

The roles of cognitive ergonomics in reducing human error and burnout among emergency room nurses during the Covid-19 pandemic

Rezki Amelia Aminuddin A. P.^{1*}, Hakim²

^{1,2} Faculty of Engineering, Islamic University of Makassar, Jl. Perintis Kemerdekaan, No 9, Makassar, 90245, Indonesia

^{1*} rezkiamelia.dty@uim-makassar.ac.id; ² hakim@uim-makassar.ac.id

* corresponding author



ARTICLE INFO

Article history

Received December 28, 2022

Revised February 23, 2023

Accepted March 5, 2023

Keywords

Cognitive Ergonomic

Burnout

Nurse

Human Error

HEART

ABSTRACT

Background: Mental health, particularly burnout syndrome, is one of the concerns that can influence the productivity of health workers during the pandemic. This is because health professionals are under intense pressure, but there is no guideline or procedure in place to safeguard them in terms of mental health. The objective of this study is to discover burnout and human error, as well as to provide advice, by analyzing the ergonomic factors.

Method: Human Error Assessment and Reduction Technique was the identifying approach employed (HEART) in this study. The sample consisted of ten emergency room personnel from one of the hospitals in Yogyakarta.

Results: The activity with the greatest HEP was the delivery of first aids, which had a value of 0.068. This activity requires more difficult and complex labor abilities, making human unreliability more significant and increasing the likelihood of human error.

Conclusion: Recommendations are made to assist nurses in dealing with heavy and varied workloads so that the reliability of nurses at work can be increased and burnout can be reduced, including the suppression of environmental factors to be as small as possible to reduce the workload of nurses, urging nurses to begin monitoring the situation and taking anticipatory steps so that the burnout does not worsen, and holding regular sharing sessions among nurses, upgrading knowledge and fostering a sense of togetherness.



This is an open access article under the [CC-BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) license.

How to Cite: AP, R. A. A. & Hakim. (2023). The roles of cognitive ergonomics in reducing human error and burnout among emergency room nurses during the Covid-19 pandemic. *Periodicals of Occupational Safety and Health*, 2(1), 21-28. <https://doi.org/10.12928/posh.v2i1.6635>

1. Introduction

The Corona Virus Disease-19 (COVID-19) pandemic in Indonesia has become one of the issues affecting the country's health care system, especially the health care personnel (Hamid et al., 2020; Ilpaj & Nurwati, 2020). According to (Suhartono et al., 2021) the health and safety of health workers (health workers) is an element that demands special attention, as they are the frontliners in the

defense against COVID-19 and are extremely vulnerable to life-threatening dangers due to the exposure. Aslam et al., (2020) reported that more than 100 doctors and hundreds of other health professionals died from COVID-19 while providing health services. In addition to the risk of infection with COVID-19, mental health issues, such as the risk of burnout syndrome, might influence the productivity of health workers during a pandemic (Kim et al., 2020). This is due to the fact that health workers are under intense pressure, but there are no guidelines or policies in place to safeguard their mental health (Sunjaya et al., 2021). According to Colaneri et al. (2020), the ER Nurse is one of the hospital work units with a significant primary responsibility during the covid-19 epidemic (Emergency Unit). The ER has a highly variable patient load, resulting in a high burden for the nurses as a result of extended hours and limited rest time (Hussein et al., 2020). Nurses at the emergency room must be available 24 hours a day, regardless of the patients' condition, to accept and treat patients. This will have a detrimental effect on the mental health of nurses. X Hospital is an acute care facility located in Sleman Regency. The emergency room is one of the units where the on-duty nurse has a heavy workload. In addition to providing treatment for patients, emergency department nurses are responsible for recording and summarizing all the patient data, treating patients for referral to other hospitals, and providing early diagnosis and classification of patients entering the emergency room. Based on the described situations as obtained from the interviews, nurses reported a number of issues. A number of physical problems were mentioned such as dizziness or headache, neck and back pain, leg cramps, and sleeping difficulties as a result of abnormal sleeping patterns. In terms of non-physical (mental) complaints, nurses complained about the difficulty of collecting patient data with a high degree of accuracy, so that it was easy to feel panic when a large number of patients with various emergency conditions arrived at the ER. Nurses also complained that they could not concentrate when they were tired (Baljani et al., 2020).

There have been a number of previous studies on burnout experienced by nurses during the covid-19 pandemic (Chor et al., 2021; di Monte et al., 2020; Manzano García & Ayala Calvo, 2021; Martínez-López et al., 2020). However, as a preliminary study to identify burnout and its influencing factors, no one has provided a solution to burnout experienced by emergency room nurses during the covid-19 pandemic. In this study, the detection of burnout and human mistake will be conducted, and ergonomic recommendations will be made to reduce these occurrences. Emergency Room of Hospital X, one of the hospitals in Sleman Regency, Yogyakarta, will serve as the case study hospital.

2. Method

This research is a type of descriptive research to determine the level of burnout and human error among nurses during the Covid 19 pandemic period at Hospital X. Questionnaires were distributed to 10 nurses on duty in the emergency room based on the work shift schedule. The burnout level was measured using the MBI (Maslach Burnout Inventory) questionnaire and then analyzed using the HEART method which is based on the principle that every time a task is carried out, then there is a possibility of failure and that this possibility is influenced by one or more EPC (Error Producing Conditions) such as: distraction, fatigue, cramped conditions and others. Factors that have significant influence on performance are shown with the largest HEP values. These conditions can then be applied to a "best-case scenario" estimate of the probability of failure under ideal conditions to obtain the final error opportunity. Finally, recommendations are given based on the EPC value.

2.1. Burnout

Burnout is a condition caused by labor and characterized by extreme stress. Burnout can negatively influence both mental and physical health. In this study, the only scale used was the MBI-GS. Two clinical psychologists and two bilingual professional translators were responsible for the translation of the scale. When harmonizing the first translation into Indonesian, their reports were reviewed. Their translation was reverse-translated, and every element of the new English version was compared to the original English version. Expressions deemed unclear or culturally insensitive were revised as a result of discussions within the expert panel, and alternative expressions and clarifications of the questions concerning feeling depressed and tired for no apparent reason were

proposed. The panel observed that the Indonesian translation of "feeling nervous" is similar to "feeling angry," which could cause confusion among some participants. The panel advised that a conceptually equivalent term for "anxious" be added to this item. They also suggested replacing "how often" with "how much" because the literal translation of "how often" is uncommon and difficult for many Indonesians, particularly those with lower levels of education, to understand. After several phases of adaptation, translation, and reverse translation replacement of items with low factor loadings and testing, the panel of experts determined that all final items were of high quality.

2.2. Human Error Assessment and Reduction Technique (HEART)

The HEART method is a technique used in the human reliability assessment (HRA) field to assess the likelihood of human error occurring during the completion of a specific task.

The HEART method is based on the idea that every time a task is performed, there is a chance of failure, and that this chance is influenced by one or more EPCs (Error Producing Conditions). With the EPCs in mind, the HEART method also has the indirect effect of providing a variety of ergonomic recommendations for improving reliability. The HEART method is founded on a number of factors, including:

1. Human dependability is contingent on the generic nature of the task to be performed.
2. Under "perfect" conditions, the level of reliability tends to correspond with the nominal probability within the probabilistic limits.
3. Given that perfect conditions do not exist in all situations, the extent to which identified Error Producing Conditions (EPCs) may apply may affect the predictability of human performance.

The steps for measuring Human Reliability with the HEART method are as follows:

2.2.1. *Classifying Jobs According to the GTC (Generic Task Categories)*

This is the processing phase of the HEART methodology. The results of a human task analysis are then categorized in the GTC table. Grouping aims to determine the probability of an operator's inability to perform a given task.

2.2.2. *Calculating the value of Assessed Effect and Probability of Human Error*

This is the step to identify the activities that can lead to human error by referring to the EPC (Error Producing Condition) table for identification. Next, the proportion of influence is determined. Then, calculation is made on the value of the Assessed Effect. The subsequent phase is Human Error Probability value calculation, which is the final step of the HEART method. Using the formula, the probability of human error will be calculated. The human error calculation is then compared and a probability is selected to find the leading cause of human error.

2.2.3. *Error Identification Utilizing Error Mode Tables and Error Consequences*

This phase is known as the Human Error Identification (HEI) phase. Human error is categorized and then put into the table of error codes. The purpose of this phase is to determine whether operator errors are action errors, checking errors, retrieval errors, or communication errors.

2.2.4. *Establishing the Type of Error Probability*

This method has three types of error probabilities: L (Low), M (Moderate), and H (High) (High). The probability of this type of error is determined through brainstorming and interviews followed by consultation with specialists in the field. Probability is derived from the frequency of the error. This phase is utilized to determine the severity of human error.

3. Results and Discussion

3.1. Human Error Assessment and Reduction Technique (HEART)

Using the HEART (Human Error Assessment and Reliability Technique) method, the following steps were required to calculate the Human Error Probability (HEP): Determine the type of task based on the errors that could occur (HEP) from the HEART Generic Categories table. After creating a hierarchy based on the existing task analysis, the next step was to determine the nominal value of

human unreliability by comparing the types of tasks to the task categories contained in the HEART Categories and discussing them with the experts in this subject (see Table 1).

Next step was for the nurse to pick and evaluate the EPC. At this stage, conversations with specialists were undertaken to choose EPC that could create errors for the job being analyzed, followed by an evaluation of the EPC to determine the likelihood that it could cause errors or failures. Then, the evaluation of each EPC was multiplied by the overall HEART impact found in Table 2.

These outcomes provided an assessed effect, which was then put together to get the overall assessed effect. Based on the type of labor, the total value of the assessed effect was multiplied by the HEART Generic Categories (see Table 1) to give a probability of failure that showed the probability of a job failing. HEART Generic Categories were derived by classifying tasks into multiple groups in Table 1.

Table 1. HEART analysis of Patient Admission

Task	Possible Error	HEP	Failure	Reability
Patient Admission	Late receipt of patient registration	0,05	0,092	0,908
	Ignoring the triage process	0,002		
	Error in labeling emergency	0,002		
	Not taking the patient to the examination room	0,038		
Treatment Process	Not performing a physical examination at the beginning of the patient's treatment	0,00112	0,1724	0,8276
	Early diagnosis error	0,0016		
	Not reporting the patient's condition to the doctor in charge of the ER (emergency room) on duty	0,05		
	Too late to give first aid	0,00168		
	Not taking patient's blood	0,068		
	Not controlling patient's condition regularly	0,05		
Action evaluation process	Not making patient medical records	0,056	0,096	0,904
	Not reporting the patient's laboratory results to the doctor in charge of the ER on duty	0,04		
Inpatient Patient Administration	Not providing specialist doctor recommendations to patients	0,036	0,182	0,818
	Not preparing the treatment room according to the patient's consent (patient chooses the room)	0,044		
	Not inputting patient administrative data	0,05		
	Being late to take the patient to the treatment room	0,052		
Outpatient Administration (not inpatient only care in the ER)	Not inputting patient administrative data	0,05	0,140	0,860
	Not preparing drug prescriptions for patients	0,05		
	Late release of infusion or medication, other medical devices installed in the patient	0,04		

Based on Table 1, the overall system reliability is:

$$R_{\text{system}} = 0.908 \times 0.8276 \times 0.904 \times 0.818 \times 0.860 = 0.477$$

Based on the data processing using the HEART technique, it is known that the biggest possibility of human error is task 1, namely patient acceptance with the value of 0.908%. Workload fluctuates due to uncertainty in patient numbers and patient severity, diverse nursing assignments, the need for nurses to be on standby for 24 hours a day, the need for nurses to be able to work quickly, accurately, and responsively with patients, and pressures and demands. Emergency nurses have to face a heavy workload due to moral demands, the needs of hospital leadership, and the demands of the patient's family to save the patient. It is believed that the workload of ER nurses will lead to burnout and reduce their dependability for the work.

The dependability value of 0.477 indicates the intensive and varied workload of the nurses. The reliability of emergency room nurses is still lacking, even though nurses should have high reliability because their work includes patient safety (Iswanto, 2020).

3.2. Burnout

The results of this burnout evaluation will reveal the physical (physical weariness), emotional (emotional exhaustion), and mental/personal achievement fatigue experienced by emergency room nurses (personal accomplishment). The 22-item MBI questionnaire will assist nurses to understand the sentiments and working environment they have encountered thus far. The Maslach Burnout Inventory questionnaire was handed to all respondents, a total of 10 nurses who worked in the ER, and they were asked to select the response that best reflected their feelings on a scale from 1 to 10. The acquired information was subsequently examined.

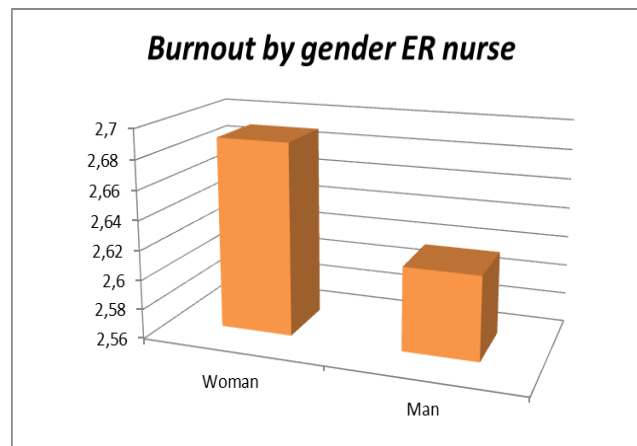


Fig. 1. Burnout by gender Emergency Room of 10 Nurses

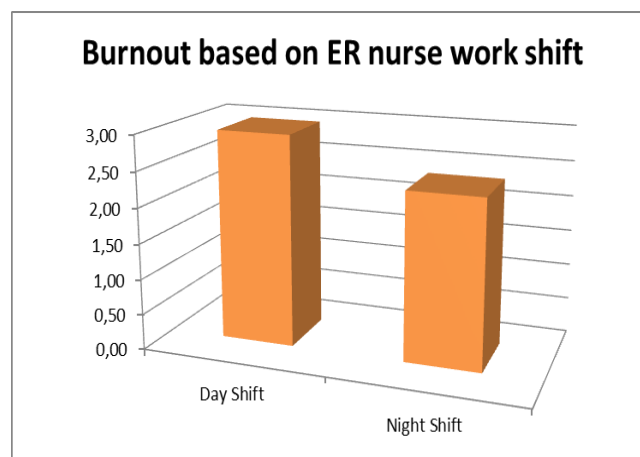


Fig. 2. Burnout based on work shift in Emergency Room of 10 Nurses

Burnout can be seen from physical, mental and emotional exhaustion, as well as low self-esteem. One indicator that causes burnout is physical workload and mental workload. Physical workload and mental workload are closely related to the study of ergonomics. From an ergonomics perspective, mental workload is included in the cognitive ergonomics dimension. Cognitive ergonomics is a branch of ergonomics that deals with human mental processes, including; perception, memory, and reaction, as a result of human interaction with the use of system elements.

Referring to Figure 1, it is known that morning/afternoon nurses experienced greater burnout than night shift nurses due to the greater intensity of patient arrivals during the morning/afternoon shift. Female nurses were more prone to burnout. The results of the burnout calculation utilizing the

Maslach Burnout Inventory indicated that the burnout level experienced by the emergency room nurse was in the range of 2-3, indicating that the nurse must begin to monitor her condition and take preventative action so that the perceived burnout did not worsen. This indicates that the severe and varied duty of ER nurses leads to burnout (Havaei & MacPhee, 2020).

In this manner, the workload of ER nurses also influenced their dependability for the job. This was evidenced by the poor overall dependability value (R system) of 0.477%. This demonstrated that despite the tremendous and varied workload of nurses, the reliability of ER nurses was still rather low, despite the fact that nurses should have a high degree of dependability due to the high-risk nature of their profession.

In order to boost the dependability of nurses' work, it is required to use a number of measures to prevent human mistake. These improvements will be implemented on activities that are most likely to result in human error, particularly on activities with the highest HEP (Human Error Probability) value, namely in the process of providing nursing care, namely in assisting patients, in order to prioritize the implementation of improvements on these activities.

3.3. Recommendations

Recommendations were given to 10 nurses based on the EPC. The recommendations given are as follows in Table 2.

Table 2. Recommendations

Faktor EPC's HEART	Recommendations
4	<p>Conducting training (stress management training) and upgrading on the personality and motivation of nurses so as to restore the work spirit of nurses</p> <p>Carry out more structured assignments so that patients do not experience delays in handling</p> <p>Relax and arrange a comfortable nurse's room so that they can work more focused</p>
11	<p>Nurses should often check the results of patient diagnoses with other doctors and nurses so that there is no miscommunication</p>
13	<p>Create a work order checklist for each work activity from the beginning of patient registration to completion of service, so that the risk of errors due to missed procedures can be minimized</p>
16	<p>The nurse provides information about the patient's health development to the family, and focuses on completing the responsibilities of one patient first, and the patient's family actively asks/reports to the nurse if there is a missed or delayed treatment</p>

4. Conclusion

Based on the calculation method with HEART, the results of the human dependability value utilizing the Human Reliability Assessment indicate that the inpatient administration process activity has the lowest reliability value, with the value of 0.818. The action with the highest HEP is delivering first aid, with a value of 0.068. This activity needs more difficult and complex labor abilities, making human unreliability more significant and increasing the likelihood of human error. Similarly, the total system's reliability score is rather low, at 0.477%. Therefore, some changes are required.

The study recommends improvement in the use of Maslach Burnout Inventory and HEART assessments to assist nurses in coping with heavy and varied workloads so that the reliability of nurses at work can be increased and burnout can be reduced, among other things, by suppressing environmental factors as much as possible to reduce the workload of nurses, encouraging nurses to begin monitoring the situation and taking preventative measures so that the burnout etiology can be mitigated.

Acknowledgment

Gratitudes are extended to all the parties involved in this research.

Declarations

- Author contribution** : Rezki Amelia Aminuddin A.P was responsible for the entire research project. She also led the writing of the manuscript and the collaboration with the second author. Hakim participated in the data collection, transcription and analysis. He also revised the manuscript. Both authors approved the final manuscript.
- Funding statement** : This research did not receive any funding.
- Conflict of interest** : Both authors declare that they have no competing interests.
- Additional information** : No additional information is available for this paper.

References

- Aslam, M. R. A., Suryawati, C., & Agushybana, F. (2020). The Importance of Prevention and Control of Coronavirus Disease (Covid-19) in Dental and Oral Hospital. *Jurnal Ilmu Kesehatan Masyarakat*, 11(2), 89–100. <https://doi.org/10.26553/jikm.2020.11.2.89-100>
- Baljani, E., Memarian, R., & Vanaki, Z. (2020). Protective disciplinary exchange: A qualitative study into nurse managers' supportive strategies for nursing error management. *Nursing and Midwifery Studies*, 9(3), 135. <https://www.nmsjournal.com/text.asp?2020/9/3/135/289983>
- Chor, W. P. D., Ng, W. M., Cheng, L., Situ, W., Chong, J. W., Ng, L. Y. A., Mok, P. L., Yau, Y. W., & Lin, Z. (2021). Burnout amongst emergency healthcare workers during the COVID-19 pandemic: A multi-center study. *The American Journal of Emergency Medicine*, 46, 700. [10.1016/j.ajem.2020.10.040](https://doi.org/10.1016/j.ajem.2020.10.040)
- Colaneri, M., Seminari, E., Novati, S., Asperges, E., Biscarini, S., Piralla, A., Percivalle, E., Cassaniti, I., Baldanti, F., & Bruno, R. (2020). Severe acute respiratory syndrome coronavirus 2 RNA contamination of inanimate surfaces and virus viability in a health care emergency unit. *Clinical Microbiology and Infection*, 26(8), 1094-e1. <https://doi.org/10.1016/j.cmi.2020.05.009>
- di Monte, C., Monaco, S., Mariani, R., & di Trani, M. (2020). From resilience to burnout: psychological features of Italian general practitioners during COVID-19 emergency. *Frontiers in Psychology*, 2476. <https://doi.org/10.3389/fpsyg.2020.567201>
- Hamid, M., Tavakkoli-Moghaddam, R., Golpaygani, F., & Vahedi-Nouri, B. (2020). *A multi-objective model for a nurse scheduling problem by emphasizing human factors*. Proceedings of the Institution of Mechanical Engineers, Part H: Journal of Engineering in Medicine, 234(2), 179–199. <https://doi.org/10.1177/0954411919889560>
- Havaei, F., & MacPhee, M. (2020). The impact of heavy nurse workload and patient/family complaints on workplace violence: An application of human factors framework. *Nursing Open*, 7(3), 731–741. <https://doi.org/10.1002/nop2.444>
- Hussein, A., Elsayah, S., & Abbass, H. A. (2020). The reliability and transparency bases of trust in human-swarm interaction: principles and implications. *Ergonomics*, 63(9), 1116–1132. <https://doi.org/10.1080/00140139.2020.1764112>
- Ilpaj, S. M., & Nurwati, N. (2020). Analisis pengaruh tingkat kematian akibat COVID-19 terhadap kesehatan mental masyarakat di Indonesia. *Focus: Jurnal Pekerjaan Sosial*, 3(1), 16–28. <https://journal.unpad.ac.id/focus/article/view/28123>
- Iswanto, A. H. (2020). Innovative work shift for health workers in the health service providers in handling COVID-19 cases. *Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal)*. <https://www.journal.fkm.ui.ac.id/kesmas/article/view/3949>
- Kim, J.-H., Kim, A.-R., Kim, M.-G., Kim, C.-H., Lee, K.-H., Park, D., & Hwang, J.-M. (2020). Burnout syndrome and work-related stress in physical and occupational therapists working in different

-
- types of hospitals: which group is the most vulnerable? *International Journal of Environmental Research and Public Health*, 17(14), 5001. <https://doi.org/10.3390/ijerph17145001>
- Manzano García, G., & Ayala Calvo, J. C. (2021). The threat of COVID-19 and its influence on nursing staff burnout. *Journal of Advanced Nursing*, 77(2), 832–844. *Journal of Advanced Nursing*. <https://doi.org/10.1111/jan.14642>
- Martínez-López, J. Á., Lázaro-Pérez, C., Gómez-Galán, J., & Fernández-Martínez, M. del M. (2020). Psychological impact of COVID-19 emergency on health professionals: Burnout incidence at the most critical period in Spain. *Journal of Clinical Medicine*, 9(9), 3029. <https://doi.org/10.3390/jcm9093029>
- Suhartono, S., Munir, M., Utami, A. P., & Widyaningsih, I. N. (2021). Community Perception on Covid-19 Vaccination in Sidomukti Village Tuban Indonesia. *Indonesian Journal of Community Health Nursing*, 6(2), 58–63. <http://dx.doi.org/10.20473/ijchn.v6i2.30185>
- Sunjaya, D. K., Herawati, D. M. D., & Siregar, A. Y. M. (2021). Depressive, anxiety, and burnout symptoms on health care personnel at a month after COVID-19 outbreak in Indonesia. *BMC Public Health*, 21(1), 1–8. <https://doi.org/10.1186/s12889-021-10299-6>