

Pharmaceutical involvement in Infectious Disease control: Strategies, Challenge and Solutions

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ABSTRACT

This study aims to explore the role of the pharmaceutical sector in controlling infectious diseases, focusing on strategies, challenges, and solutions that can be implemented. The research method used is Systematic Literature Review (SLR) to collect and analyze data from related literature. Inclusion criteria include articles published in the last ten years, using English or Indonesian, and discussing pharmaceutical strategies in controlling infectious diseases. The literature search process was carried out through scientific databases such as PubMed, Scopus, and Google Scholar. The results of this study are Infectious disease control strategies involve the development of new vaccines and drugs, efficient drug distribution, and public education. The pharmaceutical sector plays an important role in creating medical solutions and implementing vaccination campaigns. The main challenge is antimicrobial resistance, which is caused by the unwise use of antibiotics. To overcome this challenge, public education, strict supervision in health facilities, and the development of new drugs are needed. The application of digital technology, such as AI-based applications, can also help monitor drug use and provide early warnings about the spread of disease. The role of pharmacists is vital in providing information and education about disease prevention, correct drug use, and the importance of vaccination. With innovative solutions such as the development of emergency pharmaceutical packages, the implementation of e-prescription, and technology-based training for pharmacists, it is hoped that the global health system can be more resilient in dealing with infectious disease outbreaks. Collaboration between the pharmaceutical sector, governments, and international organizations is essential in strengthening infectious disease control efforts and improving the readiness of the global health system.

INTRODUCTION

Infectious diseases, such as tuberculosis, HIV/AIDS, and malaria, continue to pose a significant threat to global public health. Tuberculosis (TB) is an infectious disease

caused by the bacteria *Mycobacterium tuberculosis*. Sari, et al. 2023). This disease primarily attacks the lungs, but can also affect other parts of the body. TB is spread through the air when an infected person coughs or sneezes (Mar'iyah, K., & Zulkarnain, Z. 2021, November). TB treatment requires a long time and high compliance with a strict drug regimen. HIV/AIDS is a disease caused by the HIV virus (Human Immunodeficiency Virus) which attacks the immune system. HIV is spread through contact with infected body fluids, such as blood, semen, and vaginal fluids. Without treatment, HIV can progress to AIDS (Acquired Immunodeficiency Syndrome), which makes the body susceptible to infections and other diseases. Malaria is a disease caused by the *Plasmodium* parasite, which is transmitted through the bite of an infected *Anopheles* mosquito. Malaria causes symptoms such as fever, chills, and anemia. This disease can be fatal if not treated quickly and properly (Lie, H., & Marianto, M. 2019).

To overcome the spread of this infectious disease, a strategic approach is needed that involves increasing access to health services, educating the public about disease prevention, and strengthening the health system. Investment in health infrastructure, training of medical personnel, and provision of effective medicines are also very important (Vierdiana, 2024). Global collaboration and support from various parties, including governments, international organizations, and the community, are essential to control and reduce the impact of this infectious disease. Its rapid spread, especially in areas with limited health facilities, requires a strategic approach to control. To overcome the spread of this infectious disease, a strategic approach involving various aspects is needed. Kawasi, 2024). The public needs to be given information on how to prevent the transmission of disease, such as the importance of cleanliness, use of personal protective equipment, and vaccination. Global collaboration and support from various parties, including governments, international organizations, and the community, are essential to control and reduce the impact of this infectious disease. With a comprehensive strategic approach, it is hoped that the spread of infectious diseases can be controlled and their impact on global public health can be minimized. The pharmaceutical sector plays a key role in supporting public health through innovation in medicines and vaccines. Medicines developed by the pharmaceutical industry help improve the quality of life of patients by providing more effective and safe therapies. For example, the development of antiretroviral drugs has enabled better management of HIV/AIDS, so that patients can live longer and healthier (Palupi, 2023). Likewise, new medicines for tuberculosis and malaria have helped reduce mortality from these diseases. Vaccination is one of the most effective ways to prevent the spread of infectious diseases. The pharmaceutical sector plays an important role in the research, development, and production of vaccines. Vaccines developed by the pharmaceutical industry have successfully eradicated or controlled many infectious diseases, such as polio, measles, and hepatitis. Mass vaccination has also helped reduce the spread of infectious diseases worldwide.

In addition, the pharmaceutical sector also plays a role in ensuring the availability of affordable medicines and vaccines for the community. Through collaboration with governments and international organizations, the pharmaceutical industry can help provide medicines and vaccines at more affordable prices, so that more people can access the care they need. For example, the development of a COVID-19 vaccine in less than a year shows the importance of the pharmaceutical sector in the rapid response to infectious disease outbreaks (World Health Organization, 2023). The role of pharmacists has evolved from being drug providers to public health consultants who are directly involved in the prevention and control of infectious diseases. They play a vital role in educating

the public and ensuring the availability of essential medicines. In ensuring the availability of essential medicines, pharmacists are responsible for managing drug stocks in pharmacies and health facilities. They ensure that medicines needed for the treatment of infectious diseases are always available and accessible to the public. Pharmacists also play a role in ensuring the quality and safety of the medicines provided, as well as providing information on the proper use of medicines (Trisnantoro, 2024).

With this expanding role, pharmacists are an important part of the public health system that focuses on the prevention and control of infectious diseases. They not only provide medicines, but also serve as a source of information and support for the community in maintaining health and preventing the spread of disease. Antimicrobial resistance is one of the biggest challenges in controlling infectious diseases. Reports state that 700,000 deaths occur each year due to drug-resistant infections. This resistance is caused by the unwise use of antibiotics, both among the community and health facilities.

Developing countries often face challenges in the form of limited pharmaceutical infrastructure, which includes several important aspects. The distribution of medicines is often uneven in many developing countries, due to inadequate transportation infrastructure that hinders the delivery of medicines to remote areas. As a result, people in these areas have difficulty obtaining the medicines they need. In addition, the shortage of experts in the pharmaceutical field is also a serious problem. Many developing countries experience a shortage of trained pharmacists and medical personnel, which has an impact on the quality of pharmaceutical services provided to the community. Without adequate experts, it is difficult to ensure that medicines are used correctly and safely. Community access to pharmaceutical services is also often limited in developing countries. Factors such as high drug costs, lack of health facilities, and low levels of community education about the correct use of medicines all contribute to this problem. (Wijaya, et al. 2023). People living in rural or remote areas often have to travel long distances to obtain pharmaceutical services. To overcome these challenges, collaborative efforts are needed between governments, the private sector, and international organizations. Investment in health infrastructure, training of medical personnel, and community education programs on the correct use of medicines are essential. In addition, policies that support equitable distribution of drugs and better access to pharmaceutical services are also needed to improve public health in developing countries (Hanafiah, A. 2024).

Collaboration across sectors, including between the pharmaceutical sector, government, and international agencies, is critical to the success of infectious disease control. This collaboration can create a more resilient system to deal with infectious disease outbreaks. The pharmaceutical sector plays a role in the research and development of effective drugs and vaccines to prevent and treat infectious diseases. With continued innovation, the pharmaceutical sector can provide better and faster medical solutions to overcome disease outbreaks (Prasetyawan, 2024). The government has an important role in regulating and overseeing the distribution of drugs and vaccines, as well as ensuring that people have fair and equitable access to health services. The government is also responsible for developing health policies that support the prevention and control of infectious diseases, as well as providing adequate budgets for health programs. International agencies such as WHO and UNICEF play a role in providing technical and financial support to countries in need. They also assist in global coordination for the response to disease outbreaks, as well as providing guidance and recommendations based on current research and data.

Collaboration between the pharmaceutical sector, governments, and international agencies enables more effective exchange of information and resources. For example, the pharmaceutical sector can work with governments to ensure targeted distribution of medicines and vaccines. Governments can work with international agencies to gain support in handling disease outbreaks. In addition, international agencies can help coordinate the global response to disease outbreaks, making disease control efforts more integrated and effective. With strong cross-sector collaboration, it is hoped that the global health system can become more resilient in the face of infectious disease outbreaks. This collaboration involves the pharmaceutical sector, governments, and international agencies working together to create a more effective and responsive health system. The pharmaceutical sector plays a role in the research and development of effective medicines and vaccines to prevent and treat infectious diseases. Governments are responsible for regulating and overseeing the distribution of medicines and vaccines, and ensuring fair and equitable access for the community. International agencies such as WHO provide technical and financial support, and assist in global coordination for the response to disease outbreaks. This collaboration enables more effective exchange of information and resources, making disease control efforts more integrated and efficient. For example, the pharmaceutical sector can work with governments to ensure targeted distribution of medicines and vaccines, while governments can work with international agencies to gain support in handling disease outbreaks. With strong cross-sector collaboration, it is hoped that the global health system can reduce the impact of infectious diseases on public health and improve preparedness for future health threats. This will help create healthier and more resilient communities in facing various health challenges. This article aims to analyze the involvement of pharmaceuticals in infectious disease control, identify the challenges faced, and propose innovative solutions to overcome these obstacles. This approach is expected to provide strategic guidance for policy makers in the health sector.

METHODOLOGY

This study uses the Systematic Literature Review (SLR) method to collect and analyze data from literature related to the role of pharmacy in controlling infectious diseases. The SLR approach provides comprehensive and in-depth coverage of previous research, so that the results can be a strategic reference. Inclusion criteria in this study include articles published in the last ten years, using English or Indonesian, and discussing pharmaceutical strategies in controlling infectious diseases. (Sastrini, 2023). Articles that were not relevant or did not meet these criteria were excluded from the analysis. The literature search process was carried out through scientific databases, such as PubMed, Scopus, and Google Scholar, using the keywords "pharmacy in infectious disease control" and "antimicrobial resistance." Relevant articles were selected based on their abstracts and full contents. Data obtained from the literature were coded and analyzed using a thematic approach. This analysis helps identify patterns, themes, and relationships between pharmaceutical strategies and the effectiveness of infectious disease control. Validation of the findings was carried out through data triangulation involving public health experts. This approach ensures that the results of the analysis can be practically applied in the context of infectious disease control.

RESULTS AND DISCUSSION

Infectious Disease Control Strategy

Strategies implemented by the pharmaceutical sector in controlling infectious diseases include the development of new vaccines, efficient drug distribution, and public education. Community pharmacists play a vital role in vaccination campaigns and education programs aimed at raising public awareness about the prevention of infectious diseases. Infectious disease control strategies involve integrated approaches to prevent and reduce the spread of disease. One of the main strategies is the development of new, effective drugs and vaccines (Santika Permatasari Ely, ELY 2024). This research and development enables the creation of better medical solutions to treat and prevent infectious diseases. In addition, public education is also an important strategy. Providing information to the public about ways to prevent infectious diseases, such as the importance of hygiene, the use of personal protective equipment, and vaccination, can help reduce the spread of disease. Strengthening the health system is also needed, including increasing laboratory capacity for the diagnosis of infectious diseases, developing surveillance systems to monitor the spread of disease, and improving coordination between various health institutions. Cross-sectoral collaboration, including with international organizations such as WHO, is essential to obtain technical and financial support in controlling infectious diseases. Finally, strict supervision and regulation of the use of antibiotics and drugs are also needed to prevent drug resistance. By implementing these strategies, it is hoped that the spread of infectious diseases can be controlled and their impact on public health can be minimized (Bainus, A., & Rachman, JB 2020).

Challenges in Controlling Infectious Diseases

Studies show that antimicrobial resistance remains a major challenge in controlling infectious diseases. Studies show that antimicrobial resistance remains a major challenge in controlling infectious diseases. Antimicrobial resistance occurs when microorganisms such as bacteria, viruses, fungi, and parasites develop the ability to survive despite being given drugs designed to kill or inhibit their growth. This makes treating infections more difficult and often requires stronger drugs or combinations of drugs. One of the main causes of antimicrobial resistance is the unwise use of antibiotics, both among the community and in health facilities. The use of antibiotics that is not in accordance with a doctor's prescription, such as stopping treatment prematurely or using antibiotics for infections that do not require them, can encourage the development of resistance. In addition, the use of antibiotics in animal husbandry and agriculture also contributes to this problem (Sitepu, 2020).

Antimicrobial resistance has a significant impact on public health. Drug-resistant infections can lead to increased mortality, longer hospital stays, and higher medical costs. Treatment of drug-resistant infections often requires the use of more expensive drugs or more complex drug combinations. This can increase the financial burden on patients and health systems. In addition, drug-resistant infections can also hinder the success of other medical procedures, such as surgery and chemotherapy, which depend on the effectiveness of antibiotics to prevent infection. Overall, antimicrobial resistance threatens the success of infectious disease control and requires special attention from various parties, including the government, pharmaceutical sector, and the community. Joint efforts to educate the public about the correct use of antibiotics, monitor antibiotic use in health facilities, and develop new effective drugs are essential to overcome this challenge (Apriliany, 2022).

In addition, antimicrobial resistance also threatens the success of medical procedures such as surgery and chemotherapy, which depend on the effectiveness of antibiotics to prevent infection. To overcome this challenge, a comprehensive and coordinated approach is needed. This includes educating the public about the correct use of antibiotics, strict monitoring of antibiotic use in health facilities, and the development of new, effective drugs. Cross-sector collaboration between governments, the pharmaceutical industry, and international agencies is also essential to address the problem of antimicrobial resistance and ensure successful control of infectious diseases. This resistance is exacerbated by inappropriate use of antibiotics and lack of education in the community. The role of pharmacy in educating the public and monitoring antibiotic use is very important in overcoming this problem (Sekeon, 2023).

Solutions to Overcome Challenges

Addressing the challenge of antimicrobial resistance requires a comprehensive and coordinated approach. One of the main solutions is public education on the correct use of antibiotics and the importance of completing the entire treatment regimen. Health campaigns are also needed to raise awareness about the dangers of antimicrobial resistance. In addition, strict monitoring of antibiotic use in health facilities and farms is essential to ensure compliance with established guidelines. The development of new drugs that are effective against resistant microorganisms must also be increased through investment in research and development, as well as collaboration between the pharmaceutical industry, government, and research institutions (Supadmo, 2024). Strengthening health systems, including increasing laboratory capacity for the diagnosis of antimicrobial resistance and developing surveillance systems to monitor the spread of resistance, is also very important. Cross-sectoral collaboration with international organizations such as WHO can provide the technical and financial support needed to address antimicrobial resistance. By implementing these solutions, it is hoped that the challenge of antimicrobial resistance can be overcome, so that infectious disease control becomes more effective and its impact on public health can be minimized.

The application of digital technology in the pharmaceutical sector, such as AI-based applications, is one of the promising innovative solutions in controlling infectious diseases. AI-based applications can be used to monitor drug use in real-time, ensure that patients follow the correct treatment regimen, and reduce the risk of drug resistance. In addition, these applications can provide early warnings about the spread of disease by analyzing data from various sources, allowing for a faster and more effective response to disease outbreaks.(Solomon, 2023).

Digital technology can also improve the efficiency of drug distribution in remote areas. By using an AI-based supply chain management system, drug distribution can be optimized to ensure that essential drugs are available in areas that need them most. This system can monitor drug stocks in real time, identify shortages, and organize drug deliveries more efficiently. In addition, digital technology can be used to educate the public about the correct use of drugs and the importance of disease prevention. Health applications can provide easily accessible information on ways to prevent infectious diseases, as well as provide reminders for vaccinations and routine health checks. With the application of digital technology, the pharmaceutical sector can become more responsive and efficient in facing global health challenges. Digital technology not only helps in controlling infectious diseases, but also improves access and quality of health services for people around the world. AI-based applications, for example, can monitor

drug use in real time and provide early warnings about the spread of disease (Kustiyanti, SA 2023). This technology also enables more efficient drug distribution, especially in remote areas, by monitoring drug stocks and organizing optimal deliveries. Cross-sector collaboration between the pharmaceutical sector, government, and international organizations is essential to strengthen efforts to control infectious diseases. These partnerships enable more effective exchange of data, resources and knowledge in addressing global challenges. The pharmaceutical sector can provide innovation in medicines and vaccines, while governments are responsible for regulating and overseeing distribution and ensuring equitable access for communities. International organizations such as the WHO can provide technical and financial support, and assist in global coordination for disease outbreak responses.

With strong collaboration, it is hoped that the global health system can become more resilient in dealing with infectious disease outbreaks. Cross-sector collaboration between the pharmaceutical sector, governments, and international organizations allows for more effective exchange of data, resources, and knowledge in dealing with global challenges. The pharmaceutical sector can provide innovation in medicines and vaccines, while governments are responsible for regulating and overseeing distribution and ensuring equitable access for the community. International organizations such as WHO can provide technical and financial support, as well as assist in global coordination for the response to disease outbreaks. With strong collaboration, it is hoped that the global health system can reduce the impact of infectious diseases on public health and increase preparedness in dealing with future health threats. This will help create a healthier and more resilient society in dealing with various health challenges (Jayatmi, I. 2022).

The Role of Pharmacists in Controlling Infectious Diseases

The role of pharmacists in controlling infectious diseases has grown significantly. They are not only responsible for providing medicines, but also act as public health consultants who are active in preventing and controlling diseases (Rahman, A., & Utama, LS 2020). Here are some important roles of pharmacists in controlling infectious diseases:

1. **Community Education:** Pharmacists provide information to the community about ways to prevent infectious diseases, such as the importance of hygiene, use of personal protective equipment, and vaccination. They also counsel patients on the proper use of medications, including how to take the medication, possible side effects, and the importance of adherence to the medication regimen.
2. **Participation in Prevention Programs:** Pharmacists are involved in public health programs aimed at controlling the spread of infectious diseases. They work with other health agencies in vaccination campaigns, health education, and disease prevention programs. Pharmacists also play a role in monitoring and reporting the incidence of infectious diseases, which can help in early detection and rapid response to disease outbreaks.
3. **Drug Stock Management:** Pharmacists are responsible for managing drug stocks in pharmacies and healthcare facilities. They ensure that the drugs needed for the treatment of infectious diseases are always available and accessible to the public. Pharmacists also play a role in ensuring the quality and safety of the drugs provided, as well as providing information on the proper use of drugs.
4. **Collaboration with Other Healthcare Professionals:** Pharmacists work closely with physicians, nurses, and other healthcare professionals to provide comprehensive

care to patients. They contribute to the development of effective treatment plans and ensure that patients receive care that is appropriate to their needs.

With this expanding role, pharmacists have become an important part of the public health system that focuses on the prevention and control of infectious diseases. They not only provide medicines, but also serve as a source of information and support for the community in maintaining health and preventing the spread of disease. Pharmacists provide education to the community about ways to prevent infectious diseases, such as the importance of cleanliness, use of personal protective equipment, and vaccination. They also provide counseling to patients about the correct use of drugs, including how to take the drug, possible side effects, and the importance of adherence to the treatment regimen. In addition, pharmacists are involved in public health programs aimed at controlling the spread of infectious diseases, working with other health institutions in vaccination campaigns, health education, and disease prevention programs. With this expanding role, pharmacists have become an important part of the public health system that focuses on the prevention and control of infectious diseases. They not only provide medicines, but also serve as a source of information and support for the community in maintaining health and preventing the spread of disease (Kurniawan, F., & Ibu, SP 2023).

Innovative solutions to future challenges in infectious disease control include several approaches that can strengthen global health systems. First, the development of emergency pharmaceutical packages for remote areas is essential. These packages contain essential medicines and medical equipment that can be used in emergency situations, ensuring that people in remote areas have quick access to the care they need. Second, the implementation of e-prescription systems can improve the efficiency and accuracy of drug administration. These systems allow doctors to send prescriptions directly to pharmacies electronically, reducing the risk of prescribing errors and ensuring that patients receive the right medicines quickly. E-prescriptions can also help monitor drug use and prevent antibiotic misuse. Third, technology-based training for pharmacists can improve their skills and knowledge in infectious disease control. This training can include the use of digital technologies, such as AI-based applications, to monitor drug use and provide early warnings about the spread of disease. With the right training, pharmacists can become more effective in educating the public and ensuring the correct use of medicines. With these innovative solutions, it is hoped that global health systems can become more resilient in the face of infectious disease outbreaks. Cross-sector collaboration between the pharmaceutical sector, governments, and international organizations is needed to strengthen infectious disease control efforts. This partnership enables more effective exchange of data, resources and knowledge in addressing global challenges, thereby reducing the impact of infectious diseases on public health and improving preparedness for future health threats.

CONCLUSION

Infectious disease control strategies involve an integrated approach that includes the development of new vaccines and drugs, efficient drug distribution, and public education. The pharmaceutical sector plays a critical role in creating medical solutions and implementing vaccination campaigns to raise awareness of disease prevention. In addition, strengthening health systems, such as laboratory capacity and surveillance systems, is also part of this strategy. Collaboration across sectors, including with international organizations such as WHO, is essential in strengthening disease control. A

major challenge in infectious disease control is antimicrobial resistance, which is caused by the indiscriminate use of antibiotics. This makes infections more difficult to treat, worsens patient outcomes, and increases medical costs. Addressing this challenge requires a comprehensive approach, including public education on the correct use of antibiotics, close monitoring in health facilities, and the development of new, effective drugs. In addition, the application of digital technologies, such as AI-based applications, can help monitor drug use and provide early warnings about the spread of disease. The role of pharmacists in infectious disease control is vital, not only as drug providers, but also as public health consultants who provide information and education on disease prevention, the correct use of drugs, and the importance of vaccination. With innovative solutions, such as the development of emergency pharmaceutical packages for remote areas, the implementation of e-prescription, and technology-based training for pharmacists, it is hoped that the global health system can be more resilient in dealing with infectious disease outbreaks. Collaboration between the pharmaceutical sector, governments, and international organizations is essential in strengthening infectious disease control efforts and improving the readiness of the global health system.

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