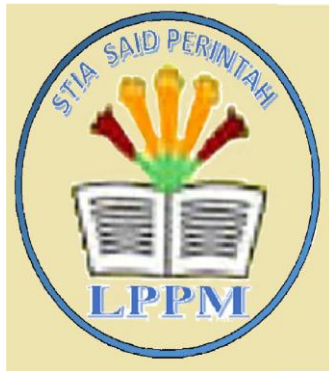

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The Impact of Information and Communication Technology on Enhancing Health Service Quality

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Abstract

This study investigates how information and communication technology (ICT) can enhance health services at the Central Maluku District Health Office. The findings reveal that website and mobile applications, telemedicine, and GIS need infrastructure upgrades, improved technological literacy, enhanced data security, and training for medical staff. Social media is utilized to raise public awareness, while Electronic Medical Records (EMR) streamline administrative efficiency and coordination. However, management systems for clinics and hospitals are still inadequate, leading to long wait times and scheduling problems. On a positive note, digital reporting is advancing, allowing for real-time monitoring and analysis at RSUD Masohi.

Keywords : Role, ITC, Accessibility, Efficiency, Effectiveness

Introduction

Health development is a systematic and ongoing effort aimed at enhancing the quality of life within a community by improving health levels. This includes various initiatives such as providing quality healthcare services, increasing access to healthcare facilities, and empowering individuals and communities to adopt healthy lifestyles. Health development encompasses not only physical health but also mental, social, and environmental well-being. Collaboration among the government, the private sector, and the community is crucial for achieving inclusive and sustainable health development. Key factors in addressing global health challenges such as infectious diseases, chronic diseases, and health impacts from climate change include the development of health infrastructure, research innovation, and the effective use of medical technology. By employing a comprehensive approach, health development aims to foster a healthy and productive society.

Health development is a systematic and sustainable initiative focused on enhancing the overall health status of the community from both individual and collective viewpoints. This initiative integrates promotive, preventive, curative, and rehabilitative measures through various programs and policies aimed at creating a healthy environment and improving access to quality health services. It also involves cross-sectoral collaboration with areas such as education, environment, and economy, all of which impact community health. Globally, health development is a vital component of the sustainable development agenda (SDGs), particularly in ensuring healthy lives and well-being for all individuals of all ages. In Indonesia, health development faces challenges, particularly in remote, archipelagic, and rural regions, such as Central Maluku District, which require adaptive and inclusive policy and technology approaches.

This study stands out from previous research by specifically examining the role of information and communication technology (ICT) in enhancing the quality of health services provided by local government, particularly the Health Office of Central Maluku Regency. Unlike other studies that typically focus on the effectiveness of health programs or patient satisfaction at service facilities, this research highlights how the integration and application of ICT can improve managerial systems, access to information, and service efficiency at the institutional level. Furthermore, the unique geographical context of Central Maluku, as an archipelago facing distinct challenges in health service distribution, adds a novel dimension

that has not been extensively explored in existing literature. This study aims to contribute empirically to the development of digital-based health service policies in similar regions.

As a densely populated country, Indonesia faces numerous public health challenges, including malnutrition, infectious diseases, maternal and child health issues, environmental pollution, limited access to healthcare, and an increasing prevalence of non-communicable diseases (NCDs). The situation is further complicated by mental health disparities and the coexistence of infectious and non-communicable diseases, known as the double burden of disease. This dual challenge underscores the necessity for comprehensive healthcare strategies.

Central Maluku Regency, like many other regions in Indonesia, grapples with significant public health challenges. General health conditions in the region are influenced by environmental factors, social behaviors, and the availability of healthcare services. According to Amatulloh, (2021), healthcare services comprise several components, including the availability and quality of facilities, medications and health supplies, healthcare personnel, financing, and management. Baihaqi, (2022) emphasizes that public health involves all activities aimed at preventing disease (preventive), promoting health (promotive), providing therapy (curative), and facilitating recovery (rehabilitative). The main pillars of public health science include epidemiology, biostatistics, environmental health, health education and behavioral sciences, health administration, community nutrition, and health services.

In Central Maluku Regency, significant challenges hinder the provision of adequate healthcare services. Despite various efforts by the local Health Office, several obstacles continue to impact the quality and accessibility of services. Geographical constraints, particularly in remote and hard-to-reach areas such as the Banda Islands and the mainland regions of Seram Island, pose major difficulties. Many of these areas fall into the 3T category (Poor, Underdeveloped, and Lagging), complicating healthcare delivery.

The 2023 Performance Report from the Central Maluku District Health Office indicates that several key health indicators have not met their targets. Life expectancy remains a concern due to persistently high infant mortality rates (6 per 1,000 live births in 2023), elevated mortality from infectious diseases such as Tuberculosis and Hepatitis, and deaths related to excessive alcohol consumption and traffic accidents. Additionally, non-

communicable diseases like Hypertension and Diabetes Mellitus significantly contribute to mortality rates.

The accreditation of community health centers (Puskesmas) also falls short, with a target of 70% but a realization of only 68% and an achievement rate of just 67%. This gap is attributed to a shortage of healthcare professionals, inadequate facilities and infrastructure where at least 60% of required resources must be met for accreditation and budget constraints for quality improvement initiatives.

Moreover, the development and utilization of Health Information Technology have not yet created new opportunities for enhancing healthcare accessibility. Key digital health solutions, such as telemedicine, electronic medical records, and other health information systems, remain underutilized.

According to the report, the achievement of Minimum Service Standards (SPM) in the health sector reached 72% of the target, which was set at 75%. This shortfall can be attributed to several factors, including limited health human resources, inadequate facilities and infrastructure including health information technology devices suboptimal cross-sector coordination, and insufficient budget allocations to support SPM-related activities. Additionally, Central Maluku District faces challenges in accessing health services, particularly for residents in rural and remote areas, highlighting the urgent need for information and communication technology-based interventions to improve efficiency and service coverage.

Literature Review

The health sector, including medical practice, is significantly impacted by advancements in information technology. Rapid developments in healthcare are often driven by technological innovations, which influence various areas such as hospital organization, medical practices, and research and development in health sciences (Rosari et al., 2023).

Research, including a study by Manganello, Jennifer, et al. (2017) in the article "The Relationship of Health Literacy with Use of Digital Technology for Health Information: Implications for Public Health Practice" (Forestal, 2017), indicates that public health services are shaped by the integration of digital technology. Furthermore, health

interventions utilizing digital technology have proven to be highly effective in serving communities, as highlighted by Rosari et al., (2023).

Technology

Technology involves applying knowledge to perform specific tasks more effectively. According to Rosenzweig, (2000), technology is defined as the organization and application of knowledge to achieve practical goals. This definition encompasses not only physical tools and machines but also techniques and intellectual processes used to solve problems and attain desired outcomes.

Information

Information is derived from processing data or facts to enhance their meaning. It offers new insights, reduces uncertainty, and serves as a foundation for informed decision-making by presenting options with measurable risks. In this context, data is transformed into useful information, which holds greater value. According to Ekram (2022), information is often referred to as processed data, as it results from the processing of useful data. Simply put, information clarifies the meaning of data or facts (Ekram et al., 2022). It supports accurate decision-making by minimizing uncertainty and providing viable options. In higher education, relevant information must be generated through data processing to address specific challenges. This information fosters a better understanding of the current situation and facilitates appropriate decision-making.

Information Technology

Wibowo, (2020) defines information technology as the means and infrastructure comprising hardware, software, and useware used for acquiring, transmitting, processing, interpreting, storing, organizing, and meaningfully utilizing data. Similarly, Supriyanto, (2023) describes information technology as a field of knowledge focused on computer-based information and its rapid development. Hamzah B. Uno and Nina Lamatenggo, (2011) further emphasize that information technology encompasses the technology used to process data (Abbas et al., 2022). This processing includes acquiring, organizing, storing, and manipulating data in various ways to generate high-quality information that is relevant, accurate, and timely.

Health Information Technology

The advancement of technology significantly impacts various sectors, particularly the medical field through the use of health information technology. Healthcare services, both clinical and non-clinical, benefit greatly from these technological developments, especially those directly related to patient care. Technology plays a crucial role in supporting clinical decision-making and can also serve as a management system for healthcare facilities (source: <https://stikeshb.ac.id/teknologi-informasi-kesehatan-dan-perkembangannya>, accessed May 30, 2023). The application of this technology includes various tools such as Electronic Medical Records (EMRs), Electronic Health Records (EHRs), and Personal Health Records (PHRs). These tools are designed to provide healthcare providers with accurate patient health information, which is essential for informed decision-making and ensuring patients receive appropriate care. Additionally, health information technology aids in the diagnostic process and effectively reduces the likelihood of medical errors.

Public Service

Public service can be defined as the provision of services to meet the needs of individuals or communities that have an interest in the organization, in accordance with established rules and procedures. As previously noted, the core purpose of government is to serve the community. It is not designed to serve its own interests but to fulfill the needs of the community and create conditions that allow every member to develop their abilities and creativity to achieve collective goals (Rasyid, 2000). Consequently, public bureaucracy has an obligation and responsibility to provide high-quality, professional services. In this context, public service refers to the provision of services aimed at addressing the needs of individuals or communities with an interest in the organization, in compliance with the established basic regulations and procedures. Meanwhile, contemporary society has experienced dynamic growth, accompanied by improvements in living standards, which signifies the ongoing empowerment of the community (Widodo et al., 2023).

In *Delivering Quality Services* by Zeithaml, Valarie A. et al. (1985), the authors discuss how customer responses and expectations towards the services they receive—whether in the form of goods or services are shaped (Parasuraman et al., 1985). In this context, the overarching goal of public service is to prepare services that align with the needs and expectations of the public and to effectively communicate the available options and

methods for accessing these services, as planned and provided by the government. To achieve this objective, the following key points are outlined;

1. Identifying the types of public services to be provided;
2. Treating service users as customers;
3. Striving to meet the desires and expectations of service users;
4. Identifying the most efficient and highest-quality service delivery methods;
5. Providing alternatives for service users who have no other available options.

Research Method

This research employs a qualitative approach, specifically utilizing the phenomenological research design. The study is conducted within the environment of the Central Maluku District Health Office. The data types used in this research are primary and secondary data, with 10 informants participating in the study. The data collection techniques employed the triangulation method, as outlined by (Miles and Huberman, 2014), which is considered a crucial strategy for validating data in qualitative research (Miles, 2014). The data were gathered through interviews, observations, and documentation. The data analysis method follows the framework proposed by Miles and Huberman, consisting of the following stages: data collection, data display, data condensation, and conclusion drawing/verification (Miles and Huberman, 2014).

Discussion

Tasks, Functions, and Organizational Structure of the Health Office

The Health Office is a regional agency that functions as an element in the implementation of health governance affairs. It is led by a Head of Office, who reports directly to the Regent through the Regional Secretary. The Health Office's primary responsibility is to assist the Regent in carrying out government affairs related to health and to manage tasks delegated to the Central Maluku Regency.

Department Resources (Healthcare Personnel)

Based on the data, the majority of employees at the Central Maluku District Health Office hold a Diploma 3 qualification, totaling 1,334 individuals, which accounts for approximately 98.8% of the 1,350 respondents. This indicates that healthcare personnel

with a Diploma 3 qualification dominate the organization, occupying key roles such as nurses, midwives, and other healthcare staff. This trend highlights the significant demand for healthcare workers at this educational level, which is crucial for maintaining the office's operational capacity.

A smaller proportion of employees possess a Bachelor's Degree (S1), with 13 individuals representing about 1% of the total workforce. These employees typically work as general practitioners, nurses, pharmacists, and other specialized healthcare professionals, roles that require higher qualifications and specialized skills. Additionally, 7 respondents (approximately 0.5%) hold a Master's Degree (S2), suggesting that individuals with advanced degrees are employed in leadership or specialized roles. Most positions at the higher echelons, Eselon II and Eselon III, are occupied by employees with S1 and S2 qualifications, while the majority of staff positions are filled by individuals in more technical or administrative roles.

In summary, the employee distribution at the Central Maluku District Health Office demonstrates that the workforce is predominantly composed of Diploma 3-qualified healthcare personnel, with a smaller proportion holding S1 and S2 qualifications. This composition reflects the organization's diverse needs, with specialized positions being filled by higher-level graduates, and a significant number of staff occupying technical and operational roles.

The Role of Health Information Technology in Improving Accessibility, Efficiency, and Effectiveness of Services at the Health Office in Central Maluku Regency.

The development of a website and mobile application for the Central Maluku District Health Office represents a significant advancement in improving public access to health information, medical services, and consultation schedules at any time and from anywhere. This digital platform offers several benefits, such as easy access to health information, the ability to register or book medical services online, and access to a broader range of health education, including vaccination campaigns and healthy living guidelines. Furthermore, this technology facilitates telemedicine services, enabling remote consultations that overcome distance and time barriers.

However, the development and implementation of this platform face several challenges. One major issue is the limited infrastructure, such as unstable internet connections in remote areas, which hinders community access to the website or application. Additionally, many residents lack mobile devices, and budget constraints present a significant barrier to the development and ongoing maintenance of the platform. Issues related to data security and privacy, as well as limitations in user experience (UX), may also diminish the effectiveness of the platform. To address these challenges, improvements in network infrastructure, technological training for both the community and healthcare workers, and policy support from local governments and third parties are essential. Furthermore, the implementation of a reliable and user-friendly security system is crucial to ensure that the community feels comfortable using this platform.

The challenges in the development of websites and mobile applications for health services directly impact the efficiency and effectiveness of services provided by the Central Maluku District Health Office. Unstable internet connections in remote areas cause delays in accessing health information and services, affecting the speed and accuracy of service delivery. The low level of digital device ownership and technological literacy within the community further limits optimal use of the platform. Additionally, budget constraints hinder the maintenance and enhancement of system features, negatively impacting the performance of digital services. Concerns regarding data security and privacy also affect public trust in online services, while a less user-friendly interface design exacerbates the user experience, particularly for certain age groups. As a result, service efficiency is compromised, and effectiveness is reduced because not all segments of society can access or benefit equally from these digital platforms.

Moreover, it is crucial to offer interactive features and ensure that the content provided is consistently updated and relevant. The research findings highlight the need for utilizing information technology (Ekram et al., 2022), adopting a public service approach (Herizal et al., 2020), ensuring service accessibility (Tuakora & Rolobessy, 2024), and monitoring performance (Gustia et al., 2024).

The Importance of Geographic Information Systems (GIS)

Geographic Information Systems (GIS) play a crucial role in enhancing healthcare services at various levels. This technology facilitates the collection, analysis, and

visualization of spatial data, offering clearer and more detailed insights into the health conditions of communities across different regions. One of the primary advantages of GIS is its ability to identify and map various factors that influence public health, such as disease distribution, healthcare facility locations, and access to medical services.

As noted by sources, GIS is particularly valuable in mapping and monitoring disease outbreaks, allowing for faster and more targeted responses (Dinas Kabupaten Maluku Tengah, 2024). Additionally, GIS enables the integration of socio-economic data, which is essential for understanding the correlation between factors such as poverty and disease prevalence. With this detailed information, health policies can be developed more accurately and tailored to the specific needs of each region. However, the success of GIS implementation largely depends on the quality of the data collected, the availability of adequate infrastructure, and the provision of sufficient training for healthcare personnel and workers.

Adequate infrastructure and training are two critical elements supporting the effective use of information and communication technology in the healthcare sector. Infrastructure encompasses the availability of a stable internet network, hardware such as computers and servers, and software that meets the needs of healthcare services. Without sufficient infrastructure, digital services cannot be optimally accessed, especially in remote areas that still experience a technology gap. On the other hand, providing adequate training for healthcare workers and the community is essential to ensure proficiency in operating the available digital systems. This training should include technical skills, enhanced digital literacy, and awareness of the importance of data security. With robust infrastructure and skilled human resources, the digital healthcare system will become more efficient, effective, and inclusive, reaching all levels of society, including those in areas previously underserved by conventional services.

Health Education and Information Portal

The results of interviews with various medical personnel in Central Maluku Regency highlight the need for a more comprehensive health education portal provided by the Health Office. This portal should not only offer administrative information but also serve as a resource for health education materials that can be easily accessed by the community. The

materials should cover topics such as disease prevention guidelines, health maintenance tips, vaccination information, and details on local endemic diseases.

Some of the primary challenges identified include limited access to health information in remote areas, difficulties in obtaining effective health counseling, and a lack of preventive health education.

To address these challenges, the Health Office can develop a comprehensive health education portal that is accessible even with limited internet connectivity. This strategy involves optimizing the portal's design to ensure it is user-friendly, using local languages to engage rural communities, and incorporating multimedia content such as videos and infographics to facilitate understanding. Additionally, the portal can be integrated with online consultation services or AI based health chatbots to enable people to quickly and interactively obtain information or counseling.

Involving health cadres at the village level to distribute information offline is also an effective approach for reaching areas without internet access. Furthermore, providing digital literacy training for both communities and health workers will enhance the utilization of the portal, ensuring that preventive health education is disseminated equitably and sustainably throughout the region.

Social Media and Communication: The use of social media to disseminate health information and educational campaigns allows information to reach more people in a short period of time.

The results of interviews with various medical personnel and staff from the Central Maluku District Health Office revealed that, although social media holds significant potential for disseminating health information, its use in the region remains suboptimal. Afiah Gani, a nurse at RSUD Masohi, pointed out that social media is particularly useful in reaching the community, especially in remote areas, and during emergencies such as a pandemic (Dinas Kabupaten Maluku Tengah, 2024). However, she also emphasized that the Health Office has not yet fully optimized the use of social media to distribute the health information needed by the community. The potential to enhance public health awareness and knowledge through social media remains largely untapped.

Despite its significant potential as a tool for information dissemination and increasing public health awareness, the full utilization of social media faces several challenges. One of

the primary obstacles is low digital literacy, particularly among rural communities and the elderly, which makes it difficult for them to distinguish between credible information and misinformation. Additionally, limited access to stable internet and technological devices in some areas further hampers the reach of social media-based health campaigns. There is also a shortage of trained personnel to manage health-related social media content in a professional and sustainable manner. Furthermore, social media platform algorithms often prioritize sensational or entertaining content, causing educational messages to be overshadowed and preventing them from reaching the intended audience. Collectively, these factors hinder the effectiveness of social media as a strategic tool for public health promotion.

Efficiency of Healthcare Services

The implementation of Electronic Medical Records (EMR) facilitates the digital storage, management, and access of patient data, thereby reducing dependence on physical documents that are susceptible to loss or damage. This system offers several benefits, including faster retrieval of patient information, a reduction in medical errors caused by incomplete or delayed data, and enhanced data security, as it can be protected by advanced digital security systems.

Overall, sources agree that the introduction of Electronic Medical Records (EMR) in Central Maluku Regency will provide numerous advantages, such as increased administrative efficiency, improved coordination among healthcare facilities, and heightened security and confidentiality of patient medical data. While there are challenges to be addressed in the implementation of this system, including the need for sufficient infrastructure, training for medical personnel, and the selection of an appropriate system, experts believe that EMR can be a significant step toward improving the quality of healthcare services in the region.

In conclusion, they emphasized that with the appropriate support, the EMR system will be highly beneficial for all parties involved in healthcare service provision and can significantly improve the quality of care received by patients in Central Maluku Regency.

Clinic and Hospital Management System

The importance of online registration and queuing in the healthcare service system is considerable, particularly in enhancing operational efficiency and patient comfort. Online registration and queuing help reduce waiting times and improve the efficiency of schedule management. Some patients and medical staff have reported that the current manual system causes several issues, including long waiting times, irregular schedule management, and patient discomfort, especially for those traveling from remote areas. Manual registration negatively impacts the patient experience, as it requires additional time for registration, leads to long queues, and often results in uncertainty regarding visit schedules.

The implementation of an online system can significantly improve the management of service capacity. By enabling real-time monitoring of patient numbers, medical staff can more effectively manage schedules and prevent overload, which often leads to delays in service delivery.

Inventory Management: The use of technology for inventory management ensures the availability of medicines and medical equipment, as well as prevents shortages or waste.

The results of interviews conducted with several pharmacists in Central Maluku Regency indicate that the integration of technology in the management of drug and medical equipment inventory is crucial for improving operational efficiency and the quality of healthcare services. The pharmacists highlighted several challenges resulting from the lack of technology-based systems, such as difficulties in accurately tracking drug stocks, budget inefficiencies, and shortages of essential medications, which can hinder the medical care process.

Without an automated system, stock management is prone to human error and heavily dependent on time-consuming and labor-intensive manual checks. This makes healthcare facilities struggle to respond to sudden surges in demand for urgent medications or medical equipment, which can ultimately lead to delays in distribution and service. The implementation of a technology-based system can address these challenges by enabling real-time stock monitoring, ensuring that the supply of medicines and medical equipment is consistently maintained and available on time when needed.

Digital Reporting and Monitoring

Overall, interviews with administrative staff at RSUD Masohi revealed several challenges due to the absence of a digital reporting system. Without an efficient and integrated reporting system, the Health Office and other healthcare facilities are severely limited in their ability to respond promptly to outbreaks of infectious diseases or environmental health issues. Additionally, they face difficulties in monitoring disease trends and quickly identifying health concerns, which ultimately disrupts the smooth delivery of healthcare services.

However, staff believe that the implementation of an integrated digital reporting system would significantly improve the situation. Such a system would enable faster responses to health issues, allow for real-time data analysis, and enhance coordination between healthcare facilities, resulting in more effective and efficient management of health problems (Dinas Kabupaten Maluku Tengah, 2024).

Effectiveness of Healthcare Services (Big Data and Machine Learning)

The application of advanced technologies such as Big Data and Machine Learning (ML) holds significant potential to improve the quality of healthcare services in Central Maluku Regency. Although the region currently relies on traditional systems for health data management, these technologies offer numerous advantages that can enhance efficiency, accuracy, and speed in data processing and decision-making.

Utilizing Big Data and Machine Learning in the healthcare system can improve service quality, accelerate decision-making, and enable more effective responses to health issues. This technology can assist the Health Department in designing more precise policies, preparing the necessary medical resources, and developing prevention programs that are more focused and data-driven.

Conclusion

The implementation of Health Information Technology (HIT) is crucial for improving healthcare services in Central Maluku Regency. Key developments such as websites, mobile applications, telemedicine, and Geographic Information Systems (GIS) offer significant benefits, but they require improvements in infrastructure, data security, and training for medical staff. GIS adoption depends on high-quality data and robust infrastructure. Social

media plays an important role in expanding health campaigns and increasing public awareness. Electronic Medical Records (EMR) enhance administrative efficiency and data security, although challenges like infrastructure limitations and staff training remain.

Adopting online clinic and hospital management systems can improve operational efficiency, reduce waiting times, and enhance patient comfort. Implementing technology in inventory management can minimize waste and ensure timely supply availability, improving service quality. An integrated digital reporting system will improve coordination and response times, particularly at RSUD Masohi. Lastly, using Big Data and Machine Learning (ML) can optimize healthcare planning and decision-making, enhancing policy efficiency and response to health challenges.

Recommendations

Enhancing healthcare services in Central Maluku Regency requires improvements in technology infrastructure, including better internet access and essential hardware/software. Continuous training programs are necessary to improve the digital competence of healthcare professionals. Implementing health information systems like Electronic Medical Records (EMR), digital service applications, and telemedicine will increase efficiency and accessibility.

Public awareness should be raised through digital literacy campaigns, health education, and policy support to encourage community engagement in digital healthcare. Clear policies and regulations are essential for supporting ICT adoption in healthcare, ensuring data security, patient privacy, and system interoperability. These measures will help build public trust, facilitate seamless technology integration, and promote a patient-centered healthcare system, enabling healthcare providers to adopt digital solutions effectively and improve service delivery.

Limitation and Future Research

This study has several limitations. First, it focuses solely on Central Maluku Regency, so the findings may not be applicable to other regions with different conditions. Second, the study primarily examines technological and infrastructure aspects, while cultural norms and community attitudes toward technology were not explored in depth. Third, the data from interviews with medical personnel and administrative staff may reflect subjective

perspectives and do not include the views of the broader public or patients. Additionally, there was limited access to secondary data on the broader implementation of health technologies in the region.

For future research, it is recommended to broaden the geographical scope to include regions with varying characteristics. Future studies should also examine social and cultural factors affecting the acceptance and use of health technology, involve patients to gain deeper insights into their experiences, and analyze existing policies and regulations. Further research could also assess the long-term impact of health technology implementation on healthcare quality in the region.

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