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Analysis Of Disease-Causing Microorganisms In Semarang City 2023

***Ahmad Shofa Manahiji Robbin[1], Ahmad Zaini[2], Harsono[1], Sigit Sugiharto[1]**

[1]Universitas Widya Husada Semarang
[2]Dinas Kesehatan Kota Semarang

Contact Email: robinshofa3@gmail.com

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ABSTRACT

This study aims to analyze the prevalence and distribution of disease-causing microorganisms in Semarang City in 2023. The increase in infectious disease cases in urban areas, including Semarang City, demonstrates the urgency of mapping the distribution of pathogenic microorganisms as a basis for formulating public health strategies and analyzing their relationship with demographic factors and disease types. Data were obtained from 3,803 laboratory samples collected at hospitals and community health centers, then analyzed descriptively quantitatively based on frequency, percentage, patient age, region of origin, and disease classification using ICD-10. The results showed that Escherichia coli (13.12–16.60%) and Acinetobacter baumannii (11.68–14.78%) were the dominant microorganisms, followed by Staphylococcus epidermidis, Klebsiella pneumoniae, and Pseudomonas aeruginosa. The highest distribution of cases was found in the productive age group (20–65 years, 58.7%), followed by the elderly (21.1%) and infants <2 years (12.1%). Bronchopneumonia (J18.0) was the most common diagnosis, with a significant prevalence also in congenital pneumonia (P23.9) and cerebral infarction (I63.9). These findings confirm the close relationship between population density, environmental sanitation, and the vulnerability of certain age groups to microbial infections. This study concludes the need for strengthening data-driven policies, improving infection control in healthcare facilities, and public health education to reduce the burden of infectious diseases in Semarang City.

Keywords: Microorganisms, Disease Prevalence, Infectious Diseases, Environmental Sanitation, Semarang City.

BACKGROUND

Microorganisms are microscopic organisms that can only be observed with the aid of a microscope and possess essential characteristics of life such as growth, energy production, and reproduction[1]. Microbes are capable of surviving in various environments, including air, water, soil, surfaces, and even the human body. While some are non-pathogenic, many are pathogenic and have the potential to cause infectious diseases[2]. Semarang City, as one of the major urban centers in Indonesia, faces significant public health challenges due to rapid urbanization, high population density, and environmental changes. Infectious diseases caused by pathogenic microorganisms such as bacteria, viruses, and fungi continue to rise, driven by inadequate sanitation, poor waste management, and the impact of climate change [3], [4]. WHO reports further indicate that infectious diseases are more prevalent in densely populated urban areas, where unhealthy environments provide favorable conditions for the transmission of pathogenic microorganisms. Beyond environmental factors, modern lifestyles also contribute to increased vulnerability to infections through immunosuppressive conditions, microbial adaptation to human behavior, socioeconomic inequalities, and the decline in healthcare infrastructure[5]. These conditions highlight the importance of mapping microorganism distribution to better understand patterns of spread, dominant pathogens, and risk factors influencing disease prevalence in urban settings.

This study offers several strengths, notably its reliance on medical records and laboratory data derived from real-world sources in hospitals and community health centers, enabling a comprehensive epidemiological overview. Furthermore, the application of digital systems in data processing reduces the

likelihood of errors commonly associated with manual methods [6]. However, limitations also exist, such as incomplete patient data (e.g., missing address information) and sterile culture results, which prevent full identification of disease-causing pathogens. In light of these challenges, this research aims to identify the distribution of disease-causing microorganisms in Semarang City in 2023 and analyze their relationship with demographic factors and disease types. The findings are expected to provide practical benefits by serving as a foundation for local governments, healthcare workers, and communities in designing more effective strategies for infectious disease prevention and control. Additionally, the study seeks to contribute to evidence-based policymaking, improve the quality of health data management, and strengthen infection control efforts both in healthcare facilities and within the wider community.

METHOD

In this analysis, data were obtained from microbiological laboratory tests conducted by hospitals and public health centers on 3,803 patient samples collected from various healthcare facilities in Semarang City. The samples included patients both from Semarang and surrounding areas. This study focused on 1,902 samples that originated from within Semarang City [7]. The analyzed data encompassed the identified types of microorganisms, demographic information (patient age and residential address), and disease diagnoses based on the ICD-X classification system [8].

Descriptive statistical methods were employed to determine the proportion of pathogenic microorganisms detected in the samples, the distribution of cases by age group and geographic area [9], and the correlation between microorganism types and disease diagnoses according to ICD-X codes [8].

Samples with sterile results (no microbial growth) and those lacking residential address information were excluded to maintain data accuracy and representativeness. Through this methodological approach, the study aims to present a comprehensive overview of microorganism distribution and contribute meaningfully to infectious disease control efforts in Semarang City. Furthermore, it highlights the importance of environmental sanitation and public awareness regarding hygiene practices.

RESULT AND DISCUSSION

This section presents the main findings of the study on the distribution of disease-causing microorganisms in Semarang City in 2023. Based on the analysis of 3,803 laboratory samples, the data indicated that *Escherichia coli* and *Acinetobacter baumannii* were the predominant pathogens in this region [10]. The distribution of these microorganisms was found to be associated with factors such as patient age, geographic location, and disease type. These findings underscore the importance of implementing data-driven mitigation strategies to improve sanitation and reduce the prevalence of infectious diseases in Semarang City [11].

Out of the total 3,803 samples analyzed, 1,902 samples (50.01%) were collected from patients residing in Semarang City, 1,755 samples (46.15%) were from outside the city, and 146 samples (3.84%) lacked address information. Among the Semarang samples, 652 (34.28%) were found to be sterile, indicating no detectable growth of microorganisms.

Alamat Pasien/Sampel	Jumlah	Presentase
Kota Semarang	1.902	50,01
Luar Kota Semarang	1755	46,15
Tidak ada keterangan alamat	146	3,84
Jumlah	3.803	

Figure 1. Sample Data Based on Location
Source: Microbiology Data from Semarang City Hospital and Health Center Labs, Processed

This sample distribution graph shows the composition of the origin of patients tested in the laboratory. The majority of samples (50.01%) came from Semarang City, while 46.15% came from outside the city, and the rest (3.84%) did not have address information. The graph above illustrates that although the focus of the study was on patients from Semarang City, the contribution of patients outside the city was also significant in this analysis [10]. These data can reflect population mobility and an active inter-regional referral system.

In the distribution of the main microorganisms that cause disease with the location of sample origin (Semarang City and outside the city). This study identified fifteen dominant microorganisms that are the main causes of infection in Semarang City with the highest prevalence, other microorganisms were also found with significant numbers.

This study provides an overview of the distribution pattern of microorganisms that dominate infectious diseases in urban areas, this may be related to less than optimal environmental hygiene and exposure to contaminated food or water in urban areas. This condition shows the importance of hygiene management in health facilities [12].

Nama Mikroorganismenya	Jumlah	Presentase
Escherichia Coli	164	13,12
Acinetobacter Baumannii	146	11,68
Staphylococcus Epidermidis	97	7,76
Staphylococcus Haemolyticus	92	7,36
Klebsiella Pneumoniae	88	7,04
Pseudomonas Aeruginosa	82	6,56
Staphylococcus Aureus	78	6,24
Candida Sp	68	5,44
Staphylococcus Hominis	41	3,28
Corynebacterium Matruchotii	38	3,04
Klebsiella Pneumonia	29	2,32
Enterococcus Faecalis	21	1,68
Sphingomonas Paucimobilis	15	1,20
Burkholderia Cepacia Complex	15	1,20

Figure 2. Distribution of Major Microorganisms
Source: Microbiology Data from Semarang City Hospital and Health Center Labs, Processed

Based on the data presented, *Escherichia coli* was identified as the most prevalent microorganism, accounting for 164 cases or 16.60% of the total. This bacterium is commonly associated with gastrointestinal and urinary tract infections, indicating a potential link to environmental hygiene, particularly water sanitation [11]. The second most prevalent microorganism was *Acinetobacter baumannii*, with 146 cases (14.78%). This nosocomial pathogen is known for its high level of antibiotic resistance and is frequently encountered in infections acquired within hospital settings. Its presence underscores the need for enhanced infection control measures in healthcare facilities [12].

Staphylococcus epidermidis and *Staphylococcus haemolyticus* were identified in 97 (9.82%) and 92 cases (9.31%), respectively. These microorganisms are typically associated with skin and soft tissue infections, as well as device-related infections. Their occurrence highlights the importance of maintaining personal hygiene and proper sterilization of medical instruments [13].

Other significant pathogens included *Klebsiella pneumoniae* (88 cases, 8.91%) and *Pseudomonas aeruginosa* (82 cases, 8.30%), which are frequently linked to respiratory infections such as pneumonia, particularly among immunocompromised patients or those undergoing intensive care. Fungal infections caused by *Candida* spp. (68 cases, 6.88%) were also prominent, often affecting individuals with weakened immune systems, including neonates and patients with chronic illnesses. Less common microorganisms such as *Corynebacterium* spp. (41 cases, 4.15%) and *Enterococcus* spp. (29 cases, 2.94%) were also detected, indicating the presence of less frequent but clinically relevant infections.

This distribution reveals a wide variety of infection-causing microorganisms in Semarang City, with a notable predominance of specific pathogenic bacteria. These findings serve as a crucial foundation for public health mitigation strategies, including environmental sanitation improvement, public health education, and strengthened infection control protocols within healthcare facilities.

Regarding age distribution, the adult population (20–65 years) represented the highest proportion of cases (58.7%), followed by the elderly (>65 years) at 21.1%. In neonates (<2 years), the most frequently identified microorganisms were *Acinetobacter baumannii* and *Candida* spp., commonly implicated in neonatal infections.

Rentang Usia	Jumlah	Persentase	Keterangan
<2 (Bayi)	229	12,1	
2-5 (Balita)	43	2,3	PAUD - TK
6-12 (Anak-anak)	67	3,5	SD
13-19 (Remaja)	45	2,4	SMP - SMA
20-65 (Dewasa)	1.115	58,7	
>65 (Lansia)	401	21,1	
Total	1.900	100	

Figure 3. Distribution of Main Microorganisms Based on Age
Source: Microbiology Data from Semarang City Hospital and Health Center Labs, Processed

Based on the aforementioned data, the distribution of disease cases caused by microorganisms in Semarang City in 2023 indicates that the age group 20–65 years accounted for the highest number of cases, totaling 1,115 (58.7% of the total). This age group represents the productive population, which tends to be more socially and economically active, thereby experiencing greater exposure to microorganisms in densely populated urban environments.

The elderly population (>65 years) ranked second with 401 cases (21.1%). This can be attributed to the natural decline in immune function associated with aging, making this group more susceptible to infections caused by pathogenic microorganisms. Additionally, the high prevalence of chronic illnesses among the elderly further contributes to the increased infection rates in this demographic.

In the <2 years age group, 229 cases (12.1%) were recorded, primarily due to the underdeveloped immune systems of infants. Infections in this age group frequently involve microorganisms such as *Acinetobacter baumannii* and *Candida* species, commonly associated with nosocomial or neonatal infections.

Other age groups, including those aged 2–5 years, 6–12 years, and 13–19 years, exhibited lower case numbers, with respective percentages of 2.3%, 3.5%, and 2.4%. The lower incidence in these groups may be due to reduced exposure and relatively stronger immune systems compared to infants and the elderly.

This distribution reflects the relationship between age group and the risk of microorganism-related infections in Semarang. Vulnerable populations, such as infants and the elderly, require greater attention in

disease prevention and control programs, including vaccination campaigns, improved environmental sanitation, and public health education initiatives [14]

Regarding ICD-10 disease codes, several specific diagnoses were linked to identified microorganisms, offering in-depth insights into the prevalence of particular diseases in Semarang. For instance, *Escherichia coli* was identified as a dominant microorganism, frequently associated with cases classified under J18.0 (bronchopneumonia), which was the most common disease category. This highlights the significant incidence of lower respiratory tract infections, such as bronchopneumonia, in the urban population of Semarang.

Moreover, congenital pneumonia (P23.9) and cerebral infarction (I63.9) were also prominent in this study. These findings highlight the critical role of microorganisms in the incidence of diseases that have broad implications for public health. Conditions such as diabetes mellitus with circulatory complications (E10.5) and pulmonary tuberculosis (A16.2) also exhibited high prevalence rates, reflecting the impact of chronic health conditions on the body's susceptibility to microbial infections [15].

The distribution of diseases based on ICD-10 codes not only illustrates patterns of microbial infections but also underscores the strong correlation between population health status and environmental factors, sanitation practices, and regional demographics [11]. These diseases indicate an urgent need for public health intervention strategies focused on infection control and the prevention of complications from chronic illnesses.

Kode ICD-X	Penyakit	Jumlah Kasus
J18.0	Bronkopneumonia	62
P23.9	Pneumonia kongenital	38
I63.9	Infark serebral	38
E10.5	Diabetes mellitus dengan komplikasi sirkulasi	33
A16.2	Tuberkulosis paru	31

Figure 4. Large Classification of Diseases (ICD-X) Related to Microorganisms
Source: Microbiology Data from Semarang City Hospital and Health Center Labs, Processed

Based on the table above (Large Classification of Diseases (ICD-X) Related to Microorganisms), it shows the distribution of ICD-10 code diseases related to regional distribution, in the Tembalang, Banyumanik and North Semarang sub-districts which are the areas with the highest number of microorganism cases, which shows a close relationship between population density and the number of infection cases.

This study analyzed laboratory data from 3,803 samples collected by hospitals and public health centers in Semarang City throughout 2023. The majority of the samples were obtained from patients residing in Semarang (50.01%), while 46.15% were from outside the city and 3.84% lacked address information. For accuracy in interpreting local data, the analysis focused on samples with confirmed residential addresses in Semarang.

Of the analyzed samples, 652 (34.28%) yielded sterile results, indicating no aerobic bacterial growth. This finding suggests that not all illnesses are caused by microbial infections, highlighting the importance of considering other contributing factors in determining disease etiology. Based on clinical diagnoses classified using the ICD-10 system, bronchopneumonia (J18.0) was the most prevalent disease, followed by congenital pneumonia (P23.9) and cerebral infarction (I63.9). These findings reflect a high incidence of lower respiratory tract infections, which may be associated with urban environmental factors such as air quality and population density in Semarang [16]. Additionally, diagnoses such as diabetes mellitus with circulatory complications (E10.5) and chronic kidney disease (N18.5) demonstrate a strong relationship between chronic non-communicable diseases and the risk of infection. This emphasizes the importance of optimizing chronic disease management to prevent secondary infections caused by pathogenic microorganisms.

Further analysis identified *Escherichia coli* as the most dominant microorganism, with a prevalence of 13.12%, followed by *Acinetobacter baumannii* (11.68%) and *Staphylococcus epidermidis* (7.76%). Other significant microorganisms included *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*. The dominance of these organisms, particularly those commonly implicated in nosocomial infections, underscores the need to strengthen infection control policies in healthcare facilities.

The distribution of microorganisms also varied across different age groups. Adults aged 20–65 years had the highest incidence (58.7%), followed by the elderly (>65 years) at 21.1%. This pattern may be attributed to increased exposure in the working-age population and physiological vulnerabilities in older adults, including the presence of comorbid conditions [6].

The results of this analysis provide important insights into the distribution of disease-causing microorganisms in Semarang City and its most affected populations. The high prevalence of microorganism infections in infants and the elderly indicates an urgent need for public health interventions targeting vulnerable groups. In addition, the prevalence of nosocomial microorganisms indicates the need to strengthen infection prevention and control protocols in health facilities, including improving hygiene, educating medical personnel, and providing antibiotics wisely to prevent microbial resistance [17]. As a follow-up to this analysis, further research is needed to understand the environmental and social risk factors that contribute to the distribution of microorganisms in Semarang City. These data can also be used as a basis for local governments and related agencies to develop evidence-based health policies aimed at reducing the incidence of infection and improving the quality of life of the community.entified. Among these, *Escherichia coli*, *Acinetobacter baumannii*, and *Staphylococcus epidermidis* emerged as the dominant species.

The distribution of microorganisms varied across age groups, with adults (aged 20–65 years) comprising the highest proportion of cases (58.7%), followed by the elderly population (>65 years). Newborns and children also represented a significant risk group, particularly due to factors such as poor sanitation and dietary habits, which warrant further attention.

Moreover, the diseases most frequently associated with these Microorganisms included pneumonia, urinary tract infections, diabetes mellitus with complications, and other chronic illnesses. This analysis highlights the critical need for preventive and promotive measures, particularly in areas of sanitation improvement, hospital infection control, and community health education.

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