

Analysis of Pressure Sensor Accuration to Occlusion Measurement on 2 Channels Infusion Device Analyzer with TFT Display

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ABSTRACT Syringepump and Infusumpump function to provide drugs or fluids that are carried out directly and continuously for a certain period of time through a blood vessel. Often encountered problems with blockage during use which causes the incoming drug fluid does not flow constantly. Occlusion limit set at 20 Psi according to ECRI. The purpose of this research is to analyze the accuracy of the pressure sensor on the Occlusion measurement on the Infusion Device Analyzer 2 Channel showing TFT. This study has 2 channels so that it can calibrate 2 tools simultaneously. This module uses a Water Pressure Sensor to measure occlusion and a solenoid valve to simulate pressure. When the sensor is depressed, the sensor detects the pressure and is processed by Arduino. The pressure results are then displayed on the TFT LCD in the form of graphs and numbers in real time. At the setting of 100ml/h using a Syringe Pump with Terumo and b-braun brand syringes, the average device was 11.86 and 15.72 PSI. In the Infusion Pump with the Terumo and b-braun brand infusions, the average equipment was 8.8 PSI and 6.4 PSI. The different results were caused by mechanical errors, differences in the size of the hose and syringe used in mechanics, and a less than optimal drain system. Overall the system works and can be used to calibrate the infusion pump and syringe pump.

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I. INTRODUCTION

Syringe pump and Infusion Pump is a device that is used to insert intravenous fluids into our bodies automatically carried out continuously for a certain period of time and in a certain volume with high accuracy so that there are no errors in dosing to patients.[1][2] Infusion pumps and syringe pumps can be used instead of conventional infusion devices in the form of hanging pole infusions[3][4]. Especially in situations related to neonatology or cancer treatment.[6][5] The infusion pump and syringe pump have settings for the flow rate and volume that will automatically enter the liquid at a constant speed and within a certain time.[7][8] At the time of administering the drug, a stable infusion flow rate is required.[9] Occlusion problems are often encountered in the use of infusions. The presence of occlusion is indicated by an alarm buzzer that will sound when a blockage is detected.[10][11] The occlusion limit is set at 20 PSI according to ECRI.[12][11][13] During the use of a syringe pump that if installed continuously will cause occlusion that causes the drug fluid to be inserted into the patient's body can

not flow continuously and can form a large pressure on the syringe if left can be the cause of swelling.[14][15] The occurrence of swelling can be a sign of blockage and lead to phlebitis in patients.[16] This is very dangerous for the patient because phlebitis is an inflammation of the vein that occurs due to damage to the vein wall which results in the release of inflammatory mediators and the potential for blood clot formation.[17][18] If left unchecked, it can cause the drug liquid to not flow constantly and can cause swelling in the patient. Time to occlusion alarm in peristaltic infusion devices is long at low flow rates.[19][20] Time to occlusion alarm on prolonged peristaltic infusion devices at low flow rates the patient can experience clinically important impairment in treatment. while accuracy claimed by the specifications (the lower the flow, the greater the standardization of results).[21] [22]. In this study, references to previous studies were used to complete the research. In previous studies, it was known that Syringepump and infusumpump had a predetermined error value deviation. The percentage error value is smaller than the standard value tolerated by ECRI, which is 5% for general

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patients and 10% for serious patients.[23][12] When using Syringepump and Infusumpump, there is a blockage detection indicator called occlusion. Each syringepump and infusumpump takes a different time to trigger the Occlusion alarm. This is influenced by several factors such as the speed of the infusion flow and the type of injection, as well as the presence of impurities in the canal [24][25] Likewise with the infusion pump and syringe pump calibration methods. In general, both the syringe method and the gravimetric method can be used to calibrate with an acceptable value of uncertainty. The Coriolis method has some problems with device pressure drop so it is not recommended to be used for calibration.[26][27] Peng Zhang shu-yi has conducted research on the design of an infusion calibrator equipped with occlusion with a display in the form of a PC monitor and has verified that this method is efficient in various types of infusion pumps. The results of this study are quite effective because when testing the occlusion pressure on the infusion pump the pressure accuracy error is $\pm 1\%$. However, in this study, it should be noted that the software and programs must be addressed in more detail and detail regarding the calculations so that the resulting graph is less linear. [24][2] In another study, Nuntachai Thongpance also conducted a study on the Design of an Infusion Pump Calibrator. This Infusion Pump Calibrator is designed to consist of a control section for flow detection mode and occlusion blockage. In this study, a development has been carried out with a character LCD display. After testing 10 times with the gold standard, the data showing the percentage of flowrate and occlusion errors were 0.21% and 0.45%, respectively.[23] Similarly, the development by Yasmin Aprilia who developed a device capable of detecting the flow velocity in the infusion pump. In processing the data, this tool uses the AT89S51 microcontroller and displays a 2x16 character LCD. The working principle of this tool is to measure the droplets that are accommodated by the tube and detected by the optocoupler. However, this tool can only perform measurements 3 times in a row with the selection of predetermined settings. In the next research, Yasmin Aprilia has designed an infusion device analyzer using a water pressure sensor type SKU SKU237545 microcontroller arduino nano as a controller. The results of this research will be compared with a standard infusion device analyzer. In this study, it has been equipped with an SD card to store measurement data every 900ms in txt form. The 2x16 character LCD is still used in this study as a display of the sensor output in the form of numbers and cannot display graphics.[28] The research was then developed by Riara Ramadhani in order to calibrate 2 infusion pumps or syringe pumps at the same time. In this study, Riara compared the infusion device analyzer module with a calibrated syringe pump. In this study using 2 water pressure sensors with type SKU237545, then using STM32 as a controller and equipped with a motor as a drain system to remove liquid from the hose. The output is in the form of measurement numbers displayed on a 20x4 character LCD and has not been equipped with storage.[29]

In addition to using PC monitors and LCDs, the use of

web displays can also be implemented with Arduino controls. System development is used to make it easier for users to retrieve and access information during operation.

Based on the identification of the research that has been done [23][24][25][26][27][28][29] the researcher intends to conduct further research on the infusion device analyzer which focuses on discussing the accuracy of the pressure sensors in occlusion parameter against the gold standard.

This article has the following structure, in Section 1 (Introduction) which contains the background of the research. Then Section II (Materials and Method) explains the materials used in the research, data collection, and procedures used. In Section III (Result) contains the results and data analysis of the research that has been done. Section IV (Discussion) contains sections that need to be discussed regarding the findings in the research conducted. For Section V (Conclusion) contains the conclusions of the research that has been done and suggestions for further research.

II. MATERIALS AND METHODS

This research was conducted as an experimental research. The author intends to conduct further research on the water pressure sensor SKU 114991178 which will be used in the infusion device analyzer. Materials and methods will be explained in the following sections.

A. DATA COLLECTION

In this study, the infusion pump with the TOP-3300 brand and the syringe pump with the B-BRAUN brand were used as the units tested to measure occlusion parameters using a module. Measurements were carried out 6 times with a flow rate setting of 100 ml/hour. The results displayed are the highest pressure (PSI) which will be compared with a standard infusion device analyzer with the Rigel brand.

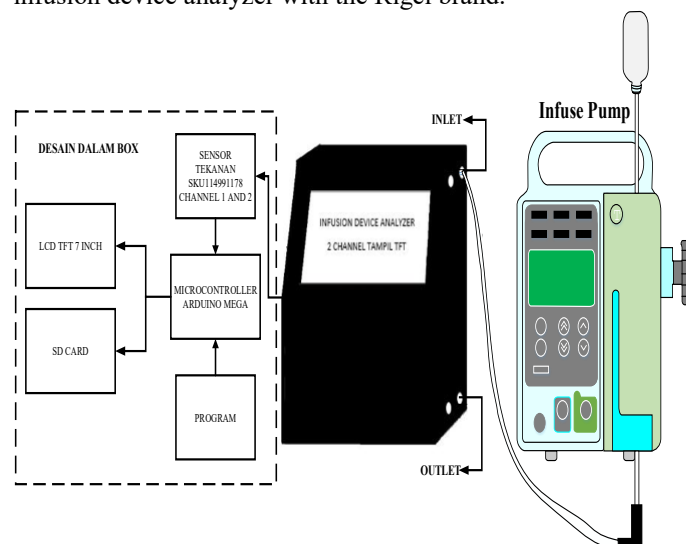


FIGURE 1. Infusion Device Analyzer Module Block Diagram

FIGURE 1 shows a block diagram of the infusion device module where at first plug the infusion device analyzer power cable into the PLN grid then press the power button to activate

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the Infusion device analyzer. So that the power supply circuit and the entire circuit get a PLN voltage. After that setting the Infusion Pump/Syringe pump with a flow rate of 100ml/hour. Select the occlusion parameter on the LCD, then the liquid from the infusion pump and syringe pump will flow into the hose located on the IDA. The liquid will be held by the solenoid valve so that the liquid is trapped inside and produces water pressure which is detected by the water pressure sensor SKU 114991178. The pressure that has been measured is processed by the microcontroller and displayed on the 7 Inch TFT LCD in the form of graphics and numbers and stored on the SD card. After that the liquid will come out towards the disposal.

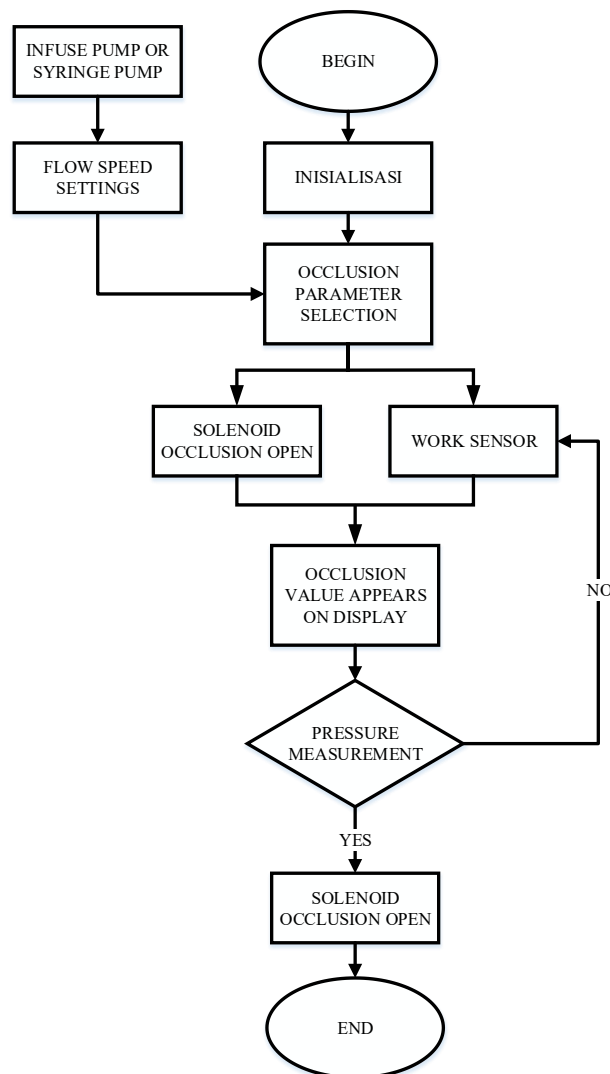


FIGURE 2. Infusion Device Analyzer Module Flowchart

FIGURE 2 explains when the infusion pump/syringepump and Infusion device analyzer are turned on, setting the flow rate for the infusion pump/syringepump. At the same time the TFT LCD will initialize. Followed by parameter selection. The solenoid occlusion is open and the pressure

sensor is working, at the same time the fluid from the infusump entering the IDA is read by the pressure sensor in the form of a voltage value which will then be converted into a pressure unit value (Psi). If a pressure measurement occurs, the measurement results are displayed on the TFT LCD. If there is no pressure measurement, the sensor will continue to work to take pressure readings. When the infusump/syringepump alarm sounds, press stop on the infusump/syringepump so that the pressure sensor stops taking measurements, the TFT LCD displays the measurement results and the solenoid drain opens so that the liquid comes out to the drain and the measurement data results are stored on the SD card.

B. DATA ANALYSIS

The measurement of occlusion parameters was carried out 6 times according to ECRI. The average measurement value is obtained by using the mean or the average by applying equation(1) :

$$(\bar{X}) = \frac{\sum Xi}{n} \quad (1)$$

Where the symbol $\bar{X}$ indicates the average of the measurements, the symbol $\sum Xi$ is the total number of measurement data, and the symbol (n) is the number of measurement data. The standard deviation is a value that indicates the level (degree) of variation in a group of data or a standard measure of deviation from its mean. The standard deviation (SD) formula can be shown in equation(2):

$$SD = \sqrt{\frac{\sum_{i=1}^n (Xi - \bar{X})^2}{(n - 1)}} \quad (2)$$

Where xi indicates the amount of the desired values, x indicates the average of the measurement results, n shows the number of measurements. Uncertainty (UA) is doubt that appears in each measurement result. The uncertainty formula is shown in equation(3):

$$UA = \frac{SD}{\sqrt{n}} \quad (3)$$

Where UA indicates the uncertainty value from the total measurement, SD shows the resulted standard deviation, and n shows the amount of measurement. the %error shows the error of the system. The lower value Error is the difference between the mean of each data. The error can show the deviation between the standard and the design or model. The error formula is shown in equation(4):

$$\%Error = \frac{(Xn - \bar{X})}{\bar{X}} \times 100\% \quad (4)$$

where xn is the value measured from the calibrator machine. The x is the value measured from the design.

III. RESULT

The module design build infusion device analyzer has tested the performance of syringe pump brand B-Braun, Infusion pump brand TOP-3300 using several brands of infusion sets and syringes. The results showed that the infusion device analyzer module has worked well and can display numbers and graphs on a 7-inch TFT LCD screen, the pressure sensor on the module can read the highest occlusion on the Syringe pump and infusump quite well and can compare the measurement results with the standard Infusion Device Analyzer.



FIGURE 3. Infusion Device Analyzer Module Front and Rear view

A. GRAPH RESULTS FROM DATA DISPLAYED ON SD CARD

This Infusion Device Analyzer (IDA) module is equipped with SD Card storage so that the resulting data can not only be viewed via a 7 inch TFT LCD, it can also be stored on SD Card storage in the form of a .txt file. The data will be stored automatically on the SD Card every 0.9 seconds. Which with the Occlusion data stored can be used to analyze and view the previous data value. The following are the results of the Occlusion measurement on the Syringe pump and Infusump:

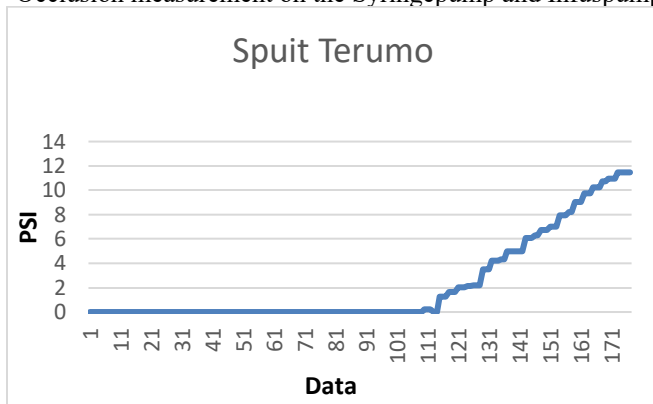


FIGURE 4. Excel chart using the Terumo syringe on the infusion device analyzer module

FIGURE 4 show an excel display graph of Syringe Pump measurements using a Terumo syringe on the Infusion Device Analyzer module where the graph above shows the change in pressure from 0 Psi to 11.47 Psi in 4 minutes 31 seconds.

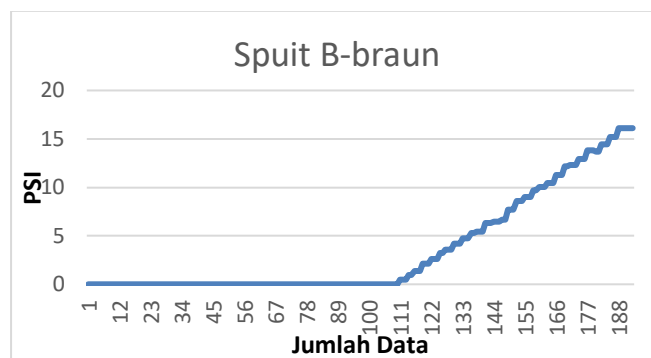


FIGURE 5. Excel chart using the B-braun syringe on the infusion device analyzer module

FIGURE 5 show an excel display graph of Syringe Pump measurements using a B-braun syringe on the Infusion Device Analyzer module where the graph above shows the change in pressure from 0 Psi to 16.11 Psi in 5 minutes 25 seconds to reach the highest pressure.

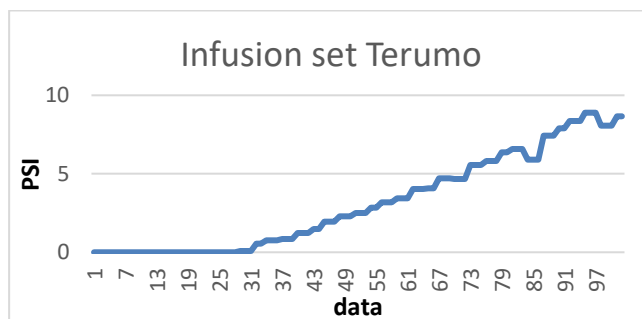


FIGURE 6. Excel chart using the Terumo infusion set on the infusion device analyzer module

FIGURE 6 show an excel display graph of the infusion pump measurement using the Terumo infusion set on the Infusion Device Analyzer module where the graph above shows the change in pressure from 0 Psi to 8.65 Psi within 2 minutes 48 seconds to reach the highest pressure.

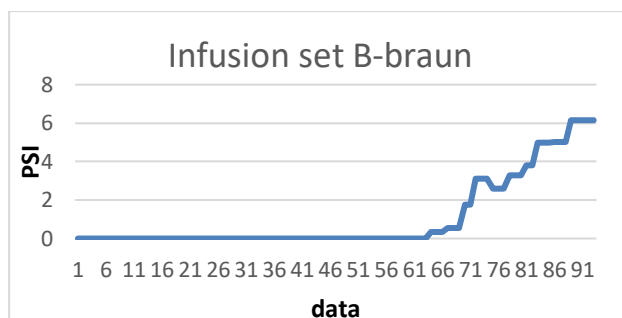


FIGURE 7. Excel chart using the B-BRAUN infusion set on the infusion device analyzer module

FIGURE 7 show an excel graph of the infusion pump measurement using the Terumo infusion set on the Infusion Device Analyzer module where the graph above shows the pressure change from 0 Psi to 9.86 Psi in 3 minutes 51 seconds to reach the highest pressure.

B. WATER PRESSURE SENSOR MEASUREMENT

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AND TESTING RESULTS

In the measurement and testing of the water pressure sensor measured on the sensor output, the red multimeter probe is connected to the output leg of the water pressure sensor and the multimeter black probe is connected to the ground. Measurements are performed on two conditions, namely when the sensor before being depressed by water and depressed by water at pressures of 0 Psi, 5 Psi, 10 Psi, 15psi.

TABLE 1. WATER PRESSURE SENSOR MEASUREMENT AND TESTING RESULTS

Channel	Pressure (psi)	Rated voltage (v)
1	0	0.62
	5	0.99
	10	1.13
	15	1.22
2	0	0.64
	5	0.96
	10	1.16
	15	1.26

Based on the TABLE 1 above, we can see that when the air pressure sensor does not get pressure, the output from the sensor on channels 1 and 2 respectively is 0.62 V and 0.64 V, when the sensor gets a pressure of 5Psi, the sensor output is 0.99 V and 0.96 V, when the sensor is given a pressure of 10 Psi, the sensor output is 1.13 V and 1.16 V, when the sensor detects a pressure of 15 Psi, the sensor will output a voltage of 1.22 V and 1.26 V. Based on this, there is a change in the voltage released by the air pressure sensor, namely the greater the pressure detected, the greater the voltage issued by the sensor which then the voltage will be processed through the microcontroller to convert it back into pressure data with units of Psi.

C. PERFORMANCE MEASUREMENT AND TESTING RESULTS

TABLE 2. MEASUREMENT OF THE SYRINGE PUMP USING THE TERUMO SPUIT

	SPUIT TERUMO		IDA STANDART (psi)
	CH1(psi)	CH2(psi)	
AVERAGE	11,92	11,810	11,778
SD	0,44	0,370	0,32
UA	0,18	0,150	0,130
ERROR	0,14	0,040	
RELATIVE ERROR	0,751%		

The TABLE 2 above shows the results of pressure measurements on the Syringepump B-braun using the Terumo brand Infusionset on channel 1, channel 2 infusion device analyzer module and comparison Infusion Device Analyzer. Data measurement was carried out 6 times on each channel and comparison tool. On channel 1 obtained an average of 11.92 PSI, channel 2 of 11.81 PSI and the comparison of 11.77 PSI It is known from the measurement results that the error value is 0.751%, the average tool is greater than the the average comparison tool is 11.86 PSI and the comparison average is 11.77 PSI.

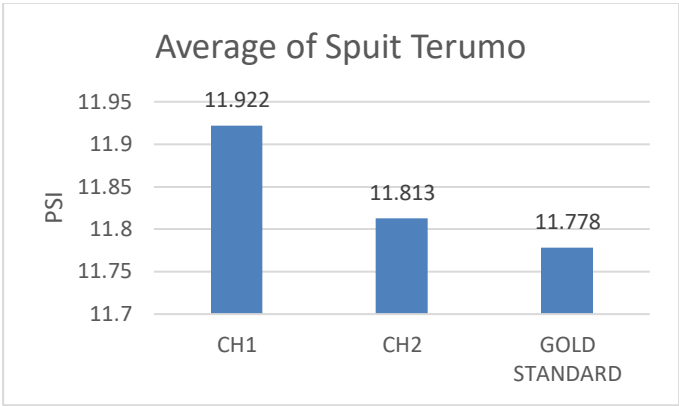


FIGURE 8. average graph using a syringe terumo

FIGURE 8 shows that the measurement using a syringepump with a Terumo syringe obtained an average of 11,922 PSI on channel 1, 11,813 PSI on channel 2 and 11,778 PSI on the gold standard.

TABLE 3. MEASUREMENT OF THE SYRINGE PUMP USING THE B-BRAUN SPUIT

	SPUIT B-BRAUN		IDA STANDART (psi)
	CH1(psi)	CH2(psi)	
AVERAGE	15,64	15,80	16,080
SD	0,38	0,269	0,088
UA	0,16	0,110	0,030
ERROR	0,44	0,280	
RELATIVE ERROR	2,31 %		

The TABLE 3 above shows the results of pressure measurements on the b-brun syringe pump using the B-braun brand Infusionset on channel 1, channel 2 infusion device analyzer module and comparison Infusion Device Analyzer. Data measurement was carried out 6 times on each channel and comparison tool. On channel 1 obtained an average of 15.64 PSI, channel 2 of 15.80 PSI and a comparison of 16.08 PSI It is known from the measurement results that the error value is 2.311%, the average tool is smaller than the average The average comparison tool is 15.72 PSI and the comparison average is 16.08 PSI.

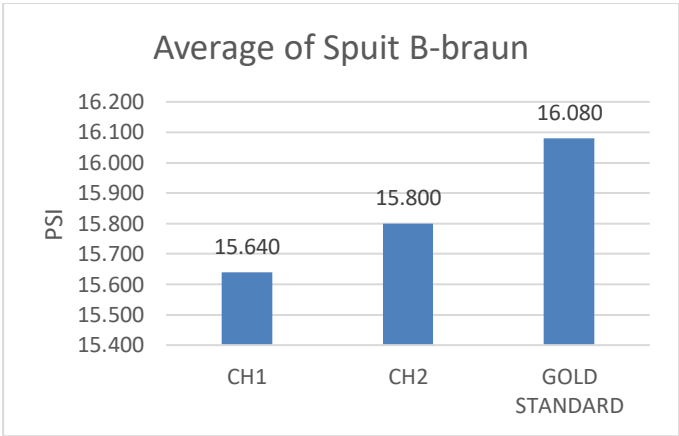


FIGURE 9. average graph using a syringe B-braun

FIGURE 9 shows that the measurement using a syringepump with a B-braun syringe obtained an average of 15,640 PSI on channel 1, 15,803 PSI on channel 2 and 16,085 PSI on the gold standard.

TABLE 4. MEASUREMENT OF THE INFUSPUMP USING THE TERUMO INFUSION SET

	INFUSET TERUMO		IDA STANDART (psi)
	CH1(psi)	CH2(psi)	
AVERAGE	8,75	9,032	6,913
SD	0,19	0,680	0,755
UA	0,77	0,280	0,308
ERROR	1,83	2,110	
RELATIVE ERROR	22,22%		

The **TABLE 4** above shows the results of pressure measurements on the TOP-3300 infusump using the Terumo brand Infusionset on channel 1, channel 2, Infusion Device Analyzer module and Infusion Device Analyzer for comparison. Data measurement was carried out 6 times on each channel and comparison tool. On channel 1 obtained an average of 8,745 PSI, channel 2 of 9,031 PSI and the comparison of 6,913 PSI. It is known from the measurement results that the error value is 22.22%, the average tool is greater than the average comparison tool, which is 8.883 PSI and the comparison average is 6.913 PSI.

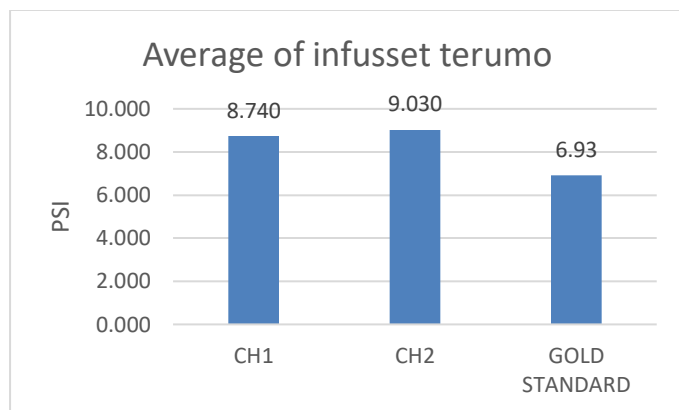
**FIGURE 10. average graph using a infuset Terumo**

FIGURE 10 shows that the measurement using a Infusump with a Terumo infuset obtained an average of 8,740 PSI on channel 1, 9,030 PSI on channel 2 and 6,930 PSI on the gold standard.

TABLE 5. MEASUREMENT OF THE INFUSPUMP USING THE B-BRAUN INFUSION SET

	INFUSET B-BRAUN		IDA STANDART (psi)
	CH1(psi)	CH2(psi)	
AVERAGE	5,88	7,030	5,910
SD	0,52	0,250	0,36

UA	0,22	0,103	0,149
ERROR	0,03	0,263	
RELATIVE ERROR	8,41%		

The **TABLE 5** above shows the results of pressure measurements on the TOP-3300 infusion pump using the B-braun brand Infusionset on channel 1, channel 2 infusion device analyzer module and comparison Infusion Device Analyzer. Data measurement was carried out 6 times on each channel and comparison tool. On channel 1, the average is 5.88 PSI, channel 2 is 7.03 PSI and the comparison is 5.55 PSI. It is known from the measurement results that the error value is 8.412%, the average tool is greater than the average comparison tool, which is 6.458 PSI and the comparison average is 5.91 PSI.

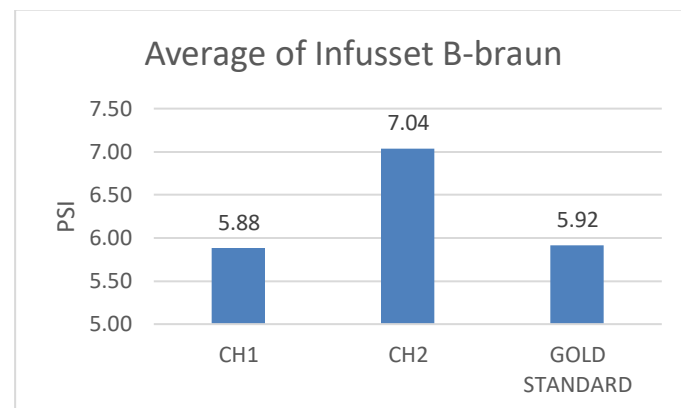
**FIGURE 11. average graph using a infuset B-braun**

FIGURE 11 shows that the measurement using a Infusump with a B-braun infuset obtained an average of 5,88 PSI on channel 1, 7,04 PSI on channel 2 and 5,92 PSI on the gold standard.

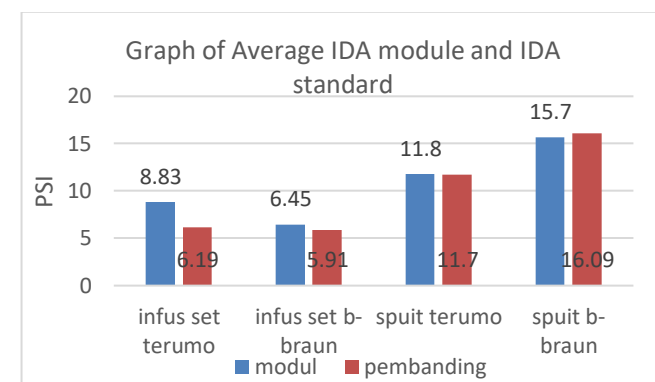
**FIGURE 12. Average graph of IDA module and IDA standard**

FIGURE 12 above shows the average module data with a Comparative Infusion Device Analyzer. Where at the time of measurement using the infusion pump the average on the module is higher. Meanwhile, when using the syringepump the average module was lower than the comparison tool and was close to the value of the IDA standard.

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IV. DISCUSSION

From the research that has been done, the results of the error from the Infusion Device Analyzer module using the terumo and b-braun infusionsets still have errors of 22.20% and 8.41%, respectively. Meanwhile, the syringepump measurement error results from the Infusion Device Analyzer module using the terumo and b-braun syringes had errors of 0.751% and 2.31%, respectively. Based on the author's experience during the research, the different types of infusion sets and syringes used at the time of measurement affect the time difference or the response of the device to detect pressure so that the infusion pump or syringe pump alarm sounds. Errors on the tool are caused by mechanical errors such as water leaks in the mechanics of the tool (hose, hose connection, solenoid valve connection), the use of a syringe pump or infusion pump which is less stable because it has been used for a relatively long time during measurement, the presence of dirt that enters the infusion set through the end of a dirty tube or syringe, so that it can block the flow of liquid.

Measurements of the syringe pump and infusion pump were carried out 6 times and the flow rate setting was selected using 100mL/hour because it adjusted the existing worksheet on the syringe pump calibration work method. for occlusion to occur. In measuring the syringe pump and infusion pump using either the IDA module or the IDA Rigel comparison, it can be concluded that both are still suitable for use, because they do not exceed 20 Psi. the sensor used uses 2 water pressure sensors type SKU 114991178 which has an accuracy specification of $\pm 1\%$ which is displayed in the form of 2 graphs and numbers on a 7 inch TFT LCD.

This infusion device analyzer module has not been able to detect any bubbles in the flow during measurement, other than when the measurement has been completed, the infusion device analyzer module still detects the presence of residual liquid pressure in the hose inside the module, due to the drain system being less than optimal at the time of module manufacture.

Based on the research, the 2 channel infusion device analyzer module can be used properly. In addition, the use of the infusion device analyzer module is time efficient and displays measurement results in graphical form, which can facilitate the user in analyzing the stability of the liquid in the infusion pump and syringe pump in real time. So that the user can view the graph in real time and can see the previous data that has been plotted in the form of a graph.

V. CONCLUSION

The purpose of this study is to conduct further research on an infusion device analyzer with 2 channels that focuses on discussing the accuracy of sensor occlusion parameters. Based on the results that have been obtained, it is concluded that the whole system can work well, can display numbers and graphs on a 7 inch TFT LCD screen, the pressure sensor SKU 114991178 on the module can read the highest Occlusion on the Syringe Pump quite well and can compare the measurement results with the Infusion Device Standard analyzer. After measuring and treating the sensor SKU 114991178 the results obtained were better using a syringe pump than the results on an infusion pump. This is because the infusion pump has

peristaltic motion which causes vibrations in the hose and affects the results. In addition, the use of different infusions and syringes, the placement of the sensors and the leakage of the hoses also affect the results. When the measurements were compared with the gold standard (infusion device analyzer Rigel), the results showed a small error value of 0.75% when using the Terumo syringe, and -2.3% when using the b-braun syringe. Meanwhile, when using the Terumo infusion, the errors were quite large, namely 22.22% and 8.41% when using the B-braun infusion. This research can be used as a reference by other researchers who want to develop an infusion device analyzer with 2 channels in the future, better mechanical settings and using a water pressure sensor that has a higher accuracy than SKU 114991178.

REFERENCE

- [1] M. Baeckert *et al.*, "Performance of modern syringe infusion pump assemblies at low infusion rates in the perioperative setting," *Br. J. Anaesth.*, vol. 124, no. 2, pp. 173–182, 2020, doi: 10.1016/j.bja.2019.10.007.
- [2] EDUARDO COSTA DA MOTTA, "– 4 de Outubro de 2017 COMPARISON OF TWO SENSORS FOR PRESSURE MONITORING AND OCCLUSION DETECTION IN INFUSION PUMPS E," *XIII Simp'osio Bras. Automa, c~ao Intel. Porto Alegre – RS, 1o – 4 Outubro 2017 Comp.*, vol. 2, 2017.
- [3] W. Zeng, S. Li, and Z. Wang, "Characterization of syringe-pump-driven versus pressure-driven microfluidic flows," *Proc. 2015 Int. Conf. Fluid Power Mechatronics, FPM 2015*, pp. 711–715, 2015, doi: 10.1109/FPM.2015.7337207.
- [4] B. G. Soares, "Calibration of microsyringe and infusion pump in the range of 130 μ L to 210 μ L," *Metrol. 18 a 21 outubro 2021*, vol. 1, 2021.
- [5] N. H. Ahniar, Hendra Marwazi, and Rismarini Yufita, "Comparison of Flowrate and Occlusion in a Vertical Infusion Pump and Horizontal Infusion Pump," *J. Electron. Electromed. Eng. Med. Informatics*, vol. 2, no. 1, pp. 1–6, 2020, doi: 10.35882/jeeemi.v2i1.1.
- [6] A. Pudji, A. M. Maghfiroh, and N. Thongpance, "Design an Infusion Device Analyzer with Flow Rate Parameters using High Sensitive Photodiode Sensor," *Indones. J. Electron. Electromed. Med. Informatics*, vol. 3, no. 2, pp. 39–44, 2021.
- [7] H. Elkheshen, I. Deni, A. Baalbaky, M. Dib, L. Hamawy, and M. A. Ali, "Semi-Automated Self-Monitored Syringe Infusion Pump," *2018 Int. Conf. Comput. Appl.*, vol. 1, 2018.
- [8] M. Ridha and S. Luthfiyah, "Design of Two Channel Infusion Pump Analyzer Using Photo Diode Detector," *Indones. J. Electron. Electromed. Med. Informatics*, vol. 3, no. 2, pp. 65–69, 2021.
- [9] M. E. Mansour, "Design of Low Cost Smart Infusion

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- Pump,” *Int. Conf. Comput. Control. Electr. Electron. Eng.*, vol. 1, no. 1, 2020.
- [10] E. Batista *et al.*, “Assessment of drug delivery devices,” *Biomed. Tech.*, vol. 60, no. 4, pp. 347–357, 2015, doi: 10.1515/bmt-2014-0138.
- [11] N. Sholihah and A. Kholiq, “A Real-Time Alert for Infus Pump Occlusion Using Bluetooth Communication,” *IJEEMI*, vol. 2, no. 1, pp. 34–41, 2020, doi: 10.35882/ijeemi.v2i1.7.
- [12] ECRI, *Inspection and Preventive Maintenance System*, vol. 1, no. 610. 1995.
- [13] BRENDA, “infusion-device-analyzer-1996.pdf,” 1996.
- [14] N. F. Hikmah, I. Sapuan, and Triwiyanto, “Rancang Bangun Syringe Pump Berbasis Mikrokontroler ATmega 8535 Dilengkapi Detektor Oklusi,” *J. Phys. Appl.*, vol. 1, no. 3, pp. 74–91, 2013.
- [15] A. Tavakoli Golpaygani, M. M. Movahedi, M. Reza, and K. Hassani, “A study on performance and safety test of infusion pump devices,” *Biomed. Res.*, vol. 28, no. 12, pp. 5179–5181, 2017.
- [16] M. S. V. Appaji, G. S. Reddy, S. Arunkumar, and M. Venkatesan, “An 8051 Microcontroller based Syringe Pump Control System for Surface Micromachining,” *Procedia Mater. Sci.*, vol. 5, no. May, pp. 1791–1800, 2014, doi: 10.1016/j.mspro.2014.07.391.
- [17] W. Iradiyanti and E. Kurnia, “Giving Medicine Through Intravenous Towards Incident of Phlebitis To Hospitalized Patient in Hospital,” *J. Penelit. STIKES Kediri*, vol. 6, no. 1, pp. 109–118, 2013.
- [18] A. K. Patel, A. Jha, A. Patwardhan, and P. More, “Design and Fabrication of Infusion Pump to Control the Flow Rate of Solution for Synthesis of Zinc Oxide Nanomaterial,” *Int. J. Appl. Eng.*, vol. 14, no. 5, pp. 1091–1097, 2019.
- [19] F. ABRANTES, “USING CORRELATION TO DETECT DOWNSTREAM OCCLUSION IN INFUSION PUMPS.pdf,” *Res. Gate*, vol. 1, 2012.
- [20] F. Doesburg, R. Oelen, M. H. Renes, P. M. Lourenço, D. J. Touw, and M. W. Nijsten, “Multi-infusion with integrated multiple pressure sensing allows earlier detection of line occlusions,” *BMC Med. Inform. Decis. Mak.*, vol. 21, no. 1, pp. 1–12, 2021, doi: 10.1186/s12911-021-01668-7.
- [21] MENTERI KESEHATAN REPUBLIK INDONESIA, “PERATURAN MENTERI KESEHATAN REPUBLIK INDONESIA NOMOR 54 TAHUN 2015,” vol. 151, no. March, p. 2, 2015.
- [22] Junaidi *et al.*, “Flow Rate and Volume Control of Fluid Based on Arduino for Synthesis of Silver Nanowires,” *J. Phys. Conf. Ser.*, vol. 1338, no. 1, 2019, doi: 10.1088/1742-6596/1338/1/012018.
- [23] N. Thongpance, Y. Pititeeraphab, and M. Ophasphanichayakul, “The design and construction of infusion pump calibrator,” *5th 2012 Biomed. Eng. Int. Conf. BMEiCON 2012*, vol. 100, pp. 3–5, 2012, doi: 10.1109/BMEiCon.2012.6465429.
- [24] P. Zhang, S. Wang, C. Yu, and M. Zhang, “Design of occlusion pressure testing system for infusion pump,” *JBise*, vol. 2, no. 6, pp. 431–434, 2009, doi: 10.4236/jbise.2009.26062.
- [25] A. Dönmez, C. Araz, and Z. Kayhan, “Syringe pumps take too long to give occlusion alarm,” *Paediatr. Anaesth.*, vol. 15, no. 4, pp. 293–296, 2005, doi: 10.1111/j.1460-9592.2005.01436.x.
- [26] E. Batista, J. Alves E Sousa, A. Ribeiro, L. Martins, M. Pereira, and H. Navas, “Calibration of Infusion Pumps Analyser,” *J. Phys. Conf. Ser.*, vol. 1065, no. 9, 2018, doi: 10.1088/1742-6596/1065/9/092003.
- [27] R. Assunção *et al.*, “Developing the control system of a syringe infusion pump,” *Int. Conf. Remote Eng. Virtual Instrum.*, vol. 1, no. February, pp. 254–255, 2014.
- [28] Y. A. Anggraini, A. Pudji, and M. Ridha, “Low-Cost Infusion Device Analyzer With Occlusion Pressure Parameter Test,” *TEKNOKES*, vol. 2, no. 1, pp. 26–33, 2020.

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