Study on Clinical Patient-oriented Education System for Medical Organizations

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ABSTRACT

Recent healthcare studies evaluate the effective impacts of a patient educational information intervention in hospitals on adherence to communicating knowledge, life quality, and therapeutic response in patients treated with highly active therapy in medical organizations. Therefore, the aim of this study is to design and implement the effective and systematic frameworks by providing clinical patient-oriented education system(CPES), which enhances health promotion and medical cures. CPES initiatives accelerate positive financial returns with network-driven educational system. To validate the CPES, the author analyzes the efficiency and effectiveness using statistical survey works. With this outcome, it is compared with previous system. One of the findings is that the system can improve compliance with treatment right dietetics and give patients self-manage their conditions in S hospital. Patients' acknowledge of their condition and its treatment process can be improved through the educational systems.

Key words : Collaboration, Communication, Education, Hospital, Patient

의료기관에서의 환자 중심 교육 시스템 연구

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요 약

환자의 입원전후, 입원생활, 수술전후, 퇴원후 정보교육 및 식사 영양지도 등 의료 기관에서의 적재 적시적 환자교육 정보의 부재, 지연과 오류는 임상적 예후는 물론 의료의 질 저하와 의료분쟁 등 심각한 문제를 야기시키고 있다. 따라서 최근 의료선진국을 중심으로 의료의 질 관리, 상호소통 및 의료분쟁의 화두와 함께 맞춤형 환자교육 체계의 중요성이 크게 부각되고 있다. 의료진, 원무행정 및 임상 실험실들을 중심으로 환자교육이 네트워크기반으로 활발하게 이뤄질 때 의료 질이 향상되고, 궁극적으로 병원의 경영이익창출에도 도움이 되는 것으로 S병원 사례에서 유의미하게 나타났다. 이러한 동기에서 본 논문에서는 CPES 개념의 연구를 바탕으로 웹기반 맞춤형 환자교육 시스템을 제안하고 S 병원을 대상으로 설계와 구현을 진행하였다. 더불어 S병원에서의 실증적 계량분석을 통해 맞춤형 환자 중심 교육 시스템의 도입 효율성과 효과성을 분석하였다.

키워드 : 협업, 커뮤니케이션, 교육, 병원, 환자

1. Introduction

Patient-orientated education(or patent education) is widely acknowledged as a core value in patients through medical staff interactions[1][5]. The educational system can improve patients′ better understanding and compliance with their medication and medical cure as well as care.

Clinical effectiveness can also be enhanced by improving the education quality of the physician and staff-patient interactions[18]. When patients learn how to have a meaningful discussion with their physician and clinical staffs, they are more likely to provide forehanded clinical reports of their illness symptoms and adverse reactions. It minimizes possibilities that the patient gives up therapy without first contacting their educational system due to lacking of explanation of physician or other medical staff. Clinical results can also improve significantly when the quality of patient self-care improves[7][10].

Patient education plays an important role in reducing risk in given conditions such as cardiovascular disease and in improving treatment of conditions like congestive heart failures. Clinical ignorance error has critical consequences in health care process. Forehanded collaborative education to patient promotes mutual clinical value creations and emphasizes medical quality increases[1][6].

From this motivation, this paper proposes the design and implementation approach of the clinical patient-oriented education system(CPES), and investigates the potential impact of the CPES based on empirical study in Section 4.

CPES can be applied to in-patient as well as out-patient. It includes a personalized educational diagnosis based on problems with personal or family medical histories so that it enhances self-treatment   medications to the acute and chronic illnesses[8][13].

The objectives are to improve patient knowledge regarding disease, transmission mode, monitoring and treatment and to prepare patients for problems they might encounter in real-life situations. Patients are given a therapeutic planning over the system through physicians and staffs who participated in the educational system for enhanced communication.

They can update patient education contents. CPES initiatives accelerate positive financial returns with network-driven educational system [2][17]. CPES may evolve in terms of (i) patient interaction, (ii) strategy focus, and (iii) medical education, as depicted in Fig. 1.

Currently, some overseas advanced hospitals are creating their own infrastructures for modernizing their systems by taking advantage of the advances in network based telecommunication implementations [8][16].
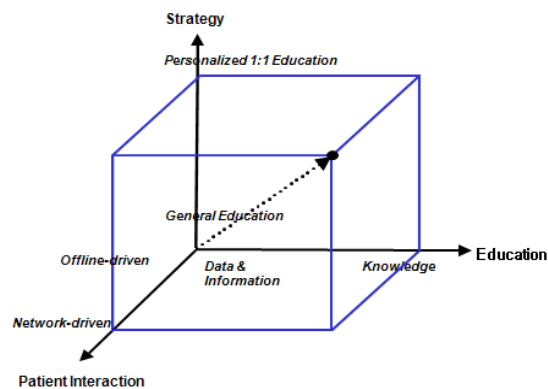
(Fig. 1) CPES initiatives

This paper is organized as follows. In the second section, a review of the published literature on patient education is followed by CPES design and implementation case in third section. Fourth section illustrates system assessment to implement the CPES prototype. Finally, this paper is concluded by the last section.

2. Background and Previous Approaches

Due to the limitations to providing direct feedback and actively controlling patient education process over the network online[14], clinical staffs have to be careful when doing their answers to a patient's inquiries. Patients' knowledge is limited by the available information on the communication partner's knowledge level[15][16]. As an example, the use of technical language can point to a level of expertise[11]. In particular, it has been shown that more medical knowledge is attributed to non expert patients who use technical language in online inquiries than to ones who use everyday language[18]. More direct information about a patient's knowledge level is also relevant for knowledge anticipation.

2.1 Patient Education Definition and Domain

There are a variety of definitions on the patient education. They lay stress on the importance of sharing information and expertise through education among all the stakeholders, and emphasize clinical communication to enhance timely decisions and performance. Major definitions are shown in table 1.

<Table 1> Definitions of Patient Education

Definitions	Reference
The process of informing a patient about a health matter to secure informed consent, patient cooperation, and a high level of patient compliance.	[25]
Patient education involves helping patients become better informed about their condition, medical procedures, and choices they have regarding treatment.	[26]
The teaching or training of patients concerning their own health needs.	[27]
Philosophical skill during health care encounters improves satisfaction, compliance and adherence to treatment regimes, provision of preventive services, and clinical outcomes.	[10]

For enhanced patient-oriented education, computer network-driven enhanced medical staffs and patients' communication are essential. This on-line system can make patients understand their disease, illness, treatment processes through the system[20][22].

In this arena, researches on patient-oriented education had been surveyed through digital libraries. In 43 papers, 32 percent in the researches had a relationship with chronic disease controls. 12 researches contain information or expresses for the matters of diseases whether network-driven patient-oriented education system had implemented or not[23].

<Table 2> Domains of Previous Researches

	Arena	Research Paper
Study Design	Empirical researches	10 Researches
	Quantitative researches	3 Researches
	Hybrid approaches	3 Researches
	Hypothesis enlargement, estimation credentials,	10 Researches
	Special issue on oncology	1 research
Chronic Illness	Diabetes & Bronchial asthma	7 Researches
	Oncology	6 Researches
	Chronic illness (undetermined diseases)	8 Researches
	Continual fatigue & Fibromyalgia syndrome	4 Researches
	Chronic obstructive pulmonary disease	2 Researches
	Melancholy	3 Researches
	Degenerative arthritis	1 Research

Table 2 shows the arena in patient-oriented education. Generally, patient-oriented education in medical organizations represent 4 perspectives [10][12][20]; educating patient disease and treatment process, knowing preventive behaviors and health habit, and medical staff relationships. In addition, several current researches had focal points on health promotion and information delivery

methodologies in the offline situations using patients' education contents.

2.2 Previous Approaches for Patient Education

2.2.1 Clinical Education Process

Different from the sequential approaches in conventional healthcare education systems, the CPES process makes significant decisions which can substantially affect education lead time, healthcare cost, and education quality at the every stage[4]. To link patient needs and education specifications at the early phase, the healthcare CPES teams are confronted by multiple and conflicting goals to achieve, and thus require analytic methods using certain metrics with which to compare several alternatives. These considerations can be healthcare patient needs, education goal, education specifications, and feasible healthcare education alternatives[3][9]; detailed patient medical history knowledge on required level to satisfy; healthcare education capacity, healthcare cost estimates and other decision constraints. The most common of these methodologies is healthcare re-processes which provides optimal education design with feasible education capacity at minimum time and costs.

2.2.2 Network-driven Patient Education

The CPES needs a communication infrastructure which facilitates transfer and sharing of data, information and knowledge on patient needs since the relevant information should be available when healthcare team members require it. Current rapid evolution of information technologies accelerates healthcare organizations to communicate between hospital and patient stockholders under the CPES practices [21].

To deal with the concept of efficient use of a computer program to educate patients about interventions, various types of multi-media contents are needed in the areas of health education, processes, and medical resource allocation for the common cold reduced the time of health care visits [24]. Young children with chronic disease are more suitable to this form of patient education[6][8][17].

2.2.3 Patient-oriented Education Re-engineering

The initial process to adopt CPES includes construction of a healthcare cross-functional team led by a strong CPES project manager. The primary objective of this organizational change is to provide a parallel and concurrent patient educations required at each phase of the CPES practice[15]. The required educational digital materials are gathered by the cross-functional patient healthcare staff from variety of disciplines such as prognosis, pathogenesis, symptom analysis, therapy, and administrative-support. For this purpose, cross-functional teaming and team leader appointment are important elements. The principles of teamwork are summarized as follows.

Select cohesive CPES teams based on mutual linking and each other's education expertise[15], bring specialists from all major functional areas, ensure the common vision of the collaborative education process, organize controlled convergence to education solutions that everyone accepts, perform actively open-minded thinking, maintain the best balance between individual and medical staff group work, use both formal and informal educational communication, and provide principled educations.

2.2.4 Patient Satisfaction

The CPES involves various phases of activities; healthcare CPES education conception, education

design including preliminary and detailed healthcare education service process, and contents details preparation. The educational conception phase requires more detailed efforts to define, analyze, and consider external and internal patient requirements in the early design stage. One of the most popular approaches in this category is education quality function deployment and elderly clients reported patient satisfaction with this technology [3][9].

The quality function deployment for patient education satisfaction is a visual and connective process that helps healthcare teams identify the external and internal healthcare patient desires and deploy them throughout all functions and activities of the CPES, remaining faithful to the voice of the patient. The quality function deployment method involves construction and evaluation of a matrix form which is known as the house of quality at each phase of decision. The matrix chart forms a visual map containing the needs of the consumers in the input row and the healthcare service decisions to meet the patient desires in the output column. Starting from the voice of healthcare patient satisfaction as an initial input element, the house of education quality generates the output of healthcare team decision, which afterward becomes the input of new house of education quality to eventually make the final phase education programs[22].

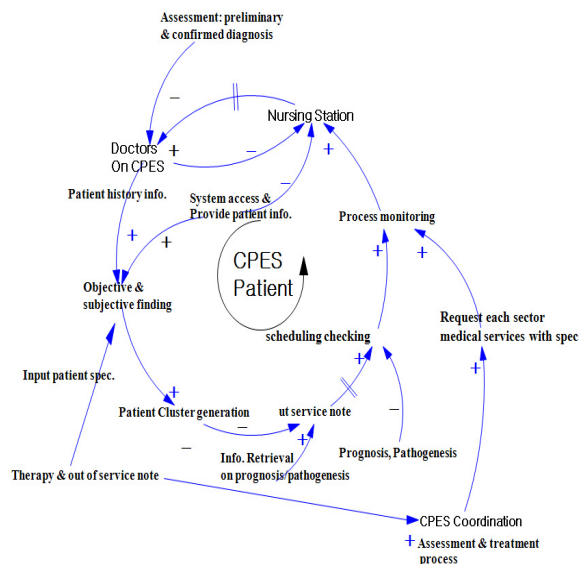## 3. CPES Design and Implementation

To implement the practices of CPES in the real world healthcare, a systematic seamless approach has been developed and adopted by advanced healthcare organizations considering upon their medical education strategies and goals[5]. The partial CPES has been developed using the MS Visual InteDev V6.0 for Web system and Oracle

RDBMS as a DBMS KERNEL in Microsoft Windows Server with Internet Information Server 5.0 as a Web Server.

The Oracle V8.1.7 manages the repository as a DBMS[19]. IBM compatible Pentium PC has been used as a hardware platform. For this work, author has been involved and collaborated for the last seven years with Electronic Healthcare Department of ETRI(Electronics and Telecommunications Research Institute). The specific development environment is shown in Table 4[22].

<Table 4> Implementation Environment

Tool	Description
Oracle V8.1.7	DBMS KERNEL, DML, DDL
Active Server Page V3.0	Server Script
Internet Information Server V5.0	Web Server
Microsoft ODBC for Oracle V2.8	Windows ODBC Driver
MDAC V2.7	Data Query
MS Visual InteDev V6.0	Web system
Site Gallexy V1.1	Upload Component
Oracle Client	Oracle Connection

(Fig 2) Partial CPES information flows

The partial information flow modeling of CPES is depicted as a diagram, as shown in Figure 2. The purpose of this specification analysis is to sharpen specific missions and their CPES stockholders′ relationships on the basis of arrows sign[8][22].
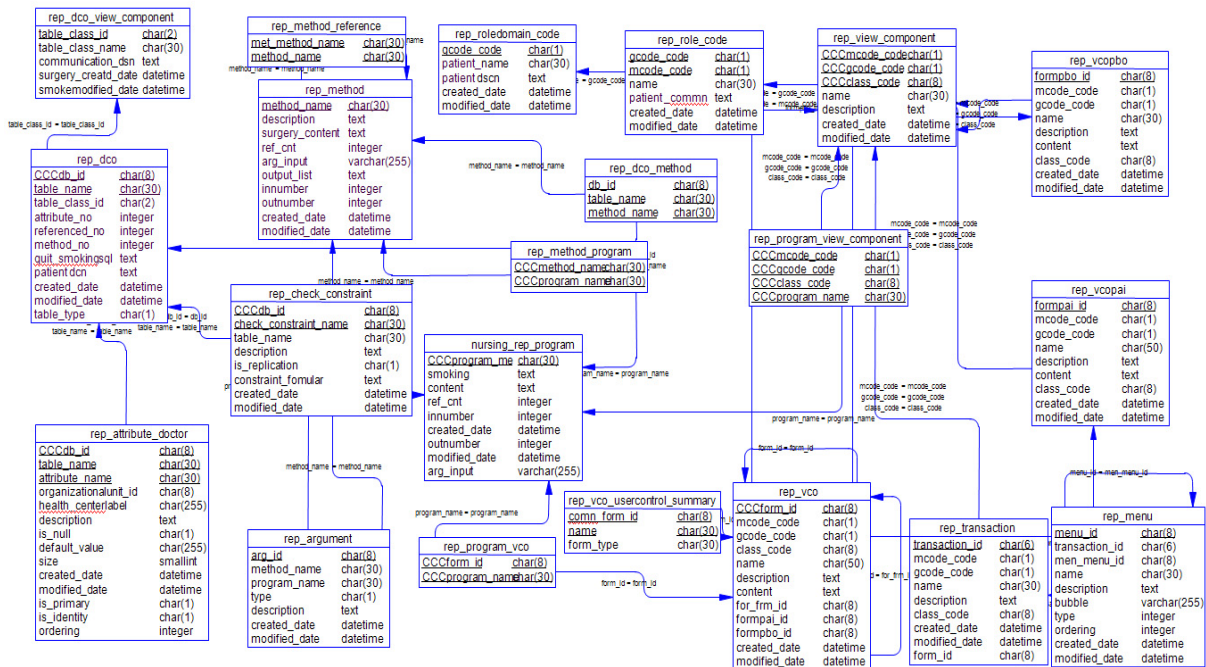
Those data manipulated in the data schema are shown in the Figure 3. It can be notified how each stakeholder in medical organizations must gather data that clearly demonstrates the value of patient education systems. Education stakeholder comprises three major tasks: to analyze education scenarios for each action, to capture the education scenarios and to establish relationships. Education scenarios help understand the required education works among the multiple stakeholders[8][16][22].

The repository introduces data-schema for CPES design artifacts. It is based on information resource dictionary standard for artifacts management. For example, Rep_roledomain_code entity represents a large classification of medical component group which is a core competence unit of stakeholder, and rep_mission entity means medium level of medical component classification that is a specified unit for a education mission domain.

Rep_view_component is small level of component classification which is a navigational primitive of CPES requirements; determined at a conceptual level. Rep_program is for logical component that will be implemented according to the education component view responsibilities; invoked from a screen or dialogue unit; may become a whole or partial view responsibility. Rep_method for simple logics such as creating, retrieving, updating, deleting and caller functions from a CPES component view; invoked from a screen or dialogue unit[22].

For data component, rep_dco corresponds to a data attribute set or relational table. For visual component, rep_vco is subdivided into a screen type for a navigational primitive that will be implemented as a screen interface, and a dialogue type for a primitive

(Fig. 3) A Partial Data Schema

of CPES multimedia data that may be accessed from a screen unit. Therefore, any component from VCO, LCO, and DCO is mapped to a component view such as rep_vco_view_component, rep_lco_view_component, and rep_dco_view_component, consists of three types of components, called a set of components for educations[22].

Fig. 4 shows a partially implemented web version of CPES. The clinical staffs can select educational contents required for each patient[18].

(Fig. 4) Main Screen for CPES Prototype

They access the data of patient status along with visual specifications. If required, on-line visual education function can be used between the patients and medical staff stakeholder sides. This process is performed by the use of cluster codes protocol.

To access the CPES, user needs to provide information on identification, password, and site address. Depending on the user's role, access area in the system can be restricted.

Role-based access control is used to specify and enforce stakeholder-specific security policies in a way that maps naturally to CPES. With the control, authority is managed at a level that corresponds closely to CPES structure.

Each user is assigned one or more roles, where roles are based on the user's job responsibilities and competencies in the medical organization. Each role is assigned one or more authorities. It is a

user's membership into roles that determine the privileges the user is permitted to perform. Security consists of determining the operations that must be executed by user in particular jobs, and assigning stakeholders to the proper roles.

The representation of patient abnormal status, including the patient's medical history attached is considered for first aid order.

Menu and tool bar structure of CPES is described in table 5.

<Table 5> Menu and Tool Bar Structure of CPES

Menu	Sub Menu	Description
File	New	Create a new CPES component or contents by role
	Open	Open an existing CPES component or contents by role
	Save	Save the current CPES component or contents by role
	Print Setting	Save the current CPES contents
	Print	Print the current CPES contents
	Exit	Quit the current CPES contents
View	Tool Bar	Show tool bar
	Status Bar	Show status for CPES contents work processing
	Workspace	Provide CPES contents window by role
	Property Bar	View CPES contents processing
Tool	Schema Sync	Check up CPES contents data schema by role
	Schema Role Manager	Manage Role-based access control for CPES schema
	Print DCO	Print CPES data component tables by role
Edit	Auto Script	Edit CPES contents program based on generated scripts
	Activate	Register CPES contents program by role
	Deactivate	Cancel CPES contents program registration
	Tab Order	Align CPES program scripts
Server	Connect Server	Connect to associated database CPES server
VCO	User Interface	Implement CPES contents visual component
	Simulate	Test visual component results
	Refresh	Refresh modified or implemented CPES contents visual component
LCO	Program Logics	Implement CPES contents logical component
	Refresh	Refresh scripts for CPES contents logical component
Help	Index	Provide tips on each CPES contents function

For the patient education for the system, instruction process took place during S hospital work time and was conducted on site. It generally lasted about an hour and were used to gain an understanding of how system was used and its effects on education and other activities. By adopting the system, S Hospital′s stakeholders can share information from a variety of sources for better education.

4. CPES Assessment

For experimental designs, pretest-posttest designs are performed to compare participant groups and measure the degree of change occurring as a result of CPES adoption. This survey is conducted in collaboration with S hospital managements for the validation in the potential adoption of the CPES, and performed: pretest on 4nd week on February, 2012 and posttest on 2nd week on August, 2012.

Medical customers(10 male and 11 female)

volunteers aged 18‑71 years(mean ± s.d., 42.3 ± 6.5) participated in the survey. Subjects gave written informed consent, and the CPES using experiments were compared to the before and after patient education systems.

4.1 Survey Contents and Data Analysis

The efficacy of the system was assessed using 5 major parts: CPES experience, system evaluation, CPES usefulness, treatment process/medical service, and general information on questionnaire respondents. The detail constitutions are shown in the below table.

For the patients, CPES were administrated for the education regarding their own medical condition, service processes, and medical background. Patients who participated in network-driven education experienced significant changes in the desired results. This assessment Research supports the positive impact that the proposed CPES network-driven patient education has on knowledge

<Table 6> Survey Questionnaire Contents Structure

Part	Questions	Descriptions			Etc.
CPES Experience	5	· information quality · usage time and frequency · intention use constantly · understanding personal situation · related medical contents and service easiness			
System Evaluation	11	· authority · correctness · Q&A · CS	· conformability · up-to-date · completeness · interoperability	· quality · design · access speed	5 point scale
CPES Usefulness	3	· security on personal situation · decision making on future medical service alternative			
Treatment process/ Medical service	4	· treatment process understand-ability · medical service understand-ability · network-Internet · network-Mobile			
General information on involver	7	· gender · education degree · family income · personal information	· age · job/carrier · motivation in hospitalization		

<Table 7> Response Average by Questionnaire

Question No.	N	Before Adopting CPES Mean±S.D.	After Adopting CPES Mean±S.D.	t	p
Authority	21/21	3.13±0.788	4.14±0.456	1.76	0.00*
Correctness	20/21	2.43±0.566	4.00±0.345	1.77	0.15*
Curiosity	21/21	3.65±0.565	4.47±0456	1.76	0.00*
Easiness	21/21	3.86±0.245	3.39±0.787	1.77	0.00*
Up-to-datedness	21/21	3.21±0.234	4.43±0.567	1.76	0.00*
Completeness	21/21	2.43±0.564	4.23±0.454	1.77	0.00*
Information Quality	21/21	2.12±0.565	4.21±0.890	1.76	0.00*
Design	21/21	N/A	3.60±0.565	N/A	N/A
Access Speed	21/19	1.83±0.564	3.86±0.857	1.78	0.00*
Customer Satisfactions	21/20	2.37±0.565	3.97±0.730	1.79	0.00*
Interoperability	21/21	2.34±0.764	3.64±0.852	1.79	0.00*

*p<0.05

acquisition and the communication that occurs between patient and provider.

For instance, Information Quality(mean ± s.e. before, 2.12±0.565; after, 14.21±0.890; p < 0.0, paired t-test), Customer Satisfactions(mean ± s.e. before, 2.37±0.565; after, 3.97±0.730; p < 0.0, paired t-test), Access Speed(mean ± s.e. before CPES, 1.83±0.564; after CPES, 3.86±0.857; p < 0.0, paired t-test)in agreement with adopting CPES justifications. In the case of "design" could not be measured and ruled out due to the offline and online characteristic. One of the findings is that it demonstrated the value of patient and guardian education systems by providing timely information and data.

The results are consistent, and result reports indicating that CPES does affect patient attention, education function, as well as related personalized education contents. The present findings are remarkably similar to previous literature survey findings in Section 2. The active involvement of the medical stockholder is essential key for successful working of CPES that can enhance the value of roles and reap much greater patient loyalty in return [10, 11].

Collected data were analysized using statistics software, SPSS 12.0.1, for the variables, descriptive, cross-tabulation, and multiple response analysis was performed.

These findings indicate that CPES are the sources of sustainable competitive advantage of S hospital and are valuable capabilities in the light of comparing the before and after CPES installation. None of the question analyzed less significant in the light of mean and p values. Most of response analyzed superior to previous offline system especially such as correctness, completeness, information quality, access speed, and customer (patient) satisfactions.

5. Conclusion and Discussion

Patient-oriented education has emerged as an important component of many health promotion and disease control programs. Corresponding to increasing pressures to provide more informed and interactive information resources to patients at lower cost, Patient educators in hospitals are starting to realize the benefits of using web-driven technology to support the health care learning process. This paper suggest that the use of the technology to improve patient knowledge and to involve them in health care decisions leads to better health promotions as well as managerial outcomes in medical organizations. The information

educations require IT(information technology) -driven tools. Important elements of patient education are IT-system implementation and responsibility such as patients need to how, inform time and why they need to make a better outcome.

The competency and value of the information can be featured as follows:
- Risk control: prevented malpractice risk.
- Enhanced self-confidence in decision to self healthcare
- Enhancing medical condition, diagnosis, disease, or disability
- Medical patients' satisfaction: Patients feel you've provided the information they need
- Exploitation: effective use of medical services
- Amplified fulfillment: Effective communication and patient motivation to care process.
- Results: likely to respond well to their treatment plan
- Enhancing methods and means to manage multiple aspects of medical condition

Healthcare-related quality of life measures generally address patients' perceptions of their physical, social, role functioning, mental health, vitality, pain, and cognitive functioning. In many cases the improvements in patient education quality are a natural result of improved clinical results.

From this motivation, this paper is to study CPES, and investigates the potential impact of the CPES system on the daily experiences in medical organizations. CPES is an individualized program that administrates in each in-patient as well as out-patient. It included a personalized educational diagnosis based on problems with personal or family medical histories. CPES initiatives arising from the mobile or Web explosion are performed in this paper.

One of the findings in statistical survey investigation is that patients' perception of their quality of cure is also improved significantly under 95% confidence level when they are empowered by well-designed educational systems. Empowered patients tend to feel more personally capable of positively impacting their results. For patients with chronic conditions, health-related education quality of life can improve significantly when they are trained in self-management techniques and empowered with education.

The results of this study provided strong recommendations for S hospital on the role of patient education. This educational intervention is easily translated from the research to the clinical setting and could be duplicated across a very broad range of hospital environments. The CPES can be suitable for other hospital settings when modified.

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