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Visualization and Data Analysis of Measles Incident in the Sukorejo I Community Health Center Work Area

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Abstract: Data visualization is becoming important in the health sector, which is developing along with the times. Data visualization can be used as a reference material for the control and prevention of infectious disease. Measles is a disease caused by a virus from the Paramyxovirus group, measles is easily transmitted and can cause complications and even death. Data on the distribution of measles is limited in the form of descriptions and cannot be disseminated widely and easy to understand. The aim of this study was to visualize measles distribution data using web media and analyze the distribution of measles in the working area of Sukorejo 1. This study uses a mixed method design, descriptive and in-depth interview and uses entire case population in the Sukorejo 1 health center work area. Measles outbreak often occur at the age of five and six year and more common girls than boys. The distribution pattern of measles outbreak is clustered and can be identified by the characteristic of school and residence. A web display is generated containing a diagram related to measles distribution. Analysis shows that more measles cases occur in Sukorejo ward. It is hoped that these results will help community health center officers and health services in planning the handling and management of measles cases.

Keywords: Extraordinary incident; Measles; Outbreak; Visualization

Introduction

Data are raw facts or observations that are used to provide information. Data visualization is becoming important in the health sector, which is developing along with the times (Battineni et al., 2021; Usharani et al., 2022). Data visualization can help to make it easier to understand data presentation and can assist efforts to control and prevent measles based on case mapping (Rao et al., 2019). An extraordinary incident (outbreak) is the emergence or increase in the incidence of morbidity and/or mortality that is epidemiologically significant and occurs in a certain area within a certain period of time, and is a condition that can lead to an epidemic. Investigation of an outbreak is an important process in epidemiology and public health. One of the infectious disease that causes outbreak in several region is measles, which is an acute infectious disease caused by a virus from the *Paramyxovirus* group that attacks the respiratory tract and mucous membranes (Moss & Griffin, 2023).

Measles has symptoms of cough, runny nose, fever and typical rash and can cause serious complications and even death (Islam et al., 2023; Nwalozie et al., 2023; Sarawarastri, 2023). The incidence of measles is estimated to be 12 – 18 times higher than other common childhood disease others (influenza dan pertussis) (Gastañaduy et al., 2021). Until this day, measles is still responsible for more than 100.000 deaths each year (Sato & Chatterjee, 2023). Adegboye et al. (2024) also predict that measles cases will continue to increase along with globalization activities including increasing international imports and exports. Measles can also cause economic losses based on research conducted in

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Clark County in 2019 (Pike et al., 2021) measles can cause economic losses of $2.376.048.48 or the equivalent of 38 million rupiah.

Measles is an endemic disease in Indonesia and is reported every year, but since 2022, measles cases in Indonesia have increased significantly (Chacko, 2023). A total of 2.161 suspected measles cases occurred during a two months period between January 1 – April 3, 2023 (Sitepu et al., 2020). In Kendal district, Central Java health data from Sukorejo 1 health center states that there have been 21 cases of measles. Data visualization is needed in measles outbreaks which can help identify factors that influence the spread of measles. This study aims to visualize measles distribution data using web media and analyze measles distribution in the Sukorejo 1 health center work area. In previous research, it was shown that the variables that were the highest risk factors for measles were housing density, maternal knowledge, immunization status and nutritional status (Ramadhani et al., 2023). What distinguishes this research from previous research is that this research uses the variables of gender, age, school and sub-district.

Based on the preliminary study that has been conducted, it was found that there were measles cases in Kendal Regency, precisely in the working area of Sukorejo I Health Center, so the researcher was interested in conducting a field study on the measles outbreak case at Sukorejo I Health Center.

Method

Figure 1. Sukorejo I Health center work area map

This study uses a mix method design, namely descriptive and in-depth interview, using the entire population of cases in the Sukorejo 1 health center work area. While in-depth interviews are done to find out the chronology and efforts that have been made by the health center. According to Sugiyono (2017), semi-structured interviews aim to find problems more openly, where the informant can express his/her opinion. Therefore, researchers need to record what is stated by the informant. Semi-structured interviews are categorized into in-depth interviews.

The area of the research location is the working area of Sukorejo I Health Center which is one of the health centers in Kendal Regency, Central Java Province. The working area of Sukorejo I Health Center is 40.53 km^2 with 10 wards/sub-districts. The working area of Sukorejo I Health Center borders Pageruyung District, Sukorejo I District, Plantungan District, and Temanggung Regency.

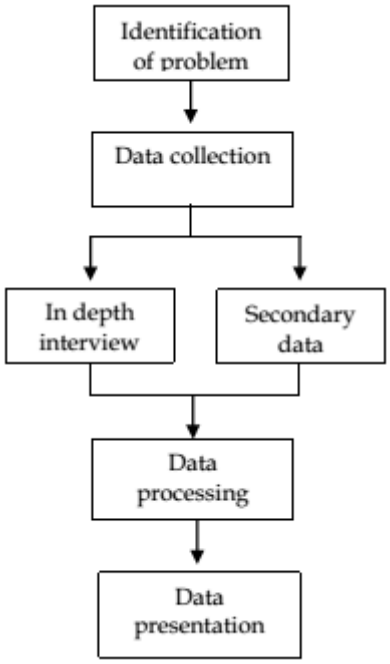

Figure 2. Research flow chart

Interview

Interviews are conducted by asking questions to the subjects (Taherdoost, 2022). The form of questions given is open-ended questions to explore chronological information. The questions given are based on previously prepared guidelines. These guidelines are designed to follow the theme and are followed by several additional spontaneous questions.

The following are the guidelines used in this study: respondent identity (name, age, address); place; the flow of events from the appearance of symptoms to being

confirmed positive; and efforts by health centers to overcome.

Observations were made by looking at health center report data as a secondary data source related to the distribution of measles outbreak s. Triangulation is done to compare information from different sources to provide reasonable justification of the information that has been collected. The information that has been obtained is immediately evaluated and combined in the researcher's notes, then data reduction, presentation and interpretation of data are carried out.

The technique used is triangulation. In the triangulation method, it can be done in various ways, namely comparing interview data on a person's circumstances and perspectives with various opinions and views of people, comparing interview results with the contents of a related document. The discussion is carried out descriptively on the elements of input, process and output. Researchers also use validity testing of the data that has been obtained using triangulation source triangulation and triangulation method.

Results and Discussion

Research Result

Visualization of Measles Case Distribution Data

The research results contain a visualization of health data on the ArcGIS StoryMaps page. The designed web page can be accessed via the web address https://arcg.is/T0Gej0.

Figure 3. Web view

Measles cases are included in the Outbreak which must be managed immediately. Measles is included in the Outbreak because it can cause many people to be attacked, the area affected is wide and the transmission is fast. Measles is determined as an Outbreak if there are at least 2 confirmed positive cases of measles. The following are the results of research conducted in the work area of Sukorejo I Health Center.

Table 1. Distribution of Measles cases by Gender

Gender	Frequency	Percentage (%)
Man	7	67
Woman	14	33

Table 2. Distribution of Measles Cases by Age

Age (years)	Frequency	Percentage (%)
5	5	23.80
6	8	38.09
7	2	9.52
8	2	9.52
10	1	4.76
13	1	4.76
14	1	4.76
24	1	4.76
Total	21	99.97

Table 3. Distribution of Measles Cases by School

School	Frequency	Percentage (%)
Community Development School	8	38.1
Nurul Qur'an Elementary Level Memorization School	1	4.76
Muhammadiyah 2 Elementary School, Kebumen	2	9.52
Ibn Aba Klaten Islamic Boarding School	1	4.76
Darul Muslikhin Islamic Boarding School	1	4.76
Salimah High School	8	38.1

Table 4. Distribution of Measles Cases by Sub-district

Ward	Frequency	Percentage (%)
Ngargosari	1	4.76
Purwosari	6	28.57
Bringinsari	1	4.76
Mulyosari	2	9.52
Kalibogor	2	9.52
Thank you	2	9.52
Sukorejo	7	33.33

Table 3. Distribution of Measles Cases Based on Immunization Status

Measles immunization status	Frequency	Percentage (%)
Yes	1	4.76
No	20	95.24

Epidemiological Investigation

Measles has occurred in Sukorejo District 5 years ago where measles should have been eliminated. However, in 2023, the first new case of measles appeared in Sukorejo, precisely in Trimulyo Ward. On Wednesday, May 25, 2023 at 07.00 WIB, Sukorejo I Health Center received a report from the Independent Midwife in Trimulyo Ward who reported that there was a patient with measles symptoms such as fever, cough, runny nose, red rash, and no history of previous

immunization on behalf of MFI, male, 8 years old, residing in Sukorejo ward.

On May 25, 2023 at 07.00 WIB, a suspected case of measles was reported from the Emergency Unit of Sukorejo I Health Center in the name of RLN, female, 5 years old, domiciled in Sukorejo. From the report, the team coordinated with the Bina Umat school principal at 09.45 WIB on May 25, 2023 together with the ward midwife, laboratory officers and surveillance officers, it was found that 6 students experienced these symptoms, 2 children were siblings in the name of MIA, female, 7 years old and KAR, female, 5 years old.

After from Trimulyo Ward, we continued the search for a suspect named AA, address Mulyosari Ward. A has a playmate and is in the same class with him, named SY, address Kalibogor Ward. Another student from Bina Umat School who is suspected of having measles, named MI, address Sukorejo Ward, with symptoms of fever and cough since May 19, 2023, is still in school, then a red rash appeared since May 22, 2023, MI has not attended school since May 20, 2023. 6 Suspects from Bina Umat School that we found had the last immunization status of Hb 0.

On June 12, 2023 at 07.00 WIB, a patient was found from the report of the Bringinsari ward midwife in the name of BG, address Bringinsari Ward, male gender, 7 months old with symptoms of fever since June 2, 2023 and a red rash appeared on June 11, 2023 with other symptoms of cough, runny nose, red eyes.

On June 12, 2023 at 09.08 WIB, a patient from a midwife in Kalibogor ward named BH, Kalibogor address, was found with symptoms of fever since June 10, 2023, a red rash appeared since June 11, 2023, accompanied by cough, runny nose, red eyes. The last immunization history was a 9-month measles immunization. BH attended the Nurul Qur'an Elementary Tahfid School.

On June 17, 2023 at 11.32 WIB, a patient named AF, 6 years old, female, was admitted to the Sukorejo I Health Center, Sukorejo Ward, with symptoms of fever and a red rash that appeared on June 11, 2023, other symptoms were diarrhea, the last immunization history was Hb0. Attending Bina Umat School.

On June 27, 2023 at 11.52 WIB, Sukorejo I Health Center received a report from the Kalibogor ward midwife that the patient named T, 4 years old, female, address Kalibogor Ward. Having fever since June 18, 2023 and red rash on June 20, 2023, other symptoms are cough, runny nose with a history of complete immunization.

On July 3, 2023 at 09.59 WIB, a patient named ZA, 6 years old, female, was admitted to the Sukorejo I Health Center, Mulyosari Ward, with symptoms of fever since June 27, 2023 and a red rash since July 1, 2023. Other symptoms include coughing and red eyes. The last immunization history was Hb0. Attends school at Bina Umat School.

A total of 13 cases of suspected measles were given 3 doses of vitamin A and self-isolation and blood serum collection for examination, efforts that have been made are cross-sector and cross-program coordination and the Kendal Regency Health Office to be able to carry out the handling of suspected measles cases. From *the suspected* measles examined, on July 27, 2023, the results of 4 negative cases came out in the names of MI, T, BH, and BG.

On Saturday, July 8, 2023 at 07.00 WIB, a patient named MB, aged 10 years, was hospitalized with symptoms of shortness of breath, fever, and a red rash with a history of the last immunization being Hb 0. MB attends SD 2 Muhammadiyah Kebumen and lives in Sukorejo Ward.

On July 15, 2023 at 07.00 WIB, a patient named LR, 24 years old, from Kalibogor Ward, was admitted to the Sukorejo I Health Center Emergency Department. Fever appeared on July 13, 2023 and a red rash appeared on July 14, 2023, the last immunization history was Hb 0, LR is a student in Kalibogor Ward, precisely at the Darul Muslikhin Islamic Boarding School.

On July 18, 2023, Sukorejo I Health Center received a report that MB's older brother, ML, aged 14, was sick with symptoms of fever and red rash. ML went to school at Pondok Ibnu Aba Klaten when MB was sick. ML was already in Sukorejo for school holidays.

In addition to ML, Sukorejo I Health Center received a report on July 18, 2023 that ML and MB's neighbors whose house is right behind them and MB's playmate named RA, aged 8 years, were sick with symptoms of fever and red rash, RA attended SD 2 Muhammadiyah Kebumen, the last immunization history was Hb 0.

On August 24, 2023 at 04.59 WIB, Sukorejo I Health Center through the Ngargosari Ward midwife reported that a patient named K aged 6 years had symptoms of fever and red rash, the fever appeared since August 19, 2023 while the red rash appeared since August 23, 2023, with these symptoms, the ward midwife immediately gave him 2 doses of vitamin A, and carried out self-isolation, the last immunization history was Hb 0, K lives in Ngargosari Ward, goes to school at STTD Salima Purwosari.

On August 25, 2023, our rapid response team from Sukorejo I Health Center consisting of the person in charge of the P2P program, the measles program implementer, surveillance officers, ward midwives, doctors, and laboratory officers carried out case tracking by contacting STTD Salmiah teachers to find close

contacts. According to the teacher, there were 8 children with the same symptoms as K.

On August 31, 2023, the Sukorejo I Health Center rapid response team consisting of the P2P program manager, measles program implementer, surveillance officers, ward midwives, doctors, and laboratory officers conducted a visit to collect samples and manage cases, on behalf of AZ, 13 years old, male, address Bringinsari Ward with symptoms of fever, red rash, cough, runny nose, fever appeared on August 19, 2023, red rash appeared on August 16, 2023, the last immunization history was Hb 0.

A, male, 6 years old, address Desa Purwosari with symptoms of fever, red rash and cough, fever appeared on August 19, 2023, red rash appeared on August 22, 2023, last immunization history was Hb 0.

ZAA is a 6-year-old male with symptoms of fever that appeared on August 23, 2023, with a history of last immunization of Hb 0.

AK is a 6-year-old female with the address of Purwosari Ward, with symptoms of fever and red rash, fever appeared on August 21, 2023, red rash appeared on August 22, 2023, the last immunization history was Hb 0.

IA is a 7-year-old male with Purwosari Ward address with symptoms of red rash fever, fever appeared on August 19, 2023, and red rash appeared on August 21, 2023, the last immunization history was Hb 0.

HN is a 6-year-old female with the address of Purwosari Ward with symptoms of fever and red rash, fever and red rash appeared on August 22, 2023, the last immunization history was Hb 0.

NZ is female, address Purwosari Ward, with symptoms of fever and red rash, fever appeared on August 19, 2023, red rash appeared on August 23, 2023, last immunization history was Hb 0.

Efforts that have been Made by the Health Center

Investigation Flow of Measles Outbreak at Sukorejo I Health Center

Guidelines for the management and prevention of measles have been regulated in (WHO, 2022). The health center received a report of suspected measles through passive surveillance activities through the Ward Midwife or IGD of Sukorejo I Health Center. It was reported that there was a child with measles symptoms. An investigation was carried out within 1 x 24 hours. First, the health center coordinated with the rapid response team consisting of surveillance, measles program holders, laboratories, and doctors. After coordinating, the team immediately went to the field with the available data to meet the child suspected of having measles and then took a blood sample. The sample was sent to the Yogyakarta Labkesda through the Kendal Regency Health Office. After the case report was received to the health center, the health center also immediately notified the DKK because it was for the purpose of mobilizing samples to the Labkesda. In addition to taking samples, the health center also found out the school of origin of the child. After receiving the report, the health center interviewed the principal to find out whether in the last three weeks/28 days (measles incubation period) there were any students who had similar symptoms. After getting information from the principal, the Health Center immediately went to the suspect's house and then took a blood sample from the suspect to be sent to the Yogyakarta Health Laboratory. After getting the results from the Laboratory, the Health Center team immediately made a report on the Measles Outbreak and reported it to the Kendal Regency Health Office.

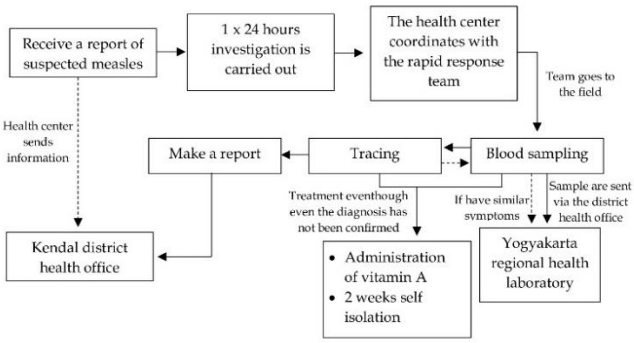

Figure 4. Sukorejo I health center measles investigation flow

Measles Outbreak Reporting Flow at Sukorejo I Health Center

The reporting flow starts from the health center reporting the W1 form and descriptive report to the Kendal Health Office, then the Kendal Health Office sends it to the Central Java Province, then from the Province it is sent to the Ministry of Health.

Obstacles to Investigation of Measles Outbreak at Sukorejo I Health Center

There is no SHP map yet

This map is useful in making it easier for surveillance programmers to describe and understand the distribution of cases, so that the surveillance process in the field can run more optimally. People refuse immunization, refuse to be examined, and experience discrimination from society.

Measles has been designated as an endemic disease in Indonesia (Herini et al., 2021; Rifani et al., 2024; Sari et al., 2019; Zeffira et al., 2024). In recent years, immunization coverage has met the target. However, confirmed cases of measles are still found in the field. Kendal Regency is one of the areas affected by measles

where the largest distribution of cases is in the Sukorejo 1 Health Center work area. Based on the results of the study, the case of measles occurred mostly in the age group of five and six years and occurred more often in girls than boys, it was found that 21 patients who were confirmed positive for measles did not have a history of receiving measles immunization in the complete basic immunization series. Measles sufferers are spread across 7 of the 10 wards in the Sukorejo I Health Center work area and come from 6 different schools. The distribution pattern of measles outbreaks is clustered. The Health Center has conducted an outbreak investigation and reported it to the Kendal DKK to then be forwarded to the Provincial Health Office. From the data visualization summarized in ArcGIS StoryMaps, it was found that the confirmed positive cases of measles were in Sukorejo Ward rather than other wards.

The distribution of measles outbreak can be identified by the characteristics of residence and school. Generally, measles symptoms in the form of fever and typical rash, this is in line with previous research conducted by Jalal et al. (2024). The incidence of measles is correlated with measles vaccination status, where 20 out of 21 measles sufferers had never received the measles vaccine, this is in line with research conducted by Akilbekova et al. (2024) who said that 96% of measles cases are those who did not get the measles vaccination. The high death rate caused by measles is inversely proportional to the low vaccination rate, this was stated by Idé et al. (2022). Although in Indonesia it is mandatory to get complete basic immunization, this is clearly not being implemented due to rejection, lack of awareness of the importance of vaccines, and limited vaccine availability. A study in Uganda conducted by Walekhwa et al. (2021) stated that the second dose of the measles rubella vaccine can increase immunity after receiving the first dose.

Conclusion

Visualization of the distribution of measles cases has been carried out using ArcGIS application and has been disseminated via the web using the ArcGIS StoryMaps application which can provide convenience for customizing the design of the appearance and content of the web. Visualization is done to find out the distribution of measles cases and is done using the ArcGIS application feature. Visualization is the depiction of data in an interactive visual form to make it easier to understand and strengthen observations using the help of fa computer that supports it. Data visualization can be used as a material for decision making for policy makers. The result of the analysis also show that the distribution of measles cases is predominantly located in Sukorejo ward and has a clustered distribution pattern. The result of this study are expected to contribute to health centers in analyzing the distribution of measles and improving the quality and speed of response in the Sukoorejo 1 health center working area.

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Conflicts of Interest
The authors declare no conflict of interest.

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