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### Factors Affecting Control and Eradication of Malaria in Cape Coast, Ghana

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#### ABSTRACT

The Global Malarial Action Plan (GMAP) addresses different measures towards achieving complete elimination of malaria, the most dangerous vector-borne disease. Present efforts for prevention and treatment of malaria in Cape Coast, a small town in southern Ghana, has achieved significant improvement from the past in controlling both the morbidity and mortality rates through various approaches. However, the current efforts and methodology in proceeding towards elimination of malaria presents many unanswered questions in terms of its level of sustainability. This report provides an overview of the current strategies implemented and addresses multifactorial issues that impede the control and eradication of malaria in Cape Coast. In addition, the effectiveness and sustainability of these strategies to achieve such intended goals have been evaluated. This study was conducted within Cape Coast, Ghana among 2 rural villages, Cape Coast Teaching Hospital and the general populous. Data collection involved face-to-face interviews of 55 individuals residing in Cape Coast, as well as, the use of hospital records on malaria. The paper concludes by indicating that more funding in infrastructure, as well as, serious advancement in public action is essential for improved malarial control and complete elimination of the disease.

**Key Words:** **DDT:** Dichlorodiphenyltrichloroethane, **GMAP:** Global Malaria Action Plan, **IRS:** Indoor residual spraying (insecticide), **ITN:** Insecticide-treated nets, **LBW:** Low birth weight, **LLIN:** Long-lasting insecticide-treated nets, **LSM:** Larval Source Management, **NHIS:** National Health Insurance Scheme, **Pf:** Plasmodium Falciparum, **WHO:** World Health Organization

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## BACKGROUND

Malaria, a parasitic infection, is transmitted by mosquitoes and known to be one of the most devastating infectious diseases (Schantz-Dunn & Nour, 2009). It is the leading killer among all the vector-borne diseases, which cause more than one million deaths globally each year (Schantz-Dunn & Nour, 2009). Vectors are living organisms, which are capable of transmitting infectious diseases to human beings from human or animal reservoirs (WHO, 2017b). Vectors, like mosquitos, thrive in contaminated environment and are often found in poorly established residential areas, hence causing maximum toll on those that are disadvantaged.

Pregnant women, children, and immunocompromised individuals have the highest morbidity and mortality incidences in malaria-endemic communities with adverse consequences including maternal anaemia, placental malaria parasitaemia and infant with low birth weight (LBW) (Ofori et al., 2009; Schantz-Dunn & Nour, 2009). It exacerbates the poor economic status of the affected individuals making them unable to work and support themselves and their family. When the disease turns endemic it severely affects the economic development of the affected region as a whole.

Malaria, which is a preventable and curable disease, gets transmitted through the bites of female *Anopheles* mosquitoes (WHO, 2017a). Among five species of the parasite that cause malaria in humans, *Plasmodium falciparum* (Pf) parasite is responsible for 99% of malarial deaths globally and it is the most prevalent malaria parasite in the African continent (WHO, 2017a). So, why does malaria consistently have such a heavy impact? Simply, many individuals in these endemic countries lack adequate access to tools and resources that prevent, protect, diagnose, treat and control the spread of the disease.

Vector control has proven to be the main approach towards preventing malaria and reducing transmission (WHO, 2017a). Two of the most common and inexpensive methods for long term protection against malaria are use of insecticide-treated bed nets (ITNs) and indoor residual spraying of insecticides (IRS) (WHO, 2017a). Usually DDT and pyrethroid based insecticides are mostly used as IRS (WHO, 2014). The insecticide DDT can be effective for 6-12 months compared to pyrethroid being effective for 3-6 months (WHO, 2014). Consistent use of Insecticide-treated bed nets (ITNs) has shown to reduce illness and death due to malaria in endemic regions, especially reducing the morbidity rate of children under 5 years from all causes by approximately 20% (CDC, 2014).

ITNs form a protective barrier around people sleeping under them and these nets are treated with pyrethroid-based insecticides (CDC, 2014). These insecticides have proven to have very minimal health risks to humans and other mammals, but are toxic to insects at very low doses (CDC, 2014). Additionally, malarial control would be greatly enhanced if all community members use Long-lasting insecticide-treated nets (LLINs) alongside ITNs, as The National Malaria Control Strategy promotes the progressive movement towards universal coverage of LLINs, where people are encouraged to fix window and door screens in their houses, apply IRS in regular intervals, and use mosquito repellents and coils (CDC, 2014). According to Centers for Disease Control and Prevention (2014) between 2008 and 2010, a total of 294 million nets were distributed in sub-Saharan Africa and funding for LLINs steadily increased from 2004 where 5.6 million nets were delivered, to 2010, where 145 million nets were delivered.

## METHOD

This study looks at the multi-factorial issues that directly impact the prevalence of malaria in Cape Coast, Ghana, as it still remains high even with the great level of global awareness of the disease.

Factors, impacting malarial control, discussed here include economic status, education, cultural barriers, living and environmental conditions and accessibility of the residents. These encompass the main issues that need to be addressed to ultimately minimize the impact of malaria in Ghana.

This study was conducted within Cape Coast, Ghana among 2 rural villages, Cape Coast Teaching Hospital and the general populous. Data collection involved face-to-face interviews of 55 individuals residing in Cape Coast, as well as, the use of hospital records on malaria. The interviews were used to explore the views, experiences, awareness, beliefs and motivations of individual participants. The interviews were conducted in a semi-structured manner, where multiple key questions were asked with freedom to diverge into the topic in more detail. The purpose of selecting this method was to study the social phenomenon associated with the continuous prevalence of malaria, where the detailed insights of individual participants would provide a powerful conclusion. This approach has proved to be more appropriate for exploring unexpectedly important and sensitive topics instead of following rigid experimental design where all procedures are specified from beginning to the end.

RESULTS/OBSERVATIONS

Among all of the participants interviewed, 13 were interviewed from hospital staff and patients, 36 individuals were from 2 rural villages and 6 were from the general populous.

**Table 1:** Relative distribution of male & female according to age group

	Female	Male	Female 18-60yrs	Male 18-60yrs	Female >60yrs	Male >60yrs	Total (n)
<b>No. of Participants</b>	28	27	21	21	7	6	55
<b>% Age Distribution</b>	51%	49%	38%	38%	13%	11%	

**Table 2:** Relationship between educational status of male & female and re-occurrence of contraction of Malaria

Education Level	No. of Participants	% Education	No. of Participants aged 18-60 years	No. of Participants over 60 years	Malaria Contraction Count	% Malaria Contraction
<b>Female</b>						
College	3	11%	3	0	0	0%
Junior High School	3	11%	2	1	3	10.7%
Elementary School	3	11%	2	1	3	10.7%
No Education	19	68%	14	5	10	35.7%
<b>Total</b>	28		21	7	16	57%
<b>Male</b>						
College	4	15%	4	0	2	7%
Senior High School	2	7%	1	1	2	7%
High school	1	4%	1	0	1	4%
Junior High School	7	26%	6	1	4	15%
Elementary School	2	7%	1	1	0	0%

No Education	11	41%	8	3	7	26%
<b>Total</b>	<b>27</b>		<b>21</b>	<b>6</b>	<b>16</b>	<b>59%</b>
<b>Grand total</b>	<b>55</b>		<b>42</b>	<b>13</b>	<b>32</b>	<b>58%</b>

**Table 3:** Distribution of male & female participants corresponding to the type of action taken for treatment against Malaria

Participants	Total No. of Participants (n)	Malaria contracted	1st mode of action: Spiritual Aid	1st mode of action: Hospital	# of Malaria contractions (>1)
Female	28	16	12	4	11
Male	27	16	6	10	9
<b>Grand total</b>	<b>55</b>	<b>32</b>	<b>18</b>	<b>14</b>	<b>20</b>

**Table 4:** Employment status comparison between male & female

Participants	No. of participants (n)	Percentage (%)
<b>Female</b>		
Unemployed	24	83%
Employed	5	17%
<b>Male</b>		
Unemployed	12	44%
Employed	15	56%
<b>Grand total</b>	<b>56</b>	

**Table 5:** Distribution of male and female participants for their use of LLINs or ITNs and their rate of contraction of Malaria

Participants	Total participants (n)	With LLIN/ITN	Without LLIN/ITN	Malaria contracted	% with LLIN/ITN	% without LLIN/ITN	% Malaria Contracted
<b>Female</b>	28	18	10	16	64%	36%	57%
<b>Male</b>	27	18	9	16	67%	33%	59%
<b>Grand Total</b>	<b>55</b>	<b>36</b>	<b>19</b>	<b>32</b>	<b>65%</b>	<b>35%</b>	<b>58%</b>

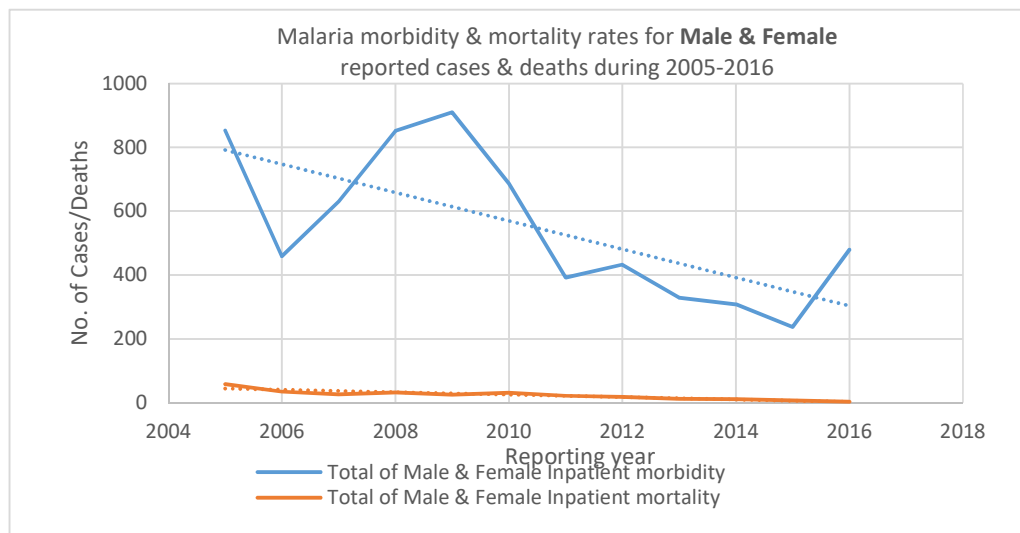
LLINs: Long-lasting Insecticide Nets, ITNs: Insecticide-Treated Nets

Chart indicates that number of malaria cases has reduced over this study period by 44% whereas the mortality rate has reduced significantly by 95% over the same period. Although there was a surge in the reported malaria cases in 2008 and 2009, several control measures were able to keep the mortality rates under control.

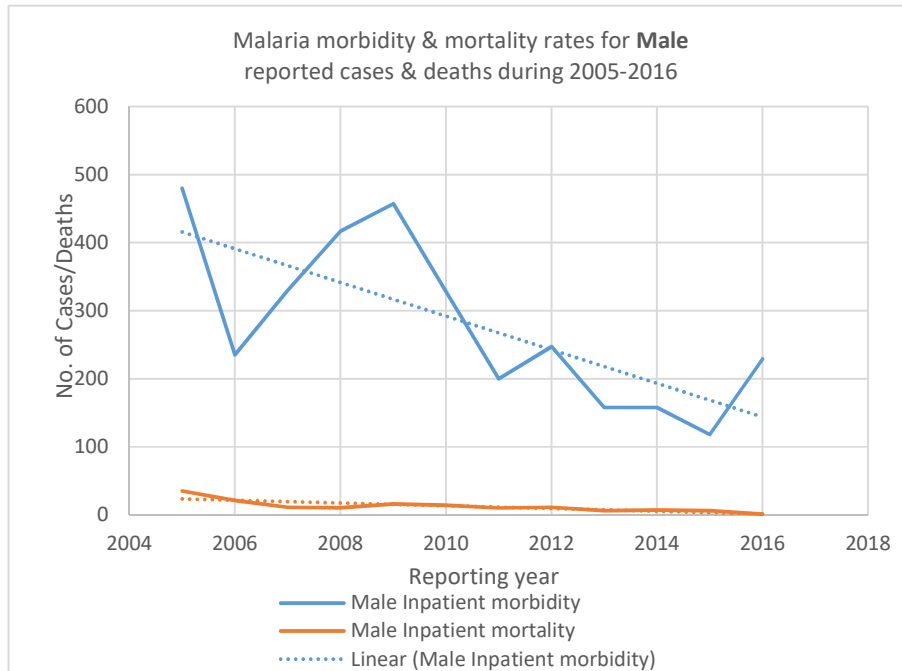
**Table 6:** Historical morbidity & mortality figures on Malaria for the period of 2005-2016, collected from Cape Coast Teaching Hospital, Cape Coast, Ghana

Reporting year	Male		Female		Combined Male & Female		Combined % age with reference to 2005	
	Inpatient morbidity	Inpatient mortality	Inpatient morbidity	Inpatient mortality	Inpatient morbidity	Inpatient mortality	Inpatient morbidity	Inpatient mortality
2005	480	35	373	23	853	58	100%	100%
2006	235	21	224	14	459	35	54%	60%
2007	330	11	300	15	630	26	74%	45%
2008	417	10	435	22	852	32	100%	55%
2009	457	16	453	9	910	25	107%	43%
2010	328	14	359	17	687	31	81%	53%
2011	200	10	192	12	392	22	46%	38%
2012	247	11	185	7	432	18	51%	31%
2013	158	6	171	6	329	12	39%	21%
2014	158	7	150	4	308	11	36%	19%
2015	118	6	119	1	237	7	28%	12%
2016	229	1	251	2	480	3	56%	5%

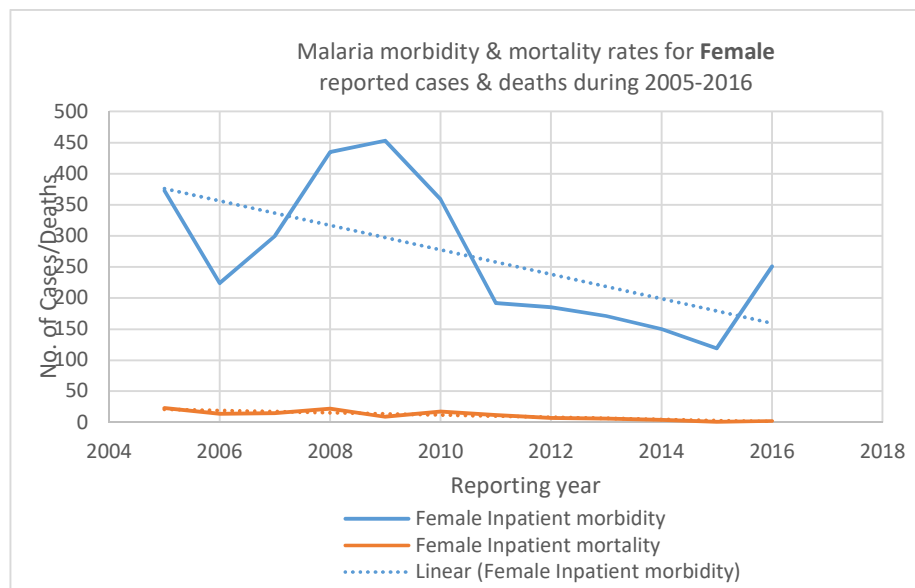
**Figure 1:** Illustrates morbidity & mortality figures of malaria of combined male & female in-patients as per Table 6



**Figure 2.** Illustrates morbidity & mortality figures of malaria only for male as per Table 6



**Figure 3.** Illustrates morbidity & mortality figures of malaria only for female as per Table 6



### THE IMPORTANCE OF EDUCATION ON LIFELONG HEALTH

The education system in Ghana continues to face major challenges related to accessibility and participation for its students (Ofori et al., 2009). For example: the low enrolment of girls in schools; low quality in terms of learning achievement among poor pupil; inadequate supply of trained and qualified teachers, resulting in smaller class sizes; and lack of resources for teaching and learning (Ofori et al., 2009). The low enrolment of girls is concerning as their inadequate education prevents the future child bearing mother from understanding and recognizing the importance of initial preventive measures against malaria during pregnancy and for the baby post-birth.

According to the data collected, out of all the female participants, 11% attended a post-secondary institution, 11% completed their junior high school education and 11% completed their elementary school education; whereas, 68% did not have any level of education (Table 2). Educational achievements are slightly greater for male participants in comparison to females as indicated in Table 2. Current issue regarding high numbers of uneducated females show gradual decline as new generations are getting better opportunities to pursue basic education in comparison to older generations due to increased globalization. The distribution of teachers in disadvantage rural areas has always been below standard as the situation and the percentage of trained teachers remains very low at the basic level (Aheto-Tsegah, 2011). The lack of education in Ghana remains of high prevalence as many of the kids tend to drop out at an earlier age in order to support their families (Aheto-Tsegah, 2011).

According to a recent database from Education Policy Data Center (EPDC) for Ghana (n.d.), among the population aged 15 years old and above, 19% of men and 33% of women have no education and 7% of men and 10% of women who are 15-19-year-old have never attended school. Only 6% of the population aged 15 years old and above have post-secondary education and 86% of women age 15-24 in urban areas can read, compared to 68% in rural areas (EPDC, n.d.). The percentage of women who can read is 48% among women aged 45-49 and 82% among women aged 15-19 (EPDC, n.d.). The lower rate of attainment of basic education for young women is disadvantageous as many of them continue to be unaware of basic primary prevention practices about many diseases including malaria.

The development of the “trickle-down effect,” occurs when deprived families are unable to provide adequate financial support for their kids to continue their education. This initiates a vicious cycle where those young children that are unable to meet adequate financial support are forced to drop out and live out of poverty with very limited potential income for the future. They seek to build a family at a younger age, but struggle to maintain the standard of living and thus cannot support their children’s financial needs for education. Most often they seek work that involve laborious and hazardous working conditions, often involving long working hours throughout the day and night. Data shows that greater the time spent outdoors (especially in the evening) the prevalence of active mosquitos increases; thus, increases the chances of contracting malaria. According to the collected data, participants that had previously contracted malaria reported that they stayed outside the house later than 6 pm most days of the week. They showed a higher rate of consecutive contraction of malaria between 6 months to 2 years. On the contrary, many participants that were able to minimize their time outdoors throughout the week never contracted malaria in their lifetime, however for those that did contract malaria showed a lower chance of re-contraction over a longer period of time.

Basic healthcare precautions often get overlooked for those that cannot meet basic human needs. This is the ultimate outcome for those with lack of education, whose basic income potential to support their family is not adequately met; thus, increases their chances of contracting various diseases, especially malaria. The benefit of education allows the individual to understand the importance of primary healthcare prevention, as the individual then realizes the importance of what to do when they contact any disease and also take preventative measures beforehand. To promote health awareness, there should be

governmental investment in social service to provide free basic health education to underprivileged individuals and families.

#### ENVIRONMENTAL DETERMINANTS PROMOTING MALARIA

Mosquitoes prefer stagnant water to lay their eggs and for which they most usually infest in ponds, marshes, swamps and other wetland habitats (Bali, 2013). Water provides mosquitoes with a place to lay eggs and grow. Hot and humid environments are most favourable to mosquito growth and survival (Bali, 2013). The warm weather alongside high humidity of Ghana are the main principal reasons that mosquitoes are highly prevalent and thus; due to the nature of the weather stronger preventative methods must be established in order to progressively minimize the growth of the *P. falciparum* parasite.

The capacity of Ghana's waste management system at residential and industrial areas is low and of poor quality (Bali, 2013). In urban areas, waste collection services are only offered to limited number of the households, while the majority of waste ends up in drains, streams and open places (Bali, 2013). The lack of trash bins result into garbage being thrown into gutters that causes clogging of drainage which creates stagnant pools of water, providing mosquitoes an ideal place for breeding (Bali, 2013). These drains were originally designed as storm drains to collect rainwater and prevent flooding, but now these open drains get choked when it rains; thereby, increasing the threat of floods (Bali, 2013). Lack of adequate awareness concerning the importance of hygiene and sanitation practices create conditions that ultimately leads to an up-scale societal issue. As reported "KMA Waste Management officer Tina Boateng said that a few years back Kumasi used to have trash bins lining the street at every 100 meters. However, authorities quickly discovered their trash bins were being stolen at an alarming rate" (Bali, 2013). Unsuccessful government initiatives should be a strong indicator that the general public is in need of greater awareness and education of the dangers of poor hygiene and sanitation practices, and how it can provide vast breeding grounds for numerous deadly diseases. If not, stricter laws and legislations must be implemented to combat such societal behaviours and ensure adequate penalty be delivered to bring about change.

Outdoor malaria transmission is becoming an increasingly important problem in the management of malaria control in Africa (Afrane et al., 2016). The nature of the environment is a great determinant for promoting breeding capacity of *P. falciparum* and they have a specific period of time and/or area when the growth is maximal. So, it's much more productive for the government to set up initiatives that find these high-risk breeding areas and use necessary tools (e.g. insecticides) to reduce their overall breeding capacity and impact. Fortunately, Larval Source Management (LSM) is a promising intervention procedure, as it can target both indoor and outdoor biting mosquitoes (Afrane et al., 2016). However, the currently available biolarvicide formulations have a short effective duration (Afrane et al., 2016). This results into larval control having a high operational expense due to the requirement for frequent re-treatment of larval habitats (Afrane et al., 2016). Current studies suggest that long-lasting microbial larvicide have a promising complementary malaria vector control tool and permits further large-scale evaluation (Afrane et al., 2016).

#### ECONOMIC STABILITY: A STRONG INDIRECT DETERMINANT OF HEALTH

Ghana's strong economic growth in the past two decades helped cut the country's poverty rate in half, from 52.6% to 21.4% between 1991 and 2012 (Molini & Paci, 2015). But according to the newly released report on "Poverty Reduction in Ghana: Progress and Challenges", sustained poverty reduction requires a commitment to reducing inequality and improving access to opportunities for all citizens (Molini & Paci, 2015). However, challenges still exist, where rural subsistence agricultural farmers are among the poorest socio-economic groups in Ghana (Caluag, 2015). Most of these farmers reside in the northern region of Ghana and do not have access to the same infrastructure and services compared to the urban southerners (Caluag, 2015).



As many Ghanaians live under the minimum wage level, they ensure that their limited income is put forth towards attaining the basic and essential human needs (e.g. food, water, shelter, clothes, etc.). According to the filed survey shown in Table 4, 44% of the male participants did not have an income and were too poor to afford such basic resources for their families. These individuals visited the hospital only when necessary and even wanted to avoid buying medicine in order to circumvent extra unnecessary expenditures. The importance of medical intervention is often overlooked in such scenarios, which lead to the gradual progression of the disease over time affecting the health of both themselves and others around them.

Approximately 35% of the participants could not afford ITNs while 65% had ITNs (Table 4), while many of them indicated that their nets were partially damaged or nearly unusable. Individuals without adequate money received ITNs from the free government distribution campaigns. Total 36 residents reported inadequate regular use of their available ITNs during sleep due to high humidity and physiological restlessness. All 55 participants expressed that they had to keep the windows closed at night to prevent mosquitoes from entering their home. Of those that did not have ITNs or do not use them on a regular basis, showed a greater number of malaria contractions and rate of re-occurrence compared to those that used such preventative tools; thus, likely showing less susceptibility for contraction in the future. Individuals that have adopted various health-related preventative methods and tools for themselves and their families have experienced fewer diseases and illnesses and reported to have a greater overall well-being. These participants had explicitly mentioned that they had some form of formal education, had the income potential that allowed them to meet their basic needs and had spare income to invest in such health-related measures.

According to Johns Hopkins Center for Communication Programs (2016), there has been substantial investment from the government to distribute insecticide-treated nets (ITNs) to 1.2 million children and their families in over 14,000 public and private primary schools. However, many having adequate income to buy their own tend to exploit these privileges and receive free ITNs from the government, depriving those that the government had initially targeted. Stricter regulations and background checks are necessary to ensure the success of such wide-spread initiatives.

Environmental elements of Ghana create greater difficulties for those underprivileged, as the weather and humidity greatly impact those that cannot remain cool and hydrated throughout the day. They often undertake laborious and strenuous tasks throughout the day/night and tend to wear clothes that are shorter in length to ensure proper perspiration, which most often doesn't cover their entire arms and legs. This is a pre-requisite that helps mosquitoes transmit *P. falciparum* through direct skin contact. Thus, the warm and humid weather plays a significant role in promoting the breeding of mosquitoes, as well as, increasing the probability for contracting malaria for those at a greater disadvantage.

Economic instability mainly impacts the health and wellbeing of children under the age of 5 and pregnant women, as diseases thrive under immunosuppressed conditions; thus, permits increased susceptibility to disease contraction and rapid progression of the disease into more complicated states. In the case of malaria, the weakened immune system of both the mother and the baby allows *P. falciparum* to thrive under these conditions. Anti-malarial prophylaxis is one of the key methods towards combatting the progression of malaria during pregnancy. Fortunately, the government has provided the opportunity for pregnant women to receive anti-malarial prophylaxis during their trimester periods for those that are economically disadvantaged. In addition, another governmental initiative has promoted for the distribution of household bug sprays to rural communities. Many feel that the use of pesticide repellents exacerbates their illness and/or they do not prefer the smell. From the collected data, 36 participants indicated that they did not use the repellent because they could not afford it. 20 individuals indicated they did not prefer the smell as it was irritating and out of those 20 participants, 5 indicated its use on few occasions, but have discontinued its use since then.

### ACCESSIBILITY IMPACTS QUALITY OF HEALTH CARE

Healthcare infrastructure is still inadequate and needs improvement, especially outside of the large cities such as Accra (“Health Issues and Healthcare in Ghana \_ InterNations,” n.d.). The availability of healthcare establishment and even doctors is very limited in the countryside, and traditional African medicine is the go-to option for large portions of the rural population that cannot afford to travel long distances for healthcare (“Health Issues and Healthcare in Ghana \_ InterNations,” n.d.). Ghanaians living in small and isolated communities far off from major cities, inadvertently restrict their accessibility to adequate health care due to geographical detachment. Lack of governmental investment to establish smaller clinics that can provide adequate healthcare to such remote communities exacerbate such healthcare inequalities. Social isolation of such communities creates more unawareness of the advancement of modern medicine, where majority frequently rely on cultural and spiritual support on health issues. Such methods encourage the constant fear of medical intervention due to normalized cultural appropriation, as younger generations become systemically and unknowingly frightened of the use of medicine and the treatment at hospitals due to possible cultural backlash.

Initially, the government had implemented the “cash and carry” scheme where it required individuals to pay for their treatment up front, making the scheme impossible to sustain for most of the population (“Health Issues and Healthcare in Ghana \_ InterNations,” n.d.). In an effort to combat this situation, the Ghanaian government has set up the National Health Insurance Scheme (NHIS). Results showed immediate success, where there was decrease in deaths and a rise in patient numbers (“Health Issues and Healthcare in Ghana \_ InterNations,” n.d.). NHIS was introduced in Ghana to ensure equity in healthcare access. The premium is heavily subsidised and exemption is provided for the poorest, however, studies reveal that they are the least enrolled in the scheme (Kotoh & Van Der Geest, 2016). According to a study done by Kotoh, & Van Der Geest (2016), of the 6790 individuals covered in the national survey, less than half (40.3 %) of the population were currently insured in the NHIS and 22.4 % were previously insured. The poorest groups had the lowest enrolment rate which is attributed to their poverty. Impoverished groups develop a day-to-day approach and due to great economic uncertainty, such groups may have the money to support the insurance cost, but rather use it for their everyday living.

Public transport is a critical area in health care access, which serves as a connection between home and health facilities (Atuoye et al., 2015). In developing countries, poor road systems and absence of reliable means of transportation leaves rural areas inaccessible; thus, making physical access to specialized health care, not provided by local health facilities, difficult (Atuoye et al., 2015). According to the collected data, 5 individuals that had lived in small communities located far from their referral hospital complained regarding their frequent check-ups during the week, as they had to travel and spend their entire day from going to the hospital, waiting there for many hours, and finally returning home in the evening. In promoting referral, distance to facilities has been identified as a critical factor (Atuoye et al., 2015). Apart from its association with delay in reaching the next point, it has the tendency of influencing rejection of referral, which has dire implications for maternal and child health, consequently increasing mortality rate to those with different complications of various diseases, such as malaria (Atuoye et al., 2015).

### HOW CULTURAL INSENSITIVITIES PROMOTE ILLNESS

From the year 2009, Ghanaians started recognizing that certain parts of their culture created developmental challenges. However, some fear to discuss such cultural challenges due to fear, intellectual incapability and judgement (Akosah-Sarpong, 2009). The belief in witchcraft, being the sole cause of calamity and misfortune, is wide spread in Ghana, which is more prevalent in the northern parts of Ghana, preventing some women from being admitted to schools (Akosah-Sarpong, 2009). Ghanaians strongly believe that traditional medicine has a strong correlation between the spiritual and physical

well-being of people (White, 2015). Traditional Africans explain and/or understand the ultimate causation of a disease is due to the attacks from evil or bad spirits (White, 2015). Spell-casting and witchcraft are also other ways one could become sick, as they view people with evil influences to serve out punishment of illness to those that are disrespectful to others (White, 2015).

The holistic methods of treatment comes with many disadvantages, as it does not rely on accurate diagnosis (White, 2015). For example, some might neglect the importance of dosage, which may be prepared in unhygienic conditions and the knowledge of the medicine is not properly distributed but kept by few individuals (White, 2015). In addition, malpractices can lead to poor treatment when it comes to certain diseases. Many cultural practices are designed based on the spiritual and holistic ideas that have been passed down for generations, but these practices may not necessarily be the safest. For example, in many rural families, females are considered property of males and require the permission of the male in the house to go to the hospital. Many in these communities have a distorted perception of modern medicine and many are frowned upon, who seek treatment outside their known values/beliefs, marking them as weak and/or incapable. Many tend to prolong certain symptoms, as they ignore enduring health issues, leading to developing complications.

Initially, in its early stages, malaria is completely curable, but if left untreated can lead to complications. *P. falciparum* can travel through the body under weakened circumstances, where it can pass the blood brain barrier and cause meningitis, encephalitis, micro haemorrhage that ultimately leads to reduced cognitive ability and ultimately death. According to the data, 33% of the participants sought after some form of spiritual aid as their first mode of treatment and 26% reported to seek hospital-based medical intervention (Table 3). Those that reported to seek spiritual aid, all participants reported varying degrees of its effectiveness. Many claimed that their choice of treatment/aid depended on the influences from their family and financial capacity. This highlights the dual existence of both spiritual and formal medicinal treatment being an essential part for the most, which is influenced by the cultural practices passed down through generations. The degree of trust and awareness of the health care system will slowly increase through modernization. In order to combat these cultural barriers, laws must be enforced to ensure that many of these unsafe cultural practices that lead to serious harm and/or death be avoided. Community-based teaching practices must be instilled to ensure progressive acclimatization of modern medical practices leading to proper healthcare for everyone. The government must be pro-active and take action towards the use of strict legislations and regulations to overcome poor healthcare practices.

## CONCLUSION

Despite the existence of serious challenges facing vector control programs, several countries have been able to reach a stage of malarial control and effective eradication. For countries that are still under heavy burden from malaria, the principal investment should be the continued and sufficient funding from the government and non-governmental organizations (NGOs) to these malaria-endemic regions. In addition, the international-scientific community shall need to be mobilized to invest heavily in novel research and development ideas for effective and affordable malaria control.

Greater community-based health education must be financed and made available to disadvantaged and poverty-stricken groups to reach a sustainable level of public awareness towards reducing healthcare inequalities and increasing basic knowledge. Education will not only increase the awareness of the population towards the prevention, control, treatment and eradication of malaria, it will also improve the financial competence of the population as a whole, which will ultimately help increase accessibility to healthcare. Vector control has proven to be the main approach towards preventing malaria and reducing transmission. Consistent use of ITNs/LLINs and IRS are the most efficient and proven methods in minimizing the onset of malarial contraction and progression. In addition, greater awareness should encourage the population to fix windows and door screens in their houses, apply IRS (mosquito

repellents and coils) in regular interval, and use ITNs while sleeping at night, as mosquitoes are mostly active throughout this time.

Insecticide resistance has become a major concern where the current vector control system is based on a single-group of insecticide called the pyrethroids, which has increased in reliance due to its effectiveness, as well as, it being the least expensive compared to other modes of intervention. Greater research is necessary to formulate new and non-resistant insecticides which would provide adequate affordability, without compromising effectiveness. Malaria control and elimination programmes must be closely co-ordinated between the partners working in malaria control, government regulators, donor organizations, UN agencies, research organizations, medical and insecticide producers. Integration is necessary among all vector control measures, treatment and prophylaxis against malaria to progress towards a sustainable eradication program.

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