



## Systematic Review

**A Clinical Decision Support System as a Tool to Improve the Accuracy of Nursing Diagnoses****Wikan Purwihantoro Sudarmaji, Sholihin Sholihin, Roby Aji Permana, Agustina Soares, and Yanuar Aga Nugraha**

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**ABSTRACT**

**Introduction:** Nursing diagnosis is an important part of the nursing process and it influences the quality of nursing care. Accuracy in establishing nursing diagnoses is one of the factors that determines the accuracy of the nursing intervention program and the speed of healing of the patients. The Clinical Decision Support System is an information system built to assist health workers in making clinical decisions including the enforcement of nursing diagnoses. Through this systematic review, the author wants to explain the clinical decision support system as a tool to increase the accuracy of the enforcement of nursing diagnoses.

**Methods:** The search for journals using the PICOT framework was conducted in the Scopus, Proquest, PubMed and Cinahl databases with a 10-year publication time limit (2008 - 2018). There were 8 international journals reviewed in full.

**Results:** Generally the journals reviewed stated that the use of the Clinical Decision Support System in establishing nursing diagnoses has been shown to improve the accuracy of nursing diagnoses.

**Conclusion:** This systematic review concludes that the use of clinical decision support systems can help nurses or nursing students in establishing accurate nursing diagnoses.

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**INTRODUCTION**

Nursing documentation is one of the factors that affects patient safety. The lack of standardized nursing language use in nursing documentation can pose a risk to the patients. The nursing process includes nursing studies, the enforcement of nursing diagnoses, the selection of nursing interventions and the determination of the results to be achieved based on scientific-based nursing classifications (Müller-Staub, 2016). Professional standards, service standards, standard operational procedures and codes of ethics are references that can be used as a basis for implementing nursing practices such as the process of nursing diagnoses enforcement.

To achieve effective and high-quality nursing practice, terminology and its definitions should be based on a standard used to formulate nursing

problems to determine the appropriate nursing interventions and to evaluate the results of nursing care as needed (Mynaříková & Žiaková, 2014). Nursing diagnoses is the result of a human's interpretation related to health in establishing nursing diagnoses; clinical decision making based on the data sourced from the patients with a low risk of mistaken accuracy in the diagnoses is needed (Jensen, Silveira, Ortega, & de Moraes Lopes, 2012). The accuracy of the nursing diagnoses is an assessment of the relevance level, specificity, signs, symptoms and manifestations that appear in the patients (de Oliveira Azevedo Matos & de Almeida Lopes Monteiro da Cruz, 2009). To improve the accuracy of the diagnoses, identifying the correct signs and symptoms, the etiology of the disease and the patient's actual condition is necessary.

The confirmation of all diagnoses found is important for identifying and obtaining optimal nursing interventions (Jensen et al., 2012). The Clinical Decision Support System is a system that assists doctors in developing clinical services by increasing practitioner compliance in implementing practices that are in accordance with the standardized clinical guidelines (Ahamed et al., 2016). Vetter 2012 in his article stated that the clinical data included in the Clinical Decision Support System (CDSS) can be used as information sources for managing patients, as a new knowledge source that can be utilized in research and treatment and as a support for enforcing diagnoses (Vetter, 2015).

CDSS is designed to assist clinical decision making. CDSS uses the characteristics of each patient to produce patient-specific recommendations. CDSS involves embedded base knowledge that contains boundaries and logical statements that summarizes knowledge based on the particular needs of clinical decision making, so it can produce specific recommendations which are in accordance with the characteristics of each patient (Lee, 2013). The purpose of this study is to explain the correlation between using a clinical decision support system as a tool with increasing the accuracy of nursing diagnoses.

## MATERIALS AND METHODS

### Research design

This study used a systematic review design with a question-based search: "What is the correlation between using a clinical decision support system as a tool with increasing the accuracy of the enforcement of nursing diagnoses?"

### Search strategy

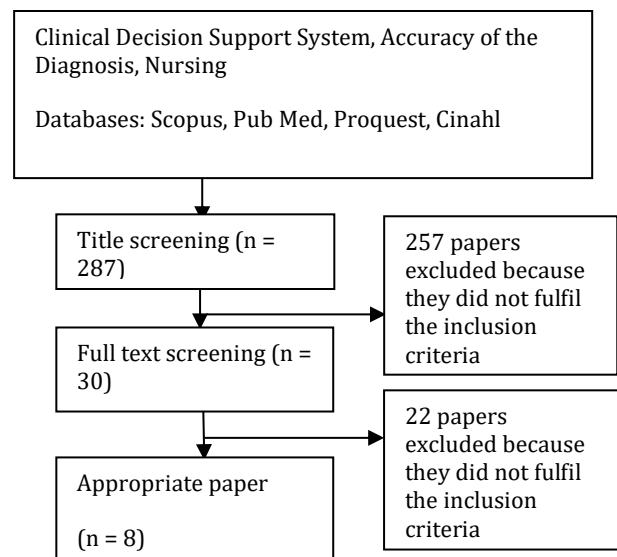
The PICOT framework was used for searching for the articles which were in accordance with the theme of the systematic reviews. The PICOT framework could be described as follows: Population: Nursing; Intervention: Clinical Decision Support System; Control: -; Outcome: Accuracy of Nursing Diagnoses; Time: 2008 - 2018, using the keywords "clinical decision support system", "accuracy diagnosis" and "nursing".

### Inclusion and exclusion criteria

The inclusion criteria in this review covered both experimental studies and non-experimental studies published between 2008 and 2018 where the participants were in nursing, where the language used was English and that focused on clinical decision support system and accuracy in the nursing diagnosis. The exclusion criteria were studies that did not involve a clinical decision support system and that did not have information on the accuracy of the nursing diagnosis.

### Article searching process

The search for the articles used the keywords 'Clinical Decision Support System', 'accuracy diagnoses' and 'nursing' in accordance with the PICOT method that has been determined. The search also used the



Boolean logic search method in the SCOPUS, ProQuest, PubMed and CINAHL databases with a time

Figure 1. Flowchart of the research on clinical decision support systems, accuracy of diagnosis and nursing

limitation of between 2008 and 2018 for the year of publication. In the search process, 287 articles were found and 8 articles were in accordance with the inclusion criteria to be explored further.

## RESULTS

Eight international journals that were in accordance with the systematic theme of the review were found and further examined by the authors. From the 8 international journals, the research design was obtained: 2 journals used a randomized control trial design, 1 journal used a pre-experimental design, 1 journal used a cross-sectional descriptive study, 1 journal used a cross-sectional quantitative study, 1 journal used a case study design, 1 journal used a randomized cross-over trial design and 1 journal did not mention the research design used.

The research conducted by Chunmei, Hualing and Haihua 2018 showed that there was a significant increase in the accuracy of the nursing diagnoses after using the Clinical Decision Support System (CDSS) based on structured EMR (electronic Medical Record). The data was taken from 300 medical records before using Nursing CDSS and 300 medical records after using Nursing CDSS (Chunmei, Hualing, & Haihua, 2018). The research conducted by Aziz, Hidayat and Uliyah 2018 showed that there was no difference between all of the nursing diagnoses enforced by expert systems and all of the diagnoses enforced by the expert nurses.

This study took 30 pediatric patients as the respondents with medical diagnoses of bronchopneumonia, bronchitis, typhoid fever, fever, gastroenteritis, upper respiratory infections, febrile seizures and morbillie. The developed expert system was able to identify the 58 nursing diagnoses that

Table 1. Comparison of the degree of accuracy of the nursing diagnoses indicated by the nursing students in the PROCEnf-USP® and paper-based systems (n=17)

Degree of accuracy of the nursing diagnoses	Paper-based		PROCEnf-USP®		p-value
	Med	(Min-Max)	Med	(Min-Max)	
Null Accuracy	1.5	(1.0-5.0)	1.5	(1.0-4.0)	0.916
Low Accuracy	0	(0-0)	0	(0-0)	-
Moderate Accuracy	1.0	(0-4.0)	2.0	(0-4.0)	0.361
High Accuracy	1.0	(0-4.0)	3.0	(0-4.0)	0.013

were enforced. The diagnoses enforced by the expert systems were compared with the diagnoses enforced by the expert nurses for the same patients and the results showed a 100% similarity in the nursing diagnoses (Aziz, Hidayat, & Uliyah, 2018). Peres 2016 conducted a cross-sectional descriptive study with 17 nursing students in the seventh semester as the respondents.

All of the respondents were asked to make diagnoses using a paper-based record and the PROCEnf-USP® software. The Scale for the Accuracy of Nursing Diagnoses (SAND) version 2 was used as the instrument to assess the accuracy of the diagnoses made. According to the Wilcoxon test, there were no statistical differences found in determining high accuracy diagnoses ( $p = 0.013$ ). The following table showed the differences in the nursing diagnoses accuracy by the nursing students when using PROCEnf-USP® and the paper-based system ( $n = 17$ ) (Peres, 2016).

Zega, Agostino and Bowles 2014 used 2 stages in developing the Nursing Assessment Form (NAF). The first stage of NAF was developed by 4 expert nurses by identifying the structure, content and links and the second stage of the NAF was validated by a panel of 11 expert nurses. In conducting the content validation, the experts examined each item proposed in each diagnosis and they evaluated the relevance of the item to the suitability of the diagnostic identification.

The experts used questionnaires with an ordinal rating scale of 4 points (1 = irrelevant items, 2 = little bit relevant items, 3 = fairly relevant items, and 4 = very relevant items) to give their responses. On the validity of the NAF items, phase 1 obtained good validity above 80%. The diagnostic validity test showed that 37 of 44 diagnoses were claimed in accordance with a 90% or more level of conformity (Zega, Agostino, & Bowles, 2014). Liao, Hsu and Chu 2015 carried out the research by examining 216 medical records from 105 patients. They examined the use of artificial intelligence to enforce the nursing diagnoses. A back propagation neural network (BPN) was used in determining the accuracy of the enforced nursing diagnoses.

The BPN estimation model was made for 123 training data sets using the Clementine software and it used 93 patient datasets for testing purposes. The test results using Clementine stated that the accuracy

level was 87.41 percent in predicting nursing diagnoses (Liao, Hsu, & Chu, 2015). The study was conducted by Emille et al 2016 on 56 nursing students by involving 13 expert nurses with clinical and research expertise in each NANDA-I domain. There was no correlation between the academic level and the number of correct answers. This indicated that students may not be exposed to NANDA-I classifications or they are exposed to it but in a shallow manner.

The students were asked to determine the characteristics and the factors related to the case, in addition to establishing nursing diagnoses using the software prototypes. The percentage of correct answers to the related factors was 65.7%, followed by 62.2% for the characteristics limit and 60.5% for the nursing diagnosis (Emille et al., 2016). A randomized crossover trial was conducted by Kurashima et al. 2008 involving 42 nurses as the subjects divided into 2 groups. The first group used a Computer-Aided Nursing (CAN) Diagnosis System in the enforcement of nursing diagnoses and the second group used nursing diagnoses. The determination of the nursing diagnoses accuracy used Lunney's 7-point interval scale.

Statistically, there was no significant difference in the correct answer between the group that used the CAN system and the group that did not use the CAN system ( $p = .341$  in case 1 and  $p = .758$  in case 2). The correct answer for the group that used the CAN system in diagnosing case 1 was 47.6% and it was 42.9% in case 2. The correct answers for the group that did not use the CAN system were 28.6% for case 1 and 52.4% for case 2.

The accuracy of the nursing diagnoses was not significantly different between the group that used the CAN system and those that did not, with  $p = .220$  in case 1 and  $p = .230$  in case 2. The diagnosis accuracy of the CAN system was 3.0 (0.5,3.5) in case 1 and 4.0 (2.0, 3.5) in case 2. The group that did not use CAN system had an accuracy of 2.0 (2.0,5.0) in case 1 and 1.0 (0.0,4.5) in case 2 (Kurashima, Kobayashi, Toyabe, & Akazawa, 2008). Helena et al. 2012 conducted a study using the Fuzzy Cognitive Map (FCM) which was implemented in Microsoft Visual C ++ ® Edition 2005, used in 195 real cases. The diagnosis enforced by the FCM system was compared to the diagnosis enforced by 3 expert nurses. The diagnosis enforced by the FCM system compared with

those established by the expert nurses had very good ( $\kappa = 0.92$ ,  $p < 0.0001$ ) and moderate suitability ( $\kappa = 0.42$ ,  $p < 0.0001$ ) (Helena et al., 2012).

## DISCUSSION

Documentation in the form of electronic medical records can be used for clinical purposes. There are several methods for assessing the quality of the documentation. The development of technology use in health systems changes the way that health workers do documentation, namely by using electronic medical records that might be related to the use of software applications (Nurjannah & Warsini, 2016).

An Expert System is a program that has been used in various health and hospital fields and it is a solution to solve problems in the same way as experts. This is because expert systems adapt human knowledge into the form of software in a computer (Aziz et al., 2018). Chunmei, Hualing and Haihua in 2018 stated in their article that the databases of nursing knowledge related to nursing plans and routines can be used as the basis for making CDSS. There is a decrease in the time required to document nursing, increased nursing diagnoses accuracy and a reduced risk of unexpected events after CDSS use in nursing practices (Chunmei et al., 2018).

The use of CDSS in nursing has become a trend in the development of information systems in hospitals. The assessment of patient problems is a dynamic process, and a useful digital instrument for managing clinical data was found and it is growing. However, the specific skills needed to perform diagnostic reasoning cannot be replaced by CDSS (Zega et al., 2014). Cognitive skills such as clinical reasoning, problem solving and decision making in nursing could be improved by using the Decision Support System in nursing education. Based on the analysis of the diagnostic accuracy, students who used the PROCEnf-USP® software were better at determining the nursing diagnoses with high accuracy than the students who enforced the nursing diagnoses by manual or paper-based methods (Peres, 2016).

Expert systems were built by facilitating the application of theory to the practical level and with a high accuracy to enforce diagnoses. Some of the steps of the expert systems application include first entering the medical diagnosis that is appropriate for the patient's condition. This is used to generate the focus questions related to the diagnosis. Second, the nurse should enter the signs, symptoms and risk factors experienced by the patient based on the physical assessment, laboratory test results and the interview with the patients. Third, there is the search for diagnosis types related to the symptoms and risk factors, calculating the number of minimal signs and symptoms found in the patients according to the number of minimal signs and symptoms needed to establish the diagnosis (Aziz et al., 2018).

The use of CAN systems could reduce the time needed to enforce nursing diagnoses without

reducing their accuracy. This efficiency was obtained from the computerized diagnostic nursing processes (Kurashima et al., 2008).

The nursing information system application is developing toward something that can be used as a support in clinical decision making. The use of clinical decision support systems can support the nurse practitioners and nursing students in enforcing nursing diagnoses. The use of clinical decision support systems can make the time needed by the nurses to enforce nursing diagnoses more efficient, so the nurses have more time to do other work. The increased accuracy of diagnoses from CDSS use has an impact on the selection of more appropriate interventions (Kurashima et al., 2008). The nurses' ability to make clinical decisions, prevent mistakes, improve care quality, increase accuracy in nursing diagnoses and the achievement of predetermined nursing care can be improved by CDSS in the context of providing care to the patients (Mary Jo Vetter, DNP, RN, 2015) (Chunmei et al., 2018).

## CONCLUSION

Patient care safety is influenced by several factors, one of which is nursing documentation. Nursing documentation, including nursing diagnoses which do not meet the standards, will cause the treatment outcome targets that have been set to not be achieved. The use of CDSS in nursing practices can improve the quality of nursing care. This system can facilitate the nurses in analyzing the clinical data sourced from the patients and it can help to validate the accuracy of nursing diagnoses effectively and efficiently. High diagnostic accuracy will improve the suitability of nursing action selection based on the patient's needs. The treatment outcome targets can therefore be achieved more optimally.

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