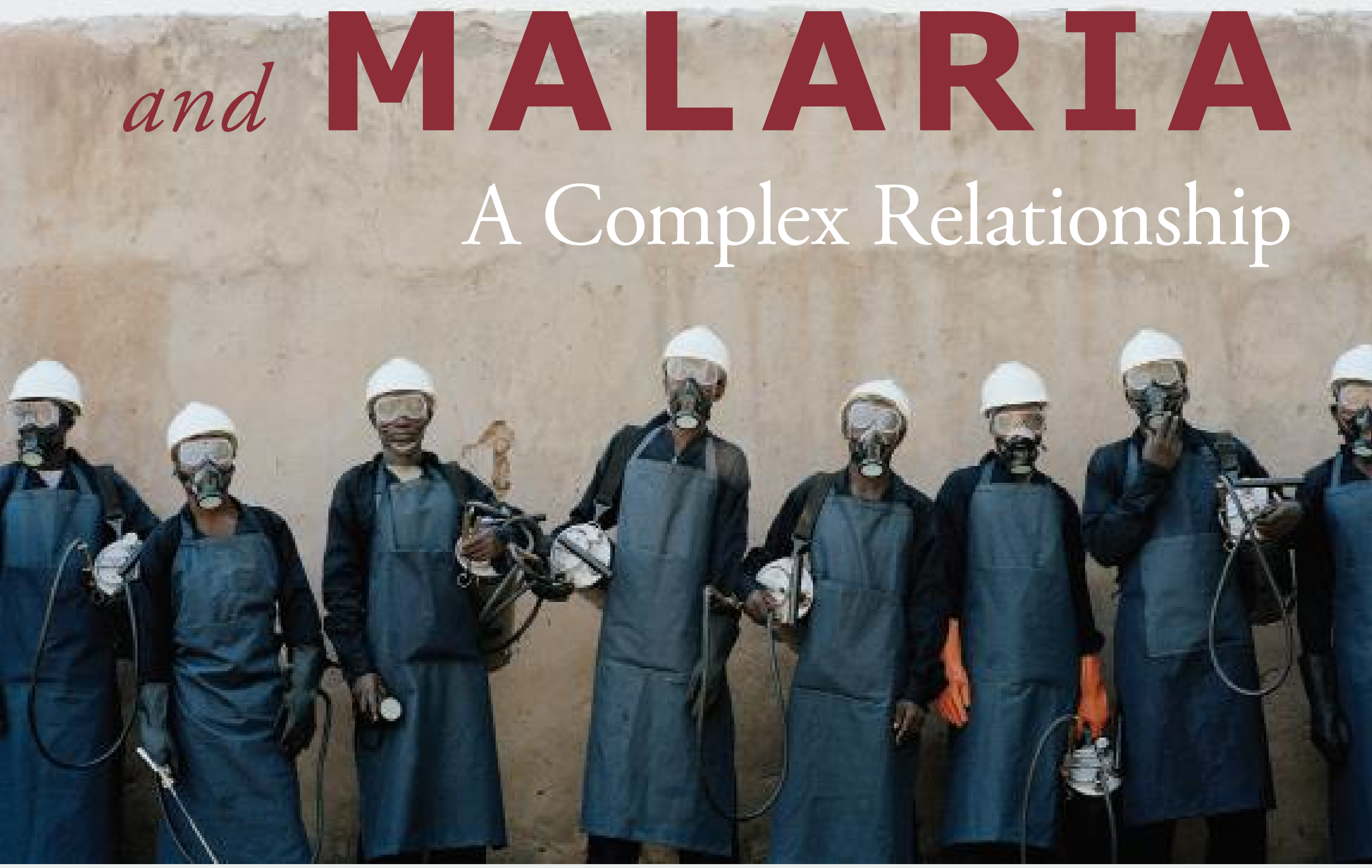
CLIMATE CHANGE *and* MALARIA

A Complex Relationship



Men are photographed after indoor residual spraying.

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By R. WICKREMASINGHE, A.R. WICKREMASINGHE AND S.D. FERNANDO

Climate change is defined as a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period typically decades or longer - that may be attributed to natural internal processes, external forcing, or persistent anthropogenic changes in the composition of the atmosphere or in land use.[1] Malaria, the world's most important and deadly tropical mosquito-borne parasitic disease kills approximately 1 million people and afflicts as many as 1 billion people in 109 countries throughout Africa, Asia and Latin America.[2] Reducing the impact of malaria will significantly enhance the efforts to achieve the Millennium Development Goals, agreed upon by every United Nations Member State.[2] Variation in climatic conditions, such as temperature, rainfall patterns and humidity, has a profound effect on the longevity of the mosquito and on the development of malaria parasites in the mosquito and, subsequently, on malaria transmission.[3]

The global temperature has risen significantly over the past 100 years, with an accelerated warming trend since the mid-1950s.[4] Elementary modelling suggests that this increase will enhance the transmission rates of mosquito borne disease and widen its geographical distribution,[5] with an increase in malaria, in particular, being identified as a potential impact of climate change.[1] While some studies report an increase in the spread of the disease in the current malaria endemic areas,[6-8] or a re-emergence of the disease in areas which have controlled transmission or eliminated the disease in the past,[9-10] others report no association between malaria and climate change.[11] Historically, malaria was endemic in Europe, including

Scandinavia, but was eliminated in 1975—despite the increase in global temperature—due to better socio-economic conditions, improved irrigation and drainage, adoption of new farming methods, behavioural changes and access to better health care.[12-13]

Due to the complex relationship between malaria and climate change, gaps in knowledge still exist in the mechanisms of the linkage. Climate change will increase the opportunities for malaria transmission in traditionally malarious areas, in areas the disease has been controlled, as well as in new areas which have been traditionally non-malarious. An increase in temperature, rainfall and humidity may cause a proliferation of the malaria-carrying mosquitoes at higher altitudes, resulting in an increase in malaria transmission in areas in which it was not reported earlier.[14] At lower altitudes where malaria is already a problem, warmer temperatures will alter the growth cycle of the parasite in the mosquito enabling it to develop faster and increasing transmission, thus having implications on the burden of disease.[15-16]

Climate change greatly influences the El Niño cycle that is known to be associated with increased risks of some diseases transmitted by mosquitoes, such as malaria, dengue and Rift Valley fever. In dry climates, heavy rainfall can provide good breeding conditions for the mosquitoes. With increased humidity, droughts may turn rivers into strings of pools, the preferred breeding sites of mosquitos.[17] In some areas, heavy rainfall can wash out the breeding sites and reduce the incidence of malaria. In Colombia and Venezuela, malaria cases increased by more than one third following dry conditions associated with El Niño. In Sri Lanka, in pre-DDT (*a synthetic agricultural pesticide used in controlling malarial life cycle*) times, the risk of malaria increased three-fold following the failure of monsoons, which were also associated with El Niño. In Southern Africa, countries have recently experienced malaria epidemics following unusual rainfall.[17] Western and north-western India recorded more malaria cases with higher rainfall during La Niña in 1996 and less rain and fewer malaria cases in the same area during the El Niño of 1998.[18] In short, the changes in the El Niño cycle have the ability to increase the malariogenic potential resulting in malaria epidemics.

It may not be possible to quantify how climate change affects malaria transmission, which depends on many factors such as population and demographic dynamics, drug resistance, insecticide resistance, human activities such as deforestation, irrigation, swamp drainage etc. and their impact on the local ecology. Further, other impacts of climate change may cause increased susceptibility to malaria. For example, negative impacts on health, which could contribute to social degradation and economic loss, may result in the inability to seek early diagnosis and treatment or impair control activities such as insecticidal spraying, thereby increasing transmission of the disease. The economics of decreasing malaria transmission by mitigating climatic changes via carbon dioxide emissions, versus using other methods, have been modelled. It is estimated that for the cost of saving one life by cutting down on carbon, 78,000 lives may be saved annually by using mosquito nets, environmentally safe indoor DDT sprays and subsidies for effective, new combination therapies.[19]

Surveillance and preparedness have been major components of the malaria control strategy, adopted since 1992 by the World Health Organization (WHO). In addition to early diagnosis and prompt and effective treatment, selective vector control and capacity building to prevent epidemics and control transmission have been the other areas of focus.[20] The emergence of three innovations in dipsticks for diagnosis, artemisinins for treatment of malaria and insecticide-treated nets for prevention of transmission in the 1990s, coupled with new initiatives such as the Roll Back Malaria initiative of WHO, the establishment of the Global Fund against AIDS, Tuberculosis and Malaria, as well as the inclusion of malarial indicators in the Millennium Development Goals led to a renewed interest in malaria control. All these efforts ensured that surveillance, including early detection and prompt treatment of cases and capacity building, together with preparedness were given priority.

The elimination of malaria from selected countries is stated explicitly in the targets of the Global Malaria Action Plan.[21] Considerable progress has been achieved in malaria elimination in some countries during the past few years. By 2015, at least 8 to 10 countries currently in the elimination stage are expected to achieve zero incidence of locally transmitted infection. Beyond 2015, countries currently in the pre-elimination stage are expected to move into the elimination phase. Consistent with the goals of the Global Malaria Action Plan, as of 2009, three countries that were in the elimination phase, Armenia, Egypt and Turkmenistan, have reported no locally acquired cases for more than three years, and have moved into the phase of prevention of reintroduction. Six countries: Azerbaijan, Georgia, Kyrgyzstan, Tajikistan, Turkey and Uzbekistan, all from the WHO European Region, had moved from the pre-elimination stage to a nationwide elimination approach by 2009.[22]

Climate change would, perhaps, increase the epidemic potential of malaria in tropical countries currently susceptible to the disease. Increasing temperatures and global travel have the

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potential to reintroduce or increase transmission of malaria in tropical and temperate countries that have either eliminated or controlled transmission. Such countries would be prone to epidemics, since surveillance and preparedness for malaria control may not be as intense when malaria was a major public health problem in these countries. It is in this context that surveillance and preparedness need to be emphasized, not compromised. This is especially true in developing countries that have to balance competing interests for scarce resources, some of which need not necessarily be health related. Let's not forget the setbacks of the eradication era which showed much promise in the initial phases, but had to be abandoned later—the classic example being the near elimination of malaria from Sri Lanka in 1963. unc

Notes

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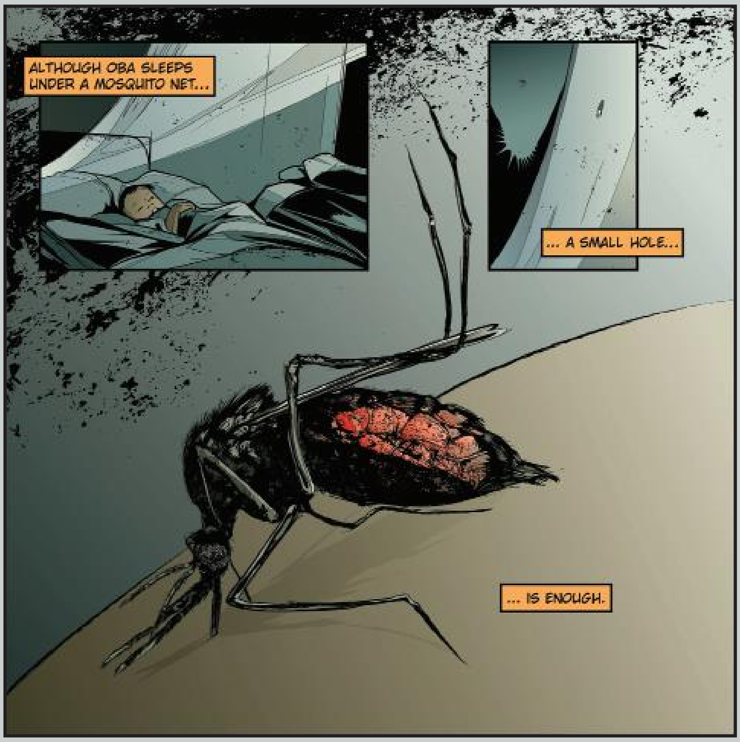
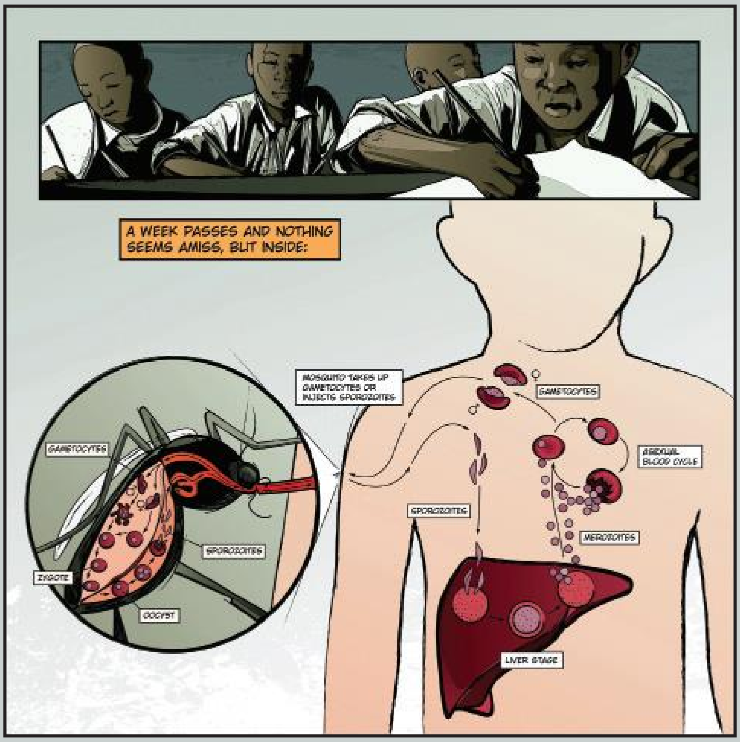
MALARIA blood, sweat, and TEARS


ALTHOUGH OBA SLEEPS UNDER A MOSQUITO NET...
... A SMALL HOLE...
... IS ENOUGH.


A WEEK PASSES AND NOTHING SEEMS AMISS, BUT INSIDE:
MOSQUITO TAKES UP GAMETOCYTES OR INJECTS SPOROZOITES
GAMETOCYTES
GAMETOCYTES
ASEXUAL BLOOD CYCLE
SPOROZOITES
MEROZOITES
SPOROZOITES
ZYGOTE
OOCYST
LIVER STAGE


MOM...I'M NOT FEELING WELL.
OBA IS SICK BUT HER MOTHER IS NOT SURE WHAT TO DO: "IT COULD JUST BE THE FLU... AND I DO NOT HAVE ANY MONEY TO SEE THE DOCTOR, TO EVEN GET TO THE CLINIC."
BUT THINGS GET WORSE...
I KNOW IT'S FAR, BUT YOU NEED TO TAKE HER TO THE HOSPITAL...
REMEMBER LAST YEAR, THE SAME SYMPTOMS... AND THAT CHILD DIED.


TWO DAYS LATER SHE TAKES ALL THE MONEY SHE HAS AND GETS THE BUS FOR A CLINIC 4 HOURS AWAY.
"I WAS SAVING THIS FOR THE CHILDREN'S SCHOOL..."
IT'S MALARIA. YOU'RE GOING TO NEED MEDICATION.
MAKE SURE SHE TAKES IT ALL.
AT THE PHARMACY...
THIS IS ALL I HAVE.
SHE HAS ENOUGH MONEY TO GET THE MEDICATION OR THE BUS RIDE HOME.
AND THIS IS ALL YOU GET.
IT'S A LONG WAY HOME...
MOM... I FEEL BETTER NOW; WHEN CAN I GO BACK TO SCHOOL?