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Description of the usefulness and ease of use wireless stethoscope for auscultation: A pilot study

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ABSTRAK

Latar Belakang: *Stetoskop merupakan sebuah alat akustik medis yang biasa digunakan untuk mendengarkan suara-suara yang ada didalam tubuh manusia. Stetoskop telah mengalami sejumlah peningkatan transformatif sejak penemuannya, termasuk pengenalan sistem elektronik dalam dua dekade terakhir. Universitas Diponegoro melalui Pusat Unggulan IPTEK Perguruan Tinggi (PUI-PT) Center for Bio Mechanics, Bio Material, Bio Mechatrhonis, and Bio Signal Processing (CBIOM3S) telah mengembangkan stetoskop menggunakan wireless sehingga lebih memudahkan dalam melakukan pemeriksaan kepada pasien karena mampu memeriksa pasien tanpa terkendala oleh tubing pada stetoskop manual. Adanya stetoskop wireless membuat tenaga kesehatan terbantu dalam melakukan pekerjaannya. Kehadiran teknologi berupa stetoskop wireless memiliki persepsi tersendiri oleh penggunanya, salah satu profesi yang menggunakan stetoskop dalam pekerjaannya yaitu perawat.*

Tujuan: *Penelitian ini memberikan gambaran persepsi perawat terhadap kemudahan dan kegunaan stetoskop wireless untuk melakukan pemeriksaan auskultasi jantung dan paru pada pasien kritis.*

Metode: *Penelitian ini merupakan pilot study dengan responden 40 perawat yang bekerja diruang critical care. Teknik pengambilan sampel menggunakan total sampling. Adapun responden yang dimaksud pada penelitian ini yaitu Perawat di ruang Intensive Care Unit, High Care Unit dan Unit Stroke di rumah sakit swasta kota Palembang. Persepsi perawat terhadap kemudahan dan kegunaan stetoskop wireless diukur menggunakan instrumen kuesioner persepsi kemudahan dan persepsi kegunaan.*

Hasil: *Persepsi perawat terhadap kegunaan stetoskop wireless menunjukkan rata-rata 4,27 sedangkan persepsi perawat terhadap kemudahan stetoskop wireless menunjukkan rata-rata 4,35 yang artinya bahwa perawat diruang critical care menerima stetoskop wireless baik secara kemudahan maupun kegunaan sebagai alat untuk auskultasi jantung dan paru pada pasien kritis.*

Kesimpulan: *Perawat menerima teknologi baru berupa stetoskop wireless dikarnakan stetoskop wireless mampu mempercepat pekerjaannya serta mudah dioprasionalkan sehingga membantu perawat dalam melakukan asukultasi jantung dan paru pada pasien kritis.*

KATA KUNCI*: persepsi kegunaan; persepsi kemudahan; stetoskop wireless*

ABSTRACT

Background: *A stethoscope is an acoustic medical device commonly utilized for listening*

to internal sounds in the human body. Since its invention, the stethoscope has undergone several transformative improvements, including the introduction of electronic systems in the last two decades. Through the Center of Excellence in the Higher Education of Science and Technology (PUI-PT), Center for Bio Mechanics, Bio Material, Bio Mechatronics, and Bio Signal Processing (CBIOM3S), the Diponegoro University has developed a wireless stethoscope to enable the user to examine the patients quickly without being constrained by tubing, unlike the manual stethoscope. The wireless stethoscope supports health workers in performing their work. This new technology creates various perceptions from its users, one of whom is nurses.

Objectives: *This study aims to provide an overview of nurses' perceptions regarding the usefulness and ease of use of a wireless stethoscope to perform auscultation of the heart and lungs of critically ill patients.*

Methods: *The research method employed was a pilot study, and 40 nurses working in the critical care units, including the Intensive Care Unit, High Care Unit, and Stroke Unit in a private hospital in Palembang City, were chosen as respondents for a total sampling technique.*

Results: *Nurses' perceptions of the ease and usefulness of a wireless stethoscope were measured using the perceived usefulness and perceived ease of use questionnaires. The nurses' perception of the use of wireless stethoscopes exhibited a mean score of 4.27, while the nurses' perception of the ease of use of wireless stethoscopes showed a mean score of 4.35. Those results indicate that nurses in the critical care units accepted wireless stethoscopes in terms of ease of use and usefulness as a device for performing auscultation of the heart and lungs of critically ill patients.*

Conclusions: *Nurses get new technology like a wireless stethoscope because it can work more quickly and is easy to use thereby assisting nurses in conducting cardiac and pulmonary auscultation in critical patients.*

KEYWORD: *perceived ease of use; perceived usefulness; wireless stethoscope*

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INTRODUCTION

Technological advances are proliferating in all fields, including the health sector, affecting patients and health workers. Technological advancements in the health sector, particularly medical devices, are needed by health workers because those devices play a pivotal role in supporting their work (1). A stethoscope is a medical acoustic instrument utilized for listening to sounds in the human body, so it becomes a primary device frequently used by health workers, including nurses (2). Nurses often use this device to examine internal sounds or auscultation, such as the heart, lungs, systolic pressure, and diastolic pressure (3,4).

Since its first invention, the stethoscope has undergone some transformative improvements, including the introduction of electronic systems in the last two decades. However, various problems still arise, limiting signal quality and diagnostic capability. Both manual and electronic stethoscopes have the most common problem, which cannot be used in a noisy environment. Improvement in technology has led to the advancement of electronic stethoscope design that dramatically reduces external noise

contamination through hardware redesign and dynamic signal processing (5).

A stethoscope that can produce clear sound can aid nurses in examining their patients. Special rooms, such as critical care units, need a fast response time. Thus, a good quality stethoscope will allow the nurses to perform their examination optimally. Critically ill patients must undergo heart and lungs examination because they have problems in either or both of those organs (6).

One of the physical examinations of the heart and lungs is auscultation, which enables the nurses to detect abnormalities in these organs (7). Cardiopulmonary auscultation is performed using a particular device, a stethoscope. To conduct this examination, a stethoscope that can produce clear sound and is flexible in use is highly preferable. One of the stethoscopes that can be used flexibly is an electronic stethoscope because it uses a wireless network known as Bluetooth; this is regarded as a form of technological progress (8).

Several studies on wireless stethoscopes showed that wireless-based electronic stethoscopes have several advantages, such as being more accessible and more convenient to be used and having measurement results comparable to direct auscultation (9). Likewise, another study stated that Bluetooth-based wireless stethoscopes eliminate the connecting cables of the conventional stethoscope, which allow ease of use, mobility, and portability; besides, it can also minimize infection spread and provide easy auscultation training to health practitioners because it can be used simultaneously for evaluation (8).

Along with technological advancement, stethoscopes continue to be developed yearly to make it easier for health workers to obtain more accurate auscultation results. Diponegoro University, through the Center of Excellence in the Higher Education of Science and Technology (PUI-PT), Center for Bio Mechanics, Bio Material, Bio Mechatronics, and Bio Signal Processing (CBIOM3S), has developed a stethoscope using wireless, allowing the users to conduct more accessible examination on the patients without being constrained by the tubing of the manual stethoscope. Needless to say, developing domestic products is crucial to increasing the value and competitiveness of sensitive and specific medical devices. In addition, previous research said that wireless stethoscopes are very effective in their use because they can reduce noise and can transmit auscultation results over long distances (11)

The phenomenon concerning the acceptance of new technology, such as this wireless stethoscope that will be used by health workers, both doctors and nurses, should be tested before use. The need to figure out the perception of a new technology utilized in the nursing field is crucial in deciding the acceptance of the latest technology. The purpose of this pilot study is to find out the Perceived Usefulness and Perceived ease of Use of a wireless stethoscope in conducting auscultation of the heart and lungs in critical patients.

MATERIALS AND METHODS

The current research is a pilot study with population nurses who treated critically ill patients at the Palembang city hospital. This research was conducted from August to September 2022. Respondents in this study amounted to 40 nurses. A total sampling technique was employed, making all nurses in the critical care units to be used as samples. The respondents referred to in this study were nurses in the Intensive Care Unit (ICU), High Care Unit (HCU), and Stroke Unit from one private hospital in Palembang City. The research instrument was a questionnaire about “perceived usefulness and perceived ease of use” proposed by Fred D. Davis. The questionnaire was in the form of a checklist with the five-point Likert Scale described as follows: strongly agree (5), agree (4), neutral (3), disagree

(2), and strongly disagree (1).

The results of the instrument validity test have been carried out by previous researchers in Indonesia. On the usefulness aspect, the results are between 0.627-0.930 so that it is declared valid, while the ease of use aspect gets a score of 0.759-0.892 so that it is declared valid. As for the reliability results on the usefulness aspect, Cronbach's alpha value was 0.899 which was declared reliable. While reliability on the ease of use aspect gets Cronbach's alpha value of 0.896 so that it is declared reliable. Reliability results are declared reliable if Cronbach's alpha value is more than 0.60. (12).

RESULTS AND DISCUSSION

RESULTS

The demographic data obtained from the 40 respondents showed that 27.5% of male nurses and 72.5% of females. Nurses ranged between 27 – 33 years (42.5%), 34 – 40 years (25,0%), and >40 years (32.5%). Based on their education level, most respondents had a Diploma-III in Nursing Program (67.5%), followed by Certified Nurse Profession (32.5%), and all of the respondents (100%) had more than four years of working experience.

Table 1. Respondents' characteristics (n=40)

Respondents' Characteristics	n	%
Age (Year)		
27-33	17	42,5
34-40	10	25,0
>40	13	32,5
Sex		
Male	11	27,5
Female	29	72,5
Level of Education		
D3 in Nursing Program	27	67,5
Certified Nurse Profession	13	32,5
Work Experience (Year)		
>4	40	100

Regarding the respondents' perception of the usefulness of wireless stethoscopes, the result showed a mean value of 4.27 **Table 2**, indicating that nurses in critical care units fall into the category of very accepted technology of wireless stethoscope as a device for auscultation of the heart and lungs of the critically ill patients. The first indicator, "work more quickly," had the highest mean value (4.33), while the second and third indicators, "to job performance and to increase productivity," had the lowest mean value (4.25). Both the highest and the lowest mean values were included under the very accepted technology category.

Meanwhile, respondents' perceptions based on the ease of using a wireless stethoscope showed a mean value of 4.35 **Table 3**, indicating that nurses in the critical care unit very accepted the wireless stethoscope technology as a device for conducting auscultation of the heart and lungs of the critically ill patients. The sixth indicator, "easy to use," had the highest mean value (4.48). Then, the lowest mean value was the second indicator, "controllable," with a mean value of 4.25. Both the highest and the lowest mean values were included under the very accepted technology category.

Table 2. Descriptive statistics of respondents' perception based on the usefulness of wireless stethoscope (n=40)

Perceived Usefulness Indicators	Mean	Category of Acceptance towards the Technology
Work more quickly	4.33	Very Accepted
Job performance	4.25	Very Accepted
Increase productivity	4.25	Very Accepted
Effectiveness	4.28	Very Accepted
Makes job easier	4.28	Very Accepted
Useful	4.28	Very Accepted
The total score of Respondents' Perceptions based on the Usefulness of Wireless Stethoscope (JSK)	25.65	
Mean Value of Respondents' Perception based on the Usefulness of Wireless Stethoscope (RK)	4.27	Very Accepted

Table 3. Descriptive statistics of respondents' perception based on the ease of use of wireless stethoscope (n=40)

Perceived Ease of Use Indicators	Mean	Category of Acceptance towards the Technology
Easy to learn	4.43	Very Accepted
Controllable	4.25	Very Accepted
Clear & Understandable	4.35	Very Accepted
Flexible	4.35	Very Accepted
Easy to become skillful	4.28	Very Accepted
Easy to use	4.48	Very Accepted
Total Score of Respondents' Perception based on the Ease of Use of Wireless Stethoscope (JSK)	26.12	
Mean Value of Respondents' Perception based on the Ease of Use of Wireless Stethoscope (RK)	4.35	Very Accepted

DISCUSSION

The characteristics of a group to accept a new technology are influenced by personal and organizational factors. The individual factors include the knowledge and experience of using technology, gender, age, job skills, education level, and interface usability. The organizational factors include training and infrastructure (13,14). According to the Technology Acceptance Model (TAM) theory, the perception of usefulness is influenced by gender, job position, experience using technology, and skills. In contrast, the experience influences the perception of ease of use in technology and the skills possessed.

The personal factor influencing a person to accept new technology is age. The current study exhibited the highest age range of respondents was between 27-33 years, with 17 respondents (42.5%). Similarly, previous research also stated that age is essential in technology acceptance in nursing services (15). Mature individuals will be open to new experiences, able to adapt quickly, and have a reflective and accepting attitude (16). The nurses' length of working experience affects their acceptance of new technology. This study revealed that all respondents had more

than four years of work experience. The size of working experience causes a person to have the knowledge and skills to carry out duties; working experience enables individuals to know how to improve their methods and how to work with new technology (17).

In addition, nurses' level of education also determines the level of acceptance towards new technology. The higher the level of education, the higher the understanding of a person to accept a new technology quickly and easily. Education is regarded as an attempt to develop one's abilities, both formal and non-formal (18). Meanwhile, gender is a factor that affects the acceptance of new technology. The present study found that females dominated the respondents with 72.5%. This result follows previous research, which stated that females positively perceive using technology in health care (19).

Based on the study results, respondents accepted technology based on perceived usefulness, with an average value of 4.27. The highest mean value of the statement of perceived use is found in the work more quickly indicator, with an average value of 4.33. While the lowest mean value is found in the job performance and increasing productivity indicator, with a mean value of 4.25.

The perception of usefulness has a high mean/average value of 4.27, meaning that respondents accept wireless stethoscope technology. This illustrates that the wireless stethoscope has the ability to usability aspect. Namely, it can be used for auscultating the heart and lungs in critical patients. It can be used as assistive technology (assistive technology) in the nursing assessment process. Previous research explained that wireless-based stethoscope technology is helpful if it leads to faster, more useful health services and reduces health check-up time (20).

The highest indicator of perceived usefulness is the work more quickly indicator, with an average value of 4.33. This illustrates that nurses accept wireless stethoscope technology as a tool for assessing heart and lung auscultation because the device has unique features that can speed up work. This feature is filter settings. Previous research explained that the filter setting can produce soft and strong heart and lung signal frequencies and is quite sensitive (21). With this, the nurse's job to perform auscultation of the heart and lungs can be done quickly.

The lowest indicator of perceived usefulness is job performance and increasing productivity, with an average value of 4.25. This is because the respondents in the study have not used a wireless stethoscope for a long time. Previous research explains that if users have used technology for a long time, it will be familiar and increase the value of perceived usefulness (22).

Based on the study results, respondents accepted technology based on perceived ease of use, with an average mean value of 4.35. The highest mean value of the statement of perceived ease is found in the easy-to-use indicator, with a value of 4.48. While the lowest mean value in the opinion of perceived ease is found in the controllable hand, with a mean value of 4.25. Perception perceived ease of use is the level of a person trusting a technology that the technology can be used easily as well. Besides that, a person's level of trust can determine attitudes toward the intention to use new technology (23).

The highest indicator of perceived ease is the indicator of ease to use, with an average value of 4.48. The mean value of this indicator is the highest mean value of perceived ease of use because respondents consider that the wireless stethoscope is easy to operate when turning on, operating, and turning off the tool. This is in line with previous research, which explains that technology is said to be easy if the user does not require more effort in its use. In addition, easy-to-use technology will increase user interest, making users more proactive in responding to

new technologies (24).

The lowest indicator of perceived ease is the indicator that can be controlled with an average value of 4.25. This category is included in the lowest mean value because wireless-based stethoscopes sometimes cannot be controlled. One of the things that cannot be controlled is that the wireless connection can be disconnected. By research on testing tools for wireless-based lung sound detection at a distance of 6-15 meters, the wireless signal will be disconnected (25).

CONCLUSION AND RECOMMENDATION

The current study provides an overview of nurses' perceptions regarding using new technology, particularly wireless stethoscopes. The results demonstrated that nurses' perceptions of wireless stethoscopes had a mean value of 4.27. It pinpoints that nurses who work in the critical units very accepted wireless stethoscopes as a device for conducting the heart and lungs auscultation of critically ill patients. Furthermore, "work more quickly" was the perceived usefulness indicator with the highest mean value. Meanwhile, the nurses' perception of the ease of use of wireless stethoscopes had a mean value of 4.35. It indicates that nurses in critical care units very accepted wireless stethoscopes as a device for performing auscultating the heart and lungs of critically ill patients. Then, "easy to use" was the perceived ease of use indicator with the highest mean value and fell into the very accepting category.

Considering that the current research is a pilot study, the results can be utilized as primary data to conduct further research on wireless stethoscopes, especially research concerning the testing of the wireless stethoscope. Therefore, using devices with new technology can continue to be developed.

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