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An Empirical Application of An Information System to Relieve Chronic Obstructive Pulmonary Disease

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Abstract

This study was attempted to investigate an empirical application of an information system to relieve chronic obstructive pulmonary disease. The subjects of this paper were 128 patients who had visited a general hospital which located in Chungnam area. As a result, first, for gender, the experimental group in a female with 64.1% showed higher than female with 60.9% in the control group. There was a significant difference in subjects who had intaked daikon after information intervention(t=-2.75, p=.000). In conclusion, a comprehensive adoption of an information system to minimize the damage of COPD will contribute effectively to the COPD recovery and prevention.

Keywords*: Application, Information system, Chronic obstructive pulmonary disease (COPD)*

1. Introduction

Chronic obstructive pulmonary disease(COPD) is a term that refers to two lung diseases, chronic bronchitis and emphysema. The COPD is used because both diseases are characterized by obstruction to airflow that interferes with normal brething and the two frequently co-exist [1],[2].

Chronic is the fourth leading cause of death in the U.S. claiming 120,970 lives in 2006, an age-adjusted death rate of 39.9 per 100,000. 2006 was also the sixth consecutive year in which more women (63,006) than men (57,970) died of COPD. In 2008, 12.1 million people in the U.S. 18 years of age or older were estimated to have COPD. However, lung function tests show that up to 24 million people may have the disease, indicating an underdiagnosis of COPD. Chronic obstructive pulmonary disease includes pulmonary components with increased comorbidity rates, as well as being a systemic disease. Comorbidities may frequently occur in COPD patients over 40 years old [3],[4],[5].

Lung damage Lung damage from COPD is irreversible, and the quality of life for a person suffering from COPD diminishes as the disease progresses. The most important step in preventing COPD and slowing its progression is to stop smoking. In addition, there are treatments available that can improve a patient's quality of life, such as medication, vaccination pulmonary rehabilitation, oxygen therapy, and surgery. These therapies are used to help the patient relieve symptoms, reduce the frequency and severity of exacerbations, and improve overall health and ability to exercise.

In order to solve the urgent problem, we should look for the practical plans. However, there were few studies to deal with effect of database system to alleviate COPD until present in Korea. we also don't have any national program about it [6],[7]. Therefore, the comprehensive and integrated information systems including chronic disease are urgently needed to control the increasing prevalence of COPD and produce its related desirable outcomes.

A database system is basically a computerized record-keeping system. In other words, it is a computerized system whose overall purpose is to store information and to allow users to retrieve and update that information on demand. The information in database

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system can be anything that is of significance to the patients or hospital concerned-anything, in other words, that is needed to assist in the general process of running the information of the patient or hospital[8],[9].

This research sought to apply the effect of it on the change of practice behavior of subjects for the prevention and treatment of COPD using a database feedback system. On the other hand, the follow-up survey was conducted at the end of this trial to compare the change before and after information intervention for health promotion behavior between the two groups. Thus, the purpose of this research was carried out to estimate the effect of database system application to alleviate COPD. A comprehensive adoption of a database system to minimize the damage of COPD will contribute effectively to the COPD recovery and prevention.

2. Materials and Methods

2.1 Development of Information System

This paper is to develop an information system ranging from identification problem structure to solution method implemented. Contents are as follows. 1) Preparation : defining information architecture, assessing the need of participants, conducting an information system, setting a goal of the system 2) Process : identifying the functional elements of the information system, designing as part of information gathering, applying the information system 3) Evaluation : verifying study impact, demonstrating the system efficiency, identifying problem structure 4) Conclusion : identifying the functional elements of information system, presenting the information usefulness, establishing system development [Fig. 1].

The essential first step of the information system is to obtain effect for the study from application or an interested result. This information system was developed through review of existing literature, assessment of patients' educational needs, available updates on COPD information, data analysis and solicitation of expert advice throughout the development process. The developed system applied to patients with chronic obstructive pulmonary disease. The user satisfaction rate for this web site was relatively high.

2. 2 Three-Step Basic Strategies

This research is composed of three-step basic strategies. The first success factor of the system is subjects' lack recognition for COPD prevention which is the biggest problem of the COPD patients. The strategies of the second-stage are program which selected the order of priority of the time and the importance in the limitation of the budget and the practical implementation. The strategies of third-stage are the effect evaluation on the empirical performance for the prevention of patients with COPD [Fig. 2].

Table 1. Contents Assigned for Patients with COPD

Division	Contents
Objective	- Objective and procedure of information system - Effectiveness of information system
Recognition	- Disease recognition and attitude of patients
Usefulness	- Clinical research and education data - Useful information for clinical management - Evaluation of information system quality - Communication method among patients - Statistical data for national health

Application	- Timely management as provided by information application - Change of health condition
Impact	- Impact of health improvement after COPD - Feasibility of information system after application to patients
Improvement	- Effectiveness of information system - Improvement of patients' health due to information system

2.3 Study Materials

The patients who were diagnosed with COPD at least 3 months ago by thoracosurgery department of a general hospital in Chungnam area. The data were collected by interview and self-administered questionnaire from January 13 through February 14, 2014. This program was totally consisted 128 persons, it has been divided into two parts. The experimental group of 64 patients which was assigned as group with information application, while the control group of 64 patients was assigned as group with no information application. The two groups are compared to know the difference of the effects of health practice by information system application. In order to estimate the system efficiency, a follow-up test had been done for the health promoting behavior of a 16-week intervention program.

2.4 Study Methods

General characteristics of study subjects were measured by percentage and number. The χ^2-test was used to observe a statistically significant difference between experimental and control group. The pairwise t-test was done to compare the before and after intervention effect of health practice rate of COPD patients. It was also performed to determine statistically significant differences between the two groups on the satisfaction of a new experimental model for measurement of an information system for the prevention of COPD.

All p-values were found to be less than 0.05, indicating statistically significant differences for each variable compared between before and after the intervention of clinical information patients.

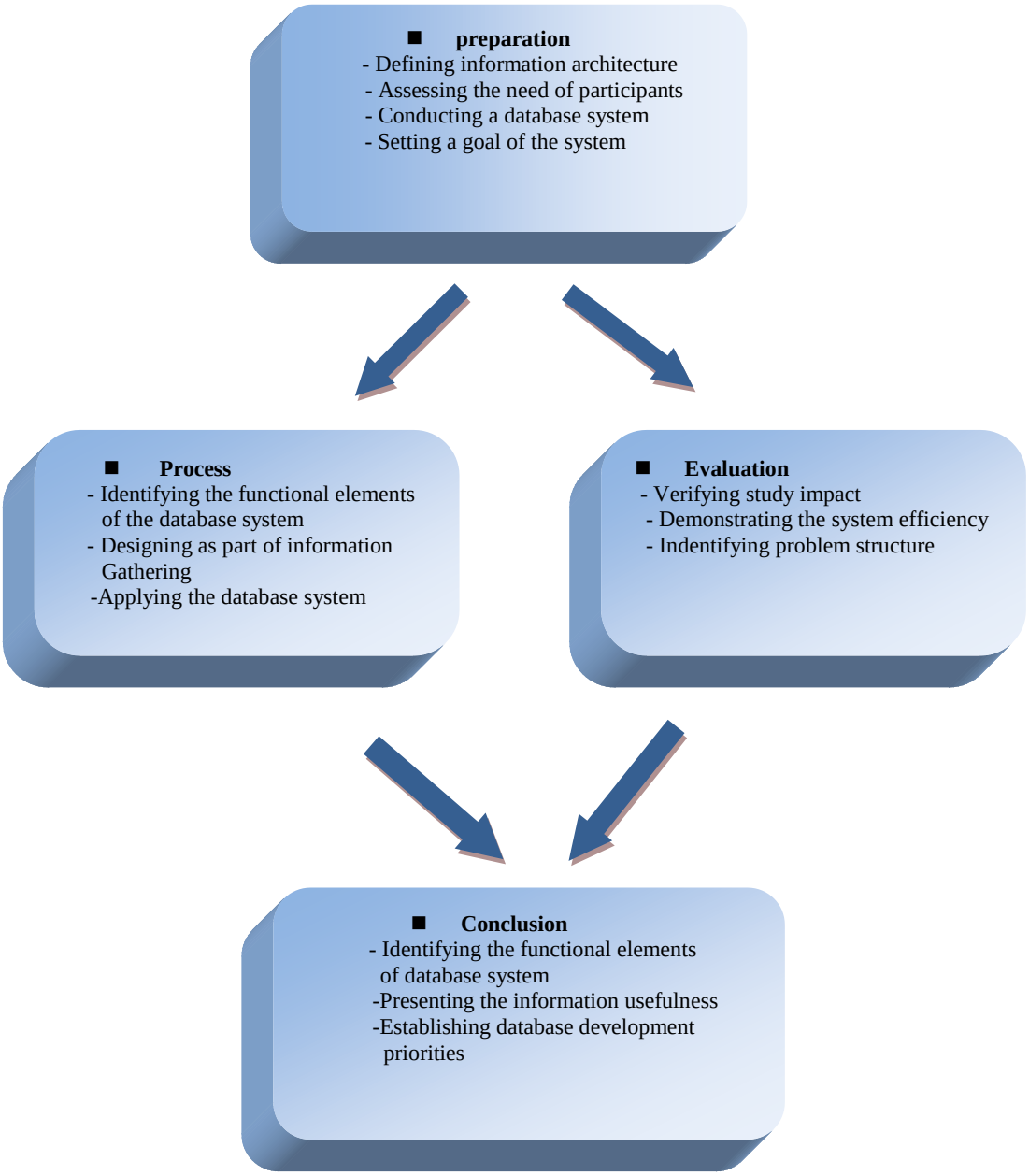


Figure 1. Process of Development of Efficient Information Model

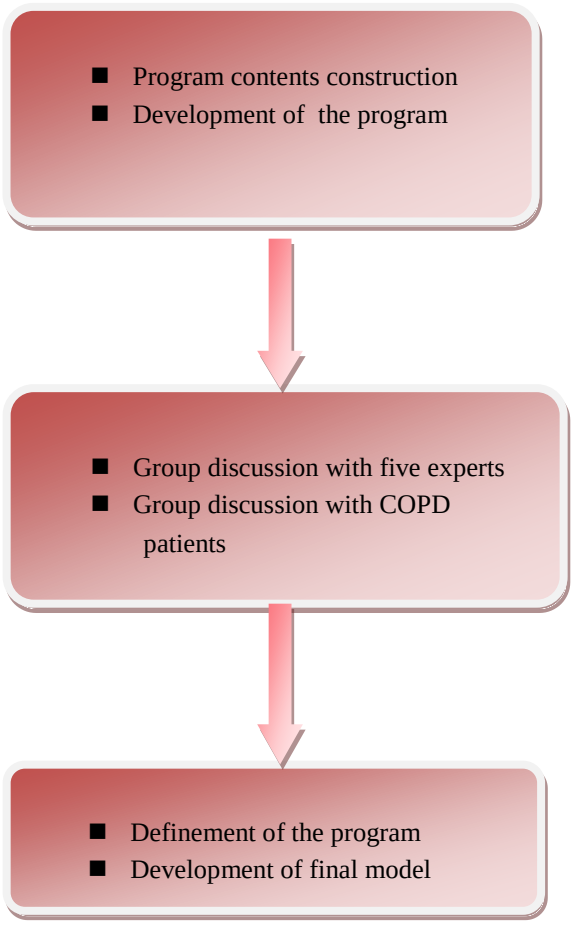


Figure 2. Composition of Three-Step Basic Strategies

3. Results

3.1 Basic Information of Study Subjects

Table 1 presents basic information of study subjects. The age groups were divided into less than 40 years, 41 to 49 years, 50-59 years, and 60 years old or more. 41-49 years old was lower in experimental group(20.3%) than in control group(25.0%). The respondent rate(32.8%) of control group was higher than the response rate(26.6%) of experimental group. However, there was no significant difference for the age group in the 50-59 years between two groups. The subject's gender was analyzed. The experimental group in a female with 64.1% showed higher than female with 60.9% in the control group. In a marital status, unmarried respondents with 29.7% in the experimental group were lower than respondents with 35.9% in the control group.

On the other hand, about respondents who have another diseases, the experimental group with 70.3% showed statistically significantly higher than control group with 32.8% (χ^2=5.74, $p<0.05$). Particularly, as for BMI, study groups were divided into 28 experimental group(43.8%) and 26 control group(40.6%) who had BMI≥25 kg/m². The experimental group higher than control group for BMI≥25kg/m².

Table 1. Basic Information of Study Subjects

Variables	Experimental group N(%)	Control group N(%)	χ^2
Age/yrs.			
≤40	5(7.8)	9(14.1)	13.81
41-49	13(20.3)	16(25.0)	
50-59	17(26.6)	21(32.8)	
≥60	29(45.3)	18(28.1)	
Gender			
Male	23(35.9)	25(39.1)	4.27
Female	41(64.1)	39(60.9)	
Marital status			
Single	19(29.7)	23(35.9)	6.90
Married	45(70.3)	41(64.1)	
Monthly income			
<200	17(26.6)	20(31.3)	10.58
201-400	31(48.4)	26(40.6)	
400≤	16(25.0)	18(28.1)	
Education level			
Under middle school	17(26.6)	13(20.3)	7.62
High school s.	28(43.8)	30(46.9)	
Over college	19(29.7)	21(32.8)	
Housemate			
Live alone	18(28.1)	14(21.9)	12.29
2-4	35(54.7)	42(65.6)	
≥ 5	11(17.2)	8(12.5)	
Another diseases			
Yes	45(70.3)	21(32.8)	5.74*
No	19(29.7)	43(67.2)	
BMI†			
18.5≤BMI<23.5	21(32.8)	17(26.6)	8.91
23.5≤BMI<25.0	15(23.4)	21(32.8)	
≥25.0	28(43.8)	26(40.6)	
Total	64(100.0)	64(100.0)	

†BMI : Body Mass Index

If X*i* are K independent, normally distributed random variables with means µ/and variances Ó²*i*, then the random variable is distributed according to the chi-square distribution. This is usually written [1]

$$Z = \sum_{i=1}^{k} \left(\frac{X_i - \mu_i}{\sigma_i} \right)^2 \quad (1)$$

The chi-square distribution has one parameter : K- a positive integer which specifies the number of degrees of freedom (i.e. the number of X*i*). The chi-square distribution is a special case of the gamma distribution. This is usually written [2]

$$Z \sim \chi_k^2. \quad (2)$$

3.2 The Effect of Before and After Information System Application

Table 2 represents the effect of before and after Information system application. For the mean score of clinical factors, comparing the mean scores in the dyspnea, subjects' score(75.18±1.63) after application was significantly decreased than subjects(91.37±2.85) before application(t=4.25, p=.000). On the other hand, for dietary factors, there was a significant difference in subjects who had intaked daikon after information intervention(t=-2.75, p=.000). The subjects who had intaked garlic were statistically significant difference after application than the mean score of subjects who didn't intake garlic before application of information system(t=-0.57, p=.000). For physical factors, there was a significant difference in subjects who do exercise after information intervention(t=-1.53, p=.000) before information application.

Table 2 The Effect of Before and After Information System Application

Items intervention	Before Mean±S.D	After Mean±S.D	t	P
Clinical factors				
Dyspnea	91.37±2.85	75.18±1.63	4.25	.000
Cold	62.14±0.29	48.60±3.47	2.13	.001
Headache	57.82±2.61	41.72±0.29	1.27	.076
Diabetes mellitus	46.57±0.62	43.29±1.53	3.84	.329
Hypertension	71.43±1.57	54.71±3.27	1.55	.018
Cholesterol	59.26±3.16	51.36±0.64	4.39	.574
Dietary factors				
Daikon intake	40.19±0.42	92.25±2.83	-2.75	.000
Carrot intake	36.62±2.19	94.18±0.57	-4.12	.000
Garlic intake	42.31±1.38	68.73±1.49	-0.57	.000
Pear juice intake	28.94±0.61	74.26±3.52	-1.49	.000
Dietary control	31.49±3.25	42.15±0.29	-3.17	.152
Smoking	63.27±2.63	41.79±1.64	2.94	.026
Alcohol drinking	79.54±0.81	62.52±0.38	0.27	.108
Physical factors				
Exercise	41.26±1.54	74.38±1.69	-1.53	.000
Body weight control	39.58±0.72	45.16±0.37	-2.76	.063
Abdominal compress	20.19±1.36	52.49±0.15	-1.49	.000
Stress control	63.74±0.45	48.27±2.74	2.65	.000
Abdominal respiration	21.36±1.98	43.59±0.53	1.54	.002
Insomnia control	57.69±2.34	49.53±1.29	0.82	.176

The t-test assess whether the means of two groups are statistically different from each other. This analysis is appreciate whenever you want to compare the means of two groups, and especially appreciate as the analysis for the posttest-only two-group randomized experimental design. This illustrates formula for the standard error of the difference between the means [4].

T-value = (Difference between group means) / (variability of groups)

$$= \frac{\overline{X_T} - \overline{X_C}}{SE(\overline{X_T} - \overline{Xc})} \quad (4)$$

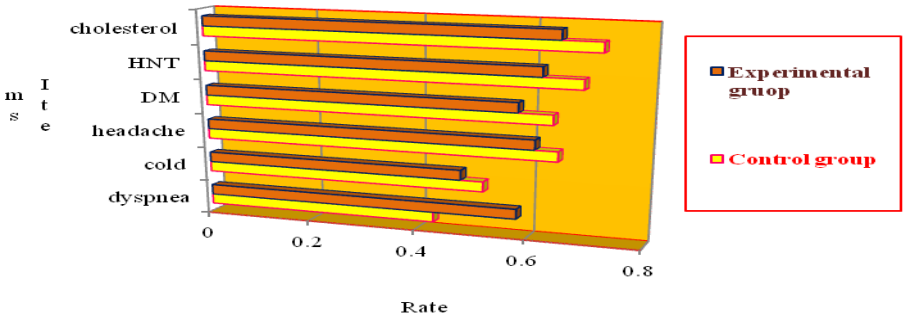
The paired t-test is actually a test that the difference between the two observations is 0. So, if *D* represents the difference between observations, the hypotheses are : *p*-value associated with it is low ($p<0.05$), there is evidence to reject the null hypothesis. Thus, this would have evidence that there is a difference in means across the paired observations [5].

Ho : $Do = 0$ (the difference between the two observations is 0)
Ha : $D0 \neq 0$ (the difference is not 0) (5)

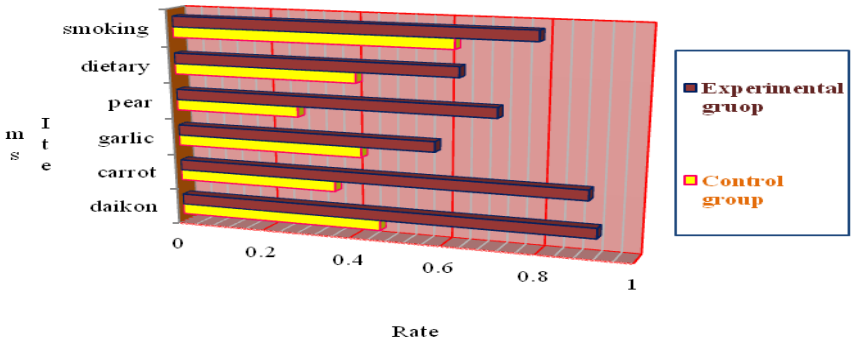
3.3 Comparison of Health Practice Rate According to Information Application

Fig. 2 compares the health practice rate according to information system application between two groups. For clinical factors, the experimental group who had dypnea was statistically significantly higher than the control group after information system application($p<.05$).

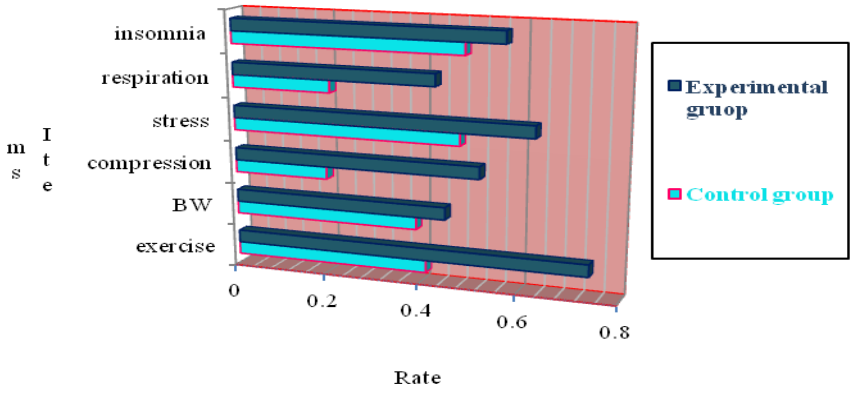
For dietary factors, the experimental group who has intaked the carrot was statistically significantly higher than the control group after information system application($p<.05$). However, for physical factors, the experimental group who has suffered from insomnia was also higher than control group after information system application. However, for physical factors, the experimental group who has suffered from insomnia was also higher than control group after information system application.



A. Comparison of Clinical Factors



B. Comparison of Dietary Factors



C. Comparison of Physical Factors

*Slope = $\frac{\triangle Y}{\triangle X}$ Where $\triangle X$: time interval
$\triangle Y$: variation of the effect by information system application

*Ratio = $\frac{\triangle Ya}{\triangle Yb}$ Where $\triangle Yb$: practice rate before application by information system
$\triangle Ya$: practice rate after application by information system

Figure 3. Comparison of Health Practice Rate According to Information Application

The slope is often called data x/deta y, This change in x/change in y. To actually calculate the y value of the triangle edge for a given integer value of x, as we move incrementally along the x axis one pixel at a time, we use the slope value.

4. Discussion

The purpose of this study was to assess the effects of the implementation of experimental group on data collection by the information system supplication. This attempt of a new experimental application was investigated to carry out about a significant improvement in COPD patients' health behaviors.

As a result of this study, it showed statistically significantly positive changes of behaviors such as taking daikon, controlling cold and dyspnea diminished the progression rate of COPD. The findings were similar with the previous studies on the respiratory disease[9],[10]. This study suggests that patients with COPD should be targeted for specific health behavioral intervention to prevent the progression of COPD. Based on the results obtained by the study, it is anticipated that this paper may be used as basic data for developing and interventing health promotion behavior for the COPD patients. In order to maintain desirable health behaviors, convergence educational program for COPD patients focused on health promoting behavior is more successful than single program. The results of this paper, after receiving application, there was a positive change for the abdominal respiration after application than before application in the mean score of abdominal respiration. The finding was consistent with the result of earlier researches[11,12]. Therefore, it needs to perform periodic respiratory management. There is a need for the program to be implemented on the groups who characterize having lower levels of health knowledge and health promoting behavior.

The present research showed that practice rate of the health behavior can be increased 52.9-64.1% by a database feedback system, which is similar to data reported in the previous studies[13,14,15]. However, for physical factor, it showed that the application

effect by a database system was not a significantly decrease. Accordingly, in order to achieve the application effect by a database system, it is very important to determine adequate application period and perform various programs in consideration of their circumstances. The present work elucidated throughout the statistical analysis how effectively the synthetic and systematic application contributes to health promoting behavior for the prevention of COPD. The future work should focus on the study of the application effect as a classification of COPD patients throughout more prolonged research based on a larger data base.

Until the present, the limitation of COPD patients lies in that there is nothing put into action despite the increase of knowledge. The result of this study would be the enhancement of practice behavior for the prevention of COPD. Thus, this paper indicated that the implemented systematic intervention showed significant positive effects on the life of subjects and health behavior. The quality of life in the experimental group has been enhanced as time passes by compared to control group. It also showed that it is an effective program for the prevention of COPD. This database system has been developed by complementing and revising preliminary program. Therefore, the database program for COPD patients implemented by application research is quite meaningful in that it is evidence-based program development which will contribute in replicating the intention under field conditions for COPD patients.

The COPD patients who had moderate stress control and who were under dietary care had better quality of life. Current practice of exercise in COPD patients was obtained through application of the database system. Therefore, adequate health practice behavior in COPD patients will improve their health status in accordance with proper database system. The development about the database system is so essential to the COPD patients. For successful performance of this study, this paper had tried to provide various information and enhance the practice rate of health behavior in COPD patients using a database system. So, there were many changes which improve the practice of health behaviors in COPD patients using the system. This study showed that a database system could help COPD patients in providing effective practice of their health behavior. Significant items such as abdominal respiration, abdominal compress, stress control and garlic intake suggested that continuous observation and assessment are required for the management of COPD patients. In addition, we hope that more application programs using database system are developed and expanded as necessary to enhance the health practice in patients with COPD.

5. Conclusion

The purpose of this research was to determine the effects of implementing the database system application to alleviate chronic obstruction pulmonary disease. For this, this research developed the experimental database. It conducted a positive effect on health improvement of COPD patients. According to this research, the database system on health practice for the COPD patients will be contributed on the prevention construction of respiratory patients.

Researchers can use the results as guidelines for designing health behavior and networks. As a result of this study, positive changes of behaviors diminished the progression rate of COPD. This paper found that the health promoting behavior in COPD patients was increased by 52.9-64.1% compared with the previous status and the patients positively perceived on a database system. Moreover, this paper showed that the system as health practice tool was a good way to enhance the practice rate of health behavior in COPD patients.

The database system for health promotion can be applied to any hospital which has respiratory disease. Also, this system can be extended to inpatient or outpatient

departments. With integration of the database system, the effective management in patients with respiratory disease would also be possible.

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I appreciate to study subjects who had participated in the design of clinical information model. The experimental model will provide effective services in multi-environments to patients and help for improving their health conditions of stroke patients. My paper entitled "The Effect of Database System Application to Alleviate Chronic Obstructive Pulmonary Disease", had been presented at the 7th International Conference on Advanced Software Engineering and Its Applications(ASEA) hold on December 20-23, 2014 at Haikou of Hainan in China.

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