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AN OVERVIEW OF PREVENTING MEASURES TOWARDS SPREAD OF MALARIA DISEASE

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Abstract:
Malaria is a worldwide public health problem, with an estimated 229 million cases recorded in 2019. African countries accounted for approximately 94% of all reported cases. So far, over 200 different species of protozoa have been identified, with at least 13 of them being pathogenic to humans. The malaria parasite's life cycle is a complex process involving an Anopheles mosquito and a vertebrate host. Its pathophysiology is characterized by fever caused by erythrocyte rupture, macrophage ingestion of merozoites, and/or the presence of antigen-presenting trophozoites in the circulation or spleen, which promotes tumor necrosis factor (TNF-) release. Malaria can be diagnosed clinically by observing the disease's signs and symptoms. Other diagnostic methods for malaria include microscopic detection of parasites in blood smears and antigen-based fast diagnostic assays. Malaria treatment includes both preventive and curative measures. Because simple malaria can escalate to severe malaria if left untreated. WHO recommends using combination therapy for all bouts of malaria using at least two efficacious antimalarial drugs with diverse mechanisms of action to avoid or postpone the spread of antimalarial drug resistance. The Centers for Disease Control (CDC) warns that no preventive agent can completely prevent malaria. As a result, prophylaxis must be supplemented with the use of personal protective measures.

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INTRODUCTION:

Malaria is a potentially fatal and acute infection of red blood cells caused by Plasmodium protozoa parasites. The parasites are passed from person to person by the bite of an infected female anopheles mosquito. Malaria is caused by four parasite species: P. vivax, P. malariae, P. falciparum, and P. ovale. P.falciparum and P.Vivax are the most dangerous [1]. It is both preventable and treatable [2]. All people are at risk of developing malaria, but pregnant women, babies, HIV/AIDS patients, and children under the age of five are the most vulnerable to dying or suffering significant repercussions from the disease [1, 3]. Malaria has a significant impact on fetal health, resulting in preterm and low birth weight [1]. Malaria rates in young children were affected differently by increased vector control and routine case treatment [4]. In 2018, P.falciparum was responsible for 99.7% of estimated malaria cases in the WHO African Region and 71% of estimated malaria cases in the WHO South-East Asian Region, respectively. P.Vivax, on the other hand, is the most common parasite, accounting for 75% of malaria infections in the WHO American Region [1].

According to the World Malaria Report, there were 228 and 229 million malaria cases worldwide in 2018 and 2019, respectively. Almost 95% of all malaria cases worldwide occurred in 29 nations. Malaria deaths were projected to reach 405,000 and 409, 000 in 2018 and 2019, respectively. Children under the age of five accounted for 67% of all malaria deaths worldwide [5, 6]. In Ethiopia, roughly 60% of the population lives in malaria risk zones, which is exacerbated by the rising frequency and scale of malaria epidemics [7]. Furthermore, malaria transmission in Ethiopia is unstable, highly seasonal, and varies spatially across the country, and outbreaks are classified as public health emergencies [8]. More importantly, during the current COVID-19 pandemic, practicing malaria prevention mechanisms have the greatest advantage, as evidence showed the association between COVID-19 and malaria epidemics was devastating, particularly in low and middle-income countries like Ethiopia, where malaria is endemic, are at risk of suffering from the consequences of COVID-19 due to mutual side effects, such as less access to treatment for malaria patients due to the pandemic. The WHO advised each nation to maintain malaria services as part of the country's critical health package while trying to control COVID-19 [10].

Malaria is a communicable disease caused by Plasmodium protozoan parasites that primarily affects the tropics and subtropics. Plasmodium falciparum and Plasmodium vivax are the two most dangerous parasite species known to cause malaria in humans [11].

Approximately 70 Anopheles mosquito species are capable of transmitting human malaria, with 41 of these species classified as the "dominant" malaria vector species globally [12]. Three species of the Anopheles gambiae species complex, along with Anopheles funestus, are the primary vectors of malaria in most African countries [10,12], but other parts of the world have a greater diversity of vector species. Anthropophilic, endophagic, and endophilic vectors, such as An. funestus, predominantly feed on human blood indoors (and then rest indoors), making them effective malaria vectors. Species that feed opportunistically on both humans and cattle, like as An. arabiensis, or that bite or rest outside are generally less efficient malaria vectors, but they might still be the primary vector species in a given location. These ecological and behavioral differences across vector species also result in significant variances in the efficiency of vector control strategies [12].

DISCUSSION:

Following WWII, significant progress was made with the discoveries of DDT and chloroquine, reducing the global extents of both Plasmodium vivax and Plasmodium falciparum and benefiting vast areas of the Americas, Europe, and Asia [13]. These enormous advances in malaria control lasted until the first decade of the twenty-first century, but the second decade appears to be more difficult. Malaria has been on the rise in various locations since 2014 [14]. In 2019, an estimated 229 million cases (from 87 malaria-endemic countries) were reported worldwide. The African region accounted for approximately 94% of all reported cases (215 million cases). Southeast Asia accounts for around 3% of the worldwide malaria case load. In the same year, an estimated 409,000 people died from malaria, with Africa accounting for 94% [15]. Malaria primarily affects children under the age of five, accounting for 67% of all deaths in 2019. Underdeveloped immunity is regarded to be the primary reason why children under the age of five are prone to malaria. Fever and illness-related side effects such as decreased eating, limited social life, and restricted play all lead to stunted growth [16].

Malaria Chemoprophylaxis

Casual prophylaxis is a medication that works against the pre-erythrocytic (liver stage) malaria parasite. After leaving the malaria-endemic area, these medications can be stopped. Suppressive prophylaxis,

on the other hand, refers to the administration of medications that act against asexual blood-stage (erythrocytic) parasites. Unlike casual prophylaxis, these medications must be taken for at least 4 weeks after leaving the area to eradicate asexual parasites arising from the liver weeks after exposure.46 Suppressive prophylaxis is recommended in locations where P. falciparum malaria is common, such as Sub-Saharan Africa. Where P. vivax coexists with P. falciparum or exists alone, causative prophylaxis is advised [17].

The Centers for Disease Control and Prevention stresses that no antimalarial agent can completely prevent malaria. As a result, prophylaxis must be supplemented with the use of personal protective measures. Currently, four medicines are licensed for use in malaria chemoprophylaxis: atovaquone/proguanil, chloroquine, doxycycline, and mefloquine. Client factors (pregnancy, disease conditions such as renal impairment and cardiac conduction problems), cost, frequency of administration preference, acceptability, resistance profile of the area, and the like are used to make the decision. [18].

"Domiciliary malaria" [19] demonstrated that the majority of cases resulted from mosquito bites within dwellings, leading to an emphasis on physical barriers to prevent mosquitos from entering households, as well as killing those that did. Since 1830, when the process was mechanized and prices were reduced, wire gauze was utilized to guard against flying insects. There are anecdotal stories from as early as 1830 when a doctor from Connecticut proposed that shielding dwellings in this manner would protect against malaria (no reference found except a mention in Encyclopaedia Americana 1835).

The use of wire gauze to protect humans (US patent 281 502, 1883) and dwellings (US patent 415,913, 1889) from mosquitoes is documented in US patent records. At the end of the nineteenth century, wire gauze was commonly used throughout the Mediterranean region to minimize mosquito bites. The discovery in 1881 that yellow fever was transmitted by the Stegomyia mosquito prompted the use of physical mosquito protection, as advised by Carlos Finlay [20]. However, there is no proof that hospitals or households were outfitted as he suggested. After the role of the vector was demonstrated, physical protection was implemented in 1899-1900 at the Hospital Las Animas of La Habana, and its use was systematized by Reed and Gorgas [20].

Malaria Vaccine

The parasite's resistance to antimalarial medicines, as well as the toxicity associated with chemoprophylaxis, highlighted the need for the creation of an effective malaria vaccine. Recently, researchers have focused on developing vaccines, and thus far, just one candidate has advanced to a big Phase III study. Other promising alternatives are being investigated as well. Malaria vaccines are classified as pre-erythrocytic, erythrocytic, or transmission-blocking based on where they target in the malaria parasite lifecycle [21].

RTS, S/AS01 is a monovalent recombinant protein vaccine that has advanced clinical trials and has been well investigated in the inhibition of P. falciparum sporozoite. It triggers an immunological response against circumsporozoite protein (PfCSP), a protein found on the surface of sporozoites [22]. As a result, it enhances immunoglobulin G (IgG) antibody reaction to the citrate synthase (CS) protein area and robust T-cell (CD4+) response [23].

WHO presently recommends RTS, S/AS01 for use on children in Sub-Saharan Africa and other parts of the world with moderate-to-high P. falciparum transmission. It should be given in four doses to youngsters beginning at the age of five months. This decision is based on the findings of an ongoing pilot program in Ghana, Kenya, and Malawi, which has reached 800,000 children since 2019. The pilot program in these three nations will continue to investigate the benefits of providing the fourth dose as well as the long-term impact on child fatalities. Similarly, among vaccines in development, PAMAVAC is a potential blood-stage malaria vaccine [24].

Vector control refers to efforts taken against a disease vector in order to minimize its potential to transmit the disease by protecting places known to be receptive to transmission [24]. Malaria susceptibility is determined by the vectorial capacity of local vector populations, which includes not only the existence of the vector but also its population size, human biting behaviors, and longevity in relation to the period of sporogony. Climate, local environment, and human and vector activity all have a substantial influence on each of these characteristics. To be effective, vector control strategies must be tailored to the local environment. The goal of vector control in an elimination phase is to reduce the vectorial capacity of local vector populations below the critical level required to maintain transmission [24].

Insecticide-treated mosquito nets (ITNs)

Long-lasting insecticidal nets (LLINs) have an insecticide that lasts up to three years while conventionally treated nets have an insecticide that lasts up to 12 months. The WHO advised that all health ministries and donor agencies increase ITN distribution, particularly to vulnerable groups such as young children and pregnant women [24]. Most national malaria control programs have now embraced universal coverage of ITN delivery, including periodic mass distribution campaigns. As a result, of the total 663 million malaria cases avoided in SSA over the last 15 years, 67-73% can be linked to the widespread distribution and usage of ITNs [25]. Evidence from cluster-randomized controlled trials (RCT) indicated pooled relative decreases in child mortality of 18% and parasite prevalence of 20% from net use, motivating the huge expansion in ITN distribution [25].

Nonetheless, despite substantial scaling-up of ITN distribution in SSA, there are gaps and disparities [26], which jeopardize long-term elimination or control initiatives. A recent study in SSA on equity patterns in ITN ownership found that a considerable increase in ITN ownership favored the poorest households in most settings, which has been linked to a surge in national ITN distribution campaigns. Sierra Leone and Zimbabwe improved the most in equity [27]. There is still a significant difference in terms of ownership and utilization. In SSA, ITN ownership ranges from 34 to 98.4% of families at risk of malaria. A multi-country analysis of observational data in SSA looking at associations between ITN household ownership and child mortality as well as parasitemia prevalence found that owning at least one ITN was associated with a pooled relative reduction in child mortality of 23% and a pooled relative reduction in parasitemia prevalence in children of 24% [27]. Another study in western Kenya found that, despite high mosquito net ownership, actual utilization is still surprisingly low, with significant seasonal changes [28]. During the rainy season, parasite prevalence in under-five children not using ITN and using ITN was 14 and 11%, respectively, in Emutete, according to the study. During the dry season, the parasite frequency in under-five children who did not use ITN was 10% and 4% in those who did [28].

Indoor residual spraying (IRS)

The Global Malaria Eradication Campaign's principal technique was indoor residual spraying, which resulted in the eradication of malaria in many countries and dramatically decreased its impact in others [27]. In 2015, the IRS safeguarded roughly 106 million persons [19]. It has mostly targeted locations with low and/or seasonal transmission, and its recent expansion into high transmission areas has been questioned due to long-term sustainability issues [28].

IRS has been employed in various places to eradicate malaria and reduce epidemics. Several research have demonstrated its usefulness. For example, in a randomized controlled trial (RCT) in Tanzania with stable malaria cases (entomological inoculation rate (EIR) > 1), IRS reduced re-infection with malaria parasites observed by active surveillance in children after treatment. The protective efficacy (PE) in minimizing parasite re-infection was 54%. In the same scenario, malaria case incidence was reduced marginally in children aged 1 to 5 years; the PE was 14%, but not in children older than 5 years, where the PE was 2% [29]. IRS lowered the incidence rate of all malaria infections in two RCTs for unstable malaria (EIR 1); the PE was 31% in India and 88% in Pakistan.

In Northern Uganda, a community-based experiment concentrating on children under the age of five saw an increase in malaria cases after IRS was discontinued. The incidence rate ratio in the under-five population increased from 0.77 in December 2014 (when spraying began) to 1.74 in June 2015, after spraying was discontinued. Another study found that after discontinuing IRS for 4-18 months, absolute malaria test positive rate (TPR) values increased by an average of 3.29% per month [30].

LSM (Larval Source Management)

Larval source management (LSM) is the management of aquatic ecosystems that are possible mosquito breeding grounds in order to minimize immature development. It is one of the oldest strategies in the fight against malaria, but it is mostly neglected and commonly ignored as a malaria control strategy in Africa [31]. With the recent understanding that outdoor biting contributes to malaria transmission [32], LSM has received increased attention, as it provides the dual benefit of reducing the number of house-entering mosquitoes as well as those that bite outdoors.

Mass drug administration (MDA)

The treatment of an entire population in a geographic area with a curative dose of a drug without first testing for infection and regardless of the presence of symptoms is known as mass drug administration [33].

It has been used to control malaria since the early 1930s and was supported for malaria elimination and eradication by WHO in the 1950s.

Recent advances show that mass drug administration of ivermectin is effective in malaria control, particularly for residual malaria. Ivermectin is an endectocide that is now licensed for use in humans. It is a semi-synthetic derivate of Streptomyces avermectinius fermentation products. It is one of the few medications utilized in human mass drug administration (MDA) campaigns, and over the previous 25 years, more than one billion treatments have been administered to manage neglected tropical illnesses such as onchocerciasis, strongyloidiasis, and lymphatic filariasis [34]. When injected, the medicine lingers in the bloodstream for around 6 days, causing blood to become toxic to malaria mosquitos. As a result, Anopheles mosquitoes that feed on an ivermectin-treated human after a single conventional oral dose have a lower chance of surviving [34].

CONCLUSION:

Malaria is one of the most common and easily avoidable causes of death worldwide. Although the incidence and rate of malaria-related mortality have been dropping for decades, progress appears to be slowing. Malaria has been on the rise in numerous areas since 2014. Though the practice of malaria prevention methods obtained in this study was comparable to other studies, it was lower than the predefined strategic goal of Ethiopia's operational malaria plan. The study participants who slept under an ITN performed somewhat worse than the national operating strategy for malaria, which called for levels over 80%. The IRS protects more than three-quarters of study participants (76.7%). More than three-quarters of the survey participants actively participated in the draining of stagnant water and the cleanup of shrubs surrounding their home. Being an urban dweller, finishing secondary and higher school, having a positive attitude, and having adequate knowledge of malaria were all connected with malaria prevention measures.

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