PDSS: The decision support system of diabetic patient for Public Health

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Abstract

The decision support system for data analysis of diabetic patient to risk complications the feet were (1) to analyze the factors of the patient (2) decision of complications and featured primary care patient. Therefore, the objective of decision support system is one of the most important public health in Thailand. The diabetic patient decision support system for public health is called PDSS.

This uses web application technology to developed by using Language PHP as the main Language and using mathematical model i.e., linear trend of algorithm Exponential, Linear Regression, Logarithm, Polynomial and Power.

This program collects patient data to analyze the risk of complications. The paper also discusses mathematical models used in PDSS to obtain the risk for decision support system by providing data analysis. Evaluation results indicate that PDSS can provide more than 80% accuracy compare with real patient data.

One methodology of decision support system is called program collected patient data for analyze the risk of complications.

Keywords: Patient Diabetes, Decision Support System, Mathematical model, Risk score model.

1. Introduction

Since, 20 years, the risk for diabetes to with compared the general population. The case study of reporting for patients with serious complications. The relationship is to environmental that causes important for complications, i.e., resistance microalbuminuria, diabetic neuropathy, Insulin while it will be storage detailed explanation order by this development required data protection strategy that is appropriated for complications [1, 8].

Inpatient diabetes management is becoming more

important in recent years. Given the ever-increasing rates of diabetes incidence in the general population, it is no surprise that 20–30 percent of the patients admitted to the hospital have a diagnosis of diabetes [8]. Therefore, the treatment of diabetic patient is becoming a more important aspect of inpatient care. Although it was shown that prevention of reduces morbidity, mortality, and length of stay, optimal inpatient glycemic goals remain controversial [6, 7].

The number of older patients consulting for diabetes who also exhibit cognitive difficulties is consistently growing because of the increased longevity of the population as a whole and, according to a number of studies, the increased risk of cognitive impairment and dementia in older diabetic patient. Many studies demonstrate a link between poor glucose control and deteriorated cognitive function in diabetic patient. The history of severe hypoglycemic episodes is also associated with a greater risk of late-in-life cognitive deficits [4].

The model for analysis of risk diabetic patient with persistent symptoms of foot complications. There are estimating the risk of developing foot complications. In patients with diabetes, high blood sugar levels in the state. The format of the existing data. The result is Glucose in bringing out the form and continuity, as well as other factors such as the loss experience of work environment factors. Because the response time of the characteristics of the failure for insulin resistance [4, 5].

Currently, most of the diabetic patient can be used to inform to support their decision in selecting the patient that confirm to their preference. The most common method is the decision support system for experiences.

As discussed above, present with the complications of many factors in order to obtain the analyze risk score under the concept of compare. Therefore the information technology can be very helpful to support analyze the risk of complications. The decision support system is one of information technologies which help to store and manage the

diabetic patient data to inform and automatically generate the risk of complications. However, all the existing decision support system are not considered on the risk score for cut the feet.

This paper proposes the decision support system of diabetic patient for public health, under the concept of analyze the factors of the patient risk score and decision of complications for care patient. The system framework will be proposed in section 2. Section 2 presents methodology used to analyze factors for diabetic patient, called the risk score process. Section 3 describes the model analyze for complications. Section 4 presents PDSS implementation issues and techniques, presents the model evaluation by comparing with mathematical model. The conclusions and future work are presented in section 5.

2. PDSS Framework

The framework of PDSS system is depicted in “Fig. 1” consisting of input process and output. The input consists of data and method. There are three types of data used in the model development, which are user preferences and the patient’s database.

Figure 1. PDSS framework

This proposed system is an internet-based application consisting of three processes as follows: Mathematical Model, Risk-score Model and Evaluation model. The user preferences are data defined by user, e.g., factor for diabetic patient of the feet that users analyzed plan over all 21 factors. By default, all the patients (x) are 300 sample and year 2008-2010.

2.1 User Input

The user input is a process that helps block any access from unauthorized data from different users i.e., doctor and nurse. It uses specially webcam to diagnosis individual patient. The webcam can snap shot the feets and edit picture of each patient i.e.,(add, delete, edit input data). Moreover, it also provides different view for authorized users. Mathematical model is a process of planning error for diabetic patient. While user management is risk score analyzer model and average score. The whole process is the process of applying knowledge for analysis, planning and evaluating the model.

2.2 Patient Database

While patient database is used to store data of patient i.e., factors, month, year and risk score to development of using MySQL database and data type i.e., Interger, Varchar, Text, Date and Decimal etc. They are used to store important score levels of risk to separate factor of patients as well as in “table 1”

- 0 is equal to risk score normal
- 1 is equal to risk score low
- 2 is equal to risk score medium
- 3 is equal to risk score high

The risk score level of factors requires an advice from an expert; doctor or nurse to collect data. Therefore, the expert can list all 19 factors of diabetic patient on database.

2.3 Mathematical Model

The mathematical model were to linear programming as regressive equations. There are techniques learning to structured data i.e., “The exploration and analysis of large quantities of data in order to discover meaningful patterns and rules” [2]. Therefore, the mathematical model is used to evaluate model for indicates that in average case of error. For example: $Y = mx_{(i)} + b$; where m is a slope [3]. Where $x_{(i)}$ is factors, e.g., detection of foot ulcers and Results of the right etc. The b is a month and year. An example 2 : $Y = mLn(x) + b$; where m is a slope. Where $Ln(x)$ is interception and factors all, e.g., detection of foot ulcers and Results of the right etc. The b is month and year. The evaluation factors are calculated from several mathematical model in “table 2”.

Table 1. Id-factor and Name-factor of all diabetic patient of the feet into database.

Id-factor	Name-factor	(c _i)				Id-factor	Name-factor	(c _i)			
		1	2	3	4			1	2	3	4
1	detection of the left foot	0	1	2	3	13	Results of the right foot	0	1	2	-
2	detection of foot ulcers	1	1	2	0	14	History of foot ulcers	2	0	1	-
3	Historical cut the legs / feet	2	0	1	-	15	History of loss of consciousness	2	0	1	-
4	The nail problems	0	2	1	-	16	Detected wart, corn	0	2	1	-
5	The foot deformities	0	2	1	-	17	Detected hair loss.	0	2	1	-
6	Touching the feet warm	2	0	1	1	18	The detection of foot fungus	0	2	1	-
7	The skin color detection of infarction	0	3	2	1	19	Results of audits sense	0	2	2	-
8	detection of infarction	0	2	1	1						
9	Posterior tibial pulse to the left	3	2	0	-						
10	Posterior tibial pulse to the right	3	2	0	1						
11	Dorsalis pedis pulse to the left	3	2	0	3						
12	Dorsalis pedis pulse to the right.	3	2	0	3						

Table 2. Mathematical Model

Linear Regression	Mathematical Model
Linear	$Y = mx + b$
Logarithmic	$Y = mLn(x) + b$
Polynomial	$Y = c_1x + c_2x^2 + b$
Power	$Y = cx^b$
Exponential	$Y = ce^{bx}$

2.4 Risk-score Model

The risk score model process to equations of average while the patient database stores specific details of each patient, e.g., month per year of each member (y_i), (m_i),

where $2008 \leq y_i \leq 2010$ and n is the number of all factors;

Step 1 : It stores patient data into database using the risk score from the expert. The level score set of number factor (x_i) between $0 \leq x_i \leq 3$ and input data is to each patient in records all 300 member (i.e., detection of foot ulcers, detection of the left foot, Historical cut the legs / feet etc.)

Step 2: The create is user interface for input data each factors and each patient. It is a value used to specify by user that checking in radio box all factors. The user can be used to select into each factor from over all. After the selection, it should be submitted into the database because of, the system of process in the time. The user needs to cancel the process if can't input database.

Step 3: Before submitting input data. The input data will be used for planning the data of all factors which will bring the accuracy and error data. After the user insert into database, it can be preferences factors process planning to risk score. Thus the risk score level can be shown in the output model.

Step 4: Read model score that contains factor which was selected by user. To calculate the model, the results will be read in textfile by using file surname, “/txt”.

Step 5: The equation of each factor is defined in “(1)” and the average equation is defined in “(2)”, risk score model is able to rank by using these score level, i.e., normal-lower-medium-high.

$$X(i) = w_1a_1 + w_2a_2 + w_3a_3 + w_4a_4 + w_5a_5 + w_0 \quad (1)$$

where $X(i)$ is a sum all factors and total. It is factors (w_i). cross number patients each individual.

$$risk_{score} = \sum_{i=0}^n x(i) / c_i \quad (2)$$

where $risk_{score}$ is a average. The complex equations, it is count all factors (c_i) and total ($\sum_{i=0}^n x(i)$) derived count all factors (c_i).

Thus, $risk_{score}$ of threes level is defined:

Where $risk_{score}$ between $0 \leq x_i \leq 3$;

$risk_{score} < 1$; Comment the risk low

$risk_{score} < 1.5$; Comment the risk lower and medium

$risk_{score} < 2$; Comment the risk over medium and high

The proposed risk score model for user illustrated color to (green, yellow and red) and care the feets for diabetic patient show in “Figure 3”.

2.5 Evaluation Model

The evaluation model uses average while PDSS can evaluate the model by using 300 diabetic patients' data. Based on the mathematical model and error (%). Thus, using to equations for error as defined in “(3)” is shown optimal in table 3:

$$error(\%) = \sum_{i=0}^n x(i)/f_i * 100 \quad (3)$$

where f_i is a sum all factors in 2008-2010 of estimation.

3. PDSS Implementation Issues

PDSS is designed for doctor and nurse for public health in Thailand. Thus, users can analyze and planning, risk of complications for each individuals. PDSS visualize the estimation plan results with line chart. They are implemented with PHP, AJAX, JavaScript, HTML and other related web technologies.

[illegible]

Figure 2. User Input for diagnosis patient

Figure 2 illustrated an example graphic user interface is input data for diagnosis patient. They can add, edit, update or delete parameters of each factor. The interface is designed as radio box, drop-down lists or text-boxes with values checkers in Figure 2 as counter level risk score for data input. The stored data will be used later in the analysis on step and pulling showed data.

The PDSS compute appropriate factors for optimal. Examples of summary report and Figure 4 presents output line chart of estimated values view by group of patients.

Figure 3. Compare risk score model

Figure 4. Output line chart of estimated

Figure 4 presents line chart of estimated view by threes year. The user can estimate patient's data. They can also calculate data of all by doctor or nurse. The user can also specify data of each patient, compare data from real in risk score. Therefore, factors estimation line chart occur real compare with last threes year ago.

4. PDSS Evaluations

PDSS evaluations is conducted with obtained from a decision support system for of diabetic patient for public health data (PDSS) of a 300-member for public health at Poeklang Nakhornratchasima district in Thailand. The data is collected between year 2008 to 2010. Table 3 presents the evaluation model. It indicates that in average case, PDSS can perform more than 80% accuracy (less than 3% of error) based on the logarithm regression methods.

Table 3. PDSS Evaluation Model

Factors	Linear	Logarithm	Polynomial	Power	Exponential	Optimal
detection of foot ulcers	0.00	0.64	0.01	0.01	nan	Linear
detection of the left foot	0.03	1.29	0.04	0.04	nan	Linear
Historical cut the legs / feet	0.00	0.00	0.00	nan	0.00	Logarithm
The nail problems	0.00	0.00	0.00	nan	0.00	Logarithm
The foot deformities	0.00	0.64	0.01	0.01	nan	Linear
Touching the feet warm	0.03	1.29	0.04	0.04	nan	Linear
The skin color	0.06	1.98	0.09	0.09	nan	Linear
detection of infarction	0.00	0.00	0.00	nan	0.00	Logarithm
Posterior tibial pulse to the left	0.00	0.00	0.00	nan	0.00	Linear
Posterior tibial pulse to the right	0.00	0.00	0.00	nan	0.00	Logarithm
Dorsalis pedis pulse to the left	0.00	0.00	0.00	nan	0.00	Logarithm
Dorsalis pedis pulse to the right.	0.05	2.00	0.09	0.09	nan	Linear
Results of the right foot	0.02	1.30	0.04	0.04	nan	Linear
History of foot ulcers	0.01	0.63	0.01	0.01	nan	Linear
History of loss of consciousness	0.01	1.30	0.04	0.04	nan	Linear
Detected wart, corn	0.00	0.00	0.00	nan	0.00	Linear
Detected hair loss.	0.04	2.00	0.09	0.09	nan	Linear
The detection of foot fungus	0.00	0.00	0.00	nan	0.00	Linear
Results of audits sense	-0.02	1.33	0.04	0.04	nan	Power

5. Conclusions and Future Work

This paper presents a design and implementation of a decision support system for Public Health called PDSS. The PDSS has potential to facilitate for doctor and nurse in their decision by providing risk score model analysis. It supports both individual and the public health. The paper also discusses models based on regression techniques used in PDSS to obtain the risk complications to feet of patient. Then model evaluation results indicate that PDSS can provides more than 80% accuracy compare with diagnosis the feet patient. There were to optimal group in linear and logarithm regression.

There are some improvement that could be done in near future. The forecasting model used in PDSS can be extended with alternative forecasting methodologies such as neural networks. The PDSS should be deployed in public health and perform usability and reliability testing.

References

- (1) Dangsoo S.kim and James P.walsh.: “Modelling Irregular Samples for Analyzing the Risk of Complications of Diabets Mellitus”, Vol. 28, No. 6, pp. 831-835, 2012.
- (2) Eakasit Pacharawongsakda. : “An Introduction to Data Mining Techniques”, pp.7-10, 2015.
- (3) G. B. Dantzig, “Linear Programming”, Vol. 50, No. 1, pp. 42-47, 2002.
- (4) L. Bordier, J.Doucet et.al, : “Update on cognitive decline and dementia in elderly patients with diabetes”, Vol. 40, No. 5, pp. 331-337, 2014.
- (5) Rajesh Rajendran, and Gerry Rsyman : “Glycaemic management in patients with diabetes in hospital”, pp. 718-722, 2014.
- (6) V. Tsimihodimos, and M. Florentin. : “Hypertension and Dyslipidemia in Patients with Pre-Diabetes: Dietary and Other Therapies”, pp. 157-179, 2015.
- (7) Swapnil N. Rajpathak, Srini Rajgopalan et.al., : “Impact of time to treatment intensification on glycemic goal attainment among patients with type 2 diabetes failing metformin monotherapy”, Vol. 28, No. 6, pp. 831-835, 2014.
- (8) Zijian Chen, and Michael A. Via: “Nutritional Support in Hospitalized Patients with Diabetes Mellitus”, pp. 377-385, 2015.