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# Advancement and Maintenance of Infant Incubator in Medokan Ayu Health Centre Surabaya for Effort to Kepp Continuity of Service

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**ABSTRACT** Health Development is a leading program among 45 important programs that must be carried out throughout the country related to sectoral and regional development, where the health program is in 12th place. Health programs in the city of Surabaya are carried out through Puskesmas. One of the services available at the Medokan Ayu Health Center (PKM) is interchangeable rooms. At the Medokan Ayu Surabaya Health Center, there is also a delivery room, as well as infant incubator equipment for babies born prematurely. Baby incubator makes the percentage of babies born safe and the ability to survive from hypothermia higher in premature infants. The increasing sophistication of medical devices raises questions about device safety and reliability of infant incubator tools, hence the importance of controlled parameter inspection in medical devices. safety inspection and performance are performed by clinical professionals. The community health center for maintenance activities is not yet reached because there are no staff to handle it. In community service, carrying out maintenance activities for infant incubator equipment aims to ensure that the infant incubator is ready and suitable for use so that services can continue. From the results of the activities, infant incubators have been produced which are in good condition and ready and fit for use. From the measurement results, it was found that the biggest error when the infant incubator was set at 36oC was -0.69ºC and 0.86 at 34ºC.

**INDEX TERMS** Infant Incubator, Inspection, Preventive Maintenance.

## I. INTRODUCTION

Health Development is a flagship program among 45 important programs that must be carried out throughout the country related to sectoral and regional development, where the health program is ranked 12th. as well as from related parties and all levels of society. Therefore, cooperation from all parties is expected to succeed in health development in Indonesia in general and in the city of Surabaya in particular. Health programs in the city of Surabaya are carried out through the community health center (PKM). One of the services provided by PKM Medokan Ayu is a sharing room. There is also a delivery room at the Tanah Kali Kewall Health Center in Surabaya, as well as infant incubator equipment for babies born prematurely[1][2][3][4][5]. The health and safety of the newborn is definitely a major focus for all pregnant women. This of course cannot be separated from various possible problems or risks that arise, such as the birth of a premature baby. According to WHO 15 million babies are born prematurely every year and more than 1 million babies die every year due to complications of premature birth[6][7][8]. Unstable newborns weighing 2000 g or less at birth, or stable newborns weighing less than 2000 g who cannot be given the kangaroo method of care, should be cared for in a thermo-neutral environment either under a radiation heater or in an incubator[9]. An infant incubator or neonate incubator is a device consisting of a rigid box like a cage in which the baby can be kept in a controlled environment for medical treatment, J Perez concluded that airflow is helpful in the care of premature babies [9][10]. Virat Plangsangmas conducted a study on infant incubators used in hospitals in Thailand. This situation raises the question whether the value of physical quantities such as sound pressure or temperature in the incubator is still in accordance with the requirements of international standards.

The SST result of this study is lower than 60 dBA, which is within the tolerance limit specified in IEC 60601-2-19. This study is useful for investigating hearing loss in infants [11]. The baby incubator makes the percentage of babies born safe and the ability to survive hypothermia in premature infants is higher. The performance of this tool must be a concern so that the baby is safe and comfortable [12]. Cardoso, S conducted a study evaluating the physiological and functional effects resulting from noise exposure in newborns with low birth weight in an incubator in a neonatal unit. The result is that neonates with low body weight in the incubator experience physiological changes when facing discomfort due to environmental noise in the neonatal unit [13]. F. Fernández Zacarías Premature babies usually have to spend a long time in the incubator, excessive noise can have detrimental physiological and psychological effects on the neonate. In fact, incubator noise levels usually range from 45 to 70 dB but the difference is highly dependent on the noise measurement method. levels that clearly exceed international recommendations although these levels usually meet the limits set out in standard IEC60601-2-19:2009 (60 dBA) under normal conditions of use [14]. Neille, J. conducted a study aimed at identifying the sources of noise in three NICUs in Johannesburg, South Africa, and to determine the noise level of neonates exposed to incubators at various positions in the NICU. These findings were then compared with the standards recommended by the American Academy of Pediatrics (AAP). Most noise is generated by humans, highlighting the need to develop awareness of the negative effects of noise in the NICU and implement programs to reduce noise. These findings have important implications for neonatal care, and highlight the importance of noise reduction and monitoring strategies in the NICU [15]. Fortes-Garrido, J The effects of noise are very harmful to newborns, therefore this study assessed and characterized the noise level in the neonatal intensive care unit (NICU) of a medium-sized hospital in the city of Huelva. Results The maximum noise levels measured for critical (C-in), C(out) and intermediate (I) were: 88.8 dBA, 97.2 dBA and 92.4 dBA, while for the equivalent noise level for the total measurement period ( 15 days) were 57.0 dBA, 63.7 dBA, and 59.7 dBA, respectively. The results show that the values recommended by international bodies and institutions (AAP, WHO) are exceeded by a large margin, so it is imperative to adhere to certain norms to reduce noise levels in the NICU, through physical changes to the layout, and improve awareness. health workers and visitors to encourage noise prevention in work and daily care conversations[16]. Shimizu concludes from his research Care providers should carefully assess the adverse effects of the higher sound levels produced by different modes of respiratory support and take steps to ensure that premature infants are protected from exposure to noise that exceeds the optimal safe level[17]. The baby incubator has several parameters, namely temperature, humidity, air flow and noise. The temperature inside the infant incubator is between 35.5 ℃-37 °C, with a leakage rate of ±1 °C outside temperature, humidity level between 70%, air flow rate <0.35 ms, and noise level inside the incubator <60 dBA[18].The increasing sophistication of medical devices raises questions about the safety of the device and the reliability of the infant incubator, thus the importance of controlled parameter inspection in medical devices. safety inspection and performance was performed by clinical professionals [19]. In accordance with the Law on Health Workers No. 36 of 2014 that the health person authorized to handle medical devices, including the Infant Incubator, is an electromedical profession [20]. Emre Ozdemİrcİ, et al. analyzed in 2014 an assessment of the reliability of the infant incubator and its analytical tools. The study stated that if the baby's incubator exceeds the normal limits of the agreed terms it will have a negative impact on the baby, for example if the air flow exceeds the normal limit, asphyxia will occur in the baby, and if there is noise. exceeding normal limits, dizziness will occur, blood pressure will increase and decrease in fluid in the baby's brain. In Turkey (researcher's country of origin), after calibrating several infant incubators using an incubator analyzer, parameters such as oxygen flow proved not to function properly, indicating that the relationship between the infant incubator and incubator analyzer is very important. [21]. Research on the incubator analyzer has also been carried out by other researchers with varying error results, but the airflow measurement error is still high with the results on the airflow sensor module having the highest error at 360C and 370C, which is 0.5%, and the highest error from the sensor module. noise is 0.17% at 37°C. temperature setting [22][23]. However, because of the power of electromedical until now is still limited. For the government, the lowest level of electromedical personnel is in type C hospitals. So that the puskesmas for maintenance activities has not been reached. In the use of the infant incubator, the role of the user or operator is very important to keep the tool in a well-maintained condition. At PKM Tanah Kali Kendiding there is no electromedical staff available. Based on these problems, the community service team carried out maintenance activities for the infant incubator which aimed to ensure that the infant incubator was ready and suitable for use so that services could continue.

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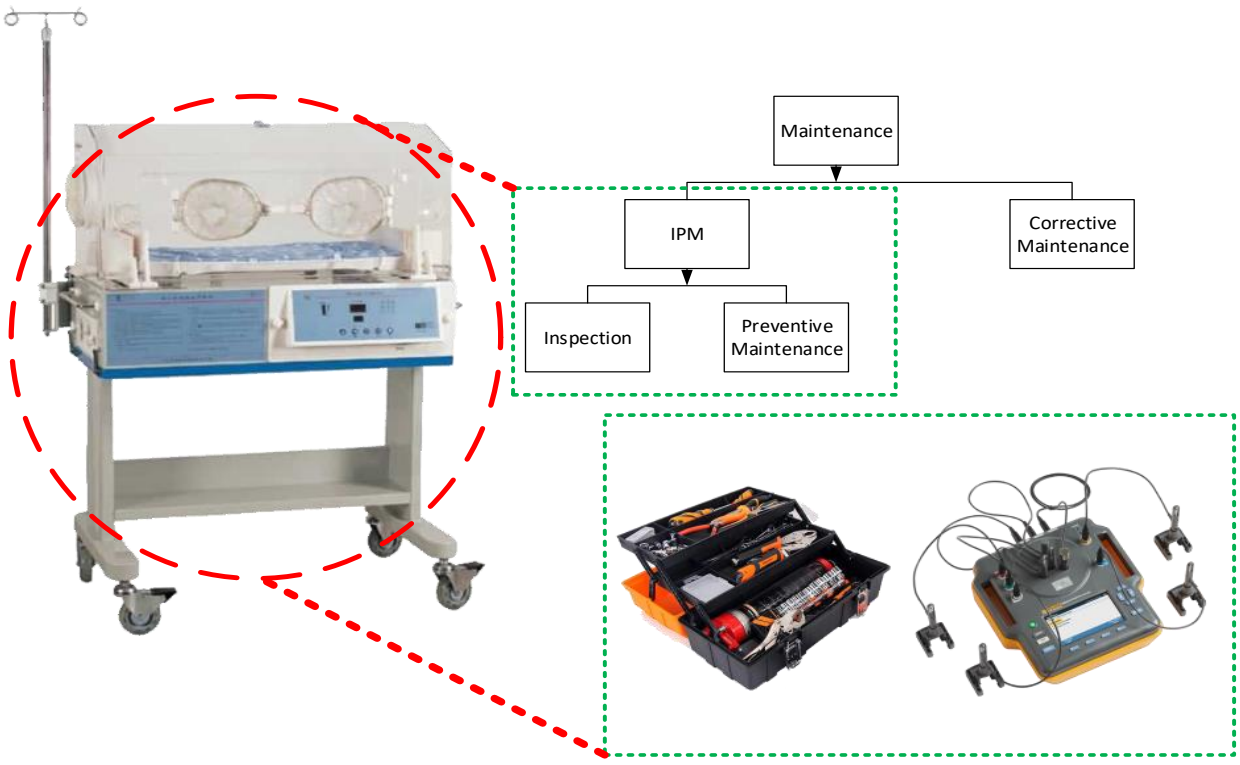


Figure 1. Methods of inspection and preventive maintenance activities on infant incubators

## II. METHOD

This activity was initiated by a discussion with the PKM regarding the specifications of the existing infant incubator. Then we determine the maintenance schedule, according to the provision that the maintenance of the infant incubator is carried out every 3 months. The PKM infant incubator used is the GEA brand type YP 100 [24]. In the maintenance of medical equipment, it is divided into 2, namely inspection and preventive maintenance and corrective maintenance [25]. We carry out inspection and preventive maintenance activities. (WHO) For this reason, we have prepared tools for preventive maintenance activities. This activity includes the Chassis/Housing. Check the cleanliness of the chassis/housing and clean if it is dirty, then check for loose nuts and bolts. Wheels and Brakes Check the physical condition of the wheels, the movement of the wheels is smooth and easy to control. Check the condition of the brakes / brakes are working properly. AC Plug Check the condition of the AC Power plug, make sure that the AC plug is properly attached to the power cord. Line Cord / Power line cable Check the condition of the power cable for signs of damage (defects), the recommended cable length is 10 ft ( 3 m), Temperature Probe check that the temperature trobe is not confused with another radiant warmer. Air filter Check the condition of the air filter, clean and replace if necessary. Controls and switches Check the physical condition of all controls/buttons, and the function of all controls/buttons. Indicator/Display Check all the condition of the indicator light, meter indicator, and visual display on the device. Make sure all digital displays are functioning properly. Heater Check the power of the heating element according to the specifications, Check the condition of the heating element and its insulation. Run the incubator with variations in temperature changes, observe whether the heater turns on and off according to the set temperature (set). Motor / fan Check the physical condition of the motor / fan must be clean, then run the tool to check whether the motor / fan is working smoothly, no noise, if noise occurs, it indicates the motor / fan is damaged. And if the noise is too high, it will disturb the baby in the incubator. Fluid Levels Check the water level in the humidifier reservoir, drain and clean the humidifier reservoir, then fill with water according to the equipment manufacturer's instructions. Bassinet/Mattress Test the left, right, top and bottom side safety systems and the locks work well. If the mattess can be adjusted up and down, test the movement and locking system. The next step after the preventive maintenance activity is completed is to conduct an inspection by measuring the output of the infant incubator using an incu analyzer. In the inspection of the infant incubator the reference used is from SNI IEC 60601-2-19:2014 [18].

## III. IMPLEMENTATION

At the beginning the community service team came to PKM and was warmly welcomed and the PKM was very grateful for the team's plan. We got data that the infant incubator in

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PKM Medokan Ayu is the Gea Brand Infant Incubator Type YP 100. FIGURE 3 The implementation of community service activities begins with recording the administrative tools on the worksheets that we have prepared. Then do a physical and functional check. After the community service team visually observed a function check by turning on the infant incubator. When turned on, an error occurs, the control panel of the tool shows an error in Sistem Failer. The first maintenance is to clean all parts of the casing.

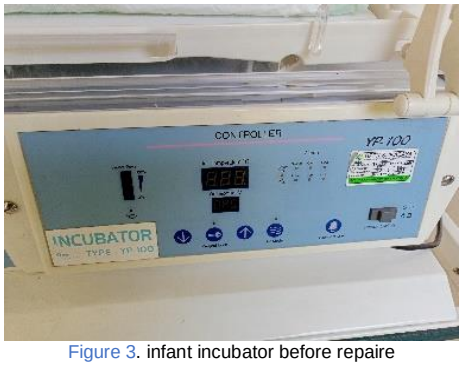

Figure 3. infant incubator before repaire

FIGURE 4 and FIGURE 6 Officers reported that the Infant Incubator had not been used for a long time because it was damaged/would not turn on. The community service team carried out a physical test, namely by trying to turn on the tool, an alarm was heard from the tool and it showed a system failure error. Apart from that, the water tank and equipment conditions are very dirty Figure 5.

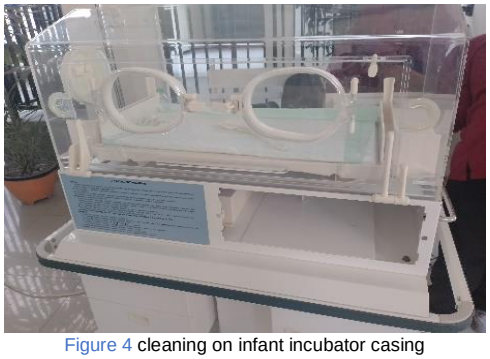
Figure 4 cleaning on infant incubator casing

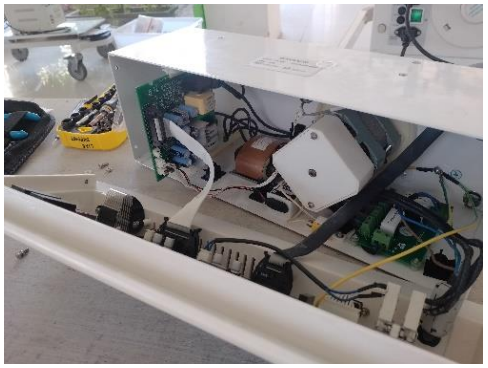
Figure 5 Repair Infant Incubator


Figure 5. Fluid Resevoir

After cleaning and checking all parts FIGURE 7, the tool is tested again and works normally. No more alarms caused by fans or blowers. So, make sure that the cause of the alarm or error because the fan is not working is due to a dirty fan condition.


Figure 7. infant incubator after Repair and preventive maintenance

The end of the maintenance activity is to carry out inspections or measurements of the output of the tool, to determine whether the tool is still suitable for use or not [21].


Figure 8. Measurement process using an incu analyzer

The process of measuring parameters in the baby incubator is as shown in FIGURE 8. The incu analyzer is installed in the baby incubator.

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## IV. RESULT AND DISCUSION

When an inspection is carried out, a graph of overshoot FIGURE 9, or the temperature at which the infant incubator reaches its peak, is obtained. This temperature will drop to the desired temperature position. This recovery time is very important. Because this recovery time will be used as a benchmark for how long the tool is heated before use. From the results of measurements of the infant incubator, both yp 100 type, the over shot recovery time is below the allowable limit, which is 14 minutes on the gea yp 100 infant incubator at a temperature setting of 34ºC. And at 36ºC setting in 9 minutes. During the counseling we conveyed that if the tool was to be used, it would be warmed up first for at least 15 minutes

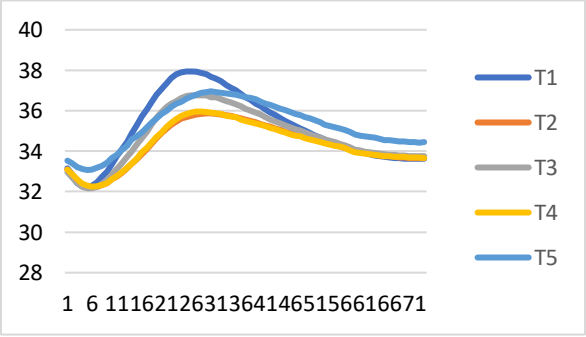


Figure 9. Graphics over shoot

Data from processing measurement results at 36ºC at the temperature setting 36 is shown in TABLE 1

Table 1.
Temperature Measurement results temperature setting 36ºC

| Sensor | Measurement Result (°C) | Error (°C) | Measurement Uncertainty (°C) |
|---|---|---|---|
| **t 1** | 35.95 | 0.00 | ± 0.45 |
| **t 2** | 35.68 | -0.27 | ± 0.44 |
| **t 5** | 35.95 | 0.00 | ± 0.65 |
| **t 3** | 35.26 | -0.69 | ± 0.64 |
| **t 4** | 35.67 | -0.28 | ± 0.65 |

From TABLE 1 the value of the measurement results and the errors that occur all meet the requirements for the feasibility of the infant incubator tool.

Table 2.
Measurement results temperature setting 36ºC

| Setting Point | Parameter | Measurement Result |
|---|---|---|
| **36 °C** | Matras Temperature | 34.04 °C |
| | Noise | 48.00 dB |
| | Air Flow | 0.01 m/detik |
| | Humidity | 66.97 % RH |

From TABLE 2 for the value of humidity, mattress temperature, humidity and noise at a temperature setting of 36ºC also meet the allowable threshold [26].

The implementation of activities in the second stage of the community service team did the same thing, namely coordinating about the timing of the activities and the community service team preparing the equipment and documents needed.

Figure 10 Infant Incubator after 2 Month

In this second activity (after 2 month), the physical condition of the infant incubator is maintained and functioning properly FIGURE 10 and FIGURE 11. The community service team continues to carry out light cleaning and water changes to the infant incubator. and carry out inspections.


Figure 11. Measurement process using an incu analyzer

Table 3.
Temperature Measurement results temperature setting 34ºC

| Sensor | Measurement Result (°C) | Error (°C) | Measurement Uncertainty (°C) |
|---|---|---|---|
| **t 1** | 33.81 | -0.53 | ± 0.48 |
| **t 2** | 33.65 | -0.69 | ± 0.45 |
| **t 5** | 34.34 | 0.00 | ± 0.55 |
| **t 3** | 33.47 | -0.86 | ± 0.56 |
| **t 4** | 33.54 | -0.80 | ± 0.59 |

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table 4.
Measurement results temperature setting 34ºC

| Setting Point | Parameter | Measurement Result |
|---|---|---|
| **34 °C** | Matras Temperature | 31.29 °C |
| | Noise | 48.00 dB |
| | Air Flow | 0.01 m/detik |
| | Humidity | 66.97 % RH |

From TABLE 3 and TABLE 4 it can be concluded that all parameters in stage 2 community service activities are in a condition that meets the requirements for proper use.

**Counseling**

In this community service activity, the community service team also provides counseling to officers or infant incubator users. The counseling is carried out by the demonstration method or showing it to the user. Material includes

**Function Monitoring**

One of the maintenance activities that can be carried out by users is function monitoring. Where this activity a user will turn on the tool and see physically and what functions of the tool all function. Monitoring of this function is carried out every day.

**Warm up the appliance before use**

When an inspection is carried out, a graph of overshoot, or the temperature at which the infant incubator reaches its peak, is obtained. This temperature will drop to the desired temperature position. This recovery time is very important. Because this recovery time will be used as a benchmark for how long the tool is heated before use

From the measurement results of the infant incubator, both yp 100 or local type and infant warmer, the over shot recovery time is below the allowable limit, namely 1 minute for the local incubator, 14 minutes for the gea yp 100 infant incubator at a temperature setting of 34ºC. And on setting 36oC in 9 minutes. So that during the counseling we convey if the tool will be used, it must be warmed up first for at least 15 minutes.

**Reservoir water replacement**

Water reservoir serves to regulate humidity. This water must be replaced by looking at the volume and cleanliness.

After the counseling was carried out, the task of maintaining function monitoring, heating and replacing water reservoirs was carried out by officers or infant incubator users at the Medokan Ayu Health Center.After the counseling was carried out, the impact was very significant on the condition of the infant incubator compared to before the counseling

## V. CONCLUSION

The condition of the infant incubator has changed for the better (the tools are clean and ready and suitable for use) after maintenance by the community service team and counseling to officers or infant incubator users. Infant incubator maintenance involves officers or operators in activities monitoring functions, heating tools and filling water reservoirs. Weaknesses in this activity include the hectic schedule of activities at the health center so that officers cannot fully participate in activities.

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