

## EVALUATION OF DIPHTHERIA SURVEILLANCE SYSTEM IN KEDIRI REGENCY, EAST JAVA PROVINCE

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### **Abstract**

**Introduction:** There were 954 cases of diphtheria in 170 regencies or cities in 30 provinces in Indonesia with a CFR of 4.6% in 2017 and 48% of cases of diphtheria came from East Java. Kediri is one of the regencies that had been affected by the outbreak in January 2018 and found 19% of toxigenic positive cases from 21 cases of diphtheria until May 2018. The diphtheria outbreak which occurred in the Kediri Regency had prompted the needs for the evaluation of the diphtheria surveillance system.

**Objective:** The present study aimed at the evaluation of the simplicity attribute and indicators for the diphtheria surveillance performance in the Kediri Regency, East Java Province, in Indonesia.

**Methods:** The present study was conducted from April 2018 to May 2018. The researchers carried out interviews with the stakeholders from the surveillance and immunization section of the Health Office in the Kediri Regency and conducted a retrospective record review of the diphtheria report, investigation form, and the laboratory report from January 2018 to May 2018. Also, the researchers adapted the 2001 CDC guidelines on surveillance to assess the simplicity and Indicators for the diphtheria surveillance performance from the guidelines for prevention and control of diphtheria from the Indonesian Ministry of Health, 2017. The results from the indicators were compared to WHO's (2017) that recommended performance indicators to accurately meet the objectives of the surveillance.

**Results:** According to the stakeholders, the diphtheria surveillance system was simple in case finding, recording-reporting, and feedback, but it was not simple in the logistics support (Diphtheria Anti Toxin), specimen collection and data analysis. The indicators of the evaluated-surveillance performance comprised eight indicators, in which seven indicators had met the WHO target ( $\geq 80\%$ ), including completeness of reporting (100%), timeliness of reporting (100%), adequacy of investigation (100%), timeliness of investigation (100%), specimen collection (100%), timeliness of specimen transport (90%) and timeliness of reporting laboratory results (100%). The indicators of the timeliness of specimen collection had not reached the target (42.85%).

**Conclusion:** This evaluation showed that the diphtheria surveillance system was simple, but not simple in the logistics support (Diphtheria Anti-Toxin), specimen collection and data analysis. Of the eight surveillance performance indicators, seven of them met the target ( $\geq 80\%$ ).

**Keywords:** *Diphtheria, Surveillance, Evaluation, Indicators, Kediri Regency*

### **Introduction**

Diphtheria is caused by *Corynebacterium diphtheriae* and it usually appears as membrane pharyngitis although it also appears in other layers of membrane disease. *Corynebacterium diphtheriae* produces toxins that cause tissue necrosis, airway duct damage and myocarditis which triggers heart failure to death (1). Diphtheria is a worldwide disease, especially found in tropical countries including Indonesia (2). Indonesia ranks second in the world after India regarding the Diphtheria case discovery in 2011-2015 with a total case finding of 3,203 cases (3). The number of Diphtheria cases in 2017 in Indonesia was 954 cases and spread to 170 Kediri Regencies or cities with a CFR of 4.6%.

The highest case of diphtheria was found in East Java (4). The report of diphtheria cases in East Java was 489 cases in 2017 and 16 cases of death spread across nine Kediri Regency (5). Kediri Regency has occupied the fourth position with the most cases of Diphtheria in East Java from January 2018 to April 2018 with a total of 21 cases (6). From 2016 to 2018, the discovery of Diphtheria cases in the Kediri Regency continued to increase. The cases of diphtheria in the Kediri Regency have increased in the last three years. The highest case occurred in 2018 with 21 cases. In the last three years, there have been 16 suspected cases and five cases of diphtheria with the confirmation of the toxigenic positive *C. diphtheriae* laboratory, i.e. one case with *gravis* variants and four cases with *mitis* variants (7). Confirmed cases are suspected diphtheria cases with positive *C. diphtheriae* strain toxigenic or PCR (Polymerase Chain Reaction) positive *C. diphtheriae* confirmed by the Elek test (8).

Inadequacy of surveillance and response in any country can endanger the population. Many

developing countries often do not have a sufficient capacity to immediately detect and adequately respond to an outbreak (9). The case of diphtheria, which had a more than two-fold increase from 2017 to 2018, needs to be followed up or implemented. All cases of diphtheria (suspected, probable and confirmation) must be immediately addressed so that morbidity and mortality can be reduced (10). One of the efforts to control and the mitigation of diphtheria is to strengthen the diphtheria surveillance system. The Diphtheria surveillance aims to obtain and provide information in order to direct the control and mitigation of diphtheria effectively and efficiently (8). The diphtheria outbreak that occurred in the Kediri Regency encouraged the need to evaluate the attributes of the surveillance system, i.e. the simplicity and the indicators of the diphtheria surveillance performance at the Health Office of the Kediri Regency.

### **Method**

A descriptive study with an evaluation study design was used in the present study. The design of the evaluation study was conducted to see and to assess the implementation and achievement of the activities or programmes that were being or had already been carried out to improve and fix the activities or programmes. In addition, an evaluation study also aims to assess the performance of the surveillance system (11).

This research was conducted from April 2018 to May 2018. The researchers conducted interviews with the stakeholders from the supervision and immunization department at the Kediri Health Department and conducted a retrospective review of the records from the diphtheria outbreak reports, investigative forms, and laboratory reports from January 2018 to May 2018.

The sample was representative of *Puskesmas* from each of the four regions (north, west, east and south) in the Kediri Regency. After the whole *Puskesmas* sample was found, a sample was then taken based on the division of the four regions with a Proportional Random Sampling so that the northern region (three *Puskesmas*), western region (three *Puskesmas*), eastern region (four *Puskesmas*) and southern region (three *Puskesmas*) are added up so that the results of the *Puskesmas* sample calculation are 13 *Puskesmas*. The researchers did not take the entire *Puskesmas* since the number of all the *Puskesmas* in the Kediri Regency was high (37 *Puskesmas*) and they had only a limited research time.

The research informants were the Head of Health Office of the Kediri Regency and the staff from the surveillance and immunization section, and surveillance staff at the Centres for Public Health consisting of 13 Centres for Public Health or better known as *Puskesmas*. The researchers assessed the diphtheria surveillance attribute, i.e. simplicity. Simplicity is a condition when surveillance officers can operate or carry out every stage of the Diphtheria surveillance system easily, including case finding, providing logistical support, specimen collection, specimen transport, recording and reporting, data analysis and feedback (8,12). The surveillance guidelines from CDC (2001) and guidelines for the prevention and control of diphtheria of the Indonesian Ministry of Health (2017) were adapted to assess the simplicity of the diphtheria surveillance. In addition, the Indicators for diphtheria surveillance performance were assessed, including the completeness of reports, the accuracy of reports, adequacy of investigation, the accuracy of investigation, specimen collection rates, the accuracy of specimen collection, the accuracy of specimen delivery and the accuracy of specimen examination results. These indicators were adapted and compared to the Surveillance Performance Indicators of the WHO Vaccine-Preventable Diseases Surveillance Standards (2017). Below are the suggested surveillance indicators proposed by WHO (2017) in Table 1.

## Results

### Simplicity

Based on the results of in-depth interviews with the surveillance staff from the Health Office of the Kediri Regency and *Puskesmas*, it can be concluded that the classification of simplicity at each stage of the diphtheria surveillance is presented in the Table 2.

**Table 2:** Simplicity of Diphtheria Surveillance System in Kediri Regency

No	Stages of the Surveillance System	Results
1	Case Finding	The diphtheria case found by Staff of Health Office is relatively simple because the health workers of the hospitals in work area of the Health Office also reported when there were diphtheria cases. The diphtheria case finding at <i>Puskesmas</i> was also relatively simple because the case definition was clear. Simplicity on case finding was 85%.
2	Logistics Support	Logistics includes; personal protective equipment (surgical masks, gloves and headgear), AMIES transport and antibiotics (erythromycin) were simple, but not simple on Diphtheria Anti Toxin (DAT).
3	Specimen Collection	Specimen collection was not simple.
4	Specimen Transport	Specimen transport was simple.
5	Recording and Reporting	Recording and reporting were relatively simple because the filling format was clear and easy to understand by the surveillance staff.
6	Data Analyzing	Data analysis was difficult (not simple) for most surveillance staff in <i>Puskesmas</i> . Simplicity on data analyzing was 38%. The surveillance staff at the Health Office also found it difficult to analyze the data.
7	Feedback	Feedback was simple because the target (community, related agencies) was cooperative and able to receive good feedback.

**Table 1:** Indicators for diphtheria surveillance performance

Surveillance Attribute	Indicator	Target	How to calculate (Numerator/Denominator)
Completeness of reporting	Percentage of designated sites reporting diphtheria data, even in the absence of cases (zero reporting)	≥ 80%	Total number of reports received/total number of reporting sites x 100 (for given time period)
Timeliness of reporting	Percentage of surveillance units reporting to the national level on time, even in the absence of cases	≥ 80%	number of surveillance units in the country reporting by the deadline/number of surveillance units in the country x 100
Adequacy of Investigation	Percentage of all suspected diphtheria cases that have had an adequacy of investigation	≥ 80%	Number of suspected cases of diphtheria for which an adequacy of investigation was done/number of suspected diphtheria cases x 100
Timeliness of investigation	Percentage of all suspected diphtheria cases that have had an investigation initiated within 48 hours of notification	≥ 80%	Number of suspected cases of diphtheria for which an investigation initiated within 48 hours of notification/number of suspected diphtheria cases x 100
Specimen collection rate	Percentage of suspected diphtheria cases with two specimens collected (pharyngeal swab and a nasal swab)	≥ 80%	number of suspected cases of diphtheria with 2 specimens collected/number of suspected diphtheria cases x 100
Timeliness of specimen collection	Percentage of suspected diphtheria cases with specimens taken before antibiotic administration	≥ 80%	number of suspected cases of diphtheria with a specimen collected before antibiotics/number of suspected diphtheria cases with a specimen collected x 100
Timeliness of specimen transport	Percentage of specimens received at the laboratory within 2 days of collection	≥ 80%	number of specimens received within 2 days of collection by laboratory/number of specimens x 100
Timeliness of reporting laboratory results	Percentage of specimens tested by culture with results reported within 3 days of receipt of specimen	≥ 80%	number of specimens tested by culture with results reported within 3 days of specimen receipt/number of specimens tested by culture x 100

Table 2 shows that the case finding in hospitals by the surveillance staff from the Health Office is relatively simple, because in addition to the surveillance staff, the hospital also actively reported the diphtheria cases found to the Health Office of the Kediri Regency. Whereas, the case finding in the *Puskesmas* can be found in the static services as well as the field visits in the *Puskesmas* working area.

The diagnosis of diphtheria was felt to be easy and clear by the staff since it had a distinctive sign of greyish white pseudomembrane and 11 out of 13 *Puskesmas* (85%) stated that the diphtheria case finding was simple.

The supply of logistical support at the Health Office was relatively easy for the supply of PPE, AMIES and erythromycin. However, the Health Office of the Kediri Regency encountered obstacles in the supply of DAT because the availability of DAT in the province was also limited, while the source of procurement of DAT at the Health Office of the Kediri Regency was only taken from the Provincial Health Office. Meanwhile, the supply of PPE logistics (surgical masks, gloves and headgear) in the *Puskesmas* are classified as easy to be available and to procure. The collection of specimens was carried out by the laboratory staff from the Health Office. According to the laboratory personnel, the diphtheria specimens taking was "neither easy nor difficult". It was said to be difficult because the patients whose specimens were taken had felt uncomfortable while being swabbed in their throats and noses, so that the collection of the specimens did not reach the target. On the other hand, it was easy because when the specimens were taken, they only did a little and short rubbing around the pseudomembrane.

The specimens' delivery was relatively easy according to the surveillance staff. The specimens that had been collected were put into a cooler and then packed in a Styrofoam box and then sent to the province. The delivery had also arrived on time and the specimens in

the cooler box were sent to the National Laboratory in Surabaya for examination.

The recording of the diphtheria data was also relatively easy because the filling format on forms W1 and Diph-1 was clear and easy to understand by the surveillance staff. Likewise, with the reporting format, i.e. the Early Warning System (EWARS) and integrated disease surveillance report, it was also clear and easy to understand for its filling and reporting by the surveillance staff of the *Puskesmas*.

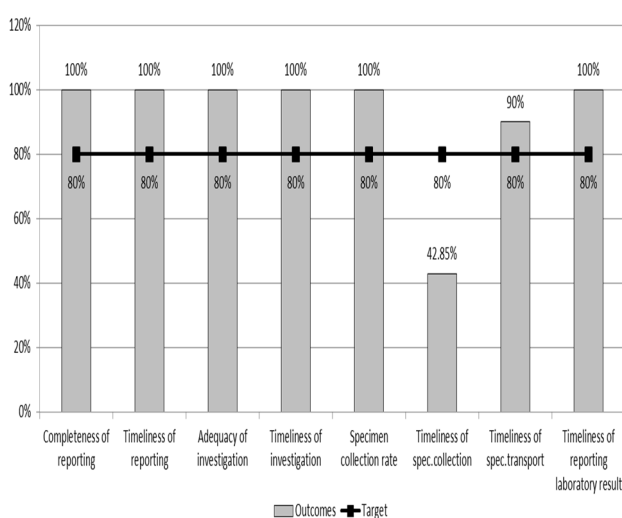
According to some staff from the *Puskesmas*, the data analysis was simple since there were few diphtheria cases. However, most of the surveillance staff found it difficult to analyze the data due to a limited time to do the analysis and multiple workloads, so they had not had enough time to finish the analysis. Since most of the surveillance staff found it difficult to analyze the data during the in-depth interviews, it can be concluded that the data analysis is classified as not simple.

The feedback made by the *Puskesmas* and the Health Office to the respective feedback targets from the results of the in-depth interviews, most of the surveillance staff stated that the target of feedback was also cooperative and they were willing to accept the material delivered by the *Puskesmas* and the Health Office.

#### ***Indicators for Diphtheria Surveillance Performance***

The indicators for the diphtheria surveillance performance were eight indicators. Based on the results from the report on the document analysis, the integrated disease surveillance in *Puskesmas* and the results of the laboratory examination from the national laboratory performed in the Surveillance and Immunization Section of Health Office of the Kediri Regency, the performance of the diphtheria surveillance system in *Puskesmas* can be rate shown in Figure 1.

Figure 1 shows that the evaluated indicators of performance were 8 indicators, in which 7 of them have reached WHO's target (>80%). The indicator of specimen collection has not reached the target (42.85%), so there were 57.15% of suspected cases of diphtheria with a specimen collected after the antibiotics. Based on the results of the in depth interviews with the staff of *Puskesmas* and the Health Office, the main reason for not achieving the indicator for timeliness of specimen collection is the lack of laboratory staff competency of the *Puskesmas* to take the samples, so the patients were first given the antibiotics while waiting for the laboratory staff to arrive from the Health Office that took a longer time.



**Figure 1:** Indicators and Achievements of Diphtheria Surveillance Performance in Kediri Regency

## Discussion

### Simplicity

The simplicity of a surveillance system includes simplicity in terms of structure and ease of reporting and the operation flow. The surveillance system should be designed as simply as possible, but still be able to achieve the intended goals (12).

The diphtheria case finding was relatively simple. The supply of logistical support tended to be easy. However, the supply of logistics to DAT had been difficult because the DAT stock depends on the availability in the Province so

that the stock of ADS in the Health Office was not always fulfilled. The supply of diphtheria surveillance in *Puskesmas* including PPE (surgical masks, gloves and headgear) was always easily available. Most of the supply of the logistics support is categorized as simple.

The collection of specimens was quite difficult because according to the laboratory staff who was in charge of taking the specimens, it needed expertise, patience and a high flight of hours or multiple experiences to be able to take the specimens appropriately. Therefore, the collection of specimens was classified as not simple.

The delivery of the specimens was carried out by the Health Office, but it should have been done by the *Puskesmas* that should have sent the specimens. The delivery of the specimens at the Health Office was relatively easy since the packaging was also not difficult and the delivery of the specimens was deposited via travel which could be certain to reach the destination (Surabaya National Laboratory) in less than two days (8).

Recording and reporting were relatively simple. However, the data analysis was classified not simple because even though there are few diphtheria cases, most of the staff had not carried out the data analysis due to multiple workloads. Data analysis is performed using descriptive epidemiological methods and/or analytics to produce information that is in accordance with the objectives (13).

Feedback in Health Office and *Puskesmas* was relatively easy since the parties who had received information tended to be cooperative and supporting facilities for the information were also available. The feedback is useful for providing information to data sources in order to improve data quality (13).

### Indicators for Diphtheria Surveillance Performance

Surveillance should be evaluated at least yearly to ensure that the surveillance system is able to meet the objectives of the surveillance

accurately. Based on the evaluation results from the eight indicators for the diphtheria surveillance performance at the Health Office of the Kediri Regency, seven of them have met the national target of > 80%, while there is one indicator that has not yet reached the national target, i.e. the accuracy of specimen collection of 42.85%.

The accuracy of specimen collection is seen from the proportion of suspected diphtheria cases taken before the administration of the antibiotics (8). Patients who have been treated with antibiotics before the specimen is taken can cause the results of the specimen examination to be negative, this is because the quality of the specimen decreases (14).

### **Conclusion**

This evaluation revealed that the diphtheria surveillance system was simple but not simple in the logistics support (Diphtheria Anti-Toxin), specimen collection and data analysis. By the eight surveillance performance indicators, seven of them had reached the target ( $\geq 80\%$ ). The indicator of timeliness of specimen collection had not reached the target (42.85%), so there were 57.15% of the suspected diphtheria cases with a specimen collected after the antibiotics. It could make the negative results from the laboratory test of the specimens.

### **Limitation**

The limitation of the present study was that not all the *Puskesmas* in the Kediri Regency were evaluated due to the limited time, energy and long distance from the researchers's location.

### **Suggestion**

Most of the surveillance staff of the *Puskesmas* still have not analyzed the data, so it is necessary to increase the competency of the surveillance staff to analyze data and enable to interpret it into accurate information. In addition, it needs certain training for the laboratory staff regarding the specimen collection so that they will be able to immediately take the specimens when there are diphtheria cases without waiting too long

for the laboratory staff of the Health Office to collect the specimens. Finally, after the specimens are taken by the laboratory staff of *Puskesmas*, the patients can immediately be given the antibiotic treatment.

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### **Ethical Clearance**

This research was approved by the Ethics Committee of the Faculty of Public Health Universitas Airlangga, Surabaya, East Java Indonesia (No: 622-KEPK).

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