

## A Study on the Real-Time Patient Management Program Development and Usefulness in Angio-Intervention Room

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**Abstract:** The aim of this study is to improve internal customer satisfaction of the new EMR-based scheduling and viewing program in intervention room. Survey process was applied before and after applying the new program, to 13 radiological technologist and nurses in angiography room and 70 ward nurses who have many interactions about interventions. Survey in the intervention room graded scale on 1-10 point by 13 people. And 70 ward nurses fill in a questionnaire by evaluating graded scale on from 1-5 point. In program satisfaction survey, wards satisfaction increased from 2.76-3.04 ( $p<0.001$ ) and intervention team satisfaction increased from 3.3-6.78 ( $p<0.001$ ) after applying the program. Phone from the wards decreased from 8.2-5.2 ( $p<0.002$ ) and intervention team workloads increased from 6.9-8.6 ( $p<0.001$ ) after applying the program. The surveyed data were processed by computerized statistics using SPSS18.0 Window. Ward survey results were analyzed by matched data analysis paired t-test and intervention room survey results were analyzed by Wilcoxon signed rank t-test because of small sample size. Ward nurse and doctor satisfaction increased. Because, they can easily search patient prepare, precaution and can search procedure time in real time after applying the program.

**Key words:** Intervention schedule program, EMR real time program management, procedure schedule, angio-intervention schedule, angiography intervention schedule, Korea

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### INTRODUCTION

To solve the contrarieties mentioned in the background of the study, questionnaire surveys were conducted with 70 nurses of seven wards that request many tests and procedures to the intervention room of S university hospital intervention before and after application of the program. Since, the operating rooms and intervention rooms of existing large domestic hospital do not open procedure (operation) schedules on-line in real time, attending physicians and nurses in charge of patients were experiencing many difficulties in relation to accurate explanations to patients and their protectors and in other various forms, their job satisfaction was quite low.

To solve such deficiencies, the program was developed and completed in collaboration with the medical information team in the hospital and was opened to the ward and the outpatient nurse room on-line in real time. Questionnaire surveys will be conducted with ward and intervention room workers before and after

application of the program to examined how much their customer satisfaction increased and since, high job satisfaction eventually shows high correlations with customer's loyalty to and preference for the medical institution, the effect that will make this program to be unprecedentedly supplied and propagated to the intervention rooms and operating rooms of university hospitals throughout the country is expected.

**Literature review:** Modern society can be said to be a society where if services are unsatisfactory and the customers do not feel satisfaction, they will not only not recommend the services to surrounding peoples but also advertise their dissatisfaction. Due to these problems, the society of today is called service society or service economy (Brandstrom *et al.*, 1998; Hilson, 2003). As one of important characteristics of modern society where we live the rapid growth of the service field can be cited. Medical services are also one of service industries to provide intangible services to satisfy customer's needs. The fact that worker's job satisfaction is connected to

patient satisfaction in the medical service field too has been identified in many studies. There are studies indicating that medical service worker's satisfaction and out of it, nurse's satisfaction in particular shows high correlations with patient's satisfaction and their preference for medical institutions. In addition, in domestic studies too, it could be seen that when national university hospital worker's job satisfaction, patient satisfaction and management performance were compared with each other, hospitals with higher job satisfaction showed higher patient satisfaction and management performance (Choi *et al.*, 2006). The intervention room of S University Hospital in Gyeonggi-do is place where extremely diverse procedures are implemented with more than 500 and procedure names. While seeking for methods that can be used to identify and handle new materials and preparation items and various complicated treatments before and after procedures more conveniently due to the diversity of various medical team's procedures, taking note of the advantage of computerization which is perfect, program development was initiated.

The past system in which patient's preparation items were informed to the ward nurses in charge by calling them through wire telephones and only those patients for whom the preparation has been completed were called through wire telephones to come down discarded and the system will be replaced by an online system. Currently, no university hospital in South Korea has any online system to inform expected time and current processes of progress of operation from working departments with uncertain expected required time such as operating rooms and similar tests or procedures under reservation systems.

The intervention room of the Department of Radiology is a place where tests and procedures for patients are performed. Since, preoperative treatments and postoperative treatments are different for every patient in many cases and procedure times are also irregular, the ward undergoes quite some inconvenience in guiding patients and their protectors and in preparing preparation items for the intervention room. To relieve the convenience, the ward developed a program that enables inquiries of procedures in the intervention room in real time as well as preoperative treatments and postoperative treatments by patient and applied the program to research. How, the real time procedure time inquiry program was introduced and how much internal customer satisfaction and customer satisfaction had been improved were surveyed. The production and application of the real time intervention room procedure schedule inquiry program (intervention patient management program) to the clinics are considered to harmonize well with the atmosphere of the full digital wireless hospital and this program was

developed to make the hospital open more information to the employees and patients and improve the quality of its services, so that, all of the employees, patients and protectors are satisfied. The intervention room of the Department of Radiology of S University Hospital located in Gyeonggi-do surveyed internal customer satisfaction and analyzed the results to find out points to be improved in the intervention room and conduct improving activities.

## MATERIALS AND METHODS

**Subjects and method of survey of internal customer satisfaction:** Questionnaire surveys were conducted with 70 ward nurses two times, one time before and one time after the development of the program. The subjects were the same for the two questionnaire surveys and each of the selection type questions was to select among 1 through 10 points full score in units of 1 point.

**Ward questionnaire survey subjects and method:** The questionnaire survey was conducted with 70 nurses of seven wards that request many tests and procedures to the this room and the subject's clinical careers were 5 years or less in the case of 48 subjects, 6~9 years in the case of 15 subjects and 10 years or more in the case of 7 subjects. The questionnaire consisted of contents regarding the degree of understanding of tests and treatments before and after procedure, satisfaction with methods of communication through wire telephone as with the previous system (on call system) and the new system (real time procedure time inquiry program) and other complaints and among nine questions in total, six were selection type questions and three were multiple choice type questions regarding sex, age and work career (Table 1).

**Intervention room questionnaire survey subjects and method:** The questionnaire survey was conducted with 13 intervention room workers with clinical careers for 5 years or less in the case of three subjects, 6~9 years in the case of six subjects and 10 years or more in the case of four subjects. The questionnaire consisted of three questions regarding satisfaction with the previous system to call patients to come down through wire telephone (on call system) and the new system (real time procedure time inquiry program), one multiple choice type question and one descriptive question (Table 2).

The data from the questionnaire surveys conducted as such were statistically processed through computing using SPSS 18.0 for windows. The ward questionnaires were analyzed using paired sample t-test variance analysis and the intervention room questionnaires were analyzed

Table 1: Ward questionnaire survey contents

Variables	Values
<b>Gender</b>	
Male	6
Female	7
<b>Work career (Years)</b>	
1~5	3
5~10	6
10 or more	4
Mean	8.69 years
<b>Age</b>	
20s	1
30s	8
40s	3
50s	1
Mean	38.8

Table 2: Contents of intervention room questionnaire survey

Variables	Values
<b>Gender</b>	
Male	0
Female	70
<b>Work career (Years)</b>	
1~5	48
5~10	15
10 or more	7
Mean	7.36 years
<b>Age</b>	
20s	45
30s	20
40s	5
50s	0
Mean	36.7

using non-parametric Wilcoxon rank t-test variance analysis because the number of samples was small and the paired sample correlation coefficient did not follow normal distribution.

**Target and method of program development:** This researcher one professor at the intervention room and a radiological technologist participated in the development by requesting to one member of the medical information team and the program was made with an interface compatible with the existing EMR (Electronic Medical Recording) system (Cowin *et al.*, 2008).

Before the present program was developed, to see whether each patient is suitable for intervention procedures or falls under contraindications, patient's individual information was identified by accessing the EMR (Electronic Medical Recording) system for the individual patient to inquire about various kinds of information and values.

However, the inquiry window of the newly developed program was applied with contents that can be identified very conveniently, so that, adverse effects such as the mechanism of contrast media, whether metformin is taken or not, GFR (Glomerular Filtration Rate) values and adverse effects and the details of infection in the alert window can be identified at a glance. Based on the results of the 1st questionnaire surveys conducted with ward and intervention room workers, the initial program was developed through several mistakes and errors and

the program was completed through revising and supplementing research. In addition, through continuous upgrading, all added or deleted contents were reflected on and stored in the program to apply the program to procedure work (Weisman *et al.*, 1993).

## RESULTS AND DISCUSSION

**Results of ward questionnaire survey:** According to the results of the ward questionnaire survey, among the 70 subjects in total, 48 had careers not exceeding 5 years, 15 had careers of 6~9 years and 7 had careers of at least 10 years, so that, the mean work career became 7.36 years. The mean age was 36.7 years and all the subjects were females due to the characteristics of nurses. The subjects of the questionnaire surveys before and after the development of the program were the same and mean satisfaction generally increased between before and after application of the program as follows, the mean satisfaction score of question No. 1, "patient's inquiries of expected test time" increased from 1.97 points before opening the program to 2.52 points after opening the program, that of question No. 2, "Have you ever heard complaints from patients because you did not know procedure beginning time accurately?" increased from 1.84-2.11 points, that of question No. 3, "How many of pre-procedure preparation items do you know?" decreased from 3.61-3.50 points, that of question No. 4, "How many of post-procedure matters that require attention do you know?" increased from 3.62-3.77 points, that of question No. 5, "telephone call volumes" increased from 3.71-3.94 points and that of question No. 6, "satisfaction with the on call system" increased from 1.84 points to 2.38 points (Table 3).

However, question No. 3, pre-procedure preparation items with a decrease in the score from 3.6143-3.5000 points and question No. 4, post-procedure matters that require attention with an increase in the score from 3.6286-3.7714 are contents well understood at normal times and the results are considered to be unsatisfactory because the original EMR program has an advantage of enabling the inquiry of the purpose of test (procedure) and matters that require attention. It could be seen that there was no particular event before and after the development of the program and the total mean increased from 2.769-3.040 points verifying that the program brought about quite some improvement (Fig. 1).

**Results of the intervention room questionnaire survey:** The number of entire workers in the intervention room of S University Hospital in Gyeonggi-do is 13 consisting of three with careers not longer than 5 years, six with careers of 6~9 years and four with careers not shorter than 10 years and their mean age was 38.8 years. Their mean work career was 8.69 years and of them, 6 were males

Table 3: Paired t-test (ward) of questionnaire surveys before and after development of the program

Questions/Program	Mean score (full score; 5 points)	SD	Standard error of the mean significance probability	p-values
<b>1</b>				
Before	1.97	0.83	0.100	p = 0.000
After	2.53	0.91	0.109	
<b>2</b>				
Before	1.84	0.93	0.111	p = 0.001
After	2.11	0.96	0.114	
<b>3</b>				
Before	3.61	0.80	0.096	p = 0.073
After	3.50	0.78	0.093	
<b>4</b>				
Before	3.63	0.75	0.089	p = 0.040
After	3.77	0.75	0.089	
<b>5</b>				
Before	3.71	0.76	0.091	p = 0.005
After	3.94	0.78	0.093	
<b>6</b>				
Before	1.84	0.81	0.097	p = 0.000
After	2.39	0.97	0.116	

Table 4: Non-parametric Wilcoxon rank t-test (intervention room)

Parameters	Call volume	Procedure time	Hand over	Workload	Occurrence of civil complaints	Satisfaction
Approximate significance probability (p-value)	0.002	0.002	0.180	0.003	0.004	0.001

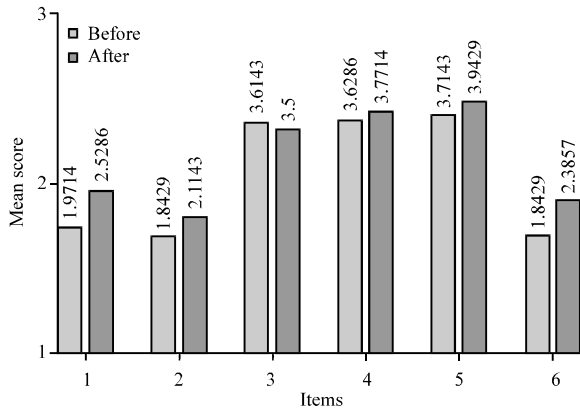


Fig. 1: A graph for the results of the ward questionnaire survey

and seven were females. The overall results of the questionnaire survey conducted on 6 items, call volumes, procedure time, hand over time, workloads, occurrence of civil complaints and satisfaction indicated improvement from 3.30-6.78 points and the difference was identified as being statistically significant at the significance level of  $p < 0.001$  through analysis. However, the data were analyzed using non-parametric Wilcoxon rank t-test variance analysis because the number of samples was small and the paired sample correlation coefficient did not follow the normal distribution (Table 4). The overall call volume score decreased from 8.46 to 5.23 points between before and after the application of the program and the procedure time related call volume decreased from 8.00 to 4.69 points ( $p < 0.002$ ) (Fig. 2).

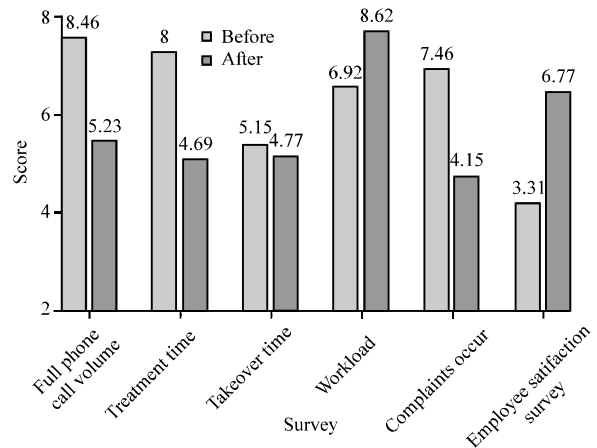


Fig. 2: Graph of the results of the intervention room questionnaire survey on satisfaction

The work hand over score decreased from 5.15 to 4.77 points indicating that there was no particular difference while the intervention room workload score increased from 6.92-8.62 points between before and after the application of the program and the score for the rate of occurrence of civil complaints decreased from 7.46 to 4.15 points ( $p < 0.004$ ).

The intervention room employee's satisfaction score out of the full score of 10 points increased from 3.30-6.78 points between before and after the application of the program ( $p < 0.001$ ).

**Program development:** To relieve the existing onerousness of furnishing books to manually record

patient books and dually preparing patient lists by writing patients records one by one on whiteboards, the real time procedure time inquiry and input program comprises a screen that enables the ward to inquire into the information input by the intervention room and a screen that enables the intervention room to inquire into and revise the information linked with the transfer program and the electronic notice board program.

In the case of inpatients, the information can be immediately entered by double-clicking the request to other department (consult) with the inquiry function in the window below the “intervention room schedule registration” window or by entering the registration number. However, in the case of outpatients or patients to be hospitalized later, the date should be selected to inquire about or enter information.

The screen was configured to enable inquiries by procedure field that is the abdominal system, the brain-nervous system, the chest system, the spinal system, the urinary system, the nonvascular system and other regions and when a procedure has been received, a patient list is created at the bottom of the screen.

To enter a schedule, if the horizontal cell where the patient is shown in the list at the bottom, the relevant patient will be moved to the screen on the top and if procedures are aligned in order and stored, the procedures can be inquired in the ward.

The pretreatment and post treatment input screen and expected required times have basic values entered for every test or procedure name and these values may be changed in case necessary.

To be prepared for inquiries through wire telephone calls, the phone numbers of individual fields of the intervention room were added, so that, they will be shown in brackets when the patients under charge are clicked and the phone numbers were programmed to enable inquiries by ward as details.

In addition, the contents of matters requested input by the intervention room can be seen and when preparation for a patient has been completed, if ‘preparation completed’ is stored, the details will be indicated in blue in the preparation items cell on the intervention room, so that, procedure can be performed for prepared patients first. In addition, the screen was also programmed to enable the ward to identify the pretreatment and prior preparation items for patients under charge, so that, the ward can prepare them in advance before the procedures.

This is a system that enables calling the patient immediately without the necessity to make wire telephone calls because when various kinds of prepared information on the patient have been entered, they will be seen in the intervention room. The states of progression on the

electronic information display board in the protector waiting room are divided into ‘preparing’, ‘in procedure’, ‘being recovered’ and ‘being transferred’ and when the transfer staff stores ‘arrived’ as soon as the patient arrived in the intervention room, ‘preparing’ will be automatically entered and ‘in procedure’, ‘being recovered’ and ‘transfer requested’ will be manually entered and stored by the nurse in charge.

When the state of progression of the procedure for a patient has been turned into ‘in procedure’, the time will be entered as the procedure beginning time, so that, the ward nurse can see the current process of progression of the procedure for the patient under her charge and can forecast the procedure finishing time to prepare for the next patient. When the state of progression of the procedure for a patient has been stored as ‘being recovered’, procedure finishing time will be entered so that the ward arrival time of the patient after completion of the procedure can be forecasted and when ‘transfer requested’ has been entered, the patient transfer will be automatically registered in the transfer program, so that, the transfer staff can begin the transfer. The system was programmed, so that, the patient name will disappear when the transfer to the ward has been completed.

**Details of development by intervention room cell (Table 5):**

- Schedule cell
- Alert view cell
- Registration number (ID) cell
- Name/age/sex/ward cell
- Diagnosis name cell
- Procedure 1 cell
- Procedure text cell
- Procedure 2 cell
- Time/room cell
- Comment cell
- Condition cell
- Enterer cell

**Details of development by intervention room icon:**

- Calendar icon
- Large icons that can be divided by room
- Division icon for entire rooms and by part
- Notice icon
- Patient transfer program icon
- Delete/refresh/new/revise/store icon
- Consult icon
- Excel icon

**Development of the ward program:**

- Schedule inquiry
- Pre and post-procedure treatments and preparation items

Table 5: Details of program development (intervention room and ward)

By applied room/ Items	Intervention room		Ward	
	By cell	By icon	Entire screen	Preparation items and actions taken
Detailed items	Schedule	Calendar	Order of procedure	Pre-procedure preparation items
	Alert view	Room division	Current procedure state	Post-procedure matters that require attention
	Registration no.	Entire division	Procedure room	Comment entry window
	Name/age/sex/ward	Division by part	Order	Fasting
	Diagnosis name	Notice	Beginning time	Denture removal
	Procedure 1	Patient transfer program	Finishing time	Written agreement
	Procedure text	Delete	Expected time required	IV line
	Procedure 2	Refresh	Name	Skin pre
	preparation items	New	Registration No.	Foley cath
	Time/room	Revise	Ward	Underwear undressing
	Comment	Store	Sex/age	Whether any analgesic was administered
	Condition	Consult	Procedure name	Sandbag
	Entered by	Excel	Remark	ABR

**Electronic display board program:** This program is interlocked with the electronic display board monitor in the protector waiting room and the condition cells of the schedule program in the intervention room to automatically update and show conditions such as preparing, in procedure being recovered and being transferred. To be prepared for cases where an emergency patient appears and the procedure order is changed, a program that enabling writing comments with the flowing characters at the bottom maximally considering customers.

**Drug and value program**

**Metformin view:** Metformin is prescribed for type 2 diabetes as a primary drug because sugar is made even when no sugar has been taken, that is during hunger information on patients with diabetes, hypertension or hyperlipidemia that take Metformin was programmed so that it can be read from EMR (Electronic Medical Recording).

**Cr/GFR(Creatinine/Glomerular Filtration Rate) view:**

Creatinine is an element that is changed when proteins are at the highest value after performing large amounts of exercise and plays the role of delivering energy to cells in the body as with proteins. Since, creatinine delivers energy almost only to muscles, it is frequently taken by those that perform fitness. Its chemical formula is  $C_4H_9N_3O_2$  and its value should be carefully watched, since, this value maintained high for long periods of time made bring about hypertension and diabetes.

Glomerular filtration rates are included in renal function tests and it is an indication of the degree of excretion of a certain substance through urine for 1 min. as the volume of the plasma that contains the substance. In the case of patients with problems in renal functions, the GFR value is very important before using the contrast

medium and since, GFR has great clinical significance for the early detection of renal disorders, the tracking of the progress of end phase renal disorders, the evaluation of the appropriateness of alternative therapy for the kidney and the determination appropriate doses of drugs for which drug removal rates by the kidney are important, intervention rooms that use contrast made should pay great attention to GFR values. Therefore, the program was written to be capable of reading the values.

After the development and application of program, ward nurse’s and medical team’s satisfaction was improved because test and procedure times can be inquired in real time from the ward and patient’s preparation items and matters that required attention can be searched, inquired and stored.

Intervention room workers felt that their workload increased because of onerousness of computerizing the contents that had been recorded manually before the development of the program but their satisfaction was improved remarkably by the time when the study was completed and the number of inquiring phone calls and the number of occurrence of complaints by patients and their protectors also clearly decreased. For many reasons as such, the program greatly helped communication with medical teams, so that, everybody’s satisfaction was improved.

Therefore, departments that perform surgery, procedures or other reserved tests of all university hospitals in South Korea should apply (open) programs as such to respond to patients and their protectors more accurately and kindly and to make efforts to relieve the fatigue of internal customers that is employees that are relatively vulnerable to external customers.

Since, all programs enable downloading Excel data, the statistics of times required by professor for the same procedure name can be known but the disclosure of individual pieces of information as such is considered to

be difficulties and since, the flows of the waiting time before procedure and the recovery waiting time after procedure can be known, more efforts should be made to identify problems in long waiting time in order to enhance customer satisfaction.

The reason why the workload of the intervention room is felt to have increased on the contrary to the results of the study is considered to be that all employees think that they now should enter, revise and inquire those prices of information that had been recorded manually on whiteboards by one person in charge in each room manually because the schedules of all patients have been computerized. Over time, the fact that this program is much more convenient and accurate will be recognized and this program will become easier to use, so that, satisfaction with it should be enhanced.

### CONCLUSION

In the surveys of program satisfaction, the score of satisfaction increased from 2.769 points before implementing the program to 3.040 points after implementation in the case of the ward ( $p < 0.001$ ) and increased from 3.3 points before implementing the program to 6.78 points after implementation in the case of the intervention room ( $p < 0.001$ ). Wire call volumes decreased from 8.2 to 5.2 points after the development of

the program ( $p < 0.002$ ) and the workload of the intervention room increased from 6.9 points before the application of the program to 8.6 points after the application of the program ( $p < 0.001$ ).

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