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# Enhancing Health Services through Telemedicine: Addressing the Gaps in LBW Monitoring and Training at Puskesmas Gedangan, Sidoarjo Regency

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**ABSTRACT** Puskesmas in Sidoarjo Regency do not yet have facilities for monitoring LBW in real time via android either by health workers at the health centre or the patient's family. Puskesmas Gedangan serves communities spread across several villages with a coverage area spread across several villages. This is an obstacle for families to get access to monitor the patient's progress, because the patient is in the NICU or ICU room. Another thing is that there is no training for users in the use of telemedicine-based Baby Incubator equipment. The role of users and families of patients is very important to keep the equipment in good condition. However, operating training based on new technology for users has never been conducted. Efforts to solve the above problems are to carry out counselling and assistance in the use of baby incubator equipment to users including nurses, midwives and other non-health worker users, to increase the knowledge of officers or users which in turn will have an impact on increasing the productivity of officers or users and improving the quality of service at the health centre. The purpose of this Community Service is to increase the role and participation of Poltekkes Kemenkes Surabaya in improving the degree of public health in the Puskesmas Gedangan area, Sidoarjo Regency. The results of community service through the application of telemedicine-based Baby Incubator at Puskesmas Gedangan are increased knowledge and skills regarding telemedicine-based baby incubator equipment. This will improve health services, especially for babies who need intensive care. The implementation of this technology provides significant benefits, including increased accessibility of health services, speed of response to patient health conditions, family involvement in care, and efficient use of resources. Assistance to Puskesmas personnel and patient families in the form of training, monitoring and evaluation of the use of appropriate technology in the form of Telemedicine-based baby incubator utilization.

**INDEX TERMS** Baby Incubator, telemedicine, low birth weight newborns, Puskesmas Gedangan

## I. INTRODUCTION

Sidoarjo Regency, astronomically, is located between 7.3°–7.5° S (South Latitude) and 112.5°–112.9° E (East Longitude). Geographically, this regency borders Surabaya City and Gresik Regency to the north, Pasuruan Regency to the south, the Madura Strait to the east, and Mojokerto Regency to the west. The regency, which has an area of 714.243 km², is divided into 18 districts. The largest district is Jabon, covering 11.34% of the regency's total area, followed by Sedati District, which covers 11.12%. Sidoarjo Regency is also known as the "Delta City" due to its location between two major rivers, branches of the Brantas River, namely the Surabaya River to the north and the Porong River to the south. Sidoarjo Regency consists of 18 districts, 31 urban villages, and 322 rural villages (out of a total of 666 districts, 777 urban villages, and 7,724 rural villages in East Java). Gedangan District, located approximately 16 km from Sidoarjo City, comprises 15 villages, 101 RW (neighborhood associations), and 717 RT (community units). The population is 133,598 people, with a

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composition of 67,623 males (50.62%) and 65,975 females (49.38%). The most densely populated area in Sidoarjo Regency is Sidoarjo District, with a density of 9,461 people per km², making it the economic and commercial center of the regency. In 2020, East Java Province had a low birth weight (LBW) population of 20,627 people.

The regencies/cities with the highest LBW rates included Jember Regency (1,908 people) and Probolinggo Regency (974 people), while the lowest were Mojokerto City (78 people), Madiun City (146 people), and Batu City (197 people). Sidoarjo Regency had 295 LBW cases (BPS East Java Province 2021). According to the Indonesian Health Profile in 2020, the leading cause of neonatal death is LBW. Although LBW infants without complications can catch up in weight with proper care, they are at risk of stunting and developing non-communicable diseases in adulthood, such as diabetes mellitus, hypertension, and heart disease. Premature infants with LBW have a mortality risk up to 20 times higher than full-term infants.

The World Health Organization (WHO) reported in 2020 that 99% of maternal deaths due to pregnancy and childbirth complications occur in developing countries, with a rate of 239 per 100,000 live births, compared to 12 per 100,000 in developed countries. The global prevalence of LBW is 15.5%, with around 20 million LBW infants born each year, 98.5% of whom are in developing countries. In 2020, Indonesia had 4,371,800 births, with an LBW incidence of 15.5 per 100 live births or 675,700 premature cases per year. The LBW incidence in Indonesia was 35.2%, while East Java Province had a lower rate of 3.7%. LBW is caused by two main factors: premature birth (gestational age ≤ 37 weeks) and intrauterine growth restriction (IUGR). LBW can lead to morbidity and mortality, and distinguishing between premature birth and IUGR is important due to their different mortality rates.

Various studies have identified several causes of LBW, including maternal factors (nutritional status, age, parity, economic status), poor pregnancy history (previous LBW births, abortions), inadequate antenatal care, and fetal conditions. Women with low socioeconomic status tend to have inadequate food intake, poor living conditions, and limited access to prenatal care, which can affect the birth weight of their babies. Mothers aged ≤ 15 years are at high risk of giving birth to LBW infants. According to the Sidoarjo Regency Health Profile in 2021, the Infant Mortality Rate (IMR) is the number of infants who die before reaching 1 year of age per 1,000 live births in the same year.

The IMR is a crucial indicator of public health and the quality of healthcare services, reflecting factors such as antenatal care, maternal nutrition, and socioeconomic conditions. In 2020, Sidoarjo Regency reported a Neonatal Mortality Rate of 2.16 per 1,000 live births, with an absolute number of 76 neonatal deaths. The IMR was 3.01 per 1,000 live births, with an absolute number of 106 out of 35,184 live births. The most common cause of these deaths was LBW (43 cases).

This community service activity is based on the need for services at Gedangan Health Center to support the monitoring of LBW infant care using appropriate technology from the research of lecturers and students of Poltekkes Kemenkes Surabaya, namely the "Baby Incubator based on Telemedicine." This community service is led by a team collaborating with two members with backgrounds in Nursing and Electrical Engineering, assisted by three students from the Electromedical Engineering Technology Study Program. This activity involves lecturers and students applying their knowledge and technology to improve the health status of the community in the Gedangan Health Center area, Sidoarjo Regency. The mandatory outcomes of this community service include scientific articles published in accredited national journals and enhanced understanding and skills of students, especially Diploma 4 students involved in using the Telemedicine-Based Baby Incubator. Currently, health centers in Sidoarjo Regency do not have facilities for real-time LBW monitoring via Android devices by healthcare workers or patient families. With the advancement of information technology, families can more easily monitor the progress of premature infants directly through mobile phone facilities.

## II. METHOD AND IMPLEMENTATION

### *A. METHOD*

This Community Service with the Community Partnership Program scheme is about "Application of telemedicine-based Baby Incubator Tools at Puskesmas Gedangan in an Effort to Maintain Sustainability of Health Services" which will help families to monitor the health development of their babies[1][2]. The model of Community Service activities carried out for counselling activities is accompanied by mentoring activities for a certain period carried out by lecturers, and students in the form of academic activities. While the activity method is carried out through presentations and demonstrations using the necessary tools and teaching materials, namely baby incubators[3].

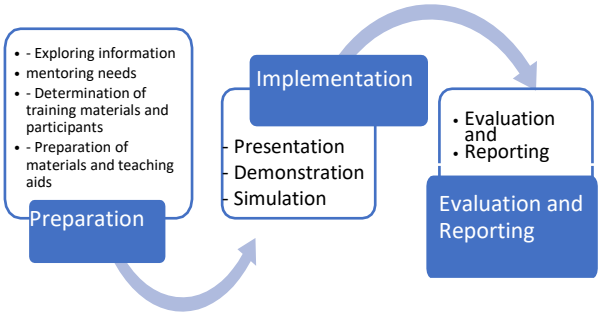


**Figure 1**
**Flow of Activity Implementation**

The steps of the Community Service activity plan are as follows:

1. Preparation

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Prior to the implementation of Community Service activities, the proposing team and partners coordinated to gather information on mentoring needs, determining the material and participants of the baby incubator demonstration, and preparing presentation and demonstration materials and props.

2. Implementation.

This Community Service activity, the proposing team involves students. The head of the proposing team is a lecturer who has expertise in the field of electromedical science and nursing science and electromedical science. While the students involved in this Community Service activity are Semester 4 of the Applied Bachelor of Electromedical Engineering Technology study programme. In conducting community service activities in the Gedangan Puskesmas environment by using a telemedicine-based Baby Incubator tool which is the result of research by a team of lecturers involving students[3]. Community Service activities carried out for counselling activities are accompanied by mentoring activities carried out through presentations and demonstrations using the necessary tools and teaching aids, namely baby incubators.

The following is the implementation plan for the Telemedicine-based Baby Incubator Tool:

1. Training phase.
   a. Install the telemedicine-based baby incubator tool in place.
   b. Installing the application on the family's android [13].
   c. Provide training to health workers on the operation of the device. Provide training for simple maintenance.

**Figure 2 Front view of the Integrated Laboratory of the Health Polytechnic of the Ministry of Health Surabaya.**

2. Operation Stage.
   a. Staff prepares the Tool.
   b. Health Centre staff receive LBW or health abnormalities.
   c. The patient's family gives consent for the implementation of treatment to
   d. The Community Service Team (Nurses) will help condition the patient who will be put into the baby Incubator[4].
   e. The Community Service Team (nurses and electromedical personnel) collaborates with Puskesmas Officers.
   f. Electromedical personnel help operate the equipment to the patient's family.
3. Monitoring Stage
   a. Electromedical personnel and nurses monitor the operation of the device.
   b. Nurses record the activity of the device.
4. Monitoring.
   a. Monitoring the use and maintenance of tools in accordance with the SOP or not.
   b. Monitoring the placement of tools in the room according to the SOP or not.
   c. Monitoring the comfort of the device on the patient.
   d. Monitoring is carried out periodically for 3 months.
5. Evaluation Design:

Evaluation of monitoring results is carried out after completion of community service. The evaluation results will be classified, recapitulated, processed, and followed up. The form of evaluation consists of:

   a. Evaluation of non-compliance with the SOP for operating the equipment
   b. Evaluation of non-compliance with daily maintenance SOPs carried out by Puskesmas personnel.
   c. Evaluation of non-conformity of repair SOPs.
   d. Evaluation results, then follow-up in the form of suggestions, or provision of additional training.

## III. RESULT

The implementation of Community Service was held in the meeting room of the Gedangan Community Health Centre (Puskesmas), Sidoarjo Regency, East Java on 12 Juli 2024. The coordination of activities was the Chairperson of community service and the Head of Puskesmas Gedangan, which was attended by 20 health workers and the person in charge of the tools and inventory of Puskesmas Gedangan health equipment.

The activity began with the opening and continued with the delivery of the purpose of arrival and activities that will be carried out during Community Service at Puskesmas Gedangan. The purpose and objectives were conveyed by the Chairperson of the Community Service, namely

1. Provide counselling for health workers or those responsible for operating the Baby Incubator Tool in carrying out the steps of use and maintenance
2. Provide training on the operation and maintenance of Baby Incubator Equipment by involving partners.
3. Provide regular mentoring to health workers Partners in carrying out maintenance steps of Baby Incubator Equipment until partners master and can do it independently[5]

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**Figure 3** Explanation of the journey to produce a baby incubator that is the result of the KRUPT scheme research

The activity continued with remarks from the Head of Puskesmas Gedangan. In brief, the Puskesmas welcomed the arrival of the Community Service Team to the Gedangan Puskesmas and was grateful for the presentation and demonstration of telemedicine-based baby incubator equipment.

The next activities are baby incubator preparation, baby incubator operation, and monitoring[6]. The following is the Application of Telemedicine-based Baby Incubator Tool:

### *A. THE PREPARATION STAGES.*

Installing the telemedicine-based baby incubator tool in place. The first step taken is to install a baby incubator tool that has been equipped with telemedicine technology[2].

**Figure 4** The health workers who attended the Community Service event at Puskesmas Gedangan, Sidoarjo

The device is equipped with advanced sensors and communication systems that enable remote supervision by health workers through the telemedicine platform. After the installation of the device, the team proceeded to install a specialised app on the Android devices of the family in charge of looking after the baby at home. The app allows parents to connect directly with the baby incubator and get real-time information on the baby's health condition. Furthermore, the team provided intensive training to health workers at the hospital on the operation of the telemedicine-based baby incubator[5].

**Figure 5** Explanation of the baby incubator device and the parameters that make it a telemedicine device.

The training covered how to operate the device, monitor vital parameters, and address potential technical issues that may arise. Additionally, the team also provided training to health workers on simple maintenance of the baby incubators[7][5]. This includes routine checks, maintenance, and minor troubleshooting that can help ensure optimal performance. With the implementation of this innovation, it is hoped that the quality of care for premature babies will improve and parents can feel more at ease as they can monitor their baby's condition more actively and be involved in their baby's health care[8].

1. **The operation stages**.

is carried out by demonstrating the tool and simulating the use of the baby incubator tool[9].

It began with an officer preparing the tools that would be used to respond to a health concern. At that time, a baby with low birth weight (BBLR) and health abnormalities was under serious attention of the medical team[10]. The health centre staff received an infant patient who needed intensive care due to his health disorder. The patient's family quickly gave consent for the treatment to be carried out. They understand that the fastest possible effort is very important to save the baby's life. The Community Service team consisting of nurses and electromedical personnel are ready to assist with this treatment process. The nurses have the necessary medical knowledge and skills to condition the patient before being placed into the baby incubator[11]. They collaborate closely with the health centre staff to ensure good coordination during the treatment process. While preparing the patient, electromedical personnel help to carefully operate the baby incubator[9]. They ensure that the device is functioning optimally and ready to be used to help maintain the baby's body temperature and monitor his/her health condition closely. Effective medical teamwork between the Puskesmas staff, Community Service team, nurses, and electromedical personnel was the key to success in responding to this urgent situation. All parties worked together with one common goal: to save the baby's life and provide the best possible care to ensure her recovery.

2. **Simulated Monitoring Stage**

Described as a hospital ward, the atmosphere is solemn. A team of electromedical personnel and nurses are focused on

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monitoring the operation of a medical device that is critical to the success of patient care. The electromedical personnel carefully inspect each component of the device, ensuring that all functions and parameters are set according to set standards. They ensure that the temperature, humidity, and other parameters in the device are within a safe range for the patient. Every indicator and monitor screen is carefully checked to detect any changes or potential problems. Meanwhile, the nursing staff concentrated on recording every activity of the device. They record the patient's body temperature, oxygen level, and heart rate, as well as other important data describing the patient's health condition

**Figure 6 Simulating a baby incubator that has been equipped with telemedicine technology**

These accurate records will later assist the medical team in evaluating and planning subsequent treatments. Both teams work synergistically, collaborating efficiently to ensure that the device functions optimally and provides the necessary information for patient care. Their hard work and expertise are key to ensuring patients get the best and optimal care.

### B. *MONITORING AND EVALUATION.*

Monitoring is carried out by a team consisting of health workers and medical equipment technicians through regular reviews of the use and maintenance of medical equipment in accordance with the established Standard Operating Procedures (SOP). The team will supervise how the equipment is used by medical personnel in accordance with the established SOPs. They check whether each step of use is followed in accordance with the pre-established procedures. This aims to ensure that the equipment is used correctly for the welfare of the patient. In addition, the team also monitored the placement of medical devices in the room in accordance with the established SOPs. They check whether the location and arrangement of medical devices meet the safety and accessibility standards required for easy use and access by medical personnel. The importance of the convenience of the equipment for patients was not overlooked. The team conducted a review to ensure that the devices provided optimal comfort for patients during use. They ensure that the devices do not cause discomfort or harm to the patient. Monitoring of the use, maintenance, placement of equipment according to SOP, and comfort of equipment is carried out regularly every 3 months. This aims to ensure that medical devices are always in good condition, used correctly, placed according to standards, and provide the necessary comfort for patients. Thus, patient care can be carried out safely and effectively in accordance with established quality standards.

Evaluation of monitoring results is carried out after completing the Community Service. The evaluation results will be classified, recapitulated, processed, and followed up. Regular evaluation of the SOP for equipment operation is carried out to ensure that medical equipment is used in accordance with established procedures. On one occasion, the evaluation team saw several discrepancies in the operation of equipment according to the SOP.

1) The evaluation team observed discrepancies in the operation of equipment according to the SOP. Some health centre personnel did not fully follow the steps described in the SOP. This could endanger patients and affect the effectiveness of the care provided.
2) The evaluation team also reviewed the implementation of the daily maintenance SOP by health centre staff. Several discrepancies were found in the daily maintenance of medical equipment. Maintenance that is not in accordance with the SOP can reduce the life of the equipment and increase the risk of operational failure.
3) The evaluation team found discrepancies in the process of repairing equipment according to the established SOPs. The repair steps that should have been followed were not implemented correctly, which could affect the quality of the equipment and patient safety.

The results of the evaluation are then used as a basis for providing appropriate follow-up. The evaluation team provided recommendations and advice to the health centre personnel on improving and increasing compliance with the SOPs for device operation, daily maintenance, and repair. In addition, additional training was organised to improve the understanding and skills of health centre personnel in applying the SOPs correctly and according to established procedures. With this follow-up, it is expected that compliance with SOPs will improve, medical devices will be better operated and maintained, and quality health services can continue to be provided to the community.

## IV. DISCUSSION

Puskesmas Gedangan is the initial target in implementing telemedicine-based baby incubators in an effort to maintain the continuity of innovative health services by implementing telemedicine-based Baby Incubators to improve the quality of health services, especially in caring for babies with health conditions that require intensive attention[12]..his Community Service aims to integrate modern technology and remote monitoring to improve the continuity and efficiency of health services in the region. The medical team at Puskesmas Gedangan welcomed the Community Service Team from the Health Polytechnic of the Ministry of Health Surabaya. The implementation of the telemedicine-based Baby Incubator has helped improve accessibility and speed of response to infant conditions that require intensive care[9].

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**Figure 7 Photo with participants, Head of Puskesmas and Community Service Team at Puskesmas Gedangan**

Doctors and health workers can monitor patients in real-time, even remotely, so that diagnosis and intervention can be carried out more quickly. The use of telemedicine enables consultation between doctors from different locations, thus providing a broader perspective of the patient's condition. This contributes to improved medical decisions and more effective treatment. In addition, the telemedicine-based Baby Incubator makes it easier for the patient's family to be actively involved in the monitoring and care of their baby[12]. They can access information regarding the baby's condition and communicate with the medical team through the app, providing a sense of comfort and trust.

While this application brought significant benefits, some challenges were also identified. The availability and reliability of internet connection is one of the main obstacles in the use of telemedicine. In addition, the skills and knowledge of healthcare workers related to technology must be continuously improved to ensure optimal utilisation of these tools.

By addressing these challenges, Puskesmas Gedangan can continue to optimise the implementation of the telemedicine-based Baby Incubator to maintain the continuity of health services and improve the quality of care for infants who require special attention[13]. In the long run, the implementation of this technology can serve as a model for other health units to improve the efficiency and effectiveness of health services.

Community Service through the implementation of a telemedicine-based Baby Incubator at Puskesmas Gedangan has brought several significant benefits to maintain the continuity of health services for infants who need intensive care.

Here are some of the benefits that can be taken from this service:

1. Improving Accessibility of Health Services: The implementation of the telemedicine-based Baby Incubator increases the accessibility of health services, especially in distant or hard-to-reach areas[14]. With telemedicine technology, parents of babies who need intensive care can monitor their baby's condition from home without having to travel far to a health centre.
2. Increased Speed of Response and Treatment: Telemedicine allows doctors and healthcare personnel to monitor and respond to a patient's condition quickly and appropriately. Real-time monitoring allows for rapid intervention if there is an urgent change in the baby's condition. This optimises the treatment process and minimises the risk of complications[13].
3. Efficiency and Time Savings: With the help of technology, doctors and medical teams can monitor multiple babies simultaneously through a single platform. This increases efficiency and time-saving in the monitoring and treatment of infants, allowing the medical team to focus more on clinical aspects and necessary services.
4. Family Involvement in Care: The use of telemedicine facilitates active involvement of the patient's family in the care process. Parents can monitor the baby's condition and gain a better understanding of the care provided, strengthening the relationship between the family and the medical team, and increasing confidence in caring for the baby after returning home.
5. Equitable Access to Health: Telemedicine technology helps address geographic and socioeconomic disparities in healthcare access[15]. Babies in remote areas or with limited access to medical facilities can also receive quality healthcare through telemedicine-based baby incubators[16].
6. Data Collection and Research: The application of this technology provides an opportunity to collect data in a structured manner. This data can be used to conduct research and analyse treatment effectiveness, advance medical science, and improve treatment protocols for the future.

Through Community Service by implementing a telemedicine-based Baby Incubator, Puskesmas Gedangan provides great benefits to patients and their families, and contributes to the overall improvement of the health system. In implementing the telemedicine-based Baby Incubator at Puskesmas Gedangan, the medical team and technicians were faced with several challenges that required appropriate mitigation strategies to maintain the continuity and effectiveness of the health service.

The following is about the challenges and the mitigation measures taken to address the issues:

1. Limited Internet Connection and Access.
   Challenges: Limited availability of internet connection in some areas may affect the effectiveness of monitoring and interaction through telemedicine-based baby incubators[16].
   Mitigation: Improvement of technology infrastructure and internet networks in remote areas to make them more reliable and faster. Implementation of temporary data storage technology (caching) to overcome unstable networks so that data can be accessed when the connection is available.
2. Limited Technology Knowledge and Skills. Challenge: Medical personnel and technicians may not be familiar

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with telemedicine technology, which may hinder the use and maintenance of these tools.

Mitigation: Conduct regular training and workshops to medical personnel and technicians on the use and maintenance of telemedicine-based tools. Create a clear and simple usage guide to make it easier for users to understand and operate the tool.

3. Limited Cost and Budget.

   Challenges: The cost of implementing and maintaining telemedicine technology, including baby incubators, can be a significant financial burden for health centres with limited budgets[17].

   Mitigation: Seeking additional funding sources through government grants, donations from non-profit organisations, or health partners. Optimised use of resources and efficient budget allocation to maximise the benefits of implementing these technologies[14].

4. Community Awareness and Acceptance.

   Challenge: The public may not be fully aware of the benefits and safety of using telemedicine technology to care for infants with health conditions that require intensive care.

   Mitigation: Conducting education and socialisation campaigns to the public regarding the benefits of telemedicine technology in supporting infant care and health improvement[15][17]. Using successful cases and patient testimonials to increase public understanding and acceptance of the implementation of telemedicine-based baby incubators[16].

By identifying challenges and implementing appropriate mitigations, Puskesmas Gedangan can minimise barriers to the implementation of this technology and ensure the continuity and success of health services provided to infants requiring intensive care.

## V. CONCLUSION

The purpose of this Community Service is to increase the role and participation of Poltekkes Kemenkes Surabaya in improving the degree of public health in the Puskesmas Gedangan area, Sidoarjo Regency. The results of Community Service through the application of telemedicine-based Baby Incubator at Puskesmas Gedangan are increased knowledge and skills regarding telemedicine-based baby incubator equipment. This will improve health services, especially for babies who need intensive care. The implementation of this technology provides significant benefits, including increased accessibility of health services, speed of response to patient health conditions, family involvement in care, and efficient use of resources.

However, challenges such as limited internet access, limited technological knowledge, budget constraints, and public awareness, are the focus of mitigation to ensure successful implementation. Strategic steps in overcoming these challenges include improving technological infrastructure and regular training for medical personnel, optimising budget allocations, and outreach campaigns to increase public awareness and acceptance.

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