The Symposium on Healthcare Architecture in Asia 2013
The Prospect of Sustainable Healthcare Architecture in Asia

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Kyoon Han
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The Symposium on Healthcare Architecture in Asia 2013
Enhancing the Nursing Unit Design of General Hospital in Qingdao, China with a Reference of the Examples in Korea
Chang-Ho Moon and Shu-Quan Song
Dept. of Architecture and Building Engineering, Kunsan National University, Kunsan, 573-701 Korea

Abstract — With the development of society & economy and improvement of people’s living conditions, nursing unit are being redesigned at a rapid rate to meet the higher demand of patients, families and caregivers. This paper aimed to compare and analyze the nursing units design of general hospital in Qingdao, China and Korea based on a variety of factors such as unit configuration & layouts, travel distance, centralized & decentralized nurses’ stations, visibility, communication and different types of patient rooms to find some suggestions to improve work efficiency and provide better environment for patients, families and caregivers for future nursing unit design with more flexibility. Improvement of nursing unit design can be summarized as adoption of compact low-rise inpatient building, new nursing unit design concept such as double-corridor unit with atrium, various compact shapes of ward plan and decentralized nurses’ station, expansion of core nursing support space, provision of sun room, establishment of a multi-level patient rooms, provision of private washroom in the patient rooms, expansion of the usable space of multi-bed rooms and creation of color environment.

Key Words — Nursing Unit Design, General Hospital, Qingdao and Korea, Comparison

I. INTRODUCTION

The emergency and development of inpatient ward is the result of a variety of factors such as society, economy, culture, science and technology, and is closely affected with the medical demand and nursing care delivery model that require a corresponding building mode to facilitate its execution.

With the rapid development of society, economy, science and technology and the improvement of medical level, the nursing care delivery model in China has shifted from a functional nursing model to primary nursing model towards optimal attainment of the physical, mental emotional, social and spiritual aspects of health, requiring close nurse-patient relationship [9].

<table>
<thead>
<tr>
<th>Name of Hospital</th>
<th>No. of Beds</th>
<th>Floor Area (㎡)</th>
<th>Floor Area/Bed (㎡)</th>
<th>Form of Ward Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hosp-1</td>
<td>1,995</td>
<td>200,000</td>
<td>100.3</td>
<td>Vertical</td>
</tr>
<tr>
<td>Hosp-2</td>
<td>650</td>
<td>72,000</td>
<td>110.8</td>
<td>Vertical</td>
</tr>
<tr>
<td>Hosp-3</td>
<td>420</td>
<td>20,000</td>
<td>47.6</td>
<td>Horizontal</td>
</tr>
<tr>
<td>Hosp-4</td>
<td>600</td>
<td>76,000</td>
<td>126.7</td>
<td>Vertical</td>
</tr>
<tr>
<td>Hosp-5</td>
<td>880</td>
<td>100,000</td>
<td>113.6</td>
<td>Vertical</td>
</tr>
<tr>
<td>Hosp-6</td>
<td>2,000</td>
<td>223,000</td>
<td>111.5</td>
<td>Vertical</td>
</tr>
<tr>
<td>Average</td>
<td>-</td>
<td>-</td>
<td>101.8</td>
<td>(102.5)</td>
</tr>
</tbody>
</table>

( ) means new hospital in construction

Date of site-visit: 2013.7.7-2013.7.25

Table 2. Information of Sample Hospitals in Korea

<table>
<thead>
<tr>
<th>Name of Hospital</th>
<th>No. of Beds</th>
<th>Floor Area (㎡)</th>
<th>Floor Area/Bed (㎡)</th>
<th>Form of Ward Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hosp-A</td>
<td>680</td>
<td>104,000</td>
<td>140.0</td>
<td>Vertical</td>
</tr>
<tr>
<td>Hosp-B</td>
<td>500</td>
<td>36,000</td>
<td>72.0</td>
<td>Vertical</td>
</tr>
<tr>
<td>Hosp-C</td>
<td>550</td>
<td>63,000</td>
<td>114.5</td>
<td>Horizontal</td>
</tr>
<tr>
<td>Hosp-D</td>
<td>580</td>
<td>60,000</td>
<td>103.4</td>
<td>Vertical</td>
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<tr>
<td>Hosp-E</td>
<td>1,000</td>
<td>171,000</td>
<td>171.0</td>
<td>Vertical</td>
</tr>
<tr>
<td>Hosp-F</td>
<td>200</td>
<td>14,000</td>
<td>70.0</td>
<td>Vertical</td>
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<tr>
<td>Hosp-G</td>
<td>600</td>
<td>97,000</td>
<td>161.7</td>
<td>Vertical</td>
</tr>
<tr>
<td>Hosp-H</td>
<td>700</td>
<td>54,000</td>
<td>77.1</td>
<td>Horizontal</td>
</tr>
<tr>
<td>Average</td>
<td>-</td>
<td>-</td>
<td>113.7</td>
<td>-</td>
</tr>
</tbody>
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<table>
<thead>
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<th>Name of Hospital</th>
<th>No. of Beds</th>
<th>Floor Area (㎡)</th>
<th>Floor Area/Bed (㎡)</th>
<th>Form of Ward Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hosp-A: National Health Insurance Service Ilsan Hospital</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>(138.1)</td>
</tr>
<tr>
<td>Hosp-B: Gwangju Veterans Hospital</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Hosp-C: Chonnam National University Hwasun Hospital</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Hosp-D: Chung-Ang University Hospital</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Hosp-E: Yonsei University Severance Hospital</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Hosp-F: Seoul Bukbu Hospital</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Hosp-G: Seoul Medical Center</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Hosp-H: Seoul National Hospital</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

( ) means average floor area per bed of general hospitals only
design that attempts to improve work efficiency and provide better space and environment for patients, families and caregivers for future nursing unit design with more flexibility is necessary.

In this research, six large and best general hospitals in Qingdao which stand for the local highest medical level and several Korean general hospitals were chosen as the research objectives. Summary information of these hospitals is listed in TABLE 1 and TABLE 2. Nursing unit of general hospitals in Qingdao, China and Korea are compared and analyzed based on a variety of factors such as unit configuration & layouts, travel distance, centralized & decentralized nurses’ stations, visibility, communication and different types of patient room to find some suggestions for better nursing unit design.

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

II. OVERVIEW OF MEDICAL HEALTH CARE AND FACILITIES IN CHINA

Since the founding of the People’s Republic of China in 1949, and the beginning of the reform and opening-up in particular, health care sector has made remarkable achievements in China. However, there is still a rather prominent contradiction between the current development level of health care sector and the people’s health demands and the requirements of balanced socio-economic development [14].

In the past, because of inadequate funds by government, unreasonable allocation of medical and health care resources in big general hospitals and primary health care institutions, the medical condition in big general hospital is much better than primary health care institutions, which makes a lot of patients flood into general hospitals. In China, due to lack of medical equipment, poor medical condition, lack of general practitioner, and skilled medical staff, only 22.5% of the patients are willing to visit community medical centers [5].

Things have changed since 2009. According to the Opinions of the CPC Central Committee and the State Council on Deepening the Reform of the Medical and Health Care System, since 2009 efforts has been made to enhance the utilization efficiency of medical and health resources and the newly added health resources must be in conformity with regional health planning, and priority will be given to weak areas such as rural and community health services [1].

In terms of hospital beds, the number of hospital beds per 1,000 population in China had gradually risen from 2.02 beds in 1980 to 3.56 beds in 2010, which had reached near to those of developed countries about 3.0 acute care beds in 2000s, but much lower than 8.8 beds in Korea and 13.6 beds in Japan (see Fig. 1).

In developed countries such as USA and United Kingdom, the decline of acute care bed density from 6.0 beds to about 3.1 beds was attributed to the provision of long-term care hospital beds in community-based hospitals and specialty hospitals. While there is a significant increase of hospital bed density in Korea and a high bed density in Japan with a slight decrease in recent years due to the occupancy of hospital beds by long-term care patients in both Japan and Korea.

Considering the lack of long-term care hospital beds in China and more severe aging problem, there should be a gradual increase of hospital beds in a short term and more long-term care hospital beds will be provided for patients in a long term.

With the reform of Medical and Health Care System, community healthcare center will be actively carried on a large scale along with the improvement of medical condition, and then the community health center will become the first choice of patients. In the near future, 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 [19].
A. Form of Inpatient Buildings

Before 1980s, because of the restrictions on economic and social development, low-rise buildings with low cost were popular in China.

Since 1980s, with the development of society and economy, the improvement of living standard and increasing of medical demand, a lot of general hospital came into a booming of reconstruction and expansion. And an important issue is to increase the number of beds in a large scale.

In recent hospital buildings, high-rise buildings become more popular (see Table 1). Since 1990s, all the new inpatient buildings are vertical and high-rise building.

Some of the inpatient buildings were reconstructed in the original site. Compared with low-rise building, high-rise building can accommodate more beds in a limited small site and can save more land for outpatient department, medical support department, green land and future expansion.

Some hospital authorities like to build ostentatious projects in order to make a good impression or show their achievements, so more attentions were paid to the image of buildings trying to make the hospital buildings to be a landmark, placing undue emphasis on the height of the buildings in the recent hospitals.

On the one hand, the rapid expansion on number of hospital beds have made the average site area per bed declined greatly which are much lower than the required standard, leading to severe deterioration of hospitalization environment, work environment and transportation.

Compared with low-rise building, more elevators and materials such as steel, concrete and fire-fighting equipment have to be used, more energy is consumed and more floor area are occupied by pipeline wells and equipments in high-rise building.

In contrast, in recent Korean general hospitals though overall forms of most hospital buildings have still vertical concept, some horizontal concept hospitals (see Table 2) also have been attempted to make the hospital have more flexibility and ability to expand and can be easily harmonized with natural environment through atrium and courtyard to get natural light and ventilation [2] (see Fig. 2).

Besides, the floor area per bed in Korean general hospitals varies from 103.4m$^2$ to 171.0m$^2$ and the average floor area per bed is 138.1m$^2$, much more than 102m$^2$ of general hospitals in Qingdao, which indicates that Korean general hospitals have more specialized space for different use.

B. Configuration and Layouts of Nursing Unit

In Chinese general hospital, a typical inpatient unit consists of patient rooms, nurses’ stations, hallways, training area and support spaces.

Before 1990s, single-corridor type is a common form of nursing unit with patient room in the south and the support and training space in the north of the unit, which allow all the rooms can get enough natural light and ventilation (see Fig. 3).

Since 1990s and 2000s, with the expansion of unit scale, the double-corridor type was adopted with the patient rooms arranged around a core of support space outside the unit to reduce travel distance between nurses’ station and patient rooms and improve work efficiency (see Fig. 3).

Especially in recent inpatient buildings in 2010s, a new concept of on-stage & off-stage with a reference to Disneyland Main Street was introduced into the double-corridor nursing unit that the nursing unit were divided into an onstage area including a core of support space and patient rooms for nursing practice while space behind the core support space were reserved for secondary support space and training space, which allow as much patient rooms as possible to get natural sunlight and ventilation and provide exclusive work area for medical staffs (see Fig. 3). While some of the support space in the core of the unit cannot get natural light and ventilation and reduce the cross-ventilation.
Especially in recent inpatient buildings in 2010s, staff travel distances, patient safety, visibility and communication, proximities and room distance are competing factors in the design of nursing unit [18].

On the other hand, instead of the rectangular shaped floor plan, various compact shapes such as triangular, “W”, pinwheel, curved rectangular, “T” of ward plan have been designed in recent Korean hospitals with atrium in unit to provide natural light and ventilation for support space and single-corridor were still used in compact triangle shape nursing unit with advantages of natural light and ventilation and a “T” shape ward for easy expansion[11&12] (see Fig. 5) in suburban area.

However, most of the double-corridor nursing unit did not reduce travel distance much compared with the same type nursing unit in Korea. In the nursing unit of Qingdao general hospitals, most of the patient rooms were arranged on the south side and the north side were occupied by secondary support space and training space, which is similar to single-corridor type in the view of patient rooms, while in Korean hospitals, the patient rooms were arranged on both side of the nursing unit and the central space in the unit were expanded to accommodate the support space(see Fig. 4), which makes the patient rooms closely around the nurses’ station and makes the nurses have easy visual access to more patient rooms improving patient and family satisfaction and aiding nurses in work tasks and interaction[18].

C. Composition and Space Allocation of Functional Area in Nursing Unit

In nursing unit, functional area consists of bedroom area, day room and other public area for patients, nursing area, training area, service area and circulation area [17].

In Qingdao general hospitals, the total area of nursing unit on average is 1,019.3$m^2$. In terms of the proportion of different functional areas, the bedrooms take the biggest proportion 45.3% followed by the circulation space 24.1%, training space & service space 14.4% and nursing support space 13.3% (see Table 3).

In Korean general hospitals, the total area of nursing unit on average is 1032.1$m^2$. In terms of the proportion of different functional areas, the bedrooms take the biggest proportion 46.6% followed by the circulation space 26.7% and nursing support space 15.5%.
Generally speaking, the total area of nursing unit and proportion of different functional space (except training space & service space) on average in Qingdao general hospital is similar to that of Korean hospitals [17]. However, there was more space for training and service in Qingdao general hospitals.

In Hosp-2, because there is only one nursing unit in each floor without another nursing unit to share the circulation space, the proportion of circulation space is as high as 32.7%, which is much higher compared with the average 24.1% in Qingdao and 26.7% in Korean general hospitals, and the proportion of bedroom space is the lowest as 37.9%, indicating that only one nursing unit in each floor may not be economic. While in Hosp-5, combination of single-corridor and double-corridor was used to reduce the circulation space and to get more patient room area, making the proportion of bedroom as high as 56.3%.

D. Types of Patient Room and Amenities

In general hospitals of Qingdao, number of beds per nursing unit(NU) ranges from 32 to 44 and average number is 38.0, which is still higher than the general hospitals of developed countries(less than 30beds/NU[2]), but is lower than about 48 beds of Korean hospitals.

In terms of patient room types, according to the interview with patients, two-bed room and three-bed room are most favored and single-bed should be more provided, while six-bed room is not welcomed because of more noise and less privacy and four-bed room is an acceptable choice for patients. In Qingdao general hospitals, two and three-bed room are in majority, accounting for 76.4% and single bed room, four to six-bed room take only a very small proportion of the total patient rooms, while in Korea, 4-6 bed room are in the majority of 61.6%, and single-bed room takes a higher proportion than Chinese general hospitals(see Table 4), which indicates that the composition of patient rooms in Qingdao general hospital is more reasonable than that of Korean hospitals, but more single-bed rooms and four-bed rooms should be provided for different groups.

In some nursing unit of Qingdao general hospitals, nursing support space is in serious shortage, only 60.4$m^2$, which is much lower than the average 160.1$m^2$ in Korean general hospitals.

Especially, the treatment room and nurses’ station (see Fig. 6) is so small that some equipment have to be placed in the corridor (see Fig. 7).

In the composition of nursing unit, only Hosp-4 and Hosp-6 east branch provide sun room for patient and their families. In the interview with nursing staff and patients, it is found that a sun room is needed by them. By contrast, most Korean nursing units are designed with the consideration of public spaces like the patient dining room and/or day room that provide social support for nursing staff, patients and their families [3].
Table 3 Average Space Allocation of Functional Area of the Nursing Unit

<table>
<thead>
<tr>
<th>No.</th>
<th>Bedroom</th>
<th>Dayroom &amp; Public Space</th>
<th>Nursing Support Space</th>
<th>Circulation Space</th>
<th>Training Space and Service Space</th>
<th>Total Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qingdao</td>
<td>461.7</td>
<td>(45.3%)</td>
<td>56.0</td>
<td>(5.7%)</td>
<td>133.9</td>
<td>246.3</td>
</tr>
<tr>
<td>General</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospitals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Korean</td>
<td>481.1</td>
<td>(46.6%)</td>
<td>73.0</td>
<td>(7.1%)</td>
<td>160.1</td>
<td>250.8</td>
</tr>
<tr>
<td>General</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospitals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Nursing Support Space: nurses’ station, treatment room, disposal room, dressing room, pantry etc.
- Training Space and Service Space: demonstration room, doctor’s office, doctor’s duty room and meeting room, switching room and cleaning room etc.

Table 4 Comparison of Average Proportion of Different Types of Patient Rooms in Qingdao and Korea

<table>
<thead>
<tr>
<th>No. of Beds/Unit</th>
<th>1-Bed Room</th>
<th>2-Bed Room</th>
<th>3-Bed Room</th>
<th>4-6Bed Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qingdao</td>
<td>38.0</td>
<td>8.1%</td>
<td>46.3%</td>
<td>30.1%</td>
</tr>
<tr>
<td>General Hospital</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Korean</td>
<td>47.3</td>
<td>16.2%</td>
<td>18.2%</td>
<td>4.0%</td>
</tr>
<tr>
<td>General Hospital</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5 Comparison of Average Area of Patient Room per Bed of General Hospitals in Qingdao and Korea

<table>
<thead>
<tr>
<th>No. of Beds/Unit</th>
<th>Average Area of Patient Room per Bed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Qingdao General Hospital</td>
</tr>
<tr>
<td></td>
<td>Largest</td>
</tr>
<tr>
<td>1-bed room</td>
<td>34.6</td>
</tr>
<tr>
<td>2-bed room</td>
<td>16.3</td>
</tr>
<tr>
<td>3-bed room</td>
<td>11.2</td>
</tr>
<tr>
<td>4-bed room</td>
<td>12.8</td>
</tr>
<tr>
<td>5-bed room</td>
<td>-</td>
</tr>
<tr>
<td>6-bed room</td>
<td>11.6</td>
</tr>
</tbody>
</table>

In most wards built in 1980s, there is no private washroom in patient room, even in some wards built in 2000s, there is no washroom in multi-bed room and in all types of patient rooms, only basic living goods such as storage cabinets, chairs and a bedside cupboard are provided. While in Korean hospitals, washroom has became an essential component of all types of patient rooms with amenities at different level according to the number of patients in the room.

In the area of patient room per bed (see Table 5 [11]), the average area of patient room per bed in Qingdao hospitals is larger than that of Korean hospitals, especially the single-bed room, two-bed room and four-bed room in Qingdao hospitals are much larger than those of Korean hospitals. However, there is a significant difference between largest room and smallest room in area per bed of all types rooms in Qingdao general hospitals, indicating that a appropriate standard need to be made to promote the design of patient rooms.
IV. IMPROVEMENT OF THE NURSING UNIT OF GENERAL HOSPITALS IN QINGDAO

Inpatient department is an important part of hospital that provides a place for inpatient to live and receive treatment. A reasonable design of nursing unit can provide support for work efficiency and quality of care.

With the reform of Medical and Health Care System, community healthcare center will gradually become the first choice for long-term care patients. In near future, hospital construction will transfer from the expansion of hospital scale such as quantity of beds to the improvement of hospital quality like work efficiency and better healing environment.

A. Site Selection and Architectural Form of Inpatient Buildings

Economic development has lead to a willingness of upgrading living quality and either urban or rural inhabitant requires a higher level of health services.

In near future, it may be appropriate to build a general hospital in urban fringe area with the connection of subway that provides convenient transportation. Besides sufficient lands for construction, the urban fringe with beautiful scenery, fresh air, plenty of sunlight and less interference factors is conducive to the rehabilitation of the patients and can also reduce the negative impact of hospitals in densely populated areas.

Considering the high initial cost, running cost and low work efficiency of high-rise hospital buildings, compact and low-rise design concept may be a better choice for future hospital design. In this concept, as the hospital function is based on the horizontal principle with departments of related functions horizontally banded on the same level, the movement from one department to another flows freely and more stably, extraneous vertical movement can be minimized and flexibility and economy are permitted in the use of space and facilities.

Besides, low-rise hospital buildings can be easily harmonized with natural environment, reducing the visual impact of what is a substantial building and providing a humane and reassuring environment for patients and staff with natural landscape and light.

B. Adoption of New Nursing Unit Design Concept

In double-corridor nursing unit, the travel distance were not reduced substantially, but more square meters were needed, and some support space in the center of unit cannot get natural light & ventilation and reduce the cross-ventilation in the unit, increasing the dependency on mechanical ventilation and artificial illumination.

New design concepts need to be introduced and implemented in inpatient buildings to solve these problems.

1) Adoption of New Layout

One choice is to make the patient rooms arranged on both side of the nursing unit and the central space in the unit is to be expanded to accommodate the support space, which makes the patient rooms closely around the nurses’ station and makes the nurses have easy visual access to more patient rooms improving patient and family satisfaction and aiding nurses in work tasks and interaction. Meanwhile, atrium can be introduced to the central support space to improve the input of the natural light and ventilation.

Another way is, instead of the strict rectangular shaped floor plan, to use various compact shapes such as triangular, “W”, pinwheel, curved rectangular, “T” of ward plan that have been adopted in Korean hospitals with atrium in unit to provide natural light and ventilation for support space. Especially, the compact & triangular shape unit is optimal for a variety of reasons such as minimal walking distance due to compactness, utilization of available space and maximum daylight exposure [18].

2) Adoption of Decentralized Nurses’ Station

Considering the nursing care delivery model has changed to primary nursing model, decentralized nurses’ station can be a good choice for the future nursing unit design, which can improve work efficiency and reduce physical fatigue through staffs’ movement for patient care & material supplies.

Therefore, decentralized nurses’ station system can get some reduction in time spent with nurses’ walking and a corresponding increase in the time spent in direct patient care activities [15], even though this system may need more nursing staffs and more working space.

C. Improvement of Functional Space

1) Expansion of Core Support Space

In some ward, nursing support space such as treatment room and nurses’ station is so small, and some equipment has to be placed in the corridor. In order to support the normal practice, more space is necessary to make the treatment room large enough for two treatment carts at the same time.

2) Provision of Sun Room

In the interview with nurses, they complained that long hours of work in space without sunlight made them depressed, so a sunroom needs to be provided for nursing staff. Researches also have showed that exposure to sunlight could alleviate pain & stress [10], foster better sleep [12] and reduce patients’ hospital stays [13].

A sunroom or day room is necessary to improve quality of care and provide a good place for patients, their
families and nursing staff to bathe in the sun to have a rest and talk.

D. Improvement of Patient Rooms

1) Establishment of multi-level patient rooms

In terms of patient room types, two-bed room and three-bed room are in majority, usually accounted for more than 60% and single bed room, four-bed room and six-bed room take only a very small proportion of the total patient rooms. And according to the interview with patients, two-bed room and three-bed room are most favored, while six-bed rooms are not welcomed because of more noise and less privacy and four-bed room can be an acceptable choice for patients.

In all types of patient rooms, only the basic living goods such as storage cabinets, chairs and a bedside cupboard are provided.

Since the general hospitals serve various income & social stratum, multi-level patient rooms with corresponding furnishings need to be constructed to provide a variety of choices for different income & social groups.

So more single-bed rooms with complete facilities need to be provided for the higher income group to improve their living standard, while four-bed rooms with basic living goods need to be provided for lower income group to relive their financial burdens.

2) Provision of private washroom in patient rooms

With the improvement of living standard, people’s demands for complete amenities are getting higher and higher. Private washroom becomes an indispensable component of patient room to reduce troubles caused by public washroom.

3) Expanding the usable space of multi-bed rooms

In some hospitals, area of multi-bed room is not enough for nurses’ practice. In most multi-bed room, net distance between adjacent beds is only 0.8m (see Fig. 8), and hard to meet the basic requirement on care practice. In this case, the division of adjacent beds has to use I or L shape curtain (see Fig. 9).

According to research, net distance between two beds should not less than 1.2m, considering the division of adjacent beds, 1.5m is a better distance to support nursing staff’s practice and patients’ daily life.

4) Creation of color environment

Hospital environment plays an important role in the healthcare process that can influence health outcomes positively or negatively according to the quality of environment [16].

Colors play an important role in patient’s life. They can have an impact on people’s perceptions and responses to the environment and also affect patient recovery rates, improving the quality and overall experience of patients, staff and visitors, promoting a sense of well-being and independence [7].

White color can create a clean environment, however modern science have also confirmed that people would be adversely affected in a white environment for a long time [6].

But the negative effect of white color did not get much attention in the design of hospitals. At present, almost all the nursing unit are covered with white colors, white walls, white ceilings, white coverlets and clothes, although clean, but inevitably also monotonous(see Fig. 10).

The application of color and design to patients’ accommodation should take account of the emotional and psychological factors which can affect their wellbeing. The objects of color in hospitals are:
(1) To make the hospital a bright and cheerful place to which the patient can come in confidence, remain in cheerful surroundings, and leave without thoughts of escaping from a dark and difficult period in his life.

(2) To make the hospital a pleasant place in which staff can work. Industry has accepted the principle that color is effective in bettering staff relations and increasing staff efficiency. (3) To ensure that dirt can be seen. It is axiomatic that if dirt cannot be seen it will be allowed to accumulate [8].

brilliance and low chroma combined with furniture and posters with shining colors can create a pleasing space for patients and nursing staffs. In order to get satisfactory result, cooperation with color professional might be essential.

VI. CONCLUSION

This paper aimed to analyze the present situation and further development of medical health and facilities in China and the situation of inpatient buildings of general hospitals in Qingdao, and find out the development direction of nursing unit of general hospitals in Qingdao with a reference of Korean general hospitals.

For a long term, there is still a rather prominent contradiction between the current development level of Chinese health care sector and the people’s health demands and the requirements of balanced socio-economic development.

However, with the reform of the Medical and Health Care System, the situation of uneven development of health care undertakings between urban area and rural area, unreasonable allocation of resources and weak work on rural and community health care will be gradually improved.

Under this situation, in near future, 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 medical environment.

In urban area, conditioned by limited site area and people’s preference for high-rise building, vertical inpatient building will continue to be in a dominate position in hospital construction for the time being.

In urban fringe area, it is appropriate to introduce compact low-rise design concept for future hospital design to improve efficiency, flexibility & economy of space and quality of healing environment.

Before 1990s, single-corridor type was a common form of nursing unit. After that, double-corridor type becomes popular in nursing unit design and construction due to the expansion of nursing unit scale. In 2010s, a new concept of on-stage & off-stage with a reference to Disneyland Main Street were introduced into the double-corridor nursing unit to make the patient rooms arranged in the south side and provide a dedicated space for nursing staffs.

New design concept might be introduced to the design of nursing unit: 1) expanding the central space to accommodate support space with atrium in double-corridor, 2) using various compact shapes, especially triangle shape unit with advantages of minimal walking distance, flexibility, utilization of available space and maximum daylight exposure, 3) adopting decentralized nurses’ station to improve work efficiency, quality of care and reduce physical fatigue.

Improvement of nursing unit includes expansion of core nursing support space, provision of sun room, establishment of multi-level patient rooms, provision of private washroom in patient room, expansion of the usable space of multi-bed rooms and creation of colorful environment in nursing unit.

A good nursing unit is the result of comprehensive consideration of various factors. Further research on the architectural plan layout of nursing unit needs to be continued.

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