Design a Predictive Analytics Model of Hospital Accreditation Continuity from Employee Readiness based on Artificial Intelligence

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Abstract: Hospitals are required to have an accreditation in an effort to improve the quality of health services. Some employees feel accreditation is a workload and they are not ready to carry out the sustainability of hospital accreditation. The purpose of this study is to design a predictive analytics model of hospital accreditation continuity from employee readiness using support vector machine (SVM) method. The data were obtained from a population of 230 employee with sample of 70 respondents. Statistically, measurement data from the questionnaire was processed using univariate, bivariate with chi-square tests, and multivariate with multiple logistic regression at a 95% confidence level ($\alpha = 0.05$). For hospital application needs, measurement data are modeled by the SVM method. The results showed that there was a relationship between readiness to change, management support, and self-benefits to the sustainability of hospital accreditation $p < 0.05$. The variable that has the greatest relationship with the sustainability of hospital accreditation is management support with the value Exp (B) / OR = 18.978. The results of predictive model between input and output variables show significant success with an accuracy rate of 88.6%.

1 INTRODUCTION

Law Number 44 Year 2009 (regarding Hospitals) Article 29 letter b states that hospitals are required to provide safe, quality, anti-discrimination and effective health services by prioritizing patient interests in accordance with service standards. Then in Article 40 paragraph (1) it is stated that in an effort to improve the quality of hospital services, accreditation must be carried out periodically at least once every three years (Secretariat of the Republic of Indonesia, 2009). Based on the aforementioned laws hospital accreditation is important to be carried out on the grounds that quality can be integrated and cultivated into the service system.

Policies related to accreditation have been set in the regulation of the minister of health number 34 of 2017 concerning accreditation and number 99 of 2015 concerning changes to the regulation of the minister of health number 71 of 2013 concerning health services on national health insurance. Accreditation is an important requirement to be fulfilled by hospitals because in addition to aiming to guarantee the quality of health services to the community, it can also be evidence that the hospital has a commitment to provide plenary and standard services (Idris, 2019).

Internationally, accreditation is a widely adopted tool for quality control and quality improvement in health care . In accreditation, an external institution assesses an organisation based on predefined quality standards and after a formalsite visit by surveyors, the accreditation body decides whether to grant accreditation status to the organization (Due et al, 2019).

Accreditation programmes in developing countries, especially in the Middle East, are rapidly picking up pace, and numerous healthcare organizations are becoming involved in enhancing the quality of their healthcare by adopting such programmes, thereby enhancing their reliability and showing their commitment to improving quality of care (Algunmeeyn et al, 2019). Through the accreditation process, one of the benefits is to increase public trust where hospitals focus on patient safety and quality of service (Ministry of Health, Republic of Indonesia, 2011). Developing countries frequently use hospital accreditation to guarantee quality and patient safety (Subashnie Devkaran and Patrick O'Farrell, 2015). Imperfections found in health services have caused so many people to use health services in neighboring countries such as Singapore and Malaysia (Leonarda, 2011).

Acreditation of primary care settings was shown to strengthen quality control and improvement. Result of study on the effectiveness of quality-improvement in primary care showed management progress in the practice that applied organizational standards (Alia Ghareeb, Hana Saod and mohamad el zoghbi, 2018).

Hospital accreditation is widely adopted as a visible measure of an organization's quality and safety management standards compliance. Hospital accreditation programmes are avenues through which a complex policy intervention functions to promote adherence to quality and safety management standards and drive continuous quality improvement on a more practical level, these programmes represent a quality management system (QMS), total quality management (TQM) or continuous quality improvement (CQI) standards that should lead to an improvement of the hospital's overall performance (Wardhani et al, 2019).

In general, medical personnel assume that the quality of service will be guaranteed to be good by increasing the quality of the expertise of doctors with continuous education and practice, and sophisticated equipment (Azwar, 2015). However, the community as service users, hospital managers, hospital owners, and those who have direct or indirect interests in hospital services can have a different opinion (Leonarda, 2011).

Hariyono's research at Rajawali Citra General Hospital in Bantul Regency stated that there were still difficulties in the preparation of human resources considering that the staff appointed to prepare the accreditation device did not understand occupational health safety science (Hariyono, 2013). According to Algunmeeyn et al (2020) at Jordanian hospital that The present study has explored the main obstacles to implementing accreditation, based on responses from a sample of hospital staff members (including nurses and doctors): low wages and poor incentives, high workload, the cost of accreditation implementation, staff shortages, and high staff turnover. These barriers should be addressed because they could impact on accreditation in hospitals; negatively influencing the quality of healthcare services and thereby incurring serious problems.

Research conducted by Hariyono (2013) at Rajawali Citra General Hospital in Bantul Regency related to the analysis of readiness to face hospital accreditation that readiness to change employees or hospital employees is one of the factors that encourage the sustainability of accreditation. There are still difficulties in the preparation of hospital human resources because the staff appointed to prepare the accreditation tools do not understand

well. Research Mandawati et al. (2018) at KRT Setjonegoro Wonosobo Hospital got the result that nurses had a positive perception of accreditation and were ready to change, besides that nurses also hoped that the spirit of accreditation would not only be limited to assessment.

Based on research Sembodo et al (2019) that an Accreditation Status positively meaningful with Service Quality, Service Quality is positively related to Patient Satisfaction and there is a significant positive relationship indirectly between Accreditation Status and Patient Satisfaction. But the accreditation results did not always directly improve the quality of hospital services. This is because accreditation of health services in Indonesia has not yet assessed the clinical indicators of health services (Soepojo et al, 2012; Turnip et al, 2020; Wijaya et al, 2019).

Based on data from the Stella Maris Hospital in Medan, there were 230 permanent staff consisting of 30 medical staff, 72 nurses, 54 midwives, 15 laboratory workers, 21 pharmacists, 10 nutrition workers , radiology staffs as much as 2 people, maintenance staff 11 people, medical records staff as many as 3 people, administrative and administrative staff as many as 12 people. To provide the best service in carrying out operational activities for people who come for treatment or delivery, the work shifts are divided into 3 (three) shifts for operations 24 hours a day, while for administrative (office) activities only consist of 1 (one) shift.

The preliminary survey was conducted by interviewing 15 employees about services after hospital accreditation: as many as 8 people said they continue to work in accordance with the demands of hospital accreditation that is working with maximum service. As many as 7 people said that after accreditation was completed, they could be more relaxed in carrying out the work, because they felt burdened as when accreditation would be done by doing work that exceeded work on normal days. Sometimes employees must work overtime in the accreditation process. Accreditation encourages employees (medical and non-medical personnel) to reopen standard operating procedures that have so far only been used as documentation. All nursing activities have Standard Operating Procedures (SOPs) that must be obeyed.

To facilitate management in monitoring and making decisions, the relationship between employee readiness and the sustainability of hospital accreditation is developed using the Support vector machine (SVM) method. The application of SVM methods in the hospital management is still rarely used especially in terms of accreditation.

2 METHOD

This type of research used in this research was a quantitative analytic study with a cross sectional research design. This research was conducted at the Stella Maris Hospital in Medan in November 2019. The population of the study was 230 employee, and the sample was obtained by 70 respondents with stratified random sampling technique. Statistically, data from the results of questionnaire measurements were evaluated by univariate, bivariate using chi-square tests, and multivariate using multiple logistic regression tests with a confidence level of 95% (α = 0.05).

Machine learning is an application branch of Artificial Intelligence that focuses on developing a system that is able to learn on its own without having to be repeatedly programmed by humans. Machine learning applications require data as learning material (training) before issuing outputs. Support vector machine (SVM) is a technique for making predictions, both in the case of classification and regression. SVM is in the same class as Artificial Neural Network in terms of functions and problem conditions that can be solved (Kusumandari et al, 2018; Turnip et al, 2018). In this study, the SVM technique is used to find the optimal separator function (classifier) that can separate two data sets from two different classes. The use of machine learning techniques, because of their convincing performance in predicting the class of new data. In general, the classification process has two processes as (i) The training process uses training data sets that have known labels to build models or functions, (ii) The testing process uses data testing sets to predict and test the accuracy of the model or function that will built in the training process.

The concept of SVM can be explained simply as an attempt to find the best hyperplane that functions as a separator of two classes in the input space (Turnip et al, 2018). The classification problem can be translated by trying to find a line (hyperplane) separating between two groups as in Figure 1. The best hyperplane separator between the two classes can be found by measuring the hyperplane's margin and finding its maximum point. The closest pattern is known as a support vector. The solid line in Figure 1 shows the best hyperplane, which is located right in the middle of the two classes, while the red and yellow dots in the black circle are support vectors.
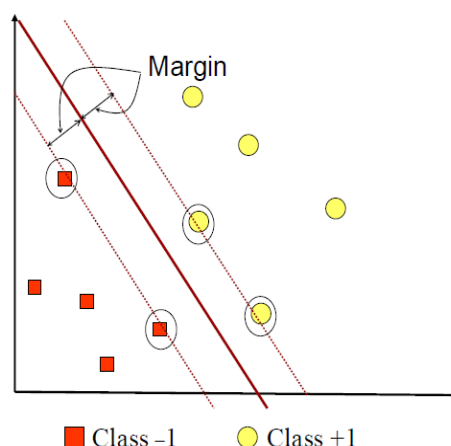

Figure 1: The best hyperplane that separates the two classes -1 and +1 with SVM.

In this paper, the SVM method was used develop a predictive analytics model that will automatically recognize and predict the name of a hospital accreditation continuity from an employee readiness. This is essentially the problem of acreditation information that the classifier to predict the level of a hospital status from current conditions without complicated measurement of many possible variables. The diagram of the SVM predictive model is shown in Figure 2.
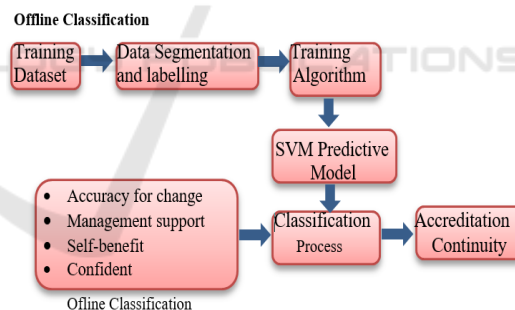

Figure 2: The SVM Predictive Model Diagram.

3 RESULTS AND DISCUSSIONS

Characteristics of respondents including age, sex, last education, and length of work can be seen in Table 1. Most respondents aged <32 years (54.3%), aged> 32 years (45.7%), female sex (74.3%), male (25.7%). Most of them have D-3 education (55.7%), a small proportion have D-4 and S2 education respectively (1.4%). Most respondents worked> 5 years (64.3%), a small proportion worked <5 years (35.7%).

Table 1: Characteristics of Research Respondents.

Characteristics	Number	
	f	%
Age:		
a. <32	38	54,3
b. ≥32	32	45,7
Number	70	100,0
Sex :		
a. Male	18	25,7
b. Female	52	74,3
Number	70	100,0
Education :		
a. SMA/SMK	11	15,7
b. D3	39	55,7
c. D4	1	1,4
d. S1	18	25,7
e. S2	1	1,4
Number	70	100,0
Length of work:		
a. <5 years	25	35,7
b. ≥5 years	45	64,3
Total	70	100,0

Based on the results of bivariate analysis obtained a significant relationship with the sustainability of accreditation, namely the accuracy to change (p = 0.017), self-confidence (p = 0.001), management support (p = 0,000), and self-benefit (p = 0,000).

Table 2: The Relationship of Each Independent and Dependent Variable.

Variables A	Continuity of Accreditation				Total	p-value
	Good		Lsss			
	f	%	F	%	F	
Accuracy for Change:						0,017
Precise	52	88,1	7	11,9	59	
Less Precise	6	54,5	5	45,5	11	
Confident:					52	0,001
High	48	92,3	4	7,7		
Low	10	55,6	8	44,4	18	
Management Support:						0
Support	53	91,4	5	8,6	58	
Less Support	5	41,7	7	58,3	12	
Benefits:						0
Helpful	50	92,6	4	7,4	54	
Less Helpfull	8	50	8	50	16	

Furthermore, multivariate analysis with multiple logistic regression tests showed that of the 4 variables

tested were found as many as 3 variables related to the sustainability of hospital accreditation namely accuracy for change, management support and self-benefit.

The variable that has the highest weighting relationship with output is the management support variable with the value Exp (B) / OR = 18.978. While the accuracy to change variable has the value Exp (B) / OR = 9,229 and the benefit variable for yourself has the value Exp (B) / OR = 7,539. Overall results of multiple regression tests can be seen in Table 3.

Table 3: Multiple Logistic Regression Test Results.

Variables	B	Sig.	Exp(B)	95%CI for Exp(B)
Accuracy to change	2,222	0,027	9,23	1,294-65,802
Management support	2,943	0,002	18,9	2,828-127,341
Benefits	2,020	0,019	7,54	1,392-40,829
Constant	-11,015	0,000		

3.1 Accuracy for Change

Based on the results of the study showed that there was a relationship of accuracy to change with the continuity of accreditation, p = 0.027 <0.05. The accuracy to change variable has a value of Exp (B) / OR = 9,229 meaning that employees with accreditation were the right time to change, have the opportunity to have a good hospital accreditation 9.2 times higher than employees who claim accreditation was not the right time for change. Positive perceptions should be put to good use by hospital leaders to improve services on an ongoing basis. This spirit can be used as capital to improve services by assessing the quality of clinical service indicators so that patients will really feel the difference in the services provided by the hospital.

Appropriateness to make changes was a dimension of someone's readiness that explains the individual's belief that the proposed change will be right for the organization and the organization will benefit from implementing change. Individuals will believe there were logical reasons for change and the need for proposed changes, and focus on the benefits of change for the company, the efficiency obtained from changes, and the congruence of company goals with change goals (Holt, Armenakis, Field, & Harris, 2007). Obligations to accredit services provided encourage almost all hospitals to carry out the program, especially since the government also gives obligations to the central and regional governments to support hospitals in their area when accrediting.

The results of this study prove that the readiness of employees on the dimensions of accuracy to

change was significantly related to the sustainability of accreditation. Employees who have readiness to change tend to continue to carry out work in accordance with hospital accreditation demands and conversely employees who were less ready to change feel that the implementation of accreditation will continue to add to their workload. Employees who were ready to change and claim that accreditation is a good time to change are confident that by doing accreditation there will be a change that is better for the hospital and for itself. The existence of accreditation will also change the organization of the hospital for the better than before. Employees also believe that with the accreditation of hospitals, they will benefit from being the community's reference for treatment.

According to the assumption, Accreditation was a logical or reasonable reason for most employees to improve their performance in accordance with their respective professions. Accreditation was considered as a need for better change and employees can work more safely, comfortably, effectively and efficiently. However, a small number of employees feel that accreditation is a workload because they have to carry out work in accordance with accreditation standards, which they say adds to the workload.

3.2 Management Support

Based on the results of the study showed that there was a relationship between management support and the sustainability of hospital accreditation is $p = 0.002 < 0.05$. Management support variable that has a value of Exp (B) / OR = 18.978 means that employees who declare hospital management support in the continuity of hospital accreditation have a good chance of continuing accreditation by 18.978 times higher than employees who claim hospital management was less supportive.

In general, hospitals are not ready to face accreditation because they do not yet have a policy related to the implementation of officers for the protection of medical record documents from damage and loss, the absence of working groups, infrastructure that does not support and the limitations of the hospital management system. In addition, nurses also hope that the support of hospital management and the spirit of accreditation will not only end with the completion of the assessment.

At present many hospital leaders consider that accreditation was merely achieving the graduation status of the hospital and increasing the "prestige" of the hospital when it gets an accreditation certificate so that it often ignores the process of achieving

graduation, which means maintaining the quality culture and patient safety on an ongoing basis is often neglected.

For hospital management, the accreditation program is a valid instrument to determine the extent to which services at the hospital meet national standards. Accredited status can also increase public trust in services in hospitals and as a means of preventing malpractice cases. The results of this study prove that management support is related to the sustainability of hospital accreditation. In addition, management provides full support to employees who strive to change in accordance with accreditation demands. Management also provides support for employees to have creative ideas at work and in accordance with the demands of accreditation that can improve service quality.

3.3 Benefits for Yourself

Based on the results of the study showed that there was a relationship of benefits for theirself with the sustainability of hospital accreditation was $p = 0.019 < 0.05$. The benefit variable itself with the value Exp (B) / OR = 7.539 means that employees who claim to be beneficial to themselves have a good chance of continuing hospital accreditation by 7.5 times higher than employees who claim to be beneficial to themselves. Some employees stated that the reason for approving accreditation was that there were many positive impacts in accreditation, including: more organized management of hospitals. And changes in the way decisions are made by the leadership. All employees come to know what indicators to consider in service, how to report problems, and decisions based on the aspirations of subordinates.

Personal benefit is a dimension that explains aspects of beliefs about the perceived personal benefits that will be obtained if the change is implemented. The matter of concern, especially in maintaining the application of accreditation standards is not easy. There needs to be a common perception about the benefits of hospital accreditation, both the benefits for themselves and the benefits for the hospital, so that all employees play an active role, with encouragement and monitoring of the leaders. Individual perception can directly influence participation to increase commitment to work decisions and productivity.

The results of this study prove that employee readiness on the self-benefit dimension was significantly related to the continuity and sustainability of hospital accreditation. Employees who claim that accreditation was beneficial for

themselves tend to carry out continuous work in accordance with the demands of accreditation. The most important thing was that they learn more about new things related to their work and daily tasks.

According to the researchers' assumptions, employees who claim that accreditation was beneficial for themselves can work according to the job description because so far they sometimes do work that is not their job. This will make them better trained to carry out work that is their responsibility and make them more skilled.

In the application of SVM method, the best hyperplane was obtained using 2D plane as shown in Figure 2. Clearly visible in the hyperline image functions to separate between classes. In the correct prediction the class / group agree () for accuracy to change can reach the range of 35-40 and confident it can reach the range of 35-40. From Figure 1 (x-axis is accuracy of change and y is confident), it was known that the output value obtained by the amount of training data is 50% of the initial data. From the results of the output in Figure 2 it is known that the level of accuracy of the prediction results with training data is 0.886 or 88.6%. Accuracy is used to see a measure of how well the model tolerates results with attributes in the data used. Sensitivity is used to measure the proportion of positive observations that are precisely predicted. Then the specificity value is 0.8134 or 82%. 'Specificity' is used to measure the proportion of negative observations that are precisely predicted. Then for an accuracy balance value of 0.8151 or 82%. 'Balanced Accurancy' is used to measure the accuracy of the proportion of positive class observations that are precisely predicted.

prediction). If one of the colors is getting thicker, then it shows that the prediction is toward the intense color. For example: in the picture above the solid color is blue and the faintest is orange, then the incorrect prediction is smaller. Furthermore, the percentage of accreditation data that has been classified can be seen in Figure 3. There are also TPR and FDR which are the conclusions of each percent prediction of correct and incorrect.

Figure 3: Confusion matrix of clasification results

In Figure 4, parallel output image only serves to see the relations between variables that have been used as input in this data, then here can also be seen, which relations are correct and incorrect.
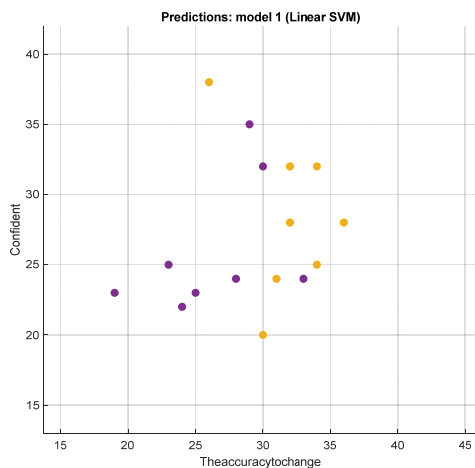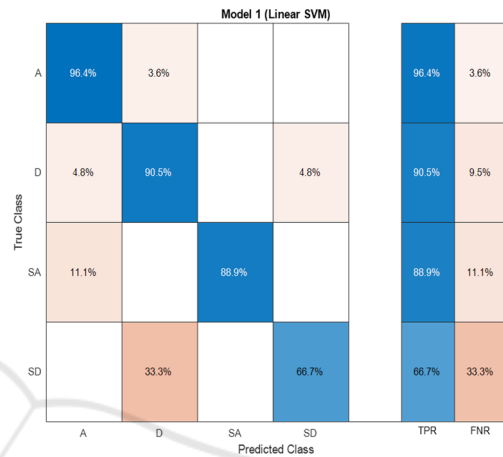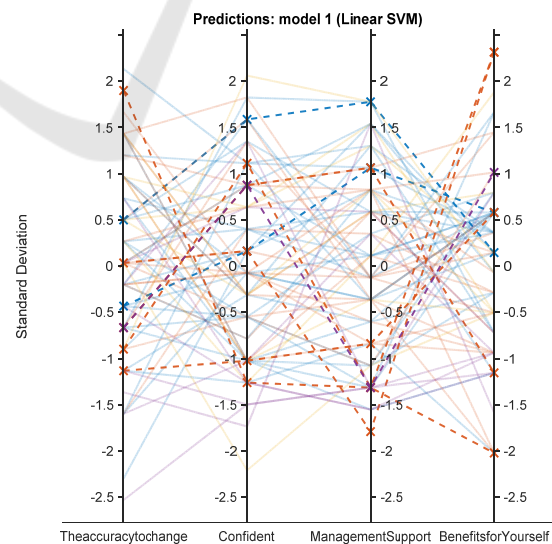

Figure 4: Predictions model

Figure 2: the 2D hyperplane for classes separation.

In Figure 3 (confolution matrix) there are two colors, blue (correct prediction) and orange (incorrect

4 CONCLUSIONS

The results showed that there was a relationship of accuracy to change, management support, self-benefit with the sustainability of hospital accreditation. While self-confidence is not related. The management support variable has a greater relationship with the continuity of hospital accreditation both with Exp (B) / OR value = 18,978.

It is known that the classification of the SVM model in training data is of type C-classificaton, with a radial kernel. Cost is the kernel parameter value is 1, gamma parameter value is 0.125, and the number of support vectors is 70. The accuracy level of the prediction results with training data is 0.886 or 88%, for the sensitivity value obtained is 0.8167 or 81%, then the Specificity value is 0.8134 or 81%, and the balance accuracy value is 0.8151 or 81%.

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