



Migration Surveillance as a Maintenance Effort of Malaria Elimination Status (Study in Banyumas Regency, Central Java, Indonesia, 2021)

Shaffira Indah Paramesti¹ , Dwi Sarwani Sri Rejeki^{1*} , Siwi Pramata Mars Wijayanti¹ , Sri Nurlaela¹ , Devi Octaviana¹ , Bangun Wijayanto² 

¹Department of Public Health, Faculty of Health Sciences, Universitas Jenderal Soedirman, Purwokerto, Indonesia; ²Department of Informatics, Faculty of Engineering, Universitas Jenderal Soedirman, Purwokerto, Indonesia

Abstract

BACKGROUND: BACKGROUND: Banyumas Regency is a malaria-receptive area with the occurrence of imported cases, particularly in sub-districts with the potential for transmission and even extraordinary events. To eliminate malaria in the regency, migration surveillance is needed.

AIM: This study aims to evaluate implementing a malaria migration surveillance system to maintain its elimination status in Banyumas Regency in 2021.

METHODS: This qualitative case study was conducted in Banyumas Regency with a total of nine informants consisting of two people from the health office, four from the community health center, two from the health laboratory, and one village head. Data were collected through Forum Group Discussions, in-depth interviews, and secondary data through document review. This study also adopted content analysis with a thematic network approach.

RESULTS: There are several limitations to implementing malaria migration surveillance, namely, the lack of human resources, ineffective implementation of village regulations, and the lack of public awareness in reporting symptoms of malaria.

CONCLUSION: Therefore, comprehensive training, policies socialization, improved partnerships, and application-based village reporting are required to maintain the elimination of migration surveillance.

Edited by: Slavica Hristomanova-Mitkovska
Citation: Paramesti SI, Rejeki DSS, Wijayanti SPM, Nurlaela S, Octaviana D, Wijayanto B. Migration Surveillance as a Maintenance Effort of Malaria Elimination Status (Study in Banyumas Regency, Central Java, Indonesia, 2021). Open-Access Maced J Med Sci. 2022 Nov 06; 10(E):1751-1758. <https://doi.org/10.3889/oamjms.2022.10840>

Keywords: Surveillance; Malaria migration; Elimination
***Correspondence:** Dwi Sarwani Sri Rejeki, Department of Public Health, Faculty of Health Sciences, Universitas Jenderal Soedirman. Jl. Dr. Soeparno, Karangwangkal, Purwokerto, Indonesia. E-mail: dwi.rejeki@unsoed.ac.id

Received: 24-Aug-2022

Revised: 13-Sep-2022

Accepted: 27-Oct-2022

Copyright: © 2022 Shaffira Indah Paramesti, Dwi Sarwani Sri Rejeki, Siwi Pramata Mars Wijayanti, Sri Nurlaela, Devi Octaviana, Bangun Wijayanto

Funding: This research was supported by the Institute of Research and Community Service (LPPM) at Jenderal Soedirman University

Competing Interest: The authors have declared that no competing interest exists

Open Access: This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (CC BY-NC 4.0)

Introduction

Malaria is an unsolved global health problem, and Indonesia is one of the countries in the Southeast Asia region that has made an effort to eradicate this disease. Its morbidity, based on Annual Parasite Incidence (API) per 1000 population sequentially from 2015 to 2017, tends to increase by 0.85‰; 0.88‰; and 0.99‰. Furthermore, it decreased to 0.84‰ in 2018 and rise again to 0.93‰ in 2019. The three provinces in Indonesia with the highest API values in 2019 were East Nusa Tenggara, West Papua, and Papua, and each has 2.37‰; 7.38‰, and 64.03‰, while the other 31 (91.2%), including Central Java Province, have a value of <1 per 1000 population [1].

There is a trend to be a yearly decrease in the malaria incidence in Central Java Province. This was observed from the changes in the API value sequentially from 2015 to 2019, which are 0.05‰; 0.03‰; 0.03‰; 0.023‰; and 0.012‰ [2]. API is an indicator used to assess the readiness of the regency/city to eliminate

malaria. The several areas in the province that still report these cases include the sub-districts of Banyumas, Cilacap, Purbalingga, Banjarnegara, Kebumen, and Purworejo [3], [4], [5].

The malaria incidence in Banyumas Regency tends to increase from 2015 to 2018, as indicated by the sequential changes in the API value of 0.0009%; 0.00099%; 0.00297%; and 0.004% for the period, before decreasing to 0.0027% in 2019, showing a better development [6]. Despite imported cases being reported annually, there are no more indigenous malaria incidents in the regency as of early 2016. The report showed 8 imported cases in 2020 and 9 in 2021 [7].

A factor affecting the increase in imported malaria cases is migration [8]. Therefore, the Indonesian government has committed to reducing morbidity and mortality with a malaria control program through the elimination. This aims to stop its transmission in a certain area, such as a regency/city or province [9]. According to data from Infokes, at least 300 Indonesian regencies/cities declared malaria elimination in 2019, with the objective set for

345 in 2021 and 405 of 514 being free of this illness by 2024 [10]. Furthermore, the regency/city that declared malaria elimination received a certificate from the Ministry of Health and conducted malaria migration surveillance. This is essential in eradicating efforts to prevent the entry of imported cases through collecting and examining blood preparations of people just arriving from malaria-endemic areas and showing related clinical indications [11].

Malaria migration surveillance activities should have a good system to support its elimination efforts. The readiness in question is a comprehensive and specific system into surveillance subsystems such as input, process, and output. This approach can be used to identify the components constraining the implementation of the system. Therefore, this study aims to describe the implementation of a malaria migration surveillance system as an effort to maintain status in Banyumas Regency in 2021.

Methods

This qualitative case study aims to investigate, find, describe, and explain the implementation of a migration surveillance system to support malaria elimination in Banyumas Regency in 2021. The total informants involved were nine people consisting of key, main, and supporting informants. Key informants have comprehensive information about the problems observed. They are Head of Communicable Disease Prevention and Control Section and Staff of Health Infectious Disease Prevention and Control Section of Banyumas Regency Health Office. Furthermore, the main informants, four people from the surveillance staff of the community health center, have technical and detailed information about the study problem. Meanwhile, supporting informants provide additional information to complement the analysis and discussion (Head of Community Health Laboratory of Banyumas Regency, Laboratory Administration, and village head). Primary data were collected through Focus Group Discussion (FGD) and in-depth interviews, while secondary data were collected through document review. This study was conducted in four stages, namely, (1) literature study, (2) FGD to identify features and problems in the implementation of malaria migration surveillance, (3) in-depth interviews to obtain deeper information regarding the description, limitations, and recommendations in the implementation of the system, as well as (4) analyzing data using content analysis with a thematic network approach. Ethical approval was given from the ethics committee of the Faculty of Health Sciences, Jenderal Soedirman University No. 443/EC/KEPK/V/2021.

Results

Based on the results and content analysis carried out, the following global themes and sub-themes were identified:

Content analysis results (Figure 1)

The results of FGDs and in-depth interviews with informants showed that implementing the malaria migration surveillance system in Banyumas Regency in 2021 was analyzed thematically, and four main themes with thirteen sub-themes were obtained. The four main themes consist of available resources that need to be improved. These include quantity and quality, the implementation of the system conducted passively with epidemiological investigations and improving IEC but not cross-notification, as well as barriers and recommendations in the input and process components toward the implementation in the following years.

Global Theme	Sub-theme
Resources still need to be improved in terms of quantity and quality	The human resources involved are sufficient, but not all competent Funding is considered sufficient but limited only to carrying out case tracking activities The availability of tools and materials in the implementation of malaria migration surveillance at the Banyumas Regency Health Office is still limited The availability of facilities and infrastructure is sufficient There are already guidelines for the implementation of malaria migration surveillance, but its implementation is considered not optimal
The implementation of malaria migration surveillance is carried out passively with epidemiological investigations and improvement of Information Communication and Education, but no cross notification is carried out	Surveillance of malaria migration is passive with mechanisms, namely epidemiological investigations through alert reports, case investigations, contact surveys, risk factor investigations, and prevention. Examination of blood preparations is carried out by rapid diagnostic test (RDT) and microscopic examination of malaria Efforts to improve Information, Education, and Communication (IEC) are carried out through increasing health promotion with counseling as well as building partnerships through cross-program and cross-sectoral No cross notification is carried out on the implementation of malaria migration surveillance Recording and reporting of cases have been carried out routinely Monitoring and evaluation are carried out every quarter, yearly, or by case through meetings
Barriers to input and process components for the implementation of malaria migration surveillance in the following years	The human resources capacity is still lacking, village regulations are not implemented, and there is a lack of public awareness in reporting when they have clinical symptoms of malaria.
Recommendations on input components and processes for the implementation of malaria migration surveillance in the following years	Increased human resource capacity, improved implementation, and implementation of village regulations, as well as application-based village reporting

Figure 1: Content analysis results

Input

Human resources

The human resources (HRs) involved in implementing malaria migration surveillance in Banyumas Regency are considered sufficient. The health department consists of the Section Head and

the Communicable Disease Eradication Staff (P2M). Furthermore, the community health center level includes surveillance staff, analysts, health promotion personnel, sanitarians, doctors, and nurses, referred to as the workload analysis (ABK). At the village level, there are village midwives, cadres, and officials, communities to Babinsa (Bintara of Village Trustees) as well as Bhabinkamtibmas (Bhayangkara of Community Security and Order Trustees).

“Enough. There are cadres in society. There are sometimes villagers who are concerned about malaria but are not formally designated cadres” (P1).

“Support from the Community Health Center and the villagers is sufficient. Babinsa, Bhabinkamtibmas, and other local officials are involved” (P5).

However, there is no longer a Village Malaria Interpreter (JMD) in its implementation. This is because, since 2020, there has been a change in Health Operational Assistance (BOK) funds for handling COVID-19.

“Before COVID, it still existed through JMD, now JMD no longer exists” (P5).

Some microscopic officers received laboratory training, including representatives of a few participants. The informant stated that there is a need for additional training related to malaria migration surveillance as a form of early alertness, strengthening the capacity of officers, as well as increasing the knowledge and abilities of new officers in particular.

“There are officers that regularly undergo microscopic training at the Community Health Laboratory. Also, there is e-SISMAL training, only for refreshing. Meanwhile, for analysts, there are representatives from the Ministry of Health and the Community Health Center Kemranjen II” (P2).

“It is necessary because there are many new analysts, and to strengthen the capacity for e-SISMAL officers, hence, they understand better” (P3).

Funding

The funds received for implementing malaria migration surveillance at the Banyumas Regency Health Office are sufficient but limited in conducting case-tracking activities. This is sourced from the Regional Revenue and Expenditure Budget as well as Health Operational Assistance (BOK) for community health centers. These sources are not allocated specifically to the program but are integrated into the control program for infectious and animal-sourced diseases. The existence of these limited funds is currently allocated majorly for handling COVID-19 and absorbs approximately 50%. Therefore, several activities are postponed, and the allocation of funds, specifically for implementing the program, is reduced.

“When it is said to be enough, then it is, hence, other activities, such as spot surveys and others cannot be conducted. For tracking, yes, it can be done” (P2).

“This year’s funding allocation for COVID has been drastically reduced by over 50%. Consequently, the budgets for all programs are reduced” (P6).

Availability of tools and materials

There are limited tools and materials in implementing malaria migration surveillance program. Therefore, equipment procurement in each community health center is conducted based on the malaria cases, which are then submitted to the health office.

“This is very limited. We only had a few boxes yesterday, 5 of 125 pieces in a year. Despite running out of malaria drugs, it can be borrowed from the neighbors, Purbalingga. Furthermore, whenever a request arises, attach a letter with the case data to the PE from the Community Health Center” (P2).

Availability of Facilities and Infrastructure

The facilities and infrastructure for implementing malaria migration surveillance are adequate, become permanent assets, and do not require redistribution.

“Yes from themselves. Internet devices are also sufficient for mobilization” (P1).

Policy

Several Technical Guidelines from the Ministry of Health and local bylaws serve as internal Standard Operating Procedures for implementing malaria migration surveillance. However, it is considered not optimal. This is because the existing policies were not routinely socialized, and there has been an incomplete transfer of information on village regulations regarding the program between old and new employees.

“There are guidelines from the Ministry of Health regarding migration surveillance, reference books on malaria, and implementation of PE” (P5).

“It is admitted that the implementation has not been maximized. The 2011 Village Regulation already exists. However, from the change of village heads and its officials, this information is not always conveyed” (P2).

Process

Epidemiological investigations passively conduct malaria migration surveillance through alert reports, case investigations, contact surveys, risk factor investigations, and countermeasures rapid diagnostic test (RDT) and microscopic examined the blood

preparations. Furthermore, the Banyumas Regency Health Office supervised monitoring and provided instructions for the related activities.

“Yes, we are awaiting information from the community and the village midwife when, for example, someone is traveling from an endemic area. The issue is when there is no information indicating which region we’re from, and then we check, people typically refuse afterwards” (P5).

“...the patient goes to the Community Health Center, screened by a doctor and then his RDT is checked. The Mass Blood Survey (MBS) was then performed by twenty people around the case’s house. Furthermore, the drug is administered and monitored. The blood samples were collected and checked on the 3rd, 14th, and 21st days and showed negative results on the 21st. For migration surveillance, RDT is sufficient at the Community Health Center; continue to slide and cross-check at the Laboratory” (P8).

However, cross-notification was conducted during the implementation of malaria migration surveillance. This is because, according to the informant, the reports were integrated between regencies through the e-SISMAL application, hence, imported cases were followed up directly only with epidemiological investigations.

“No, this is only from that person’s story, then it is examined, and treated” (P1).

“... later it will be reported to the office. Yes, it will be automatic when it is between regencies. However, when it is between health centers, they will be notified, hence, they are followed up for implementing PE” (P3).

Efforts have been made to improve Communication, Information, and Education (IEC) by increasing health promotion through counseling and building partnerships with cross-programs and cross-sectors.

“We go into the field with health promotions. There are special forms, and some are in conjunction with other activities, such as participation in social gatherings and village community associations. Specifically, at that time, blood preparations were collected from the province, which was also included with counseling” (P2).

“Cross-program means we also coordinate with doctors, health promotions for counseling, and health care. Furthermore, cadres, and villages, from the community, are involved” (P4).

In accordance with the punctuality time, the activities of recording and reporting cases in implementing the program are also conducted regularly every month through the e-SISMAL application. Furthermore, the Community Health Laboratory reported the results to cross-check microscopic examination to the health office.

“Yes, there are monthly reports regardless of the number of instances” (P1). “Through e-SISMAL, there is already an application, and we only need to enter the data, then it will be promptly updated. The report is before the 6th, and for example, when accuracy is insufficient after the date, it will still be reported even when there is no case” (P4).

Monitoring and evaluation in the implementation of the program are performed based on each institution, either quarterly, annually, or according to the presence of cases at meetings.

“Yes, there should be, yearly or by case, and through meetings” (P1).

“It is conducted through a meeting every three months” (P3).

Output

SPR percentage

The slide positivity rate (SPR) results in Banyumas Regency showed that imported malaria-positive cases were 100%. The percentage of treatment was in accordance with the 100% standard. This includes treating those that were positive when examining malaria blood preparations with a microscope or RDT. This study showed that the percentage of cross-notifications was 0%.

Constraint

There are still some input systems and process limitations in implementing malaria migration surveillance. These include the lack of human resources, village regulations related to the program that are not effectively implemented, lack of policy socialization, and lack of public awareness in reporting the related clinical symptoms.

“It is possible that just from sending samples that do not fit, thereby requiring multiple repetitions, there are samples that are close enough to be read.” (P9).

“Yes, maybe there are some less responsive residents that lack awareness. Suddenly it is a few days from Kalimantan, Papua. Therefore, when a report is not obtained from the village, we do not know who just arrived from the malaria area” (P3).

Recommendation

There are several recommendations from the input system and process for implementing malaria migration surveillance in Sumpiuh and Tambak sub-districts, Banyumas Regency. It includes increasing

the capacity, commitment, and consistency of human resources involved in migration surveillance, improving the implementation of village regulations related to the program, as well as facilitating the reporting of the case from villages to community health centers supported by applications.

“Yes, this is aimed at officers administering the examination. The knowledge has been enhanced, and we anticipate that village midwives, cadres, health centers, and the consistency of several stakeholders will continue to improve” (P1).

“Yes, it aims to make reporting easier and richer in applications. Migration surveillance is also simpler, where the community understands, the reporting is good, and the reporters are easy to explain” (P4).

Discussion

The implementation of malaria migration surveillance in Banyumas Regency is under the Communicable Disease Prevention and Control Section of the Health Office. Following the status that has declared malaria elimination in 2019, the migration surveillance running since 2012 has been conducted to maintain its elimination in the region. In terms of quantity, the health department, community health center, and village officials provide sufficient resources for its implementation. However, currently available human resources do not include Village Malaria Interpreters because, since 2020, there have been a change in BOK (Health Operational Assistance) funds for handling COVID-19, making JMD unavailable. This result differs from Regency Magelang, which, despite having acquired the designation of malaria elimination, continues to retain the existence of JMD [12]. The role of JMD in this situation is essential in active case results, examination, drug administration, and medication intake monitoring [13], [14].

Limitations in the field of human resources are not fully implemented in every health center in Banyumas Regency. The complete training forms should include Basic Malaria Training, Malaria Management, Malaria Surveillance Training, Case Management Training, Entomologist Training, e-SISMAL, Microscopic, Program Leadership, Program Advocacy, Logistics Management, and other related training [15]. Comprehensive and routine practice for health workers is essential to maintain their competence, thereby maintaining malaria surveillance at this post-elimination stage, preventing indigenous transmission, and intensifying monitoring of imported cases [16], [17], [18].

The allocation of funding for this migration surveillance should be used for tracking cases and allocated to activities to prevent re-transmission at

the maintenance stage. This is because areas with high receptivity and vulnerability are insufficient for passive patient detection. It is advisable to add Active Case Detection activities by JMD for timely diagnosis and prevention of local incidence and vector control [11], [19]. There is limited funding due to the focus on the COVID-19 response program. This was also discovered in other regions due to budget adjustments brought on by the COVID-19 pandemic [20].

The malaria migration surveillance was conducted based on several technical guidelines from the Ministry of Health, including the Disease Diagnosis and Response Algorithm and the 2009 Epidemiological Investigation Format from the Indonesian Department of Health, Guidelines for the Management of Malaria Cases in Indonesia, Gebrak Malaria from the Indonesian Department of Health in 2010, and the Malaria Entomology Module from the Indonesian Ministry of Health in 2013. Furthermore, there is already a Village Regulation on Malaria Migration Surveillance stipulated in 2010 as a guide for all the activities performed.

The information guidelines help program managers to conduct more comprehensive and focused malaria program surveillance activities to maintain the disease certification [15]. Existing guidelines can provide technical guidance and supervision of program activities, as well as recommend strengthening and improving the implementation of malaria elimination interventions [21], [22].

Socialization regarding these guidelines does not occur routinely and has not been optimal, affecting the use of village regulations as guidelines which are considered not to be reapplied. Furthermore, the new workers were unaware of the village regulations due to the change of employees.

It is required to realign the maintenance program (prevention of reinfection) to include all health workers, the government, the private sector, and the continued consistency of village government obligations in the policy. The commitment and cooperation between stakeholders are essential to rebuilding the legal basis for implementing malaria migration surveillance involving the community. These regulations will increase the sustainability of the program system over time and create an environmental need for strong elimination controls [23], [24].

Case finding was conducted passively because there was no longer JMD as a trained staff actively searching for malaria cases. The second series of epidemiological investigations were performed through case examinations. These were conducted by interview using an epidemiological investigation form for malaria outbreaks. Meanwhile, the contact survey was done with an epidemiological investigation into the family and 20 people around the case's house, and then, a blood sample was collected. In this case, the activity is in accordance with method 2 of the Technical Manual

for Malaria Epidemiological Investigation and Mapping of Focus Areas (Elimination and Maintenance Areas).

This study discovered that the forms used in conducting case investigations, contact surveys, and risk factor investigations had not been adjusted to reflect the latest guidelines. The regulations used should be updated in line with the improvements and system updates conducted by the center [25]. Updated guidelines ensure the sustainability of new surveillance systems integrated and strengthened by dissemination to health workers [26], [27], [28].

The Banyumas Regency Health Office supervised the implementation of malaria migration surveillance, namely, program coordinators and managers that participated in monitoring activities to provide instructions and supervision. The Kano State study also mentions that it is being performed in a supportive and integrated manner where health workers are supervised as well as trained while doing their job by the Malaria Program Staff, thereby improving data quality [29].

The RDT and microscopic examinations were conducted at the community health center and then sent to the Banyumas Regency Community Health Laboratory to be cross-checked for the type of Plasmodium. Using a microscope to diagnose malaria through parasite detection is the gold standard [30], [31]. Therefore, laboratories at all levels should regularly assess skills, test, and perform quality control to ensure operability, specifically in areas with high transmission [18], [32].

In implementing malaria migration surveillance in Sumpiuh and Tambak sub-districts, Banyumas Regency did not conduct cross-notification activities. This activity is essential to detect malaria outbreaks through regular data analysis and reporting, generating appropriate public health responses, specifically in areas prone to malaria mosquito development and its endemic zones. Local health authorities are expected to ensure that areas where imported malaria transmission originates, can be investigated, examined, treated, and increased targeted interventions in the region, preventing the widespread of the case [23], [33].

All activities should be monitored regarding input, process, and output. The evaluation activity based on the study's results was conducted as monthly meetings and monitored directly by the Banyumas Regency Health Office when malaria cases occurred. Monitoring and evaluation are performed by searching for the results of monthly reports sent by the community health center to the Health Service to ensure cases are investigated according to the guidelines, which will then be used to plan the next control program [34], [35].

Treatment percentage in the regency is also in accordance with the 100% standard, namely examination of malaria blood preparations with

microscopes or RDT. The effectiveness of treatment can determine the elimination success. Effective treatment includes medicine with proper and timely program drugs. Furthermore, it can reduce plasmodium parasites' transmission rate and resistance to drugs [23], [36].

A limitation in the human resource input system is the ability to collect and examine blood preparations. Not all analysts can properly prepare blood preparations, hence, its implementation requires more samples to cross-check microscopic examination in the laboratory. The ability, skills, and professional competence of a microscopic in making blood preparations, coloring, and checking greatly determine the discovery of malaria parasites, specifically when the density of parasites is low [30]. Therefore, the accuracy and truth of the examination by microscopic need to be observed and monitored continuously [37]. The human resources involved in migration surveillance should have a good ability, commitment, and consistency in running programs. This is performed through capacity building with training. The performance of the malaria elimination surveillance system depends on a series of factors, such as human resources, which should be dedicated, trained, and supervised to implement the system at each administrative level [38]. In addition, training and refreshing are needed, including the relationship with developing program management staff.

Village regulations related to the current migration surveillance are not running effectively because of the change of employees, where old workers are not subjected to existing municipal guidelines. In addition, the socialization regarding the policy is lacking, specifically when the focus on handling prioritizes the COVID-19 case. Activity across programs and cross-sectors in this elimination are vulnerable to changes, which can be due to changing officers, policies, funding allocation, and priority sequence of problems [12]. Studies in Amazon, Africa, and India also proved that political commitment is an important indicator of the malaria control program. It is needed to maintain the sustainability of elimination program efforts over the long term and can reach all vulnerable levels of society [39], [40].

Conclusion

There are several limitations for implementing malaria migration surveillance systems in Banyumas Regency in 2021. These include the lacking ability of human resources involved, ineffective implementation of village regulations, and a lack of public awareness in reporting malaria cases. Suggestions for comprehensive training, policy socialization, increasing partnerships, and village reporting based on malaria applications should be held.

Acknowledgments

The authors are grateful to the Institute of Research and Community Service (LPPM) at Jenderal Soedirman University for funding and mentoring Research Scheme through Applied Research in 2022, as well as to all parties involved in this study.

References

1. Ministry of Health of the Republic of Indonesia. Indonesia Health Profile 2019. Jakarta: Ministry of Health the Republic of Indonesia; 2019.
2. Central Java Provincial Health Office. Central Java Health Profile 2019. Central Java: Central Java Provincial Health Office; 2019.
3. Rejeki DS, Fuad A, Widartono BS, Murhandarwati EE, Kusnanto H. Spatiotemporal patterns of malaria at cross-boundaries area in Menoreh Hills, Java, Indonesia. *Malar J*. 2019;18(1):80. <https://doi.org/10.1186/s12936-019-2717-y> PMID:30876422
4. Ahmad RA, Ferdiana A, Surendra H, Sy TR, Herbianto D, Rahayujati TB, et al. A participatory approach to address within-country cross-border malaria: The case of Menoreh Hills in Java, Indonesia. *Malar J*. 2021;20(1):137. <https://doi.org/10.1186/s12936-021-03673-7> PMID:33676491
5. Rejeki DS, Nurlaela S, Octaviana D, Wijayanto B, Solikhah S. Clusters of malaria cases at sub-district level in endemic area in Java Island, Indonesia. *Geospat Health*. 2022;17(1):1-7. <https://doi.org/10.4081/gh.2022.1048> PMID:35592925
6. Banyumas District Health Office. Health Profile of Banyumas District 2019. Banyumas: Banyumas District Health Office; 2019.
7. Dhaniarsi D, Rejeki DS, Raharjo S. Spatial Analysis of Malaria in Banyumas Regency 2009-2018. *BALABA Journal*. 2020;16(2):169-80.
8. Rejeki DS, Nurhayati N, Aji B, Murhandarwati EE, Kusnanto H. A time series analysis: Weather factors, human migration and malaria cases in endemic area of Purworejo, Indonesia, 2005-2014. *Iran J Public Health*. 2018;47(4):499-509. PMID:29900134
9. Sardjono TW, Fitri LE. *Kupas Bahas Ringkas tentang Malaria*. Malang: UB Press; 2019.
10. Ministry of Health of the Republic of Indonesia. Twelve Districts/Cities received Malaria Elimination Certificates on World Malaria Day 2021. Ministry of Health of the Republic of Indonesia Website; 2021 Available from: <https://www.p2p.kemkes.go.id/12-kabupaten-kota-mendapatkan-sertifikat-eliminasi-malaria-pada-puncak-hari-malaria-sedunia-2021> [Last accessed 2021 Jun 01].
11. Ministry of Health of the Republic of Indonesia. Decree of The Minister of Health of the Republic of Indonesia Number 293/kenkes/SK/IV/2009 28 April 2009 on Malaria Elimination in Indonesia. Jakarta: Ministry of Health of the Republic of Indonesia; 2009.
12. Ikawati B, Isnani T, Wijayanti T, Wahyudi BF, Raharjo J, Sunaryo S, et al. The role of cross program, cross sector, and community in malaria elimination at menoreh hills area. *Vektora: Journal of Vector Borne and Reservoir Diseases*. 2020;12(2):119-132.
13. Adams MW, Sutherland EG, Eckert EL, Saalim K, Reithinger R. Leaving no one behind: Targeting mobile and migrant populations with health interventions for disease elimination-a descriptive systematic review. *BMC Med*. 2022;20(1):172. <https://doi.org/10.1186/s12916-022-02365-6> PMID:35527246
14. Isnani T, Ikawati B, Sholichah Z, Prastawa A. Java culture value in malaria control to achieve elimination of malaria in bukit menoreh area. *Bulletin of Health System Research*. 2021;24(4):252-64.
15. Saputra Y, Alamsyah R, Devita Y. Monitoring of surveillance of malaria program on maintaining the elimination license in Rokan Hulu Regency. *Journal of Public Health Sciences*. 2020;9(2):131-50.
16. Xu JW, Lin ZR, Zhou YW, Lee R, Shen HM, Sun XD, et al. Intensive surveillance, rapid response and border collaboration for malaria elimination: China Yunnan's "3+1" Strategy". *Malar J*. 2021;20(1):396. <https://doi.org/10.1186/s12936-021-03931-8> PMID:34627264
17. Nsibandé D, Loveday M, Daniels K, Sanders D, Doherty T, Zembe W. Approaches and strategies used in the training and supervision of health extension workers (HEWs) delivering integrated community case management (iCCM) of childhood illness in Ethiopia: A qualitative rapid appraisal. *Afr Health Sci*. 2018;18(1):188-97. <https://doi.org/10.4314/ahs.v18i1.24> PMID:29977273
18. Zhang Q, Sun J, Zhang Z, Geng Q, Lai S, Hu W, et al. Risk assessment of malaria in land border regions of China in the context of malaria elimination. *Malar J*. 2016;15(1):546. <https://doi.org/10.1186/s12936-016-1590-1> PMID:27825379
19. Tseroni M, Georgitsou M, Baka A, Pinaka O, Pervanidou D, Tsironi M, et al. The importance of an active case detection (ACD) programme for malaria among migrants from malaria endemic countries: The Greek experience in a receptive and vulnerable area. *Int J Environ Res Public Health*. 2020;17(11):4080. <https://doi.org/10.3390/ijerph17114080> PMID:32521653
20. Asmiani A, Windusari Y, Hasyim H. Malaria vector control and the electronic malaria surveillance information system (E-SISMAL) in Bangka Barat Regency Indonesia. *J Kesehatan Lingkungan*. 2021;13(4):241-9.
21. Mace KE, Lucchi NW, Tan KR. Malaria surveillance-United States, 2017. *MMWR Surveill Summ*. 2019;70(2):1-35. <https://doi.org/10.15585/mmwr.ss7002a1> PMID:33735166
22. Moonasar DM, Davies C, Balawanth E, Misiani E, Shandukani MB, Raman J, et al. Progress, challenges and priorities for malaria elimination in South Africa. *Trans R Soc S Afr*. 2021;76(2):105-16. <https://doi.org/10.1080/0035919X.2021.1890274>
23. Kesuma AP, Pramestuti N, Prastawa A, Trisnawati UF. The implementation of village regulation for detection and monitoring of community-based malaria cases treatment. *Journal of Vector-borne Diseases Studies*. 2018;10(1):15-26.
24. Ahmad N, Isworo A, Indriani C. Analysis of malaria control situation in Magelang regency and obstacles to maintain malaria elimination status. *J Kesehatan Masyarakat*. 2018;14(2):205-13. <https://doi.org/10.15294/kemas.v14i2.14208>
25. Negari N, Eryando T. Analysis of receiving information system recording and reporting of COVID-19 case (Silacak Application Version 1.2.5) using technology acceptance model (TAM) at Cipadung Public Health Center, Bandung City. *BIKFOKES Journal*. 2021;1(3):160-76.

26. Leblanc C, Vasse C, Minodier P, Mornand P, Naudin J, Quinet B, *et al.* Management and prevention of imported malaria in children. Update of the French guidelines. *Med Mal Infect.* 2020;50(2):127-40. <https://doi.org/10.1016/j.medmal.2019.02.005>
PMid:30885541
27. Amboko B, Stepniewska K, Machini B, Bejon P, Snow RW, Zurovac D. Factors influencing health workers' compliance with outpatient malaria 'test and treat' guidelines during the plateauing performance phase in Kenya, 2014-2016. *Malar J.* 2022;21(1):68. <https://doi.org/10.1186/s12936-022-04093-x>
PMid:35241074
28. Anam LS, Badi MM, Assada MA, Al Serouri AA. Evaluation of two malaria surveillance systems in Yemen using updated CDC guidelines: Lessons learned and future perspectives. *Inquiry.* 2019;56(1):1-8. <https://doi.org/10.1177/0046958019880736>
PMid:31596152
29. Visa TI, Ajumobi O, Bamgboye E, Ajayi IO, Nguku P. Evaluation of malaria surveillance system in Kano state, Nigeria, 2013-2016. *Infect Dis Poverty.* 2020;9(1):15. <https://doi.org/10.1186/s40249-020-0629-2>
PMid:32036790
30. Tetteh M, Dwomoh D, Asamoah A, Kupeh EK, Malm K, Nonvignon J. Impact of malaria diagnostic refresher training programme on competencies and skills in malaria diagnosis among medical laboratory professionals: Evidence from Ghana 2015-2019. *Malar J.* 2021;20(1):255. <https://doi.org/10.1186/s12936-021-03796-x>
PMid:34103068
31. Nadeem MF, Khattak AA, Zeeshan N, Awan UA, Yaqoob A. Assessment of microscopic detection of malaria with nested polymerase chain reaction in war-torn federally administered tribal areas of Pakistan. *Acta Parasitol.* 2021;66(4):1186-92. <https://doi.org/10.1007/s11686-021-00374-8>
PMid:33840058
32. Diallo MA, Diongue K, Seck MC, Ndiaye M, Diallo I, Diedhiou Y, *et al.* Quality control of malaria microscopy reveals misdiagnosed non-falciparum species and other microscopically detectable pathogens in Senegal. *Ann Clin Microbiol Antimicrob.* 2018;17(1):8. <https://doi.org/10.1186/s12941-018-0261-1>
PMid:29544479
33. Franco VC, Peiter PC, Cortes JJ, Pereira RD, Gomes MS, Suárez-Mutis MC. Complex malaria epidemiology in an international border area between Brazil and French Guiana: Challenges for elimination. *Trop Med Health.* 2019;47(1):24. <https://doi.org/10.1186/s41182-019-0150-0>
PMid:31007535
34. Purnama TB. An overview of malaria control programs in Lubuk Linggau City. *Journal of Information Management and Health Administration (JMIAK).* 2019;2(2):1-9.
35. Dlamini N, Zulu Z, Kunene S, Geoffroy E, Ntshali N, Owiti P, *et al.* From diagnosis to case investigation for malaria elimination in Swaziland: Is reporting and response timely? *Public Health Action.* 2018;8(Suppl 1):S8-12. <https://doi.org/10.5588/pha.17.0043>
PMid:29713587
36. Buchan CA, Kotton CN, AST Infectious Diseases Community of Practice. Travel medicine, transplant tourism, and the solid organ transplant recipient-guidelines from the American Society of transplantation infectious diseases community of practice. *Clin Transplant.* 2019;33(9):e13529. <https://doi.org/10.1111/ctr.13529>
PMid:30859623
37. Hardin, Syarif S. Differences between malaria slide examination of Bombana Regency and cross check results at Southeast Sulawesi Provincial health laboratory. *Journal of MediLab Mandala Waluya.* 2018;2(1):20-33.
38. Lourenço C, Tatem AJ, Atkinson PM, Cohen JM, Pindolia D, Bhavnani D, *et al.* Strengthening surveillance systems for malaria elimination: A global landscaping of system performance, 2015-2017. *Malar J.* 2019;18(1):315. <https://doi.org/10.1186/s12936-019-2960-2>
PMid:31533740
39. Antiporta DA, Rosas-Aguirre A, Chang J, Llanos-Cuentas A, Lescano AG. Malaria eradication. *Lancet.* 2020;395(10233):e67. [https://doi.org/10.1016/S0140-6736\(20\)30225-7](https://doi.org/10.1016/S0140-6736(20)30225-7)
PMid:32334704
40. Ren M. Greater political commitment needed to eliminate malaria. *Infect Dis Poverty.* 2019;8(1):28. <https://doi.org/10.1186/s40249-019-0542-8>
PMid:31030666