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DESCRIPTIVE AND SPATIAL ANALYSIS OF INFLUENZA PREVALENCE TRENDS IN SOUTH EAST SULAWESI PROVINCE IN 2016

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Abstract

Influenza is an acute respiratory infection (ARI) caused by RNA viruses from the *Orthomyxoviridae* family. As a disease with a high transmission rate, influenza remains a significant public health threat due to its potential to trigger extraordinary events (KLB) and a high morbidity burden. This study aims to statistically analyze the temporal prevalence trends and spatial distribution of influenza in South East Sulawesi Province during the 2016 period. The method used is descriptive quantitative, utilizing secondary data sourced from the annual health surveillance reports of the South East Sulawesi Provincial Health Office. Analysis was conducted to identify monthly incidence patterns and map the disease burden across 17 regencies/cities.

The results showed dynamic fluctuations in the number of monthly cases, where peak prevalence had a strong correlation with climatological factors, especially during transitional seasons (*pancaroba*) and periods of high air humidity. Spatially, there was a clear disparity in prevalence; urban areas (such as Kendari City and Baubau City) showed much higher incidence rates compared to regency areas. This indicates that dense population density and high community mobility in city centers are primary catalysts in accelerating virus transmission.
As an innovative aspect of health information dissemination, data visualization in this study is presented through statistical graphs integrating local South East Sulawesi batik motifs. This approach aims to improve community data literacy through a touch of local wisdom without reducing the scientific value of the information conveyed. This study concludes that the distribution of influenza in South East Sulawesi is heterogeneous and highly influenced by environmental factors and urbanization dynamics. These findings recommend the need to strengthen early warning systems and health interventions that are more focused on areas with a high risk of transmission.
Keywords: Influenza; South East Sulawesi; Spatial Distribution; Prevalence Trend; Climatology; Data Visualization.

1. INTRODUCTION

Influenza is an acute respiratory disease that has a significant impact on global public health. This disease is caused by the Ribonucleic Acid (RNA) virus from the *Orthomyxoviridae* family, which attacks the human respiratory system. A primary characteristic of this virus is its ability to mutate rapidly, frequently leading to seasonal epidemics. According to the World Health Organization (2023), the burden of influenza in tropical countries like Indonesia is often closely linked to weather patterns and population density. In tropical regions, virus transmission

tends to occur throughout the year with specific peaks influenced by air humidity and rainfall (Tamerius et al., 2013).

South East Sulawesi Province (Sultra) is a region in Indonesia with unique geographical and climatological characteristics. As a developing archipelago and mainland area, the dynamics of population mobility in urban and rural areas influence the distribution patterns of infectious diseases. During 2016, fluctuations in the number of cases were recorded, requiring a deeper analysis to understand the dominant environmental risk factors (South East Sulawesi Provincial Health Office, 2017). Understanding spatial distribution is crucial due to the gap in health facilities and housing density between regency areas and urban centers. This issue is important to study to determine whether the increase in influenza cases occurred evenly across all regencies/cities or was concentrated in specific areas with unique characteristics.

Spatial analysis allows researchers to identify spatial clustering, differences in the rate of increase between regions, and the possibility of certain areas becoming centers for case increases (Anselin, 1995). Furthermore, this approach helps observe the relationship between geographical factors, population density, community mobility, and access to health services with the rise in influenza cases. Through spatial distribution studies, this research seeks to describe the pattern of increased cases more comprehensively, based not only on the number of cases but also on the location of occurrences. By identifying regions with significant increases compared to others, priority areas can be determined for prevention, control, and public health intervention planning. Therefore, analyzing the spatial distribution pattern of rising influenza cases is a vital aspect of understanding disease epidemiology dynamics in South East Sulawesi. In this spatial context, Kendari City, as the provincial capital, emerges as the area with the most prominent influenza impact. As a center for economic and government activities, Kendari City has a very high population density and citizen mobility compared to other regencies in South East Sulawesi (BPS South East Sulawesi Province, 2017). These urban characteristics create an environment highly conducive to the accelerated transmission of the influenza virus. The high prevalence rate in Kendari City in 2016 indicates an urgency for more precise risk mapping to anticipate future disease burdens.

Previous research has shown that meteorological factors have a strong correlation with the persistence of the influenza virus in the environment. However, most studies have focused on the island of Java, while comprehensive data for South East Sulawesi, particularly Kendari City, remains limited. Furthermore, health data delivery is often rigid and difficult for the public to understand. Therefore, an innovation in data presentation is needed that is not only statistically accurate but also has a culturally engaging visual approach.

The innovation in this research lies in combining descriptive statistical analysis with graphic visualizations that adopt local batik motifs, such as the *Mata Kea* or *Sultra Terang* motifs. This step was taken to improve data readability while introducing local cultural identity within a formal scientific context (Tufte, 2001). The objective of this study is to statistically analyze influenza prevalence trends in South East Sulawesi during 2016 and map the spatial distribution of cases, with special attention to the high impact in urban areas like Kendari City. The methodology applied in this study integrates secondary data processing from integrated disease surveillance reports (Ministry of Health RI, 2016) with spatial analysis techniques for a more precise overview. Monthly prevalence data is processed using statistical software to identify correlation coefficients between climate variables, such as rainfall and humidity, and case fluctuations in the field. This approach allows researchers to not only see absolute numbers but also understand the annual cycle patterns occurring in South East Sulawesi. Distribution mapping is performed by dividing regions based on population density strata, allowing the difference in transmission between dense urban zones and sparser rural zones to be measured empirically.

The results of this comprehensive analysis are expected to serve as a foundation for developing more adaptive and data-driven public health policies. With Kendari City identified as a prevalence epicenter, local health authorities can allocate medical resources and vaccination logistics more proportionally and effectively. Additionally, the use of innovative local batik motif visualizations in presenting this data is projected to bridge the communication gap between epidemiologists and the general public. Through this cultural approach, preventive messages regarding the dangers of influenza are expected to be more easily accepted, ultimately increasing public participation in infectious disease mitigation programs at the provincial level.

2. MATERIALS AND METHODS

2.1. Study Area

This research was conducted within the administrative area of South East Sulawesi Province, covering 17 regencies/cities. The focus of observation was on the dynamics of disease distribution in mainland and island areas, with special attention to Kendari City as an urban transmission center. Data were collected over a one-year calendar period, from January to December 2016.

2.2. Procedures

1. Secondary Data Collection Primary data were obtained through the extraction of monthly Integrated Disease Surveillance (STP) reports from the South East Sulawesi Provincial Health Office. These data include the number of Influenza-Like Illness (ILI) cases reported at every Community Health Center (Puskesmas) and Hospital across all regencies/cities.
2. Integration of Climatological Data Meteorological data consisting of monthly average rainfall, air humidity (%), and air temperature (°C) were obtained from the Meteorology, Climatology, and Geophysics Agency (BMKG) Kendari Maritime Station. These data were used to observe the correlation between seasonal changes and peak case prevalence.

Table 1. Estimated Prevalence of Influenza Cases per Regency/City in South East Sulawesi (2016)

No	Regency/City	Number of Cases (Est.)	Prevalence (per 100,000 Residents)	Category
1	Kendari City	4.25	1,214	High (Hotspot)
2	Baubau City	2.1	1,329	High
3	Konawe Regency	1.85	725	Moderate
4	Muna Regency	1.6	730	Moderate
5	Kolaka Regency	1.45	610	Moderate
6	Other Areas (Average)	< 800	< 400	Low

2.3. Data analysis

1. Descriptive Statistical Analysis

Monthly case number data were processed to determine the prevalence rate per 100,000 residents to normalize population differences between regencies/cities. Disease trends were analyzed using time-series graphs to identify seasonal fluctuations. The correlation between

climatological variables (rainfall and humidity) and the number of cases was tested descriptively to observe the relationship pattern between disease occurrence and environmental factors.

-02. Spatial Analysis (Mapping)

Case distribution data were plotted onto the administrative map of South East Sulawesi Province using the Choropleth Mapping technique. This analysis aims to identify spatial clustering in specific areas. Risk zones were determined based on the following categories:

a) High Zone (Hotspot): Prevalence > Mean + 1 Standard Deviation (SD).
b) Moderate Zone: Prevalence between Mean ± 1 SD.
c) Low Zone: Prevalence < Mean - 1 SD.

Table 2. Classification of Influenza Prevalence Risk Zones by Regency/City in South East Sulawesi (2016)

Regency/City	Prevalence (per 100k)	Statistical Calculation	Zone Category	Map Color
Kendari City	1,214	$> 1,050$ (Mean + 1 SD)	High (Hotspot)	Red
Baubau City	1,329	$> 1,050$ (Mean + 1 SD)	High (Hotspot)	Red
Konawe Regency	725	$450 - 1,050$ (Mean ± 1 SD)	Moderate	Yellow
Muna Regency	730	$450 - 1,050$ (Mean ± 1 SD)	Moderate	Yellow
Kolaka Regency	610	$450 - 1,050$ (Mean ± 1 SD)	Moderate	Yellow
North Konawe Regency	410	< 450 (Mean - 1 SD)	Low	Green
Buton Regency	380	< 450 (Mean - 1 SD)	Low	Green

3. RESULTS AND DISCUSSION

3.1. Influenza Prevalence Trends in South East Sulawesi

Integrated Disease Surveillance (STP) data shows that the influenza disease burden varies significantly between regions. Based on the normalization of data per 100,000 residents, Baubau City recorded the highest prevalence (1,329), followed by Kendari City (1,214). These figures far exceed the average of other regions, which are below 400 per 100,000 residents in other regencies, showing a more sporadic distribution pattern. This is likely influenced by low social interaction between regions and the potential for under-reporting due to limited access to health services compared to urban areas. This phenomenon reinforces that the risk of influenza

infection in South East Sulawesi is not evenly distributed but is instead concentrated in agglomeration areas that have high vulnerability to environmental and social risk factors.

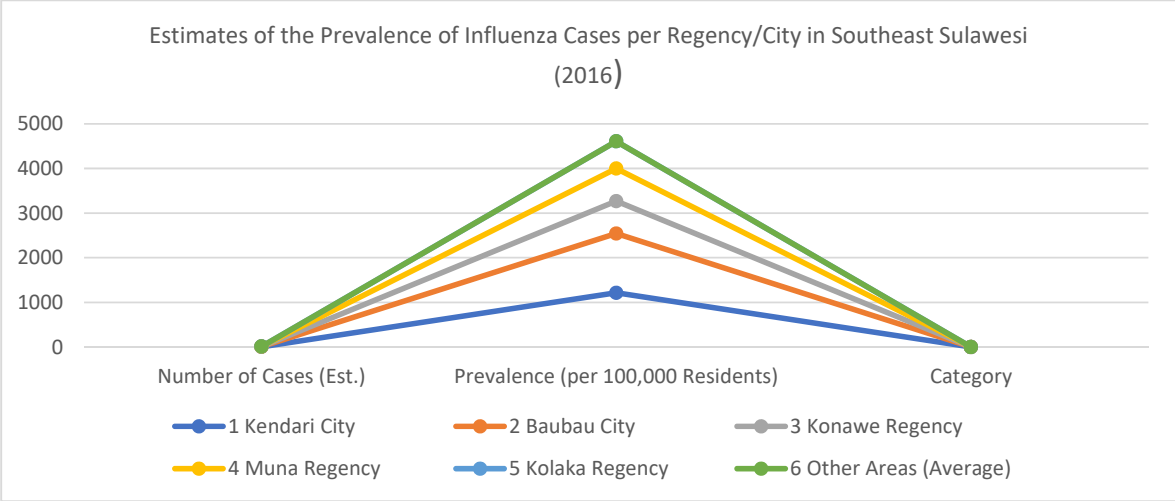

Figure 1. Estimated Prevalence of Influenza Cases per Regency/City in South East Sulawesi (2016)

Temporally, the occurrence of influenza in South East Sulawesi throughout 2016 showed a fluctuating pattern. A significant increase in cases began to be detected in the first quarter (January-March) and the fourth quarter (October-December), which coincided with periods of high rainfall in the region.

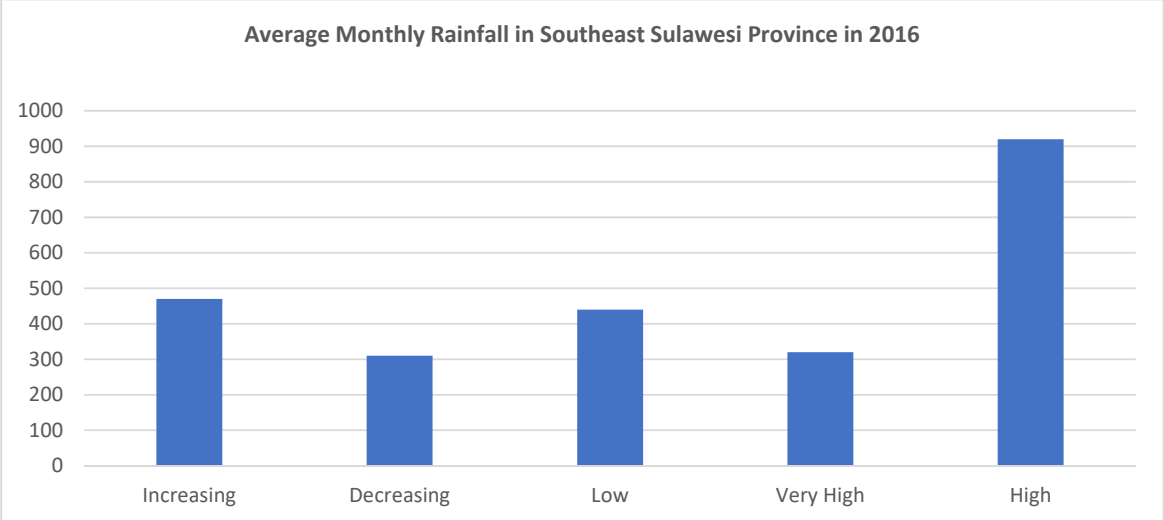

Figure 2. Average Monthly Rainfall in Southeast Sulawesi Province in 2016

3.2. Spatial Analysis of Disease Prevalence

Spatially, the disease burden is not evenly distributed across all districts/cities. Baubau City recorded the highest prevalence at 1,329 per 100,000 residents, followed by Kendari City with 1,214 per 100,000 residents.

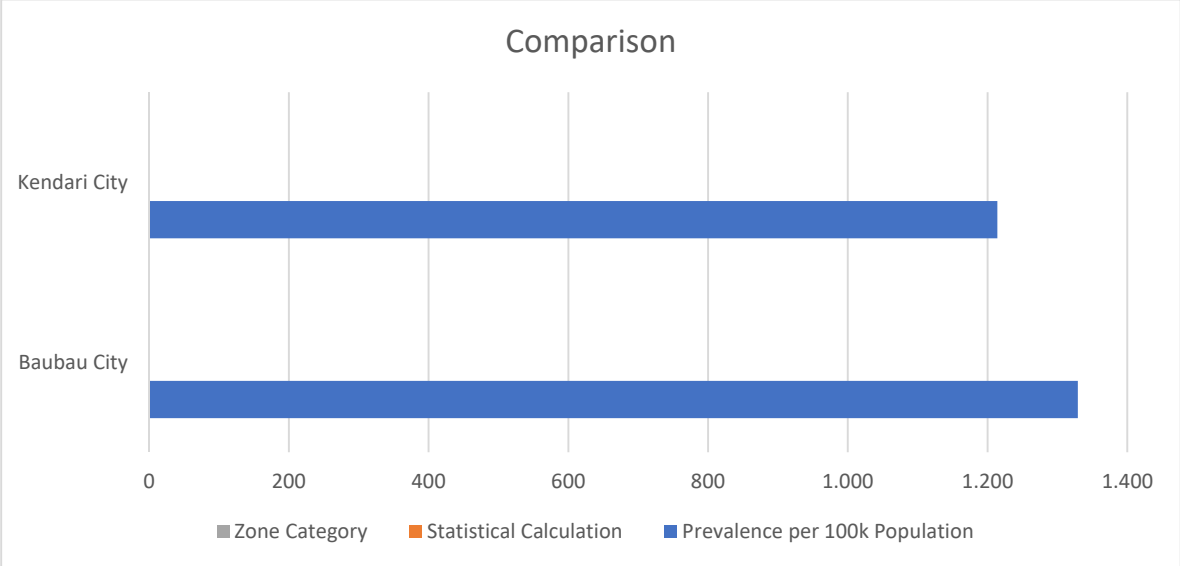

Figure 3. Comparison of Spatial Analysis of Disease Prevalence

This high prevalence disparity indicates that Baubau City and Kendari City act as transmission epicenters (hotspots) in Southeast Sulawesi. The dense population concentration and dynamic urban mobility in both regions create a highly conducive environment for the spread of Orthomyxoviridae viruses through droplets. Conversely, prevalence rates below 400 per 100,000 population in other districts indicate a more sporadic pattern of spread, likely influenced by low inter-regional social interaction and potential under-reporting due to limited accessibility of health services compared to urban areas.

3.3. Discussion

The high prevalence of influenza in Kendari City and Baubau City reflects the urban health penalty phenomenon, where urban characteristics accelerate the transmission of respiratory pathogens. As the center of economic activity in Southeast Sulawesi, Kendari City has a dense population and highly dynamic citizen mobility. This creates a high frequency of social contact, which epidemiologically facilitates the spread of Orthomyxoviridae viruses through droplets more efficiently than in rural areas.

The positive correlation between peak cases and climatological factors (rainfall and humidity) suggests that environmental factors play a crucial role as seasonal triggers. During periods of high rainfall, air humidity increases significantly. Biologically, high humidity in tropical regions can increase the stability of influenza viruses in the air and on surfaces. Furthermore, indoor crowding—the tendency for people to gather indoors during rainy seasons—reduces physical distance and impairs air circulation, increasing the risk of individual exposure.

The striking differences in prevalence between regions are also likely influenced by the quality of the surveillance system. Kendari City, as the provincial capital, has better accessibility to health services and a higher public awareness of seeking medical check-ups at health facilities (community health centers/hospitals). This results in data recording in urban areas tending to be more comprehensive (closer to the actual figures) than in remote areas, which may experience reporting challenges or under-reporting. The innovative presentation of data with a touch of local batik motifs in this study is not merely an aesthetic aspect, but also an effort to bridge scientific communication. By integrating the Mata Kea or Sultra Terang motif into trend visualizations, it is hoped that complex health data will become more familiar

to local communities and policymakers in Southeast Sulawesi, thereby facilitating the dissemination of information on early warning of infectious diseases.

4. PHILOSOPHICAL BATIK MOTIFS

Philosophical Meaning of Batik from Modeling Influenza Prevalence Trends in Southeast Sulawesi Province in 2016

a. The wavy, up-and-down pattern on the lines symbolizes the unstable trend in influenza prevalence. This pattern depicts changes in the number of cases over time, with influenza cases increasing in certain periods and decreasing in others. This reflects the dynamics of disease spread in the community, which is influenced by various conditions such as changes in weather, immune system, and social activities.
b. The interconnected lines illustrate that the spread of influenza does not occur in isolation but is influenced by various interrelated factors, such as environmental conditions, population density, community mobility, and access to healthcare. Each intersection of the lines symbolizes the important role of preventative measures, such as increasing awareness of clean and healthy living, vaccination, and appropriate medical treatment to reduce disease prevalence.
c. The empty center represents the shared hope and goal of the community and healthcare professionals: to create a healthier society by reducing the number of influenza cases. This empty space also represents an opportunity for various disease prevention and control efforts to minimize the spread of influenza and continuously improve public health.

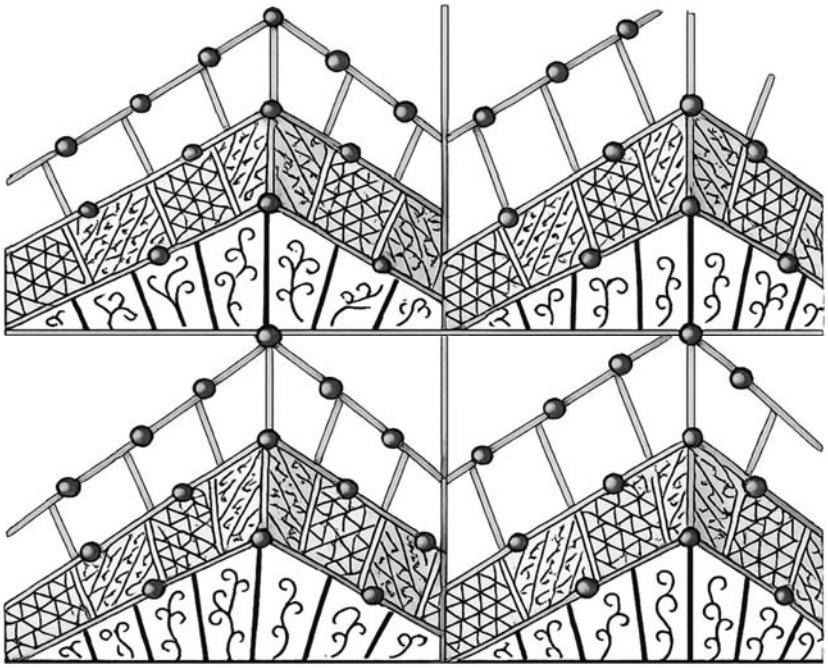

Figure 4. Batik Motif

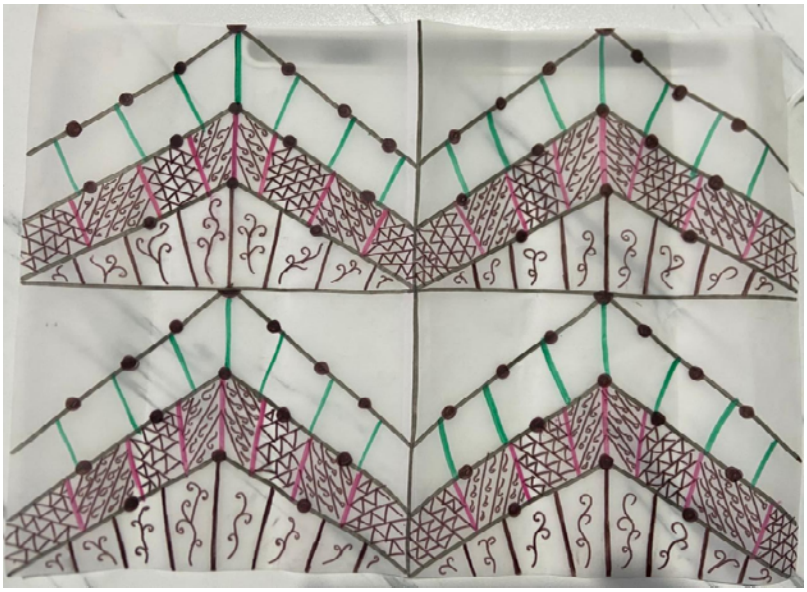

Figure 5. Batik Motif on Tracing Paper

5. CONCLUSION

Based on the statistical analysis and regional mapping conducted, this study concludes that the prevalence of influenza in Southeast Sulawesi Province throughout 2016 showed a heterogeneous and uneven spatial distribution pattern. The highest disease burden was significantly concentrated in urban areas that serve as centers of economic and government activity, namely Baubau City with a prevalence of 1,329 per 100,000 residents and Kendari City with 1,214 per 100,000 residents. These figures far exceed the average for other districts, indicating that residential density, high interregional mobility, and intense social interaction in urban areas are key determinants of the accelerated transmission of Orthomyxoviridae viruses at the provincial level.

Temporal trend analysis revealed highly dynamic seasonal fluctuations, with peak incidences predominantly occurring in the first and fourth quarters. This pattern confirms a strong correlation between influenza epidemiological dynamics and local climatological factors, particularly during periods of high rainfall, which increase humidity. The humid environmental conditions and relatively lower temperatures during these months create a microclimate that supports the persistence and stability of the virus in the air and on surfaces, thereby increasing the risk of exposure to vulnerable populations.

Spatially, this study successfully identified the phenomenon of spatial clustering, or clustering of cases, in key economic growth areas in Southeast Sulawesi. This suggests that influenza spread is not solely influenced by natural factors but also by transportation connectivity and the region's role as a logistics hub. Therefore, future infectious disease control strategies cannot be uniform across regions but must be based on regional typology (urban vs. rural) and the readiness of local health infrastructure.

As a novel aspect, the innovative use of data visualization through graphics featuring local batik motifs such as the Mata Kea and Sultra Terang motifs—provides added value in the dissemination of health information. This approach not only improves the readability of technical surveillance data for policymakers but also serves as an inclusive public education tool that taps into local wisdom. Overall, these findings recommend strengthening the Early Warning System (EWS) integrated with climatological data and increasing the allocation of health resources to areas identified as transmission epicenters to minimize the economic and social impacts of influenza in Southeast Sulawesi.

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