ORIGINAL ARTICLE

Utilization of android-based paediatric assessment triangle application as an emergency detection tool for children

Dessie Wanda, La Ode Abdul Rahman, Efa Apriyanti, Permaida, Yayah, Titik Ambar Asmarini, Indah Reski Amallia, Ina Yuhana, Ricca Olivia Nastasya

Abstract

Objective: To identify the effectiveness of an android-based paediatric assessment triangle application in emergency diagnostics.

Method: The action research study was conducted in the emergency department of a hospital under the Ministry of Defence, Indonesia, located within the Ministry of Defence Rehabilitation Centre Complex, from April to December 2020 after approval from the ethics review committee of the Faculty of Nursing, Universitas Indonesia, Indonesia, employing quantitative and qualitative methods consisting of planning, acting, observing and reflecting stages. Emergency department nurses with at least D3 nursing graduation who were able to identify emergency status in children were included. The subjects were given training on paediatric assessment triangle application before using it in their professional life. The difference was noted through pre- and post-intervention tests. Qualitative data was collected using focus group discussion and system usability scale.

Results: Of the 9 nurses, 5(55.6%) were males, 4(44.4%) were females, 8(88.9%) were aged 26-35 years, and 2(22.2%) had professional experience 1-2 years. The mean baseline score was 36.1±11.4, while the mean post-intervention score was 70.9±14.4. The fastest application completion time was 13 seconds, while the slowest was 52 seconds. Qualitative data led to the emergence of 4 themes: time required to complete the application; preference for connectivity with the hospital's electronic record system; assessment of children's clinical status; and, unfamiliarity with the computerised system. The mean system usability scale score was 72.22±11.35 (range: 52.5-92.5).

Conclusion: Paediatric assessment triangle application could be a valid tool for identifying emergency severity in patients during the triage process.

Keywords: Android, Application, Paediatric Assessment Triangle, PAT, Paediatric emergency.

(JPMA 74: S-31 [Suppl. 5]; 2024) **DOI: https://doi.org/10.47391/JPMA.Ind-RINC-09**

Introduction

Significant global development has had a favourable effect on reducing child mortality since 1990.[1] The mortality rate of children aged <5 years worldwide decreased from 76 per 1000 live births in 2000 to 39 in 2018.[2] This means that, on average, 15,000 children <5 die every day. Data shows that in the first 5 years of life, the child mortality rate is 5.3 million, including 2.5 million (47%) in the first month of life, 1.5 million (29%) at age 1-11 months, and 1.3 million (25%) at age 1-4 years. Causes of death include complications of premature birth, pneumonia, birth asphyxia, congenital abnormalities, diarrhoea and malaria. An additional 6.2 million deaths occurred in 2019 among children aged 5-14 years(1). In the United States, Australia, Singapore, England, Japan, Korea and other developed countries, the child mortality rate is low, at ≤10/1000 births. This target is a significant challenge for Indonesia. The World Health Organisation (WHO) in 2018 recorded the child mortality rate in Indonesia at 25/1000 births.[3] As a developing country, Indonesia requires proper management of child emergency care and innovations to prevent child mortality.[1]

Many developed countries use a paediatric medical emergency assessment system, known as the paediatric assessment triangle (PAT), for detecting emergencies in children. PAT is a rapid evaluation tool that determines children's clinical status and categorises the cause of an emergency using the tool without touching the child. The most important components of PAT are general appearance and tone, interactivity, comfort, look/gaze, and speech/cry. The breathing process assessment is a more accurate assessment of oxygenation and ventilation than respiratory rate or auscultation of breath sounds. Nurses look for and listen to signs of abnormal positioning, retractions, nasal dilatation and abnormal airway sounds. The last component is conducted by looking at the circulation of the child's skin colour for pallor, spots, or cyanosis to provide information about core perfusion and cardiac output.[4] This PAT component is carried out quickly and generally requires <60 seconds.[5,6]

This method was developed at a Los Angeles hospital in 2000, and since them other developed countries have

Faculty of Nursing, Universitas Indonesia, Indonesia.

Correspondence: Dessie Wanda. e-mail: dessie@ui.ac.id

ORCID ID: 0000-0003-0659-1748

adopted PAT due to its success in reducing mortality.[7]

The successful use of PAT in developed countries has encouraged researchers to participate in the development of a PAT android-based application for Indonesia, along with new operational steps so that the work process would be more efficient, and the outcomes would improve in number and quality.[8]

The current study was planned to identify the effectiveness of PAT application in emergency department (ED) diagnostics.

Materials and Methods

The action research study was conducted in the ED of a hospital under the Ministry of Defence, Indonesia, located within the Ministry of Defence Rehabilitation Centre Complex, from April to December 2020 when the coronavirus disease-2019 (COVID-19) pandemic was in its active phase. Approval was obtained from the ethics review committee of the Faculty of Nursing, Universitas Indonesia, Indonesia, and the study employed quantitative and qualitative methods consisting of planning, acting, observing and reflecting stages.

This study used total sampling, therefore all nurses in ED were invited in this study, however only nine nurses attended the PAT training including pre- and post-test completely. Those included were nurses involved in ED triage who had at least D3 nursing graduate diploma, and were able to identify emergency status in children. The enrolled subjects were given training on how to use the PAT application.

In the first stage, information was gathered regarding the need for PAT, while the PAT tool was developed in the second stage, which was subsequently introduced in an ED setting. The third stage was observation during which the tool's feasibility was assessed. The fourth stage comprised collection of qualitative data through a focus group discussion (FGD), and testing the effectiveness of the tool using the System Usability Scale (SUS) which consisted of 10 statements rated on a 5-point scale.[9] The data analysis was carried out by abstracting data, interpreting data, checking data validity, and data reflection.

Informed consent was taken from all the participants, and ethical considerations related to both the patients and the nurses were honoured, including all the rights of human subjects in research:[10] self-determination, privacy and dignity, anonymity and confidentiality, fair treatment, and protection from discomfort and harm.

Results

Of 29 nurses who worked in ED, nine nurses completed the training. Those nine nurses who were on duty in the ED triage room; 5(55.6%) males, 4(44.4%) females. There were 8(88.9%) aged 26-35 years, and 2(22.2%) had professional experience 1-2 years (Table 1). The mean baseline score was 36.1±11.4, while the mean post-intervention score was 70.9±14.4. The fastest application completion time was 13 seconds, while the slowest was 52 seconds. The mean SUS score was 72.22±11.35 (range: 52.5-92.5) (Table 2), indicating a 'good' score (Figure)

Table-1: Characteristics of the participants (n=9).

Variable	n (%)
Age (years)	
26–35	8 (88.9)
36–45	1 (11.1)
Gender	
Male	4 (44.4)
Female	5 (55.6)
Education	
S1	1 (11.1)
D3 Nursing Programme	8 (88.9)
Working experience (years)	
> 5	2 (22.2)
3-5	3 (33.3)
1-2	4 (44.4)

Table-2: Mean System Usability Scale (SUS) score (n=9).

Mean±SD	Min-Max
72.22±11.35	52.5–92.5

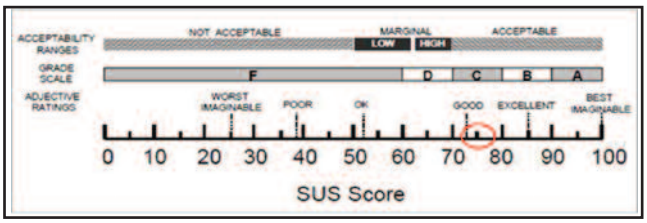

Figure: System Usability Scale (SUS) and the current sample's score.

Qualitative data led to the emergence of 4 themes: time required to complete the application; preference for connectivity with the hospital's electronic record system; assessment of children's clinical status; and, unfamiliarity with the computerised system.

The first theme suggested that the nurses required more time to complete patient names that had complicated spellings. Filling in the patient's date of birth also took a long time because the nurses had to find the year, month, and date of the patients' birth in their records.

"*It is easy unless the name of the child is difficult.*" (P02)

"*It is a bit difficult and takes a while to find the month of the birth of the children.*" (P01)

Despite this, the nurses felt that the PAT application was

very helpful in quickly identifying emergency status in children in less than a minute. The documentation of PAT results could be undertaken more quickly than writing on paper. "*In terms of time, I think PAT is efficient, takes at least 30 seconds, not even a minute.*" (P02)

"*It is faster than writing, so it makes our work easier. It needs less than a minute, since we only have to click here and there. If we use it frequently, maybe later, it will be easier for us, just tick, tick, and tick; 30 seconds won't be too long.*" (P03)

"*It is easier to do it, it is better than if we have to write a long one.*" (P04)

The second theme was preference for connectivity with the hospital's electronic record system. The PAT application, in the opinion of the nurses, was simple to use. However, they felt that if it were linked to the hospital's electronic recording system, it would be more beneficial as the participants still had to manually type the name of the nurse in charge. The participants believed that because the hospital's computer system served as an electronic documentation system for patient medical records, it would be simpler to use the PAT application if it were also connected to it. "*The tab itself is easy to operate; for example, if you log on to the computer, the app could immediately provide a name, so we don't have to type in the nurse's name and the patient's name. It is certainly easier if you could also insert it in Teramedik.*" (P01)

"*It would be better if the application on each handphone has a link to the hospital computer, so we just have to click on the patient's name, and we already know what happened to him/her yesterday.*" (P02)

The third theme was assessment of children's clinical status. The PAT application could identify children's clinical status quickly and easily. This application was considered helpful for facilitating nurses' rapid assessment of the children's condition and determination of further actions.

"*It is good for scoring children.*" (P01)

"*This is a very advanced health system since it is already computerised and makes our movement fast; for example, if it was an emergency, we still can handle it. It helps us to study instructions easily due to the available options. For example, when you have to complete the finishing part, and you cannot think about what intervention should be used, sometimes you just have to look at it on the app. Then, it comes out right away. It speeds up what actions the SOP demands. It makes our work easier and faster, too.*" (P02)

"*It makes our job easier because if you use the system, you do not use paper. You just have to click, click, and click, and it is done already. It is easy.*" (P03)

The fourth theme was unfamiliarity with computerised systems. The participants were not familiar with the computerised system and needed time to learn using the PAT application.

"*The assessment is possible electronically if you get used to it. Therefore, the main limitation is the humans who are not used to the computerisation system yet.*" (P02)

Discussion

In the first stage, the current study comprised a literature review regarding the use of PAT in detecting emergencies in children. A study[11] in Japan examining PAT's use for unstable patients found that it was able to predict the severity of Kawasaki disease with high levels of initial treatment resistance. A study in India reported that PAT and direct clinical assessment prevented child mortality.[7]

PAT was developed in the form of an android-based application in collaboration with an information technology (IT) specialist. The application was revised and improved several times before actual use in the ED.

Initially, the PAT training was provided to all nurses who were interested in the programme. Thirty-five nurses from ED and paediatric wards were involved in targeted training, however 24 nurses were able to participate until the end of the study. This was due to the official schedule and high number of visitations for COVID-19 patients at the ED and the wards. The material provided during the training related to the concept of PAT, and the nurses were exposed to simulated use of the application. It provided examples of paediatric emergency cases in the form of videos.

In the next stage, all nurses who were on duty in the ED triage room received guidance on how to use the PAT application. Nurses who could not fully participate in the training activities were given another introduction session regarding the use of the PAT application. At this stage, the nurses were able to detect an emergency by using the PAT application in <60 seconds. The fastest time recorded by a nurse in charge to detect an emergency in a child patient was 13 seconds.

The participants needed more time to complete patient names having complicated spellings. Filling in the patient's date of birth also took a long time because the participants had to find the year, month, and date of the patients' birth in their records. This delay occurred because participants needed more practice utilising the application based on the specific condition and situation. The more often the PAT application is utilised, the better participants will be at implementing it.

The participants reported that the application was simple

to use. However, they felt it would be more useful if it were connected to the hospital's electronic recording system. The participants felt that because the hospital's computer system served as an electronic documentation system for patient medical records, it would be simpler to use the PAT application if the two were connected.[12]

If the application is programmed into the hospital's electronic registration and connected to the system for every nurse on duty in the ED, the hospital's electronic system could provide a unique code or password for each nurse or doctor on duty in the ER. In this way, it would be accessible without manually typing the name, and would save more time. The hospital electronic records have been specifically designed to support users by providing various facilities with accurate and complete data, including warnings and signs. The hospital system also supports clinical decisions and links data with medical knowledge and other tools.[13,14]

If the PAT application was linked to the hospital's electronic medical records, the patient's data could be preserved in a digital repository, stored, and protected so that only authorised users like doctors or nurses could access it securely. This might prevent medical errors or unnecessary repeated checks by other officers.[15,16]

The PAT application was regarded as a great resource for helping nurses swiftly analyse the health of the children and decide what to do next. This finding was in accordance with the finding that PAT was a rapid evaluation tool to determine children's clinical status.[7] The application is designed to be easy to use. Assessment of the children's clinical status on the PAT application was carried out without touching, using only visual and auditory instructions. It did not require equipment, and it took only 30-60 seconds for an initial assessment of appearance.[17]

The current results showed that the participants were not fully familiar with the computerised system and required more time to learn how to use the PAT application.[18,19]

The training and workshops provided were highly beneficial, as they taught the participants to recognise parts or terms of the assessment components in the PAT application. The training provided experience to the participants to develop their knowledge, skills, and attitudes. Participants who attend trainings have a better understanding of and familiarity with the application.[20,21]

The SUS analysis showed that the lowest score was 52.5 and the highest was 92.5. This assessment showed the subjective points of view of the individual users on the PAT application developed by the researchers. The nurse with a score of 52.5 stated that difficulty and confusion were faced in using the application because it was the first time electronic-based assessment was being used. The nurse who scores 92.5 stated that it was very helpful to have the PAT application when triaging children at the ED.

The mean SUS value of 72.22 indicated that the PAT application had a high acceptability range. Therefore, it could be accepted and ready to be used with all available functions. The grading scale in the PAT application was in the C, or 'good', grade, and can be further developed to achieve an A grade.

Conclusion

The PAT application was found to be a valid tool as a first step in identifying children's emergencies in <60 seconds. Not only was time efficiency obtained by nurses and doctors, the application also provided convenient ED management to save children's lives, and can support government programmes aimed at reducing child mortality.

Limitation: The sample size was not calculated for this study and the total number of the nurses available in the emergency room were included. The study was conducted during the COVID Pandemic era which also limited the availability of the participants.

Acknowledgement: We are grateful to the patients who participated for supporting the study.

Disclaimer: The text has been presented as an Abstract at the 5th Riau International Nursing Conference.

Conflict of Interest: None.

Source of Funding: Universitas Indonesia through Pendanaan Perancangan Dan Pengembangan Purwarupa 2020 programme.

References

1. World Health Organization (WHO). Paediatric emergency triage, assessment and treatment of critically ill children. Geneva, Switzerland: WHO Press; 2019. [Online] 2019 [Cited 2024 May 17]. Available from URL: https://www.who.int/publications-detail-redirect/9789241510219.
2. United Nations International Children's Emergency Fund (UNICEF), World Health Organization (WHO), World Bank Group, United Nations Population Division. Levels and trends in child mortality 2019. New York, USA: UNICEF; 2019. [Online] 2019 [Cited 2024 May 17]. Available from URL: https://www.unicef.org/reports/levels-and-trends-child-mortality-report-2019.
3. Aehlert B. PALS: Paediatric advanced life support study guide. 4th ed. Massachusetts, USA: Jones & Bartlett Learning, 2017; pp 1-179.
4. Ogden K. The use of the paediatric assessment triangle in the management of the sick child. Emerg Med J 2016;33. DOI: 10.1136/emermed-2016-206139.16.
5. Fernández A, Ares MI, Garcia S, Martinez-Indart L, Mintegi S, Benito J, et al. The validity of the paediatric assessment triangle as the first

step in the triage process in a paediatric emergency department. Pediatr Emerg Care 2017;33:234–8. DOI: 10.1097/PEC.0000000000000717.

6. Fuchs S, Terry M, Adelgais K, Bokholdt M, Brice J, Brown KM, et al. Definitions and assessment approaches for emergency medical services for children. Paediatrics 2016;138:e20161073. Doi: 10.1542/peds.2016-1073.
7. Kumar VS, Kumar PR, Subramanian SB, G SS. A study on the role of paediatric assessment triangle, clinical scoring and serum lactate in the management of septic shock in children. Int J Contemp Pediatr 2019;6:2037. DOI: 10.18203/2349-3291.ijcp20193720.
8. Creswell JW, Poth CN. Qualitative inquiry and research design: Choosing among five approaches. 4th ed. California, USA: SAGE Publications, 2017; pp 1689–99.
9. Lewis, JR. The system usability scale: Past, present and Future. Int J Hum-Comput Interact 2018;34:577-90. DOI: 10.1080/10447318.2018.1455307.
10. Macnee CL, McCabe S. Understanding nursing research. Using research in evidence-based practice. 2nd ed. Philadelphia, PA: Lippincott Williams & Wilkins, 2008; pp 1-431.
11. Kawai R, Nomura O, Tomobe Y, Morikawa Y, Miyata K, Sakakibara H, et al. Retrospective observational study indicates that the paediatric assessment triangle may suggest the severity of Kawasaki disease. Acta Paediatr 2018;107:1049-54. Doi: 10.1111/apa.14249.
12. Suhardin S. The Influence of Gender Differences and Knowledge of Basic Ecological Concepts on Environmental Concern. EDUKASI: Journal of Religion and Religious Education Research 2016;14:117–32. Doi:10.32729/edukasi.v14i1.15.
13. Nuryati, Widayanti NA. Evaluation of the Implementation of the Electronic Health Record (EHR) System at the Gadjah Mada University Academic Hospital Based on the Pieces Analysis Method. Indonesian Journal of Health Information Management 2015;3:17–30. DOI:10.33560/.V3I1.66.
14. Sampurna B, Hatta GR. Guidelines for health information management in health service facilities/ author. Jakarta, Indonesia: University of Indonesia Publishers (UI-Press), 2011.
15. Aswad HN, Ferrial E. Influence of Education Level, Training and Compensation Against Nurse Performance at UIT Hospital Makassar. The Mirai Management Journal 2016;1:413–25. DOI: 10.37531/mirai.v1i2.23.
16. Baren JM, Brennan JA, Brown L, Rothrock SG. Paediatric emergency medicine. Amsterdam, Netherlands: Elsevier Inc, 2008.
17. In: Marx JA, Hockberger RS, Walls RM, Adams J, Rosen P eds. General approach to the paediatric patient. In: Rosen's emergency medicine: concepts and clinical practice. 7th ed. St. Louis, Missouri: Mosby, Inc, 2010; pp 2081–92.
18. Santoso J. Usability User Interface and User Experience Android-Based Kolok Bengkala Dictionary Learning Media. Journal of systems and informatics (JSI) 2018;12:174-81.
19. Marchantia A. Differences in Career Focus between Young Adult Workers Who Have Changed Jobs and Not Changed Jobs in Jakarta. [Online] 2008 [Cited 2024 May 22]. Available from URL: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://lib.ui.ac.id/file?file=digital/old15/126729-331.702%20AND%20p%20-%20Perbedaan%20Fokus%20-%20Abstrak.pdf
20. Rismathul K, Ayunda N. Periodization of late adult development. J Chem Inf Model 2019;53:168.
21. Ridho M, Alimin Maidin HM, Perdana N. Factors influencing executing nurses performance in Bhayangkara tingkat IV Hospital Kendari Makassar. [Online] 2012 [Cited 2024 May 22]. Available from URL: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://pasca.unhas.ac.id/jurnal/files/bd29a9f147b2ba75620896aa63c3c6f1.pdf