Computer–based Medical Group Decision Support for Stroke Patients

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Abstract—A patient having a certain disease will have a medical record for disease to support the doctors. For stroke disease, a patient will get treatment referring to the governance according to the disease record for supporting proper action for the patient. This disease needs a extra high careful in handling since it has connection with neuron structure which is vulnerable on every part of human organs. In this research, a model for governance medicalto support group decision on stroke was developed. System model used for this system is the governance for neurologist disease, lung disease, heart disease, neuro disease, internal disease, and endocrine disease. This system is designed for specialist doctors and p for paramedics involved in this Group Decision Support System (GDSS). The database for the system is centralised so that if an involving doctor is not available, the system will provide a solution for the existing.

Keywords: Group Decision Support Systems, Medical Group Decision Support, Stroke, governance

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1 INTRODUCTION

A governant can be considered as a medical rule based that can be used on the result of stroke diseade. This can affect on the weight setting for each doctor in the decision making. The problem with handling stroke patient can be very complex, therefore, we need some theories such as Group Decision Support System (GDSS) for determining proper handling based on the patient's conditions. In order to decide medical treatment, opnions from various specialist doctors are needed. [1] - [4]. Stroke patient handling will involve some doctors to make a proper group decision making, based on the patient's conditions or criteria in handling disease of every decision makers. In general, specialist doctors in stroke, pulmonologist, internist, blood, and cardiologist, have different opnions and criteria, or even the same in evaluating treatment in handling stroke patients.In this case, the doctors stick on the medical rule base, that is the governance. [5].

An involvement the group of doctors is necessary whenever a complication happens on stroke patients, especially for common treatment. The conditions of stroke patient can be varirous, suc as on the complication of their disease. Solving the problem of handling treatment for stroke patients involving a group of governants becomes doctor's consideration in handling stroke disease[6]. Based on WHO data, stroke is the number 3 deadly disease after cardiologist, and even Indonesia has 500.000 stroke patients every year [7]. With that condition, it is necessary to have common decision in handling stroke patients so that group governance will be able to help faster decision in handling stroke patients.

In the complication problem of stroke sufferer, it affects the patient's condition that can suddenly change and can lowering patient's immunes, so that it requires careful treatment. Complications on stroke sufferer require some specialist doctors to handle, such as cardiologist, pulmonologist, blood, internist, and neurological surgeon. By involving those specialist doc-

tors, the governance group decision plays an important role in handling patients [8].

In order to handle stroke patients, it requires a development of a model of a group decison support system on the governance in diagnosing disease involving the principles of the medical rule base, i.e. the governance to have common decision [9]. This system will be able to help doctors in making proper decision, so that it needs a tool of group medical governance models in handling stroke patients [10].

The use of this group medical governance model is needed for handling problem on stroke patient involving some specialist doctors in group decision making. Some metods of group decision support systems (GDSS) on medics have been applied on drug medication [11], nutrient intake for gerriatry patients [12]. This system is required for the use of GDSS on medics, especially in handling stroke patients involvinga group of specialist doctors in decision making. The concept of Group Decision Support Systems is shown in Figure 1.

The purpose of this research is to popose a model by applying group models. This research began with a literature review using a model of medical governance group in handling stroke patient to help doctors in decision making. This model is expected to assist in giving an assesment of criteria and weighting of each specialist doctors based on the patient's condition in group decision making, known as GDSS.

2 GROUP DECISION: OVERVIEW AND TAXONOMY

2.1 Group Decision Support Systems

A group decision support system (GDSS) is a combination of hardware and software to improve workgroup performance [13]. A group decision support system (GDSS) is a common term consisting of all forms of collaborative computation. A group decision support system (GDSS) is a computer based

system to support a group of people involved in some common tasks, and to provide in interface for an environment for common use [14].
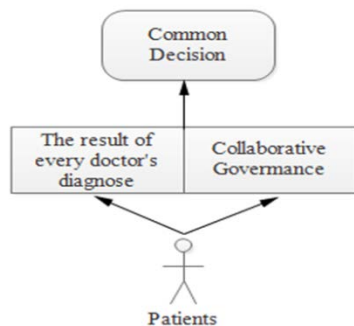

Figure 1.

Common Decision

The difference between group decision support system (GDSS) and decision support systems (DSS) is its focus on decision making by group or by indivual. Basically, the components of group decision support system (GDSS) are the same as DSS in terms of hardware, software, and humans, but for decision support system (DSS), in addition for decision support system (DSS), there are collaborative environment, communication, and network technology for handling participants from different places. There are three types of basic GDSS components:

- Software, consists of database and management database, user interface especially to support many users, applications specific for facilitating atvities for decision making group, and ability to model

- Hardware, consists of input output devices, PC or *workstation*, monitor for each decision making participant or public screen for the group, network for communication

- Human, consists of decision makers and facilitator, where facilitator is a person directing participants through planning process [15].

The main component of the DSS in medics is methods on Clinical Decision Support Systems (CDSS) including statistical methods, neural network, knowledge based methods, fuzzy logic rule based methods, genetic algorithm, etc. The selection of the methods depends on the domain, solutions, the number of data needed for the decision making [10]-[11].

In some cases, such as diagnosing disease, the CDSS method is commonly used in DSS for clinics and hospitals. Computers possess clinical knowledge about the tasks specifically defined or even can work with basic case reasoning.

2.2 Formalization Decision

Conceptually, a group decision can be used to solve the problem of handling treatment on stroke patients in connection with medical governance rule based with the possibility of the existance of discrepancy in handling so that it requires some doctors to handle stroke patients and doctors [1]. Doctor involvement is necessary in order to combine governance from every specialist doctor, to get the discrepenacy information for handling treatment on stroke patients [2]. In this group medi-

cal decision, it is not the same as group decision support system (GDSS) other than medics sincee they focus on financial aspects [13], in this cases, there are no powernship role nor controling on a decision maker, but on the condition of stroke patients by holding on rile based for medical guidance diagnostic governance [14]. The main idea is to combine the governance of every doctor to give a policy for group decision makers.

2.3 Taxonomy Decision

Decision is categorised on individual decision becoming group decision. The discussion will be based on group or collective decision. Therefore, the taxonomy of group decision on the governance becomes very important. To simplify, it will be referred to every decision discussion in this paper. A decision basically can be considered as (1) individual decision, (2) group decision (conditionally) [7].The proposed method in this research is based on the Simple Additive Weighting (SAW) method with the basic concept of finding the sum of performance rating of each alternative on all attributes. The method obligues the decision makers to provide weight on every attribute. Total score of each alternative is obtained from adding of all multiplication between rating and the weight of every attribute [2]. Methode model can be changed according to the real data to be obtained.

3 MODELS OF GOVERNANCE GROUP DECISION

The result of grovernance group decision of doctors is the purpose of the research, and it does not go deeply into the process of diagnosing since it will be very complex in the proposal. There are two parties to be involved: stroke patients, and a group of doctors. The claim is that in the process of rapid handling treatment can be a solution for doctors to make decision. This decision involves the process of medical negotiation on the group of governance, intertreatment on the governance level, and is oriented on the recommendation of group decision. The following is the decision model in Figure 2.
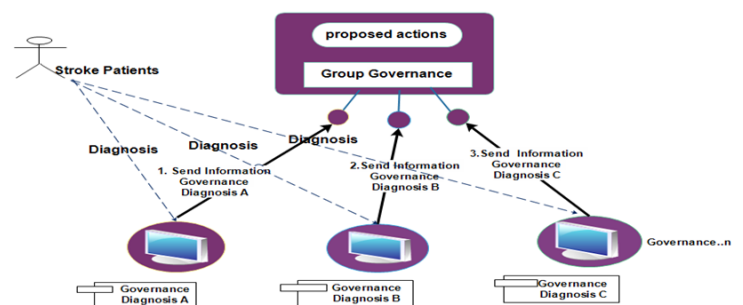

Figure 2. Group Governance Scenario

The scenario begin with an stroke patients (SP), and then the stroke patients (SP) obtains the governance from diagnoses A, B, and C, and then the governance of the diagnoses A, B, and C. The three governances are combined to give governance group, and this is the main point of the research, processing

governance group using GDSS.

4 PROPOSED SOLUTION

Group decision shows a relation at least between two decision makers. In governance group decision making, the two parties can be considered as important points between stroke patients and diagnosing gavernance. As an example, a troke patient is deiagnosed by some specialist doctors, namely: neurological surgeon (e1), cardiologist (e2), and blood (e3), then E = {e1, e2, e3, …., eN}. Every doctor will give his governance with category A = {a1, a2, …, am}, and supposedthat the governance has some specific fitures related to the risk level of handling treatment. And then, for the importance level, a knowledge base is built using a rule base suitable for the problems (matched with governance risk level) using operator AND [13].

$$C_1 \text{ AND } C_2 \text{ AND } ....\text{AND } C_n \quad (1)$$

Every diagnose governance gives different important levels respons to a possible handling treatment on stroke patients. The following is a governance structure covering {medicine - $\rightarrow$ doses-- $\rightarrow$ risk level} and {treatment-- $\rightarrow$ risk level}, and the governance knowledge data as follows [7] as shown in Table 1.

Table 1. Governance Knowledge Base (Source: Perdossi 2011)

Disease	Medicine	Doses	Medicine Risk	Treatment	Treatment risk
Acute Stroke Hypertention	Diazoksid	50-100mg; IV infus; 15-30 mg/min	Salt and Fluid restention, high hyperglikemia (1-12 hours)	For patients with accute intraserebral blood stroke, if the systolic blood tension > 200 mmHg, or the Mean Arterial Pressure (MA P) > 150 mmHg, the blood pressure is lowered with antihypertension intravena drug continuously with blood tension monitoring every 5 minutes.	Pasca stroke attact may cause bleeding as a result bursting interserebral aorta causing the blood to enter to the brain tissue so that there will be a pressure on brain structure and aorta
Acute stroke On medical complication	Sulfamethoxazole; thimethoprim	800mg; 160 mg	Causing high fever	Fast lowering of blood pressure on hypertension of accute stroke patients can be a danger sign and not a good sign, and hypothemia may be better than nomothemia. Giving early meal either through mouth or nasogastic tube (NGT) on accute stroke patients with disfasia will improve asprisation accident	Lowering infectious on stroke patient.

4 GOVERNANCE GROUP COORDINATION

Coordination on logical governance rule base will be explained. For the discussion, the following notation will be used: (C) for criteria and (AG) for alternative to represents diagnose governance. On this governance group decision, the criteria consist of treatment: neuro surgery, therapy, and medicine. Table 2 shows the relation between criteria and alternative of stroke patients. This example is for one stroke patient.

Table 2.Show The Relation Between Criteria And Stroke Patient Alternative

(C) Criteria of stroke patient's condition	Weigth	(AG)Alternative's rating					
		Therapy		Conservative		Neuro surgery	
		Priority	Risk	Priority	Risk	Priority	Risk
Diagnosis (e₁)	0.4	1	3	3	2	2	3
Diagnosis (e₂)	0.3	2	1	1	2	3	1
Diagnosis (e₃)	0.3	3	2	3	2	3	3
Diagnosis …n	-	-	-	-	-	-	-

Weighting values are derived from an agreement among the specialist doctors, for example e1, e2 and e3, and the alternatives are every alternative of treatment given by the doctors along with the risks of the treatment: therapy, conservative, and neuro surgery. From each alternative, there are priority rating and risk rating of the treatment. As an example, doctor e1 has a weigth of importance 0,4 and giving priority 1 and risk 3 for therapy, then priority 3 and risk 2 on conservative, and priority 2 and risk 3 on neuro surgery.Using SAW method, it can be inferred thatthe total rating of

Therapy: priority	=0.4 x 1 + 0.3 x 2 + 0.3 x 3 = 1.9
Risk	=0.4 x 3 + 0.3 x 1 + 0.3 x 3 = 2.4
Conservative priority	=0.4 x 2 + 0.3 x 3 + 0.3 x 3 = 2.6
Risk	= 0.4x 3 + 0.3 x 1 + 0.3 x 2 = 2.1
Neuro surgery: priority	=0.4x 2 + 0.3 x 2 + 0.3 x 2 = 2.0
Risk	= 0.4x 3 + 0.3 x 1 + 0.3 x 3 = 5

From this example, it can be concluded that

For priority :	For risk:
1. Therapy	1. Conservative
2. Conservative	2. Therapy
3. Surgery	3. Surgery

That means if low risk is considered, then conservative treatment is recommended, but if priority will be considered, then therapy treatment should be recommended.

Governance group all alternatives affects treatment consideration one to another on stroke patients, so that every treatment will take into account its risk.

5 INDIVIDUAL GOVERNANCE

From diagnose of stroke patients, some information of patient's condition is shown on the result of the governance. This will help the doctor in evaluating next treatment on the patient. As an example, the result of stroke patient diagnose and the governance is shown in the Figure 3 and Figure 4. Governance Group Coordination.

A conclusion for this condition is that if the systolic blood preassure > mmHg, or the Mean Arterial Pressure (MAP) > 150 mmHg, the blood pressure is lowered using anti hypertension intervena drug continously with blood pressure monitoring every 5 minutes.The risk can cause congertive heart failure. It is adviced to avoid diuretics during lowering the blood pressure, however is is suggested to use diuretics if the

patient has heart disease. It can be shown in the governance that there is a treatment risk level between governance so that the important level for the sake of patient's safaty is considerably important with those criteria values. Operation solution will be considered if all involved specialists or experts agrre because the problem in their expertise overcome or the factors that make the worse has been anticipated. Therefore, the proposed GDSS is a method having the smallest risk but optimising the curing [7].
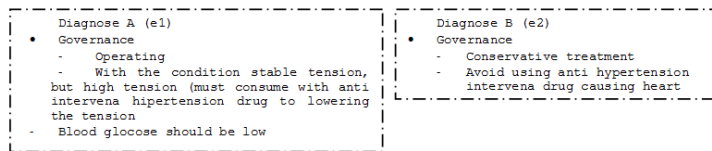
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┌─────────────────────────────────────┐   ┌─────────────────────────────────────┐
│    Diagnose A (e1)                   │   │    Diagnose B (e2)                  │
│•   Governance                        │   │•   Governance                       │
│    -    Operating                    │   │    -    Conservative treatment      │
│    -    With the condition stable    │   │    -    Avoid using anti hypertension│
│      tension, but high tension (must │   │      intervena drug causing heart   │
│      consume with anti               │   │                                     │
│      intervena hipertension drug to  │   │                                     │
│      lowering the tension            │   │                                     │
│    -  Blood glocose should be low    │   │                                     │
└─────────────────────────────────────┘   └─────────────────────────────────────┘
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Figure 3. Diagnose A (e1) and Diagnose B (e2) its governance (Source Perdossi 2011)

6 CONCLUSION

In this paper, the decision on group of governance has been discussed as a method to improve group decision between diagnoses for stroke patients and the governance for each diagnose. In GDSS model, the computation solution is proposed for considering involved alternative and criteria. These are needed when a patient in this condition need immediate treatment.

REFERENCES

[1] S.Kusumadewi, S.Hartati, R.Wardoyo, and A. Harjoko, *The use of Quantifier Guided Dominance Degree (QGDD) operator as a Certainty Factor on Clinical Group Decision Support Systems (CGDSS) (Indonesian: Penggunaan Operator Quantifier Guided Dominance Degree (QGDD) Sebagai Certatinty Factor Pada Clinical Group Decision Support System (GDSS)), Proceeding on National Seminar on Information Technology Applications, UII Teknik Informatika, Yogyakarta*(UII Teknik Informatika , Yogyakarta, 17 June 2006).

[2] S. Kusumadewi and S. Hartati, *Utilizing Fuzzy Multi-Attribute Decision Making For Group Clinical Decision Making Model*, (Proccedings On International Conference Soft Computing, Intelligent System And Information Technology (ICSIIT), Bali, Indonesia, 26-27 July 2007)

[3] L.Lima, P. Novais, R. Costa, Cruz, J.B. and J. Neves, *Group Decision Making and Quality-of-Information in e-Health System*s, (Oxford University Press Logic Journal of the IGPL, Inggris, 2011)PP 315-332.

[4] Ermatita, S. Hartati, R.Wardoyo and A. Harjoko, *Electre-Entropy Method In Group Decision Support System Modelto Gene Mutation Detection* (International Journal Of Advanced Research In Artificial Intelligence (IJARAI), Bradford Inggris,2012) PP 58-63.

[5] TIM PERDOSSI, *Guidance Book of Stroke Governance : Buku Pedoman Tatalaksana Stroke*, (PERDOSSI Indonesia , 2011)

[6] D. Jingyi and C. xusheng, *The Design of Group Decision Support System for Emergency Management* (Third International Symposium on Electronic Commerce and Security, Nanchang, Cina, 29-31 July 2010)

[7] PDPERSI, *Center of Data and Information: Pusat Data dan Informasi,*(www.pdpersi.co.id, Indonesia10 December 2013)

[8] E. Turban, Aronson, J.A. and Ting-Peng, *Decision Support Systems and Intelligent System-Sevent Edition (*Prentice Hall 0f India, New Delhi, 2007)

[9] McLeod and R.J.D, *Management Information System (Translation), (*PT. Indeks, Jakarta, 2004)

[10] Abdulaziz and Y. S. Mumtazeh.*" Infant Cry Recognition System: A Comparison of System Performance based on Mel Frequency and Linear Prediction Campestral Coefficients.",* (International Retrieval & Knowledge Management Faculty of Computer Science and Information Technology IEEE, Malaysia, 2010) PP 260 -263.

[11] J.A Linder, J.L Schnipper, L.A Volk, R.Tsurikova, R., M. Palchuk, M. Olsha-Yehiav, S.J Melnikas, A.J. and B. Middleton, *Clinical Decision Support System to Improve Antibiotic Prescribing fot Acute Respiratory Infection : Results of Pilot Study*(AMIA Symposium Proceedings, Washington DC, 11 Oktober 2007)

[12] S.A Lin, Duffy, R. I. Whitfield, I. M. Boyle, *Integration of decision support systems to improve decision support performance* (Knowledge & Information Systems Springer-Verlag, 2009) PP 261 – 286.

[13] J. Berger, J. Karen and Williams, *Fundamental Of Nursing; Collaborating for Optimal Health, Second EditionsApleton and Lange*(Prenticehall, USA, 1999)

[14] M. Miranda, A. Abelha, M. Santos, J. Machado, J. Neves, *A Group Decision Support System For Staging Of Cancer*, (ICST-Institute For Computer Sciences, Social Informatics And Telecommunications Engineering, London, 2008)PP 114-121

[15] Ma, Jian; Zhang, Quan; Zhou, Duanning; andFan, Zhi Ping.,*A Multiple Person Multiple Attribute DecisionMaking Method Based on Preference Information and Decision Matrix* (Department of Information System, City University of Hong Kong, Cina, 2004).

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