

A Study on the Architectural Situation and Improvement way of General Hospitals in Qingdao

Song, Shuquan*

Moon, Changho**

Abstract

Most of the previous hospital design researches mainly focus on the functional arrangement of services and functional units, as the layout of various departments, the form of the typical nursing unit, paying less attention to the important role of the establishment of good hospital environment.

This paper takes general hospitals' environments in Qingdao, China as the research object. Social and environmental psychological research, some site visits, theoretical studies, and analysis of various architectural environment factors are made to explore some environment design problems. Suggestions for a better humanistic environment could be the increase of parking space and green area, placement of courtyard with artwork, arrangement of convenient facilities, improvement of indoor spaces, provision of outdoor views from patient and consideration of some sensory factors.

Keywords : General Hospital, Physical Environment, Qingdao Hospital, Environmental Improvement

1. INTRODUCTION

In the past 3 decades, the whole world including China has witnessed rapid science and technology development, along with the highly improvement of medical levels. Under these trends, the medical model has changed greatly from biomedicine to holistic medicine.

Cure of disease is not only considered as an attempted remediation of a health problem, but also including increasing the patients' comfort. In such circumstances, Chinese hospitals which were mainly established in 1950's and 1960's are far more to satisfy the patients' present needs of stress-free and homelike hospital environments.

The purpose of this paper is to analyze the present situation of medical health and facilities in China, the existing environmental shortcomings of general hospital in Qingdao, and offer some suggestions for further improvement and future hospital design.

In this research, six large and best general hospitals in Qingdao which stand for the local highest medical level were chosen as the research objectives. Summary informations of these hospitals are listed in Table 1.

Table 1. Information of Sample Hospital

Name of Hospital	No. of Beds	Site Area (m ²)	Floor Area (m ²)	No. of Outpatients per Day	No. of Staffs
Hosp-1	1,995	130,000	200,000	3,616	2,600
Hosp-2	500	-	30,000	374	845
Hosp-3	420	22,600	20,000	500	-
Hosp-4	600	58,000	76,000	1,389	920
Hosp-5	600	93,000	56,000	792	970
Hosp-6	2,000	292,000	223,000	2,777	3,254

Hosp-1: The Affiliated Hospital of Medical College Qingdao University
Hosp-2: Qingdao Women and Children Medical Healthcare Center
Hosp-3: Qingdao Combined Western and Traditional Chinese Medicine Hospital
Hosp-4: Qingdao Eighth People's Hospital
Hosp-5: Qingdao Central Hospital
Hosp-6: Qingdao Municipal Hospital

As the research method, the current situations of medical health and facilities in China and Qingdao general hospitals were analyzed, theoretical materials were collected together with related drawings, documents & literatures, and observation & interview were executed through the site-visit.

* PhD. Candidate, Department of Architecture and Building Engineering, Kunsan National University, Kunsan, Korea.

** Professor, Department of Architecture and Building Engineering, Kunsan National University, Kunsan, Korea.
(E-mail : mchangho@kunsan.ac.kr)

The main contents of this paper include the present situation of medical health and facilities in China, the importance of good environment, present physical environmental situation of general hospitals in Qingdao, and some suggestions for better outdoor and indoor environments.

2. PRESENT SITUATION OF MEDICAL HEALTH AND FACILITIES IN CHINA

Since the reform and opening up, China has maintained the rapid growth of national economy. The GDP per capita has been increased quickly, which can be easily seen in the statistics, as 309 dollars in 1980, 292 dollars in 1985, 344 dollars in 1990, 604 dollars in 1995, 949 dollars in 2000, 1703 dollars in 2005, and 4,394 dollars in 2010 respectively. Especially among the recent 10 years, a sharp growth is booming up(see Fig 1).

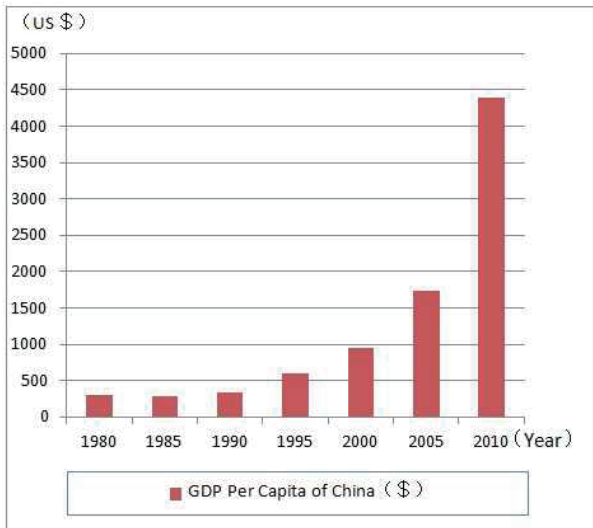


Fig. 1 The Growth of GDP per Capita of China

(Source: Statistical Communique of The People's Republic of China on the National Economic and Social Development)

Meanwhile, the investment for medical health has been increased quickly and the ratio of total health expenditure to GDP also gradually rose from 3.15% in 1980 to 5.01% in 2010(see Fig. 2), showing an increasing trend. However, this ratio was not only below the average 8.1% across developed countries, but also below the average 6.2% across developing countries¹⁾, which indicated that the investment was still low in medical and health with large space to improve, comparing with economic development.

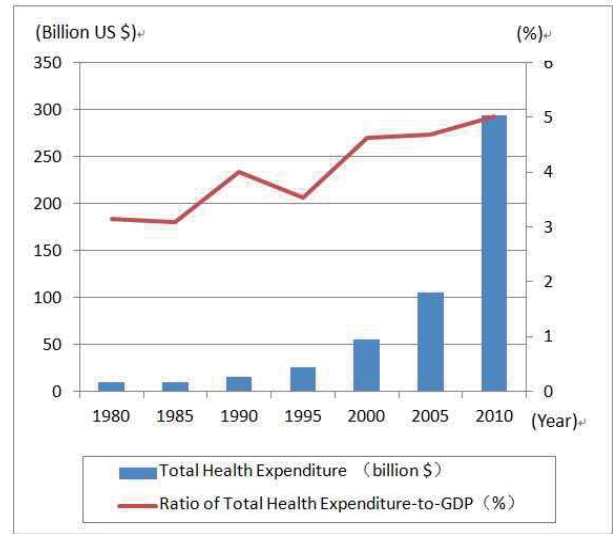


Fig. 2 Total Health Expenditure and Ratio of Total Health Expenditure-to-GDP

(Source: China Health Statistical Yearbook 2011)

Recently the number of hospital beds per 1,000 population in developed countries has declined from 6.0 beds to 3.1 beds in USA, 3.0 beds in United Kingdom from 1980s to 2000s due to the provision of long-term care hospital beds in community-based hospitals and specialty hospitals.

While because a significant part of hospital beds were occupied by long-term care patients in both Japan and Korea, there is a significant increase of hospital bed density per 1,000 population in Korea and a high bed density per 1,000 population in Japan with a slight decrease in recent years. At the same time, China's number of hospital beds per 1,000 population had gradually risen from 2.02 beds in 1980 to 3.56 beds in 2010, which had reached near to those of developed countries in 2000s (see Fig 3).

Considering the lack of long-term care hospital beds in China and more and more severe aging problem, there should be a continual increase of hospital beds in future and more and more long-term care hospital beds should be provided for the aging patients. At that time, hospital construction may transfer from the expansion of hospital scale such as quantity of beds to the improvement of hospital quality like work efficiency and distribution of medical resource.

An investigation of 206 general hospitals of China in 2003 showed that the average floor area per bed ranged from 78m² to 106m² among different scale of hospitals (see Table 2). And without the specialized hospitals, the floor area per bed of Korean hospitals built in 2000s ranged from

1) Homepage of Tianto Information Consulting Co., Ltd. (<http://www.tiainfo.com/news/news3795.html>)

103.4m² to 171.0m² with enough specialized space for different use²⁾).

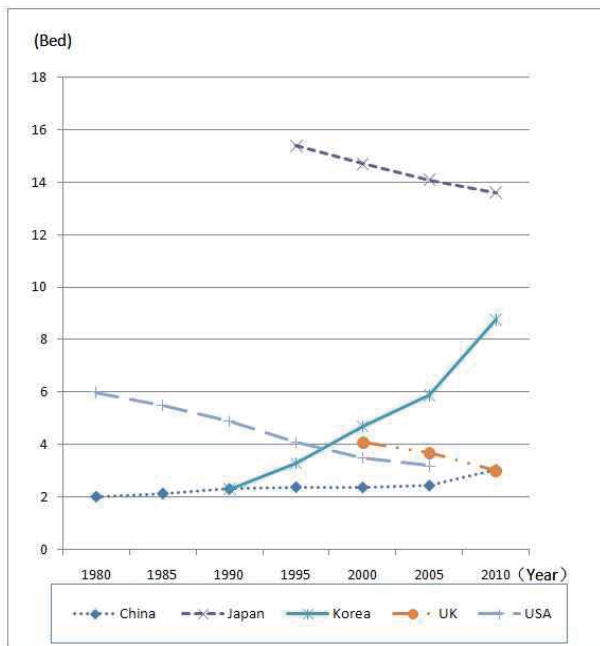


Fig. 3 Number of Hospital Beds per 1,000 Population (Source: China Health Statistical Yearbook 2005 & 2011 and OECD Health Data 2012)

Comparatively, there are not enough space for registration, cashing and rest in these Chinese hospitals, making the space somewhat in chaos. Along with the expansion of inpatient department, lands for green space were occupied, which led to a high density of building and low green coverage and worsen the traffic and circulations.

Table 2. Floor Area per Bed of Chinese General Hospitals

Scale	Number of Hospitals	Floor Area per Bed(m ² /bed)
200 Beds	21	78.1
300 Beds	23	90.4
400 Beds	22	82.7
500 Beds	28	91.7
600 Beds	27	82.9
700 Beds	15	101.1
800 Beds	28	92.9
900 Beds	6	106.4
1000 Beds	36	92.8

(Source: Standard for Construction of General Hospital(2008))

2) Moon, Chang-Ho, A study on the Architectural Characteristics in Recent Hospital Design, Journal of The Architectural Institute of Korea, 2008.11, pp.13~20.

3. THE IMPORTANCE OF GOOD ENVIRONMENT

Research in the environmental psychology, architecture, and medicine shows that hospital environment can influence health outcomes³⁾. The hospital environmental characteristics, as an important determinant, affect the way people think, feel and act, which play an important role in the healthcare process. Well-designed hospital environment can positively affect the healthcare process and well-being of patients and staff.

In a study, it is found that environmental satisfaction is a significant predictor of overall satisfaction, just below the satisfaction of quality of nursing and clinical care.⁴⁾

Benefits of good medical environment can be summarized as follows; reduction of staff stress and fatigue, increase of effectiveness in delivering care, improvement of patient safety, reduction of patient stress and anxiety, as well as improvement of outcomes and healthcare quality⁵⁾. In the process of hospital site-visit it is also clearly found that good environments usually make hospitals more attractive to the patients.

Besides, growing scientific literatures have confirmed that the conventional ways that hospitals were designed causes to stress and danger, and this level of risk and stress is unnecessary, because improved physical settings could make hospitals safer, more healing, and better places to work⁶⁾.

4. PRESENT PHYSICAL ENVIRONMENTAL SITUATIONS OF GENERAL HOSPITALS IN QINGDAO

In the past, clinical practice in hospitals formerly focused on treating illness while neglecting the psychological, social and spiritual needs of patients⁷⁾. Correspondingly, healthcare facilities design emphasized concerns only on functional

3) Ulrich R S., Evidence based environmental design for improving medical outcomes, Proceedings of the Healing by Design: Building for Health Care in the 21st Century Conference, Montreal, Quebec, Canada, 2000.

4) Harris, P. B., McBride, G., Ross, C., & Curtis, L., A place to heal: Environmental sources of satisfaction among hospital patients, Journal of Applied Social Psychology, Vol.32, No.6, 2002, pp.1276-1299.

5) Ulrich R S., 2000, p.1; and Ulrich, R. S., Quan, X., Zimring, C., Joseph, A. and Choudhary, R., The Role of the Physical Environment in the Hospital of the 21st Century: A Once-in-a-Lifetime Opportunity, Report to The Center for Health Design for the Designing the 21st Century Hospital Project, 2004, pp.3~27.

6) Ulrich, R. S. et al., 2004, pp.2~3.

7) Dilani, A., Psychosocially Supportive Design - As a Theory and Model to Promote Health, International Academy for Design and Health, 2005, pp.31~38.

efficiency, costs, providing effective platform for medical treatments and technology, and ignore the influence of environment for patients and staff.

In addition, because of lower social and economic development and lack of long-term planning, the overall layout of hospital became somewhat in chaos in the process of hospital reconstruction and extension.

Under the influence of above factors, many hospital design and constructions ignored the role of environmental factors in the creation of convenient and comfortable surroundings. However, with the improvement of living standard and quality of life, the demand for pleasing environment is rising, so nowadays many Chinese hospitals already can not meet people's desire for comfortable medical environment.

The main shortcomings of the general hospitals in Qingdao can be summarized as follows;

4.1 Shortcomings in Functional Aspects

1) Lack of parking space.

In the past, parking space did not get much attention in hospital design. However, with the rapid economy development and the rising of personal income, more and more private cars come into ordinary families(see Table 3), leading to an urgent demand for parking lots(see Table 4) in hospital, as well as severe traffic congestions(see Fig. 4).

Table 3 Number of Private Cars in Qingdao

Year	Total Number of Private Cars(1,000,000)	Number of Private Cars per 1,000 Population
2005	28.9	39.0
2008	40.4	53.3
2009	58.0	76.0
2010	73.0	95.0
2011	89.5	116.8
2012	105.7	137.3

(Source: http://news.bandao.cn/news_html/201301/20130107/news_20130107_2055142.shtml)

Table 4 Number of Parking Spaces in Sample Hospitals

Name of Hospital	Required Number of Parking Spaces	Actual Number of Parking Spaces
Hosp-1	400	600
Hosp-2	60	180
Hosp-3	40	90
Hosp-4	152	220
Hosp-5	112	150
Hosp-6	60	300

Although, the actual number of parking spaces are more than the required number of parking spaces(1 parking lot/500 m² floor area) according to the guidelines of parking lots in most hospitals, actually there is still a big demand for parking spaces. In order to provide more parking spaces for patients, in some hospitals private cars of staff are forbidden to park in the hospital.



Fig. 4. Square Used for Parking in Hosp-2



Fig. 5. Outdoor Environment of Hosp-3

2) Insufficient convenient facilities

In most Qingdao general hospitals, convenient facilities such as shops, flower store and coffee shops are not provided for patients. Patients and their family members have to move a long distance to go outside for shopping.

Also, there are only a few outdoor rest facilities in some hospitals, which deter the provision of social support for patients. Generally, the patients are usually sick and weak, being accompanied by family members and they need a space to refresh themselves and have a rest and communication.

4.2 Shortcomings in Healing Environmental Aspects

1) Low green coverage.

In order to meet the increasing need of medical treatment and site restraints, the expansions and reconstruction of hospital buildings inevitably have to occupy lots of green land, which makes a low green coverage in some hospitals(see Table 5).

Another reason that lead to low green coverage is the increasing of parking spaces, which also occupied lots of green land(see Fig. 5).

2) Monotonous outdoor environment.

In some hospitals, the yards are usually covered with gray concrete or bricks without changing in colors and texture, as well as few green area, making the courtyard unattractive to the patients(see Fig. 6).

3) Indifferent interior environment

It is reported that each patients stays in the hospitals for 146 minutes in average, 2/3 of visiting time was spent in waiting rooms⁸⁾, so the quality of interior environment impacts patients' feeling(see Fig. 7).



Fig. 6. Outdoor Environment of Hosp-5



Fig. 7. Waiting Space of Hosp-3

Table 5 Information of Green Coverage in Sample Hospitals

Name of Hospital	Required Green Coverage Rate	Actual Green Coverage Rate
Hosp-1	30%	20%
Hosp-2	30%	11%
Hosp-3	30%	3%
Hosp-4	30%	17%
Hosp-5	30%	23%
Hosp-6	35%	40%

4) Dull color environment.

The development of modern science has confirmed that people in a white environment for a long time would be adversely affected⁹⁾. However, at present, a lot of Chinese medical buildings have still mainly a white tone, although clean, but inevitably also monotonous.

5. SUGGESTIONS FOR THE IMPROVEMENT OF MEDICAL ENVIRONMENTS

Promoting environment quality through environmental elements can be accomplished in two ways: by reducing effects of negative elements or by enhancing the positive elements, such as natural scenery, colors and so on. In view of the existing poor environment, some positive stimuli are recommended to improve the physical medical environment in the outdoor and indoor environment.

5.1 Improvement of Functional Aspects

1) Increase of parking space

It is reported that in 2008, there were only 2,000 parking lots in Qingdao's hospitals, and 3,000 more parking lots would be built in two years¹⁰⁾. According to the present Code for Design of Parking-area¹¹⁾, parking spaces should be constructed by the principle that one parking space should be allocated per 500m² floor area.

Actually, in most hospitals, the actual number of parking space have exceeded the required number of parking spaces(see Table 4), but is still not enough due to the rapid increasing of private cars.

Lack of parking space is a challenging problem for completed hospitals. In light of site constraints and high cost of underground parking lot, the ecological parking, as a combination of parking and green, maybe a good choice for the completed hospitals, which not only increase the parking lots but also increasing the green coverage rate(see Fig. 8).

For those without much land to use, the appropriate way might be to construct parking building near the hospital to solve this problem.

2) Increasing of convenient facilities

Nowadays, in developed countries convenient facilities such as commercial shops, flower store and coffee shops, have been introduced into outpatient hall of hospitals, which not only offer greater convenience to the patients and their family members but also provide a place for social support to eliminate patients' anxiety.

Making reference of the Hospital Street(see Fig. 9) to those clinic halls with large enough area around the atrium, some public services as retail store, flower shop, restaurants, and book store could be arranged, providing a shopping, entertainment and communication place, making the patients have an experience of social life, and easing their mental fear¹²⁾.

In the courtyard, more rest facilities are necessary. Divers rest facilities can provide the patients space to refresh themselves and place to have a rest and communication with other people.

8) Luo, Yunhu, Design of Modern Hospital Architecture, 1st ed., China Architecture and Building Press, Beijing, 2003, p.107.

9) Xu Chong & Zhang Shizheng, A Primary Study of Hospital Architectural Colors, The Chinese Journal of Hospital Administration, Vol.18, No.10, 2002, pp.627-628.

10) <http://www.parkingbj.com/xinwenzixun/qiyexinwen/2008011678.html>

11) Ministry of Construction of the People's Republic of China, Code for Design of Parking-area, 1998.

12) Zhao Jianbin, Mu Wei & Fan Hui, Humanized space design of modern medical buildings, Shanxi Architecture, Vol.33, No.17, 2007, pp.30-31.

5.2 Improvement of Healing Environmental Aspects

5.2.1 Outdoor Environment:

1) Improvement of green coverage

Many researches provide convincing evidence that visual exposure to the nature would improve outcomes such as the stress and pain relief¹³⁾. According to the Construction Standard for General Hospital¹⁴⁾, the green coverage rate should not be lower than 35% in new general hospitals, 30% in reconstructed general hospitals.

However the green coverage rate is lower than 30% in most reconstructed general hospitals(see Table 5), due to the expansion of hospital and construction of parking area. At present, high density of building and low coverage of green hinder the development of outdoor environment. In order to improve external environment, some measures should be taken to increase the green coverage.

a) According to the growing characteristics of plants, a combination of grasses, shrubs and trees is necessary in the limited green area, which could be divided into tree layer, shrub layer and herb layer in vertical space, to increase the quantity of plants.



Fig. 8. Ecological Parking Lot Fig. 9. Hospital Street

(Source: http://news.dayoo.com/gov/61794/61800/200810/13/61800_4280446.htm) (Source: <http://www.dnkb.com.cn/archi-ve/info/20101021/065404670.shtml>)

b) Considering the use of balcony, window sill and walls for planting flowers, which can not only beautify the outdoor environment but also provide natural scenery for people in the buildings.

c) The roof garden would be necessary in urban hospitals (see Fig. 10). With the development of high-rise buildings, hospitals increasingly become more and more high-rise buildings, which make some patients away from the ground and may cause some negative impact on patients. The construction of roof garden can alleviate this problem.

Well-designed roof gardens can become another good landscape for patients in the external environment¹⁵⁾.

2) Enhancement of hospital courtyard environment

Courtyard is an important part of outdoor environment, playing an important role in hospital medical care. However, in many hospitals, the courtyards are usually covered with gray concrete or bricks with little green, greatly reducing the medical healthcare function and environmental beautifying function.

Combination of flowers, grass, water and stone in courtyard by imitating nature can create an active visual imagination for patients(see Fig. 11), which is better than sole grass in creating an atmosphere of lightness and pleasure.

The natural settings in courtyard can help patient to recover from stress quickly and cause beneficial physical changes, for instance, in blood pressure and heart activity. As a positive distraction, natural scenery also diverts patients from focusing on their pain or distress.



Fig. 11. A Photo of Hospital Healing Garden

Fig. 10. Roof Garden

(Source: <http://www.zlylh.com/Product/wudinghuayuan/2011/1010/83.html>) (Source: http://www.kurusu.com/kurusu-portfolio.shtml#health_rockford)

Hospital gardens not only provide restorative or calming natural views, but also can reduce the stress and improve outcomes through other mechanisms, for instance, fostering access to social support and providing opportunities for positive escape and sense of control with respect to stressful clinical settings.¹⁶⁾ Thus, enough recreational facilities should be provided to support social interactions, increasing the accommodation of patients and escorts in yards.

Artwork, especially sculpture is also an important component of courtyard environment, like a bright spot in the garden space, in creating a diverse space environment,

13) Ulrich, R. S. et al., 2004, p.21.

14) Ministry of Health of the People's Republic of China, Construction Standard for General Hospital, 2008.

15) Luo, Yunhu, 2003, pp.61-63.

16) Cooper M. C., & Barnes, M., Gardens in healthcare facilities: Uses, therapeutic benefits, and design recommendations, Martinez, CA: Center for Health Design,1995; and Ulrich, R. S., Effects of gardens on health outcomes: Theory and Research. Healing gardens, Wiley Press, New York, 1999, pp.27-86.

which is similar to the nature in reducing stress and diverting patients from focusing their distress.

However, researches also showed that a great number of patients respond positively to the representational nature art, but many react negatively to chaotic abstract art.¹⁷⁾ So, besides the scale and size to surroundings, the form of artwork should give priority to representational natural elements.

5.2.2 Indoor Environment:

Outpatient department is the front window to patients, taking the role of accepting patients and making primary diagnosis and treatment for a large number of patients. However as a result of patients concentration, especially in the morning, patients spent 2/3 of the time in registration and waiting in average, which not only increase the patients' psychological stress but also severely affect the satisfactions to hospital service. So it is urgent to take some measures to reduce the anxiety caused by long time waiting and poor medical environment.

1) Improvement of the clinic hall environment

For those early constructed clinical hall, due to small area, decentralized registration is a appropriate choice to distribute patients, decreasing congestion and noise.

In addition to setting convenient facilities in the clinic hall, laying artworks and natural elements such as trees and flowers in the hall can create a more humanistic environment. Artworks like large landscapes painting fixed on the wall of clinic hall can visually enlarge the space, creating a pleasant atmosphere, bringing a relaxed experience. Natural elements in the clinic hall can provide a positive escape from disease and create an attractive environment for patients.

2) Provision of positive distraction in waiting space

Positive distractions refer to a small set of environmental features or conditions that have been found by research to effectively reduce stress. The most effective distractions can include certain types of music and comedy, companion animals, laughing or caring face and especially natural elements.¹⁸⁾ Nature related artworks and scenery can reduce

stress, alleviate patients' anxiety for waiting and divert patients from focusing on their pain or distress.



Fig. 12. Waiting Room



Fig. 13. Waiting Room of

Pediatrics in Seoul Children Hospital
(Source: <http://janellekeith.blogspot.kr/2011/07/gods-waiting-room.html>)

To alleviate patients' anxiety and pressure, some positive distraction can be provided as follows;

a) Views of outdoor from waiting room or corridor wherever possible.

b) Murals or paintings of natural scenery are also helpful if natural view is not available. Especially large scale natural scene paintings on wall can significantly enlarge waiting space visually, reducing psychological pressure caused in narrow space (see Fig. 12).

c) A wall-mounted television to play video of natural scenes and sounds (birds, insects chirp) or pleasing music.

d) Ample natural light wherever possible and using color-corrected lighting in interior spaces which closely approximates natural daylight.

e) Cheerful and varied colors and textures to create a pleasing environment and reduce patients' depression.

3) Creation of a colorful environment

80% of the information people get is from vision, which means color environment can greatly affect patients' appraising on hospital image and change patients' emotion.

At present, interiors of many hospital buildings are still in a white tone, although clean, but inevitably also monotonous. And modern science has confirmed that people in a white environment for a long time would be adversely affected. So it is necessary to adopt diverse colors to create a colorful environment to alleviate the patient's pain and regulate emotion.

For the exterior of buildings, generally large area could use elegant color with high brilliance and low chroma. Building group should have unified and coordinated color tone¹⁹⁾.

17) Ulrich, R. S. & Gilpin, L., *Healing arts: Nutrition for the soul, Putting patients first: Designing and practicing patient-centered care*, Jossey-Bass Press, San Francisco, 2003, pp. 117-146.

18) Ulrich, R. S., *Effects of interior design on wellness: theory and recent scientific research*, *Journal of Health Care Interior Design*, Vol.3, No.1, 1991, pp.97-109.

19) Yang Yang & Zeng Zhixing, *Humanization of Interior Design of Hospital Construction*, *Shanxi Architecture*, Vol.34, No.7, 2008, pp. 86-87.

For interior medical space, it is appropriate to use soft color with high brilliance and low chroma, such as light orange and beige. Meanwhile, different department should use different colors according to the psychological effect of colors, for example, in Obstetrics and Gynecology clinic, purple can be used because purple can make pregnant women comfortable, while brown environment can help hypertension patients to reduce blood pressure, light blue can help patients with fever to counteract the fever and blue in department of pediatrics can make the children calm and so on²⁰⁾ (see Fig. 13).

Furthermore, combined with green plants, furniture, posters and signage using shining colors can create a pleasing space with vitality.

6. CONCLUSION

This paper aimed to analyze the present situation of medical health and facilities in China and the existing environmental shortcomings of general hospitals in Qingdao and offer some suggestions for further improvement and future hospital design. Major contents consisted of the present situation of medical health and facilities in China, the importance of good environment, present physical environmental situation of general hospitals in Qingdao, and some suggestions for better outdoor and indoor environments.

Traditionally, healthcare facilities design emphasized concerns on functional efficiency, costs and providing effective platform for medical treatments and technology, which disregard the psychological and social needs of patients and staffs²¹⁾.

Along with restriction of economic development level at that time and unordered construction in the late due to lack of long-term planning, many previous hospitals in China have sharply lagged behind people's requirements for well-designed environment.

Nowadays, as the medical model transferred from biomedicine to holistic medicine, there is a growing awareness of the need to create healing environments to improve patient health outcomes, therefore the environmental quality of healthcare architecture has been more and more emphasized and improved.

The main shortcomings of Qingdao general hospitals can be briefly summarized as lack of parking space, insufficient convenient facilities, low green coverage, monotonous outdoor environment with gray concrete and bricks, indifferent interior environment and dull color environment.

And some suggestions for better clinic environment could be summarized as increase of parking lots by adopting ecological parking, increasing of convenient facilities, improvement of green coverage, enhancement of courtyard environment with natural elements and artworks, improvement of the clinic hall environment by providing social life facilities, provision of positive distraction in waiting space to provide positive distractions and creation of a colorful environment with diverse colors.

Further research on the expansion and use of public space, the introduction of healing garden and horizontal hospital with easy extension and change through literature review and analysis of various site-visits need to be continued.

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9. Luo, Yunhu, Design of Modern Hospital Architecture, 1st ed., China Architecture and Building Press, Beijing, 2003.
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