

Comparing Methods of Diagnostic Reasoning in Nursing

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Abstract- Background. Several methods of diagnostic reasoning have been explained in the literature, but there has been no research to date comparing one method of diagnostic reasoning to another.

Aims. This study aimed to identify differences between the 4 steps method and the 6 steps method of diagnostic reasoning in terms of what the possible diagnoses based on scenario provided and in terms of ease of use, effectiveness, usefulness and the possibility of implementation in a clinical setting.

Method. Forty four participants, including nurse practitioners and academics participated in this study. All participants were attending a diagnostic reasoning workshop. Participants were taught the 4 steps method and the 6 steps method of formulating a nursing diagnosis. Using three scenarios participants identified possible diagnoses using each method, which were then compared. The participants were subsequently given a questionnaire with Likert scale. Statistical analysis with a Wilcoxon signed-rank test was performed using SPSS version 20.

Result. Results of this study showed that the 6 step method of diagnostic reasoning can identify more possible plausible diagnoses and differential diagnoses (DDx) than the 4 step method can. The 6 steps method of diagnostic reasoning also reduced the possibility of identifying inaccurate nursing diagnoses. The 6 steps method was considered easier to use, more effective, more useful and more likely to be implemented in a clinical setting than the 4 steps method ($p < 0.001$).

Key words: *method, diagnostic reasoning, nursing*

I. INTRODUCTION

The nursing process is a framework and a frame of thinking for the nursing profession. Originally, Yura and Walsh (1) divided the nursing process into assessing, planning, implementing and evaluating while Carpenito (2) considered the nursing process to consist of assessment, problem identification, planning, intervention and evaluation. In today's clinical environment Wilkinson's (3) definition of the nursing process as a cyclical process involving assessment, diagnosis, planning, implementation and evaluation is commonly adopted.

Two important components of the nursing process are assessment and establishing nursing diagnoses. These

components will influence the next steps of the nursing process, which are to plan, implement and evaluate care. The diagnostic process is considered the most critical point that concerns patient safety (4). Carnevali and Durand (5) states that diagnostic errors will lead to wrong, ineffective and damaging intervention.

The process by which a nurse arrives at diagnoses is considered to be complex, and this process is viewed differently by different authors (6). The literature shows that different authors use different terminology to refer to the process of establishing a nursing diagnosis such as diagnostic reasoning, clinical judgment, and clinical decision making (7).

This study uses the term 'diagnostic reasoning' which is considered to be a critical element in the effort to identify problems experienced by a client in nursing practice (8). In the process of diagnostic reasoning in nursing, identifying possible diagnoses is considered to be an important part of the process (9).

In this study diagnostic reasoning is defined as 'a component of clinical decision-making that involves the recognition of cues and the analysis of data in clinical situations' (10). This process of reasoning will result in diagnostic labels which can vary as a function of task complexity (10).

Several authors describe different steps in the process of diagnostic reasoning. Carnevali says it involves seven steps (11), Lunney five steps (12), Wilkinson 4 steps (3) and Nurjannah 6 steps (13).

The 4 steps method of diagnostic reasoning consists of (3):

1. Interpret
 - Level I: Identify significant cues
 - Level II: Cluster cues and identify data
 - Level III: Draw conclusion about present health status
 - Level IV: Determine etiologies and categorize problems
2. Verify
3. Label
4. Record

The 6 steps method of diagnostic reasoning consists of (13):

1. Classify data and use the Intan's Screening Diagnoses Assessment (ISDA) or the book *The Fast Method of Formulating Nursing Diagnoses for Diagnostic reasoning in Nursing* to identify possible nursing diagnoses and collaborative problems
2. Activate possible nursing diagnoses and collaborative problems
3. Read or learn from appropriate references about those possible nursing diagnoses and collaborative problems and determine:

- A. If the diagnoses are confirmed
- B. If the diagnose are ruled out
- C. If more assessment is needed related to those nursing diagnoses and/or collaborative problems
4. Use the poster *The Map of Nursing Diagnoses* for nursing diagnoses which have an 'A' category
5. Continue focused assessment if necessary (for nursing diagnoses and collaborative problems of category A and C) to identify etiology or other defining factors
6. Label the diagnoses.

ISDA is a primary tool in the 6 steps of diagnostic reasoning that helps nurses when assessing their clients by screening all possible nursing diagnoses and collaborative problems. ISDA is based on the understanding that data collected can belong to nursing diagnoses, collaborative problems or both (14).

Nursing diagnoses in ISDA are mostly referred to in the NANDA-I classification. Müller-Staub considered that NANDA-I classification is the best-researched and most widely implemented classification system compared with other four classification systems (ICNP®, ICF, NANDA and ZEPF) (15).

Familiarity with cues (signs and symptoms) is considered to be important in the nurse's effort to generate possible diagnoses. However, nurses may have a problem determining to which diagnoses those cues may belong. In other cases, data may be collected without an initial awareness of possible diagnoses (16). Thus nurses may collect data that has low relevance to possible nursing diagnoses. Previous research reveals that poor accuracy in nursing diagnoses was related to a high amount of low relevance data (16).

Cues however, are not the only way to determine possible nursing diagnoses or collaborative problems. Understanding the definition of diagnoses is considered to be the first step to screen possible nursing diagnoses. This is because the definition of nursing diagnoses can directly lead a nurse to find what cues are important in each diagnosis. An example of this is nursing diagnosis: 'Autonomic Dysreflexia' [14]. This diagnosis is only experienced by a client if the client suffers from a spinal cord injury at T7 or above [17]. Although paroxysmal hypertension is a cue in the defining characteristics of this diagnosis, this cue may not important if the client does not have an injury to their spinal cord at T7 or above. Understanding the definitions of nursing diagnoses was the first step in the design of ISDA. ISDA also considers routine nursing activities such as vital sign measurements as important assessments activities (17). The result of vital sign measurements is the first screening assessment activity in ISDA (14).

Assessment in ISDA is divided into several sequences involving 28 aspects and the first three aspects are considered as three basic assessments including assessment for vital signs, assessment for safety and assessment for specific circumstances. The assessment for vital signs, safety and specific circumstances are located in the first screening because these three sections are considered as a priority related to emergency circumstances to ensure whether a patient is in a crisis circumstance or not (14). A sample of ISDA can be accessed from the web (14).

Several methods of diagnostic reasoning have been explained in the literature, but there has been no research to date comparing one method of diagnostic reasoning to another. This study aimed to identify differences between the 4 steps method and the 6 steps method of diagnostic reasoning using comparative analysis.

This research was conducted outside a clinical setting which will allow better standardization, and to improve efficiency, to have broader variety of clinical pathologies and to improve reliability over clinically based assessments (18).

II. METHODOLOGY

A. Design

This is a quasi-experimental post-test only research design. All participants were attendees of the diagnostic reasoning workshop on 25 November 2012 in Jakarta Indonesia. The study was approved by the Research Ethic Board Faculty of Medicine Gadjah Mada University, Yogyakarta, Indonesia and each participant provided signed informed consent.

B. Sample

Forty four participants, consisting of nurse practitioners and academics participated in this research study. The total number of attendees of the workshop was 53. Participants comprised 43 females and one male with a mean age of 34 years. The average working experience was 11.6 years. The participants' highest educations were 13 masters, 26 out of 28 undergraduates participants currently studying master degree, 2 three-year diplomas and one diploma-IV (another year of education in addition to three-year diploma in nursing). 22 participants come from maternity-pediatric nursing, 18 participants work experience in medical surgical nursing, 3 participants work experience in community nursing and one participant did not mention her work experience.

C. Procedure

In the workshop, the researcher explained about the nursing process and the two models of diagnostic reasoning which are the 4 step model (3) and the 6 step model (13). In this section, the researcher showed how to use the 4 step method of diagnostic reasoning using Scenario A. Participants were divided into several groups (10-15 persons) for a guided application exercise. After this exercise researcher showed how to use the 6 step method of diagnostic reasoning using Scenario B. Following this, participants undertook a second guided application exercise. Each guided application exercise was facilitated by trained research assistants.

After the explanation session, the researcher distributed scenario C, D, E and asked participant to choose and work only one scenario using both the 4 step and the 6 step method of diagnostic reasoning. During this process, participants identified possible nursing diagnoses and collaborative problems based on the scenario they have chosen and wrote the result using instrument data collection I for the 4 step method of diagnostic reasoning and instrument data collection II for the 6 step method of diagnostic reasoning. This activity was conducted over two hours.

In both the 4 step and 6 step methods of diagnostic reasoning, participants were provided with NANDA-I (North American Nursing Diagnosis Association) taxonomy and list of collaborative problems as a reference.

Seventeen participants chose to work on scenario C, 15 participants chose to work on scenario D and 11 participants chose to work on scenario E. Facilitators only helped in the process of distributing the scenario and references. There was a presentation session by participant groups after these activities. The researcher explained and discussed the answer for Scenario C, D and E in the last session of workshop. At the end of the session, participants were given a questionnaire with Likert scale (instrument data collection III).

D. Instrument

Since the participants came from different fields of nursing, scenarios were created considering the difficulties this might present. As a result three scenarios were created. Case studies are considered to be a power tool to foster nurses' expertise (19). Scenario C focused on pediatric, while scenario D emphasized medical surgical nursing and the last scenario (scenario E) focused on community nursing. All significant data were written in bold and underlined to make sure all participants worked with the same data for each diagnostic reasoning method. The scenarios include content specificity which is related to signs and symptoms and also context specificity, for example the setting of case is different among scenarios (20).

Scenario and data collection instrument (I, II and III) were in English. The information sheet and informed consent were professionally translated to Indonesian and certified.

Scenario C:

Infant was born **prematurely (30 weeks)** with **1300 gr birth weight** and length **40 cm**, infant suffer from congenital problem: **Hirschsprung's Disease**. Infant's skin is **yellow, bilirubin > 2mg/dl**. Infant **startle** easily, shows **irritability** and shows **uncoordinated movement**.

Hirschsprung's Disease as a medical diagnoses was included in the scenario C because nurses often monitor patient medical condition in a clinical setting (21).

Scenario D

A 54-year-old man with **postoperative thorax surgery**. He has got **tube feeding (NGT)** and is experiencing increasing **shortness of breath, extreme weight gain**. He needs helps for **bathing, dressing and toileting**.

Scenario E

Newspaper shows increases number of **marital problems/marital conflicts** in a specific community. The number of **vandalism, terrorism, unemployment, poverty and divorces cases** also increases in one village.

E. Data Analysis

The results of data collection I and II were compared with the list of diagnoses determined by the researcher based on

NANDA taxonomy (22) and list of collaborative problem (23). There are three categories of diagnoses:

- A "possible diagnosis" related to the context of the scenario is a list consisting of nursing diagnoses and collaborative problems that are considered the most plausible diagnoses related to the context of the scenario.
- A "possible differential diagnosis (DDx)" is a list consisting of nursing diagnoses and collaborative problems (collaborative diagnoses) in which significant data in the scenario belongs to the diagnoses in this list. However, the diagnoses are not considered the most plausible diagnoses related to the context of the scenario.
- A "rule out diagnosis" is a list consisting of nursing diagnoses and collaborative problems that do not belong to the list of possible diagnoses and possible differential diagnoses (DDx) above (inaccurate diagnoses).

Statistical analysis with a Wilcoxon signed-rank test was performed using SPSS version 20 for data collection III.

III. RESULT

Results from the analysis shows different possible diagnoses when participants use the 4 and 6 step methods of diagnostic reasoning on:

- the possible diagnoses related to the context of the scenario
- the possible differential diagnoses (DDx)
- the diagnoses that are ruled out.

A. The "possible diagnosis" related to the context of the scenario

It was found that more possible diagnoses can be identified when participants used the 6 step method than the 4 step method of diagnostic reasoning in all scenarios provided (Scenario C, D and E) as can be seen in Fig. 1.

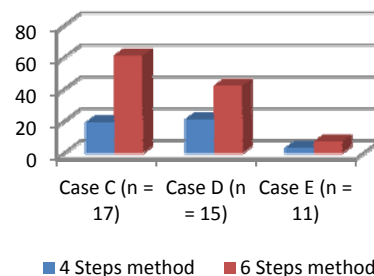


Figure 1. The number of possible diagnoses in relation to the context of the scenario identified using the 4 and 6 steps method of diagnostic reasoning

The details of possible diagnoses that can be identified using the 4 and 6 steps method can be seen in the Fig. 2 (scenario C) and Fig. 3 (scenario D and E).

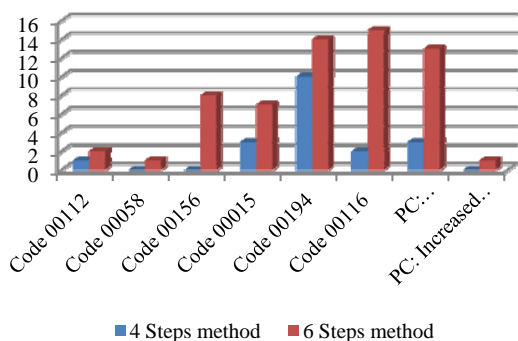


Figure 2. Frequency of possible diagnoses can be identified using the 4 steps and 6 steps methods for scenario C.

The possible diagnoses related to the context of the scenario C are:

- Code 00112 : Risk for delayed development
- Code 00058: Risk for impaired attachment
- Code 00156: Risk for sudden infant death syndrome
- Code 00015: Risk for constipation
- Code 00194: Neonatal jaundice
- Code 00116: Disorganized infant behavior
- PC: Hyperbilirubinemia
- PC: Increased intracranial pressure

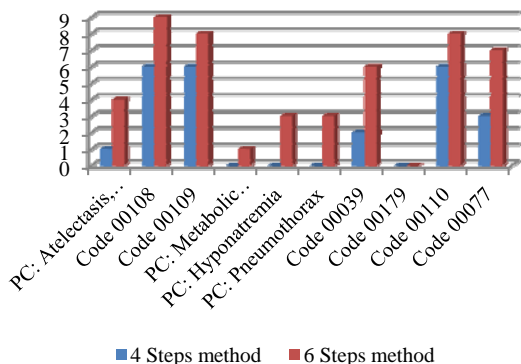


Figure 3. Frequency of possible diagnoses can be identified using the 4 steps and 6 steps methods for scenario D and E.

The possible diagnoses related to the context of the scenario D are:

- PC: Atelectasis pneumonia
- Code 00108: Bathing self-care deficit
- Code 00109: Dressing self-care deficit
- PC: Acidosis metabolic
- PC: Hyponatremia
- PC: Pneumothorax
- Code 00039: Risk for aspiration
- Code 00179: Risk for unstable blood glucose level
- Code 000110: Toileting self-care deficit

The possible diagnosis related to the context of the scenario E is:

- Code 00077: Ineffective community coping

B. The “possible differential diagnosis (DDx)”

This study also shows that participants are able to identify more possible differential diagnoses (DDx) with the use of the 6 step method than the 4 step method (Fig. 4).

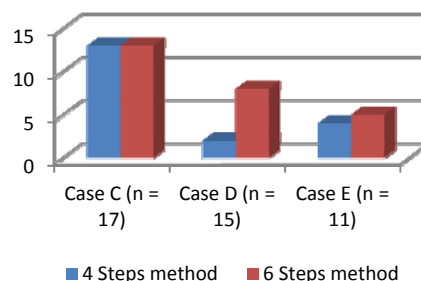


Figure 4. The number of possible differential diagnoses (DDx) can be identified using the 4 and 6 steps method of diagnostic reasoning

The details of possible differential diagnoses (DDx) that can be identified using the 4 and 6 steps method can be seen in table 1 (scenario C), table 2 (Scenario D) and table 3 (Scenario E).

TABLE 1. THE POSSIBLE DIFFERENTIAL DIAGNOSES (DDx) IDENTIFIED USING THE 4 AND 6 STEPS METHOD FOR SCENARIO C

Possible differential diagnoses (DDx) can be identified	
Using the 4 steps method	Using the 6 steps method
Impaired comfort	Impaired comfort
Impaired physical mobility	Impaired physical mobility
Risk for impaired attachment	Risk for impaired attachment
Risk for dysfunctional gastrointestinal motility	Risk for dysfunctional gastrointestinal motility
Risk for imbalanced body temperature	Risk for imbalance body temperature
Risk for neonatal jaundice	Risk for neonatal jaundice
Sleep deprivation	Sleep deprivation
Disturbed energy field	Anxiety
Imbalanced nutrition: Less than body requirements	Risk for infection
Ineffective breastfeeding	Risk for disorganized infant behaviour
Ineffective infant feeding pattern	Risk for disproportionate growth
Risk for deficient fluid volume	Risk for unstable blood glucose
Risk for infection	PC: Preterm labour

TABLE 2. THE POSSIBLE DIFFERENTIAL DIAGNOSES IDENTIFIED USING THE 4 AND 6 STEPS METHOD FOR SCENARIO D

Possible differential diagnoses (DDx) can be identified	
Using the 4 steps method	Using the 6 steps method
Activity intolerance	Activity intolerance
Ineffective breathing pattern	Impaired Gas exchange
	Risk for autonomic dysreflexia
	Risk for bleeding
	Risk for falls
	PC: Dysrhythmias (Post operative status)
	PC: Hypovolemia (post operative status)
	Risk for constipation

TABLE 3. THE POSSIBLE DIFFERENTIAL DIAGNOSES (DDX) IDENTIFIED USING THE 4 AND 6 STEPS METHOD FOR SCENARIO E

Possible differential diagnoses (DDx) can be identified	
Using the 4 steps method	Using the 6 steps method
Anxiety	Dysfunctional family process
Dysfunctional family process	Fear
Interrupted family process	Impaired individual resilience
Parental role conflict	Impaired parenting
	Ineffective role performance
	Parental role conflict
	Readiness for enhanced resilience
	Risk for contamination
	Risk for delay development
	Risk for disproportionate growth
	Risk for impaired parenting
	Risk for self-directed violence
	Risk for self-mutilation
	Risk for suicide
	Sleep deprivation

TABLE 5. INACCURATE DIAGNOSES IDENTIFIED USING THE 4 STEPS METHOD AND 6 STEPS METHOD OF DIAGNOSTIC REASONING FOR SCENARIO D

Inaccurate diagnoses were identified	
Using the 4 steps method	Using the 6 steps method
Excess fluid volume	Anxiety
Imbalance nutrition: less than body requirements	Excess fluid volume
Impaired comfort	Imbalance nutrition: less than body requirements
Impaired physical mobility	Imbalance nutrition: more than body requirements
Impaired skin integrity	Pain
Post operative thorax surgery	PC: Air embolism
Risk for infection	PC: Hypo/hyperglycemia
	PC: Hypermagnesemia
	Risk for activity intolerance
	Risk for disuse syndrome
	Risk for imbalance body temperature
	Risk for infection
	Risk for injury

C. The rule out diagnosis

The result of the study also shows that by using both the 4 and 6 step methods, participants may identify diagnoses that are considered inaccurate and should be ruled out. The use of the 6 steps method, however, resulted in less identification of inaccurate diagnoses than using the 4 steps method, as can be seen in Fig 5.

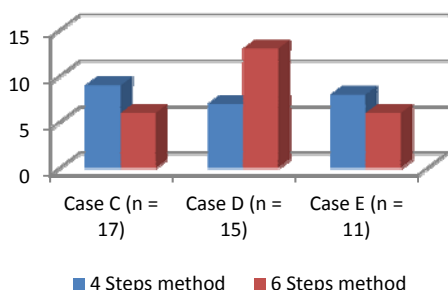


Fig 5. The number of inaccurate diagnoses identified using the 4 and 6 steps method of diagnostic reasoning

The details of inaccurate diagnoses that were identified using the 4 steps method and 6 steps method can be seen in table 4 (scenario C), table 5 (scenario D), and table 6 (scenario E).

TABLE 4. INACCURATE DIAGNOSES IDENTIFIED USING THE 4 STEPS METHOD AND THE 6 STEPS METHOD OF DIAGNOSTIC REASONING FOR SCENARIO C

Inaccurate diagnoses were identified	
Using the 4 steps method	Using the 6 steps method
Disturbed sleep pattern	Disturbed sleep pattern
Dysfunctional gastrointestinal motility	Dysfunctional gastrointestinal motility
Fatigue	Ineffective breathing pattern
Incontinence defecation	Risk for impaired skin integrity
Ineffective thermoregulation	PC: Hypovolemia
Risk for ineffective thermoregulation	PC: Neurologic/sensory)
Risk for electrolyte imbalance	
Risk for injury	
PC: Hepatic dysfunction	

TABLE 6. INACCURATE DIAGNOSES IDENTIFIED USING THE 4 STEPS METHOD AND 6 STEPS METHOD OF DIAGNOSTIC REASONING FOR SCENARIO E

Inaccurate diagnoses were identified	
Using the 4 steps method	Using the 6 steps method
Deficient community health	Grieving
Disturbed sleep pattern	Impaired religiosity
Impaired comfort	Risk for compromised resilience
Situational low self esteem	Risk for other directed violence
Imbalanced nutrition: less than body requirements	Risk for situational low self esteem
Risk for injury	Risk impaired religiosity
Risk for disturbed personal identity	
Risk for others directed violence	

Statistical analysis also shows that Nurjannah’s diagnostic reasoning method was considered easier to use, more effective, more useful and more likely to be implemented in a clinical setting than the Wilkinson’s diagnostic reasoning method (p<0.001).

IV. DISCUSSION

The results show that participants are able to identify more possible diagnoses related to context when they use the 6 step method as compared to the 4 step method of diagnostic reasoning.

A possible explanation of why the 6 step method can identify more possible diagnoses is that the ISDA (Intan’s Screening Diagnoses Assessment), the primary instrument in the 6 steps method, is designed to systematically access information about diagnoses easily and quickly. Marian (24) found that a lack of systematic data collection will influence the process of diagnostic reasoning. Each symptom may open up a multiple of possible diagnoses (26) and the human brain has a difficulty to consider each possibility without any tools that can help this process.

Lunney [10] argues that the possible knowledge of diagnoses, definitions, and defining factors is vast and complex and that these results in nurses being unable to remember all of the information required for an accurate nursing diagnosis. Lunney (12) also encourages nurses to know how to access

information to assist in this task since locating the relevant information is an important step in determining an accurate diagnosis (25).

ISDA also helps to overcome the limitations of the human brain in information processing by providing the most relevant data needed in each possible diagnosis. Recognizing a cue which is called 'cue acquisition' (27) or 'noticing' (28) is a fundamental basis of clinical reasoning. Research conducted by Coiera (29) found that evidence retrieval systems will help clinicians to find correct answers and help to reduce the amount of time needed to find information. ISDA is another form of retrieval system which may also have a similar impact on the usage evidence retrieval system in the diagnostic reasoning process.

According to Bordage and Zacks (30), the large amount of knowledge and also the superior organization of knowledge and the ability to quickly locate relevant knowledge are characteristic of expert clinicians which relate to the accuracy of diagnostic reasoning. In this study, ISDA can help to attain this ability as it consists of systematic and relevant information and cues which are easily located. Other studies found that the lack of exposure to the tools needed in clinical reasoning will influence the process of diagnostic reasoning (25).

The complexity of the healthcare arena precludes reliance on memory as a sole resource for problem-solving because it can be unreliable (25). Kuiper (25) examines the benefits of the PDA (Personal Digital Assistant) in the thinking process and clinical reasoning for problem-solving and decision-making. This research, however, only examines the benefits of the PDA and does not scrutinize whether the PDA can help to determine diagnoses accurately or not.

Nursing handbooks might also be considered knowledge stimulants with knowledge presented having a positive effect on the diagnostic process (31). In this study, the same handbooks which are NANDA-I taxonomies and list of collaborative problems are used in both of the diagnostic reasoning methods. Handbooks are therefore considered as one of source of knowledge that will guide nurses to accurate documentation of nursing diagnosis (32). Findings from this study show that although a handbook is important in the diagnostic reasoning process, there are still difficulties in finding relevant information and it is clear that ISDA can help to reduce these issues. In addition, Hasegawa (33) stated that knowledge of the definitions and defining characteristics of the diagnoses are required to use diagnostic labels available in books and electronic systems. The usage hand book in this study is considered as a way to obtain knowledge (34). This study however shows that without knowledge or tools such ISDA, the usage of handbook may not be effective.

Although ISDA is aimed at helping nurses to assess clients in order to screen possible nursing diagnoses and possible collaborative problems, nurses need to remember that ISDA is not aimed at exactly determining which nurse diagnoses or collaborative problems are actual or potential. The tool is only designed to help in identifying possible nursing diagnoses and collaborative problems and nurses need to continue to the next step of ruling out or confirming nursing diagnoses and collaborative problems by using relevant literature such as the NANDA-I taxonomy (14).

Besides the ability to help participants identify the possible diagnoses related to the context of the scenario, the 6 step method can also help participants identify and differentiate between the plausible diagnoses (DDx). Westfall (9) said that the ability to identify the differential diagnoses (DDx) is an important process in diagnostic reasoning.

It can be seen in Table 2 that when participants use the 4 step method, they are unable to identify collaborative problems. This is due to the fact that the information related to the collaborative problems is massive and finding possible collaborative problems can be tedious and time-consuming.

Thompson (35) also found that computing and assigning probabilities to options have not been part of traditional education of nurses which has led to the limitation of alternatives chosen by nurses.

The implication from this finding is that if there are no obvious possible differential diagnoses (DDx), nurses will not search out other data in order to confirm or rule out differential diagnoses related to collaborative problems (DDx). The identification of collaborative problems is important as nurses need to make accurate and appropriate clinical decisions regarding pathophysiological changes in the client's health status (36). Lee (21) states that nurses often need to monitor the medical condition of a patient in clinical setting.

In Scenario E (Table 3) it can be seen that participants can identify more differential diagnoses (DDx) when using the 6 step method than the 4 step method. It is because the data in Scenario E actually includes more possible differential diagnoses (DDx) if it used to assess individuals or families. The context of the scenario however, refers to large-scale community issues rather than individual or family issues. In the process of diagnostic reasoning using the 6 step method, participants mostly adopted The Fast Method of Formulating Nursing Diagnoses for Diagnostic Reasoning in Nursing (37)] to track the possible diagnoses in Scenario E.

It is assumed that the process of diagnostic reasoning for Scenario E was more difficult since most participants had work experience in hospital settings and only three participants had worked in community settings. This result is due to the fact that nurses' specialization influences the choice of information in making a diagnosis (38). In this study however, even though only some of the participants work in community settings and they were not familiar with the scenario provided, they were still able to identify more differential diagnoses (DDx) using the 6 step method rather than 4 step method.

Using both the 4 step method and the 6 step method also resulted in the identification of diagnoses which were considered inaccurate and needed to be ruled out. Less accurate diagnoses were identified when the participant used the 4 step method rather than the 6 step method. It was only in Scenario D that this result was reversed (Table 5). This may be due to the greater use of intuition than the tools as most of the participants seemed familiar with the data and they may have used intuition with more confidence in order to determine the possible diagnoses without even looking at the handbooks in more detail.

This result is supported by research in which expert nurses were found to use intuitive decision-making strategies in two other studies (39)(40). Another study that supports this supposition was conducted by King (8) in Kentucky on 164

nurse practitioners and 65 students. King (8) found that nurses' diagnostic reasoning abilities increased in line with age and experience but decreased as a result of greater acknowledged use of intuition. One study conducted by Yang et al, (41) found that nurses sometimes are overconfident regarding the accuracy of their judgment and this can lead to diagnostic errors.

Another cause of judgment error of diagnosis is the incorrect usage of heuristic strategies (42). Heuristics are defined as "rules of thumb" or mental shortcuts designed to make a decision (4). Heuristic strategy are mostly used in uncertain situations. Cioffi (42) and Hasegawa (33) state that heuristic strategy has a high risk for making errors as not all available information is considered (43).

The result of quantitative data also confirms that the 6 steps method was considered easier to use, more effective, more useful and more likely to be implemented in a clinical setting than the 4 steps method ($p < 0.001$).

The possible explanation that the 6 levels methods was considered easier to use maybe because the signs and symptoms can be located more easily in ISDA. The 6 levels are also considered more effective because this method does not need to use clustering in the process of diagnostic reasoning while the 4 levels have a step for clustering data. Clustering data is tricky and because there is no guideline how to cluster, this process can be considered as difficult. The capacity to cluster cues is more highly affected by experience than by knowledge (5).

ISDA is also considered as a tool that can effectively support in the diagnostic reasoning as Paans (44) found that the use of computer generated standardization to help nurses in the diagnostic reasoning process.

V. CONCLUSION

This study shows that the 6 step method of diagnostic reasoning can identify more possible plausible diagnoses and differential diagnoses (DDx) than the 4 step method can. The 6 step method of diagnostic reasoning also reduces the possibility to identify inaccurate diagnoses. The 6 step method also considered as easier, more efficient, useful and likely to be implemented in clinical setting than the 4 step method. ISDA as a primary tool in the 6 step method can be considered an appropriate tool to help nurses in the process of diagnostic reasoning. To further explore its usefulness in a clinical setting and to possibly refine and expand on the tool itself, further investigation of the ISDA in a clinical setting is being conducted this year in Indonesia.

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