Original Article

An Evaluation of Malaria Surveillance System in Punjab, India, 2020

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Abstract

Background: India accounted for 6% of global burden of malaria with 95% population residing in malaria endemic areas. However, Punjab is in the malaria elimination phase with annual parasite incidence (API) <1/1000 population. **Objectives:** We evaluated malaria surveillance system in Punjab using CDC's updated guidelines for evaluating public health surveillance systems to provide recommendations for strengthening the existing system and to overcome the challenges in the path of malaria free Punjab. **Methods:** We chose two districts of Punjab, Amritsar (lowest API) and Mansa (highest API), interviewed stakeholders, and performed a retrospective desk review. We evaluated the overall usefulness of the system and assessed seven attributes at state, district, health facility, and village level during July–August 2020. **Results:** In Punjab, there was progressive decline in the malaria cases from 2,955 cases in 2009 to 1,140 in 2019 and no malaria deaths since 2011. Regarding various attributes, overall score for flexibility was good (85.9%); average for simplicity (77%), acceptability (74%), data quality (74%), and timeliness (70%); and poor for representativeness (59%) and stability (57%). **Conclusions:** Malaria surveillance system was useful in analyzing the trends of morbidity and mortality and for generating data to drive policy decisions. To improve stability, representativeness, and acceptability, surveillance staff should not be engaged in supplemental work, and reports from private sector must be ensured. Supportive supervision and regular trainings should be carried out regarding reporting formats, guidelines, and timely epidemiological investigations to improve timeliness, data quality, and simplicity.

Keywords: Evaluation, India, malaria, Punjab, surveillance

Introduction

Malaria is a potentially life-threatening vector borne parasitic infection that affected approximately 228 million population globally in 2018. The majority (93%) of malaria cases were from the African region; India accounted for 6% of global burden of malaria.[1,2] Most of the cases were reported from eastern and central parts of India with 95% of the population residing in malaria endemic areas.[3,4]

Malaria not only contributes to morbidity and mortality but also imposes a social and economic burden. Each case of malaria had a direct out-of-pocket expenditure of at least US$ 2.67 and additional minimum indirect cost of US$ 10.85 due to loss of productivity of 3–4 days.[5]

There has been a progressive decline in malaria transmission in India from an annual parasite incidence (API) of 2.1/1000 in 2001 to 0.25/1000 in 2019.[3] In Punjab also there has been 82% reduction in total malaria cases between 2010 and 2015.[6] Punjab is in the malaria elimination phase with an API of <1 case/1000 population in all of the 22 districts for last five years.[2]

The National Vector Borne Disease Control Programme (NVBDCP) is an umbrella program under the National Health Mission for the prevention and control of six vector borne diseases, including malaria. In alignment with the 2016 National Malaria Elimination Campaign, the Government of Punjab launched the Punjab Malaria Elimination Campaign (PMEC) 2017–2021 with a vision to achieve zero case of indigenous malaria in the state of Punjab

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by 2021. Punjab malaria elimination campaign has objectives to interrupt the malaria transmission from areas where cases are still being reported to identify the foci of infection and efforts to eliminate it with integrated vector management and to prevent reintroduction of malaria transmission in areas where interruption has been achieved.[6]

Epidemiological surveillance, both active and passive, is a core intervention under NVBDCP to eliminate malaria from Punjab. The surveillance reports are maintained on the malaria format registers (MF), and the information in the system flows from village to national level [Figure 1].

The results of this evaluation will provide recommendations to the Department of Health and Family Welfare, Punjab on overcoming challenges on the path of a malaria free Punjab.

Materials and Methods

Usefulness is defined as the ability of a surveillance system to meet its objectives and to support disease-control programs and policy decisions.[7] We assessed the overall usefulness of the malaria surveillance system and other attributes by using the CDC's updated guidelines for evaluating public health surveillance systems[7] during July to August 2020. To evaluate usefulness, we also analyzed the trend of malaria cases (both Plasmodium vivax and P. falciparum) and malaria deaths from 2009 to 2019. We chose seven attributes; simplicity, flexibility, acceptability, data quality, timeliness, stability, representativeness, and evaluation were conducted at district, health facility, and village level. Two of Punjab's 22 districts were selected according to the API, one district with lowest API (Amritsar) and another with highest API (Mansa) in 2019. We randomly selected two community health centers (CHC) from the rural areas of each district, one primary health center (PHC) from each CHC, one subcenter from each PHC, and one village from that subcenter. We interviewed key stakeholders using semi-structured questionnaire and performed a retrospective desk review. In urban areas, health personnel under the Urban Malaria Scheme at district level were selected for interviews. The data were collected and compiled using Microsoft Excel and presented in frequencies and proportions [Table 1]. The overall attribute score was calculated by taking average of the indicator scores of both districts. Likert scale was used to evaluate the performance of each attribute. An attribute with a score >90% was ranked "excellent," a score between 80% and 89% was ranked "good," a score between 60% and 79% was ranked "average,", a score between 40% and 59% was ranked "poor," and a score <40% was ranked "very poor."

Ethical considerations

Necessary permissions from state government and NCDC, Delhi were obtained. Interviews were conducted after taking written informed consent, and information was kept confidential.

Results

We conducted 42 interviews (22 from Amritsar District and 20 from Mansa District) at two district HQs, 12 health facilities, and four villages. Key informants included two district epidemiologists, two medical officers (MO), five assistant malaria officers (AMO), 12 multipurpose health supervisors (male) [MPHS (M)], six multipurpose health workers (male) [MPHW (M)], four multipurpose health workers (female) [MPHWs (F)], five lab technicians (LT), two insect collectors (IC), and four accredited social health activists (ASHA).

Usefulness

Malaria surveillance system was useful in analyzing the trend of malaria cases over time, and trend of cases can also be compared with the same time period of previous years. There was progressive reduction in the malaria cases since 2010 (3,476) till 2019 (624) and then cases again rise in 2019 (1,140) due to increased surveillance among the migratory population. There were three malaria deaths in 2011, since then were no malaria deaths in Punjab [Figure 2].

The data generated by the malaria surveillance system were utilized by the World Health Office Country Office of India and NVBDCP, India to prepare the strategic action plan for malaria elimination in Punjab for 2018–2020 in collaboration with NVBDCP, Government of Punjab.[2]

Simplicity

The malaria case definition was easily understood by 100% (42) respondents, and around 90% respondents had knowledge of malaria case definition. About 74% respondents were aware of treatment of malaria, and 61% had correct responses regarding the number of follow-up slides prepared for each malaria case. Only 60% respondents were able to explain the complete information required on the malaria reporting formats. Overall mean score for simplicity was 77%.

Flexibility

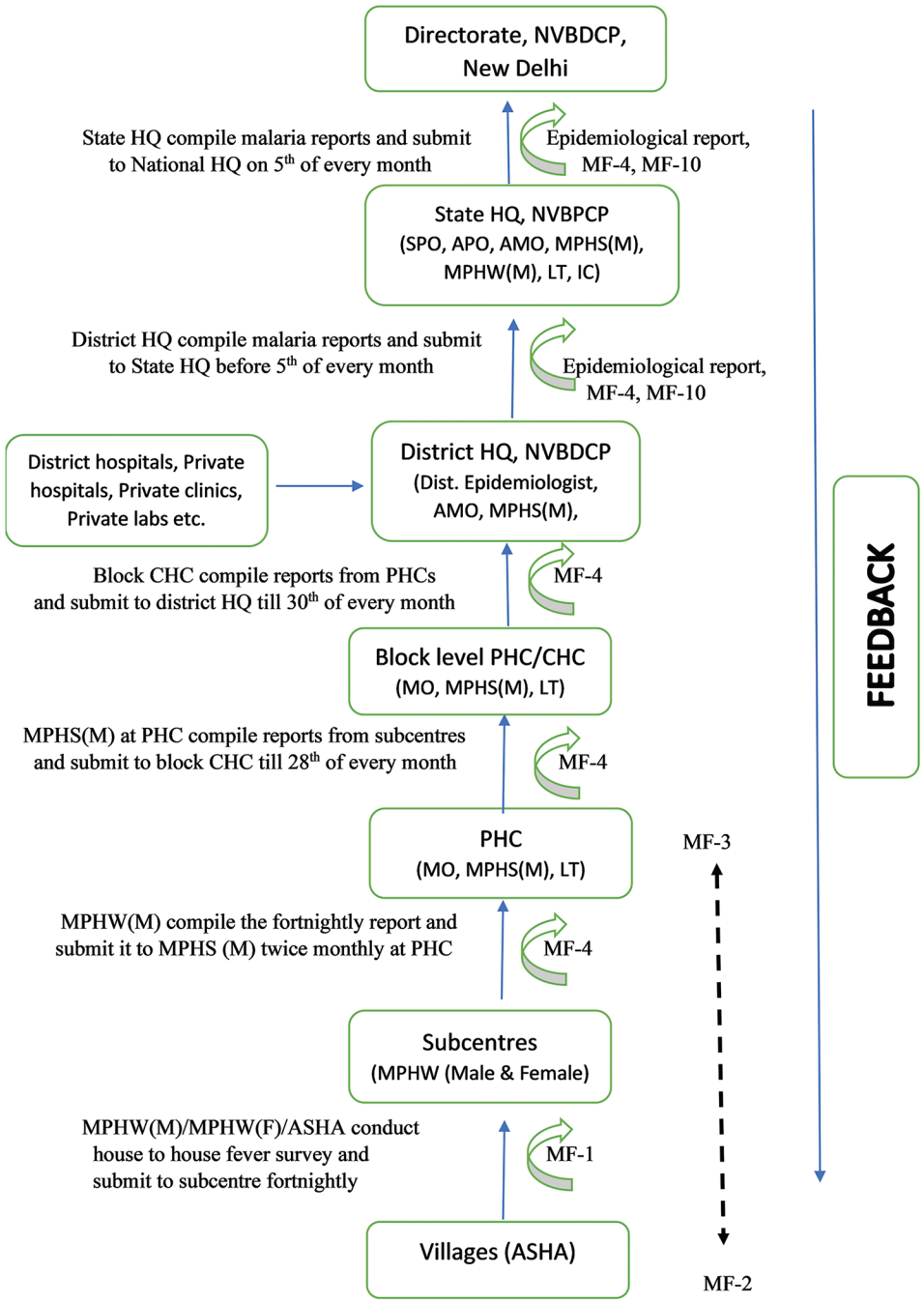
During the transmission season in 2019, the surveillance reporting period was changed from monthly to weekly reporting with minimal cost and effort. Reporting formats were provided by the NVBDCP HQ in New Delhi; however, formats were modified as per the needs with due permission from the Government of India. Out of 40 respondents, 92% agreed on editing the information required on malaria reporting formats and 80% agreed on changing the surveillance period from monthly to weekly. Overall mean score for flexibility was around 86%.

Data quality

The completeness of the malaria formats received from state HQ from May to June 2020 was 100%. But below the district level, 48% malaria reporting formats (56% in Mansa and 40% in Amritsar) were completely filled by the respondents. Overall mean score for data quality was 74%.

Acceptability

Of 42 respondents, 55% were satisfied with the surveillance system. In June 2020, at the health facility level, 69% fever



***MF-1**: Fortnightly surveillance report of fever cases by ASHA/MPHW/Health Facility

†**MF-2**: Laboratory requisition format for slide examination

‡ **MF-3**: Record of slide examination in PHC laboratory (subcentre wise)

****MF-4**: Fortnightly report of cases from subcentre, PHC, district and state

‡‡**MF-10**: Passive agencies report

Figure 1: Flow of data in the malaria surveillance system, Punjab, July–August 2020

cases (86% in Mansa and 52% in Amritsar) were tested for malaria parasite. All the malaria cases in Mansa and Amritsar Districts were entered in an online portal in 2019. Overall mean score for acceptability was 74%.

Timeliness

There were 240 malaria cases (237 in Mansa and 3 in Amritsar) from July to December 2019. However, CIFs were available for 226 cases (223 in Mansa and three in Amritsar). Complete

Table 1: Description of attributes, indicators, data source, and collection method with analysis for the evaluation of malaria surveillance system in Punjab, India, July—August 2020

Attributes and Indicators	Data collection	Analysis (Proportions)
Simplicity		
Simplicity in malaria case definition and reporting formats	Interviews of #DE, *MO, †AMO, ‡MPHS (§M), ||MPHW (M), MPHW (¶F), **LT, ‡‡ASHA, ††IC	Respondents who were able to explain the case definition and reporting formats in native language
Knowledge about malaria case definition	"	Respondents aware of case definition for malaria
Knowledge about treatment and follow-up	Interviews of DE, MO, AMO, MPHS (M), MPHW (M), MPHW (F), LT	Respondents aware of malaria treatment and follow-up
Flexibility		
Flexibility in the surveillance period and reporting formats	Interviews of DE, AMO, MPHS (M), MPHW (M), MPHW (F), ASHA, LT, IC	Respondents who agreed on changing the surveillance period and reporting formats
Data Quality		
Completeness of filled reporting formats	Reporting formats filled by MPHS (M), MPHW (M), LT, IC for May-June 2020	Completely filled reporting formats filled by respondents
Completeness of reports at state ¶¶HQ	Monthly reports received at state HQ for May–June 2020	Completely filled reporting formats received at state HQ
Acceptability		
Satisfaction with malaria surveillance	Interviews of DE, MO, AMO, MPHS (M), MPHW (M), LT, MPHW (F), ASHA, IC	Respondents satisfied with malaria surveillance
Willingness to test fever cases	Review of OPD registers for fever cases in June 2020	Fever cases tested for malaria by blood slide
Willingness for online entry of malaria cases	Observe online portal entries of malaria cases in 2019	Malaria cases in 2019 entered online on website portal
Timeliness		
Reporting, investigation and treatment of malaria cases	Record review of case investigation forms (CIFs), July-Dec 2019	Cases reported within 24 hours of slide examination, investigated with 48 hours and treated within 24 hours
Reporting at state HQ	Reports received at state HQ via emails within first five days for May-June 2020	Reports received at state HQ on time
Stability		
Existence of feedback mechanism	Interviews of DE, MO, AMO, MPHS (M), MPHW (M), LT, IC, MPHW (F), ASHA	Respondents who received feedback in last 6 months
Training for malaria surveillance	"	Respondents trained in malaria surveillance in the last 1 year
Engagement in other work	Interviews of AMO, MPHS (M), MPHW (M), LT, IC	Respondents not engaged in other work
Loss of surveillance date	Key informant interview of DE	Health facilities with stable computerized system
Representativeness		
Passive surveillance	Record review of monthly reports received at district HQ for June 2020	Govt. and private health facilities shared malaria reports
Active surveillance	"	Villages covered under active surveillance

*MO=Medical officers. #DE=District epidemiologist. †AMO=Assistant malaria officers. ‡MPHS=Multipurpose health supervisors. §M=Male. ||MPHW=Multipurpose health workers. ¶F=Female. **LT=Lab technicians. ††IC=Insect collectors. ‡‡ASHA=Accredited social health activists

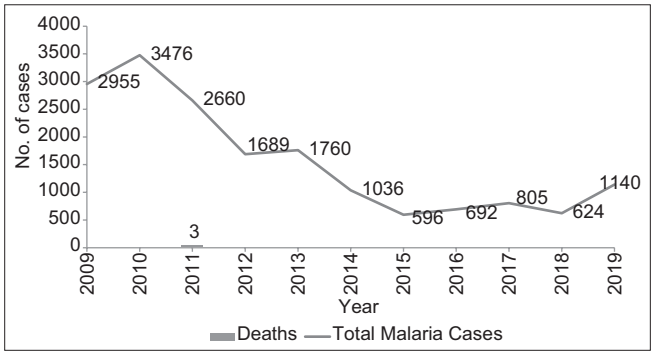


Figure 2: Trend of malaria cases and deaths in Punjab, India, 2009–2019

information was available for 212 cases for treatment, 218 cases for epidemiological investigation, and 225 cases for reporting from the CIFs. The majority (98%) of malaria cases were reported within 24 hours of blood slide examination; 85% (69% in Mansa and all three in Amritsar) cases received anti-malarial drugs within 24 hours; and 21.5% (10% in Mansa and one of three in Amritsar) cases were investigated within 48 hours of reporting. At state HQs, 75% of monthly reports were received on time from May to June 2020. Overall mean score for timeliness was 70%.

Stability

Of 42 respondents, 32 (76%) received feedback from their supervisors in last six months, and 17 (41%) were trained in malaria surveillance in 2019. Only 3 of 32 malaria surveillance staff were completely engaged in surveillance; the remaining 29 were also involved in other jobs. There were two computer systems (one NVBDCP and one personal) in Mansa and one IDSP computer system in Amritsar. All the computer systems

were stable as there was no loss of data due to a system crash in 2019. Overall mean score for stability was 57%.

Representativeness

Of the 1100 villages (241 in Mansa and 859 in Amritsar), all of them were covered under the active surveillance. Regarding passive surveillance, 100% (31) government health facilities were doing malaria reporting at district level, but there was zero reporting from private facilities in both districts. Age distribution showed that patients diagnosed with malaria ranged from 1.5 years to 90 years old. Overall mean score for representativeness was 59%.

Discussion

Of the seven attributes, flexibility was good; timeliness, acceptability, data quality, and simplicity were average; and stability and representativeness were poor. Surveillance system was useful in analyzing the morbidity and mortality pattern of malaria cases over time and was used to support policy decisions.

System was simple in terms of structure and data flow from village to state HQs, but it was average in terms of ease of operations. Many MPHSs and MPHWs were not able to understand the reporting formats and the number of follow-up slides to be prepared for each malaria case.

However, the system was flexible. It could accommodate changes in reporting formats as well as surveillance period as per the needs during transmission season. This finding was consistent with malaria surveillance evaluations conducted in the Bhutan and Nigeria.[8,9]

Data received at the state HQs were of excellent quality in terms of completeness of reports. But at district level and below, almost half of reporting formats examined were incomplete, especially in Amritsar. A study in Chipinge district of Zimbabwe showed that completeness of reports was 100% at district level, but gaps were still there in completeness at health facility level.[10] Overall, the surveillance system had an average level of data quality.

Acceptability of the surveillance system at the health facility level was poor. When comparing the out-patient department (OPD) data with surveillance data, 31% (14% in Mansa and 49% in Amritsar) fever cases were not investigated for malaria at health facility level. However, reports received at state/district HQs showed that all fever cases were investigated for malaria, raising the issue of authenticity of these reports. Almost half of respondents wanted to change the surveillance system because of the shortage of manpower; many health personnel were involved in other health programs like immunization and administrative work like death-birth registration, etc., In comparison with Amritsar District, Mansa experienced considerable shortage of manpower, especially lab technicians. However, willingness to enter malaria cases on the web portal was excellent. Overall, acceptability was average. This is in contrast to a study conducted in Kano State, Nigeria that showed all respondents were willing to continue with same surveillance system and 84.6% were fully involved in malaria surveillance system, depicting the high level of acceptability.[11]

The surveillance system was excellent at reporting malaria cases within 24 hours of blood slide examination; however, the epidemiological investigation of malaria cases in terms of active case search in community, entomological investigation, etc., was very poor, especially in Mansa. Timeliness in sharing monthly reports at state HQs was average, especially in Amritsar. Overall, timeliness was average.

Stability was poor as majority of respondents were engaged in other activities in addition to malaria surveillance. These malaria surveillance staff were simultaneously engaged in COVID-19 duties, death-birth registrations, and other health programs activities. About 60% respondents had not had refresher training in the last year and one-fourth had not received feedback from their supervisors in last six months. Regarding logistics, there were shortages of MF registers, rapid diagnostic tests (RDTs), and anti-malarial drugs at health facility level. Amritsar District did not have dedicated computer system by NVBDCP for generating and sharing the reports. Similarly, according to the study in Kano state in Nigeria, 68% of respondents indicated stock-out of the malaria commodity as one of the major challenges, along with irregular supply of RDTs, other data tools, guidelines, etc.[11]

For active surveillance, all the villages were covered, but passive surveillance was poor because no private health facility was reporting for malaria surveillance. Government health facilities shared monthly reports even in in the absence of malaria cases. Private health sector only provided information when confirmed malaria case was detected, otherwise there was no regular (or even nil) reporting. Population sub-group analysis showed malaria cases reported from a wide range of ages. Overall, representativeness was poor due to lack of reporting from the private health sector.

The study had few limitations. Since the study was conducted in two of the 22 districts of Punjab, the results of the surveillance evaluation cannot be generalized to the whole state; however, the study findings will definitely help the decision-makers to understand the challenges ahead of malaria free Punjab. Due to COVID-19 pandemic, the district hospital in Amritsar was not visited as it was converted into COVID-19 hospital. However, some extra efforts were carried out to collect the data telephonically for the surveillance evaluation. Due to lack of literature on malaria surveillance in India, the results of the study were compared with the studies conducted in other Asian and African countries.

Conclusion

Malaria surveillance system under NVBDCP was useful in estimating the morbidity and mortality and allowed trend analysis of malaria cases over time. Overall, it contributed to

the prevention and control of malaria as there have been no malaria deaths in Punjab since 2011. However, the system's attribute performance was only average.

First and foremost, stability and representativeness need to be strengthened. Malaria surveillance staff should not be engaged in supplemental work; even if they are involved in other activities due to shortage of health staff, malaria surveillance should not be hampered. Regular trainings on reporting formats and updated guidelines should be prioritized. Government must ensure regular reporting including nil/zero reporting from private health facilities. Regular and uninterrupted supply of MF registers, RDTs, and anti-malarial drugs are needed. To increase willingness to prepare malaria blood slides, we recommend supportive supervision to ensure that every fever case gets investigated for malaria at health facility and village level. For each malaria case, timely epidemiological investigation should be carried out within 48 hours.

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Conflicts of interest

There are no conflicts of interest.

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