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Rebounding Malaria and the failures of eradication in Zanzibar: The World Health Organization campaign and the after effects, 1957–1985[☆]

Melissa Graboyes^{a,*}, Judith Meta^b

^a University of Oregon, Department of History, USA

^b Independent Scholar, Public Health Professional, Tanzania

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ABSTRACT

This article presents a case study of the WHO's malaria elimination attempt in Zanzibar and the decades after the program's conclusion in 1968. Drawing on archival, ethnographic, and interview data, we find that Zanzibar experienced a rebound malaria epidemic in the 1970s–1980s when prevalence rates surged higher than they were prior to the WHO's intervention. We show that scientists were aware of the risks of rebound before it happened and recognized the rebound epidemic as it was happening. We argue that many of the challenges facing Zanzibar in the 1960s remain dilemmas today, and many of the ethical questions about rebound malaria remain unaddressed.

1. Introduction

Although a small island, Zanzibar plays a unique role in larger global discussion about the current feasibility of malaria elimination and the history of past attempts. It has long been considered an ideal place to attempt elimination due to its small size, island ecology, endemic malaria situation, and largely stable political climate. It is also unique in that it is a place in sub-Saharan Africa once labeled holoendemic that is now nearly malaria-free after 15 years of interventions funded almost entirely by foreign donors and agencies. Widespread availability and use of insecticide-treated bed nets, rapid malaria tests, artemisinin combination therapy, indoor residual spraying, and a digital tracking system have led to reductions of more than 90% in prevalence, incidence, and human biting rate across the island. Since 2008, malaria prevalence on some parts of the island hovers at 1% (Zanzibar Malaria Program Annual Report 2019–2020). In one well-studied district, a 2005 prevalence of 16% in the general population had dropped to 1.9% in 2015 (Björkman

et al., 2019). Talk of global malaria eradication was reenergized in 2007, when the Gates Foundation issued a challenge to reconsider the possibility and pledged additional foundation funds (Gates Foundation, 2007). In 2011, the Foundation returned to the topic, touting the intervening years' success—specifically highlighting gains in Zanzibar (Gates, 2011). Born of these many successes, Zanzibari agencies and foreign donors now speak directly of the goal of malaria elimination on the island.¹

What's often forgotten is that this isn't the first time Zanzibar has been on the cusp of island-wide elimination. The current situation is strikingly similar to that of the 1950s–1960s, when the World Health Organization ran a 11-year elimination attempt as the part of the larger Global Malaria Eradication Programme (GMEP). With a campaign that relied primarily on indoor residual spraying with DDT and dieldrin, the island was vexingly close to interrupting the transmission cycle and eliminating the disease. Zanzibar was repeatedly described by the WHO and international officials as a “model malaria eradication program”

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* Corresponding author. Department of History, 1280 University of Oregon Eugene, Oregon, 97402, USA.

E-mail address: graboyes@uoregon.edu (M. Graboyes).

¹ A note on language: following Fenner et al. (1998) and Stepan (2011) we use “eradication” to refer to when a disease has zero incidence globally and “elimination” when a disease has zero incidence on a smaller local, national, or regional scale; we also use the more well-known name of “Zanzibar” to refer to Unguja Island, the largest island of the Zanzibar archipelago.

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meant to show the feasibility of interrupting transmission in tropical conditions (WHO, Assessment of Zanzibar Map 1963). The WHO program was not the first malaria reduction program on the island, nor the last. Yet despite more than a century of interventions, the mosquito vector and malaria parasite remain firmly entrenched in the local environment and local bodies.

This paper focuses on the WHO's program in Zanzibar, which we argue managed to be a success, a failure, and a public health disaster all at the same time. To consider the program chronologically, the first 11 years (1957–1968) were a great success at malaria control: prevalence rates were reduced to under 5% (Zanzibar Malaria Eradication Project, 1963; Plan of Operations, 1966). Those same years were also a failure: the program was unable to interrupt the transmission cycle or eliminate the disease. Finally, the 1968 conclusion was the start of a disastrous program “afterlife”: an epidemic of rebound malaria in the 1970s–1980s with malaria rates surging higher than they had been before the WHO arrived, causing widespread sickness and death among Zanzibaris who had lost their protective acquired immunity.

The paper makes three contributions to re-thinking the history of malaria elimination attempts in Zanzibar and in sub-Saharan Africa more broadly. First, we provide evidence that the WHO's program in Zanzibar was part of a real effort by the Global Malaria Elimination Programme (GMEP) in Africa. The Gates Foundation has claimed “During the eradication era of the 1950s and 1960s, the global health community pursued an everywhere-but-Africa strategy” (Gates, 2011). But that isn't true. Archival documents make clear that the WHO actively pursued ambitious, well-funded, carefully organized programs in different parts of the continent, and that experts involved believed elimination could be accomplished. Between 1959 and 1968 there were at least 24 official GMEP efforts occurring in at least 21 different African countries (Graboyes and Alidina 2021; Executive Board, 1958; World Health Assembly, 19, 1966, World Health Assembly, 21, 1968). Many of these programs were referred to as “pilots,” “schemes,” or “experiments,” but these are misnomers for what were often well-funded, well-organized, expert-led campaigns that expected positive results. There is no comprehensive account of *all* the GMEP Africa programs. The few that have received attention include the Garki project in Nigeria, the Pare-Taveta Malaria Scheme in Tanganyika and Kenya, and activities in Liberia (Molineaux, 1980; Graboyes 2014; Webb 2010). This article presents a small piece of the larger puzzle of GMEP campaigns in Africa, showing that Zanzibar was most certainly a real effort at elimination.

Second, we differ from past works in drawing attention to the “afterlife” of the WHO elimination attempt—by focusing on what happened when the official program concluded. This is an important yet oft-neglected period, when a project concludes, when scientists have left, when data is no longer collected, but when unintended consequences often begin to appear. It was during this project afterlife that a dangerous rebound malaria epidemic struck. The 1970s and 1980s are decades that have largely been overlooked in terms of Zanzibar's malaria history, but it was a period that was locally devastating. Finally, this is the first work to integrate interviews with Zanzibaris to reveal how the WHO program years are remembered locally, and how the 1970s–1980s rebound epidemic is understood by Zanzibaris today.

1.1. Sources, methods, & limitations

This article draws primarily on archival materials, but also incorporates interviews with Zanzibaris, and ethnographic observations in Zanzibar to tell a more comprehensive story about the history of malaria on the island. Consulted archives included the World Health Organization (WHO) archive in Geneva, the Zanzibar National Archives, the Zanzibar Ministry of Health, the Zanzibar Malaria Elimination Programme offices, the Zanzibar Statistics Bureau, the UK National Archives in London, the Bodleian library in Oxford, the London School of Hygiene and Tropical Medicine archive, and materials obtained through a US Freedom of Information Act request (FOIA) pertaining to the 1980s

USAID project in Zanzibar. The archival sources included colonial government reports, technical reports from international health agencies, maps, epidemiological data, and newspapers in English and Swahili from the 1920s onward.

Interviewing data complements the archival sources. Between 2017 and 2021, we conducted 98 interviews with 84 Zanzibaris in the population center of Zanzibar Town/Ng'ambo and surrounding peri-urban communities. These consisted of interviews with 5 high-level malaria experts (directors or deputy directors of the national malaria elimination programme); 17 interviews with medical professionals or current malaria employees (managers, sprayers, entomologists, health educators for the malaria elimination programme); and 62 interviews with members of the Zanzibari lay public (those without specialized knowledge or direct connections to malaria work). 14 interviews were follow-up interviews with original participants. In total, 34 unique women and 50 unique men were interviewed. Additionally, 5 more informal interviews were conducted with American and European malaria experts on the topic of rebound malaria, presenting information about this specific Zanzibari case study to elicit their feedback.

Zanzibari participants were recruited through personal and professional contacts, snowball recruitment, and introductions from local community leaders (*shehas*). Participants included those who self-selected in by approaching us and asking to participate. Interviewed participants are not random or representative. The interview included questions about the WHO years, the rebound epidemic of the 1970s–1980s, and impressions of current interventions. Interviews were conducted by the authors in Swahili and English and typically lasted 45–90 min. After gaining verbal consent, with permission, interviews were audio recorded. At the conclusion of the interview, each participant was provided a gift worth approximately 12,000 Tanzanian Shillings (approximately \$5 USD) delivered in the form of soap, sugar, tea, cloth or cash. Research was reviewed and approved by the University of Oregon Institutional Review Board (IRB) and by the Zanzibar Research Committee.

Ethnography has been a long-accepted partner to historical research in Africa, with historians engaging in participant observation, conducting interviews, and spending long periods of time in local communities (Miller, 1999). Mixed methods works by Livingston (2012) and Mika (2021) present nuanced details of daily life on African oncology wards, and convey the demands and concerns of patients and practitioners. A series of publications by Geissler and co-authors present interviews, fieldwork, observations, and commentaries on the material cultural of medical and scientific research while reconstructing an important history (Geissler and Molyneux 2007; Geissler 2015; Geissler et al., 2016). This interdisciplinary approach has been productively used outside of biomedical spaces, such as by Giles-Vernick (2002) to reconstruct environmental histories of the Central African rainforest. Ethnography also adds to the archival research, interview data, and secondary sources on this topic. We spent time in the current Zanzibar Malaria Elimination Programme (ZAMEP) offices and observed ZAMEP workers carrying out various activities in the field. Being present allowed for more informal discussions of rebound malaria, acquired immunity and international partnerships, and greatly informed our thinking.

One limitation of this project is a larger challenge faced by anyone writing medical or health histories in Africa: finding reliable epidemiological data. Despite spending years searching across three continents, we never found monthly, quarterly or annual records showing malaria prevalence rates across the island in the 1970s–1980s. Based on interview data, it appears likely that decades of locally produced malaria records existed but were destroyed. One high-level malaria expert confirmed that records from this period were burned when the malaria agency moved from one building to another and there were concerns about space. Even without consistent malaria prevalence rates generated in Zanzibar, we were able to locate WHO, CDC, and Zanzibari government reports that present snapshots of malaria during the 1970s

and 1980s. These disparate sources confirm there was a rebound epidemic following the WHO program, but the lack of local data prevents us from being as detailed as we would like. This data problem is not unique to malaria or East Africa (Tichenor 2017; Gerrets 2015), as Biruk (2018) does an excellent job laying bare HIV data shortcomings, while Adams (2016) reminds us of the socially constructed nature of global health metrics and Jerven (2013) points out the generally poor quality of development data. We believe source reliability and gaps ought to be more openly discussed in papers presenting quantitative data about and from Africa.

1.2. Malaria research and Zanzibar

This article builds on carefully done works on the history of malaria in Africa, notably Packard's *The Making of a Tropical Disease* (2007) and Webb's *The Long Struggle Against Malaria in Tropical Africa* (2014). These two key monographs have established that there were real and sustained efforts at malaria control and elimination in Africa during the colonial era; that many of these programs were temporarily successfully but ultimately failed; and that top down, internationally organized programs often did not properly account for local historical, cultural, ecological, entomological, or epidemiological conditions. This article compliments these past works by taking a slightly different approach in considering the afterlife of the WHO's program, and offering new ethnographic and interview data meant to highlight contemporary Zanzibari understandings of rebound.

Over the past century of malaria research, much has been learned globally about efficacious malaria interventions, which are well summarized in Chen et al. (2018). Globally, the methods used for both control and elimination attempts have included repeated indoor residual spraying, consistent use of bed nets, mass drug administration, widespread testing, availability of artemisinin combination therapy, environmental modifications, and the imagined future uses of the RTS,S malaria vaccine and genetically modified mosquitoes. Research specific to Zanzibar has called into question the efficacy of some of these interventions. Morris et al. (2018) showed no significant impact on malaria incidence after two rounds of mass drug administration; and Cook et al. (2015) showed no effect on incidence despite two rounds of mass screenings and treatments. There has been no definitive study about the impact of nets on the island, though work by Koenker et al. (2013) presents understandings and barriers to widespread and consistent net use. Two studies have shown positive effects of layered interventions. Bhattarai et al. (2007) found that widespread access to artemisinin-combination therapy and long-lasting insecticide treated nets reduced malaria morbidity and mortality. Aregawi et al. (2011) found that a combination of insecticide treated nets, indoor residual spraying, and artemisinin-combination therapy contributed to a reduction in malaria deaths. A more low-tech path forward would be to better understand the local disease environment—an approach that has been started in work by Hardy et al. (2015) with a detailed mapping of malaria hot spots.

Also important for this paper are Zanzibar-specific works by Issa (2009, 2011), Nisula (1999), and Larsen (2008), detailing the history of malaria control efforts on the island, dating back to the turn of the 20th century, and the rich offerings of healing systems available in Zanzibar for treatment of malaria and other illnesses. Historically and in the present, malaria continues to be framed, explained, managed, and treated outside of a biomedical framework. It is often presented as an alternate malady more broadly discussed as *homa* (fever). Other works focused on Zanzibar, such as histories by Fair (2001), Bissell (2011), Myers (2003), and Thompson (2017) provide a broader context for the British colonial-era and the post-independence years. These works remind us that understanding the local historical and cultural context are often as important as knowing about local epidemiology and accurately identifying vectors. How people conceive of private and communal space (Myers, Bissell) influence willingness to allow spraying

both outside and inside homes; the gendered nature of labor, space, and politics (Fair) affects how people clean their environments and see personal responsibility vis-à-vis state responsibility (Graboyes et al., forthcoming); and larger cosmological norms (Larsen 2008; Nisula 1999) provide insights into how people may understand and respond to international global health programs, and the rumors that may exist or persist (Thompson 2017). Although not a large part of this paper, our understanding of the importance of the 1964 socialist revolution for our interview participants was strengthened by works by Burgess (2009), Glassman (2011), Sheriff (2001), and Shivji (2008). The island's history of socialism and revolution continues to shape peoples' understandings of power inequities, trust in the state, and Zanzibar's perceived place in the world.

2. WHO elimination attempt, 1957–1968

Malaria control is not new to Zanzibar and early public health measures were undertaken by the Omani Sultanate in the 1880s in the form of piped water and cisterns in the main town. Efforts by the British protectorate government from the 1920s–1950s focused on larviciding, environmental control, and occasional mass drug administration (Issa, 2011). Yet until the WHO's program, malaria elimination had not been attempted on the island.

In June 1957, as part of the WHO's Global Malaria Eradication Programme (GMEP) an intense set of activities in Zanzibar began; the stated goal was “to achieve complete eradication of malaria” and to do so through the elimination of anopheline vectors (WHO, Plan of Operation, Malaria Eradication in Tanzania; Annual Report, 1959). Malaria was a significant public health problem in Zanzibar when the WHO arrived. Epidemiological data from multiple sources indicate that in the late 1940s and early 1950s, malaria was endemic and prevalence rates ranged from 52% to 69% (Conner, 2021; WHO, Malaria Situation in Zanzibar/Pemba, 1974).

The WHO activities started with indoor residual spraying (IRS) with dieldrin and DDT in 1958. The hope was that by spraying all structures on the island twice a year, all indoor resting mosquitos (*anopheles gambiae* and *anopheles funestus*) would be eliminated and malaria transmission would halt. The success of indoor residual spraying was dependent on a set of scientific assumptions being correct and on a handful of tasks being completed well year after year. These included that the spraying was done with the right chemical, at the right time of year, with the right frequency, with the right spray equipment, and that every structure was sprayed. Figuring out where to spray was dependent on accurate geographic reconnaissance, which meant a team of individuals had to produce a reliable map of every structure on the island twice a year. This proved to be a challenging set of tasks, and WHO documents make clear that the basic part of the program—consistent spraying twice a year of all structures—never occurred. As the handwritten marginalia on a 1962 official report put it, “Zanzibar is always causing trouble” and as one from 1963 foretold the future: “Zanzibar seems well on the way to qualify as a problem area” (Correspondence between Cambourne and Alvarado; WHO, Malaria Control Project Zanzibar: 2nd Quarter Report, 1963).

Despite Zanzibar being the site of trouble and problems, the program was still very successful in lowering prevalence rates for a decade. Multiple sources indicate that during the intervention years, malaria was reduced to less than 5% prevalence (Zanzibar Malaria Eradication Project, 1963; Plan of Operations, 1966.) Coupled with the spraying were strengthened systems to find, test, and treat those with malaria symptoms (such as enlarged spleens and fevers), and provide free and prompt treatment. This was meant to reduce the human reservoir of parasites. There had initially been plans to repeatedly carry out mass drug administration (MDA) where everyone on the island would be given a malaria treatment; however, those plans were only carried out sporadically in the early 1960s. As a control program, WHO activities were extremely effective, and more successful than any other campaign

carried out in the 1980s and 1990s.

However, problems ranging from mis-timed spray operations to poor worker morale to “muddled thinking” by WHO advisors on the ground were significant enough that opinions changed about whether elimination was possible on the island. As time passed, the initial optimism gave way as the experts converged around the idea that elimination would not be accomplished. A 1963 WHO report pointed out the growing gap between expectations and reality: “There was every reason to expect a model malaria eradication program in Zanz [sic] which would have demonstrated the feasibility of malaria eradication in the presence of tropical African vectors and under tropical African climatic conditions.” Despite those initial high expectations, only a few years into the program, the author concluded: “frankly, this project constitutes a considerable embarrassment to the Organization” (WHO, Assessment of Zanzibar Map 1963). Another memo from the same year noted a “peculiar situation which is likely to develop in the malaria eradication programme, namely—a frank admission at least of partial defeat ...” (WHO, Correspondence between Quenum and Bernard). By the early 1960s, the WHO’s own scientists had shifted their opinions about what might be accomplished.

When the program ended in 1968 and the WHO team stopped all activities, there was good news and bad news, successes and failures. The good news was that malaria was “no longer considered a public health problem” (Malaria Situation in Zanzibar/Pemba). As a control program, it was an absolute success. But as an elimination program, it had failed. Transmission had never been interrupted. The elimination failure set the scene for a public health disaster as malaria prepared to come surging back among Zanzibaris that had lost their acquired immunity to the disease. As one Zanzibari doctor told us, the situation became so serious in the 1970s that “You could hear the roar of malaria all the way on the Tanzanian mainland.”

3. Rebound Malaria, 1970s–1980s

The consequence of ending the WHO program and the Zanzibari government’s decision to discontinue malaria-specific interventions set the island on a crash course with rebound malaria. When the Revolutionary Government of Zanzibar took over the program, malaria control stopped as a stand-alone program though there were sporadic spraying campaigns, larviciding, and prophylactic chloroquine distribution beginning in 1972 and a USAID project from 1984 to 1989 (Matola et al., 1984; Minjas et al., 1989). Archival documents indicate that WHO scientists and experts recognized the risk of rebound before it happened, recognized the epidemic while it was happening, and that when it concluded, clearly stated the cause was the ending of the WHO program. This section sheds additional light on Zanzibar’s 1970s–1980s rebound epidemic and what happened in the afterlife of the WHO’s program.

The rebound malaria epidemic could be called tragic, or preventable, but it could never be called surprising. WHO scientists were well aware of the phenomenon of lost acquired immunity leading to rebound malaria epidemics. Throughout the 1930s–1950s scientists debated the risks, benefits, and ethics of lost acquired immunity (Dobson et al., 2000; Corbellini 1998; Graboyes 2015). A colonial correspondence from 1939 laid out the contours of the dilemma, noting that, “preventing malaria may prove an evil instead of a blessing, if found to take away a certain amount of immunity” (Correspondence between MacDonald and Russell). Such debates even happened in Zanzibar in 1957 in relation to the use of the malaria prophylactic, paludrine, being used en masse among Zanzibari school children because there were concerns about “preventing the development of a natural immunity” (Correspondence between Baird and Director of Education).

In Zanzibar and in the larger world of malaria studies, there has been scant attention to the specifics of rebound malaria. As one expert described the lacuna, “epidemic rebound/resurgence is a phenomenon that remains relatively absent from discourses of malaria control and utterly neglected in the social scientific literature” (Anonymous

reviewer Graboyes NSF Proposal). The major article in the field, by Cohen et al., persuasively shows rebounds have occurred frequently and in geographically diverse areas. Cohen and his team identified 75 cases of resurgent malaria in 61 countries between the 1930s and 2000s and almost all cases were caused by the weakening of malaria control measures, most frequently funding disruptions (2012). In an in-progress replication and extension of Cohen’s 2012 paper, Graboyes et al., have identified 110 cases of resurgent malaria in 86 countries between 1861 and 2018 (unpublished results). Rebound epidemics continue to occur into the present and have been shared in conference presentations (Davis, 2014) and in publications documenting rebound in Tanzania, South Sudan, and Zimbabwe (Khatib et al., 2018; Pasquale et al., 2013; Sande et al., 2017). Rebound epidemics are dependent on the fading or disappearance of acquired immunity, which typically provides older children and adults a degree of protective immunity against malaria infections. Despite being a critical area of importance, our knowledge in this area is still relatively incomplete. Multiple studies have documented that acquired immunity fades when a person is not regularly exposed to infection, and malaria interventions that reduce prevalence to near zero or temporarily stop transmission can lead to a weakening of acquired immunity, but it remains unclear the exact timing of when this happens, and how (Griffin et al., 2015; Langhorne et al., 2008; Trape et al., 2014).

A careful evaluation of sources from the 1970s and 1980s indicate Zanzibar experienced a rebound epidemic: rates increased after the WHO campaign ended, and these rates surged higher than malaria levels had been prior to the campaign beginning in 1957. Before the WHO campaign, malaria rates were estimated at 52%–69% on the island (Conner, 2021; Malaria Situation in Zanzibar/Pemba, 1974; Draft Plan of Operation, 1962; Curtis and Mnzava, 2000). During the WHO years, malaria was reduced to less than 5% prevalence (Zanzibar Malaria Eradication Project, 1963; Plan of Operations, 1966.) After the WHO left, rates in the 1970s and 1980s climbed steadily. They reached a high in 1983 of 78% prevalence (Evaluation of the USAID Zanzibar Malaria Control Project, 1983). Zanzibar did not return to its malaria “equilibrium” of approximately 50% prevalence until 1984–14 years after the WHO program concluded (Zanzibar Malaria Control Project External Review, 1986).

In defining what constitutes “rebound” we follow Cohen et al. (2012): when malaria incidence or prevalence increases for a period of more than a year or a single transmission season in a previously malaria-endemic area where the disease had been suppressed due to concerted control strategies. This definition builds on earlier ones by Bruce-Chwatt (1974) and Nájera et al. (1998). With the available data, it is impossible to estimate the extent of the increase in morbidity and mortality, though it’s reasonable to infer that based on faded or lost acquired immunity and increased prevalence levels, the toll in terms of additional sickness and death would have been significant. Having a robust and intact acquired immunity does not prevent against malaria infection, but it does protect against severe disease.

In a 1967 report produced before the rebound epidemic started, one of the WHO experts clearly laid out the potential risks in Zanzibar as discussion began about how to shut down the multi-year intervention. He noted “precipitate withdrawal of spraying could have serious consequences ...” and he went on to recommend a slow and staged ending of the spraying and case detection activities. He called for the close monitoring of malaria rates as two rounds of yearly spraying was reduced to one, and as active case detection (searching out those infected with malaria in communities) gave way to passive (waiting for malaria patients to arrive to a clinic or biomedical facility). He also made clear that depending on malaria levels, the WHO should provide drug treatment for those who tested positive as a way to reduce the burden (WHO, Correspondence between Sambasivan and Kaul). It does not appear that this plan was followed. However, even this improved plan didn’t dwell on what might happen when all activities eventually ended. The document is one of many that shows a clear awareness of the problem of rebound, and its causes, yet no one from the WHO argued

that the organization had any obligations once the program officially ended.

Zanzibar's malaria situation was steadily worsening in the early 1970s, and in 1974 the WHO commissioned a report by technical experts who briefly visited the island. That report made clear that prevalence rates were increasing dramatically and the authors drew clear connections between the WHO's 11 years of successful reduction of malaria rates, the cessation of those activities, the loss of acquired immunity among Zanzibaris, and the subsequent rebound epidemic. They wrote, "Since the intensive operation in the past have decreased the endemicity of malaria from that of hyper-endemicity to either hypo-endemicity or zero, the immunity of the population has, presumably, also been reduced to a very low level. As anticipated, epidemics of malaria appear to have subsequently occurred, with high morbidity and mortality, amongst all age groups due to discontinuation of systematic control measures" (WHO, Malaria Situation in Zanzibar/Pemba, 1974).

The WHO's 1974 report went further in discussing causation and blame for Zanzibar's malaria situation than any prior report. The authors were clear in pointing the finger back at the WHO, international funders, and the Zanzibari government. They wrote how the malaria situation "has ... clearly shown that in the absence of substantial technical and financial commitment as well as maintenance of proper vigilance [emphasis in original]; resurgence of malaria ... is, to all intent and purpose, a certainty" (WHO, Malaria Situation in Zanzibar/Pemba, 1974). The WHO no longer provided the technical commitment, international partners withdrew financial support, and the Zanzibari government was unable to maintain proper vigilance. To these visiting experts, the rebound epidemic was obvious and there was plenty of blame to go around. Despite the clarity of the findings in this 1974 report, and the clear link back to the WHO's earlier program activities, the WHO did not intervene to improve conditions on the island.

The third set of sources providing clear evidence of the rebound epidemic are those generated after the rebound, but that present data about the 1970s–1980s. A 1989 WHO report stated that "almost immediately" after the dismantling of the program in 1968, "malaria began its dramatic comeback, and by 1973, the prevalence rate for Unguja had reached 54%" (WHO, Malaria Control in Zanzibar, 1989). The author took this dramatic increase as "illustrating the disastrous effects of halting malaria control activities ..." (WHO, Malaria Control in Zanzibar, 1989). It is both sad and ironic that WHO reports and materials produced after the Zanzibar rebound epidemic present rebound not as a remote possibility, but as an expected reality. A 1998 WHO malaria report succinctly stated: "A temporary suppression of the transmission leads to a drop in the herd immunity, so when malaria finally returns, it causes more devastation than before the attempt at control" (WHO, 1998). That was the story of Zanzibar.

4. Remembering rebound Malaria

This section considers oral data collected in discussion with Zanzibaris. These interviews focused on the WHO program and more broadly, the island's history with rebound malaria. We found significant differences between malaria experts and the lay public in awareness of Zanzibar's history with the WHO and in understandings of the cause of the rebound malaria epidemic of the 1970s–1980s.

Greatest awareness of rebound was found among the highest-level experts, such as the past directors of the national malaria elimination programme and medical doctors. Among this group, there was detailed knowledge of rebound's occurrence in Zanzibar in the 1970s–1980s, and full understanding of rebound as a concept. All were certain that rebound malaria epidemics were *caused* and each spoke at length about how Zanzibar's own history with rebound had been linked to much larger issues such as the power inequities between Zanzibar and foreign governments, Zanzibar's dependence on foreign funding for more than 99% of the island's malaria activities, and local experts' inability to direct programs in ways that would best fit local needs and priorities.

For these experts, all spoke pointedly of how the rebound came because of the WHO program's conclusion and the Zanzibari government's decision to discontinue intensive malaria activities. Among these experts, all felt certain that the risk of rebound malaria remained in the present.

While we anticipated that all Zanzibaris working in malaria control would be familiar with rebound malaria and the island's own history, that was not true. Among a large percentage of general malaria employees we interviewed, the 1970s–1980s epidemic was virtually unknown and many had no familiarity with the concept of rebound malaria. These employees acknowledged that malaria rates can, and have, gone up and down in Zanzibar, but a vast majority of interviewees did not assign any cause for those increases. One malaria worker in his 50s remembered how the disease shot up again in the 1970s, noting, "the disease returned again seriously, a lot of people died, others were severely sick, others became disabled." But while many recognized malaria rates increased quickly and dramatically in the 1970s, no one named this as a case of rebound malaria, even after we offered the concept. Throughout the interviews, it was common for these employees to strip history from their activities (insisting there was no significant history of prior malaria control on the island, or that it was not relevant even when the interviewer asked directly) and ignore or minimize the failures of past interventions.

Among lay members of the Zanzibari public old enough to remember the 1970s–1980s, all recalled those decades as a time with extremely high malaria rates and mortality. One man told us in detail of the death of his young child to malaria, and how another one of his children also became severely ill requiring an extended stay at the hospital followed by weeks of nursing by relatives. Another man described how during these decades "you would find two or three sick people" in each house as mosquitoes came into households to "bite Juma, then John, then Davi." People noted the 1970s as a significant break from earlier years when "there wasn't even one mosquito."

In all of the 62 interviews with Zanzibaris who did not have specialized training in relation to malaria, no one was familiar with the term "rebound malaria" or discussed specific causes for why malaria rates increased so dramatically. Even when introduced to the concept of rebound malaria and acquired immunity by the interviewer, no one expressed any familiarity. Our finding is in slight conflict with that reported by [Bauch et al. \(2013\)](#) when discussing the perception of malaria risk among Zanzibaris. In that paper, they found "some residents expressed concern that immunity to malaria has also declined, leaving them at greater risk of malaria should it resurge." It is unclear if the respondents in that paper were referring to a more generalized understanding of immunity (*kinga* or *kinga mwili*) or malaria-specific acquired immunity (what we translated as *kinga-mwili ya mtu anayoipata baada ya kuugua malaria*).

One pattern appearing consistently across all demographics was reference to the 1964 socialist revolution. It was an important marker, and most dated the WHO's work as starting before the revolution and ending some years after it. While there was rough agreement that the WHO worked on the island in the 1950s–1960s, there were many different reasons offered for why the program ended. One man, a retired soldier in his 70s stated, "there was a misunderstanding between the WHO leaders who were managing the program and the revolutionary government of Zanzibar ... there were some problems ... there came some political issue." Nearly everyone referred to political differences, and some spoke specifically of the socialist turn in Zanzibar after the revolution. One retired Zanzibari doctor in his 80s was explicit in laying out the suspicions during that time: "we did not accept the WHO and we kicked all of them out ... [Interviewer: Why?] Because they were spying, the white people are spiers! [interviewee laughter] The revolutionary government kicked all of them out." Due to a variety of reasons, we did not ask explicitly about politics or the revolution in past interviews, but anticipate following up on this line of inquiry in future research.

5. Contemporary implications & ethical questions

What can be taken from this case study from a small Indian Ocean island? Given the realities of past rebound malaria and the risks that remain, we argue there are two areas that need urgent reform. First is that there needs to be a dramatic shift in respecting the autonomy of African community members participating in malaria interventions by truth telling about the risks of rebound malaria. Second is that there needs to be a radical move away from short term funding of projects that create the conditions for rebound epidemics to occur.

Widespread in North America and Europe is a “4 principles” approach to considering medical ethics, which directs researchers to respect autonomy through the process of consent; practice non-maleficence by minimizing risks and harms; practice beneficence by maximizing benefit; and to be attentive to justice by neither overburdening or orphaning specific populations (Beauchamp and Childress, 2001). These norms are products of North American and European histories and have been solidified in a series of guidance documents such as the Nuremberg Code (1947), the Belmont Report (1978), the Declaration of Helsinki (1964) and a variety of CIOMS guidelines (1982, 1993, 2002, 2009, 2016). While these norms are imported around the globe, there is debate about whether they are appropriate to all places, and there is a lively literature about whether there are uniquely African bioethics that might be more suitable (Tangwa 1996; Gbadegesin, 1993).

For the time being, we accept the 4 principles approach on the African continent, but see gross deficiencies in how they are being practiced. The first principle requires respecting the autonomy of African participants. While many condense this principle to the act of consent, it is actually dependent on truth telling. In the case of malaria activities, it would require the honest, clear, sharing of information about risks such as lost acquired immunity and rebound epidemics. By informing participants about these risks, individuals and communities would be able to give informed, understanding, and voluntary consent—considered the gold standard (Nelson et al., 2011; Molyneux et al., 2004). In other areas of malaria research, African authors have argued forcefully that participants have a right to know all risks, for those to be carefully explained, and for participants of all varieties to be empowered to refuse (Kilama 2005, 2009, 2010; Ndebele and Musesengwa 2012; Doumbo, 2005). Just as American patients participating in medical research must be told, and understand, the risks to particular interventions before consenting to participate, African communities participating in malaria control or elimination attempts must understand the medium-to-longer-term risks of lost acquired immunity and rebound epidemics.

The historical record shows that appropriate disclosure—or at least consent processes that meet well-established ethical standards for medical research—have not been the norm in Africa over the past century. Across East Africa, people were not told about the risks of failed malaria control/elimination programs, and rarely did foreign researchers present their activities as anything other than purely beneficial. This is a historical reality that raises intense ethical questions about respect for autonomy in the present (Graboyes and Alidina, 2021). We found no evidence—archival, ethnographic, or oral—that any malaria campaign in Zanzibar over the past century openly discussing the risks of rebound malaria or took the time to explain the concept. This shows in our contemporary interview data. Interviews indicated that the Zanzibari lay public does not understand the risks created when acquired immunity fades during years of successful malaria control, nor do most people recognize that rebound malaria epidemics are the product of specific conditions. Depending on one’s perspective, this situation on the ground requires either a commitment to radical truth telling, or at least a commitment to inform African participants of the risks of the projects they are participating in.

Interviews and informal conversations with American and European malaria experts indicate that it has been a conscious decision not to

speaking about acquired immunity, rebound malaria, or these risks. High level experts agreed that while they personally understood these concepts, and recognized them as relevant, they judged them as unimportant or too complicated to explain to people on the receiving end of malaria interventions. This is a starkly paternalistic perspective. Withholding of relevant information, claiming it’s too complicated, or making an assessment it’s unimportant, are well-established hallmarks of neo-colonial relationships where foreign experts from the Global North decide what is best for Africans. Withholding this type of information does not meet the ethical standard of respect for autonomy and there is no space for this type of interaction to continue in the future.

The second area in need of reform concerns donor funding patterns and the tendency toward short term funding of projects. Despite research by Cohen et al. a decade ago showing that rebound epidemics are often triggered by disruptions to funding, international funding patterns remain unstable, with donors and agencies committing to only a few years of support at a time. Global power inequities are at the heart of these funding norms: poor countries are required to accept whatever is offered, since it almost always amounts to more than what they could provide independently. Informal discussions with Zanzibari malaria experts made clear they were aware of this pattern. Multiple interviewees mentioned that upwards of 90% of current malaria spending came from foreign donors. They were all honest and slightly despondent in noting that Zanzibar would be unable to continue current interventions if donor funding stops or shifts to another disease. This is perhaps the most challenging problem, where individual Zanzibaris have the least agency. If changes are to happen in this area, it will need to start with agencies based in the Global North.

The WHO’s activities in Zanzibar provide us with a narrative of how ambitions of global malaria eradication started a chain of events that led to rebound malaria on one island. There are insights here—and cautions—for other Gates-funded elimination programs, and for the recent calls for another attempt at global malaria eradication put forth by the Lancet Commission on Malaria Elimination (Feachem et al., 2019). These calls for eradication are recent, real, naïve, and pay no attention to the reality of historical failures from Africa. These contemporary plans for more top down malaria interventions, that are based on foreign priorities with little local guidance, cannot be the way forward for global health. This case study from Zanzibar provides evidence of the naivety of assuming a project ends when foreign scientists leave, and a reminder to pay attention to the afterlife of a project. It highlights ethical dilemmas that remain unresolved, and the disproportionate risk being borne by Africans who aren’t even being made aware of the risks. Many have claimed that malaria control is a Sisyphean task, and we agree (Smith et al., 2011). From a historical perspective, Zanzibar’s most important contribution may not be as a model for successful elimination, but of the perils of what happens when elimination fails.

Declaration of competing interest

We have no competing interests to declare.

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Archival research was conducted by MG, and interviewing was

conducted by both MG and JM, together and independently. Both participated in creation of the interviewing tool and data analysis; MG drafted the article and both approved of the final version.

Appendix

Wellcome Online Library

Annual Report of the Public Health Department/Annual Medical and Sanitary Report. Zanzibar Protectorate. 1909, 1912–1960.

British Online Archive

Zanzibar Protectorate Blue Book. Zanzibar: Government Printer. 1913–1947.

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