIV, syphilis, and tuberculosis.^{2,3} Some have even been implemented on a large scale, as has been the case since 2010 for malaria RDTs in Burkina Faso. Although RDTs are generally viewed positively by health professionals, their uptake is often presented as a challenge, particularly in regard to the interpretation and use of the tests results.^{4,5} In essence, it appears that ensuring effective use of these tests and adherence to their results remains extremely challenging, especially in scale-ups, where there continue to be many problems and issues.^{6,7} In this article we focus on the use of one such innovation in Burkina Faso: dengue RDTs.

According to the World Health Organization (WHO),⁸ the incidence of dengue fever has increased 30-fold over the past 50 years. Around 3.9 billion people are exposed to this vector-borne disease in 128 countries. Dengue outbreaks have been increasingly observed in all regions of the African

¹Département Socio-économie et Anthropologie du Développement, Institut des Sciences des Sociétés, Centre National de la Recherche Scientifique et Technologique, Ouagadougou, Burkina Faso

²Department of Epidemiology, Biostatistics and Occupational Health, McGill University Health Centre, Montreal, QC, Canada

³Faculté de médecine, Université de Montréal, Montreal, QC, Canada

⁴IRD (French Institute For Research on sustainable Development), CEPED (IRD-Université Paris Descartes), Universités Paris Sorbonne Cités, ERL INSERM SAGESUD, Paris, France

Corresponding author:

Valéry Ridde, CEPED, IRD, Université Paris Descartes, 45 rue des Saints Pères, Paris 75006, France.

Email: valery.ridde@ird.fr



continent, and several Asian and South American countries are in endemic situations.^{9,10} The most recent epidemic in Burkina Faso occurred in 2013. Yet, dengue fever remains poorly recognized and underreported.^{11,12} The lack of symptom specificity between dengue, malaria, and other febrile illnesses makes its diagnosis a complex task and the probability that health professionals will not recognize its presence is high.^{13,14} In severe forms, hemorrhage, shock, neurological problems, and even death can occur, depending on a certain number of factors.^{8,15} Rapid diagnosis is required to initiate adequate management as swiftly as possible, facilitate disease surveillance, and implement control strategies.^{16–18} In Africa, however, dengue diagnostics is a recent activity and is only done in specialized laboratories not suited to existing health centers, which had neither laboratory equipment nor trained personnel.¹⁹ Nonetheless, recent years have seen advances in dengue diagnosis. Several biological tests, including RDTs, have been developed and evaluated; then have been commercialized and used in research settings.^{20–22} In this article, we analyze health professionals' use of these tests in a research context in Burkina Faso, as well as their perceptions of this “new” diagnostic tool—this, in a socio-professional environment where malaria RDT have been used since 2010 and dengue awareness was limited until its recent outbreak in 2013.

Methods

Background

The study was carried out in Burkina Faso, a sub-Saharan African country with a tropical climate characterized by a short rainy season from June to September. The country's health system is organized on three levels: central, intermediate (13 regional departments), and peripheral (70 health districts). Healthcare is provided by various public services reporting to the three levels of the health pyramid and by private facilities.²³ Malaria remains the primary reason for consultation, hospitalization, and death among children under 5 years of age.²⁴ The epidemiological landscape is dominated by infectious diseases, some of which, like dengue, are recurring with increasing frequency.²⁵ In fact, the first dengue epidemic was reported in 1925, and a significant number of cases were reported in the 1980s.^{12,26} Two studies, one conducted in 2003 looking at blood donors and pregnant women^{27,28} and other during 2013 in general population,²⁹ uncovered the presence of the dengue and the circulation of different serotypes. However, detailed and recent information on the presence of the virus in the population remains limited, and few health centers have the equipment needed to diagnose the infection. Between September and November 2013, populations and health professionals were worried about the presence of the virus. There was an increase in the number of consultations due to fever that did not respond to the systematically prescribed antimalarial medication. This

newsworthy situation attracted considerable media coverage, leading health authorities to use commercial RDTs to conduct immediate investigations in four centers of the capital. Of the suspected cases that underwent RDTs for dengue (whose results were confirmed by outside laboratories), several were found to have been positive.³⁰

At the same time, to study the presence of dengue, our team conducted a study in December 2013, in six health and social promotion centers (CSPS) of Ouagadougou city.^{29,31} These health facilities were selected based on past prevalence of flaviviruses.²⁷ Three health professionals from each of the six CSPS were selected to undergo training that included general dengue information (i.e. etiology, diagnosis, and case management) and elements directly related to the study (questionnaires and use of RDTs). The total sample size was 18. Following the training, the research coordinator was available to assist the CSPS health professionals with any technical problems related to study materials. The first (quantitative) phase, conducted from December 2013 to January 2014, consisted of running dengue test on non-malaria febrile patients seen during routine consultations using the SD Bioline Dengue NS1, IgG/IgM (PanBio[®], Seoul, South Korea) RDTs, from which it is possible to make a rapid assessment of dengue presence. The rapid test is made up of two cassettes, each with a well into which drops of the patient's blood and reagents are deposited. The first cassette qualitatively measures the presence of the NS1 antigen, which is produced early in the infection. The second cassette measures the presence of IgM and IgG, which are antibodies that provide evidence of acute and past infection, respectively. Compared to malaria RDT, this test is more complex to use because it consists of two sections. It must be read within 15–20 min, at the latest, because the risk of obtaining false-positive results if read after the period indicated by the manufacturer.

In addition to the dengue cases assessment, an entomological survey was conducted and results of this study phase are described elsewhere.²⁹

Data collection

Qualitative data were collected from May to June 2014. The survey consisted of in-depth individual interviews with health-care professionals from each of the collaborating health centers participating on the study. The data collection was conducted using a semi-structured interview guide. The guide was pretested before data collection. Each interview lasted between 30 to 60 min. Topics covered included: (1) use of tests; (2) prescribing practices; (3) perceptions of the tests; and (4) challenges and issues associated with routine testing. A minimum of 3 days was spent in each CSPS. The time was determined by the health professionals' availability. Given the ways in which activities were organized in the CSPSs, and for purposes of comparison, we focused not only on those professionals who had undergone RDT training for the study but also on those who had not been trained. This

Table 1. General characteristics of study participants.

Sites	Gender		categories			Status		Total participants/ CSPS
	Female	Male	Health outreach worker (AIS)	Licensed nurse (IB)	State certified nurse (IDE)	Trained	Non- trained	
CSPS A	02	04	02	01	03	03	03	06
CSPS B	02	02	00	02	02	02	02	04
CSPS C	02	04	01	02	03	03	03	06
CSPS D	03	03	01	05	01	03	04	07
CSPS E	02	04	01	02	03	03	03	06
CSPS F	01	02	00	00	03	03	00	03
Total	12	19	05	12	15	17	15	32

diversification of profiles was done to assess whether the training made any difference in how the health professionals interacted with the diagnostic tool. There were three or more interviews conducted in each CSPS and with the exception of one who had been trained but was on administrative leave at the time of data collection, all health professionals who had undergone the training (n=17) and 15 others who did not, were interviewed. The total sample size was 32 (Table 1) and was obtained following criterion sampling.³²

Data analysis

All interviews were conducted in French. All were audio-recorded, fully transcribed, and entered into a word processing program. The data were coded using the qualitative data processing software QDA-Miner 4 (Provalis Research, Montreal, Canada). The resulting corpora were subjected to content analysis based on the statuses “trained” and “not trained,” the interview topics and health center. To maintain anonymity, the six CSPSs were designated with the letters A, B, C, D, E, and F.

Ethical aspects

The study was authorized by the health research ethics committees of Burkina Faso (N°2013-11-03/13) and of the University of Montreal Hospital Research Center (N°15.192).

Results

1. Use of dengue tests in a research context

The use of the tests was preceded by a 3-day training program (theoretical and practical), attended by three health professionals per center. They were expected, in turn, to train their colleagues and to share all the information and knowledge they had been given. This process led to differences in health professionals' involvement with and use of tests.

- i) Use of tests by trained and non-trained health professionals

In all the CSPSs, the health professionals who had been trained had primary responsibility for processing the dengue RDTs; they were in charge of that activity. Activities were organized in such a way that one member of the trained team was routinely present in consultations to ensure effective use of the tests. This organization enabled health professionals who had not been trained to practice using RDTs. Thus, both trained and non-trained personnel were involved in performing the tests:

With the others [not trained], when we're there, they're also present and they learn, they watch. Sometimes ... for example, today, I'm here, and there are others working with me, and at the same time they're learning, they're watching and so they have the opportunity to try it. (IB, CSPS D, trained)

While some non-trained personnel expressed interest in the activity and learned to perform the tests, others did not become involved. There were several reasons given for their lack of interest, but the main ones were the fact that they had not been chosen for training, and their belief that those who had been trained had received financial compensation; however, the study did not provide any sort of compensation to those who underwent training.

The health professionals who had been trained were thus considered to be in charge of the intervention. Its implementation and especially its success were their particular responsibility. While the financial considerations mentioned by some respondents were certainly a factor, the exploratory nature of the study was another factor to be considered in explaining health professionals' level of involvement.

ii) Prescribing practices in relation to RDT use

According to the health professionals, prescriptions dispensed based on dengue RDT results respected the directives received during the training and took into account the known contraindications for certain type of medications:

No aspirin! Especially no anti-inflammatories! These two are the most important, because the person is predisposed to

haemorrhage and those aggravate bleeding. So, no Aspégic® (IDE, CSPS A, trained)

For patients whose test results were negative, analgesics, antibiotics, and antipyretics were favored. Patients were also advised to rest and cautioned against auto-medication. Some respondents nevertheless reported having prescribed antimalarial for certain negative results. The reasoning they used to justify this practice was one of ensuring coverage and preventing any complications of a possible malaria case.

Prescribing antimalarial in cases of negative dengue RDT results echoes a certain perception of malaria RDTs. The health professionals noted that malaria RDTs can, given certain factors, produce false negatives, whereas a thick blood smear might produce a positive result for the same patient. As such, some preferred to prescribe antimalarial to prevent complications of a “false-negative malaria case.”

With regard to the clinical management of positive cases, all the health professionals—trained and non-trained alike—spoke of a purely symptomatic treatment. In this situation, there are no other treatment options for patients, aside from rest and hydration. Medications are prescribed based on the patient’s symptoms. According to the health professionals, these prescriptions involve analgesics for pain, antipyretics for fever, antibiotics when other bacterial infections are suspected, or anti-emetics for patients who are vomiting.

Generally speaking, the health professionals reported changes in their prescribing practices prompted by their use of the tests. For instance, while non-steroidal anti-inflammatory drugs (NSAID) and acetylsalicylic acid (ASA) are routinely used to treat pain, inflammation, or fever, these medications are contraindicated in either laboratory confirmed (presence of antibodies type IgM/IgG or antigens such as NS1 in blood or serum samples) or presumptive cases (presence of signs and symptoms according to the WHO 2009 guideline) of dengue; due to the proven hemorrhagic complications generated by the interaction between such medicines and the physiological effects of dengue. This new information (delivered in the training sessions) thus led to the reduction, and even elimination, of this class of medications—which previously had been routinely used—being prescribed and administered, regardless of the test results:

We applied [anti-inflammatories] in some cases because we didn’t know, so it was after the training that we were told, no more anti-inflammatories. Now, since the training, when we do a test and it’s positive, we don’t even risk it anymore, but before, well, we used it. (IDE, CSPS E, trained)

Using the tests thus helped to correct certain practices that could have been fatal in undifferentiated fever cases, as explained by this nurse from CSPS A:

Before the arrival of dengue RDTs in our CSPS, we once treated a colleague’s child who had repeated fevers that never went down; at that time, we didn’t know about dengue. Because the fever persisted with pain, we injected him with anti-inflammatories, and that was the end for him; he passed away,

he died [cause of death unknown] ... Others also came several times for treatment; we prescribed antimalarials but despite everything their fever never went down. At the last minute, we referred them to the next level, but we later learned that one or two had died. (AIS, CSPS A, not trained)

After the outbreak, this measure remained unchanged. At the time of the survey (5 months after the tests had stopped being used), health professionals reported that they continued to be careful about prescribing NSAID and ASA-based medications in the clinical management of febrile cases. This precaution was even more warranted because, since the end of the trial, they no longer had tests available to establish a differential diagnosis, as this nurse explained:

We pay careful attention because now it’s complicated! We avoid, as much as possible, anti-inflammatories, aspirin, Aspégic®; whenever we can, we avoid prescribing them to patients, especially because we have no dengue RDTs. Before, faced with fever, right away you would tell someone to take ibuprofen, but that can complicate things, so we try as much as possible to avoid using anti-inflammatories. So when colleagues come by, I often tell them, be careful, with dengue we need to avoid certain products. (IDE, CSPS F, trained)

2. Perceptions of dengue RDTs

i) Comparisons with malaria RDTs

Different opinions were expressed regarding the handling of the tests. While the health professionals—both those who were trained and those who were not trained but had learned to use the RDTs—saw the value of the tool, they nevertheless reported that the testing was laborious. Their assessment of the handling of dengue tests was founded on a comparison with malaria RDTs, which they had been using routinely since 2010 and to which they were more accustomed:

The malaria RDT is easy [laughter]! It’s easy because if you get only one drop, you just add the solution, and that’s it. But for the dengue RDT, you need to work fast so that there’s no coagulation. When there’s coagulation, you’re sitting there, you can see for yourself that it’s not descending properly. (IB, CSPS D, not trained)

The handling required for dengue RDTs was considered acceptable but more complex than for malaria RDTs. The perceived complexity of the tool had to do with the type of test used for the trial and the quantity of blood it required:

The dengue RDT requires more blood than the malaria RDT, so that’s often [a problem], too. If you don’t do it the right way, you can have trouble getting blood; if you haven’t properly prepared the finger, you could have difficulty collecting the blood ... And especially the pipettes for collecting the blood, well, that’s another problem (IB, CSPS A, not trained)

The conditions of the trial also added to this perceived complexity of the tool.

The dengue RDT was much more complicated, as we had to draw blood from the patient at least twice, because we had to run a malaria test before going back, and for some we had to do it three times! If you didn't get a good blood sample, you needed to go back and do it again, and that was the main problem. (IDE, CSPS E, trained).

ii) Test reliability in relation to results obtained

Health professionals in sites where no positive cases were found were more reserved about the reliability of the tests. Although they attributed this outcome to the fact that the study was conducted after the crisis period, they thought that even just one positive diagnosis would have helped confirm the value of the RDTs. The health professionals at CSPS B were among those who expressed the greatest reservations about the tests, having had no positive cases:

Yes, we have confidence. Because, look, we had at least ... Here alone, I believe we had two or three positives, so there! We had two or three positives! (IDE, CSPS C, not trained)

For others, the fact that the health authorities collaborated with the study and authorized the use of the tests was proof enough of their reliability:

I assume that whatever the State has authorized to be done is reliable. The State wouldn't expose its population to tests that are not reliable. There's a high risk of pandemic, so the State wouldn't want to do that! So, everything the State does, like vaccines, we have confidence in the State, [we trust] that the State would not allow tests that are not reliable. (AIS, CSPS A, not trained)

Health professionals in sites where no positive cases were found were more reserved about the reliability of the tests. Although they attributed this outcome to the fact that the study was conducted after the crisis period, they thought that even just one positive diagnosis would have helped confirm the value of the RDTs. The health professionals at CSPS B were among those who expressed the greatest reservations about the tests, having had no positive cases:

Convincing? Since we didn't have any positive cases, I myself can't express any opinion on that, because, if it had been during the time ... I know that if it had been at the right time, then, we might have been able to say whether it was reliable or not, but as it is ... [Question: It's a bit complicated?] Right! If there are no [positive] cases, we can't say anything! (IB, CSPS B, trained).

Some health professionals also noted that negative results sometimes turned positive past the time indicated for reading the results, when the consultation was over and the patient had returned home. Despite these diverse opinions about test reliability, the health professionals said they were satisfied to have tried these new tests. All had positive views about the use of dengue RDTs.

iii) Tests useful for differential diagnosis of febrile illnesses

Although this was the first time most of the health professionals had used dengue RDTs, their assessments were positive. They considered the tests to be useful because it improved their ability to establish a differential diagnosis and to manage cases more easily during infection outbreaks. They especially appreciated the possibility to differentiate an acute from a past dengue infection. This specific feature of the test, in fact, made it possible to identify, among the health professionals who underwent testing during the training previous dengue exposures. Their memories of the symptoms they had developed during those past illness episodes gave them a better understanding of the test results. Furthermore, for health professionals, given the similarity of symptoms between dengue and malaria, and the latter's endemicity, it is difficult to establish a presumptive diagnosis of dengue. Only biological tests can establish a differential diagnosis, which then facilitates better management of febrile illnesses—hence their perceived utility:

For sure, it's useful! Very useful, in fact [laughter], because to diagnose dengue, we need to do RDTs, since clinically it has the same symptoms as several other illnesses at the same time, so only the dengue RDT can help us with the diagnosis, otherwise we might miss it In any case, we could miss it because often there's fever, there's coughing, and I know, too, that these symptoms occur in dengue, so the patient who presents, you might think of bronchitis, for example So, with the dengue RDT, if it's done promptly and dengue is ruled out, then the management is made easier; so the dengue RDT is really very necessary! (IDE, CSPS F, trained)

Prior to dengue RDTs introduction and therefore before the health professionals had acquired any in-depth knowledge on this infection, most febrile cases seen in consultation (at the start of the crisis) were routinely treated as malaria. Patients who returned with no improvement in their symptoms were considered resistant to antimalarials and treated accordingly:

Before the training, we told ourselves, for example, that we had many cases of relapse, but we couldn't relate this to dengue because we didn't know what dengue was. [For us] these were malaria cases that were difficult to treat Today, with combination therapies, things normally would clear up within three days. But in three days, in those cases! It was as if the malaria itself had returned, so that, in the rainy season, we were really up against it. But as I said, it was with the training that we understood, and once we re-oriented the treatment there wasn't even a problem. (IDE, CSPS F, trained)

In summary, by using RDTs, health professionals were able to improve their practices and manage patients with appropriate prescriptions and fewer risks of complications. When health professionals compared their treatment of

patients at the start of the outbreak (before the use of tests) and after the trial, their positive perceptions of the use of RDTs were reinforced.

3. Routine use desired, but conditional

All the health professionals wanted dengue RDTs to be introduced into routine consultations. Despite the constraints encountered in their use, all wished to see the experience renewed, and in fact scaled up, as had been done for malaria RDTs:

That it should be permanent, always available, since, given that the vector agent isn't like the others—these are mosquitoes that sometimes spread via trucking and shipping—this means dengue is possible at any time. Sure, there's a specific season, especially when the weather is humid, it's true, but all the same, each time, even if it's just one case, it can happen! And if it's permanent, then it will be a great help. (IDE, CSPS E, trained)

They especially wished to have the tests available in periods of high malaria prevalence, given that, on one hand, these are also considered high-risk periods for dengue and, on the other hand, with rapid tests, it would be easier to establish a differential diagnosis, provide more effective treatment, and as a result, make better use of resources allocated to malaria:

This needs to be made part of the patient management system, especially in malaria season, which is about to start. Yes, they just have to add it, because they said it's mosquitoes, and the mosquitoes are about to start up, so we need to have these tests along with malaria RDTs, and maybe, in that way, we won't miss any cases. (IDE, CSPS D, not trained)

Still, certain conditions must be met, according to the health professionals. In essence, they would like a “simplified” test. The majority of health professionals expressed this condition, since the perceived complexity of the tests used was seen as the primary constraint. The desired simplification needs to be accompanied by better health services organization to reduce patient wait times and mitigate the discomfort associated with drawing blood samples. Also needed is an urgent-care system to manage complications. There was also the question of test availability. The health professionals thought the health centers should be regularly stocked, especially prior to the beginning of periods considered high risk to facilitate clinical management and avoid the stock shortages that occurred for certain tools, particularly malaria RDTs.

Another condition expressed was that all health professionals should be properly trained, to ensure the tests are widely adopted. All our respondents saw training as the foundation for strong adoption and proper use of the tool. Hence, they stressed that training should not be provided just to a few health professionals, as is customarily done, but should be generalized.

Discussion

This study analyzed health professionals' attitudes and opinions regarding the use of a health innovation and its impact on their diagnostic and prescribing practices. This innovation was introduced in a context presenting two sets of new experiences. The first was the re-emergence of dengue, around which a great deal of information, some of it erroneous, was circulating, and the second was the exploratory nature of the study, which introduced both new knowledge and new diagnostic tools. Prior to the outbreak of 2013, health professionals' knowledge about dengue was very limited. Few febrile cases were diagnosed, and much less treated, as dengue cases. The endemicity of malaria explains in part why most fevers were initially treated as such.¹¹ For most of the health professionals in our sample, the introduction of dengue RDTs was the starting point for their interaction with this “re-emergent” and neglected disease. The exploratory nature of the study and the “newness” of the infection thus influenced health professionals' behaviors toward the tests. The data showed that those who had been specially trained in the use of the tests became more invested in the study's implementation, and even some who had not been trained became interested in using the tool. This could be due to the established controlled condition in which the necessary equipment, logistics, and human resources were all in place. Several studies have shown that clinical trials and research programs, because of the means available to them, have a positive influence on quality of care and on health professionals' motivation to perform activities. However, they can also be demotivating and even a source of conflict, particularly for those health professionals who are not considered and therefore feel excluded.^{33,34} The results likewise suggest this commonly experienced difficulty of involving health professionals in the study. Those who were not trained did not necessarily feel any responsibility for implementing the intervention, even when they were interested in it. While this attitude may have been due to the cascade training strategy, an approach increasingly adopted in implementing health interventions,³⁵ another factor may have involved certain persistent notions associated with these types of training and with research projects in general. It is widely assumed that such projects offer per diems and other forms of financial compensation, even when this is not necessarily the case.^{36,37} In such a context, enlisting everyone's involvement in the activities remains a significant challenge. In this study, regardless the training, the differences in health professionals' use of the tests and involvement in the research, all appeared to have benefited from the training on management of presumed cases of dengue, particularly regarding contraindications for certain categories of medications.

Use of test results

Using test results when prescribing medications was a key aspect of the recommendations related to clinical

management of patients. In contrast to what has been observed in studies on malaria rapid testing, in which health professionals did not always respect directives on prescribing (in both research and routine contexts),^{38,39} the results of this study showed relatively good compliance in relation to dengue testing. Health professionals reported more or less strict compliance with the recommended prescriptions and even a change in their prescribing practices, which should be confirmed by subsequent quantitative analyses. Test results appeared to be used more conscientiously for dengue than for malaria. This finding contrasts with those of a study in Cambodia which showed that, as in malaria rapid tests, negative dengue RDT results were not taken into account by health professionals, who preferred to rely on clinical intuition to administer the WHO protocol for patients with dengue-like symptoms.¹⁹ In Burkina Faso case, the reported strict adherence to prescribing directives might be explained in part by the research context, in which the tests were used only for a limited time, the sensitive nature of the situation and media coverage, as well as the need for a diagnostic alternative in undifferentiated cases of fever with negative malaria RDT results. The study context was, marked by Ministry of Health involvement in the implementation of the activities in the health centers, with the dengue epidemic being the focus of a Ministry press conference in November 2013.⁴⁰ There were also regular supervisions by the research team, in contrast to the malaria RDTs, which have been routinely used without any regular supervision of those activities. The nature of the infection itself appeared to have an influence on health professionals' practices. Essentially, their limited knowledge about dengue—as opposed to malaria, which they encountered routinely—and the complications that certain medications could provoke in cases of dengue led them to be more cautious in their prescriptions. Hence, their practices were driven by test reliability and their conceptions of this “new” disease. With respect to compliance with prescribing directives, however, the changes observed in our study related only to dengue testing. Directives related to malaria were still circumvented when test results were negative, as has been found in other studies.^{41,42} The reliability of dengue tests was also less often called into question than was that of malaria RDTs. This may have been due to health professionals' lack of experience with the tests and with dengue management. The reliability of dengue tests was also less called into question than it was with malaria RDTs. This could be due to health professionals' lack of experience with the tests and with dengue management. Studies have shown that health professionals' empirical experiences of managing certain pathologies structure their attitudes toward the reliability of biological tests and medication prescriptions.⁴³ In the case of dengue, the health professionals encountered had no such empirical foundation, at least not until the dengue outbreak was confirmed. This situation was perceived as a novelty in Burkina Faso, as a learning opportunity and a chance for

health professionals to become familiar with the disease, rather than call into question a working tool.

Issues around routine use or the challenge of prioritizing health problems

While potential routine use of dengue RDTs in health centers in Burkina Faso would offer certain benefits, it would also pose very significant challenges for local health systems. The benefits include improved detection of the infection in the population and rapid access to appropriate management, as well as avoidance of inappropriate use of certain medications such as antimalarials and antibiotics in a context of limited resources,^{19,44} which could potentially not only improve the management of febrile illnesses but also reduce the burden of disease. This could also strengthen the surveillance and control system, to the extent that the system requires cases to be confirmed by biological testing and reports.⁴⁵ If there is one aspect of dengue management—not only in Africa but in other regions globally where it is endemic—about which researchers agree, it is the inadequacy of disease surveillance and control systems.^{46,47} If dengue (and its burden) is still poorly understood, it is because of serious gaps in the diagnosis, case confirmation, and limited surveillance systems.^{10,48} Lack or insufficient surveillance systems may lead to, among others, limited access or application of guidelines and to an inadequate disease management and control.⁴⁹

In Burkina Faso, the dengue surveillance system has existed only since 2014, but it is not very sensitive, mainly because of the lack of knowledge about the disease at all levels of the health system and the limited laboratories capacity (including RDTs), together with the limited training of its health professionals.⁵⁰ The limited number of studies conducted to date on dengue and the way in which the 2013 outbreak was managed are clear indications of this lack of knowledge.^{40,51} This could be partially explained by the fact that dengue is a re-emerging disease or because it had been eclipsed by the preponderance of malaria (around eight million cases reported per year).²⁴ Until its 2013 outbreak, it had received no particular attention and was absent from all health plans.^{25,52} The 2013 outbreak highlighted, on one hand, a need for knowledge about the disease on the part of health professionals, the health system, and the public at large, and on the other hand, a need for measures to ensure surveillance, diagnosis, and patient care in health centers. Yet those health centers are already contending with many difficulties associated with managing other diseases, such as malaria, HIV, tuberculosis, among others. Thus, large-scale use of dengue RDTs will depend on health services' capacity to introduce new tests in a context where: (1) there are already several diagnostic and support tools in routine use; (2) those tools are not always used in accordance with official directives; and (3) the weight assigned to dengue in relation to other health priorities has yet to be determined. Although the Ministry had considered dengue a public health priority and had—timidly

and incompletely—put in place several actions (e.g. clinical directives, draft of a dengue surveillance plan), the 2014 Ebola epidemic diverted its attention and concerns toward this new infection. Dengue's visibility was reduced, as were the actions initiated and the resources allocated. Moreover, the burdens of other infectious diseases such as HIV, malaria, and meningitis continue to weigh heavily on the country, and certain neglected tropical diseases have become the focus of particular attention.⁵²

The health professionals we encountered did not see dengue testing as extra workload, most likely due to the research context of the intervention, but they recognized that its routine use could create competition among activities. Better organization of health services, large-scale training of health professionals, and dependable access to tests that are easy to use were seen as measures to mitigate this competition, and especially to foster more use of these tests.⁵³ Given the current state of knowledge about dengue and its management by the health system, these measures should not only be applied in basic healthcare structures but should be extended to the system at large. However, for the time being, rather than focusing on routine use of dengue RDTs, it is probably advisable to concentrate on interventions that would strengthen the health system overall and local systems for dengue surveillance and vector control.⁴⁶ These interventions could include, among others, making tests available in cases of epidemics and training health professionals.

Limitations

The timing of the use of tests, which was toward the end of the epidemic, such that in some health centers no cases were diagnosed and influenced health professionals' perceptions of the tests' reliability was a limitation, as well as it was the timing of the qualitative survey. The 4-month interval between the end of the tests' use and the interviews with health professionals definitely mitigated any bias that might have been introduced by our presence on site while they were using the tests, but conversely, it meant we were unable to compare their discourses with their actual practices in situ. Our analysis is therefore grounded more in their reports than in any direct observations, such that the presence of social desirability bias cannot be excluded. On another front, the different characteristics of the tests used in this study limited any comparisons with malaria RDTs, with which the health professionals were more familiar. Hence, any interpretations of perceived differences between tests must be considered only in the context of the study. Despite these limitations, the study's results contribute significantly to the scientific knowledge on dengue and its management by health systems, in both Africa in general and Burkina Faso in particular.

Conclusion

In Burkina Faso, dengue continues to be under-diagnosed in health centers because of health professionals' limited

knowledge about it, the absence of tools to diagnose and confirm cases, and the lack of awareness. In this study, conducted in a research context confined to a dengue outbreak, we assessed health professionals' use of tools to confirm diagnoses, as well as their prescribing practices when dealing with this long-overlooked but very present infection. While health professionals appreciated the tests and were able to perform them, the value of using them routinely remains to be established. Essentially, it is not so much the health professionals' capacity to use the test that is at issue but rather health centers' capacity to integrate new tools and the place assigned to dengue in local health systems. This place has yet to be clarified in a way that would support surveillance and infection control interventions.

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Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

Ethical approval for this study was obtained from the health research ethics committees of Burkina Faso and of the University of Montreal Hospital Research Center (CRCHUM).

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ORCID iD

Valéry Ridde  <https://orcid.org/0000-0001-9299-8266>

References

1. Peeling RW and Mabey D. Point-of-care tests for diagnosing infections in the developing world. *Clin Microbiol Infect* 2010; 16(8): 1062–1069.
2. Chappuis F, Alirol E, d'Acremont V, et al. Rapid diagnostic tests for non-malarial febrile illness in the tropics. *Clin Microbiol Infect* 2013; 19(5): 422–431.
3. Cowan J, Michel C, Manhiça I, et al. Implementing rapid testing for tuberculosis in Mozambique. *Bull World Health Organ* 2015(93): 125–130.

4. Ezeoke OP, Ezumah NN, Chandler CC, et al. Exploring health providers' and community perceptions and experiences with malaria tests in South-East Nigeria: a critical step towards appropriate treatment. *Malar J* 2012; 11(1): 368.
5. Chandler CI, Whitty CJ and Ansah EK. How can malaria rapid diagnostic tests achieve their potential? A qualitative study of a trial at health facilities in Ghana. *Malar J* 2010; 9(1): 95.
6. Bastiaens GJH, Bousema T and Leslie T. Scale-up of malaria rapid diagnostic tests and artemisinin-based combination therapy: challenges and perspectives in sub-Saharan Africa. *PLoS Med* 2014; 11(1): e1001590.
7. Pai NP, Vadnais C, Denkinger C, et al. Point-of-care testing for infectious diseases: diversity, complexity, and barriers in low- and middle-income countries. *PLoS Med* 2012; 9(9): e1001306.
8. World Health Organization (WHO). Dengue and severe dengue. WHO, <http://www.who.int/mediacentre/factsheets/fs117/en/> (2012, accessed 24 July 2015).
9. Messina JP, Brady OJ, Scott TW, et al. Global spread of dengue virus types: mapping the 70 year history. *Trends Microbiol* 2014; 22(3): 138–146.
10. Were F. The dengue situation in Africa. *Paediatr Int Child Health* 2012; 32(Suppl 1): 18–21.
11. Stoler J, Al Dashti R, Anto F, et al. Deconstructing “malaria”: West Africa as the next front for dengue fever surveillance and control. *Acta Trop* 2014; 134: 58–65.
12. Amarasinghe A. Dengue virus infection in Africa. *Emerg Infect Dis*, http://wwwnc.cdc.gov/eid/article/17/8/10-1515_article.htm (2011, accessed 29 June 2015).
13. Chipwaza B, Mugasa JP, Mayumana I, et al. Community knowledge and attitudes and health workers' practices regarding non-malaria febrile illnesses in eastern Tanzania. *PLoS Negl Trop Dis* 2014; 8(5): e2896.
14. D'Acremont V, Lengeler C, Mshinda H, et al. Time to move from presumptive malaria treatment to laboratory-confirmed diagnosis and treatment in African children with fever. *PLoS Med* 2009; 6(1): e252.
15. Arauz MJ, Ridde V, Hernández LM, et al. Developing a social autopsy tool for dengue mortality: a pilot study. *PLoS ONE* 2015; 10(2): e0117455.
16. Fatima A and Wang J. Progress in the diagnosis of dengue virus infections and importance of point of care test: a review. *Pak J Pharm Sci* 2015; 28(1): 271–280.
17. Carter MJ, Emary KR, Moore CE, et al. Correction: rapid diagnostic tests for dengue virus infection in febrile Cambodian children: diagnostic accuracy and incorporation into diagnostic algorithms. *PLoS Negl Trop Dis* 2016; 10(2): e0004453.
18. Guzman MG, Halstead SB, Artsob H, et al. Dengue: a continuing global threat. *Nat Rev Microbiol* 2010; 8(12 Suppl): S7–S16.
19. Andries A-C, Duong V, Ngan C, et al. Field evaluation and impact on clinical management of a rapid diagnostic kit that detects dengue NS1, IgM and IgG. *PLoS Negl Trop Dis* 2012; 6(12): e1993.
20. Hunsperger EA, Yoksan S, Buchy P, et al. Evaluation of commercially available diagnostic tests for the detection of dengue virus NS1 antigen and anti-dengue virus IgM antibody. *PLoS Negl Trop Dis* 2014; 8(10), <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4199549/> (accessed 22 February 2016).
21. Blacksell SD. Commercial dengue rapid diagnostic tests for point-of-care application: recent evaluations and future needs? *Biomed Res Int* 2012; 2012: e151967.
22. Peeling RW, Artsob H, Pelegrino JL, et al. Evaluation of diagnostic tests: dengue. *Nat Rev Microbiol* 2010; 8(12 Suppl): S30–S38.
23. Ministère de la Santé. *Plan National de Développement Sanitaire 2011–2020*, Ouagadougou, Burkina Faso: Ministère de la Santé, 2011, http://www.who.int/pmnch/media/events/2014/bfa_pnds.pdf (accessed 30 March 2016).
24. Ministère de la santé. *Tableau de bord 2014 des indicateurs de santé*. Ouagadougou, Burkina Faso: Direction Générale des Études et des Statistiques Sectorielles, 2015, http://www.cns.bf/IMG/pdf/sante_tableau_de_bord_2014.pdf
25. Tarnagda Z, Congo M, Sagna T, et al. Outbreak of dengue fever in Ouagadougou, Burkina Faso, 2013. *Int J Microbiol Immunol Res* 2014; 2(7): 101–108.
26. Gonzalez JP, Du Saussay C, Gautun JC, et al. Dengue in Burkina Faso (ex-Upper Volta): seasonal epidemics in the urban area of Ouagadougou. *Bull Soc Pathol Exot Filiales* 1985; 78(1): 7–14.
27. Fournet F, Vaillant Z, Roudot A, et al. Unveiling the permanence of flavivirus transmission in Ouagadougou (Burkina Faso). Ouagadougou: Research Report, IRD, 2012.
28. Collenberg E, Ouedraogo T, Ganamé J, et al. Seroprevalence of six different viruses among pregnant women and blood donors in rural and urban Burkina Faso: a comparative analysis. *J Med Virol* 2006; 78(5): 683–692.
29. Ridde V, Agier I, Bonnet E, et al. Presence of three dengue serotypes in Ouagadougou (Burkina Faso): research and public health implications. *Infect Dis Poverty* 2016; 5: 23, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4820922/> (accessed 14 April 2016).
30. Ministère de la Santé. *Rapport d'étape d'investigation de cas suspects de dengue dans la région sanitaire du Centre*. Ouagadougou, Burkina Faso: Ministère de la santé, 2013.
31. Lim J, Carabali M, Lee J, et al. Evaluating dengue burden in Africa in passive fever surveillance and seroprevalence studies: protocol of field studies of the dengue vaccine initiative. *BMJ Open* 2018; 8(1): e017673.
32. Palinkas L, Horwitz S, Green C, et al. Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Adm Policy Ment Health* 2015; 42(5): 533–544.
33. Angwenyi V, Asante K-P, Traoré A, et al. Health providers' perceptions of clinical trials: lessons from Ghana, Kenya and Burkina Faso. *PLoS ONE* 2015; 10(5): e0124554.
34. Zongo S and Ouattara F. Quand la prévention de la transmission mère-enfant du VIH “cause problèmes” : une ethnographie des relations interprofessionnelles dans trois sites de Ouagadougou. *Sci Tech Sci Santé Spéc Hors Sér* 2008; 1: 107–115.
35. Öztekin Z. *Evaluation of “cascade strategy” for training of health care workers for immunization programmes. An analytical literature review*. Ankara: International Children's Center, 2012, <http://www.icc.org.tr/uploads/documents/EvaluationofCascadeStrategy20.11.pdf>
36. Vian T, Miller C, Themba Z, et al. Perceptions of per diems in the health sector: evidence and implications. *Health Policy Plan* 2013; 28: 237–246.
37. Ridde V. Réflexions sur les per diem dans les projets de développement en Afrique. *Bull APAD* 2012; 34–36, <https://apad.revues.org/4111> (accessed 23 February 2016).

38. Zongo S, Ridde V and Haddad S. Les Tests de Diagnostic Rapide du paludisme. Entre directives officielles et réalités d'utilisation au Burkina Faso. Rapport d'étude, Montréal, QC, Canada; Ouagadougou, Burkina Faso: CRCHUM-CNRST, 2013, p. 77, <http://www.equitesante.org/tests-diagnostic-rapide-paludisme/> (accessed 30 March 2016).
39. Uzochukwu BSC, Onwujekwe E, Ezuma NN, et al. Improving rational treatment of malaria: perceptions and influence of RDTs on prescribing behaviour of health workers in Southeast Nigeria. *PLoS ONE* 2011; 6(1): e14627.
40. Ridde V, Carabali M, Ly A, et al. The need for more research and public health interventions on dengue fever in Burkina Faso. *PLoS Negl Trop Dis* 2014; 8(6): e2859.
41. Ochodo E, Garner P and Sinclair D. Achieving universal testing for malaria. *BMJ* 2016; 352: i107.
42. Coulibaly SO, Brieger WR and Ouédraogo Y. USAID, MCHIP, 2010, http://pdf.usaid.gov/pdf_docs/PA00JQ1T.pdf
43. Faye SL. Améliorer la prise en charge du paludisme par les tests de diagnostic rapide (TDR): appropriation par les prestataires et bénéficiaires de soins au Sénégal. *Bull Soc Pathol Exot* 2012; 105(3): 237–244.
44. Crump JA, Morrissey AB, Nicholson WL, et al. Etiology of severe non-malaria febrile illness in Northern Tanzania: a prospective cohort study. *PLoS Negl Trop Dis* 2013; 7(7): e2324.
45. Jaenisch T, Junghans T, Wills B, et al. Dengue expansion in Africa—not recognized or not happening? *Emerg Infect Dis* 2014; 20(10), http://wwwnc.cdc.gov/eid/article/20/10/14-0487_article
46. World Health Organization. Dengue: prevention and control—report by the secretariat. ReliefWeb, <http://reliefweb.int/report/world/dengue-prevention-and-control-report-secretariat> (2015, accessed 24 July 2015).
47. Wilson ME and Chen LH. Dengue: update on epidemiology. *Curr Infect Dis Rep* 2015; 17(1): 457.
48. Wichmann O, Yoon I-K, Vong S, et al. Dengue in Thailand and Cambodia: an assessment of the degree of underrecognized disease burden based on reported cases. *PLoS Negl Trop Dis* 2011; 5(3): e996.
49. Horstick O and Morrison AC. Dengue disease surveillance: improving data for dengue control. *PLoS Negl Trop Dis* 2014; 8(11): e3311.
50. Munoz M, Ridde V, Yaro S, et al. Beyond Ebola: surveillance for all hemorrhagic fever in West Africa should be enhanced. *Pan Afr Med J* 2015; 22(1 Suppl): 3, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4695527/>
51. Pacodi M. Burkina : Attention la Dengue est là ! L'Évènement, 27 November 2013, <http://www.evenement-bf.net/spip.php?article805>
52. Munoz-Bertrand M. Analyse de la surveillance de la dengue au Burkina Faso. Département de médecine sociale et préventive Faculté de Médecine, Université de Montréal, Montréal, QC, Canada, March 2015, p. 51.
53. Asiimwe C, Kyabayinze DJ, Kyalisiima Z, et al. Early experiences on the feasibility, acceptability, and use of malaria rapid diagnostic tests at peripheral health centres in Uganda—insights into some barriers and facilitators. *Implement Sci* 2012; 7: 5.