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René Umlauf / Uli Beisel

**TRANSLATING TECHNOLOGIES
IN GLOBAL HEALTH
DIAGNOSTIC SPACES BETWEEN
STANDARDIZATION AND
ADAPTATION IN UGANDA'S MALARIA
CONTROL PROGRAMME**

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TRANSLATING TECHNOLOGIES IN GLOBAL HEALTH

DIAGNOSTIC SPACES BETWEEN STANDARDIZATION AND ADAPTATION IN UGANDA’S MALARIA CONTROL PROGRAMME

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SPP 1448 sub-project “Translating Global Health Technologies: Standardisation and organisational learning in health care provision in Uganda and Rwanda”

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Introduction

This paper examines the implementation and use of Rapid Diagnostic Tests (RDTs) for *Plasmodium falciparum* malaria at different access points for anti-malaria drugs in Uganda. These new technologies are assumed to bring evidence-based diagnosis and therapy closer to the homes of people living in remote areas where basic public health services are not available. This means that from a policy perspective the rollout of RDTs has the potential to increase accuracy and access to parasitological diagnosis and malaria care considerably. Access to care has been a dominant trope in global health over the last decades. The rise of the so-called „global health complex“ has increased not only the visibility of health care problems in economically deprived countries (McGoey, Reiss, and Wahlberg 2011), but also resulted in greatly increased funding for so called ‘neglected diseases’ (ibid; Kelly and Beisel 2011; Cohen 2006). New disease control schemes have sprung up on the continent, and improved access to care and reduced malaria case numbers have widely been recorded¹. In malaria control current global efforts have mainly been shaped by attempts to provide universal access to new first-line treatments like *Artemisinin Combination Therapy* (ACTs). However, from a biomedical and pharmacological point of view questions of access are inextricably linked to clinical treatment protocols where therapy is always preceded by adequate parasitological diagnosis.

However, decades of neglect of biomedical malaria care in most endemic countries not only resulted in highly fragmented health infrastructures but are also characterized by the coexistence of a variety of treatment practices that complement and at times contradict clinical understandings of diagnosis/therapy nexus (Langwick 2007). But not only so called traditional medicine has relied on non-parasitological diagnosis, also in biomedical clinics a vast majority of malaria diagnoses have long been made based on symptoms of fever. Parasitological diagnosis via microscopy often remains out of reach for poor and rural settings as it requires costly laboratory equipment and expertise. Such infrastructural weaknesses are often compounded with understaffed clinics and high patient pressure. From a biomedical perspective this is worrying as it means many patients are not treated for the illness from which they actually suffer and that drugs might not be used rationally. Self-diagnosing and/or presumptive treatment with anti-malaria drugs are prevalent practices for managing the disease or the symptoms associated with it, leading to over- as well as under-diagnosis of malaria (Chandler et al. 2008).

Our paper traces the epistemological and ontological changes the introduction and use of *Rapid Diagnostic Tests* (RDTs) has triggered in how malaria is diagnosed and subsequently treated. In this paper we examine the two assumptions that underlie the public health discourse on RDTs, namely that (i) rapid tests are easy to use and mobile, and so (ii) make standardisation of parasitological diagnosis possible across a variety of health care facilities. In what follows we first discuss the public health discourse on rapid diagnostic tests, second introduce our theoretical understanding of standardisation, and finally discuss three different technologies to diagnose malaria. In the three empirical vignettes on malaria microscopy, symptom-based diagnosis and rapid testing we focus on the technologies’ capacity to standardize and the work

1 Already by 2006, these new actors had invested \$35 billion to fight the diseases of the world’s poor J. Cohen, “The New World of Global Health,” *Science* 311, no. 5758 (2006): 162. For instance with regards to investments in malaria control this has meant that funding quadrupled over the last few years—from \$249 million in 2004 to \$1.1 billion in 2008 D. McCoy, S. Chand, and D. Sridhar, “Global Health Funding: How Much, Where It Comes from and Where It Goes,” *Health Policy and Planning* 24, no. 6 (2009): 407–417.

that is involved to accommodate and adapt the technology to the everyday routines in the health facilities.

The Public Health Rationale for Rapid Diagnostic Tests

Strong arguments for the introduction of the mobile diagnostic devices have been drawn from the public health discourse (e.g. Hopkins et al. 2009). Firstly, adequate diagnosis is assumed to minimize the long persisting practice of fever-based management of malaria ('fever equals malaria'). Such fever-based management increases the risk of leaving diseases untreated that also have fever as a primary symptom. The phenomenon of concordant symptoms can become a life threatening issue e.g. children afflicted by pneumonia. Secondly, confirmation of malaria with RDTs is assumed to address uncontrolled prescription practices and usage patterns. This promises to avoid drug wastage and hereby reduce a strain on public-health budgets. Thirdly, the mobility of diagnostic means is important, as research into local treatment practices has revealed an estimated 50–60% of all suspected malaria cases are treated outside formal / public health care sector (Gyapong and Garshong 2007).

This specific situation triggered global access programs and governments not only to mobilize Community Health Worker (CHW) but also to integrate the private and the informal sector into (transnational) subsidy-chains for cost-effective dissemination of ACTs (e.g. Affordable Medicines Facility malaria (AMFm)). However, the announcement by the WHO of the new standard of parasite-based diagnosis for routine case management of malaria (WHO 2010) can also be understood as a complex example of how both the rise and the decline of financial resources in Global Health is articulated through different technologies. During the late 90's and early 2000s the emergence of vast funding bodies like the Global Fund, Bill and Melinda Gates Foundation (BMGF) and other related public-private partnerships in global health (e.g. GAVI, MMV, FIND) was coupled with a strong focus on technical fixes of the (developing) world's health problems. Resembling emergency narratives identified for the HIV/Aids industry (Nguyen 2010), the push for novel first-line treatment for case management of malaria (e.g. *Artemisinin Combination Therapies* or ACTs) can be seen in this line of thought. While the hasty adoption of ACTs by national malaria control programmes in most endemic countries was not entirely uncontested within the Global Health community (Kamal-Yanni 2010; Bloland PB et al. 2000), the emphasis shows that the distribution and use of the drugs was mainly inspired of older practice of "fever equals malaria".

The concerns raised for the push for novel ACTs to become default first-line treatment in poorly performing public (and private health) care services of most affected regions reached its climax with the detection of resistant strains of malaria parasites against the central agent of the drug at the boarder land between Thailand and Cambodia (Noedl et al. 2008). But the discovery of the new resistance coincided with the global financial crisis putting many donor countries in recession and eventually in trouble to fulfil their pledges. Drug resistance, high subsidies of ACTs together with poor treatment and prescription practices furthered a significant shift of the underlying therapeutic paradigm from the former "fever equals malaria" to "not all fevers are malaria" making diagnosis of malaria a promising and necessary priority in the Global

Health. While the use RDTs gains its scientific / biomedical legitimacy from its promises to bring parasite-based diagnosis to remote areas that despite the massive funding push largely remain disconnected from laboratory and microscopic infrastructure, its function as a resource saving tool must also be taken into consideration. Treating only when there is evidence of malaria parasites helps *target* expensive drugs to only those individuals that actually have malaria and eventually helps reduce over-prescription.

Thus, RDTs are assumed to complement microscopic services helping to make parasite-based diagnosis a standard operating procedure at all points of care. RDTs are deemed promising mainly due to two features: their simplicity and robustness. RDTs do not require to be cooled but withstand warm climates fairly well while maintaining high accuracy in diagnosis. Secondly, they are assumed to be easy to perform: a drop of blood is inserted in a hole on the test, a few drops of buffer in a second hole and 15 minutes later the results can be read. Similar to pregnancy tests, the binary code the tests operate with is expressed in a combination of control lines that determine either a positive or negative result. A positive test result provides evidence to access malaria treatment. The alternative scenario in which the patient/client is presented with a negative test result requires further follow up diagnostics at the same or referral to a higher level health facility in order to determine the cause of symptoms.

While the tests' simplicity and robustness is deemed to be a particularly compelling feature for use outside of formal health facilities, it is also important for use in health centres, clinics and hospitals. In order to accommodate high patient loads, staff shortages and suboptimal infrastructure, RDTs need to be simple to perform in a few steps with minimal training, and should be relatively independent of supporting infrastructure (Mabey et al. 2004; Makhni 2010). Thus, it is argued that RDTs can be successfully introduced along pre-given institutional divisions and help to enact parasite-based diagnosis as standard operation procedure for the case management of malaria throughout the entire health system. However, the advent of RDTs and its promise to standardise parasite-based diagnosis inside and outside laboratories adds an experimental dimension to the briefly sketched institutional patterns of pre-existing diagnostic capacities and practices. In the following section we introduce our analytical perspective on standardization before delving into our empirical material on diagnosing malaria.

Standardising Diagnosis

In line with what Foucault (2007) has argued standardisation can be seen as one mode of operation of modern capitalist societies to govern circulation of goods and people in certain territories. In his endeavour to carve out a genealogy of biopolitics and also to distinguish it from his reflections on sovereign exceptionalism and disciplinary normalisation Foucault highlighted the relation between security and circulation beginning to take shape in 18th century. "If sovereignty worked upon a territory and discipline delimited a particular space, biopolitics appeared as pre-eminently temporal, focussed on the aleatory, the uncertain and the event" (Aradau and Blanke 2010, 44). The quest to secure and govern the life of populations was driven by "organizing circulation, by eliminating its dangers, making a division between good and bad circulation, and maximizing the good circulation by diminishing the bad" (Foucault 2007, 34). Today with the intensification of circulatory movements under globalization attempts to prevent, regulate and control e.g. infectious diseases, terrorism and migration constitute only

the most prominent fields of control societies. Circulation has not only become an instrument but also a main target of governing processes.

In this line of thought standardisation can be seen as a series of power exercising tools in which prioritization inscribed in scientific practices and technology should safeguard and stabilize some flows over others. Thus, we understand standardisation as a process of constructing uniformities across time and space (see also Bowker and Star 1999). This we assume happens through the generation of agreed-upon rules (Timmermans and Epstein 2010). Making parasite-based diagnosis a standard throughout an entire health system follows a modern logic: to see is to know, and to know enables improvement. These claims are strongly coupled with other imperatives like the demand to measure improvements and to ensure that no resources are wasted (Rottenburg 2000). Our paper suggests that the “generation of agreed-upon rules” in standardization is not a smooth and linear process but involves negotiations of different understandings regarding the role of different actors and institutions; regulation of the best-to-use technologies and ultimately (dis-)agreements of what improvement of health and health care services actually means. We will argue that standardization (as a series of agreed-upon rules) can only fully be understood when we recognize that the use of technologies – which are meant to translate the standard into practice – involves making-up (new) rules (Wynne 1988). As we will see these new rules do not necessarily fit in smoothly with the inscribed and agreed-upon rules of global standards.

Furthermore, one crucial aspect for a successful (and democratic) introduction of a new technology constitutes its capacities to legitimize and justify specific field(s) of application. What public health experts refer to as *feasibility* involves various scientific practices and economic calculations, by which a technology’s affordance with a specific usage context is measured, tested and eventually agreed upon. Its mobility and ease of use are assumed to render RDTs both independent *and* useful for a wide range of field applications. Given this openness and indeterminacy (more accurate would be the German *Unter-determiniertheit*, under-determinacy) we analyse how the introduction of RDTs evolves around prioritization practices and negotiations of inclusionary and exclusionary effects.

In the following sections we trace the multiple and at times conflicting practices engrained in the stabilization and institutionalisation of a specific field of application of a (mobile) technology. Our cases show that establishing an (institutional) order based on standards and standardising technologies requires mobilization of other technologies and actors. We argue that efforts to determine the most efficient field of application of RDTs along a pre-given institutional order not only changes this order but is also undermined and challenged by existing diagnostic services and local priority setting practices. We not only show how diagnostic spaces interact with each other but how they do so in (sometimes) conflicting ways.

In what we call *Counting, Sensing and Reading* we introduce the three predominant modes (technologies) of diagnosing malaria. Describing these three modes of diagnosing malaria not only excavates some of the ontological and epistemological dimensions in diagnosing malaria, but helps us identify the interaction of their various temporal qualities. The final section of this paper then analyses the new complex landscape that malaria diagnosis in Uganda has become through the introduction of RDTs.

COUNTING (or The Gold Standard)

Broadly speaking three different laboratory techniques exist to identify malaria parasites in the blood stream: The classic tool is the identification and counting of malaria parasites (MPs) in a blood sample visualised and magnified by an optical microscope. More recently, two more technologies have been developed: (i) antigen rapid diagnosis tests (RDTs), which we will discuss in later sections of the paper in more detail; and (ii) molecular diagnostic techniques detecting parasite nucleic acids by using polymerase chain reaction (PCR). Molecular analysis is recognised as the most reliable method to detect malaria parasites in a body. But it is an expensive technology that not only requires the availability of PCR equipment in laboratories but also highly skilled technicians. Due to these requirements, it is (currently) not a realistic alternative for routine malaria testing and broad implementation in sub-Saharan Africa. Although RDTs are increasingly wide-spread in routine testing for malaria, the technology offers only a binary result (are malaria parasites present in the tested blood – yes/no), while microscopy and PCR also offer a quantitative result, they allow one to specify how high or low the parasite-load in the tested blood is, and so enable a judgment about the potential severity of the infection.

Due to this restriction of RDTs and the impracticability of PCR in routine testing, malaria microscopy continues to be recognised as the gold standard in malaria diagnosis. Thus, while technology has progressed significantly over the last century, the same technique with which the parasite first took to stage in the biomedical community remains the diagnostic gold standard. The man credited with the discovery of the malaria parasite is Charles Louis Alphonse Laveran, a French military doctor stationed in Algeria. Laveran describes the process of his discovery on 6 November 1880 as follows: “examining a fresh preparation of blood taken from a soldier suffering from malaria, I observed with astonishment a series of thin and transparent filaments on the periphery of round pigmented bodies. These moved with great agility and their living nature was incontestable. I soon found similar elements in the blood of other patients suffering from malaria and I had no longer any doubt as to their parasitic nature.” (Laveran, quoted in Garnham 1967, 754). It was indeed those living and moving filaments that Laveran later identified as the cause of malaria and initially named “*oscillaria malariae*”. His observation was only the beginning of the scientific discovery of the genus *Plasmodium*, the parasitic protozoa causing malaria in humans and animals. Nearly 20 years went by before the second cycle of the parasite in the mosquito was identified by Ronald Ross working in India, and only 70 years after Laveran the third cycle in the liver was first scientifically described. Leonard Bruce-Chuvatt, who was himself a famous malariologist, emphasises that Laveran’s discovery also attests to his visual skills on the microscope:

One must not forget that Laveran saw the new bodies in a fresh, unstained blood-film, on a slide under a coverslip, using a microscope with a dry lens (1/6”) giving a magnification of about 400 diameters. One can only admire his eyesight and his powers of observation! (Bruce-Chuvatt 1981, 532)

But not only Laveran needed excellent eyesight to identify malaria parasites in blood, in today’s laboratories in sub-Saharan Africa malaria microscopy receives special attention too. As one of our interviewees (a laboratory technician) tells us, “one needs a silent room with a nice atmosphere for malaria microscopy. Malaria microscopy is demanding, it requires a lot of concentration. Especially the species identification is hard”.

But before species are identified, the parasites seen in the blood sample first have to be counted. There are two WHO-recommended systems to count parasites (WHO 1991). The first one is slightly more complex, and involves relating the count of leukocytes to parasites. One counts 200 (or 500 leukocytes, in case there are under 9 parasites present when 200 leukocytes are counted) and then relates the parasite count to the number of leukocytes. The second, slightly simpler and hence in practice probably the more popular system is commonly called ‘the plus system’: here simply the number of parasites in the blood gets counted. The microscopist scans 100 fields (one field is defined as the area seen under the magnification without moving the lens) and if he/she finds 1–10 malaria parasites it is +, a mild malaria, if there are 11–100 malaria parasites present it’s ++, moderate malaria, if you however find 1–10 per 50 fields it is severe malaria and +++ (WHO 1991).

Both techniques seem fairly straightforward, but only in theory. In practise, so called ‘artefacts’ are one potential stumbling block. Artefacts—other organisms present in the blood such as fungi or microfilariae, can make malaria microscopy challenging². And so can other changes in the blood. In a laboratory course on malaria microscopy³ an interesting discussion about limitations of optical microscopy emerged. The discussion emerged around what ‘malaria diagnosis’ actually means. One microscopist made the point that “the whole diagnosis is relative anyway. Sometimes you see the parasite, sometimes you don’t. There is luck involved”. In this context, another one remarks that inflammation or bacteria (changing the ratios of leukocytes and erythrocytes in the blood) would cause the microscopist to scan fewer fields (since the rule is to scan 200–500 leukocytes). At this point of the discussion the trainer intervenes, and adds another aspect of uncertainty in malaria microscopy: “If a patient has malaria you are expected to see MPs. But with low parasitemia this does not have to be the case. Ideally, this is the case, but not in reality. Sensitivity, even for experts, is therefore not defined 100%”.

In other words, there is indeed ‘luck’ involved. If one has a bacterial infection, if there are only few parasites in the blood and/or if the malaria infection is in early stages, even very experienced microscopists might miss the presence of malaria parasites. Especially if the microscopist has to scan many slides per day. The trainer hence suggested that a good malaria microscopist needs to develop an ‘eagle eye’: “This means one should see every detail from above, like the eagle spots its prey, even from afar. One should scan every slide with an eagle eye and see the parasite hiding. Every detail needs to be seen before one moves on to the next slide”. This shows that experience and practice are very important to the quality of microscopic diagnosis; the trainer also underlines that constant training is necessary, as he put it: “If you have not been on the mic for some time, you’ll lose your eye and need to practise again”. But the challenges of malaria diagnosis do not stop at identifying MPs in the blood. For the microscopist it does, he/she reports the result ‘no MPs seen, +, ++ or +++’, and the laboratory sheet goes into the consulting room. And herewith leaves the second part of diagnosis to the doctor.

In this section we have encountered a version of malaria that gets enacted through visualising and counting parasites in the blood stream. It comes to life in the laboratory and might (or might not) live on when the result sheet encounters the doctors and patients in the consultation room. Nevertheless, in the microscopic logic ‘malaria parasites seen’ equals malaria, even if it is asymptomatic and would not qualify as the clinical disease called malaria⁴. Furthermore, seeing

2 For a scientific discussion of ‘artefacts’ in malaria microscopy see Chapter 9 in WHO (1991).

3 One of us (UB) attended this malaria microscopy course in 2007 in Agogo, Ghana.

4 This hints at a more profound question when aiming to standardize malaria diagnosis, namely the relation between parasites in the bloodstream and malaria as a clinical disease. Indeed, parasitological research has shown that most people living in highly endemic malarious areas are parasitized but healthy.

parasites in the blood, is an expert skill—it requires attention to detail, an eagle eye and is time-consuming. These challenges of counting malaria parasites are compounded with (trained and experienced) staff shortages, electricity blackouts and broken (or stock-out) equipment. Already due to high patient pressure, for most health facilities routine malaria diagnosing with microscopy is not achievable, as it would require one to two laboratory technicians solely dedicated to reading malaria slides all day. These issues render microscopy into an excellent diagnostic tool in theory, but in practice the quality of results is highly variable. Malaria microscopy has for long been known for its low sensitivity rates. One of our interviewees⁵, who works for a leading diagnostic organisation in the field, told us that in WHO reference studies he was part of, sensitivity rates well under 50% were no exception (meaning that trained microscopists in more than 50% of the cases they examine come to the wrong result). This has led some to calling microscopy “the imperfect gold standard” (Ohrt et al. 2008). But it is also imperfect in a second sense: in many settings microscopy was never even introduced. Malaria diagnosis here is made by what we call ‘sensing’.

SENSING (or, where there is no lab)

While microscopic diagnosis of malaria is the gold standard, it is certainly not the norm in malaria diagnosis in sub-Saharan Africa. Before the introduction of rapid diagnostic tests, the majority of diagnoses were made based on symptoms of fever at home or in health structures. Indeed, most malaria cases are first treated at home, often with inadequate drugs bought in shops or pharmacies. Many patients only access formal medical care late, leading to treatment delays with life-threatening consequences as most malaria deaths occur within 48 hours of onset of symptoms. In other words, many people self-diagnose themselves with malaria, and it is this we would like to focus on first in this section.

Take for instance Gad, in an interview he told us that he usually buys artesunate⁵ when he feels feverish. He would not go to the hospital, since he says he knows how malaria feels. For him, he says, it is a pain in the belly that comes together with fever. Other people describe different symptoms to me that they specifically associate with malaria. But what our interviewees agree on is that malaria can be identified easily, you know how it feels in your body after you have had it once. A body that is familiar with malaria does not need clinical or laboratory diagnosis Gad would argue, one knows how to self-diagnose malaria. Thus, Gad—like most people who have grown up with malaria—is aware of his own malaria symptoms. To him there is no need to spend precious time and money in the hospital for a diagnosis, where—as he complains—the doctor or nurse often would not do a blood test for him anyways and just prescribe malaria medication. And the nationally recommended combined therapy, we ask? No,

5 Artesunate is an artemisinin-based monotherapy to treat malaria. It is used widely, even though WHO recommended a policy change away from malaria monotherapies and introduced artemisinin-based combination therapies in 2003. This had become necessary because since the 1960s drug-resistance against three important malaria drugs (chloroquine, sulfadoxine-pyrimethamine and amodiaquine) developed and spread on a world-wide scale, necessitating the phasing out of monotherapy. It is hoped that combination therapies will slow down the development of resistance considerably. Despite this widely implemented policy change towards combination therapy, malaria monotherapy and artesunate continue to be widely available, and are popular with patients like Gad because they have few side-effects and provide quick relief of malaria’s symptoms.

Gad does not use it, he says it makes him weak, his body aches and he cannot work if he uses it. So Gad ends up buying artesunate monotherapy in a pharmacy, which is readily available and he is happy with the effectiveness of the treatment in his body.

What we might call street-level malaria care involves people buying various antimalarial drugs over the counter. But, and this is important, they do so as both well-informed customers and experienced bodies: negotiating life and malaria go together. It is important to note that people do not buy monotherapy over the counter because they don't know better, but because this is the option that they feel is best tolerated by their bodies and that connects most to the rhythms of their everyday lives that need to be sustained while and despite feeling feverish. And then, of course, people do much more against malaria than just taking drugs that are recommended by the clinic, government or sold in pharmacies. Herbal medicine, spiritual ceremonies, a variety of protective measures and many more activities represent strategies against fever/malaria. As Stacey Langwick has showed so called "traditional" medicine would not treat 'malaria', as malaria/fever to the healer exists in a different onto-epistemic realm and requires different actions. Nevertheless it might overlap with symptoms that a doctor in the clinic would call 'malaria', or what the malaria microscopist would visualise as *Plasmodium* parasites (Langwick 2007). However, it does not matter much if these diseases could or could not be visualised as malaria under a microscope; it is important to recognise that people through their practices define the disease. Malaria is located in *the practices of the patient*. It comes into being differently according to what people feel and self-diagnose, where they go for support and how they (get) treat(ed) themselves.

But not only in self-diagnosing of malaria sensing is used to diagnose malaria. Before the introduction of rapid diagnostic tests (we will discuss rapid tests and their implications in the following section 'reading'), symptom-based clinical diagnosis was the most common way to diagnose malaria in health centres and hospitals too. Many small rural health centres do not have a laboratory, and the ones who do fight with lack of infrastructure and/or trained personnel. The empirical story we would like to share in the following forms no exception. The health centre is headed by a midwife called Esther. She is in charge of health care for 15 scattered farm state communities and the village, where the health centre is located. The village (of roughly 200 households) does not have electricity or mobile phone coverage, and the only treasure of the health centre is a gas fridge for medication. The midwife is very experienced, she is in her 12th year in this village already and before that worked in several big hospitals as well as managed numerous health centres in other villages.⁶

And this is how malaria is routinely being diagnosed in the health centre: a six-year-old girl comes into the consultation room with her mother, Esther tells us that she has treated her for malaria a couple of weeks ago already. However, later her body swell up and now she also coughs, her ribs hurt, she breathes only with difficulty and has fever. Her eyelids also reveal that she might suffer from anaemia. Esther says "I treat her for malaria and pneumonia". Esther puts the mechanic fever thermometer under the arm of the little child and shrieks, because she discovers that the child wears two warm jumpers and in addition has a cloth wrapped around her body. The fever thermometer says 39.6. After this result Esther adds paracetamol syrup to the mix, where she had already put amodaquine syrup (malaria treatment) and the penicillin injection (pneumonia treatment). While diagnosing malaria in the health centre, Esther is restricted to judging clinical symptoms with the help of simple visualising tools: a fever thermometer and

6 In fact, by the time of writing this Esther is in all likelihood retired.

the patient's history, a lifting of the eye lid, and the measurement of blood pressure must suffice to make up the midwife's mind. Esther carefully takes notes about her investigation, building up patient-histories. Generally, after she has listened to the story of the patient, asked a few questions, used some of the limited diagnostic tools on her disposal and has written everything down, she starts assembling the medication for the patient.

As Esther herself put it, "I am going to treat her for ..." and not "this patient has/suffers from ...". Diagnosing or naming the disease drifts in the background, one could even say that the concept of specific 'diseases' itself fades away. Esther knows that ideally the diagnosis of malaria or pneumonia would entail much more, but she does not have these means at her disposal. Thus, malaria diagnosis here emerges through a process we call 'clinical sensing'. However, it is important to note that this process happens with a different kind of expertise than that of a patient who self-diagnoses. As described above Esther has medical training and a life's wealth of clinical experience – if a patient knows how malaria feels in his or her body, Esther knows how it looks and feels like to her expert eyes and hands. Malaria for Esther is established with the help of fever thermometers, with her hands discovering three layers of clothing at a little sick girl, with her eyes detecting anaemia on lifted eyelids, and her general medical expertise, which she built up over years and years of practicing medicine. And her diagnosis is expressed as 'malaria' not necessarily in words, but through the choice of drugs that she prescribes. Or sometimes the choice of drugs leaves it open. For instance, a prescribed penicillin injection in combination with malaria tablets *treats for* pneumonia *and* malaria. The important part here is *treatment*, not diagnosis.

Malaria here is diagnosed by the practice, the practice of the nurse as well as by the process the medication triggers in the patient's body. If her patient gets better on malaria treatment, then Esther can *deduce* that the diagnosis was indeed malaria. Treating malaria and diagnosing malaria are thus intimately entangled with each other. Diagnosing malaria is sensing, and testing one's diagnosis is done not in the laboratory, but through the medication, through treatment. In this sense malaria care is entangled in medical "tinkering" as Annemarie Mol understands it, it becomes part of a process of controlled trial and error "caring is a question of 'doctoring': of tinkering with bodies, technology and knowledge – and with people too" (Mol, 2008, p.12). But it is this practice – sensing malaria – that is to be superseded by rapid tests, a device that promises to offer quick and simple parasitological diagnosis no matter the setting or qualification of the health care provider. The next section discusses these assumptions and the clinical realities of introducing RDTs in lower level health facilities.

READING (or, the promise of simplicity)

Despite its assumed simplicity, the introduction of RDTs into lower level facilities with no laboratory means to identify malaria – like the one Esther is working in – has been challenging. Most health workers we interviewed emphasised the tremendous change the devices brought to their routine provision of health services. The tests first and foremost increase the complexity of everyday work routines by adding another layer of tasks and requirements. The following ethnographic vignette serves us as an entry point to discuss some of the effects the use of RDTs brought to these institutions. Gathered during an informal talk outside the health centre Nicole, a 21 old nursing assistant, described the complexities of her everyday work like this:

Nicole: *“One time I was here alone and had to work on over 60 patients ... we had all the testing kits and I had to test them as well. So I had to take their history, and as you see I am writing in almost six books here, then go to the other table for testing, then go to the treatment room to give medicine and then back to this table. So that day I realised that at some point, I was writing in the books wrongly. I would write the diagnosis in the place of the treatment. Another time I forgot to write the patients names on the testing kits when I was testing, I think like three patients, and finally I couldn’t remember whose results they were exactly”*

RU: *“So, what did you do?”*

Nicole: *“I just gave all of them Coartem... because two of them were positive and one was negative. So to be on a safe side I gave all of them Coartem.”*

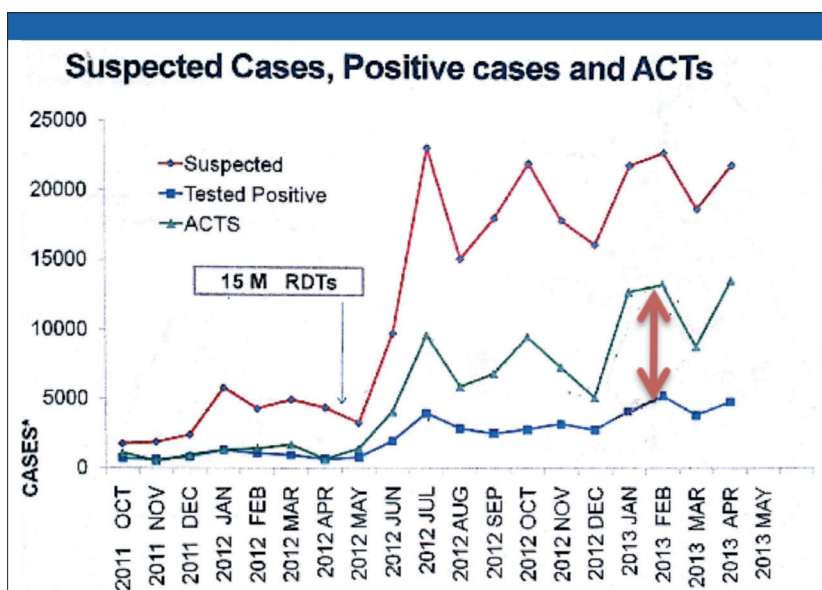
While the story illustrates the difficulties in coping with the lack (and absentism) of a professional workforce it also reveals how routine work is affected by the technical, performative and administrative requirements of RDTs. Shifting back and forth between six books (that Nicole struggles with) draws attention to the additional—and often not much loved—paperwork and accounting tasks the tests made necessary. While most health workers found it hard to grasp and accept the relevance and meaning of the time consuming data collection, and much manipulation of data can be observed this is not what interests us here. Nicole’s story shows the difficulties that health workers encounter as it falls to them to document the regulatory potential of RDTs, which goes beyond individual case management and renders the devices productive on a population level.

But Nicole’s story also hints at other complexities that are folded into the diagnostic process with rapid tests, what we call the reading of malaria diagnosis. One timesaving practice we observed most often was the collection and performance of several tests at once. Performing tests in a consecutive manner allows the health worker (or his/her colleague if available) to use the time he/she would wait for results to do other tests. After 3–6 tests he/she then makes sure all test shows results properly. Doing this well requires detailed attention to the labelling of the tests and allocation of test results to the respective patient. Another tactical adaptation due to high patient loads is the quick reading of results. While training manuals and the manufacturer recommend to wait at least 15 min before reading results, a common practice was to decipher and interpret results after only 2–5 min.⁷ These are only some selected examples of the creative work health workers employ to render new requirements and intensified workload compatible with their routine work demands, and show how the use of a novel technology is creatively fitted in with already existing work routines. What the here presented cases have in common is that simple reading of test results requires multiple and at times complex adaptation practices in order to afford the RDTs to a given context of high workload and low staffing. It also shows that the notion of time inscribed in the tests is not perceived as rapid. In direct comparison with clinical diagnosis/presumptive treatment the temporalities of performing a test together with the paper work and data collection, RDTs appear as a rather slow and time consuming device.

⁷ Reading results after a short while saves a great deal of time but this practice also needs to put in contrast with the most extreme version of time-saving, namely to skip performance of tests entirely and voluntarily shift back to clinical diagnosis (as observed in some of the health centres facing high patient loads).

Diagnostic Interactions: inclusionary and exclusionary aspects of standardisation

As mentioned above RDTs as standardizing technology not only operate on an individual level but are also rendered productive on a population level (see Graphic 1). While nationwide collection of RDT results via mobile phones has improved measurability of prevalence of malaria it has also revealed a (increasing) gap between RDT positive results and the amount of anti-malarial drugs prescribed (indicated here by red arrow). But the discrepancy in the use and efficacy of the two technologies visualizes an (absent) ideal case that if RDTs and ACTs ‘interact’ well the two lines should nearly overlap. In our interviews with national and international planning experts a common narrative we encountered referred to the abundant mistrust of health workers in negative RDTs, which (it is assumed) results in over-use of ACTs. In line with this explanatory logic current approaches to fix the gap predominantly focus on technical and scientific solutions.⁸ What remains rather unaddressed – perhaps due to its political/politicized nature – are experimental distribution patterns of RDTs that conflict with scientific and economic feasibility measures. In the next section we will try and tell a different story about what too causes the gap by following RDTs through their assigned fields of application.



Graphic 1
Source: PMI/USAID
Uganda (May 2013)

The introduction of RDTs in lower-level facilities gains its legitimacy out of a combination of various assumptions: It is assumed that clinical diagnosis (or presumptive treatment) lacks sufficient sensitivity in detecting malaria. This not only increases the risk of missing out or

8 The adoption of the problem of mistrust in RDTs results into global health circuits bears the testing and likely introduction of a new technical device (Positive Control Well (PCW)) that is assumed to serve health workers as point-of-care quality assurance (QA) tool. This technical fix is paralleled by increased scientific research into febrile diseases and new disease classification (e.g. Acute Febrile Syndrome (AFS)) as it has been recognized that health workers facing a negative RDTs would not know how to follow-up with a differential diagnosis.

delaying treatment of other potentially fatal diseases (e.g. pneumonia) in addition it causes over-prescription of novel and more expensive anti-malaria drugs, e.g. ACTs. In turn the high costs of infrastructural, personal and technical requirements of laboratory services exclude the use of microscopy in health centre II (HC II). In direct comparison with mobile and simple RDTs the microscopy emerges as a rather laborious (sic!) and static technology. Given the abundance of fever cases treated in HC II seem to render RDTs a perfect fit for these facilities. During our research in Mukono district, Uganda, however we were surprised to find nearly every facility facing stock-outs towards the end of the respective supply cycle (1 cycle=2 month). Checking the supply register forms it quickly became clear what caused the stock-outs: instead of the scheduled 1,000 RDTs/cycle all health centres only received 400 RDTs/cycle. With most facilities processing on average between 600–1,000 patients/cycle many health workers were regularly forced to shift back to clinical diagnosis/presumptive treatment. But where did the missing 600 RDTs go?

They went to health care facilities of higher order, namely health centres III and health centres IV/hospitals. In theory both health centre III and IV (HC III and HC IV) should have laboratory facilities and microscopic capacity to diagnose malaria. However, as intermediary institutions the services provided in HC III differ tremendously in quality and scope. Years of neglect and underfunding contributed to the rather ambiguous constellation with an estimated 40% of all facilities lacking a functioning microscope, adequate supply or manpower (e.g. laboratory technician). The introduction of RDTs at these sites has to be seen as an improvisation/coping strategy with complexities and fluctuations in the quality of service. Quite similar to situations in HC II the high workload (average 80 patients/day) makes most HC III that lack a microscope use up RDT supply quickly.

Secondly, and importantly, RDTs also go to HC IV/hospitals. Depending on size, management (governmental, non-governmental), and geography of the respective facility most HC IV and hospitals employ between 3–6 staff to run a laboratory with 1–4 microscopes. Some of these laboratories process around 300 patients per day, with most of the outpatient cases requiring diagnosis of malaria. Our conversations with the National Malaria Control Programme showed that the choice to include these higher-level facilities in the supply of RDTs follows a set of logics and justifications. Most often mentioned were references to the quality of results (e.g. poor sensitivity) and the expertise of the laboratory personal, herewith joining a global narrative on poor performative capacities of microscopy in Africa. But also under-staffing and subsequent long waiting hours for patients were stated to justify the ‘re-entry’ of RDTs in laboratories. Supply of higher-level laboratories is thus not only expected to improve the quality of diagnosis provided but also to speed up the processing of workload (and patients).

Explaining to us the issues at stake regarding supply of RDTs a local official in Mukono District summarized the situation as follows: “If only supply would stabilize then we could cope with the stock-outs. What you see right now is only a shift in stock-out... away from the drugs to tests...” The decision to include all public health facilities in the supply of RDTs—and to risk stock-out in lower level facilities—can be seen as an experimental intervention of the Ugandan government that renders visible the nature of global health technologies as a scarce commodity. The experimental redistribution of a limited quantity of RDTs—financed mainly through the Global Fund and other donors (USAID, Malaria Consortium), and assumed to be mainly used in settings access to a microscope—not only showcases renewed aid dependencies in health care provision, but also highlights different understandings on how to *best* improve case management of a single disease in the context of poorly performing health care services. What is at stake is the question who and what ultimately regulates the use of a technology? Is it scientific

and economic models that guide a technology's feasibility or local prioritization on how to best cope with the lack of professional health cadre?

The focus on and prioritization of the temporal features of RDTs and malaria diagnosis more broadly reveals varying and conflicting forms in the response to the lack of professional workforce by one technology. Using RDTs in laboratories where qualified staff is available enables laboratory technician to process more patients with the same amount of time and workforce.⁹ As we have seen, in lower-level settings RDTs mainly operate in an expertise-facilitating manner, which enables lay-people to carry out tasks formerly only performed by laboratory experts. But it also adds substantially to the workload in these facilities. Health workers often compared the time needed to perform a "rapid" with the temporalities inscribed in the routines of presumptive treatment / clinical diagnosis revealing that the tests take rather long to come up with results (see: Appropriating practices). In addition, regular stock-outs in these lower level facilities require staff to routinely shift between 'reading' RDTs and 'sensing' malaria through clinical diagnosis.

We have aimed to show how standardization of malaria diagnosis through the use of RDTs has in practice not worked to standardise malaria diagnosis; but rather added one more practice to the diagnostic repertoire. As much as laboratory technicians are now shifting back and forth between rapid tests and microscopy, lower level health facility staff routinely shift back and forth between rapid tests and symptom-based diagnosis. As we have shown they do so in order to save time, or to cover supply gaps in RDTs. Thus, to come back to our initial analytical framing of the paper: we have aimed to show how RDTs introduce an additional experimental dimension into diagnosing malaria. Translating rapid tests into clinical realities in Uganda has meant to strategically adapt the use of the technology to the clinics needs, as well as to strategically adapt the global policies to the needs of the Ugandan health system.

9 However it also makes them exercise tasks below their competencies and expertise and thus enrolls them as (silent) accomplices in an experimental practice that rather maintains precarious workforce situation. In contrast with the laborious procedures microscopy requires the use of RDTs promises to save a great amount of waiting and working time which can then be used to cater other more time consuming tasks (e. g. TB diagnosis).

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