Review Article

Evaluation of Leptospirosis Surveillance and Response Programs: A Systematic Review

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ABSTRACT

Background: Leptospirosis is a zoonotic disease that poses a public health problem in various tropical countries, including Indonesia. This disease is caused by Leptospira bacteria, which can infect humans through contact with the urine of infected animals.

Method: This study aims to evaluate the effectiveness of surveillance and response programs for leptospirosis in Indonesia using a systematic literature review following the PRISMA guidelines. The data used were collected from three main databases: Google Scholar, Semantic Scholar, and PubMed. Six articles met our criteria and were included in this research.

Results: The results of the study indicate that the surveillance program continues to face challenges, including a shortage of trained health workers, suboptimal case reporting and recording systems, and inadequate intersectoral coordination. Although the leptospirosis mortality rate has decreased, the fluctuating case count underscores the need to improve the surveillance system and prevention efforts.

Conclusion: Increasing the capacity of health workers, optimizing the surveillance system, and strengthening coordination between sectors are needed to improve the effectiveness of leptospirosis prevention and control programs in Indonesia.

INTRODUCTION

Indonesia is a country with various tropical diseases, one of which is leptospirosis.[1] Leptospirosis is a public health problem that is widespread throughout the world, especially in tropical and subtropical countries. The risk of leptospirosis in tropical countries is recorded to be 1,000 times higher than in subtropical regions.[2] Leptospirosis, also known as Weill's Disease, is classified as a zoonotic disease caused by bacteria from the genus Leptospira. These bacteria can infect humans and other vertebrates. Clinical symptoms in leptospirosis patients include fever, enlarged spleen and liver, jaundice, and impaired kidney function. The disease cannot be directly transmitted between humans, but Leptospira bacteria can survive and thrive in natural environments.[3]

Leptospirosis is an infection caused by the Leptospira sp. bacterium and can be transmitted to humans through direct or indirect contact with the urine of infected animals.[4] Water contaminated by the urine of reservoir animals serves as the primary medium for the spread of pathogenic Leptospira bacteria. Infection in animals or humans can occur through bacterial infiltration into the body through open wounds or mucous membranes. The severity of Leptospira infection varies, ranging from asymptomatic cases to organ failure and potentially life-threatening complications if not properly treated.[5]

Rats are the primary reservoir in the transmission cycle of leptospirosis to humans.[3] Rats belong to the order Rodentia and have distinctive morphological characteristics in their head, body, and tail. Rats can adapt to the lifestyle, and the development of rats living around settlements differs from that of other wild rats. Rats can adapt to serve as reservoirs for Leptospira sp. bacteria due to their extensive range of movement compared to other animals such as cattle, cats, and dogs, and they can also act as hosts for Leptospira sp. Bacteria.[6]

According to the 2023 Indonesia Health Profile data, there were 2,554 cases of leptospirosis spread across 12 provinces, including West Java, Jakarta, Central Java, East Java, Yogyakarta, Banten, North Kalimantan, East Kalimantan, Riau Islands, South Sulawesi, Bali, and Maluku. Of these cases, 205 deaths were recorded, with a case fatality rate (CFR) of 8%. The incidence of leptospirosis in 2023 increased compared to the previous year, although the case fatality rate decreased from 9.1% in 2022 to 8% in 2023. Several provinces, such as Yogyakarta Special Region, Central Java, East Java, Southeast Sulawesi, South Sulawesi, East Kalimantan, and North Kalimantan, reported an increase in the number of cases, while West Java, Jakarta Special Region, and Banten saw a decrease in leptospirosis cases.[7]

In Indonesia, there are still various obstacles in efforts to combat leptospirosis. Some of the main challenges include delays in patients seeking medical treatment, low sensitivity of health workers in diagnosing leptospirosis, limited laboratory facilities, and a suboptimal case reporting management system.[8]

Many cases of leptospirosis go unreported due to difficulties in clinical diagnosis and the relatively high cost of diagnostic testing. Other factors contributing to the high incidence of leptospirosis include weak surveillance systems, high rat populations as the primary vector, and poor environmental sanitation, particularly in flood-prone areas. Therefore, an evaluation of the implementation of leptospirosis prevention and control programs is needed to assess the effectiveness of program achievements and identify challenges faced in their implementation. The evaluation results are expected to provide useful recommendations for improving planning and enhancing the effectiveness of leptospirosis prevention and control programs in the future.

METHOD

This study is a literature review using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) method, which was applied systematically in accordance with the protocol and stages of the study. This method began with a search of scientific literature in databases using the keywords *evaluation, program, surveillance, and leptospirosis*. Article searches were conducted in the following databases: Google Scholar, Semantic Scholar, and PubMed. Subsequently, the titles and abstracts of each article relevant to the research topic

were reviewed. The inclusion criteria for article selection were that the article addressed the topic of evaluating leptospirosis surveillance programs, was freely accessible, available in full text, had an ISSN, and was published between 2015 and 2025. Exclusion criteria included the absence of full text, literature review articles, paid articles, duplicates, and articles not matching the keywords.

RESULTS

The search process is described in Figure 1. Based on the search results from several databases using predetermined keywords, a total of 417 articles were obtained. After screening according to predetermined criteria, six articles that met the criteria were selected and included in the analysis.
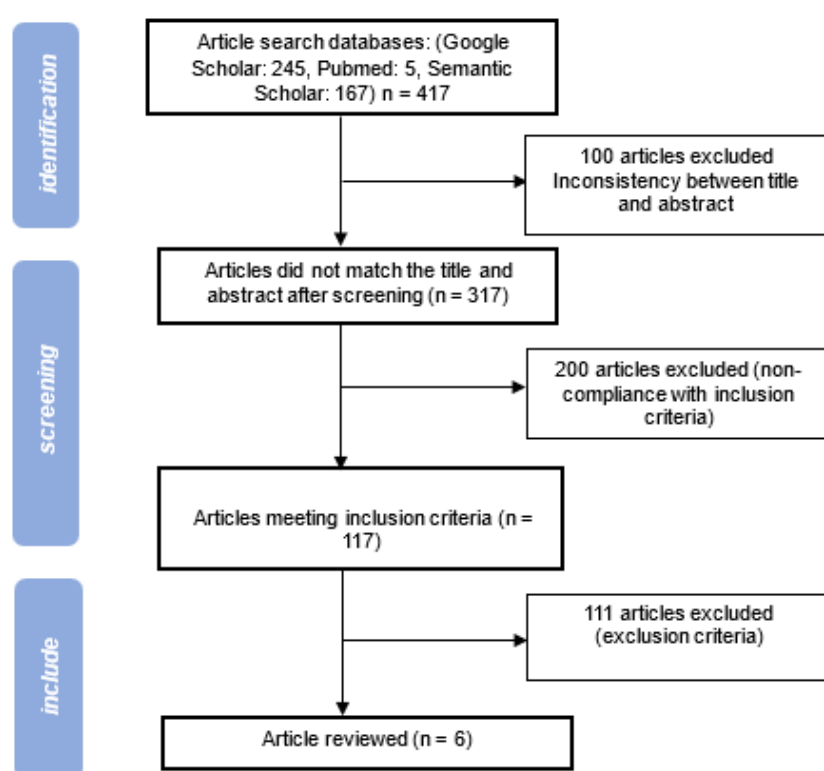

Figure 1. PRISMA Literature Review Search

After an identification and screening process, six articles were found to meet the inclusion and exclusion criteria. These were then reviewed by the researchers and summarized in Table 1.

DISCUSSION

This research aimed to evaluate the effectiveness of surveillance and response programs for leptospirosis in Indonesia using a systematic literature review following the PRISMA guidelines. We discuss the evaluation through an input, process, and output approach. We discuss the evaluation through an input, process, and output approach.

Table 1. Data from articles included in the review.

No	Author	Title	Research Method	Goals	Results
1	Fitirana, Ahmad and Djasri, 2019.[9]	Evaluation of one-health-based leptospirosis control management in Boyolali District	Descriptive observation using qualitative research methods.	To evaluate the implementation of One Health-based leptospirosis control management in Boyolali Regency.	70% of health workers have received training. Rapid diagnostic tests (RDT) are not available in primary health care facilities but are available at the Health Office. Data collection is reported passively. Leptospirosis cases in livestock are investigated when human cases are found. However, the main reservoir (rats) is not investigated by the Agriculture Office. Each case found is reported to the Boyolali District Health Office and receives treatment.
2.	Wikansari *et al.* 2019.[10]	Evaluation of the Early Warning Alert and Response System (EWARS) Program in the Implementation of Surveillance in Salatiga City, Central Java Province.	Qualitative	To evaluate the Early Warning Alert and Response System (EWARS) in the implementation of outbreak surveillance in Salatiga City, Central Java Province.	Problems in the input aspect include officers who have two or more tasks (67%) and insufficient funds. In the process aspect, challenges include target setting and planning (50%) and cross-sector coordination (33%). In the output aspect, there are delays in the submission of reports by staff. Meanwhile, in the outcome aspect, although Outbreak Events (KLB) can be detected early, there is still no epidemiological bulletin serving as a weekly public health information medium.
3.	Saraswati *et al.* 2017.[11]	Evaluation of Leptospirosis Case Surveillance Implementation at the Boyolali District Health Office.	Descriptive with an observational research design.	Conducting an evaluation of the implementation and results of leptospirosis case surveillance in Boyolali District.	The implementation of leptospirosis epidemiological surveillance in Boyolali District has not been optimal. Although all respondents have collected data, the data compilation process has only been carried out in 3 of 12 community health centers and at the Health Office. Data analysis is limited to the Health Office and only covers basic analysis related to leptospirosis case trends. Additionally, information dissemination has been carried out through reporting and feedback mechanisms.

No	Author	Title	Research Method	Goals	Results
4.	Depo, Pramono and Aryanto, 2019.[12]	Evaluation of the Leptospirosis Prevention and Control Program in Bantul Regency in 2017.	Descriptive observational.	To describe and identify factors contributing to the implementation and achievement of the leptospirosis control program from the aspects of input, process, output, and outcome in Bantul Regency.	Challenges in the input aspect include limitations in untrained human resources, limitations in Communication, Information, and Education (KIE) media, and high workloads. Meanwhile, in the process aspect, Epidemiological Investigation and Local Area Monitoring (PWS) activities have not been implemented optimally, and cross-sectoral coordination has not yet been realized. From the output aspect, an Outbreak of Leptospirosis (KLB) occurred in February and March 2016, with the highest trend of cases in 2016 occurring in Bantul District. From the outcome perspective, in 2016, cases occurred in Bantul District, with an Incidence Rate (IR) of 8.9 per 100,000 population and a Case Fatality Rate (CFR) of 5.75%.
5.	Fauziah and Handayani, 2019.[13]	Leptospirosis Control Program in Semarang City.	Qualitative descriptive.	To evaluate the implementation of the leptospirosis control program in Semarang City in 2018.	The report shows that five community health centers have implemented leptospirosis control programs. However, there were still obstacles in the planning, organization, and implementation of these programs in 2018. Therefore, it can be concluded that the implementation of leptospirosis control programs in Semarang City in 2018 was not yet optimal.
6.	Calero and Monti, 2022.[14]	Assessment of the Current Surveillance System for Human Leptospirosis in Ecuador by Decision Analytic Modeling.	Qualitative	To assess the sensitivity of Ecuador's current national surveillance system for leptospirosis in humans as a basis for an economic evaluation of the system.	The criteria that most influence the sensitivity of the system are "presence or likelihood of going to a health center" and likelihood of having symptoms, especially in coastal areas and Amazonia.

Related to Input, in the leptospirosis surveillance program, these aspects include the availability of manpower and supporting facilities. Human resources at local health centers indicate that 70% of health workers have undergone training related to leptospirosis, either in control programs or zoonosis programs, with the number of training sessions or seminars ranging from 1 to 2 times. All leptospirosis control officers have double roles such as conducting outreach, advocacy, case detection, risk factor control, technical guidance, and

reporting.[9] Research conducted by Wikansari et al. shows that 67% of officers have dual roles, which greatly increases their workload as they have to handle more than one program at a time. This situation causes the focus on leptospirosis control to be divided, resulting in delayed responses to cases, suboptimal surveillance activities, and a decline in program implementation quality. Therefore, the limited human resources who are assigned multiple tasks can affect the effectiveness of program goal achievement.[10] Meanwhile, another research identified that input aspects include untrained personnel, limitations in communication media, information, and education (KIE), as well as high workloads. This shows that weaknesses in human resources and supporting facilities can hamper the effectiveness of the program. Untrained officers are at risk of being less accurate in early detection and case management. Limitations in communication, information, and education (KIE) media have an impact on the low reach and understanding of the community regarding leptospirosis prevention. Meanwhile, high workloads, including those resulting from double roles, cause the program's focus to be divided, resulting in suboptimal leptospirosis control. [11] In addition to the availability of labor and facilities, funding and planning are also included in the input category. The facilities and tools available for leptospirosis control in Boyolali District include technical guidelines, case recording and reporting forms, educational tools, communication tools, Leptospirosis Rapid Diagnostic Tests (RDTs), examination support tools, and medications. Meanwhile, at the Health Office of Salatiga District, the availability of data processing tools is still not optimal, and transportation facilities are insufficient to meet the needs.[9] Funding sources come from Health Operational Assistance (BOK) for community health centers and the State Budget (APBN) for the Health Office. The entire budget is sufficient to support control activities.[9]

About process, we discuss this item following planning, implementation, and partnership. First is planning, leptospirosis control planning includes target setting and mapping, which covers monitoring endemic areas, detecting cases in animals, and mapping regions. Based on the results of observations, 60% of community health centers and health offices have set targets for observing endemic areas.[9] However, not all community health centers have optimally implemented the Early Warning Alert and Response System (EWARS) planning.[10] Data was collected by identifying cases of leptospirosis, with most cases in Boyolali Regency being found in hospitals.[12]

Related to implementation, the identification of leptospirosis cases is carried out passively through data collection based on reports from hospitals. Leptospirosis diagnosis is confirmed through Rapid Diagnostic Test or RDT.[15] The implementation of the Early Warning Alert and Response System (EWARS) at the community health center level includes early detection of extraordinary events (KLB), meetings at the community health center level, cross-program and cross-sector meetings, monitoring of local areas, reporting and recording, and identification and follow-up of issues in the EWARS program. However, not all PHC carry out all these stages comprehensively.[10] The data collection process begins with the identification of leptospirosis cases. To date, most cases of leptospirosis for example (for example) in Boyolali District have been detected in hospitals. Routine reports from community health centers are submitted through the Integrated Community Health Center Recording and Reporting System (SP2TP), and since leptospirosis is classified as a potential epidemic disease, weekly reports (W2) are required. Reported cases include suspected cases and confirmed cases, which are then recorded in the register based on reports from community health centers and hospitals.[11] According to the Indonesian Ministry of Health, data processing is a stage that is carried out to facilitate data analysis. This stage is intended to prepare data so that it can be easily handled during analysis and is free from errors. In general, data

processing can be done manually or computerized using software according to user needs.[13] Data analysis and interpretation of results are essential to complement the objectives of case reporting and monitoring of prevalence cases. Collected data must be analyzed and interpreted immediately because the purpose of surveillance is not only to calculate the incidence of disease but also to identify problems quickly so that intervention efforts can be carried out immediately to reduce further risks.[14] Leptospirosis surveillance includes data collection, recording, compilation, analysis, and interpretation, as well as the dissemination of epidemiological information.

Regarding supervision, the purpose of supervision is to conduct continuous monitoring of the implementation of the P2 Leptospirosis program, which includes planning, patient care, recording and reporting, as well as the provision and distribution of RDT. Supervision by the District/City Health Office of community health centers is conducted three times a year, conjunction with other programs.[11] Supervision activities aim to improve staff performance through maintaining competence and enhancing work motivation. Supervision is a crucial element in the guidance and control of the program. However, the EWARS program only receives supervision once a year or during an Extraordinary Event (KLB). This situation indicates limitations in terms of resources, both human and financial, which prevent supervision activities from being carried out optimally and continuously. In fact, regular supervision is very important to ensure data quality, reporting compliance, and early response to potential outbreaks. As a result, monitoring activities rely more on weekly routine reports from community health centers, while field supervision is considered sufficient on an annual basis or when there is a spike in cases. However, this pattern has the potential to weaken the early detection function because infrequent supervision can reduce opportunities to identify technical problems, provide direct guidance, and strengthen the capacity of field officers.[12] The implementation of monitoring and evaluation of the leptospirosis control program in Semarang City in 2018 has been applied in every health center with varying schedules. Some health centers conduct evaluations every month, every three months, and some only when cases arise. These differences occur because each health center adapts to internal policies, resource limitations, and the workload of staff who often juggle other programs. As a result, monitoring and evaluation have not been carried out uniformly, so the effectiveness of the program may vary between health centers.[15] Evaluation of the surveillance system needs to be carried out as a complementary strategy by public health workers and stakeholders.[16]

The last point is about partnership, collaboration between the Health Office and the Agriculture Office has not been optimally established, so information related to leptospirosis has not been fully conveyed to the Agriculture Office.[9] Leptospirosis control should be based on the One Health concept, which emphasizes multidisciplinary collaboration to achieve the best health for humans, the environment, and animals. Efforts to address and intervene in leptospirosis should be focused on areas with moderate to high risk levels.[17] About Output, in general the output aspect shows that a reporting and recording system is already in place, but the quality, timeliness, and completeness of information remain major challenges. Program output should not only consist of administrative reports, but also include in-depth epidemiological analysis, regular publication of epidemiological bulletins, and policy recommendations that can be immediately followed up. Thus, the success of the output is not only measured by the number of reports submitted, but also by the extent to which these reports provide a solid basis for rapid response, prevention, and control of leptospirosis in endemic areas.

CONCLUSION

Based on a review of relevant studies, surveillance and response programs for leptospirosis in Indonesia still face various challenges. Input aspects show limitations in trained health personnel, maximum availability of diagnostic facilities, and human resources with multiple workloads. In terms of process, the planning and implementation of leptospirosis control programs are still not optimal, especially in terms of cross-sector coordination, more proactive data collection, and more systematic dissemination of epidemiological information. In terms of output, a system for reporting and recording leptospirosis cases is in place, but it still faces problems related to timeliness, completeness, and quality of reports. Delays in report submission and limited epidemiological analysis result in suboptimal information for decision-making. In addition, the publication of epidemiological bulletins and dissemination of surveillance results are still inconsistent, limiting their use as a source of information and as a basis for public health policy.

Declarations

Authors' contribution

SS and YW were designing the idea. DA was doing data collection, analysis, and writing the rough draft of the article. SS and YW were reviewing the article.

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Conflict of interest

There is no conflict of interest in this research.

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