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# Collaboration Analysis of Semarang City Dengue Hemorrhagic Fever Health Surveillance Officer with Social Network Analysis

*Analisis Kolaborasi Petugas Surveilans Kesehatan Demam Berdarah Dengue Kota Semarang dengan Social Network Analysis*

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**Abstract** —This study aims to determine the pattern of a network collaboration between dengue hemorrhagic health surveillance personnel in the city of Semarang and to understand the flow of information deeply. The method of social network analysis / SNA (Social Network Analysis) on formal and informal communication networks between surveillance officers aims to produce sociometry and sociogram data so that the centrality of each actor in the network can be known. Interaction between Officers will be known through the analysis of the centrality of levels (degree), closeness (closeness), and intercession (betweenness). The approach used is descriptive quantitative. Data was collected using a research instrument in the form of a questionnaire, while the process of input and data analysis was carried out by looking at intact networks and ego networks carried out using UCINET. The results of the analysis show that officers dominate the centrality of the level and the intermediary with the position of Coordinator both City and District (Id. # 128, # 1, # 2, # 3). Collaboration based on working areas has a strong bond because 71% of the districts have a network density above 50%. While the value of closeness is dominated by surveillance members with id # 54, # 15, # 2, # 214, # 15 and # 10.

***Keywords*** —Social Network Analysis, Gasurkes, Health Surveillance Staff

***Abstrak*** *— Penelitian ini dilaksanakan untuk mengetahui pola kolaborasi jaringan (network) antara tenaga surveylans kesehatan demam berdarah dengue di Kota Semarang dan memahami secara mendalam arus informasinya. Metode analisis jaringan sosial / SNA (Social Network Analysis) pada jaringan komunikasi formal maupun informal antara petugas surveylans bertujuan menghasilkan data sociometry dan sociogram sehingga dapat diketahui sentralitas setiap aktor dalam jaringan. Interaksi antara Petugas akan diketahui melalui analisis sentralitas tingkatan (degree), kedekatan (closeness) dan keperantaraan (betweenness). Pendekatan yang digunakan adalah deskriptif kuantitatif. Data dikumpulkan dengan menggunakan instrument penelitian berupa kuesioner, sedangkan proses input dan analisis data dilakukan dengan melihat jaringan utuh dan jaringan ego dilakukan dengan menggunakan UCINET. Hasil analisis menunjukkan bahwa nilai sentralitas tingkatan dan keperantaraan didominasi oleh petugas dengan jabatan Koordinator baik itu Kota maupun Kecamatan (Id.#128,#1,#2,#3). Kolaborasi berdasarkan wilayah kerja mempunyai ikatan yang kuat dikarenakan 71% kecamatan mempunyai kepadatan jaringan diatas 50%. Sedangkan nilai kedekatan didominasi oleh anggota surveylans dengan id # 54, # 15, #2, #214, #15 dan #10.*

***Kata Kunci*** *—Social Network Analysis, Gasurkes, Tenaga Surveylans Kesehatan*

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## I. INTRODUCTION

Semarang City DBD(DHF) Incidence Rate (IR) from 2006 to 2016 is always much higher than Central Java's DBD(DHF) IR and National DBD IR. In 2016, the Semarang City DBD(DHF) IR 25.22 per 100,000 population or 47.5% lower than the Central Java DBD(DHF) IR, which reached 48.22 per 100,000 population. The national target in achieving DHF incidence rates is ≤ 51 per 100,000 population. DHF Incidence Rate Semarang City was ranked 1st in 2010 and ranked 29th IRD DHF in Central Java. One of the success factors in the downgrading of the Semarang DBD IR rank is the efforts of the Semarang City Government to establish a DHF Health Surveillance Officer (Gasurkes) according to Semarang City Regulation Number 5 of 2010 [1]. This study aims to map social networks based on the interaction of DHF Health Surveillance Officers (Gasurkes) using the Social Network Analysis (SNA) method. Based on the network mapping formed and the statistical functions of the SNA can help identify the level of surveillance role in the network and see the relationship to the success of a program.

Examples of the use of the SNA method in several studies, including research [2] in Batik Winda Sari UKM in Sragen City, concluded that individual brokers influence the relationship that occurs in these UKMs. In Research [3] [4] SNA shows that the relationship between students is not always based on academic issues, but also non-academic, the position of students in the network also determines success in examinations/studies. Research [5]. See the process of disseminating information about the "Wonderful Indonesia" country branding on the top platforms of the social networking sites Google Plus, Twitter and Facebook to become later input for the Ministry of Tourism of the Republic of Indonesia to increase the spread of country branding and the "Wonderful Indonesia" tourism campaign. Research [6] uses social network analysis to explore patterns created by the interactions of online users on Facebook during a disaster response. The study results show that social networks consist of three entities: individuals, emergency agencies, and organizations to share information in a state of disaster emergency. SNA research [7] was used by the European Commission to look at stakeholders who influence land-use decisions related to greening infrastructure at local and regional levels.

The SNA method can also be used to see collaborative research between lecturers in tertiary institutions. The resulting analysis can provide recommendations to improve the quality of research [8] as well as increase the Chancellor's expertise in recognizing the perspectives of others to anticipate emerging and systemic changes. Identify who is involved in discussions about teaching and learning and topics covered [9].

Social Network Analysis (SNA) is one of the most popular methods used to view social networks. SNA is used to analyze and map the interactions of individuals or institutions so that it

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can be seen patterns of communication, collaboration, or actors involved in it so that the background of interests and motivations can be identified [10] [11] [12]. The SNA method is also used to analyze the network of sea container transport routes at the South Korean port of Incheon [13], analyze communication structures, interpersonal communication networks and the relationship of individual characteristics with interpersonal networks in social networks [14] [15] as well as distribution patterns and find key players in the distribution of pornographic content on Social Media [16].

The SNA method can also be used to study liaison organizations or actors who have the highest centrality and are well-positioned to bridge health and community services [17], collaboration between scientists, research centers, institutional network research, centers of excellence [ 18], e-learning studies [19], government programs in agriculture [20], viral events on social media [21], use of technology [22] and SME support institutions [23].

Based on previous research, this research was conducted because no research studies the collaboration of surveillance personnel / gasurkes in the city of Semarang. As for the studies on surveillance / gasurkes personnel, including:

Research [24] which aims to determine the effectiveness of DHF surveillance officers in determining larval free rates (ABJ) in Semarang City. This study concludes that the DBD Gasurkes program in Semarang City has been effective by looking at the results of the value of effectiveness in each aspect compared to the percentage table of program effectiveness. Where the input aspect is effective (71%), the process aspect is very effective (92%), and the output aspect is effective (77%), although, in every aspect, there are still obstacles.

Research [25] aims to look for factors that influence the behavior of jumantik cadres in the early awareness system of DHF in Sendangmulyo Village, where someone who behaves well to the officers, has a significant influence and will realize good practices/behaviors in preventing DHF.

Research [26] focuses on analyzing the performance of Gasurkes in efforts to tackle DHF in endemic villages, where the results of the study showed that Gasurkes's knowledge was not good, there were good perceptions, lack of motivation, not yet enforced rewards, support of socio-economic and political environment that was not optimal, the leadership process that has not been optimal, the workload that has not been evenly distributed, insufficient labor and sufficient facilities. The conclusion of the research shows that the performance of Gasurkes in the efforts to overcome DHF in endemic villages is not optimal.

From the results of the above study, no research has been found on collaboration between the gasurkes / DHF surveillance officers in Semarang City.

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## II. RESEARCH METHOD

Based on the description above, this study aims to analyze patterns of network collaboration or relationships between surveillance personnel / Gasurkes in Semarang City and to understand in depth the flow of information. SNA is used in this research to produce sociometry and sociogram data so that the centrality of each actor and its influence on the network can be known. A sociogram is a graph that illustrates the pattern of relationships and interests in social networks. A sociogram can describe the pattern of interaction between actors in a social network or the sociometric status of an actor in a social network or the overall state of actors in a social network [27].

Based on this, a mindset was formed, which later became the mechanism that would be used in the conduct of this research. The mechanism is illustrated in the following steps:

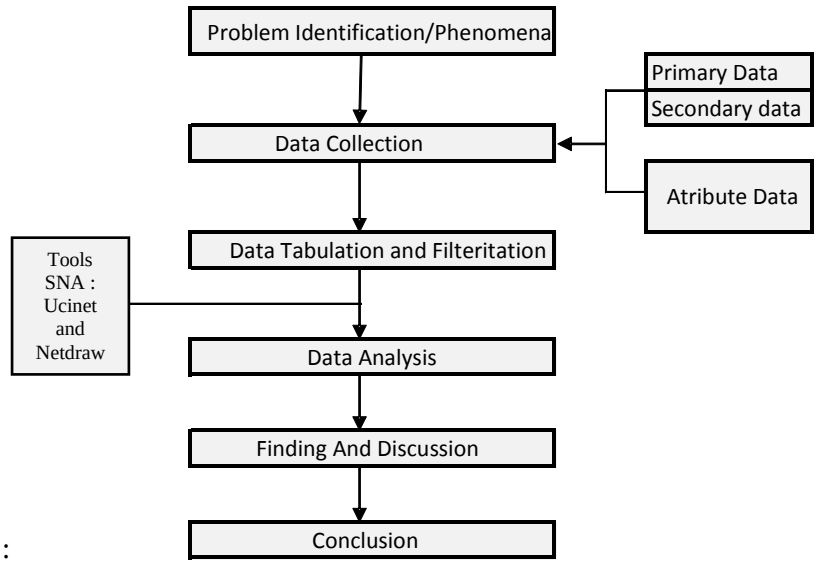


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**Figure 1.** RESEARCH STAGES

a. Identification of problems / phenomena

   Problem identification is taken through phenomena that occur, which are then continued by formulating the problem, determining research objectives, and determining the object/target of research.

b. Data collection

   Primary data collection was taken through an interview process to competent parties, in this case, the Control of Communicable Diseases, especially Dengue Hemorrhagic Fever, TB and HIV, Semarang City Health Office, and the distribution of questionnaires to all DHF surveillance / gasurkes personnel in Semarang city of 215 people. Attribute data in the form of the work area, position, and educational background of each surveillance

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personnel. In table 1, the attributes of the work area of Semarang city surveillance staff are divided into 17 subdistricts, including:

**Table 1.** DATA ATTRIBUTE OF WORK AREA SURVEYLANS

| No. | DISTRICT | CODE |
|---|---|---|
| **1** | City Coordinator | 1 |
| **2** | Centre Semarang | 2 |
| **3** | North Semarang | 3 |
| **4** | East Semarang | 4 |
| **5** | South Semarang | 5 |
| **6** | West Semarang | 6 |
| **7** | Gayamsari | 7 |
| **8** | Candisari | 8 |
| **9** | Gajahmungkur | 9 |
| **10** | Genuk | 10 |
| **11** | Pedurungan | 11 |
| **12** | Tembalang | 12 |
| **13** | Banyumanik | 13 |
| **14** | Gunungpati | 14 |
| **15** | Mijen | 15 |
| **16** | Ngaliyan | 16 |
| **17** | Tugu | 17 |

While the occupational attribute data and educational background attributes of Semarang city surveillance staff in tables 2 and 3 are divided into three categories, including:

**Table.2** ARTIBURE DATA OF MANPOWER SURVEYLANS POSITION

| No. | DISTRICT | CODE |
|---|---|---|
| **1** | Coordinator | 1 |
| **2** | Vice Coordinator | 2 |
| **3** | Member | 3 |

**Table 3.** ARTIBURE DATA OF MANPOWER SURVEYLANS EDUCATION BACKGROUND

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| No. | DISTRICT | CODE |
|---|---|---|
| **1** | Bachelor of Public Health (SKM) | 1 |
| **2** | Nurse | 2 |
| **3** | Environmental Health | 3 |

c. Data Filtration and Tabulation

Data collected from the results of the questionnaire are then converted into symmetric metrics to become relational data so that they can be processed in the UCINET and Netdraw programs. Relational data to show the relationship between one actor (surveillance officer) with another actor.

d. Analysis.

The process of data analysis uses the SNA method to measure centrality between officers, namely degree centrality, closeness, betweenness, and eigenvector. The attribute data is used to describe the collaborative relationship between surveillance personnel / gasurkes — relational data in the form of symmetric metrics containing columns and rows containing the names of officers. Researchers put a relation number 1 if there is a link. Otherwise, the number 0 is given if there is no link between the name in line and the name in the column. The data illustrations in Table 4 in the symmetrical form are as follows;

**Table 4.** RELATIONAL DATA ILLUSTRATION IN SYNTHETIC FORM

| | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| **1** | | 1 | 1 | 1 | 1 |
| **2** | 1 | | 1 | 1 | 0 |
| **3** | 0 | 1 | | 1 | 0 |
| **4** | 1 | 1 | 1 | | 1 |
| **5** | 1 | 1 | 1 | 1 | |

Degree centrality shows the popularity of officers in social networks where the degree is the number of links to and from officers. Theoretically, the maximum number of levels for officers is N-1 [28]. If in the population there are 215 surveillance officers, then the link for an officer is 215-1 or 214. The formula for the level of centrality is as follows:

$$C_d = \sum \frac{d_1}{N-1} \quad \text{……(1)}$$

Where Cd is the degree centrality, d is the number of links to and from the actor, and N is the number of members of the population.

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Whereas Closeness Centrality illustrates how close an officer is to all other officers in the network. Proximity is measured by the number of steps (path/path) an officer can contact or be contacted by other officers in the network. The formula calculates proximity centrality as follows:

$$C_c = \frac{N-1}{\sum D_{ij}} \quad \ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Where Cc is the centrality of closeness (Closeness Centrality), d is the shortest path to other actors, and N is the number of members of the population.

The last is the centrality of the intermediary (Betweenness Centrality), which shows the position of an officer as an intermediary of the act of acting through the actor or one with other actors in a network. Can officers contact other actors directly, or do they have to contact certain officers. The formula is as follows:

$$C_b = \frac{\frac{g_{ij}P_K}{g_{ij}}}{N^2 - 3n + 2} \quad \ldots\ldots\ldots\ldots\ldots\ldots(3)$$

Where Cb is Intermediary (Betweenness Centrality), $g_{ij}P_k$ is the shortest number of stages of the actor, and $\boldsymbol{g_{ij}}$ is the number of paths in the network, while N2-3n + 2 is the maximum value.

e. Results and Discussion.

The results of the analysis are then used to describe the collaboration between the surveillance personnel / gasurkes based on the work area, position, educational background (title), and overall relationship (overall) between the surveillance personnel / gasurkes.

f. Conclusion

The conclusion bases on the results of the previous discussion. The conclusion uses as an evaluation material for the follow-up of the management of surveillance / gasurkes program in the field of Controlling Disease, especially Dengue Hemorrhagic Fever, TB and HIV, Semarang City Health Office in the following year.

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## III. RESULT AND DISCUSSION

A. Network Density

Network structure can be seen through the calculation of network density. Network density is the comparison between the number of links (ties) with the number of links that might appear. Table 5 data shows that the overall network density (density) of the Semarang City Surveillance Network is 0.053 or 5.3%.

**Table 5.** DENSITY VALUE OF THE ENTIRE SURVEYLANS NETWORK

| **Densitas/Average Matrix Value** | |
|---|---|
| **Density** | 0,054 |
| **No. of Ties** | 2485 |
| **Std.Dev** | 0,226 |
| **Avg Degree** | 11,558 |
| **Alpha** | 0,925 |

The data shows the characteristics of the Semarang city surveillance network where each actor/officer is connected to a small group. The density of the surveillance / gasurkes power network in the city of Semarang is seen in a low category because surveillance personnel is divided into each work area / Sub District, with a percentage of less than 50%, whereas the relationship between surveillance officers is 2485 relations. This number is still very small compared to the possibility of relations formed by {[215 (215-1)] = 46,010}.

The results of UCINET calculations. Table 6 illustrates the overall network statistics. The total number of relationships formed in the entire network is 2485, with 215 employees. A maximum value of 76 indicates the number of actors who contacted or were contacted by each actor.

**Table 6.** DESCRIPTIVE STATISTICS FOR THE ENTIRE NETWORK

| UNIVARIATE STATISTICS | |
|---|---|
| Observation | 46.010 |
| Mean | 11,5 |
| Standard Deviation | 10,2 |
| Sum | 2485 |
| Variance | 105,9 |
| Minimum | 0 |
| Maximum | 76 |
| N of Observation | 215 |

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Density-based in the work area can be seen in Figure 2. The density of the work area shows the intensity between network members in communication. High-density networks are networks where members interact with one another. On the other hand, a network with low density is characterized by a lack of interaction between its members or uneven interaction with all officers, which is possible to be dominated only by certain officers. Based on the figure, the network density # 1 is in the Central Semarang area, # 2 in the Gajah Mungkur area, # 3 in the Gunungpati area, # 4 in the Banyumanik area and # 5 in the Candisari region, followed by other sub-district areas.

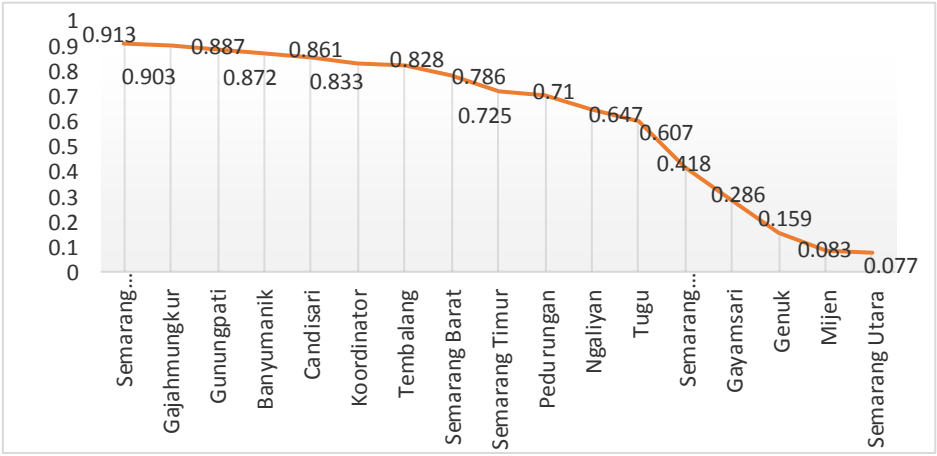


**Figure 2.** DENSITY BASED ON THE WORK AREA

Whereas density based on the position can be seen in Figure 3 where the highest network density is density between coordinators, it shows the relationship and communication between district coordinators are going well, while the lowest coordination relationship is between fellow surveillance officer members and deputy coordinators. It is possible because the deputy coordinator and members-only served in one village area.

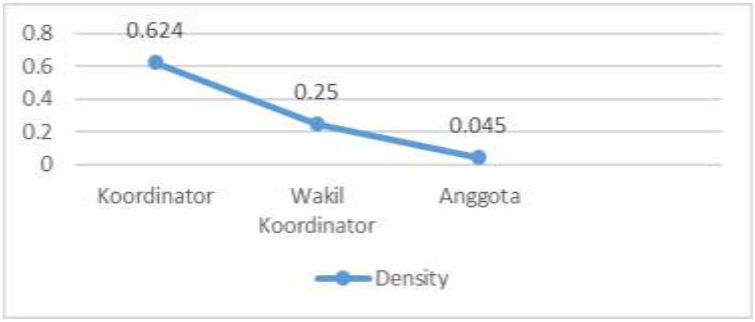


**Figure 3.** DENSITY BASED ON POSITION

While the density based on educational background can be seen in Figure 4, although the percentage is small, we see that the highest network density is in the surveillance background of public health graduates (SKM) followed by surveillance personnel with a nurse background,

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while the network density between health workers with an environmental health background is absent.

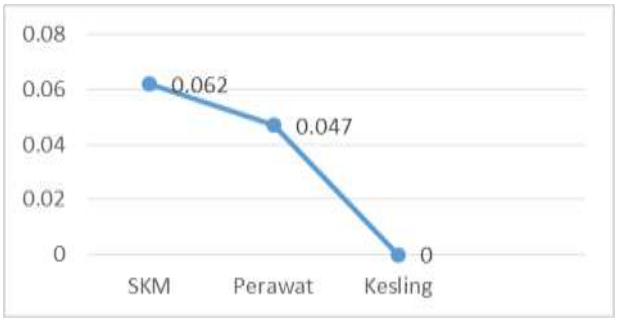


**Figure 4.** DENSITY BASED ON EDUCATION BACKGROUND

After knowing the structure of the network through density/density based on the region, position, and educational background. Analysis of the position of the actor/officer and his role in a network can be known by UCINET analysis to determine the level (degree), intercession (betweenness), eigenvector, and closeness (closeness). The analysis aims to see a close picture of the relationship between surveillance officers and other officers.

A. ***Degree Centrality***

Based on Table 7 shows ten actors with the highest degree of centrality value, where officer # 128 is the most popular central actor/actor in the surveillance network / gasurkes with 78 links, followed by actor # 1 with 65 links, actor # 2 with 63 links, actors # 3 with 53 links, actor # 55 with 43 links and followed by other actors. The implication is that the above actors have stronger capabilities in connecting other officers in the network.

**Table 7.** RATING 10, LARGE DEGREE OF CENTRALITY VALUE

| No | Actor | Degree | NrmDegree | Officer |
|---|---|---|---|---|
| **1** | 128 | 78 | 36.279 | Tembalang Coordinator |
| **2** | 1 | 65 | 30.233 | City Coordinator |
| **3** | 2 | 63 | 29.302 | City Coordinator |
| **4** | 3 | 53 | 24.651 | City Coordinator |
| **5** | 55 | 43 | 20 | West Semarang Coordinator |
| **6** | 4 | 40 | 18.605 | South and Center Semarang coordinator |
| **7** | 137 | 36 | 16.744 | Tembalang Surveylans |
| **8** | 150 | 34 | 15.814 | Banyumanik Coordinator |
| **9** | 148 | 32 | 14.884 | Tembalang Surveylans |
| **10** | 111 | 30 | 13.953 | Pedurungan Surveylans |

Statistics Descriptive statistics of degree centrality in table 8 show the average link for each actor is 15.34, while the smallest link is one link, and the maximum link is 78 links. The number

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of actors in the link is 215, while the overall link/collaboration on the actor-network is 3298 links. The network centralization value of 29.56% shows the lack of strong collaboration in the surveillance / gasurkes network in the city of Semarang.

**Tabel 8.** DESCRIPTIVE STATISTIC OF CENTRALITY DEGREE

| | **Degree** | **NrmDegree** |
|---|---|---|
| **Mean** | 15.34 | 7.135 |
| **Std Dev** | 10.716 | 4.984 |
| **Sum** | 3298 | 1533.953 |
| **Variance** | 114.829 | 24.841 |
| **SSQ** | 75278 | 16285.127 |
| **MCSSQ** | 24688.215 | 5340.879 |
| **Euc Norm** | 274.368 | 127.613 |
| **Minimum** | 1 | 0.465 |
| **Maximum** | 78 | 36.279 |
| **N of Obs** | 215 | 215 |
| **Network Centralization = 29.56%** | | |

The sociogram of the degree of centrality in the surveillance / gasurkes power network in Semarang city in Figure 5 where the red circle (O) shows the actors as coordinators, the square nodes (□) select the actors as coordinators and triangles (Δ). The color rendering is based on the attributes of the actor sub-district area. The higher the officer score, the greater the symbol and label image of an officer. From figure 4, actors number 128, 1,2, 3,55, and 4 appear dominant with the biggest symbols and labels of other actors, because this actor has the highest value of centrality. The actors in table 3 are the Coordinators from the Tembalang sub-district area, the City Coordinator, the West Semarang Coordinator, and the Central and South Semarang Coordinators.

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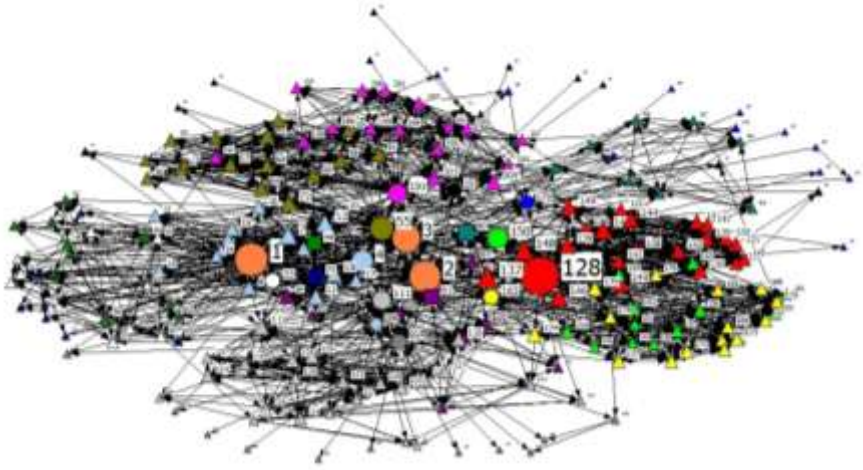


**Figure 5**. SOCIOGRAM OF CENTRALITY DEGREE OF NETWORK SURVEILLANCE

***B. Closeness***

The next data that can be taken is closeness, where the lower the value of closeness, the better it will be because it shows the low distance each actor has to deal with other actors. The shortest distance into (in fairness) is the shortest distance reached by the officer in sending information to other officers in the network. Table 9 shows that the officer who has the shortest distance in sending information to the surveillance network is officers number 54, 15, 2, 3, 167, 1, 145, 103, 4, and 55. Whereas the shortest outbound distance is the closest distance reached by officers in receiving information from other officers in an individual, table 5 shows that officers who have the closest distance in receiving information from other officers are officers number 214, 15, 10, 9, 3,6,137,25,4 and 11.

**Table 9**. 10TH RATE OF CLOSENESS CENTRALITY VALUE

| No | Closeness Centrality | Surveillance Officer Id |
|---|---|---|
| **1** | Infarness | 54, 15, 2, 3, 167, 1, 145, 103, 4, 55 |
| **2** | outFarness | 214, 15, 10, 9, 3,6,137,25,4 11 |
| **3** | inCloseness | 55,15,2,3,167,1,145,103,4,5 |
| **4** | outCloseness | 188,128,55,4,2,1,137,81,3,150 |

In Closeness value is interpreted as an indicator to measure the influence of an officer in the network, where the measure is a measure of how far information can be spread from one officer to another officer. Table 9 shows that officers who easily accept the distribution of information flow from other officers are officers number 55,15,2,3,167,1,145,103,4, and 5. While the value of OutCloseness measures the extent to which officers can convey information to other officers in the network. In table 5 shows that officers who easily convey to other officers are officers number 188,128,55,4,2,1,137,81.3 and 150.

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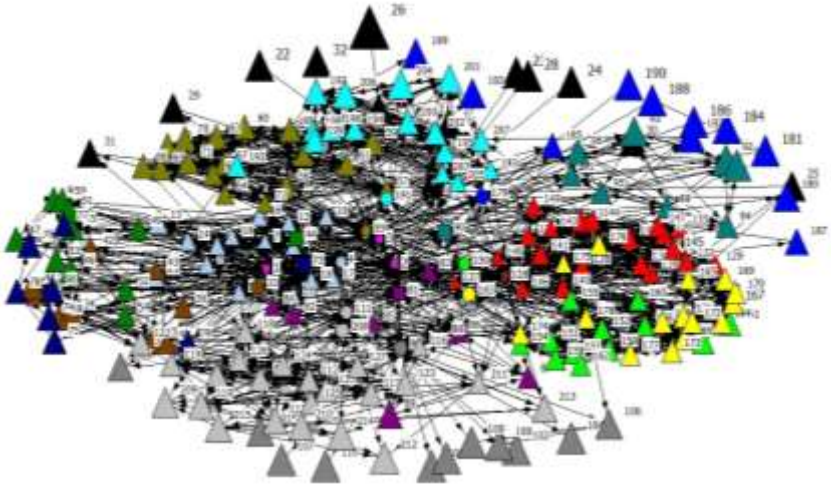

**Figure 6.** SOCIOGRAM CLOSENESS CENTRALITY NETWORK LABOR SURVEYLANS

The sociogram of closeness centrality is shown in Figure 6. The size of the symbols and labels is based on the closeness value of each actor/officer, the smaller the value of the closeness of an officer, the smaller the symbols and labels

C. ***Eigenvector***

The eigenvector approach is an attempt to find the most central actor in the network as a whole. Eigenvectors see the aspect of distance (distance) globally among actors. In table 10, we can see ten officers who have eigenvalue values in the network. From the table, it can be seen that the coordinators carry out their duties well concerning their role as central figures in the network. What is interesting is the dominance besides the coordinator, namely members of the Tembalang sub-district, who are part of the actors with the highest scores.

**Table 10.** 10TH RATE OF EIGENVECTOR CENTRALITY VALUES

| No. | Officer | Eigenvector | Officer |
|---|---|---|---|
| **1** | 128 | 0.273 | Tembalang Coordinator |
| **2** | 2 | 0.234 | City Coordinator |
| **3** | 1 | 0.197 | City Coordinator |
| **4** | 3 | 0.193 | City Coordinator |
| **5** | 4 | 0.169 | Center Semarang Coordinator |
| **6** | 137 | 0.162 | Tembalang Surveylans |
| **7** | 55 | 0.145 | West Semarang Coordinator |
| **8** | 146 | 0.136 | Tembalang Surveylans |
| **9** | 150 | 0.135 | Banyumanik Coordinator |
| **10** | 143 | 0.131 | Tembalang Surveylans |

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The statistical picture of eigenvector centrality is shown in table 11, where the average value of eigenvector centrality is 0.052. While the percentage value is 33.72%, indicating the low distance of the central actors in the overall network.

**Table 11.** DESCRIPTIVE STATISTICS OF EIGENVECTOR CENTRALITY

| **Descriptive Statistics Eigenvector** | |
|---|---|
| **Minimum** | 0.001 |
| **Average** | 0.052 |
| **Maximum** | 0.273 |
| **Sum** | 11.155 |
| **Standard Deviation** | 0.044 |
| **Variance** | 0.002 |
| **Observations** | 215 |
| **Missing** | 0 |
| **Eigen vector centralization percentages** | |
| **Centralization 33.72** | |

D. ***Betweness***

The value of betweness centrality indicates that the officer has a role as a link (bridge) between two communities. The more value betweness of the officer, the more important is his role as a liaison. From the data in table 11, it can be seen that the central role of the liaison officers in the Semarang city surveillance network is the Coordinating Officer of Tembalang District (id.128) with a value of 8681,335, followed by the three city Coordinators (Id.1,3,2) respectively with values 7495,048, 6771,141 and 6554,828, followed by the coordinator of West Semarang with a value of 5153,066 and so on.

From this table, there are several important things to deliver: (1) The dominance of the betwenes value is the coordinator officer. It means that the coordinating officer becomes an important actor in facilitating interaction between actors who connected in the Semarang City surveillance network. (2) City Coordinator Officers can carry out their role as liaison between sub-district coordinators, while sub-district coordinators can carry out their duties properly by becoming a communication bridge between members of the surveillance level at the village level.

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**Table 11.** 10TH RATE OF BETWENESS CENTRALITY VALUE

| No. | ID | Betweenes | nBetweenness | Officers |
|---|---|---|---|---|
| **1** | 128 | 8681.335 | 19.046 | Tembalang Coordinator |
| **2** | 1 | 7495.048 | 16.443 | City Coordinator |
| **3** | 3 | 6771.141 | 14.855 | City Coordinator |
| **4** | 2 | 6554.828 | 14.38 | City Coordinator |
| **5** | 55 | 5153.066 | 11.305 | Wesr Semarang Coordinator |
| **6** | 99 | 3747.097 | 8.221 | Genuk Coordinator |
| **7** | 191 | 3318.738 | 7.281 | Ngaliyan Coordinator |
| **8** | 111 | 3229.598 | 7.085 | Pedurungan Coordinator |
| **9** | 150 | 2844.379 | 6.24 | Banyumanik Coordinator |
| **10** | 4 | 2797.527 | 6.137 | .Center Semarang Coordinator |

The statistical picture of Betweness Centrality is shown in table 12, where the average value of Betweenness is 382,726; the total overall value of 82286 is normalized to 180,523. The network center index value of 18.29% shows the low relationship of intermediary officers in the overall network.

**Table 12.** DESCRIPTIVE STATISTICS FROM BETWENESS CENTRALITY

| | Betweenness | nBetweenness |
|---|---|---|
| **Mean** | 382.726 | 0.84 |
| **Std Dev** | 1189.693 | 2.61 |
| **Sum** | 82286 | 180.523 |
| **Variance** | 1415370.125 | 6.812 |
| **SSQ** | 335797536 | 1616.184 |
| **MCSSQ** | 304304576 | 1464.609 |
| **Euc Norm** | 18324.779 | 40.202 |
| **Minimum** | 0 | 0 |
| **Maximum** | 8681.335 | 19.046 |
| **N of Obs** | 215 | 215 |
| **Network Central ization Index = 18.29%** | | |

The sociogram of betweness centrality is shown in Figure 7, where the size of symbols and labels is based on the betweness value of each actor/officer. In the picture, the actor in charge as coordinator (128, 1,3,2, and 55) has a greater symbol and label than the other actors. It

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illustrates the function of the coordinator plays an important role as an intermediary/information bridge.

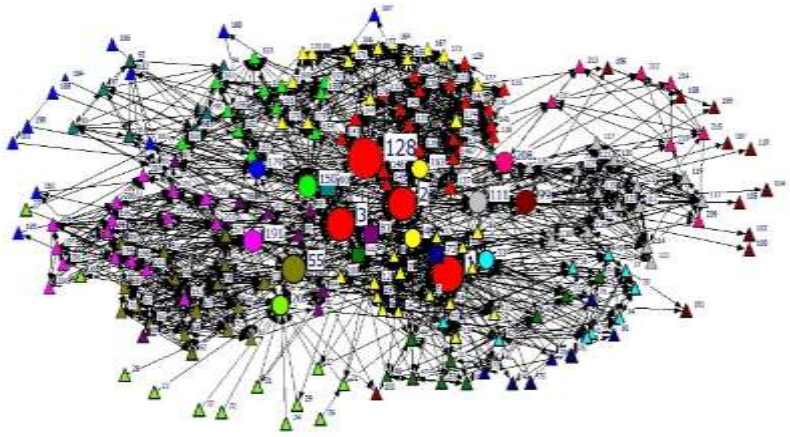

**Figure 7.** SOCIOGRAM BETWENESS CENTRALITY OF SURVEYLANS OFFICER OF SEMARANG

The collaboration of officers based on the Work Area

The success of the collaboration between officers in a sub-district area depends on the density of the network, where the denser a network/group, it will facilitate the information or knowledge spread within the group, it can be concluded the more relations are formed, the interaction between officers runs smoothly.

**Table 13.** NUMBER OF SURVEYLANS RELATIONS BASED ON WORK AREA

| No | Information | Member | The possibility of a relationship forming | Formed Relationship | % |
|---|---|---|---|---|---|
| **1** | Center Semarang | 16 | 240 | 219 | 91 |
| **2** | Gajahmungkur | 9 | 72 | 65 | 90 |
| **3** | Gunungpati | 16 | 240 | 213 | 89 |
| **4** | Banyumanik | 13 | 156 | 136 | 87 |
| **5** | Candisari | 9 | 72 | 62 | 86 |
| **6** | City Coordinator | 3 | 6 | 5 | 83 |
| **7** | Tembalang | 22 | 462 | 381 | 82 |
| **8** | West Semarang | 18 | 306 | 239 | 78 |
| **9** | East Semarang | 11 | 110 | 79 | 72 |
| **10** | Pedurungan | 17 | 272 | 193 | 71 |
| **11** | Ngalian | 17 | 272 | 176 | 65 |
| **12** | Tugu | 8 | 56 | 34 | 61 |
| **13** | South Semarang | 11 | 110 | 46 | 42 |
| **14** | Gayamsari | 8 | 56 | 16 | 29 |
| **15** | Genuk | 12 | 132 | 21 | 16 |
| **16** | Mijen | 12 | 132 | 11 | 8 |
| **17** | North Semarang | 13 | 156 | 12 | 8 |

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Collaboration calculations are based on the number of possible collaborations formed between officers in each sub-district area with the formula n x (n-1), where n is an officer. Based on tables 13 and 14 we can find the collaboration between surveillance officers based on the attributes of the highest work area in the districts of Central Semarang, Gajahmungkur, Gunungpati, Banyumanik, and Candisari, followed by the city coordinator and other sub-districts.

**Tabel 14.** KOLABORASI SURVEYLANS BERDASARKAN WILAYAH KERJA

| District ID | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 5 | 18 | 3 | 13 | 13 | 3 | 10 | 4 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 |
| **2** | 40 | 219 | 8 | 4 | 11 | 5 | 2 | 3 | 2 | 1 | 7 | 7 | 2 | 2 | 1 | 5 | 4 |
| **3** | 3 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **4** | 2 | 0 | 0 | 79 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
| **5** | 0 | 8 | 0 | 1 | 46 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| **6** | 11 | 1 | 1 | 3 | 3 | 239 | 1 | 5 | 3 | 2 | 1 | 2 | 5 | 2 | 6 | 17 | 1 |
| **7** | 3 | 1 | 1 | 5 | 1 | 1 | 16 | 1 | 0 | 0 | 3 | 1 | 1 | 0 | 1 | 0 | 0 |
| **8** | 10 | 2 | 2 | 1 | 0 | 6 | 0 | 62 | 4 | 3 | 1 | 2 | 6 | 1 | 0 | 1 | 1 |
| **9** | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **10** | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| **11** | 14 | 9 | 0 | 1 | 0 | 0 | 4 | 1 | 0 | 1 | 193 | 1 | 1 | 1 | 1 | 0 | 1 |
| **12** | 10 | 4 | 4 | 3 | 3 | 3 | 1 | 6 | 7 | 3 | 11 | 381 | 16 | 17 | 7 | 7 | 5 |
| **13** | 12 | 1 | 3 | 1 | 1 | 0 | 1 | 2 | 1 | 0 | 1 | 1 | 136 | 1 | 1 | 1 | 0 |
| **14** | 7 | 0 | 1 | 3 | 2 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 4 | 213 | 1 | 0 | 0 |
| **15** | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 2 | 0 |
| **16** | 13 | 3 | 1 | 0 | 1 | 4 | 0 | 0 | 1 | 0 | 0 | 2 | 1 | 0 | 1 | 176 | 0 |
| **17** | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 34 |

Collaboration Based on Position

Based on Tables 15 and 16, collaboration is dominated by collaboration between coordinators. It is indicated by the Coordinator density value reaching 62%. This percentage shows that collaboration between sub-district coordinators is going well. Whereas collaboration between surveillance members-only reached 4%. That is because surveillance members work based on the area of the district that is their territory, so intense collaboration can only be done during routine meetings/evaluations.

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**Table 15.** NUMBER OF SURVEYLANS RELATIONS BASED ON Occupation

| No | Information | Member | The possibility of a relationship forming | Formed Relationship | % |
|---|---|---|---|---|---|
| **1** | Coordinator | 15 | 210 | 131 | 62 |
| **2** | Vice Coordinator | 4 | 12 | 3 | 25 |
| **3** | Member | 196 | 38220 | 1723 | 5 |

**Table 16.** COLLABORATION OF SURVEYLANS BASED ON OCCUPATION

| **Position** | Coordinator | Vice | Member |
|---|---|---|---|
| Coordinator | 131 | 29 | 230 |
| Vice Coordinator | 27 | 3 | 21 |
| Member | 278 | 43 | 1723 |

The collaboration of officers based on educational background

Based on table 14, collaboration is dominated by collaboration between surveillance officers titled Bachelor of Public Health (SKM). It is indicated by the density value reaching 62%. Whereas collaboration between surveillance members entitled Nurses reached 47%, and collaboration between officers with environmental health standards did not exist.

**Table.14.** NUMBER OF RELATIONSHIP ON SURVEILLANCE BASED ON EDUCATIONAL BACKGROUND

| No | Information | Member | The possibility of a relationship forming | Formed Relationship | % |
|---|---|---|---|---|---|
| **1** | SKM | 128 | 16256 | 1010 | 62 |
| **2** | Nurse | 84 | 6972 | 331 | 47 |
| **3** | Public Health | 3 | 6 | 0 | 0 |

In table 15, we can find out that the most dominant collaboration / # 1 is a collaboration between surveillance officers titled Bachelor of Public Health (SKM) with peers who have the same title, followed by collaboration # 2 is a collaboration between nurses and SKM while collaboration between nurses and nurses is ranked # 3. Whereas collaboration-between environmental health officers and other colleagues with the same degree-was absent.

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**Table.15** COLLABORATION OF SURVEYLANS BASED ON EDUCATION BACKGROUND

| Education Background | SKM | Nurse | Public Healthy |
|---|---|---|---|
| SKM | 1010 | 518 | 28 |
| Nurse | 550 | 331 | 16 |
| Public Health | 19 | 13 | 0 |

## IV. CONCLUSSION

This research shows that the collaboration pattern among health surveillance personnel in Semarang city is dominated by the City and District Coordinators, although in some areas such as Tembalang and Pedurungan Districts, the communication center is held by surveillance members. The results of the analysis show that officers dominate the centrality of the level and the intermediary with the position of Coordinator both City and District (Id. # 128, # 1, # 2, # 3). Collaboration based on working areas has a strong bond because 71% of the districts have a network density above 50%. While the value of closeness is dominated by surveillance members with id # 54, # 15, # 2, # 214, # 15 and # 10. It is an evaluation material for the management of surveillance staff / gasurkes program in the field of Controlling Disease, especially Dengue Hemorrhagic Fever, TB, and HIV Semarang City Health Office to determine the officer who becomes the Coordinator.

Secondly, seen from the analysis of collaboration between sub-district work areas, several sub-district areas tend to have components that have weak ties. Namely South Semarang, Gayamsari, Mijen, and North Semarang. Where it is an evaluation material for the Coordinator in each of these districts, because the success of the work area is very dependent on the density of communication in the region because the denser the area, the easier information or knowledge is spread within the region. If the area density is high so there is a large amount of communication between officers. The third, looking at the results of surveillance based on educational background, it is necessary to evaluate the recruitment of surveillance personnel because there is an imbalance in the number of personnels with an environmental health education background.

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