Assessment of malaria reporting and epidemic preparedness systems in health facilities in Eldoret West District, Uasin Gishu County, Kenya

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Abstract

The most important factor in reducing the impact of an epidemic is a timely response to the onset of an outbreak. This study sought to assess the malaria reporting and epidemic preparedness systems in health facilities in Eldoret West District, Kenya. A cross-sectional study design was adapted. A census technique was used to select all the forty-five health facilities in the district comprising of government, mission and non-governmental facilities. An interviewer administered questionnaire was used for data collection and analysis done using Stata. The overall reporting rate was 91.7% for all the health facilities. Only 15 health facilities (33%) plotted malaria trend lines for number of cases of malaria. Malaria epidemics were reported within 24 hours in 22 health facilities but they lacked the appropriate supplies to respond to confirmed cases or epidemics. The overall malaria reporting completeness rate was above 90% implying that the malaria surveillance system was generally good. Concerted efforts by concerned stakeholders should ensure improvement of malaria epidemic preparedness system in all health facilities and provision of information to health personnel on malaria outbreak response strategies.

Introduction

Recent estimates from World Health Organization (WHO) show that there were 214 million new cases of malaria worldwide in the year 2015. The African Region accounted for most global cases of malaria (88%), followed by South-East Asia Region (10%) and the Eastern Mediterranean Region (2%). There were an estimated 438,000 malaria deaths worldwide with under-fives making up 306,000 death cases globally. Malaria has placed a heavy economic burden on health systems in Africa with the average annual cost of case management estimated at nearly 300 million US Dollars. Malaria surveillance is essential to guide program planning and management, inform governments and donors on progress towards malaria control, and assist with advocacy. Surveillance also provides the basis for the design, refinement and resource allocation of control programs. Periodic epidemics of malaria are a major public health problem for many sub-Saharan African countries. Populations in epidemic prone areas have a poorly developed immunity to malaria and the disease remains life threatening to all age groups. The impact of epidemics could be minimized by prediction and improved prevention through timely vector control and deployment of appropriate drugs. Malaria Early Warning Systems are advocated as a means of improving the opportunity for preparedness and timely response. In Kenya, malaria is one of the priority diseases for Integrated Disease Surveillance and Response (IDS) and falls under the category of diseases of public health importance. The four pillars of disease surveillance include; epidemic preparedness and response, laboratory surveillance, data management and training and supervision. Malaria epidemics in Kenya occur in two malaria epidemiological zones – the western highlands and the arid, semi-arid lowlands of southern Kenya. The epidemics are associated with unusual climatic conditions especially rainfall accompanied by other factors like suitable temperatures that favor breeding and longer survival of the malaria vectors. Malaria poses an enormous health and economic burden in Kenya, being a leading cause of morbidity and mortality in the country. Recognizing this fact, the government of Kenya in consultation with local and international stakeholders undertook a comprehensive malaria program review which provided information leading to the development of the Kenya National Malaria Strategy (NMS) 2009-2017. The malaria surveillance and response system for the epidemic-prone districts, managed by the Division of Disease Surveillance and Response, is an important part of Kenya’s 2009-2017 monitoring and evaluation plan. Epidemic thresholds for malaria have been set for four to six sentinel facilities in each of these districts. President’s Malaria Initiative (PMI) has supported the Division of Malaria Control (DOMC) and the Division of Disease Surveillance and Response (DDSR) in PMI-supported districts to establish these thresholds and to make use of data collated locally for planning. Health centers submit data to districts on a weekly basis, and districts then transmit the data to provincial and national level by text message. Data is reviewed at the district level and case counts above preset thresholds are investigated by the district health officer. Data published by WHO World Malaria report 2011 showed that in Kenya, completeness of reporting was at 40% therefore much needed to be done to achieve the recommended target of 100%. Since the year 2000, major epidemics have been observed in the malaria epidemic prone districts. Malaria epidemics are some of the most serious public health problems in Kenya.
health emergencies with which health officials have to deal with. Typically, they occur with little or no warning and in areas where the health system is often unprepared to deal with the problem. In most situations epidemic conditions take some weeks to build up, theoretically allowing time for preventive action. Even when an epidemic occurs, it takes several weeks to reach its peak, so that some effective control is possible if implemented in the early stages of development. The longer an epidemic goes undetected with no measures for its control, the higher the costs in terms of morbidity and mortality. This study focused on malaria reporting and epidemic preparedness systems. The main weakness of the systems are the incompleteness, delays and poor quality of routine surveillance data made available through the Health Management Information Systems (HMIS) and this was evident in health facilities in Eldoret West District. There were no prior published studies done on malaria surveillance in health facilities in Eldoret West District. It is expected that the findings of the study will be useful to the District Health Management Team (DHMT), Non-Governmental Organizations (NGO’s), Ministry of Health (MOH), community and other stakeholders to come up with baseline data and intervention strategies which will bring about long lasting solution to the control of malaria in the district and form a basis for further studies. This research will also contribute to the field of knowledge and act as a resource material for future research.

Materials and Methods

Study design and procedure

The study area was Eldoret West District, Uasin Gishu County, Kenya. The study was conducted in the two divisions, Soy and Turbo divisions in the District. A cross sectional study design was adapted. A census study design was applied where all the forty five (45) health facilities in the District were included in the study and these comprised; government, Mission, Private and NGO.

Data collection and analysis

Survey questionnaires were used to collect information in the health facilities. Information was obtained from key health personnel (i.e. malaria outbreak coordinators) to fill up the health facility survey questionnaires. A checklist for recording completeness of reporting from the health facility to the District was also administered. The checklist had the name of the various health facilities and the malaria reporting by month, total number of reports that arrived on time, total number of expected reports and total number of reports not received.

The filled health facility survey questionnaires were checked for completeness and coded. Data was then entered into a computerized Ms Access database and was later exported to Stata version 12 Special Edition (SE) for analysis. Categorical variables were summarized as frequencies and the corresponding percentages. Continuous variables were summarized as the median and the corresponding lower and upper quartiles.

Ethical consideration

The aim of the study was explained in detail to the various health personnel before gaining informed consent from them. All the information from respondents was treated with the utmost confidentiality it deserved. Respect and dignity was upheld while collecting data. An approval from the Institutional Research and Ethics Committee (IERC) of Moi University was obtained prior to the commencement of the study. Permission to conduct the study in the District was sought from the DMOH and DPHO and a formal letter was obtained.

Results

Proportion of health facilities in the district

A total of 45 health facilities were studied; 3 (7%) were clinics, 24 (53%) were dispensaries, 2 (4%) were hospitals and 16 (36%) were health centers. Of these number, 23 (51%) were from Turbo with 3 (13%) clinics, 11 (48%) dispensaries, 1 (4%) hospital and 8 (35%) health centers. The remaining 22 (49%) health facilities were from Soy with 13 (59%) dispensaries, 1 (5%) hospital and 8 (36%) health centers as shown in (Figure 1).

Government health facilities studied were 33 (76%) where 20 (61%) were dispensaries, 11 (33%) were health centers and 2 (6%) were hospitals. The rest 12 (24%) health facilities were private, mission or non-governmental health facilities where 3 (25%) were clinics, 4 (33%) were dispensaries and 5 (42%) were health centers as shown in (Figure 2).

Plotting of malaria trend lines and maps for the cases of malaria

Fifteen (33%) health facilities plotted malaria trend lines for the number of cases of malaria. However, only 4 (9%) health facilities plotted the distribution of malaria cases on a map. None of the 45 health facilities plotted malaria trend lines and map showing deaths due to malaria (Table 1).

Malaria outbreak coordinators

Thirty-four (76%) health facilities had a coordinator such as Public Health Officer (PHO), Public Health Technician (PHT), Clinical Officer (CO) or Nurse as illustrated in Figure 3. Twenty two (56%) health facilities had a PHO or a PHT and another member of staff and these were all government owned.

[Figure 1. Overall distribution of the health facilities as well as distribution stratified by division.]
health facilities. The rest 11 (24%) health facilities had no coordinators.

**Information on outbreak response to health personnel**

Twenty seven (63%) health facilities did not provide information or training on outbreak response to their staff. A graphical presentation of those who offered the training is shown in Figure 4.

**Collection of information from the community on cases or deaths due to malaria and reporting in case of an epidemic**

Among the 22 health facilities with either a PHT or a PHO, 10 (40%) health facilities collected information from the community on reports of suspected cases or deaths due to malaria on a monthly basis, 3 (12%) health facilities did so on a weekly basis, 4 (16%) did so twice a month and 3 (12%) did not do it at all. The rest of the results are as shown in (Table 2). In the event that an epidemic was suspected it was reported within 24 hours in all the 22 health facilities with either a PHO or a PHT though there were no appropriate supplies for responding to a confirmed case or epidemic in all these health facilities.

**Reporting rate**

Overall the median reporting rate was 91.7 (IQR: 66.7-100%). Government owned health facilities rate of reporting was high 100 (IQR: 83.3-100%) compared to the private, mission or NGO based health facilities. Stratified by the division, the median reporting rate in Turbo was 83.3 (IQR: 41.7-100%) and for Soy was 95.8 (IQR: 66.7-100%), these were reasonably high rates of reporting though the lower quartile for Turbo was below the 50% mark. From Table 3 we realize that an average num-

![Figure 2. Distribution of the health facilities stratified by whether it is Government or Private, Mission or NGO health facilities.](image-url)

### Table 1. Use of standard case definition and plotting of trend lines.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Levels</th>
<th>Combined N=45 (%)</th>
<th>Private, mission or NGO N=12 (%)</th>
<th>Government N=33 (%)</th>
<th>Soy N=23 (%)</th>
<th>Turbo N=22 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are diagnoses of the cases of malaria recorded in the clinic register according to the standard case definition?</td>
<td>Yes</td>
<td>45 (100)</td>
<td>12 (100)</td>
<td>33 (100)</td>
<td>23 (100)</td>
<td>22 (100)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Do health staffs use a standard case definition to report the suspected cases and outbreaks?</td>
<td>Yes</td>
<td>45 (100)</td>
<td>12 (100)</td>
<td>33 (100)</td>
<td>23 (100)</td>
<td>22 (100)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Plotting trend lines for the numbers of cases and deaths due to malaria</td>
<td>Yes</td>
<td>15 (33)</td>
<td>0</td>
<td>15 (46)</td>
<td>8 (35)</td>
<td>7 (32)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>30 (67)</td>
<td>12 (100)</td>
<td>18 (55)</td>
<td>15 (65)</td>
<td>15 (66)</td>
</tr>
<tr>
<td>Plotting the distribution of cases on a map</td>
<td>Yes</td>
<td>4 (9)</td>
<td>0</td>
<td>4 (12)</td>
<td>3 (13)</td>
<td>1 (5)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>41 (91)</td>
<td>12 (100)</td>
<td>29 (88)</td>
<td>20 (87)</td>
<td>21 (95)</td>
</tr>
</tbody>
</table>

### Table 2. Frequency of collection of information on suspected cases or deaths due to malaria.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Combined N=45 (%)</th>
<th>Private, mission or NGO N=12 (%)</th>
<th>Government N=33 (%)</th>
<th>Turbo N=22 (%)</th>
<th>Soy N=23 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not done</td>
<td>23 (12)</td>
<td>12 (100)</td>
<td>11 (8)</td>
<td>11 (8)</td>
<td>12 (15)</td>
</tr>
<tr>
<td>Monthly</td>
<td>19 (40)</td>
<td>0</td>
<td>10 (42)</td>
<td>7 (38)</td>
<td>3 (23)</td>
</tr>
<tr>
<td>Once in 3 months</td>
<td>1 (4)</td>
<td>0</td>
<td>1 (4)</td>
<td>1 (8)</td>
<td>0</td>
</tr>
<tr>
<td>Once in two weeks</td>
<td>2 (8)</td>
<td>0</td>
<td>2 (8)</td>
<td>1 (8)</td>
<td>1 (8)</td>
</tr>
<tr>
<td>Thrice a week</td>
<td>1 (4)</td>
<td>0</td>
<td>1 (4)</td>
<td>0</td>
<td>1 (8)</td>
</tr>
<tr>
<td>Twice a month</td>
<td>4 (16)</td>
<td>0</td>
<td>4 (17)</td>
<td>1 (8)</td>
<td>3 (23)</td>
</tr>
<tr>
<td>Twice a week</td>
<td>1 (4)</td>
<td>0</td>
<td>1 (4)</td>
<td>0</td>
<td>1 (8)</td>
</tr>
<tr>
<td>Weekly</td>
<td>3 (12)</td>
<td>0</td>
<td>3 (13)</td>
<td>1 (8)</td>
<td>2 (15)</td>
</tr>
<tr>
<td>Total</td>
<td>45 (100)</td>
<td>12 (100)</td>
<td>33 (100)</td>
<td>22 (100)</td>
<td>23 (100)</td>
</tr>
</tbody>
</table>
ber of 23 (51%) health facilities had a high reporting of at least 90%. This was also true for 20 (61%) government facilities and Soy division where 14 (64%) health facilities had a reporting rate of at least 90%.

Discussion

Malaria epidemic preparedness system

In sub-Saharan Africa, malaria epidemics arise suddenly in mostly remote, disadvantaged settings without effective alert systems. Most of the research on malaria epidemic preparedness show that the existent systems are mainly concerned with the climatic-related factors such as: long-range forecasting, early warning and detection improving understanding of the role of temperature, rainfall, and el niño southern oscillation events and development of epidemic detection thresholds. Malaria epidemics evolve rapidly and most often occur in remote, under resourced settings without proper surveillance. Data on their evolution may thus go unrecorded, which prevents the development of evidence-based recommendations on effective epidemic control. The objective of early detection (or epidemiologic surveillance) is to monitor a disease continually so that abnormal events can be identified rapidly, in the expectation that intervention efforts can be initiated in a timely manner. Some of the early detection methods include slide positivity rate, epidemic thresholds and risk mapping. Epidemic thresholds show deviations in malaria morbidity patterns from the normal levels established over the years. Incidence of cases over and above the threshold should signify an outbreak and prompt for appropriate actions.

In Eldoret West District, only fifteen (35%) health facilities plotted trend lines of the numbers of cases of malaria and this was quite alarming. For those health facilities that had PHO’s, some of them reported that they had never heard or been told about plotting malaria thresholds and it was new knowledge to them, none of the private, mission and NGO facilities...
plotted the cases of malaria on a graph. In some facilities the trend lines were not up to
date and in some facilities the cases were last plotted five years ago. Some reported that they
only send the weekly malaria reports but do not plot the trends. When malaria trends are not
plotted, this could weaken the response capa-
cilities at the health facility and district level. A
study done in Kenya, Burundi, Southern Sudan
and Ethiopia showed that epidemics were
detected after substantial delay and by agen-
cies other than local authorities with uncon-
tventional methods, such as RDT (Random
Diagnostic Test) monitoring among malnour-
ished children, both preparedness and control,
however, were seriously deficient. A recent
review of epidemics in Africa has also revealed
delays in both epidemic detection and
response up to 20 weeks, basically, due to poor
case reporting and analysis or low use of public
facilities. According to a study in Iran, epidemic
controls were deficient and epidemic lasted
between 15-36 weeks.14

Malaria risk maps

The first step to epidemic surveillance is
identifying areas that are epidemic prone, risk
mapping predicts where environmental condi-
tions are suitable for malaria epidemics, mon-
itor other risks as well i.e. refugee camps,
flooding, swamps etc.15 However, in Eldoret
editor other risks as well i.e. refugee camps,
flooding, swamps etc.15 However, in Eldoret
West District, only 4(9%) health facilities plot-
ted the distribution of the cases on a map. Just
as in plotting malaria cases, most of the facili-
ties visited reported that they were unaware of
this strategy.

The existing malaria risk maps have limited
operational use to support programmatic activ-
dities since they were produced at coarse spa-
tial scales (at continental and country levels).
They are largely based on expert opinion on
climate based models and specific geo-refer-
cenced point prevalence data.16-22 Other
attempts to produce similar risk maps are
based on entomological parameters that are
not fully validated.23,24 None of the health facili-
ties in the district plotted trend lines and
maps for the number of deaths due to malaria.
According to a study done by the Institute of
Health Metrics and Evaluation at the
University of Washington and published by
The Lancet medical journal, it revealed that in
many poor countries which lack medical infra-
structure, mortality is often poorly probed or
misidentified.9

Supplies set aside for epidemic
response and human resources

Outbreaks and other public health emer-
genies require the rapid mobilization of
resources such as vaccines, medicines and lab-
oratory supplies. It is prudent to establish and
preposition stockpiles of materials before an
epidemic occurs. As follow up to the public
health risk assessment activity, districts
should set up a contingency stock of drugs,
vaccines, reagents and supplies to permit
prompt management of the first cases without
delay before support arrives from higher levels.
Also regularly and carefully monitor the contin-
geney stock in order to avoid shortages and
expiry of drugs, vaccines, reagents and sup-
plies. A commonly used rule is that 10-25% of
the usual amount of supplies used in a regular
season should be easily available for emergen-
cies. Given the potential for large epidemics, it
is suggested that 20–25% should be
stockpiled.25

In Eldoret West District, of the 45 health
facilities 9 (20%) had the supplies available or
set aside for collecting laboratory specimens
during an urgent situation. Most of the facili-
ties reported that they bought supplies to be
used for a particular time and did not consider
the supplies for use during emergency situa-
tions. Most of the facilities reported that they
were not aware that laboratory supplies should
be set aside for use during emergency situa-
tions. A study done in Iran revealed that less
than half of sampled health centers had at least
one assigned small emergency site with
adequate supply and equipment stock to be
used in case of outbreaks.25

Thirty four (76%) health facilities had a
coordinator such as PHI, PHT, CO or Nurse.
The rest 11 (24%) health facilities had no coor-
dinator. Most of the government owned facili-
ties reported that the PHI or PHT were instru-
mental in outbreak coordination. Those facili-
ties that did not have PHI or PHT utilized the
PHO or PHT from the neighboring facilities.
The private, mission and NGO facilities had no
PHO or PHT and therefore they relied on the
PHO or PHT from government health facilities.
Epidemic preparedness must include a plan for
quickly locating human resources (e.g., people
to do blood surveys, mass drug administration
and vector control) and field logistics.25

Collection of information

on suspected cases or deaths due
to malaria and training on outbreak
response

All the PHOs or PHTs in government facili-
ties in Eldoret West District reported that they
utilized Community Health Workers (CHWs)
in collecting information from the community
on the cases or deaths due to malaria. Private,
mission and NGO did not collect information
from the community since they had no PHI or
PHT. The CHWs have a reporting tool which
they use to collect information from the com-
munity and they record the cases or deaths due
to malaria. The CHWs are supervised by the
PHO called the Community Health Extension
Workers (CHEWs) under the community strat-
ecgy guidelines and they report back to them.26
CHWs have recently played an active role in
malaria treatment and prevention activities in
different countries. In Ethiopia, early diagno-
sis and treatment at the village level by CHWs
was introduced in the early 1990s.27 This ini-
tiative is now accepted as an important means
of intensifying malaria control in all malaria
endemic areas of the country.

Twenty seven (63%) health facilities did not
provide any information or training on out-
break response to the staff of these facilities.
Most of the facility in-charges reported that
they had never given any training on outbreak
response since they had never experienced a
malaria epidemic in the recent years. District
Health Management Team (DHMT) need to
ensure that health staffs are equipped with the
necessary information needed in carrying out
an epidemic response.

Malaria reporting system

On a weekly basis, health workers report
data from all health facilities (i.e. health posts
and centers, district, province and central hos-
pitals), which are supposed to alert managers
of outbreaks identified through clinical time-
based abnormal variation in the data. Most of
the published cases have been focused to
detect and treat the cases rather than to focus
on reporting and circulation of information in
surveillance systems.28,32

In the IDSR guideline, reporting rate is
measured by timeliness and completeness.
While timeliness of reports is vital for detect-
ning and responding to epidemics, it was not
evaluated here since the focus was on com-
pleteness of reporting whereby this was esti-
mated by subtracting the total number of
reports not received from the total number of
reports expected divided by the total number
of reports expected multiplied by 100%. Accord-
ing to the IDSR guidelines, when the surveil-
ance system is good, completeness rate
should be approaching 100%.

In Eldoret West District, the overall com-
pleteness of reporting rate was 91.7 (IQR: 66.7-
100%) implying that the surveillance system is
good. Government owned health facilities rate
of reporting was high 100 (IQR: 83.3-100%)
compared to the private, mission or NGO based
health facilities that had a reporting rate of
45.8(IQR: 12.5-83.3%). An average number of
23 (31%) health facilities had a reporting rate
of at least 90%. However when the reporting
was stratified, there were still some facilities
that had a reporting rate of less than 50% and
even 25%. Only three out of twelve private and
mission hospitals had a reporting rate of above
90%. According to WHO World Malaria Report
of 2012, on average reporting completeness in
Kenya was at 100% (WHO, 2012).33 In Eldoret
West District, sentinel sites reporting rate was
at 100% and most government facilities had a
high reporting rate of above 90%, however private, mission and NGO facilities had low reporting rates hence pooling the overall reporting completeness rate to 91.7% and this was why the reporting completeness was slightly below the 100% rate found by the World Health Organization. Government health facilities had a reporting rate of 100% (83.3-100) which was consistent with the WHO survey.

According to HMIS survey carried out in Kenya, one of the weaknesses of the system was that the reporting rate was below 80%. In Eldoret West District, 17 facilities had a reporting rate of below 80%. Another issue found out was that since malaria reports were sent weekly, inconsistency especially in private and mission health facilities and some government facilities was a major problem. A study done in Mozambique on the analysis of the quality of routine data showed that in some health centers that cases were not being reported and later deliberately invented to cover the missing data.

**Conclusions**

In conclusion, all the health personnel used a standard case definition to register malaria suspected cases and outbreaks. However, only a small proportion (33%) of the health facilities were observed to practice plotting of trend lines for the number cases and deaths of malaria. According to Integrated Disease Surveillance and Response guidelines, frequent plotting of trend lines for the number of cases of malaria is an important strategy towards epidemic preparedness.

Close to three quarters (76%) of the health facilities had a designated malaria outbreak coordinator but on the other hand, a majority (63%) of them did not provide information or training on malaria outbreak response to their health personnel. Most (40%) of the health facilities collect information from the community on cases and deaths as a result of malaria on a monthly basis and the overall malaria reporting completeness rate was 91.7 (IQR: 66.7-100%) implying that the malaria surveillance reporting system was good since the completeness rate was approaching 100% as recommended. We recommend that the Ministry of Health and Division of Malaria Control ensures improvement of malaria epidemic preparedness system in all health facilities with reference to epidemic detection i.e. frequent plotting of malaria trend lines and mapping of malaria cases and deaths. There is also need for health facility managers to ensure continuous professional training of their health personnel with information on malaria outbreak response strategies and stock their health facilities with adequate supplies for outbreak response.

**Limitation of the study**

The data collected was limited to the practices of health care workers and did not include follow up surveys and therefore it is unknown whether improvements in health care workers performance can lead to improved malaria surveillance and epidemic surveillance and response.

**References**


35. The EQUITY Project. Using information for action: a manual for health workers at facility level. 2001. Available from: http://www.uio.no/studier/emner/matnat/if/i/NF5761/v12/undervisningsmateriale/He y w o o d % 2 0 a n d % 2 0 R o h d e % 2 0 - % 2 0 U s i n g % 2 0 i n f o r m a t i o n % 2 0 f o r % 2 0 a c t i o n % 2 0 a n d % 2 0 m a n u a l % 2 0 f o r % 2 0 h e a l t h % 2 0 p d f.