Stimulation of medical decision expert system by using of time color Petri net method

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Abstract

The role of management science methods in solving the health problems is a clear potential for improvement. Such an approach in an advanced health care system is achieved for improving the condition of treatment, increasing the efficiency and useful planning of time and human resources.

In this study, by using one of the artificial intelligence methods, time color Petri net method, the stimulation of the hospital environment and designing of expert system for optimizing of system, will be done.

Key words: *artificial intelligence, hospital expert system, time color Petri net method, hospital efficiency, system modeling.*

1. Introduction

Petri net is a system based on mathematical and graphical modeling for analyzing of system properties. The modeling is done by using the time color Petri net method, the complicated system of decision for solving the management problems and planning of the medical and nursing service system. In this research, by using the Matlab software, the planning of the hospital decision environment is carried out in order to increase the hospital efficiency [1].This descriptive-observational study is based on patient input information and Boo Ali hospital work forces, which is for Islamic Azad University Tehran medical branch, and sampling method was gradual-random method. The input criteria of this study are taken from HIS system (Hospital intermediate system) within two years (2010 & 2011). Analyzing of data is done by SPSS software and finally the modeling has been done by using of time color Petri net and designing of the expert system.

2. Background or research

From the early 1950s, the artificial intelligence was created and in 1970s Edward Migen Bam had an introduction to the creation of expert system. In 1976, a kind of software offered in order to diagnose the previous disease. In 1999, Mourtou Efstratia has been done the modeling of patient electronic records with Petri net and Matlab software in one of Greek hospitals. In 2000, Jeanbeen Jorgensen modeled patient electronic records with Yawl software and Petri net and in 2008, medical decision systems has

been done by J.Valach. Therefore, these factors are used in that model which we will introduce it[2].

3. Finding

3.1. Medical decision making system and expert system

Clinical decision support system (CDSS) which is designed by computer software, is for helping to the hospital management system in order to making appropriate decision and diagnosis for improve the patient's condition. According to the Dr.Robert Mivard, the clinical decision support system (CDSS) is a link of health views for affecting on the increasing of efficiency and improving the health care. In addition, an expert system is an intelligent computer program which uses the knowledge and conclusion methods for solving issues that because of its difficulty it needs to the human experience and skill. It includes two main components: data base and conclusion machine.

4. Using the time color Petri net for time modeling in medical decision system

Firstly, in this study, by using time Petri net of hospital environment and hospital management system for designing expert system, the modeling has been done [3].

It is assumed that by using management challenges we can provide better services and decrease the costs for patients and then we can design the clinical decision expert system (figure 1).

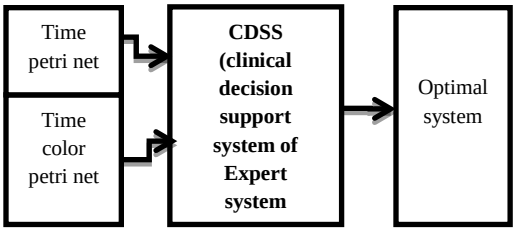


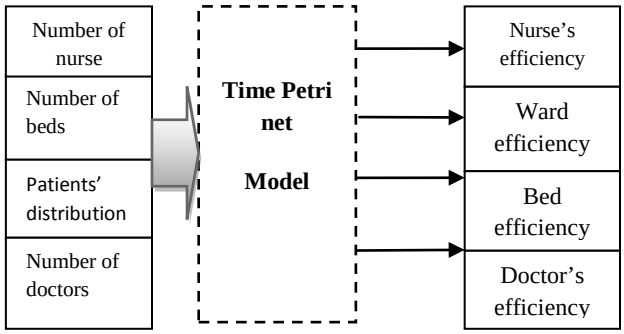
Fig1. Clinical decision expert system Modeling

1) Description of details in this study.

2) Time color Petri net approach.

4.1. Mathematical calculations for entering to the Poason input system

With exponential service time, based on the number



of individual who enters to the system there are some

Fig 2.clinical expert intelligence system modeling by

patterns similar to patterns of patient arrival to the place of service. These patterns describe the time of service so we called them 'service pattern'. We show the level of expected service with μ (mu). ɣ shows the frequency of occurrence data in the time of given service and $\gamma = \mu * e^{\wedge}(-\mu t)$, γ shows the level of service and t is the service time. Accordingly, the number of entry of individual to the system is

P n= (1- λ/μ) * (λ/μ) ^n. n is the number of individual in the system and λ is the number of entry and μ is the level of service. This formula shows the probability of a given number in the system, means the number of waiters plus the number of individual who have given service. The difference in the formula between system and queue is important. Every 48 hours means 576 steps or on other word is 576 × 7min. every steps is equal to 7min [3].

For multiplying of probable distribution in the time of delay of non urgent transfers in the model of various parts, the time recorded data was analyzed that we observed the results. In stimulating of model, the distribution of transitions is used. We define the time unit as minute in this stimulation. Based on this, we define the waiting time in the queue as: λ/μ (μ-λ) based on mentioned definitions and the summery of mathematical calculation, the designing of clinical expert intelligence system has been done.

Petri net: (P, T, W, A), P: place ,T: transition , W: weight function ,A: arc

$$System-Performance=(\sum_{i=1}^{g}Perfomance)/G\ ,$$

G:the number of all kind in a system

$$Nurse\_Performance=((\sum_{j=2}^{9}((nstep-\sum_{i=1}^{nstep}n(if\ \ t_js_i=0\rightarrow n=1))/nstep$$

$$+(\sum_{j=31}^{38}((nstep-\sum_{i=1}^{nstep}n(if\ \ t_js_i=0\rightarrow=1))/nstep))\times 100W_N$$

:n step: total number of step,t_js_i:the activity time of transition in i step,w:the number of service in a system Designing of this system is done according to modeling of figure **2**. The Inputs in this system and thus the outputs resulting from running program are observable in the following figure**.**

4.2. using time Petri net

In fact, in this research we study the tension and interaction between various parts of hospital and then data will be collected and modeling will be done by Matlab software based on mathematical calculation. Modeling of patient care service is designed for reducing the patient waiting time and increasing the time of giving service to patient with expert system. The algorithm design of expert system is carried out based on block diagram of figure 3 and then the modeling will be done according to table 1 which shows patient movement time data and based on table 3 which shows nurse shift considering that the range of nursing activity is 44 hours. Figure 4 is the graphical display window of running program. The results of running program are observable in table 4. By studding of above results and studding and making changes in input parameters we can increase the efficiency of system[5].

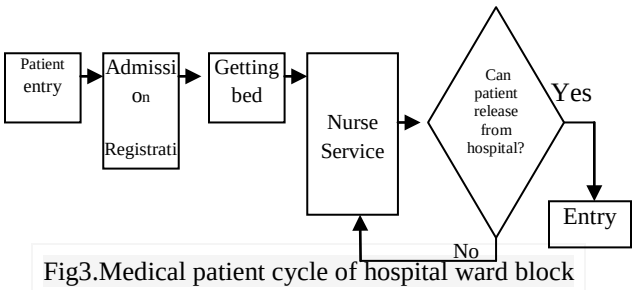


Fig3.Medical patient cycle of hospital ward block diagram

Table 1: Shown patient cycle time

patient number	Reception entry time	Entry time	doctor time	Infusion time	nurse service time
1	8.3	9	15	10	15
2	13.05	13.3	15	7	20
3	1	1.15	25	10	25

other service time	waiting time for bed	bed	nurse num
20	15	27	3
27	12	27	3
30	16	27	3

Table 2: Analysis patient ensure time (min) of hospital

Patient kind(ensure need)	Doctor service	Nurse service	total
Less ensure	5	10	15
Average ensure	10	20	20
High ensure	20	25	65

Table 3: Nurse Shift time

shift	clock
1	8-14
2	14-20
3	20-7

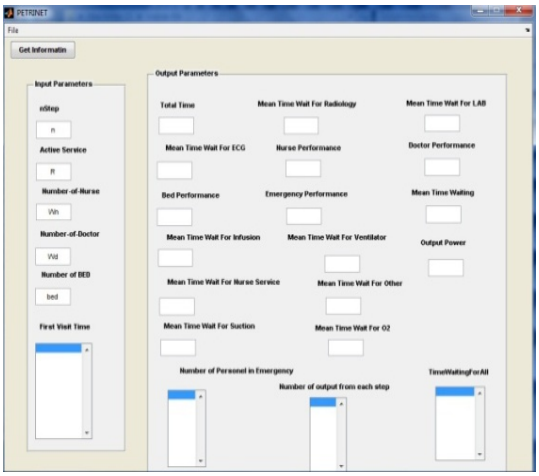


Figure4. Window of running of Time petri net of Matlab software programming

Table4.Input data table browse for program run

Patient number	Input patient time to emergency	Doctor emergency visit time	Lab time
1	21.5	21.5	21.55
2	17.31	17.3	17.4
3	21.12	21.12	-

ECG time	Get ECG time	council time REQ	Get REQ time
21.5	21.5	22.3	-
17.35	17.35	17.35	20.2
-	-	-	-

5. Modeling by using time color Petri net method

In this study, the modeling is done based on determination of Petri net color and detection time for tokens and physical behavior of system. By improving the mentioned mathematical relations and following relations[5]:

CTPN = (P, T, D, h)
,$P=\{p_1,p_2,\ldots,p_n\}$,$T=\{t_1,t_2,\ldots,t_5\}$,D:is a finite set of order pairs (p_i,t_j) defining input place and (pj,ti) definig output place,h:P→{0,1}→is an association function a mapping from places to real 0 and t∈T,and (h(p1),…,h(pi)),$h(p^*)$=OR(and(h(p_1)),…,h(p_i)),The designing of clinical expert system is done by using of time color Petri net according to figure 5.

M:marks(job token),M':fire and generates ,M'(p)=M(p)-I(p,t)+O(p,t),t→(t+60+delay()):receive time stamp.

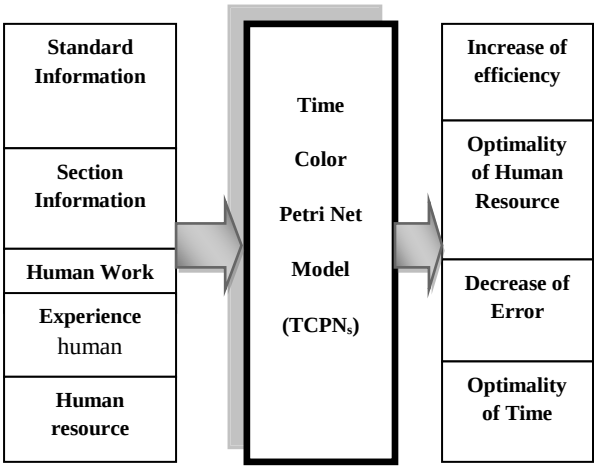


Fig5.clinical expert system modeling by using time color petri net method

For modeling, determination of places and color of tokens and transitions we should studding the content and technical criteria such as patient criteria like continuing of health service, personnel criteria like increasing coordination among nurses and hospital criteria such as decreasing the length of stay in hospital and operational criteria like increasing of concentration. Also we will study the optimal skill combination in different parts of hospital and then we apply the percentage of nursing and doctor skill in various parts of hospital. To determine percentage of skills, main approaches such as analysis, duty, record of experiences, analysis of activities and professional judgment has been studied. Table 6 shows the percentage of nursing skill in different parts of hospital [6].

Table 5: organizational structure of hospital

ICU	Coefficient w ICU	Coefficient w ICU	CCU		Title bed
organizational structure of hospital			1	m	Head of section
			1	h	Head nurse
N= Round (B × W)	2.08	1.1	N= round (B × W)	n	Nurse 44h
N= Round (B ×W)	1.33	1.3	N= Round (B × W)	n	Nurse 36h
B=The number of active bed in this section					

Table 6: According to the identify card of beds

total	**Skill combination**		**Title of hospital ward**
	Co-nurse	nurse	
100%	10%	90%	CCU
100%	5%	95%	General ICU
100%	25%	75%	Pediatric surgery
100%	20%	80%	emergency

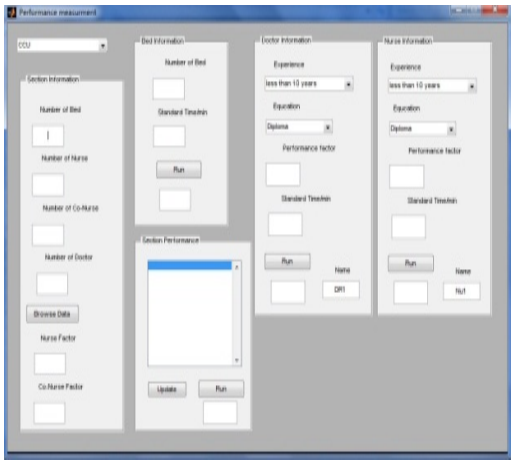


Fig6. Window of running program of time color Petri net

Modeling

This table is formed based on engineering and

technical analysis of duties in different parts of hospital by using the scientific methods. Table 7 shows coefficient of human resources who employed in nursing and healthcare service personnel in different parts of hospital in the form of bed ID and

weekly required hour work. According to the above explanation and by using time color Petri net and programming wit Matlab software, the modeling and designing of clinical expert system is done and after

running the program we can see the graphical model of window of running program in figure 3. After entering of data to the running of program we will see the results in table 7.

Table 7: the result of running program of TCPN modeling

Num of bed	Num of nurse	Num of co-nurse	Num of doctor	Num of standard bed	Nurse factor	Co-nurse factor
8	5	1	3	8	.33	.33
12	4	1	5	16	.44	.44

Standard time/doctor/min	Nurse information experience	Education of nurse	Performance of doctor factor	Doctor Time/min	Doctor information experience
15	<10	B	.11	25	<10
10	>10	B	.5	40	>10

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Table 7: continuo the result of running program of TCPN modeling

Standard time/min nurse	Education of doctor	Performance factor
7	GP	.11
7	B	.5

Doctor Performance %	Nurse performance %	Hospital performance %	Bed performance %
80	30	50	44
40	55	35	30

By considering the results of table 7 and table**4,** Which is output of two programs of time color Petri net and time Petri net, we can increase the efficiency of system such as bed, workforce, hospital and time management by studding and analyzing of defined input criteria[7].

6. Conclusion

In this research, we stimulated the hospital environment and designed hospital expert system by using of time color Petri net and presenting of new form in this method. Knowledge management technology in an organization presents a method in order to optimize the patient healthcare service. By using complicated methods (random models, mathematical, artificial intelligence and statistical methods) and by improving of this modeling and using of other artificial intelligence in the near future and by analyst approach we can improve and modify the hospital structure with reengineering of it.

7. Refrence

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