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Case Report,

Risk based Intervention Capabilities of Health challenges in Kenya a Case of Chikungunya and Dengu fever

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Introduction:

The Basic definition of risk is that it is a measure or a postulation of how variables deviate from the normal. Several phenomenon experience risks but many of them do not have a great effect on the human life. Health risks are those that would affect the health of human life directly and in particular they are hazardous since a lot of them tend to spread through large populations within a short period of time and are costly to eliminate thus the need to determine them early and mitigate them before they occur and have both a negative social and economic impact on the society

The development of a country is hinged on its human resource. A healthy and vibrant human population will favor high productivity and efficient service provision since they perform their duties and responsibility at full capacity. Indeed a region ravaged by disease has its populous fatigued by diseases or taking care of the infected. The World Health Organization (WHO) in its report of March 2016 estimated that 12.6 million people died in 2012 as a result of living or working near unhealthy places nearly 1 in 4 of total global deaths, according to new estimates from W.H.O. Environmental risk factors, such as air, water and soil pollution, chemical exposures, climate change, and ultraviolet radiation, contribute to more than 100 diseases and injuries. Health risk assessment (HRA) usually includes checking blood sugar, cholesterol and blood pressure as well as weight status and waist circumference to help individuals to understand their risk for Cardio vascular Diseases (CVD). It is extremely important to know these crucial numbers because some of them are considered "silent killers" such as high blood pressure and cholesterol, where there are rarely any symptoms to warn you that it is high. All adults should therefore have this health check done once a year or more often if recommended by a doctor.

Background Information:

This study particularly sampled the Chikungunya and Dengu fever recent outbreaks in Mombasa for investigation and development of a rapid mapping of affected areas and infected persons in order to effect rapid and fast response towards containment of the disease and cure of the disease thus alleviating pain and preventing and/ or reducing mortality rates due to the disease. These two fevers were sampled due to mainly their intriguing similarity of mode of infection and symptoms as well as the relationship they have with malarial, Zika and yellow fever infections. This makes it so difficult to distinguish them on the onset of these diseases from one another compounding their detection and clinical management process. Since the outbreak of Chikungunya occurred just after that of Dengu fever it was quite difficult to contain and clinically manage it thus the need for this study that focuses on early detection and containment.

According to (lK.A.Galán-Huertaa, 2015) Chikungunya fever is a viral disease transmitted through the bite of infected *Aedes* mosquitoes. The disease typically consists of an acute illness with fever, skin rash, and incapacitating arthralgia. The word chikungunya means, "To walk bent over" in the African dialect Mokonde, and refers to the effect of the incapacitating arthralgia seen in the affected patients. Chikungunya virus (CHIKV) is the etiological agent and a member of the Alphavirus genius in the Togaviridae family. At the onset of the viral infections caused by Chikungunya in Mombasa in 2017 many people were not aware of the disease so it spread like bushfire and caused a lot of panic. Many medical practitioners were not aware of the disease let alone its clinical management. Quite a number of people resorted to bizzare methods of managing it including drinking of water from boiled banana leaves. Due to its incapacitating nature many infected persons were sick of the disease and unable to perform their duties effectively particularly those who work from hand to mouth. This brought a lot of suffering as well as economic devastation among the citizens the most common symptoms of infection are fever and joint pain. Other symptoms may include headache, muscle pain, joint swelling, or rash. There is no vaccine to prevent or medicine to treat chikungunya virus infection. Travelers can protect themselves by preventing mosquito bites. When traveling to countries with chikungunya virus, use insect repellent, wear long sleeves and pants, and stay in places with air conditioning or that use window and door screens. (Prevention, 2018). The conversation about the clinical or otherwise management of the disease may sound simple but persons who have lived in the areas where infections occur will attest to the fact that it is easily said than done particularly when there is an outbreak and considering the fact that there is no known cure nor vaccine thus the virus remains in circulation with no near end to its decapitating effect. Thus there is need for the fast detection of the virus among citizens for easy containment. Chikungunya is not generally considered life threatening, nevertheless severe forms can also be present (lK.A.Galán-Huertaa, 2015). Patients with severe Chikungunya fever requiring hospitalization tend to be older and have comorbidities such as cardiovascular, neurologic, and respiratory disorders or diabetes, which are independent risk factors for severe disease. Severe Chikungunya can manifest as encephalopathy and encephalitis, myocarditis, hepatitis, and multiorgan failure (lK.A.Galán-Huertaa, 2015). These rare forms can be fatal and typically arise in patients with underlying medical conditions. Neonates are also at risk for severe infection associated with neurologic signs. The rate of infection of neonates born to viremic mothers and exposed to the virus during birth can reach 50 percent leading to severe disease and encephalopathy, resulting in long-term neurological sequelae and poor outcome In their article titled Dengue Fever (Schaefer, Panda, & Wolford., 2020), Dengue is a mosquito-transmitted virus and the leading cause of arthropod-borne viral disease in the world. It is also known as break bone fever due to the severity of muscle spasms and joint pain, dandy fever, or seven-day fever because of the usual duration of symptoms. Although most cases are asymptomatic, severe illness and death may occur. Common symptoms include headache, muscle, bone and joint pain, nausea, vomiting, pain behind the eyes, swollen glands, and rash. *Aedes* mosquitoes transmit the virus and are common in tropical and subtropical parts of the world. The incidence of dengue has increased dramatically over the past few decades. The infection is now endemic in some parts of the world. A few people who were previously infected with one subspecies of the dengue virus develop severe capillary permeability and bleeding after being infected with another subspecies of the virus. This illness is known as dengue hemorrhagic fever

Statement of the problem:

Having many diseases spread by the same agent has complicated containment and clinical management of many in point is the likelihood of Malaria, Yellow fever, Dengu fever, Zika and Chikungunya being spread by a mosquito. Moreover the spread of Dengu fever and Chikungunya by the same type of Mosquito complicates further the diagnosis of the same illnesses leading to delayed interventions due to late detection and discovery. This was the case during the outbreak of Chikungunya just after an outbreak of Dengu Fever in Mombasa in 2020. It was challenging to distinguish the one from the other thus increasing the risk of spreading the disease as well as managing it clinically. This paper proposes a simple method of frequent feedback from the citizen on their wellbeing, particularly as pertains to their health symptoms so as to rapidly detect and contain new outbreaks of diseases. A one hour test run was made during the continuous sporadic outbreaks were made and the results were used to easily map the areas deeply affected that would necessitate intervention.

General Objective:

To efficiently and effectively determine the health risks of a region for timely mitigation

Objectives of the study:

i) To isolate the health risks of a region for timely mitigation
ii) To map out the health risks of a region for timely mitigation
iii) To quantify health risks of a region for timely mitigation

Research hypotheses:

i) What are the isolated health risks of a region?

ii) What are the mappings of the health risks of a region?
iii) What are the quantities of the health risks of a region?

Significance of the study:

This study will provide up to date information on the health risk at Mombasa County that will facilitate its detection, management and containment leading to sustenance of healthy environments

Literature review:

Theoretical Framework

Health Belief Model

The health Belief Model (HBM) was developed by (Rosenstock, 1974) and has been identified as one of the earliest and most influential models in health promotion. It was inspired by a study of reasons people expressed for seeking or declining X-ray examinations for Tuberculosis. The modified HRM by (Nancy Janz, 1974) to include peoples' responses to symptoms and illness compliance with medical directives. In the recent years the model has been used to predict general health behaviors and positive health behavior. This research embraces the modified and recent years' model.

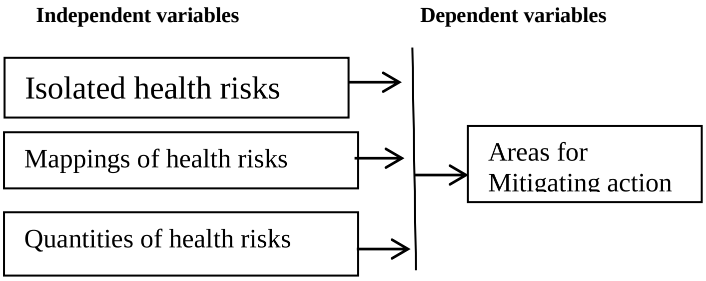
Empirical Literature:

In order to address any risky situation one needs to first of all identify the risks involved. Emily et al (2018) indicates that there are five stages included in a continuous risk management cycle and the first one being risk identification consisting of identifying a hazard or acknowledging a risk. In this research this is done by isolating health risks Overlaying maps of exposure and populations may define populations at risk. However, linking of exposure and disease is highly dependent on the accuracy of exposure assessment as well as the time elapsed between initial exposure and disease (the latency time). The longer the latency time, the more difficult it will be to associate exposure with disease because of changes in exposure over time and/or population changes due to migration (Jarup, 2004). This paper therefore seeks to determine the relationship between mapping of health risks and their mitigation Classification of health data into categories is routinely used for the analysis and understanding of health risks; however, the selection of cut-off points of categories is not a simple task, and mistakes can lead to incorrect interpretation of data thus it is desirable to have an automatic method that balances the bias and the variance for constructing categories, and which allows the verification if the amount of available data enough to draw a conclusion. Such a method is also useful in making decisions on next actions in experiment planning (Atsunori Kanemuraa, 2015). At least since the 1920s recipes for finding good parameters given data have been researched, and modern surveys have suggested that a penalized maximum likelihood (PML) method based on Bayesian information criterion (BIC) is one of the best performers. An example of parameters widely associated with risk categorization is the distribution of the body mass index (BMI) in populations, which is also used to guide decisions for large scale health policies. Cut-off points (the boundaries of histogram bins) for visualizing BMI have been a focus of interest. As medical costs continue to rise alarmingly government and other third party payers have sort ways to control them. A fundamental requirement for the control of inpatient hospital costs is a means of classifying patients admitted to a hospital by a standard which accurately reflects patients' use of health care resources. The conventional approach to this requirement has been the classification of patients into diagnosis related groups (DRGs) such as acute myocardial infarction (MCI) and congestive heart failure with or without a surgical procedure etc. (Dakakis, 1983). It is important to be able to also characterize accurately the difference in patients' severity of illness and use of resources (Dakakis, 1983). This paper determines a severity of illness index that characterizes accurately the difference in patient's severity of illness and their demographics.

According to (Xavier Franch, 2015) Possible risk mitigation strategies include *avoiding the risk, that is* not taking the action that may generate it, *accepting the risk* which refers to the situation in which the organization while well aware of the risk decides to go ahead and perform the operation that may end in the risk event occurring, *Transferring the risk*, for example, insuring an entity against the occurrence of that risk event and *reducing the risk* by taking steps to lower either the probability of the risk event happening or the amount of the damage. This paper determines to what extent isolation, mapping out and quantification of health risks mitigates them. It has been postulated that making the process of risk management explicit, systematic and logical only really began with the coming of probability mathematics. Since then areas and industries lending themselves to quantitative analysis have devised increasingly sophisticated mathematics and methodologies to determine the likelihood, impact and exposure to risks. Where data is available the results have been largely successful, where relevant data is incomplete or unable to be collated into useful information, judgment is involved. The decision-maker has to form an opinion about the situation and evaluate the costs and benefits of various action or inaction (Sparrow, 2007) . This phenomenon of risk is relevant to the health mitigation measures that are expected to be made with efficient gathering and isolation of data on the health challenges in particular regions which can then be mapped out easily to enable the determination of health risks and thus their possible mitigation

Conceptual framework:

Figure 2: The conceptual framework



Methodology:

Due to the ease with which Chikungunya or Dengu fever can spread and the devastation it can cause as a result of its symptoms particularly in relations to unproductiveness of infected individuals there is need to determine a severity of illness index for the disease (Dakakis, 1983). This will act as a risk measure that enables the mapping out of risky demographics specific to this study being age and geographical location. Questionnaires were sent out using mobile phone internet transmission methods that are simple to access and respond to out of which a risk assessment report was generated which can trigger rapid and timely responses

WhatsApp - online Questionnaire was mounted and the following link shared on WhatsApp: https://forms.gle/r9mZpXbqrFMAs25z6.

Responses are organized in charts and graphically in the results section. Severity of Chikungunya illness matrix measure and that for Dengue fever for determining risk levels are tabulated below.

Table 3: A table of the Severity of Chikungunya illness matrix measure

Characteristic/Risk Level	1	2	3	4
Stage of Physical diagnosis	Asym ptomatic	Moderate Manifestation	Major Manifestation	Catastrophic
Mobility	High	Moderate	Low	Lowest
Dependency	Low	Moderate	Major	Extreme
Risk Level	1	2	3	4

A similar matrix is drawn for Dengue fever. Once the severity of illness is measured it is mapped together with the age and location demographics

Results:

Mapping the initial questionnaire responses

Determination of Risk Levels

Table 4.22: A table of the risk levels per county

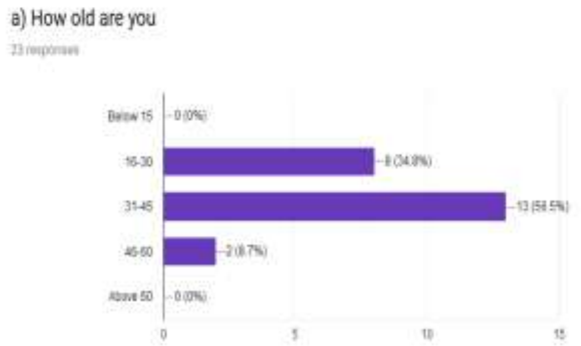


Figure 4.12: A bar graph representing the disease level per location demographic

Figure 4.13: A Mapping representing the disease level per location demographic

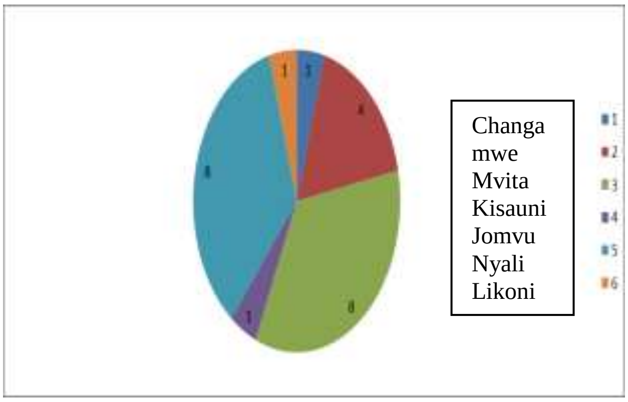
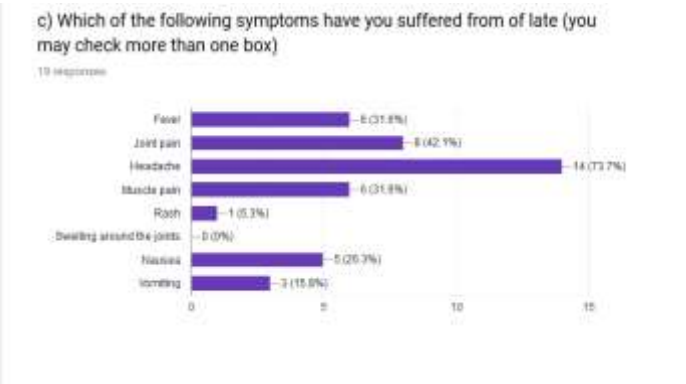


Figure 4.14: A Bar graph representing the frequency of symptoms



Risk levels are determined by mapping the symptoms shown by every individual on to the severity level matrix in table 3 above. For example an individual with a headache has a severity level of 2 for the range 1-4 where 1 represents an asymptotic individual. An individual with a fever only has Chikungunya

From the risk levels tabulated above risk per sub-county and age demographic are determined and tabulated below

Table 4.1: A summary of all the responses to the questions

a) How old are you	b) Which sub county are you located	c) Which of the following symptoms have you suffered from of late (you may check more than one box)
31-45	Changamwe	Headache
16-30	Mvita	Joint pain, Headache, Nausea
31-45	Nyali	Joint pain, Headache, Nausea, Vomiting
16-30	Mvita	Fever
31-45	Jomvu	Fever
31-45	Kisauni	Headache
31-45	Nyali	Fever, Joint pain, Headache, Muscle pain, Nausea
31-45	Kisauni	Joint pain, Headache
31-45	Mvita	Headache, Muscle pain
16-30	Mvita	Muscle pain
16-30	Nyali	
16-30	Nyali	Fever, Joint pain, Headache, Muscle pain, Vomiting
31-45	Kisauni	Joint pain, Headache, Muscle pain, Nausea
16-30	Likoni	Joint pain
16-30	Nyali	Headache
31-45	Nyali	Headache
31-45	Kisauni	Headache
46-60	Kisauni	
31-45	Kisauni	
31-45	Nyali	Fever, Headache, Muscle pain, Nausea, Vomiting
46-60	Kisauni	Fever, Joint pain, Headache
16-30	Kisauni	Rash
31-45	Nyali	

Determination of Risk Levels

Risk levels are determined by mapping the symptoms shown by every individual on to the severity level matrix in table 3 above. For example an individual with a headache has a severity level of 2 for the range 1-4 where 1 represents an asymptotic individual. An individual with a fever only has Chikungunya.

Table 4.21: A table of risk levels and probable disease type

S/No	Age	Sub-county	Type of disease	Risk levels
1	31-45	Changamwe	Chikungunya/Dengue	2
2	16-30	Mvita	Dengue	3
3	31-45	Nyali	Dengue	4
4	16-30	Mvita	Chikungunya	3
5	31-45	Jomvu	Chikungunya	3
6	31-45	Kisauni	Chikungunya/Dengue	2
7	31-45	Nyali	Chikungunya &Dengue	4
8	31-45	Kisauni	Chikungunya/Dengue	3
9	31-45	Mvita	Chikungunya/Dengue	3
10	16-30	Nyali	Chikungunya/Dengue	2
11	16-30	Mvita	Chikungunya/Dengue	1

12	16-30	Nyali	Chikungunya & Dengue	4
13	31-45	Kisauni	Chikungunya & Dengue	4
14	16-30	Likoni	Chikungunya/Dengue	2
15	16-30	Nyali	Chikungunya	2
16	31-45	Nyali	Chikungunya	2
17	31-45	Kisauni	Chikungunya	2
18	46-60	Kisauni	Chikungunya/Dengue	1
19	31-45	Kisauni	Chikungunya/Dengue	1
20	31-45	Nyali	Chikungunya/Dengue	4
21	46-60	Kisauni	Chikungunya	3
22	16-30	Kisauni	Chikungunya	2
23	31-45	Nyali	Chikungunya/Dengue	1

From the risk levels tabulated above risk per sub-county and age demographic are determined and tabulated below

Table 4.22: A table of the risk levels per county

Sub-county	**Level of Risk**
Changamwe	2
Mvita	10
Nyali	23
Jomvu	3
Kisauni	18
Likoni	2
Total	58

Several mappings are made of the risk levels per county as follows

Figure 4.21: A mapping of risk levels per county

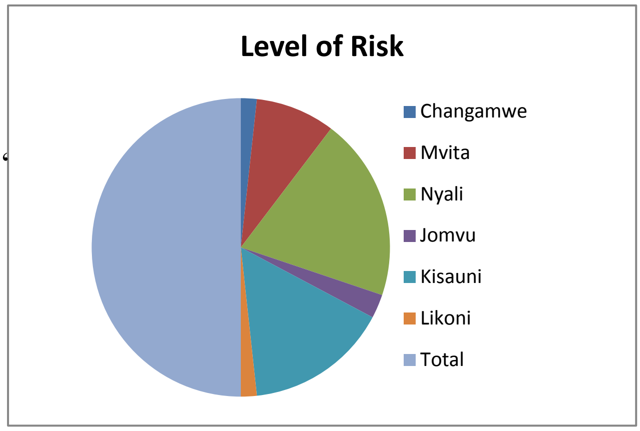


Figure 4.22: A bar graph of risk levels per county

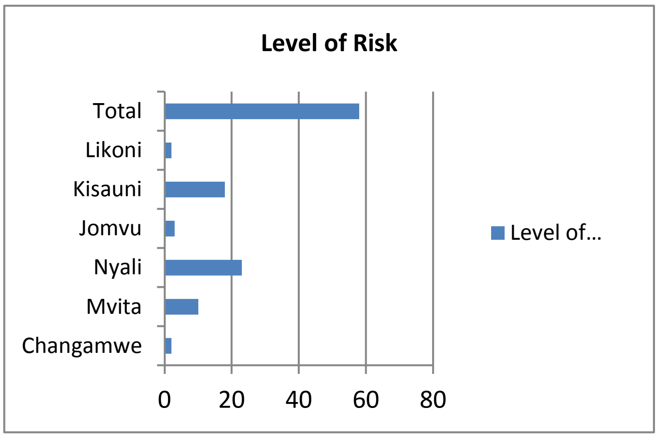


Figure 4.23: A scatter diagram of risk levels per county

Table 4.23: A table of risk levels per age demographic

Years	Level of Risk
16-30 yrs	19
31-45 yrs	35
46-60 yrs	4
Total	**58**

Several mappings of the risk levels per age demographic

Figure 4.24: A bar graph of the risk levels per age demographic

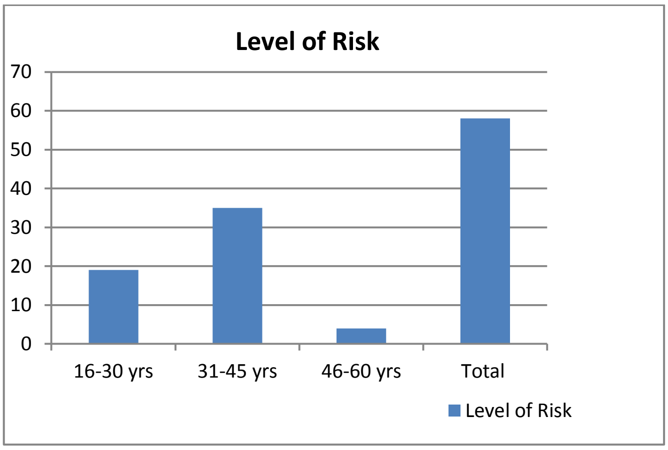


Figure 4.25: A mapping of the risk levels per age demographic

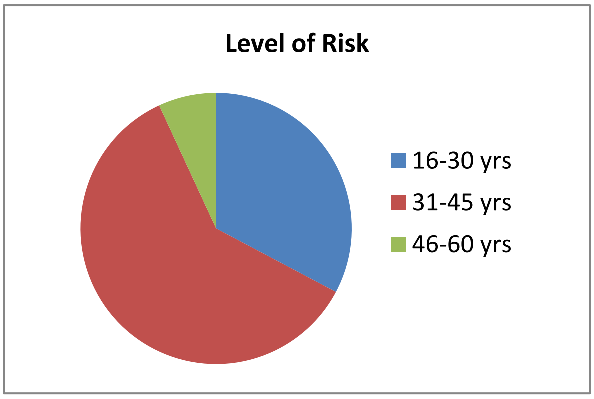
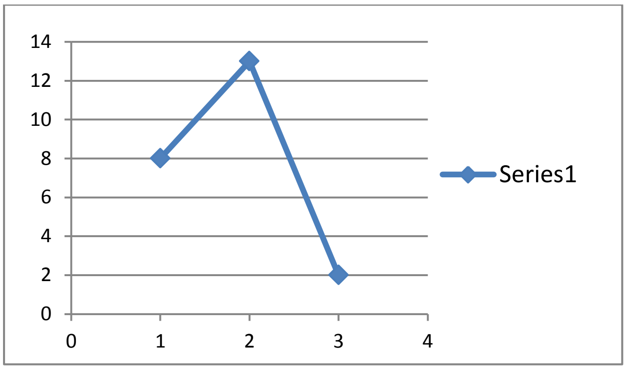


Figure 4.26: A scatter diagram of the risk levels per age demographic



5.0 Conclusion and Recommendation

Conclusion:

The initial questionnaire mapping gave the general direction of the disease that is which age and/or location demographic had the highest number of sick people as per figures 4.11-4.14 in section 4.1 but it was rich in specifics. One was able to tell which sub county had the highest number of sick persons that is Nyali and Kisauni but not the level of severity nor the proposed disease that is either Chikungunya or Dengue fever or both. This may provide the initial information needed to commence action plan which is important but there was need for further analysis of the information provided in order to concretize the specific actions needed. Thus with the conceptualization of the severity of risk level matrix and the determination of the individual severity of risk levels and hence those for the whole sub-county it would make it possible to plan for specific action targeting a specific location or disease and for a particular quantified risk loading as well as a clear mapped location. The sub-counties with the highest risk level was Nyali with a risk severity disease level of 16 out of 58 and the age demography recording of the same index.

The following public health measures are ongoing:

- WHO is supporting the MoH in drafting a chikungunya response plan for Mombasa County;
- WHO is supporting the National Emergency Operations Centre with analyzing data and developing situation reports?

Vector control activities, including eliminating mosquito breeding sites, fogging and indoor residual spraying; Chikungunya outbreak alert and fact sheet were issued to all health facilities, including private hospitals, in the affected areas; Information, education and communication materials were developed and distributed to households by the community health volunteers. SRA of course has provided this platform to share methods of easily mapping the areas affected thus enabling the fast and rapid containment of the disease as well as the curing of those affected thus saving lives and reducing the suffering of those affected

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https://core.ac.uk/reader/82028294
Automatic categorization of health indices for risk quantificationAtsunori Kanemuraa, ∗, Gérard Lipowskia, b, Hidehiko Kominea, Shotaro Akaho