

## A Literature Review of Malaria Intervention in Zanzibar

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### Abstract

**Objectives:** This review examines malaria control and treatment interventions in Zanzibar. This review seeks to identify current malaria prevention and control intervention strategies, to better understand cultural barriers to intervention, and to make recommendations on how malaria prevention and treatment activities might be adapted to address underlying cultural barriers that would otherwise impede intervention efforts.

**Methods:** The review documents published data from 36 studies on the current malaria intervention activities in Zanzibar; and identifies whether extant literature includes attention to cultural barriers as part of the implementation and dissemination of interventions.

**Results:** Quality data and information on health expenditures in Zanzibar is scarce and often out-of-date. The beliefs and cultural practices of patients are largely related to the success of malaria control programs. The most commonly described malaria prevention and treatment interventions in Zanzibar are indoor residual spraying, insecticide treated nets, sulphadoxine-pyrimethamine, and Artemisinin based combination therapy. Controlling malaria requires a competent workforce. Lack of education and financial resources restrict program success.

**Conclusions:** Integration of culture practices with malaria control strategies is the ideal solution to effectively reach communities.

**Keywords:** Malaria; Zanzibar; Malaria interventions

### Introduction

An estimated 219 million cases of malaria occur worldwide each year and of these cases, 660,000 people will die. The illness and burden is felt most severely in sub-Saharan Africa. Data indicates that in sub-Saharan Africa a child dies of malaria every minute [1]. This review reflects on the types of interventions in Zanzibar reported in literature and barriers to implementation, rather than the effectiveness of interventions per se.

The region with the heaviest malaria burden is sub-Saharan Africa. Pregnant women and children under age five are the most susceptible. Sub-Saharan Africa reports 90% of the total malaria related deaths worldwide [1], and foreshadows what is happening globally. Despite this heavy burden, there are illustrative incremental gains toward malaria elimination [1], which have prompted researchers to discuss final eradication of malaria from the region. If malaria could be wiped out from the most burden-felt region, then researchers could work outwardly from such a starting point to eradicate the disease. Zanzibar represents a special case because malaria estimates are considered low (1%). However, Zanzibar does fear the potential of malaria to rebound quickly as the parasites develop resistance to available drugs and current treatments. There are already reports concerning mosquitoes building resistance to insecticides [1]. This presents a significant problem because malaria-carrying mosquitoes lead to continued spread of the disease. Mosquito resistance to insecticides and patient resistance to current pharmaceutical treatment are emerging as serious potential threats to effective and affordable malaria control.

### Methods

This literature review combines a summary and synthesis of scholarly articles, books, and other sources relevant to malaria interventions and socio-cultural research in Zanzibar, Tanzania. A title and abstract search within the PubMed database was conducted. The Boolean search terms were malaria and Zanzibar. Search terms were

purposely broad in order to identify all possible intervention activities in Zanzibar, which then allowed for a secondary search for documents that explicitly described cultural practices in relation to malaria prevention and treatment. The PubMed search resulted in 48 studies. Searches within the Cochrane Summaries and Embase database were also conducted. The former yielded 54 reviews and the latter 78 studies. Studies from Cochrane Summaries served to validate malaria's current trend and status in Zanzibar. The studies had to be empirical, because the purpose of this systematic review was to address components related to outcomes from malaria interventions. Studies were included only if all criteria measures were satisfied. Because conditions change over time, studies published before 2003 were excluded. Table 1 describes the Systematic Review Protocol Coding Sheet used.

Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [2] standards, this study evaluated the search results (Figure 1). For instance, PRISMA calls for four phases to ensure a complete sampling of relevant studies: Identification, screening, eligibility, and inclusion [3]. The PRISMA standards accommodate the first six steps in the systematic review process [4].

After removing duplicate studies, the screening phase followed a two-part evaluation method. First, abstract and title screening filtered out nine studies. Second, a full-text review screening removed 129

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Screening questions		
1	Is the study about malaria?	Yes or No
2	Is the study conducted in Zanzibar?	Yes or No
3	Is the study empirical?	Yes or No
4	Is the study within the last 10 years?	Yes or No
5	Does the study reflect an intervention activity	Yes or No
Data extraction questions		
6	Describe the malaria topic or focus?	
7	Describe the intervention activity?	
8	Are any barriers to intervention activity explained? If yes, then provide a description	Yes or No
9	If any barriers to intervention activity are described as cultural, then identify here.	
10	Are any programs described in the study? If yes, then provide a description	Yes or No
11	Was the intervention considered effective by the authors?	Yes or No

Table 1: Systematic Review Protocol Coding Sheet.

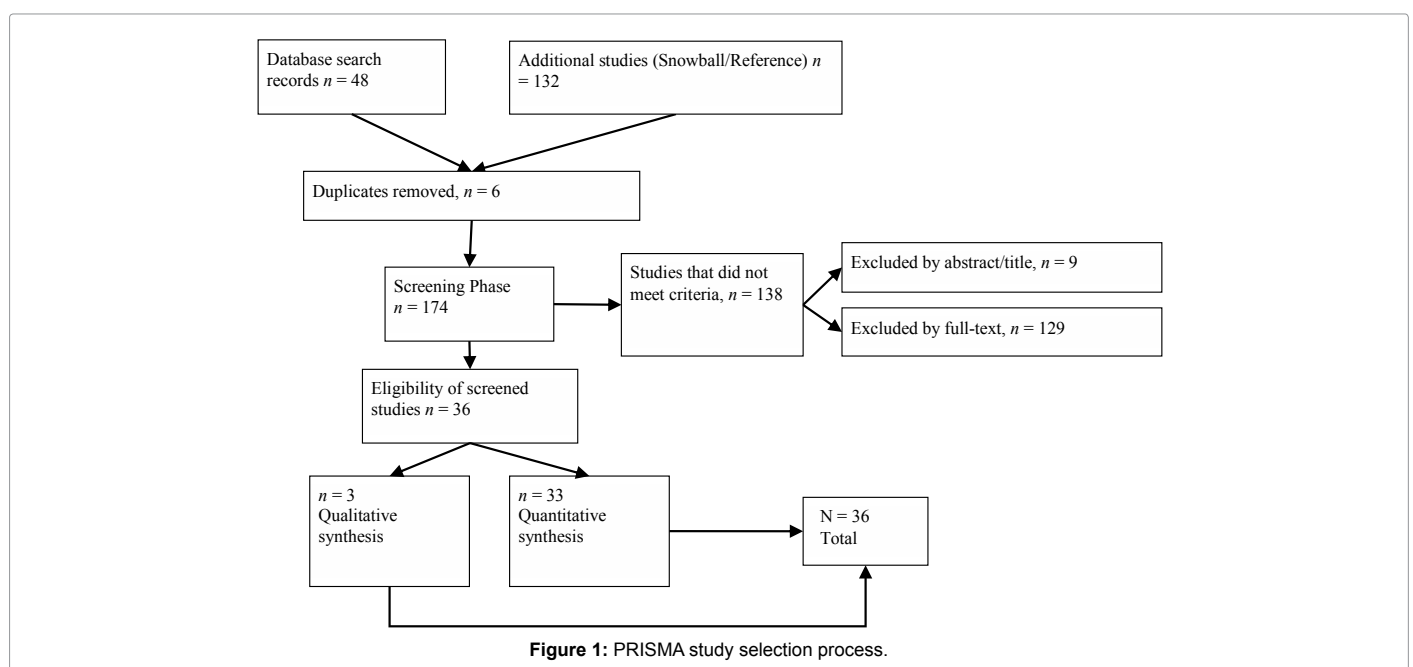


Figure 1: PRISMA study selection process.

studies. After full-text review of each study, the sample size was 36 studies, which also included the eligibility phase. All eligible studies (36) were categorized as qualitative (3) and quantitative (33). During the screening and extraction process, two raters discussed their rationale for accepting or rejecting a study followed by examining each other's data entry on the systematic review protocol. Inter-rater reliability between raters was reached through consensus.

## Results

Of the 36 studies found, the most frequent publication year was 2012 (seven studies). Ten were published in the Malaria Journal. Tropical Medicine and International Health journal carried five studies. The other studies in this review spanned across 12 other journals. Also, there was a wide range of topics related to malaria, which are organized in a matrix (Table 2).

**Cultural barriers:** Although no cultural barriers were identified for Zanzibar, other studies in sub-Saharan Africa do describe such barriers. Jombo et al. reported that the continued persistence of malaria in Africa appears to be largely due to socio-cultural factors, which are often at variance with standard control methods. Jombo's study was designed

to ascertain the socio-cultural factors affecting the control of malaria in Makurdi, Nigeria [5]. The study was cross-sectional, using systematic sampling methods to identify households from which quantitative and qualitative data were collected from adult women using structured and semi-structured questionnaires, and focus group discussions. Questionnaires were administered requesting age, educational level, marital status, malaria awareness, and prevention. Focus group discussions were used to obtain qualitative information not captured in the questionnaires. Data was analyzed using Epi Info 6 statistical software. Of the 2,075 adult women studied, 97% (n=2,013) were aware of the existence of malaria. Of these, 83% (n=1,671) did not consider malaria to be a serious health problem needing urgent attention. Higher educational level and marital status had a positive impact on knowledge about the disease (p<0.05). Accessibility to information on malaria and general knowledge of the modes of transmission and control was generally low, and to a large extent influenced by cultural beliefs, values, and economic status. The researchers concluded there was a need to intensify adult health education and that home health educators should be utilized to increase knowledge about the disease.

**Priority on allocation of financial resources:** Quality data and information on health expenditures in Zanzibar is scarce and often

	First author, year	Malaria topic	Intervention activity	Barriers to interventions or concerns
1	Morris et al., 2013	Molecular surveillance	RDT-DNA extraction	*
2	Bauch et al., 2013	Malaria transmission	LLINs, indoor residual spraying (IRS), and malaria education	Lack of staff at clinics, too few LLINs distributed, inadequate malaria education
3	Beer et al., 2013	Vector control	Bed nets, IRS	*
4	Baltzell et al., 2013	Diagnostic testing	RDTs evaluation toward diagnosing malaria infection	Human malaria species that are not picked up by diagnostic testing
5	Talisuna et al., 2012	Affordable medicine	Affordable Medicines Facility-malaria (AMFm), ACT	Depletion of resources
6	Tougher et al., 2012	Affordable medicine	AMFm, ACT	*
7	Fröberg et al., 2012	ASAQ	ACT	*
8	Beer et al., 2012	Bed net perception	Bed net usage	Bed net cost and usage during the hot season
9	Kaufman et al., 2012	Acceptance and rejection of IRS	IRS (Indoor Residual Spraying)	Attitudes and misconceptions related to IRS
10	Gosoni et al., 2012	Spatial burden estimates	Bayesian geostatistical modeling	*
11	Cavaco et al., 2012	AQ	ACT	*
12	Smith et al., 2011	Malaria funding	Sustained funding	Decline in funding
13	Aregawi et al., 2011	Scale-up initiatives	ITN (LLINs), IRS, ACT, and SP-IPTp (intermittent preventive treatment with sulphadoxine-pyrimethamine for pregnant women)	*
14	Valecha et al., 2010	Drug resistance	Arterolane – a potential alternative to artemisinin derivative in ACT	*
15	Beer et al., 2010	ITN, LLIN	Mass distribution of free LLINs to children under five and pregnant women	Mass distribution without providing communities with information, education, and communication
16	Jaenisch et al., 2010	Decline in malaria transmission before interventions	Illustrates a decline in malaria before ACT, ITNs, and IRS on the Zanzibar Archipelago	*
17	Tatem et al., 2009	Human movement patterns	Mobile phone data patterns	*
18	Beer et al., 2009	Non-adherence to drugs (artesunate-amodiaquine, AsAq)	Call for dose-specific packaging for infants, clear instructions, and first-dose demonstration	Misunderstanding or forgetting the correct dose regimen
19	Msellem et al., 2009	Diagnostic efficiency	Malaria Rapid Diagnostic Tests	*
20	Sousa-Figueiredo et al., 2008	Malaria parasitological survey	Kick-out-Kichocho, an integrated helminth-control initiative	Reduce burden of urinary schistosomiasis and soil-transmitted helminthiases
21	Stoltzfus et al., 2007	Effect of iron-deficiency in young children	Intervention strategy: Iron supplementation	Cost and logistics of screening for resource-poor areas
22	Ferreira et al., 2008	Single nucleotide polymorphisms (SNPs)	ACT (Artemisinin-based Combination Therapy)	*
23	Bhattarai et al., 2007	Roll Back Malaria	ACT, LLINs	*
24	Sisowath et al., 2007	Treatment resistance	Artemether-lumefantrine (AL) for combination therapy	*
25	Sazawal et al., 2007	Zinc supplementation on mortality in children (1-48 months)	Zinc supplementation	Overall there was no statistically significant (p=0.24) trends for lower mortality due to malaria for children (1-36 months; N=42,546) in the study
26	Stothard et al., 2006	Educational efforts	Health education study: booklet Juma na kichocho	Majority of children failed to realize that re-infection could occur after treatment
27	Iannotti et al., 2006	Effect of iron deficiency in early childhood	Iron supplementation	Greater risk of serious adverse events from malaria + iron folic acid
28	Sazawal et al., 2006	Effect of iron deficiency in children younger than age 5	Iron supplementation	Iron and folic acid in areas of high malaria transmission is harmful
29	Lemnge et al., 2005	Parasitological resistance	Efficacy of sulfadoxine-pyrimethamine (SP) and amodiaquine (AQ)	*
30	Mårtensson et al., 2005	Clinical trial	Efficacy of ASAQ and artemether-lumefantrine (AL) – ACT	Comparison of different ACTs
31	Cusick et al., 2005	Vitamin A	Effects of Vitamin A and SP on erythropoietin production in severely anemic preschoolers	Vitamin A lowered erythropoietin concentration

32	Cavaco et al., 2005	Main alleles of malaria (CYP2C8)	Frequencies of CYP2C8, a main metabolizer of amodiaquine (antimalarial)	AQ toxicity related to quinoneimine
33	Sisowath et al., 2005	Clinical trial	ACT	Resistance to artemisinin
34	Mebrahtu et al., 2004	Iron deficiency	Low-dose iron supplementation	Malaria infection was not increased
35	Mabaso et al., 2004	IRS	IRS	Insecticide resistance
36	East African Network for Monitoring Antimalarial Treatment (EANMAT), 2003	Antimalarial drug policy	SP (Sulfadoxine-Pyrimethamine), ACT (Artemisinin-based Combination Therapy)	*

Note. IRS = Indoor residual spraying; ITN = Insecticide Treated Nets; Long-Lasting Insecticidal treated Nets (LLIN); ACT = Artemisinin Combination Therapy; AQ = Amodiaquine; ASAQ = Artesunate-amodiaquine \*barriers or consequences were not explicitly stated in the study

**Table 2:** Matrix of Malaria Topics and Intervention Activities in Zanzibar.

out-of-date. The latest information available comes from the Zanzibar Health Sector Public Expenditure Review of 2006 (ZHSPER) [6]. According to the ZHSPER, recurrent health expenditure from year 2000/2001 to 2005/2006 represents about 7% of the government recurrent expenditure. In 2008 the malaria control per capita expenditure for Tanzania is \$.80 USD (PMI, n.d.c). Activities related to malaria prevention rely highly on external support such as Global Fund and Presidential Malaria Initiative (PMI, n.d.a). This is critical in terms of sustainability for malaria interventions such as procurement of bed nets, indoor residual spraying, and community mobilization because not all individuals can afford these prevention strategies.

The Household Budget Survey indicated that approximately 2.1% per capita was spent on health care within 28 days in 2004/05 [6-8]. Zanzibar health care services are provided in terms of cost-sharing or proving services to citizens at a lower cost. There is relatively little data on out-of-pocket spending by households on health services. However, high cost for individual spending on malaria impedes the overall prevention and treatment from the disease because of individuals in poverty.

**Socio-cultural factors:** In recent years emphasis has been placed in investigating socio-cultural factors that influence health-seeking behavior for malaria and cause delay in utilizing health facilities [9]. The beliefs and cultural practices of patients are largely related to the success of a malaria control program (PMI, n.d.a). Williams and Jones conducted a literature review on behavioral issues related to malaria control in sub-Saharan Africa [10]. In their study health care providers reported cultural practices related to malaria in some regions of Zanzibar: 1) Newborns are vaccinated in a timely manner [considered a common practice]; 2) Women do not make decisions concerning their children [considered a social barrier]; 3) Herbal medicine use is a generational tradition [considered a cultural factor]; and 4) Sickness is caused by the gods [considered a belief factor].

Control of malaria in sub-Saharan African communities requires knowledge of the modes of spread and the factors that enhance its control and prevention by the population of the affected region. An ethnographic study of childhood malaria in southeastern Tanzania revealed that individuals made a clear distinction between normal malaria and cerebral malaria characterized by convulsions [11]. Malaria with convulsion (degedege) in children seems to be perceived differently in some households, with popular beliefs regarding evil spirits or demons attacking the child. Parents often do not seek care at health facilities when their children experience this symptom, but rely on traditional healers for treating the children with severe malaria [12]. It has been suggested that in chronic or fatal illnesses, when symptoms change abruptly or when treatment does not provide the expected results, suspicion of witchcraft or spirits can emerge [13]. Religious beliefs can also deter individuals from receiving malaria vaccine.

In Tanzania, as in most sub-Saharan Africa, prompt diagnosis and effective treatment is the main control strategy. The government has made deliberate and successful efforts to make healthcare services accessible to the majority of rural communities. However, this does not guarantee that all patients utilize the services. Since malaria presents in different forms such as convulsions, altered consciousness, or coma, community perception of underlying causes may differ. Consequently, many patients with these conditions turn to traditional healers prior to seeking modern healthcare, which can result in treatment delay.

**Vitamins and supplements:** Five studies on mineral supplements and one on vitamins pertaining to intervention activities were identified. Early research to identify viable solutions for malaria treatment through vitamin and mineral supplements resulted in the investigation into the effects of vitamin A, zinc, and iron, which were hypothesized to work against malaria infection. However, vitamin A lowered erythropoietin concentration, which was not ideal for malaria prevention [8]. Sazawal found zinc to not have overall statistically significant ( $p=0.24$ ) trends for lower mortality due to malaria for children (1-36 months;  $N=42,546$ ) [14].

Iron has also not proven useful against malaria. While controversy that iron increased malaria infection has not been proven [7] harmful effects of iron and folic acid supplementation resulting in increased malaria risk were identified [14,15] A cost analysis of iron and folic acid therapy to children in Nepal and Zanzibar found increased adverse effects to children who were not iron deficient [16]. The study concluded that strategies to improve iron supplement therapies were needed where the health systems were second-rate.

The use of vitamin A, zinc, and iron is now overshadowed by educational outreach interventions, such as the Zanzibar School Malaria Program, which provides information and skills on malaria prevention and information on symptoms and treatment [17].

**Customary interventions:** The most commonly described malaria prevention and treatment interventions in Zanzibar, addressed in 23 studies, were indoor residual spraying, long-lasting insecticide treated nets, insecticide treated nets, sulphadoxine-pyrimethamine, and Artemisinin based combination therapy. The use of sulphadoxine-pyrimethamine is related to malaria programs that target pregnant women, since a fetus can contract malaria if the mother is infected. Artemisinin based combination therapy treatment is the most widely used form malaria treatment. However, a diagnosis has to confirm malaria infection before treatment can be administered. Rapid diagnostic tests and microscopy are the most common form of diagnostic testing.

Scale-up initiatives, such as the President's Malaria Initiative, are addressed in the literature to a lesser degree than treatment. This type of initiative, popular with government entities, involves taking the

most effective interventions known and expanding reach. Scale-up interventions often elude academic discussion since they are seldom addressed in peer-reviewed literature. Negligible information describes how these initiatives integrate with other approaches to improve monetary efficiency of outcomes (as compared to simply allocating funds to increase treatment and reach.)

**Skilled personnel:** Controlling malaria requires a competent health workforce. The shortage of staff in most primary health facilities is a challenge in Tanzania. Facilities are often headed by unskilled personnel, thus most health practices are poor in terms of reporting, confirmation, response, and control of malaria. For example, "Poor staining and slide techniques or categorization errors by laboratory technicians may have led to over reporting of positive or negative blood smears, reducing rapid diagnostic test sensitivity and specification" [18].

**Barriers:** The following barriers were identified: lack of education about malaria, lack of funding and other resources, and lack of qualified staff to diagnose and treat malaria. The described barriers are illustrative in Table 2. Intervention barriers generally require both education and funding [19]. Specifically, if Zanzibar is to eliminate malaria, funding is required for health professionals and community education. Additional studies explored the molecular mechanism of Artemisinin based combination therapy, but these studies were excluded if they were not tied to intervention activity.

## Discussion

The main findings of this review indicate more quantitative studies (33) as compared to qualitative. Of these quantitative studies, four interventions were reported to be successful (indoor residual spraying, long-lasting insecticide treated nets, Artemisinin based combination therapy, and sulphadoxine-pyrimethamine use). Effectiveness of these interventions increased when they were used simultaneously.

While vector control programs have eradicated malaria from several other nations, vector control in Zanzibar differs because the tropical climate, which is ideal for vector breeding. Therefore, additional vector control was sought in the form of bed nets and in-house spraying coupled with diagnostic and therapeutic improvements, such as Artemisinin based combination therapy and rapid diagnostic tests. In conjunction with vector control and malaria case prevention, Zanzibar has constructed a surveillance system to monitor the malaria outbreaks [6].

The most effective interventions in Zanzibar are integrated and generally involve indoor residual spraying, long-lasting insecticide treated nets, sulphadoxine-pyrimethamine to treat pregnant women for malaria, rapid diagnostic tests, and Artemisinin based combination therapies [1,20].

Although this review identified only one study describing a scale-up initiative, the finding is significant because a scale-up initiative makes use of proven interventions and increases intervention reach. The Tanzanian government initiates scale-up interventions because of funding requirements. However, non-government entities such as the Gates Foundation have participated and advocated for malaria eradication [21].

Findings from this review indicate a lack of education, funding, and trained professionals are barriers to addressing primary factors in malaria control and prevention. For this reason there are issues related to long-term financing and sustainability [22].

Because funding is limited and dependent on global economics, the

other two identified barriers of malaria prevention can be evaluated for potential solutions. Educational programs can be implemented to help the community understand malaria and contribute to prevention and control. Such action plans are reported in the Ministry of Health in Zanzibar (Revolutionary Government of Zanzibar, Ministry of Health, 2011). Zanzibar is responding through the Malaria Policy Advisory Committee and Secretariat [1,20,23].

One aspect not well addressed is how cultural practices impact malaria prevention and treatment programs. Only 8% of the qualitative studies mentioned Zanzibar's cultural/social/belief aspects of malaria. These studies revealed that researchers were evaluating constructs such as the perceptions of malaria [20,23]. A qualitative approach to identify attitudes and misconceptions related to indoor residual spraying acceptance or refusal was also identified [24]. Although not entirely focused on cultural practices, these studies provide insight into the social and belief systems of individuals that can be barriers to malaria control and prevention programs. Therefore, investigating specific cultural practices in Zanzibar by using a qualitative approach could shed light into underlying causes for why individuals disregard current malaria control and prevention programs; adding to the literature further successful methods for prevention and control.

Many studies were identified that contribute to intervention (Figure 2). Drug studies/clinical trials seemed to dominate the literature related to treatment. The effectiveness of indoor residual spraying, long-lasting insecticide-treated nets, Artemisinin based combination therapy rapid diagnostic tests, and malaria policies, along with scale-up initiatives, reflected the breath of quantitative studies. Qualitative studies considered cultural practices and their possible influence on malaria prevention and treatment.

The identification of cultural practices in Zanzibar can be of value, because in other countries, such as Ghana and Kenya, some cultural practices reduce the impact of malaria programs [25,26]. While there is lack of information concerning cultural practices and how they affect malaria programs, this type of research has the potential to increase the overall understanding of improved effectiveness of integrated scale-up initiatives currently established in Zanzibar.

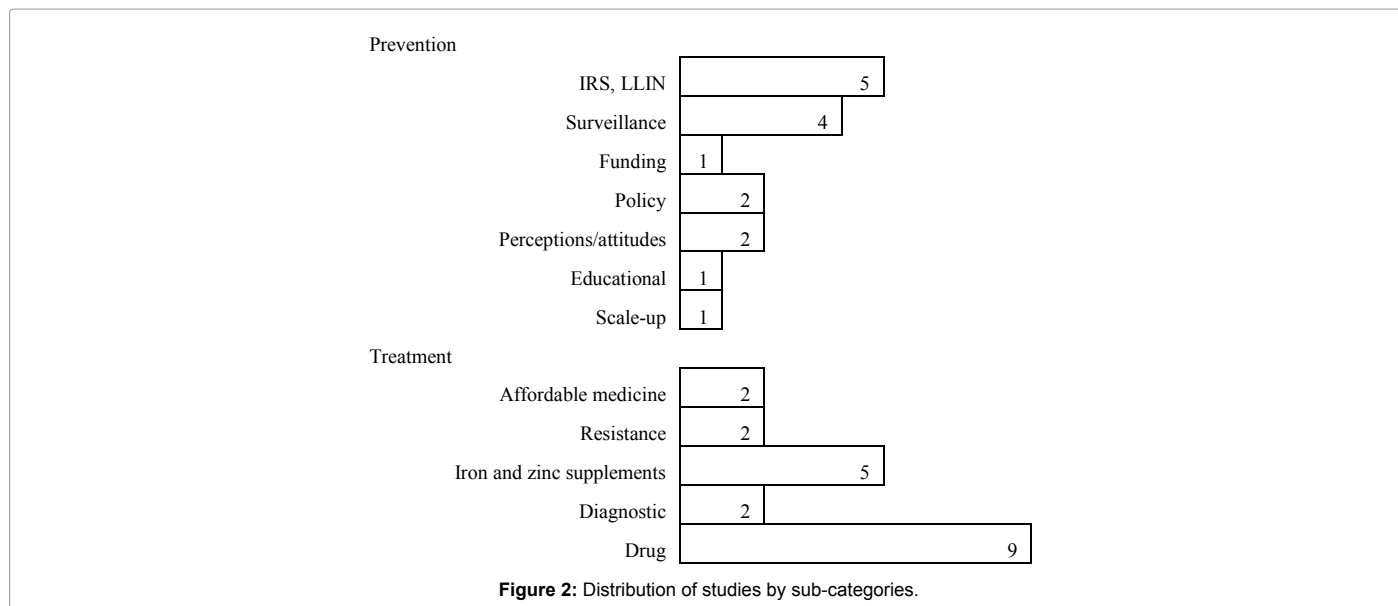
## Conclusion

Integration of culture practices with malaria control strategies is the ideal solution to effectively reach a community. Current tools and treatments are insufficient to eliminate malaria. The disease can rebound quickly as the parasites develop resistance to currently available insecticides and treatments. Innovation is essential to meeting these challenges and maintaining progress against malaria [27]. Sustained research and development is needed to create a diverse array of treatment and prevention methods and avoid overreliance on a small set of anti-malaria tools. More effective policies and increased funding to secure lasting gains against malaria are critical.

Observationally speaking, intervention activity in Zanzibar is defined and guided by global initiatives such as the WHO Malaria Policy Advisory Committee and Secretariat [20]. The WHO suggests integration and scale-up initiatives to strengthen effective interventions. Integration allows researchers to build and add new interventions to current effective interventions. However, little is known concerning the impact cultural practices on the effectiveness of malaria programs.

It is clear that addressing health determinants for malaria control in Zanzibar remains a challenge. Financial sustainability is the main key area for policy makers to consider in combating malaria in the island





[28,29]. Improvement of health care services for effective prevention and management of the disease requires high skilled personnel for better decision-making process. Many challenges still impede the control of the disease in Zanzibar. Socioeconomic status and cultural issues should be a consideration in long term national strategies.

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