

The Service System Study on Children's Hospital-Bed Nursing Based on Multi-level Experience

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Abstract. Presently, there are rarely children's hospital-beds aiming at children patients' various demand level in the field of medical treatment, which results in children patients' emotional repression and psychological burden in the life of rehabilitation and even affects the state of the children patients' illness. And during the experience economy the integrated innovation with nursing system of children's hospital-beds through experience has become the key factor for children patients' medical treatment. In the whole process of monitoring process, the integrated innovation will contribute to the rapid deployment of nursing service and help the children patients take part in the treatment process happily, which will also meet the parents, children patients and nurses' needs. So based on the theory of multi-experience characteristics of children patients, what we study is trying to collect the pains during the medical service and analyze the opportunity point by taking the Wuxi hospital as an example and using the relative research method of user experience and service process to create new user model and a number of service situation. In the end, trying to create the new service model and multi-level experience touch point by the thought of integration. The paper provides new and effective solution to the traditional children's hospital-beds with the method of system integration from the angle of service design.

Keywords: Children's hospital-bed nursing system · Multi-level experience · Service system · Design strategy

1 Introduction

With the rapid development of economy, science and technology, our health care facilities and medical environment for children are also upgrading. However, in essence, the majority of replacement is only about the expansion of function and the updating of technology. Facing with the altering of consumption process, experience economy and medical culture, the replacement that stays in the change of function-oriented level requires large investment but the effect is not as expected. As people's emotional needs' expanding, the concerns of medical treatment process nowadays are not only about the physical rehabilitation, but also the field of emotional, educational and psychological

care. Thus the essence of medical products and service design has changed dramatically. The paper applies the concept of experience and service system to children's hospital bed design and discovers the methods of relatives' deeper involvement throughout the whole process of children's medical care service by means of the innovation of humanized children's health care system experience. In addition, the paper discusses the methods of promoting the communication between patients and medical staffs and improving the staffs' working efficiently.

2 Children's Hospital Bed Nursing System and Service Experience Research Method

2.1 Children's Hospital Bed Nursing System and Design Problems

Children's hospital bed is the most significant medical devices in the children's wards since it is not only a place for receiving the treatment, but also for taking various activities such as eating, playing, talking, relaxing, speaking, writing, etc. With the improvement of medical condition, the original furniture form of the hospital bed transformed into medical device form. Basically, children's hospital bed in china is steel welded flat bed with hand crank that can only apply to the general wards with single function. Currently, pediatric intensive care unit in China usually uses adult monitoring hospital bed for children patient or reduce the size to fit for children. Developed countries use more advanced ABS multi-function electric bed as it contains complex structure and all the functions of other types of bed which some of the functions are innovative and prospective like Eleganza Smart Junior, made by LINET like the Fig. 1, the Germany hospital beds Manufacturing company which has object-oriented control panels, plug adapters, etc.



Fig. 1. Eleganza smart junior

However, for children's rehabilitation in experience economy era, children's bed should not only contain basic functions to satisfy the treatment, relaxation and daily activities for children patients, but also humanistic care and self-adaptability for unexpected problems. Moreover, it can be a suitable carrier for the doctor-patient communication and connection in the Internet age. Therefore, children's hospital bed can be developed into a system product to resolve complex problems and to adjust to the rapid development of medical care technology nowadays.

In nursing system perspective, children's health care process is gradually becoming a nursing system service platform with various experience shared by many users. The following contents will be discussed specifically: pediatric beds (size, functions and components, color and model, material and technology), pediatric wards, space environment, cultural environment, admission process, daily nursing process, discharge process, the relative care products, etc. Thus in nursing system design, not only the children's medical care, but also the psychological elements of children patients and relatives, the main contradiction and problem in the nursing process should be taken into consideration. Senior children hospital beds in market are function-oriented and design only aims at the function of bed without any improvement of experience so that obsession appears.

2.2 Service Experience Concept of Children's Hospital Bed Nursing System

Experience design is the research about user experience. The user experience is the psychological feeling set up by users during the process of using products (including material products and nonmaterial products) or enjoying the service, referring to all the aspects of interaction between people and products, programs or system (Tullis and Albert, 2008). Forlizzi and Ford (2000) defined experience from the perspective of the human-computer interaction of products, considering experience as the way users perceive products, including: the process users understand the way using a product; the mood and feeling when users use products; the humanization of products; the capability about whether the product can meet diversity of demands or not. Among them, in terms of the specific model of experience design, after the research of consumer psychology from the perspective of social psychology theory and the human brain module, Bernd Schmitt presented the experience model which contained sense, thinking, emotion, behavior and association [1] (Fig. 2).

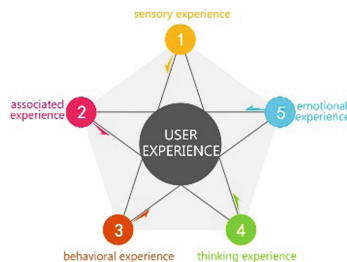


Fig. 2. Experience system presented by Bernd Schmitt

Experience design brings entirely new vision and new method to create value for foreign medical treatment service, and people-oriented theory of experience design has taken positive impact on numbers of medical service design fields. For instance, the patient-nursing staff integration service system built by IDEO for Mayo Clinic in the U.S. is an innovation of behavioral and emotional experience. IDEO turned the internal

medicine hall of the clinic into a lab to improve the experience of patient-nursing staff. They observed how the patients influenced each other in waiting area and laboratory and how they cooperated with doctors, nurses and other staff to finish their treatment. Kaiser Permanente and IDEO developed activities to promote the nurses' knowledge communication in wards which resolved the problem brought by working shift of nurses and increased the continuity of nursing between different nurses (Fig. 3).



Fig. 3. IDEO'S design cases with Mayo clinic and Kaiser permanente

Looking at the nursing system of children's hospital bed with the multi-level service experience model, the sensory experience, behavioral experience and emotional experience which are related to children's cognition need to be highlighted.

1. Sensory experience: by stimulating children's sensory system, hospital bed makes a direct experience for children. Although the stimulation won't last long, it is possible to become a deeper experience [2].
2. User experience based on behavior: Users operate products by their parts of body. As for child, the research needs to focus on the usability, durability, playability, edutainment brought by hospital bed. As for relatives and nurses, it includes further information interaction and medical activities support and etc.
3. User experience based on emotional demand level: The emotional feedback simulated by sense and interaction after using the products, including not only the emotional experience of behavior level, but also the emotional experience of communication level. It focuses on children's emotion and psychology. During hospitalization, many situations can lead to children's emotional repression such as reduction of playing space, decreasing of playmates, shortage of game, fear and aversion when faced of treatment, lacking of company of other relation and etc. which will obsess the medical treatment process. Meanwhile, during relatives' accompanying, many situations may cause passive waiting which leads to relatives' anxiety and misunderstanding. However, nurses also need more understanding in this process.

Therefore, for the hospital bed, related environment and information of children's nursing system, it is necessary to carry out investigation and analysis for the existing problems of users' needs and nursing services from the sensory part, behavior part and emotion part. Then establish new strategies to improve the existing service system and provide new solutions to avoid inappropriate behavioral and emotional feedback.

3 The Research Process

3.1 The Research Problems and Methods

Children's hospital bed design need to undertake the experience design focusing on position in sensory, behavioral and emotional experience of three macroscopic level. However, the content of experience is relatively emotional. It need to sort out by the multidimensional method about the relationship and problems between multi-users and related facilities, the environment and the service. Research will be carried out by two parts.

1. Based on the users and the environment research of nursing system, the urgent problem can be obtained from ward nursing process and space environment of participation of children patients, accompanying relatives and medical staffs. This part is mainly adopted qualitative interview analysis mainly in the children's hospital of Wuxi and the third hospital of Wuxi. At the same time, choosing typical children patients, accompanying relatives, medical staffs of different ages as a research object by observing, interviewing and recording to study the interaction in nursing service situations and problems. Interview questions explore the insufficient of hospital bed nursing space product and service experience mainly from the subjective user experience feeling. First is the background of the problem, which mainly refers to the basic situation of accompanying relatives, medical staffs, including gender, occupation, age, income, education, the disease characteristics of children patients; Second is the objective problem, which includes accompanying relatives and medical staffs' specific work in the nursing process and the nursing content associated with hospital bed use. Subjective problems is mainly referring to the emotions, attitudes, expectations and other problems of the subjective world of accompanying relatives, medical staffs. At the same time, what we need to understand is interactive information between users and hospital beds by observing behavior map to understand and trace children patients in this hospital bed space with the change of time and location. The related background information, interviews, conclusion should be intensively recorded format table (Fig. 4).

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疾病特征: 发热、引起多重重症并发症、频繁复发、咳嗽、呼吸困难、气促、肺组织退变等、治疗不易彻底、影响生长发育。

咨询内容:
彭沁今年8岁，正在读小学二年级，因为急性肺炎入院一周时间，伴有较多咳嗽，住院期间一直由母亲照护，彭沁觉得住院失去了不少快乐，所以感到很孤单，每天会找些自己喜欢的东西做，比如看漫画、玩ipad游戏、写作业等。由于彭沁喜欢的物品比较多，并且储物空间有限，或者不假收拾，床上、床头桌、床上置物架上随时乱放一堆物品。床上置物架是占用使用时间最长的物品，基本一天时间除了睡觉，护理之外的所有时间都会去用它，因为妈妈需要护理时收拾物品都不是很方便，每到晚上妈妈才会去半睡半醒孩子过夜，因为床铺太大，彭沁每晚睡在宽大的陪护床靠垫上，由于新靠垫太软，每次都要爬入睡，因为孩子经常看书、玩ipad，经常感到疲劳，所以经常使用靠背，孩子时来会自己操作控制把手以调整靠背高度，孩子的心满意足保持不错，只是希望可以有更多的娱乐方式。

需求: 增加1、下床台、扶手、扶手一、脚踏、无扶手床架、无扶手床架、无扶手脚踏、脚踏、2012年12月-2013年7月
该患儿因: 肺炎引起重症肺炎、呼吸困难、急性呼吸衰竭、人工呼吸机、护士心理、家属等等。

患儿父母主要诉求为患儿在住院期间每个功能分区，功能需求，操作方便、使用安全、耐用、环保、无异味等诉求。患儿在住院期间中主要面临以下问题，患儿父母诉求如下:

- 患儿住院期间生活、学习、娱乐和睡眠空间狭小且无隐私性且卫生性差，因为病房为公共空间且无隐私性可言，患儿在病房中只能坐在床上使用物品和看书，由于空间狭小且无隐私性，患儿在病房中只能坐在床上使用物品和看书，由于空间狭小且无隐私性，患儿在病房中只能坐在床上使用物品和看书。
- 患儿住院期间生活、学习、娱乐和睡眠空间狭小且无隐私性且卫生性差，因为病房为公共空间且无隐私性可言，患儿在病房中只能坐在床上使用物品和看书，由于空间狭小且无隐私性，患儿在病房中只能坐在床上使用物品和看书。
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- 患儿住院期间生活、学习、娱乐和睡眠空间狭小且无隐私性且卫生性差，因为病房为公共空间且无隐私性可言，患儿在病房中只能坐在床上使用物品和看书，由于空间狭小且无隐私性，患儿在病房中只能坐在床上使用物品和看书。

Fig. 4. The user interview is recorded by the format table

2. The survey is conducted aiming to multi-role user behavior and emotional needs. Because children's hospital beds involve too many stakeholders and every party has different levels of needs as well as different needs can be divided into different sub-needs, these needs have the characteristic of diversity, ambiguity, dynamics, priority and etc. So in the process of this questionnaire survey the Kano model is introduced. Kano model was proposed in 1984 by a Professor named Noriaki Kano in Japan, which is based on products, objective performance of services and users' subjective feelings. Kano model make the quality attributes of product and service divide into five categories [3]. Multiple roles aiming to each hospital bed function through this method can be divided into attractive quality, one-dimensional quality, must-be quality, indifferent quality and Reverse quality. Then by the classification, sorting, statistical processing of user needs from the survey, we will use Kano model again to analyze the satisfaction and dissatisfaction of hospital bed nursing system. During the questionnaire design, the first one we need to do is clustering with KJ method. For children patients and accompanying relatives, the user needs of children hospital bed can be divided into emotional care, learning and entertainment, security, meeting the aesthetic needs, etc. Then the 4 parts will further subdivided to the children patients' psychology, emotional care, clinical psychology, behavior modification (facing treatment positively), patient communication assistance, medical expense information and so forth to 14 third level. On this base, what we get is personalized accompanying product design, accompanying manual design, evaluating services design and so forth to 14 design elements. When designing a questionnaire, you need to understand the pros and cons to every question that you want to detect (Fig. 5). They will include the users' evaluation whether or not the tool have such functions [4]. In addition, considering accompanying relatives and nurses having different subjective initiatives and needs, different Kano questionnaires will be compiled for them. The entire questionnaire survey collects 98 KANO questionnaires written by accompanying relatives and nurses, 77 of which are effective.

How do you feel if the hospital beds use electricity to adjust?	1 Like 2 Must do 3 Whatever 4 Acceptable 5 Dissatisfied
How do you feel if the hospital beds do not use electricity to adjust?	1 Like 2 Must do 3 Whatever 4 Acceptable 5 Dissatisfied

Fig. 5. The settings of forward-backward questionnaire questions

3.2 Research Process and Results Analysis

1. Children patient with emotional repression. Although the children patients' fear caused by disease is not obvious, the pain caused by the disease will lead to emotional changes. And children patients' living environment changing, lifestyle changing, disease impact, space and entertainment reduction will lead to emotional repression, resistance, eccentric psychology, which will indirectly affect their rehabilitation

condition. In the aspect of accompanying relatives' behavior, the learning materials will be taken to the hospital for homework tutoring by their parents. And with the use of mobile phones, iPad and other digital products, the attention of children patients can be transferred in the games and cute cartoon animation to bring joy to them to moderately reduce the disease caused by depression and frustration. So by creating a relaxing atmosphere through facilities and environmental improvement, the strategies called "psychology - society" should be encouraged.

2. Accompanying relatives could not timely access to accurate information. Although relatives and children patient always stay together, many cases they encountered is still passively waiting around with anxiety and even seeking treatment advice all around the hospital. Children with inpatient rehabilitation need to experience a process like injection, medicines, diagnosis, inspections and so on. And the accompanying relatives are fuzzy about the project like children prognosis, progression of the disease, treatment projects that require to be treat, which will easily lead to the increasing pressure for accompanying relatives. In the end, the whole process will result in the negative emotions, which is easy to cause disputes between doctors and patients.
3. Medical staffs around the hospital bed function and nursing service have similar problems. Because the hospital beds have low regional function expansion, entertainment, security, and other sensory experience requirements are difficult to meet. And because the spaces of hospital beds and surrounding areas are divided unreasonable, it will have a very low utilization. Then the hospital beds have the barriers with the accompanying facilities. And although the nursing service process is complete and clear, they can't answer every individual's question and can't talk too long and in time, which will result in misunderstanding like that checking the condition and testing results are not promptly informed or no detailed explanation. Research found that through the hospital bed nursing system it will establish effective communication mechanism to help relatives to establish effective communication with medical staff under the premise of information.
4. From analysis of the Kano questionnaire emotional care of children patients, the five sub-needs are parent-children psychological and emotional care, clinical psychology and behavior modification, communication assistance, medical financial aid and accessing to information. Among them the charismatic quality requirements include parent-children psychological and emotional care and medical financial aid. With that accompanying relatives will feel humanization thinking from the hospital and will increase the satisfaction. Other three dimensional types belongs to One-dimensional quality requirement. These are the situation that most hospitals have not achieved or not achieved accompanying relatives' expectations. So in order to enhance the experience, the group demand is bound to be solved. To analyze the demand by introducing the Better-worse coefficient, it is necessary to functionally design aiming at doctor-patient communication and information acquisition (Table 1).
5. Needs weight sorting and overall analysis of children patients and relatives. By Better-Worse coefficient coordinates analyzing emotional care, learning and entertainment, security, aesthetic satisfaction, what they do is meeting the relationship between every sub-need and system design, as the table showed. Through

Table 1. The better-worse coefficient table of emotional care

Needs	Kano sorts	Satisfaction degree when improving	Dissatisfaction degree when removing
Psychology care	A	0.75	-0.38
Behavior correction	O	0.74	-0.35
Communication	O	0.80*	-0.44*
Financial aid	A	0.83	-0.31
Information acquisition	O	0.81*	-0.45*

comparative analysis, the highest demand factor of the system design is putting teaching at medical, personal information not easy to leak, information acquisition, children patients in clinical psychology and behavior modification coordinating -0.9×0.9 to -1×1 region. The higher demand factor is setting private space, medical financial aid to meet the children mental game(A), parent-child psychology and emotional care in personally coordinating -0.8×0.8 to -0.9×0.9 area. In addition, the lower demand factor is out of bed with alarming, color (A/I), patterns, shapes (A/I), providing learning assistance and other demand factors in the coordinating -0.8×0.8 lines to 0 coordinate area (Fig. 6).

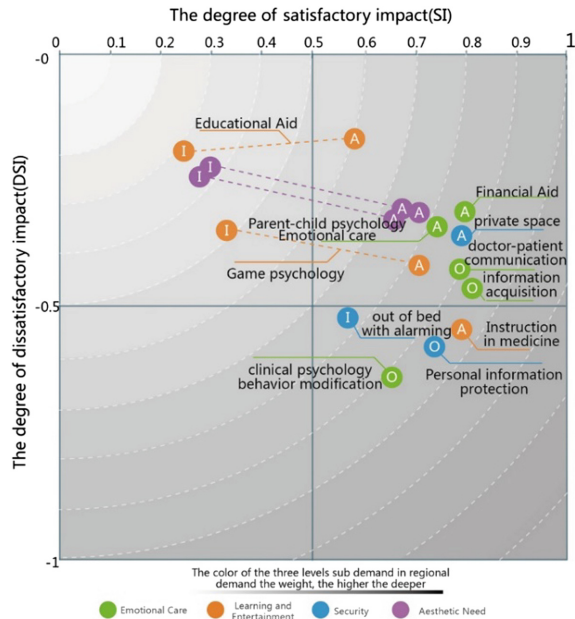


Fig. 6. Weight sorting coordinate of hospital bed needs

3.3 The Experiential Conclusion and Opportunity Analysis of User Needs

Through questionnaires and the results of the analysis, the whole process verifies the accuracy of the conclusion through the qualitative research and provides a large number of data to support. At the same time, the process also gets a high correlation demand list and defines the relationship between experience level and system need (Table 2).

4 Improved Strategy of Children's Hospital Bed Service System Experience

Based on the pain points from the survey and weight ranging from experience system problems and combining the theory and thought of emotion, behavior and sense as well as cognitive differences, environmental factors and requirement definitions, you can improve the children hospital bed nursing system from the following four aspects.

4.1 Based on Caring User's Individual Psychology, Creating Functional Hospital Bed Partition Through Modular Concept

Considering humanistic care through basic characteristic of individual element, trying to divide functional module through the individual motivation of children patients, accompanying relatives and medical staffs. Adopting the modular concept is based on different characteristics of individual, such as the children cognition difference of ages and appealing difference of accompanying relatives based on diverse cultural background. At the same time, various needs will result in various hospital bed functionalities. So what we need to do is flexible replacement and functional module reduction, which will enhance the utilization rate of resource Fig. 7.

Firstly, because the dispute between doctor and patient is always occurred during the process of subtle relationships. In order to guarantee every individual patients' psychological need, we need to ensure different users' work, activity and rest area according to the planning of functional module. Additionally, the function of every partition must make sure it is designed aiming to the users' cognition characteristic.

Secondly, in consideration of interaction effect of working and activity area between doctor, patient and accompanying relatives and operating motivation of intersection region, what we need to ensure is every function list, component and module position meeting design ergonomic. And meanwhile each user must have certain private and sharing space, which can't be meddled and influenced by others.

Lastly, by adopting the concept of module to design the hospital bed, we mainly peel off the functional component and collection according to the individual difference to design. Individual difference of sense, behavior and emotion from the same target determines the design characteristic of functional component and collection Fig. 8.

Table 2. System elements and experience conclusion of needs

	Experience level	Demand level	List of demand
Accompanying Relatives	A C	a b c d e	01.It brings fun entertainment experience features
	B	c d e	02.Actively promote children patients receiving treatment and reduce stress
	A	c d	03.Establish network of information management platform to access integrated information
	A	c d e	04. Establish an effective communication mechanism between the medical staff
	A	c d e	05. Establish feedback mechanism for health care workers
Doctors and Nurses	C	a e	01.The form of children patient's beds should be met the preferences of most patients
	A	a	02.It should have more entertainment features without considering the cost of hospital procurement
	A	a b	03.Clearly functional areas, random variations to meet the common needs of the patients and relatives
	A	c d	04.Establish and improve the accompanying cognitive learning media
	A	c d e	05.By accompanying learning help relatives promote understanding the work of medical staff
	A B	a b c d e	06.Provide a wealth of recreational activities better for children patients
	A	c d	07.Correction the children patient's behavior by strategies
	A B C	c d e	08.Make patients maintain a pleasant mood
	A C	c d e	09.Make the humanistic care concept into physical care
	A B	a b c d e	10.Bed system of humanized design to reduce nurses' working strength
	A	c d e	11.Low level of technology professionals, they expect to get more support
	A	c d e	12. Through the bed nursing system to establish effective communication mechanisms and medium. Ensure that relatives, detailed understanding of the relevant information to establish communication with medical staff.
	A B	c d e	13. Establish a persuasive sickbed its system, which makes the patient's relatives understand the social law system of bed nursing system.
	A	a b	14.Ensure the safety of the receive space
	A	c d	15.Provide real-time nursing staff to assist function
Notes A-behavioral experience B-emotional experience C-sensory experience			a-functional component b-equipment escort c-information content d-capability of information/ Propagation medium e-Individual subscriptions

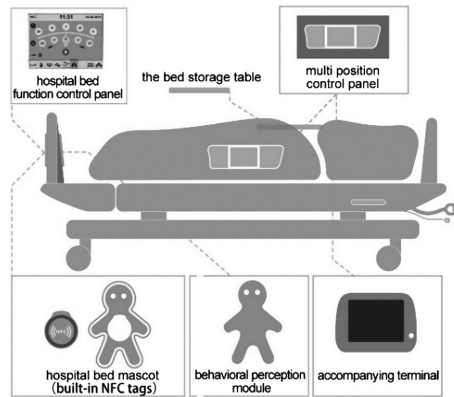


Fig. 7. Module formation of hospital bed

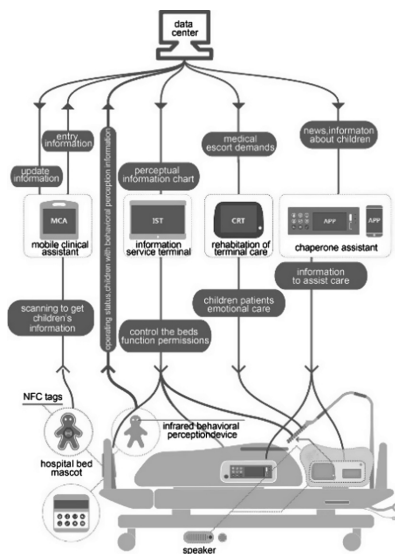


Fig. 8. Sub-system relationship map

4.2 Establishing Hospital Bed Cooperative Information System Oriented by the Real-Time Interaction Between Doctor, Patient and Accompanying Relative

Mainly behavior characteristic resulted from the psychological demands between doctor and patient creates a care experience of information collaboration. System element relationship will be established by the following 3 steps.

Firstly, the basic information system element is accessing and publishing of information. First of all, the nursing relevant information should be provided by the

hospital to let accompanying relative, children patient and medical staff consult. Then the information of medical staff and accompanying relative should be easily announced and recorded. And the key impact of information system element lies on solving the accompanying relative's questions in time and improving the nursing cognition.

Secondly, the targeted information system element is developing real-time communication platform. First of all, the suggestion between the doctor and patient is easy to be conveyed friendly, which includes interaction and emotional communication between children patients and their relatives after nursing, as well as transformation the psychological intervention information to virtual one that are easily received by the children patient. In addition, we can establish the relationship between relatives and medical staffs, which will improve the harmony between them.

Thirdly, the persuasive information system element is setting up effective task cycling mode. The system through information technology can automatically analyze the behavior and psychology of the children patient and information concerned by the relatives. Meanwhile, the system will push high relevant information and suggestions and convey the typical psychology of relatives and expected appeals to the medical staffs. So what they do above is making the medical staffs be ready, persuading the accompanying relatives correcting anxiety and letting the children's behavior be collected, which will promote the virtuous circle of nursing service.

4.3 The Experience Level Partition of Children Hospital Nursing System

The experience of children hospital bed nursing system is decided by the condition of meeting the target, difficulty and complexity during the nursing process. According to the different users' process experience, we will make the subsystem product and service of hospital bed nursing system.

To the children patient, the cyclic process can be divided by four parts. They are overall orientation process to promote the recovery of children patients, periodical cyclic process to please the children patients, to correct the behavior and psychology and to make the teaching into the treatment. On account of the close function of task flow collection, the three subsystems include the hospital basic functions like treatment, rest, security protection and daily activities needs, rehabilitation care terminal to pay attention to the psychology, behavior perception function.

To the accompanying relatives, the process can be divided by five parts. They are orientation process to follow up the nursing process, to do daily accompanying tasks, to get the information and communicate, to care the emotion of the children patient and to escort the knowledge learning. The subsystem aiming at task collection is mainly about the hospital bed control interface that can be connected with the cell phone and information service terminal. These two subsystems have a strong expandability and majority of experiencing function exists by software and the hardware architecture of subsystem will not change by the changing of the function.

To the medical staffs, the process can be divided by four parts. They are orientation process to follow up nursing service, to do the daily nursing task, to care the psychology of children patients and relatives and to promote the communication between doctors and patients. The subsystem aiming at the task collection mainly includes

information service terminal, hospital bed mascot (NFC label), hospital bed control interface and basic control parts.

5 Conclusion

Using the multi-field knowledge integration design to solve the complex medical service problem is a general trend. In this case, we integrate some parts like the multi-level experience design concept, medical technology, system innovation management and so on. In the system of children hospital bed nursing, to start with the stakeholders of multi-level experience and nursing service, we want to use the various research tools to embody the needs and redesign the experience footprint around different processes, which will satisfy the needs of children patients, accompanying relatives and medical staffs. Especially applying new information technology to the specific hospital bed creates a new solution to the traditional hospital bed design. It provides not only effective media for the service connection and communication between doctors and patients but also provides a new perspective for the manufacturer in this information and innovation era.

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