

Hospital Architecture in China

---- Through Comparison between Chinese and Nordic Hospital Design





CHALMERS

MASTER THESIS

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Spring 2015

ABSTRACT

With a large population, China is under great demands of hospital construction. However, the hospital design in China is facing several problems, such as large scale, formalism and de-humanization. In this case, the thesis aims to solve these problems so as to improve the practice of hospital design in China.

In the thesis, Chinese healthcare background is introduced by comparing with Nordic countries. The main problem of hospital design in China is investigated. A series of solution on how to reduce size and height of a hospital, avoid formalism and be humanization is learned through literature and case study in Nordic countries.

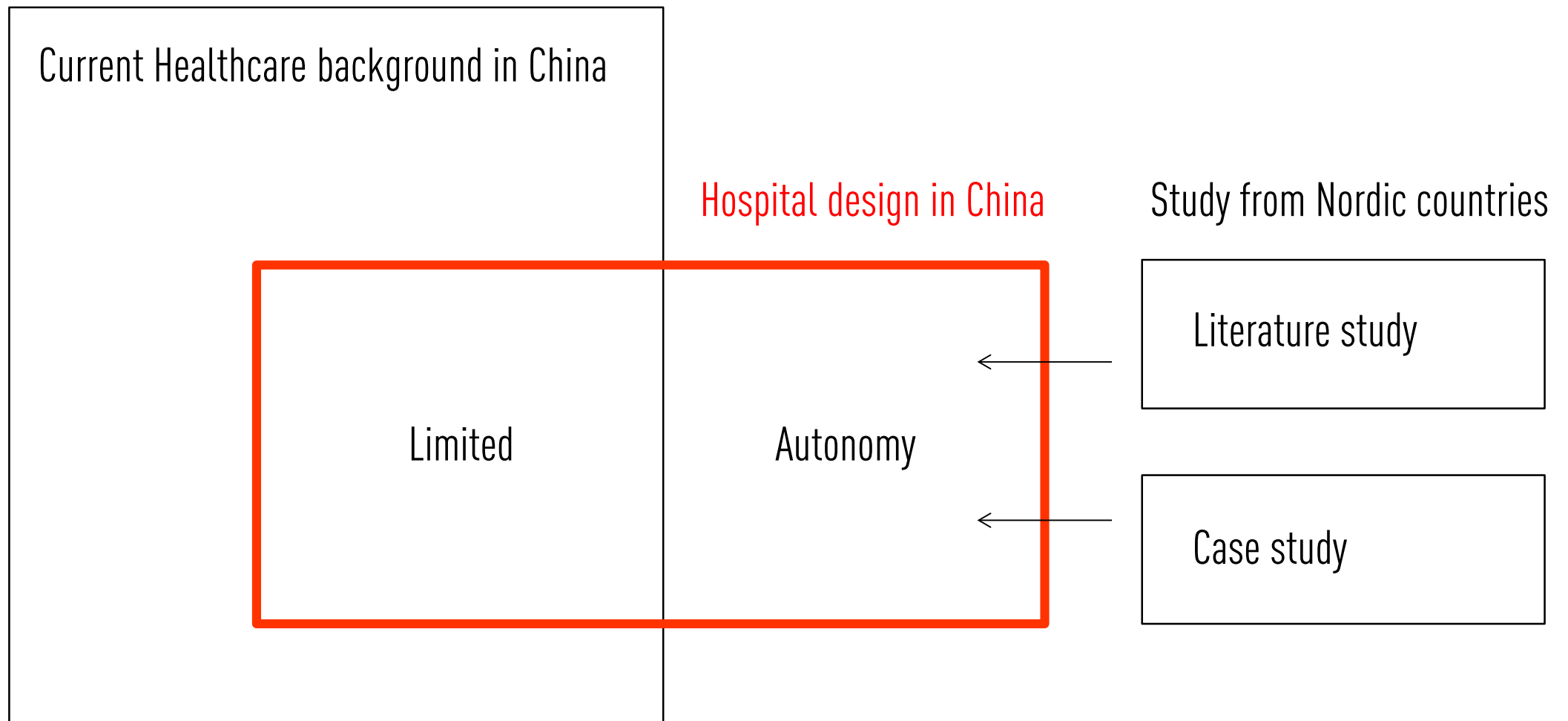
Finally, a conceptual proposal of a Chinese hospital is made as an application of the study into Chinese condition, which not only improves the original proposal, but also solves the problems as is stated above effectively.

KEY WORDS: Hospital design; China; Nordic countries; size and height; improve treatment performance; adapt to future; humanization; healthcare background; literature and case study; conceptual proposal

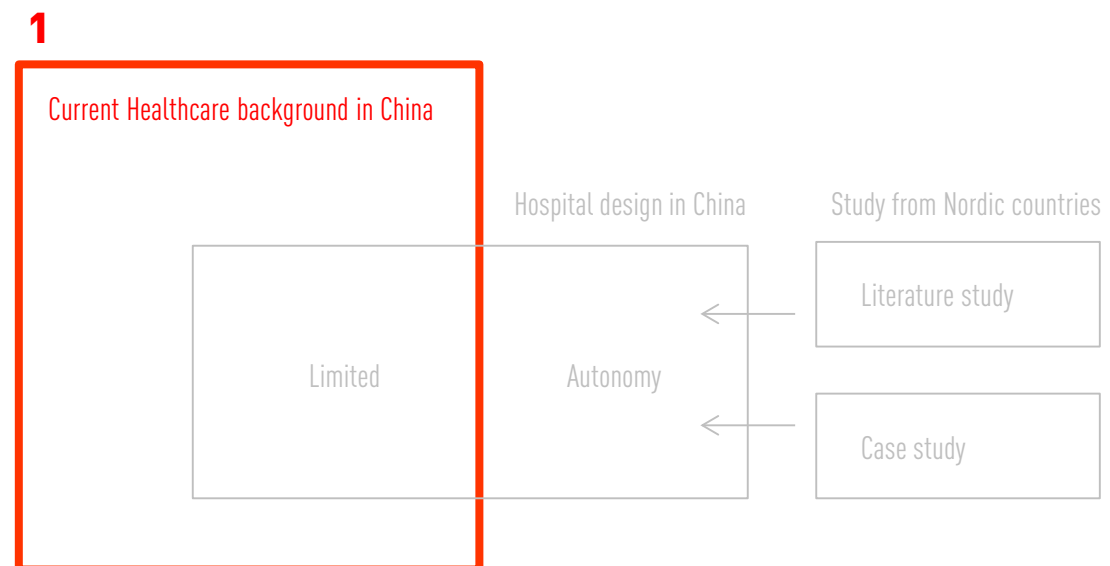
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STRUCTURE



PART 1 Current Healthcare Background in China



1.1 Population and Healthcost

China is very different from Sweden, it has a large population of proximately 1,344,920,000 people, hundred times bigger than Sweden, but the expenditure on healthcare is much less than Sweden. Despite such a disparity, they are facing a same problem of being an aging society.^[1]

From healthcare statistics comparison between China and Sweden, we can have a clear picture about the current Chinese situation. (Fig.1)

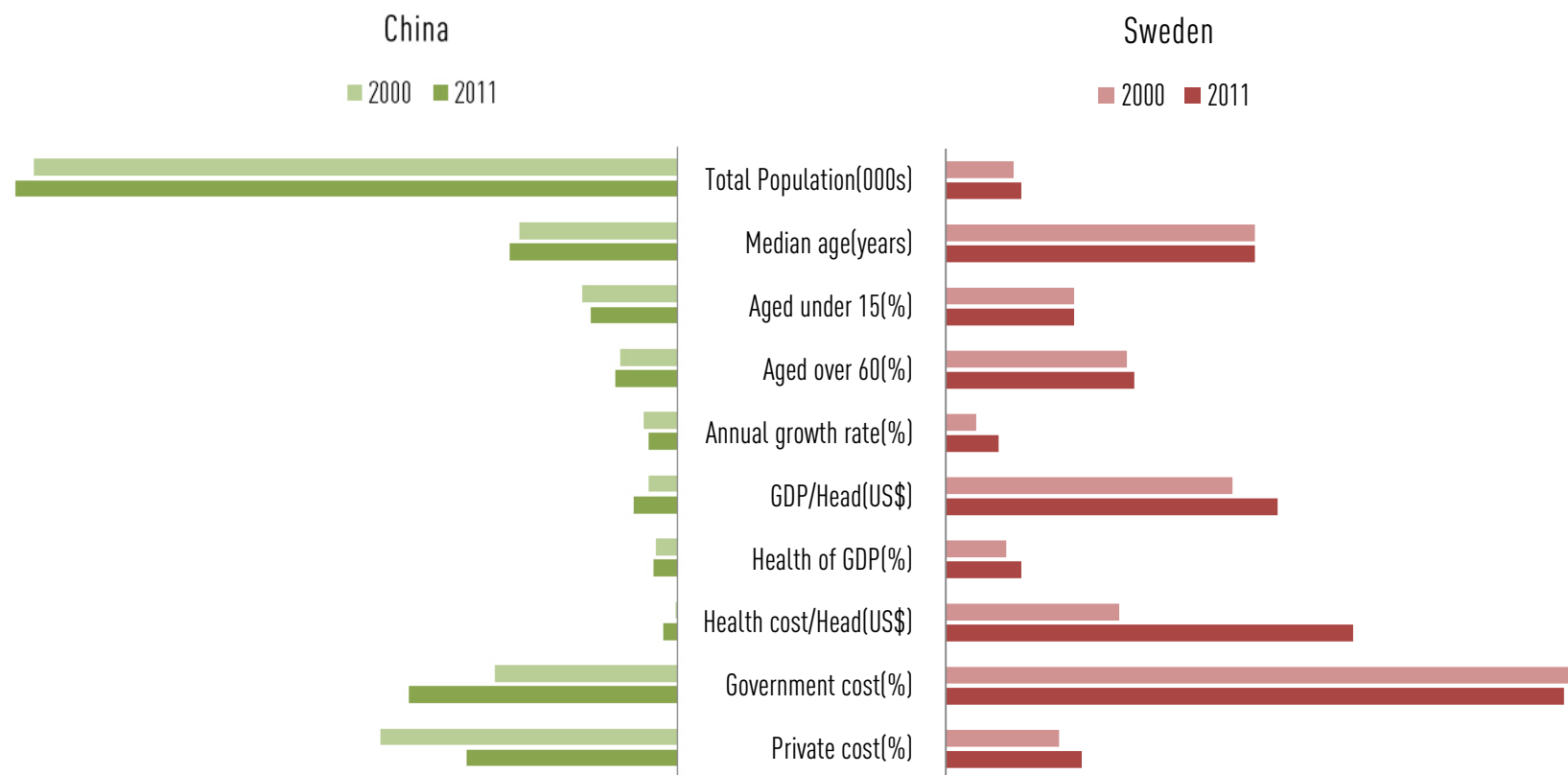


Fig 1 Healthcare statistics comparison between China and Sweden (Author: Jing Ju, based on WHO report, 2010)

1.2 Health Insurance System

The current health insurance system in China is facing several problems. Firstly, it is divided into different group of people who pay differently for the health cost, which leads to a disparity especially between urban employees and rural farmers. Besides, most resources are centralized in the designated hospital which is operated by the government because of the planned economy, which leads to the abandon of the township hospital. Thirdly, the lack of government investment on healthcare leads to a heavy burden of personal cost. [2]

The renovation of Chinese health insurance system may have the enlightenment about equality, market economy and government responsibility by looking into Swedish social insurance system. [3] (Fig.2)

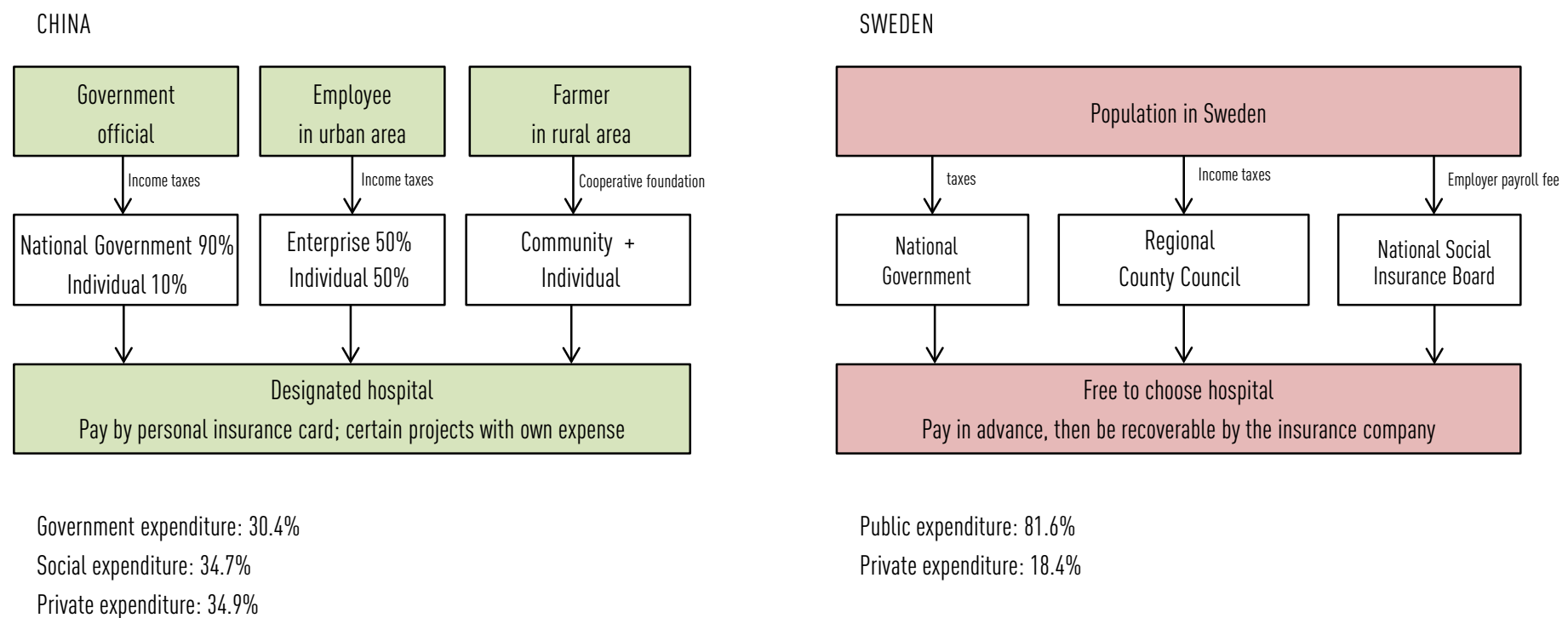


Fig 2 Health insurance system comparison between China and Sweden (Author: Jing Ju, based on reference 2.3.)

1.3 Demand of Hospital Construction

As China grows stronger, the number of hospital construction has increased rapidly in the last 50 years. According to the government statistics, there are 23,170 hospitals (including 13,384 general hospitals) built in China in 2012. [4]

Sweden, however, has gradually decreased the hospital construction year by year. Till now, the resource of hospital in China has come up with the number in Sweden. In 2010, there are 2.73 hospital bed per thousand population in Sweden, and 3.57 hospital bed per thousand population in China. (Fig 3)

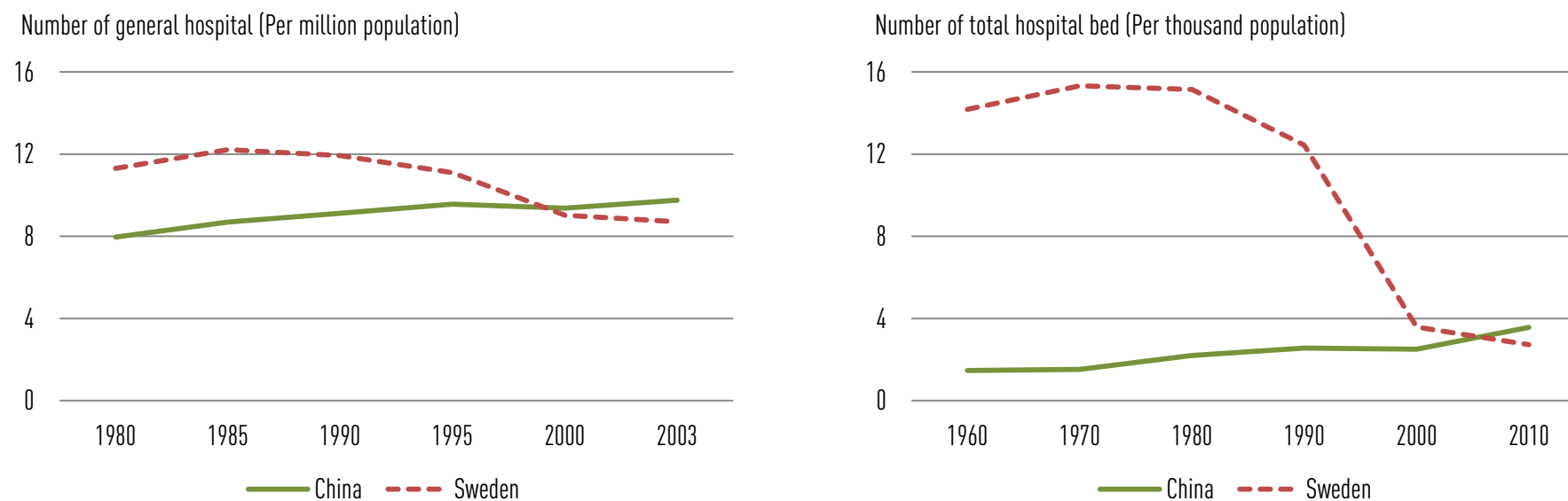
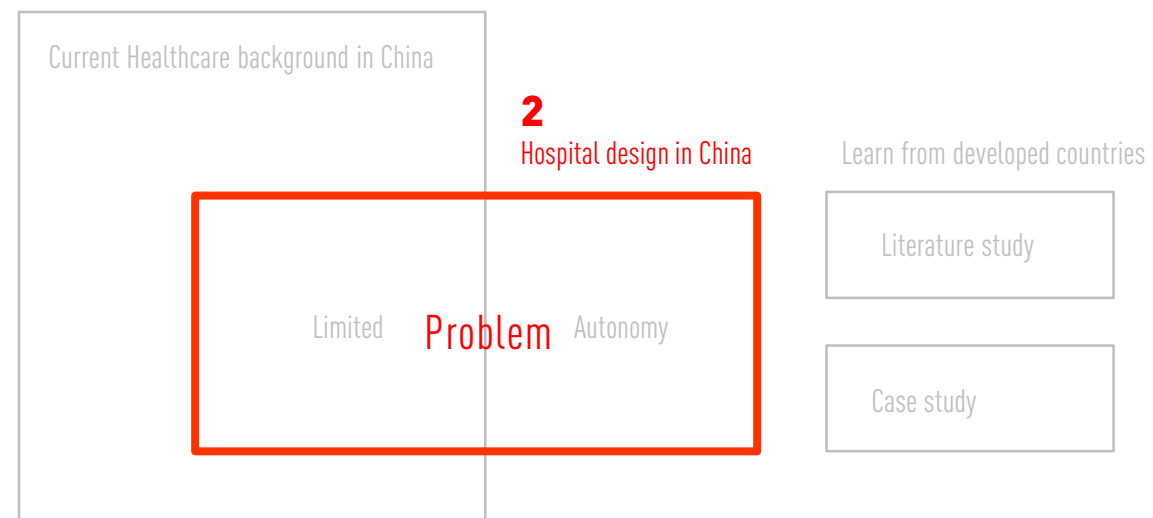


Fig 3 Comparison of hospital construction between China and Sweden in last 50 years (Author: Jing Ju, based on OECD health data.)

PART 2 The Problem of Hospital Design in China



2.1 Large Size and Height

Situation:

Because of the large population, hospital design in China tends to make the hospital very big so as to receive more patients. Many projects in recent years designed hospital with over thousands beds, and even make hospital a medical city. (Fig 4)

Disadvantage:

Such a big hospital will result to a long walking distances for patient and staff. Meanwhile, the 'medical city' which makes itself isolated from city context highlights its identity of being a hospital with 'abnormal life'.



Hospital in Shanxi, 1300 beds



Hospital in Shenzhen, 2000 beds

2.1 Large Size and Height

Situation:

Because of the limited land use with growing population, hospital design in China tends to make it high-rises. Especially in the big city like Shanghai, many projects extend the hospital vertically to over 100 meters with a centralized layout. (Fig 5)

Disadvantage:

Such a skyscraper with a large transportation core make patients wait a long time for the elevators and delay the treatment. Besides, the high located ward damages patients' feeling for away from nature.



Huashan hospital, Shanghai, 2003
21F



Ruijin hospital, Shanghai, 2003
22F



Zhongshan hospital, Shanghai, 2004
22F

2.2 Formalism

2.2 Formalism

Situation:

Since the condition that most clients of the hospital project are from local government, they are willing to focus more on the eye catching aspect so as to make their effort visible, the hospital project thus tends to be in a pursuit of formalism such as streamline, high-tech facade or a traditional Chinese roof. (Fig 6)

Disadvantage:

Such a face job leads to an over investment on facade while have no benefit for the treatment performances. Moreover, the particular form of the hospital make it impossible for the functional change in the future.



Hospital in Jinan, **Streamline**



Hospital in Suzhou, **Chinessness**

2.3 De-humanization

Situation:

Chinese hospital looks like an operated machine which only care about the symptom of decease, but lack of considering patients as individuals and care about their feelings. (Fig 7)

Disadvantage:

The hospital with little consideration of the healing environment not only damages patient's feeling, but also affects the staff effectiveness.

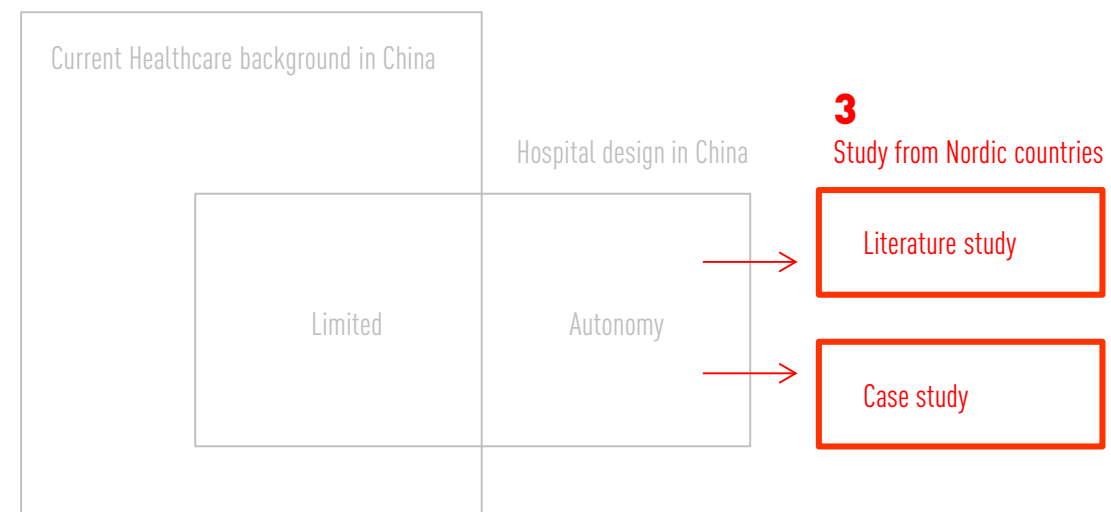


Waiting corridor with little consideration about healing environment



Multi-bed ward

PART 3 Literature and Case Study of Nordic Countries



3.1 Healthcare Background

Healthcare renovation in Scandinavia

Scandinavia healthcare planning has been heavily influenced by political and economic changes that have created strong pressure to reduce the cost of healthcare while improving its quality. In 1991, a Stockholm Model is made as an economic control meanwhile increase the freedom of choice for the patient. ^[5] (Fig 8)

The outcome of the renovation turned out to be a driving factor for improving the hospital. On one hand, it makes hospital a patient-oriented hospital since patients are given power to express their desire with money follows them. On the other hand, it makes hospital more efficiently since they have to compete with each other in an open market to attract patients.

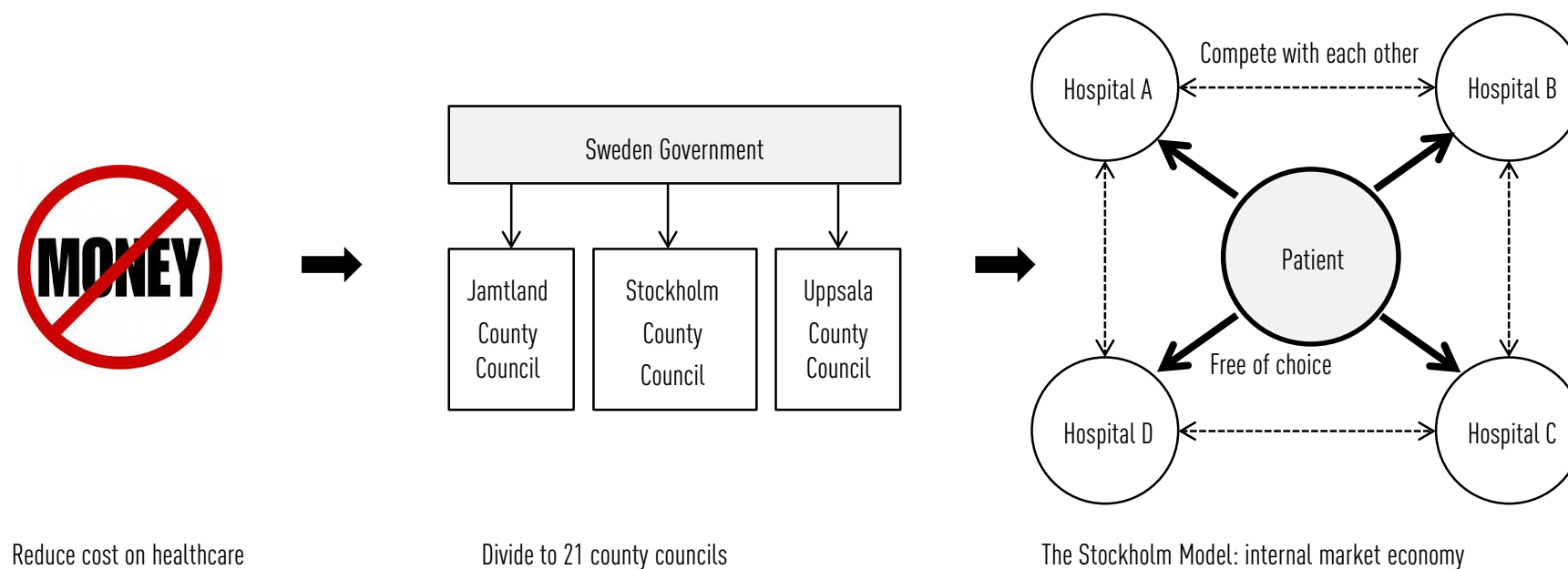


Fig 8 Healthcare renovation in Scandinavia (Author: Jing Ju, based on reference 5)

3.2 Reduce Size and Height

Network of small scale hospital

As communication network improved, portable technology will be more universally distributed. Such development will strengthen the trend towards homecare and ambulance-care. The effect will be a global reduction in large acute hospitals. ^[6] (Fig 9)

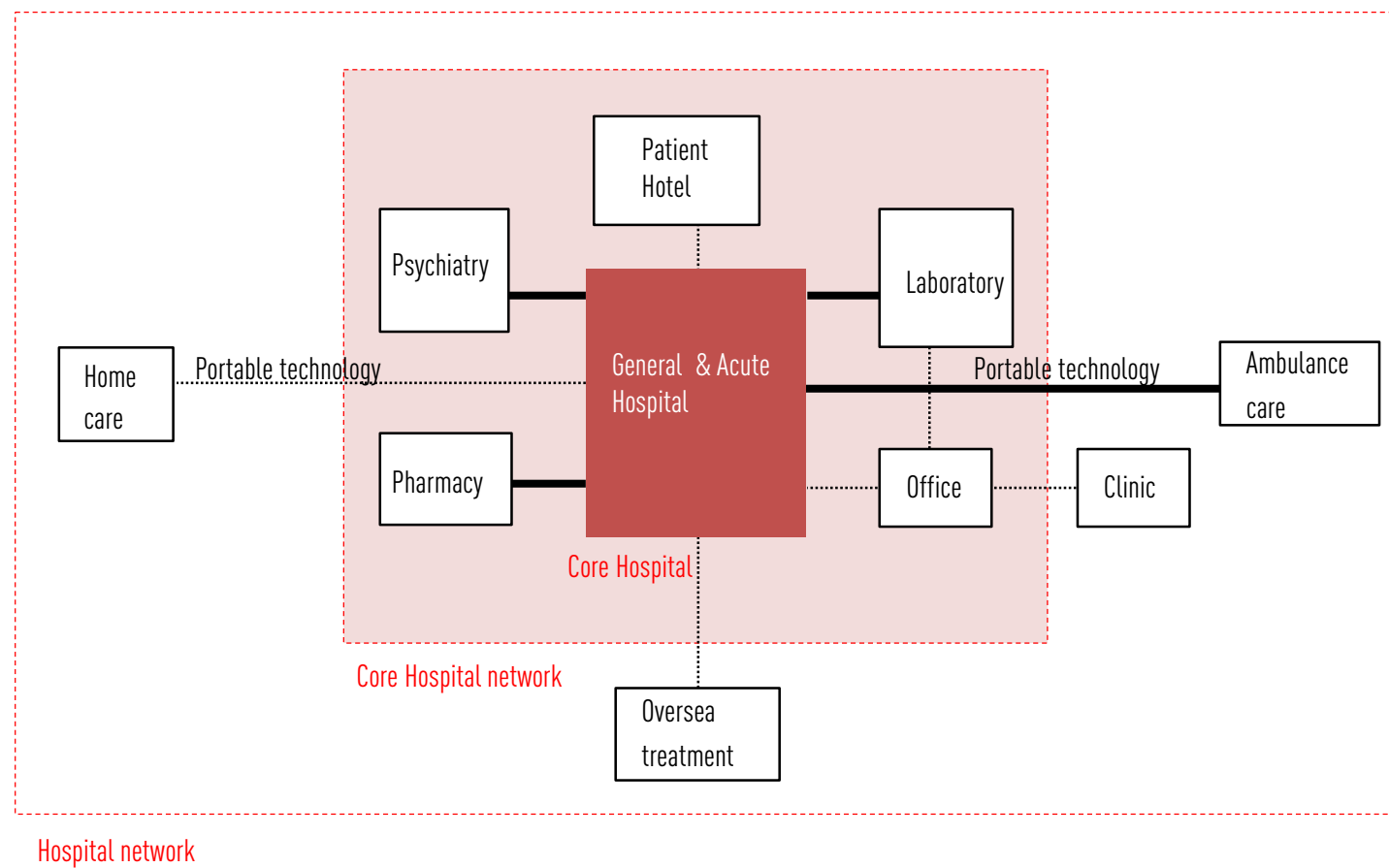


Fig 9 Network of small scale hospital. (Author: Jing Ju, based on reference 6)

3.2 Reduce Size and Height

Limited height

There is abundant evidence shows that high buildings actually will damage people's mind and feelings. They wreck the open spaces near them, and they damage light and air and view. Therefore, most buildings shall have a four-storey limit. ^[7]

The four-storey height makes people on the ground as well as the one inside the building feel secure. The higher the building is, the more frightening people will feel. It is said that the hospital should not be taller than the highest tree. (Fig 10)

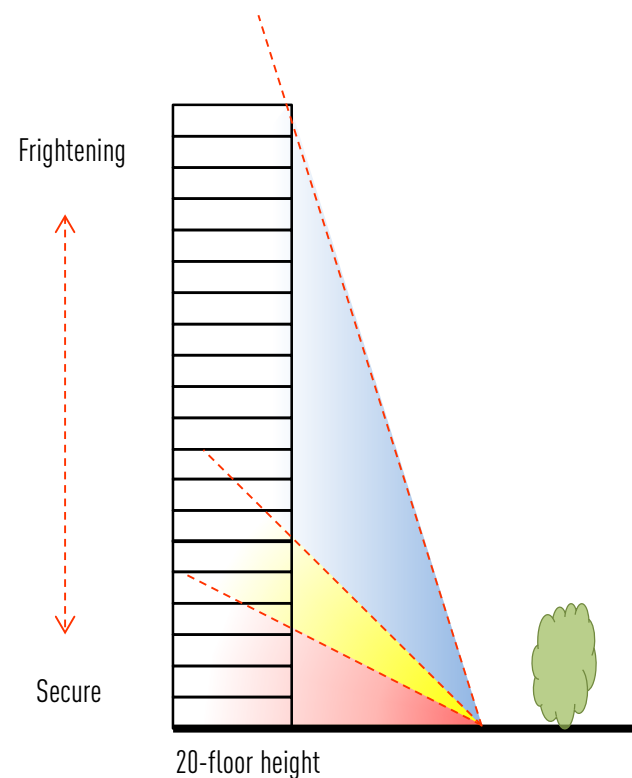


Fig 10 Limited height of the hospital (Author: Jing Ju, based on reference 7)

3.2 Reduce Size and Height

Take account of city context

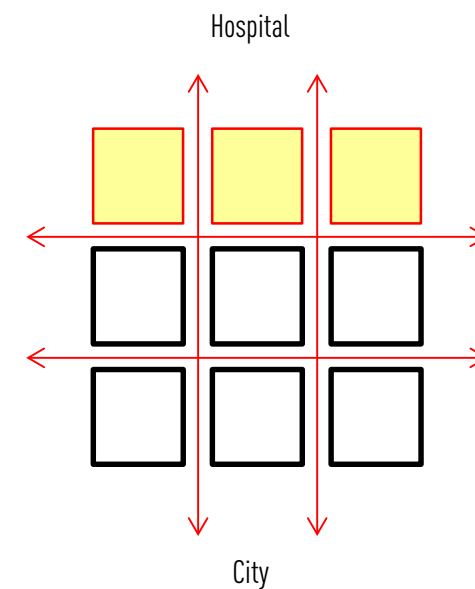
St Olavs Hospital, Norway

Architecture is an autonomous language that has a collective memory of form, which is embedded in the history of the city. We should avoid being nostalgic or based on form alone, but focus on improving treatment performance and adapt to new conditions.

In St Olavs Hospital, the hospital is divided into several blocks based on a city grid, which makes hospital well integrated with urban life, meanwhile gives easy access from every street. (Fig 11)



Hospital scale followed the city grid



3.3 Avoid Formalism

Improve treatment performance

Akershus University Hospital, Oslo

The main idea of the Akershus University Hospital is that treatment, offices, outpatient and bed wards are planned as a clinical unit which close to each other on the same floor. The hospital consists of several clinical unit which is organized according to different disease. As a result, the treatment performance become more efficiently. (Fig 12)

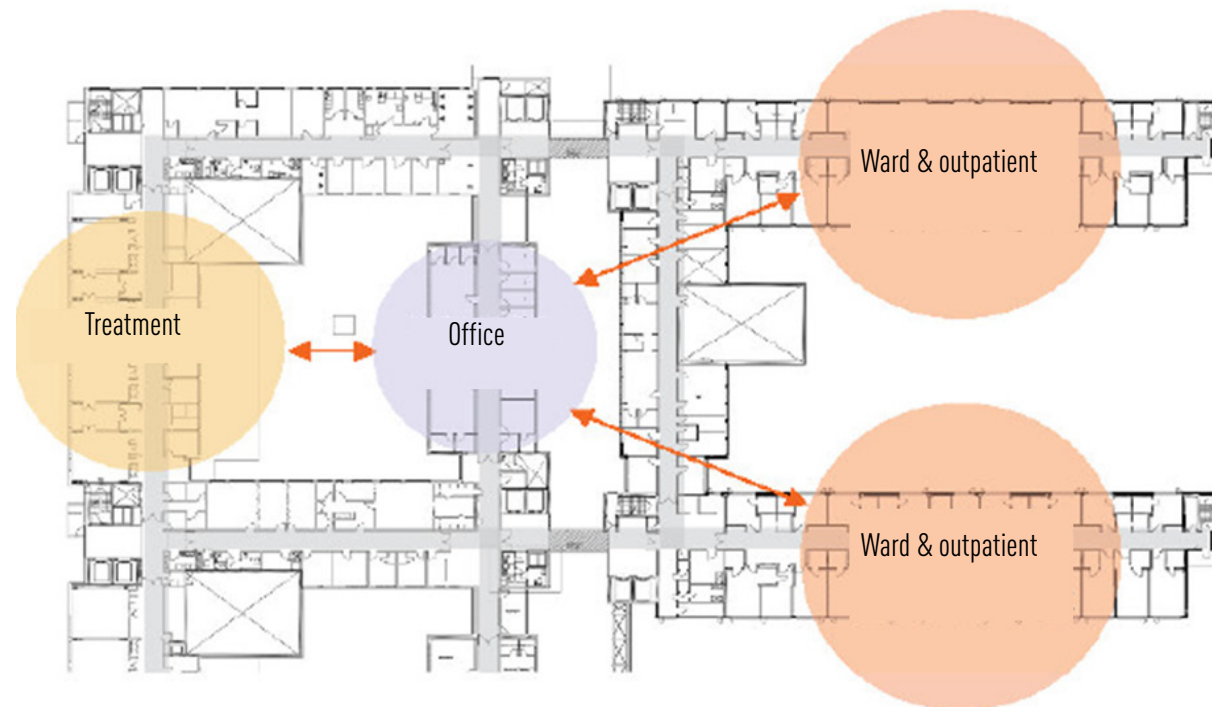


Fig 12 Improve treatment performance, Akershus University Hospital, Oslo (Source from C.F.MOLLER Architects, 2008)

3.3 Avoid Formalism

Adapt to future conditions

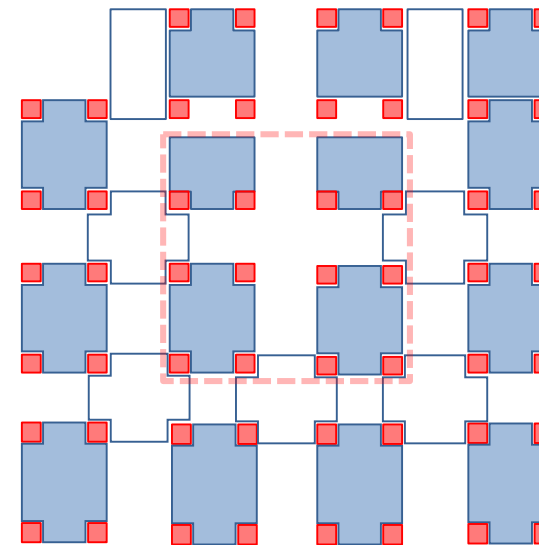
McMaster Health Sciences Center

Due to the fact that the medical technology nowadays is changing rapidly, we have to thinking long term for the flexibility and adaptability of the hospital design.

The McMaster Type is designed with rectangular forms which try to standardize different functions. In each module, the vertical shafts are on the corner of the outside wall for services ^[5] (Fig 13)



Main corridor links to all courtyards



Main corridor links to all individual modules

3.3 Avoid Formalism

Adapt to future conditions

New Karolinska Hospital, Sweden

The New Karolinska Hospital is called the 'max-flexible' hospital. Based on a general structure system, the hospital can be organized in many different ways, so that it will not be locked into any specific use and can be as up-to-date as possible when moving in occurs.

The building is designed with a general floor-to-floor height and a general load capacity so that the equipment such as X-rays and surgeries can be moved to any where in the building. The various type rooms are based on a modular network of 9*9m, which can meet the demand of possible functional change in the future.^[8] (Fig 14)

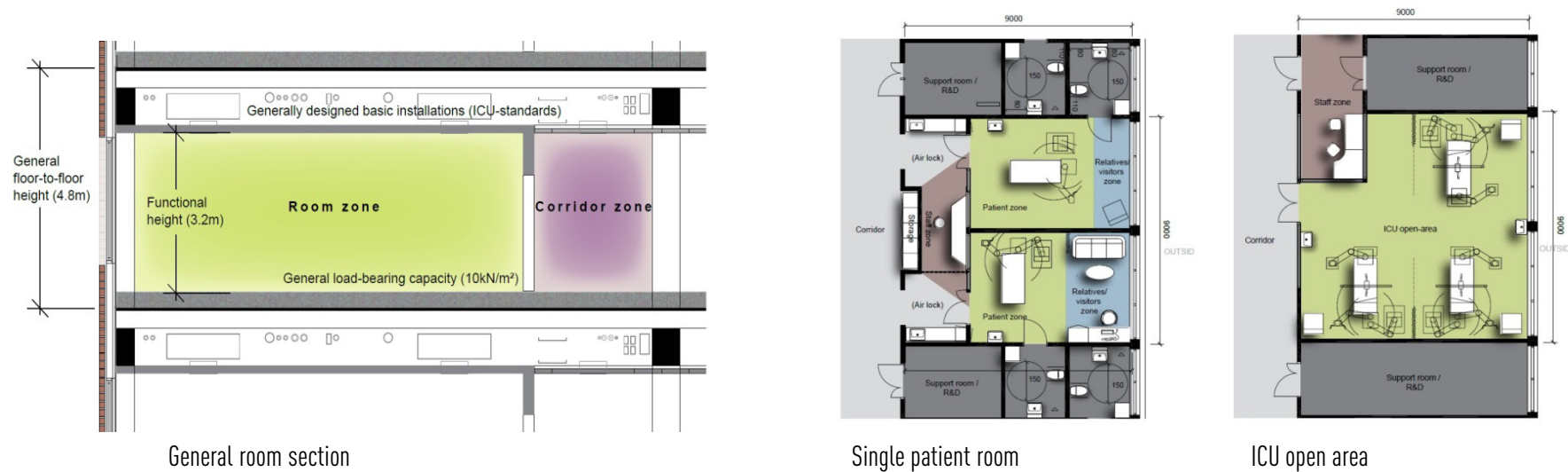


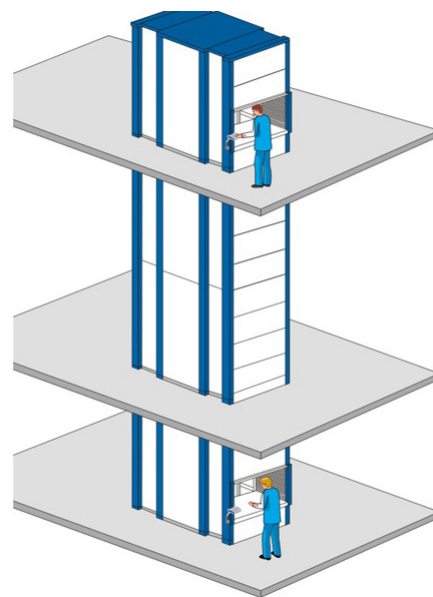
Fig 14 General room design of New Karolinska Hospital, Sweden. (Source: from reference 8)

3.3 Avoid Formalism

Adapt to future conditions

Automatic storage technology

In the future, the traditional storage room maybe replaced by automatic storage system, which have already been used in many countries in the field of healthcare. Such a system can maximum use of space on a minimal footprint, and also reduce the risk of infection in the hospital. Besides, the flexible storage with a modular system can be adapted to different needs. (Fig 15)



Open carrier to provide various storage options



Carrier with built-in drawers for secure and convenient storage



Carrier with drawers, separator set and intermediate shelf for combining various stored goods

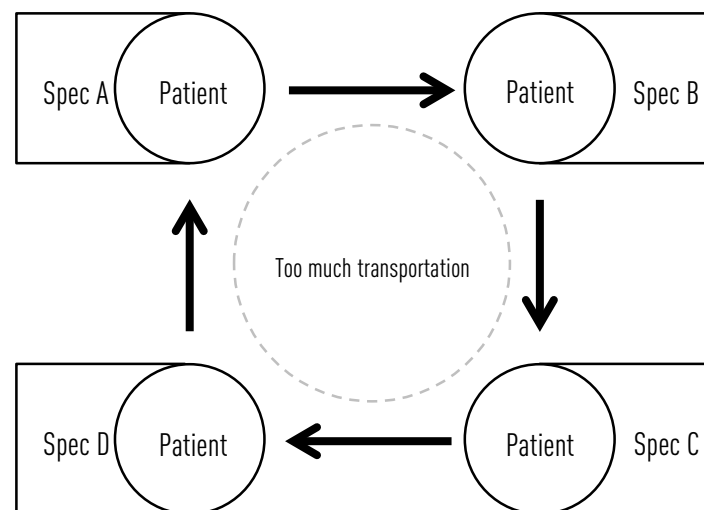
3.4 Humanization

Patient-focused Hospital

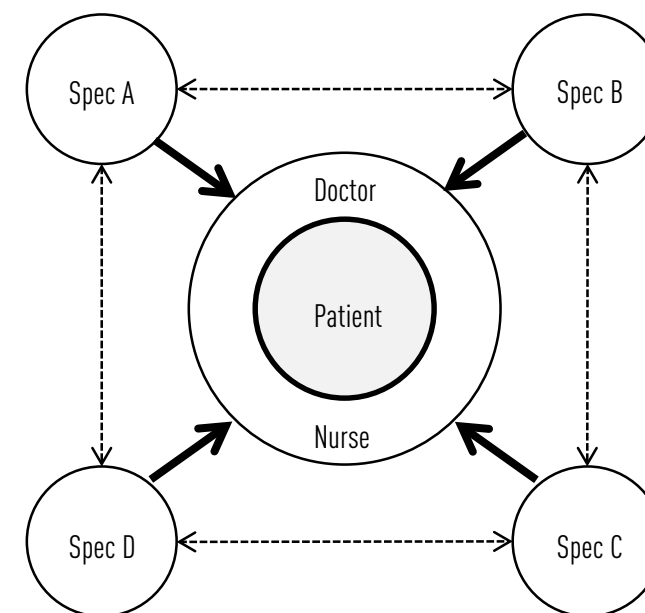
St Olavs Hospital, Norway

In the traditional nursing organization, the patients are moved to specialties and function units. Much time is spent in transportation between different units, such as operation, laboratory, wards etc.

The principle of a patient-focused hospital is that the resources are allocated to the patients. In this way, the total transportation of the patients can be reduced. Another advantage is that the individual patient will be in contact with a minimal number of staff which reduce mistakes in medication. ^[5] (Fig 16)



Traditional/functional organization of medical activities



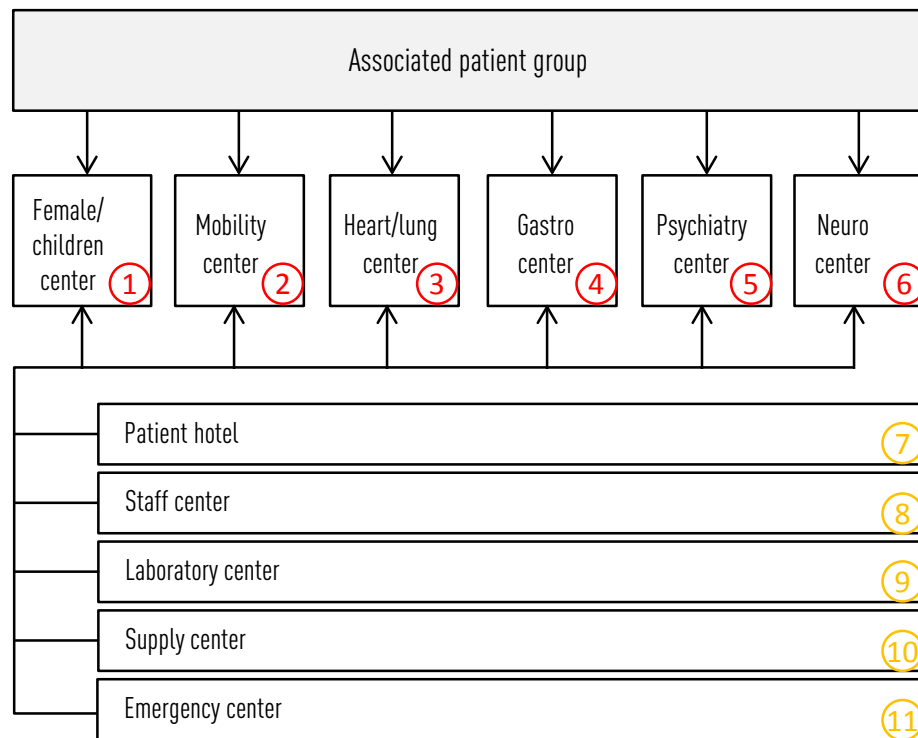
Patient-focused organization of medical activities

3.4 Humanization

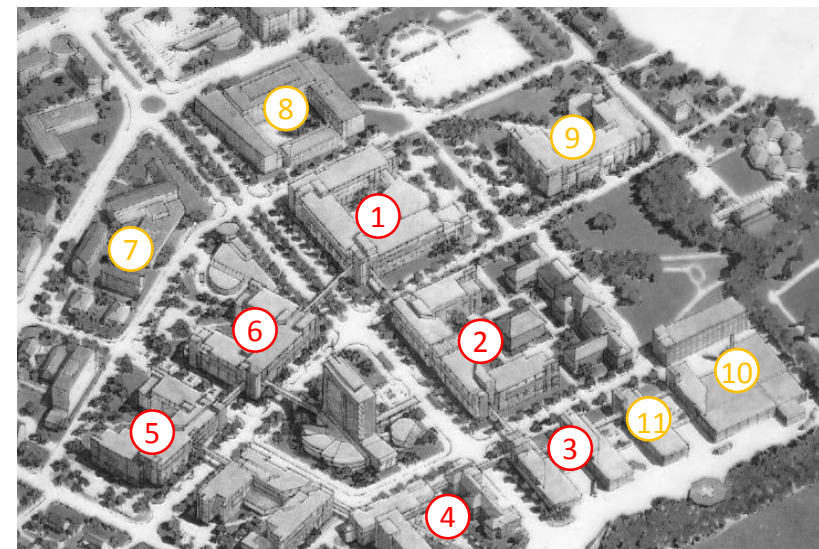
Patient-focused Hospital

St Olavs Hospital, Norway

St Olavs Hospital has a decentralized organization with six clinical centers. These centers are based on a specialty and the associated patient groups. i.e. Women/child center or heart/lung center. Each clinical center is given a high degree of self-sufficiency that traffic of patients and staff between the centers can be minimized. (Fig 17)



Organization model in diagram



Organization model on master plan

3.4 Humanization

Patient-focused Hospital

St Olavs Hospital, Norway

All the clinics have wards, polyclinics for investigation and treatment, day surgery with an operating department, special laboratories and premises for teaching and research, offices, and dining room, so that the decentralized center will be self sufficient for different associated patients. The neuro center is taken as an example to describe as follows:

Plan 1 contains general functions such as main entrance, reception, polyclinics, day surgery and canteen. Plan 2 contains teaching, research, examination, conference rooms and offices. Plan 3 and 4 contain ward spaces for treatment and operations. The underground level contains technical space, storage and culvert. (Fig 18)

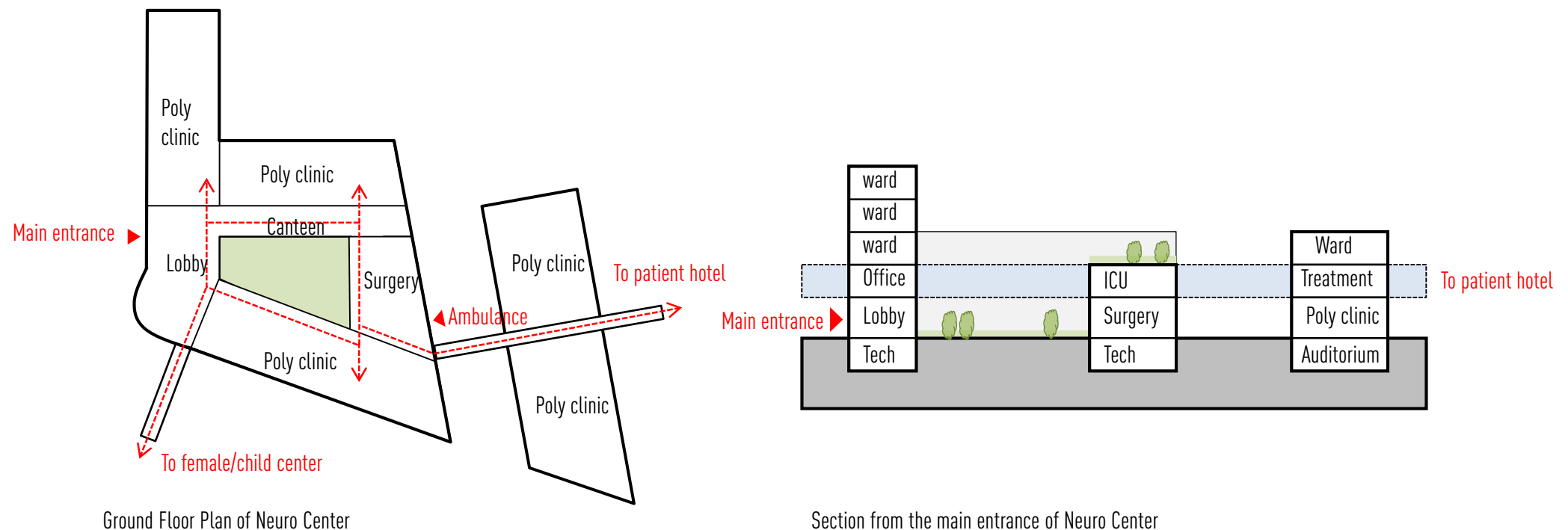


Fig 18 Floor plan and section of Neuro center in St Olavs Hospital, Norway. (Source: arkitektur n . 05 . 2007)

3.4 Humanization

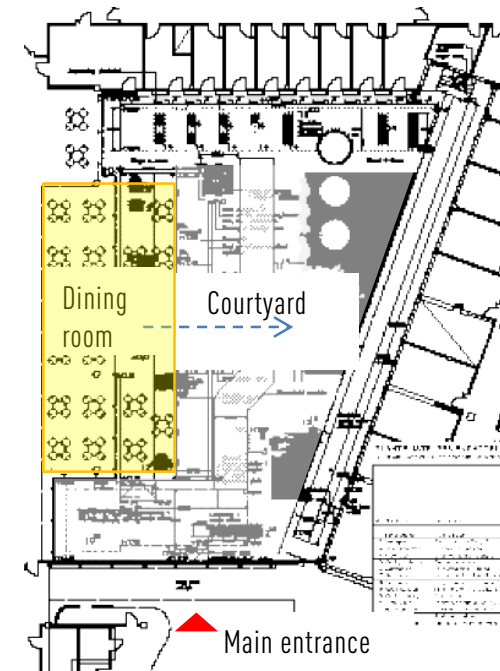
Sociality

Dayroom/dining room

Day room/dining room is very pleasant for patient to have social life and communicate with hospital staff, because it is a place where five senses can be stimulated in the same time, like the taste and smell of food, nice eye view and appealing music. The day room/dining room is better to have a close connection with the main entrance, courtyard and staff area, so that it can be frequently used. (Fig 19)



A pleasant dining room benefits for social life in hospital



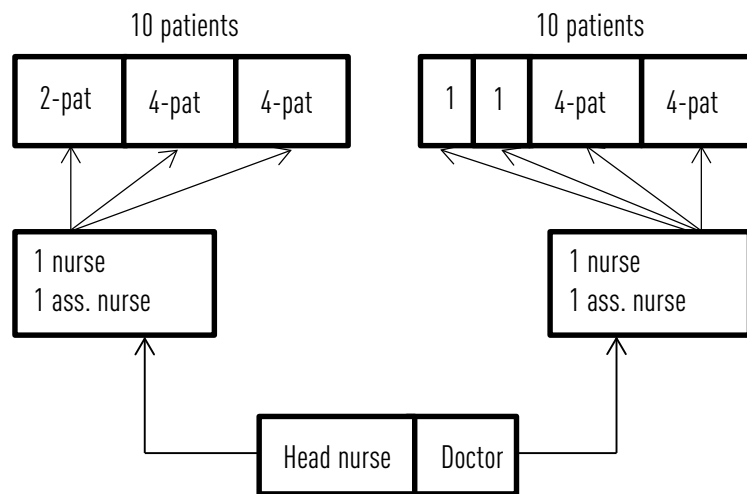
Dining room has a good connection with main entrance and courtyard

3.4 Humanization

Safety

Nursing Organization

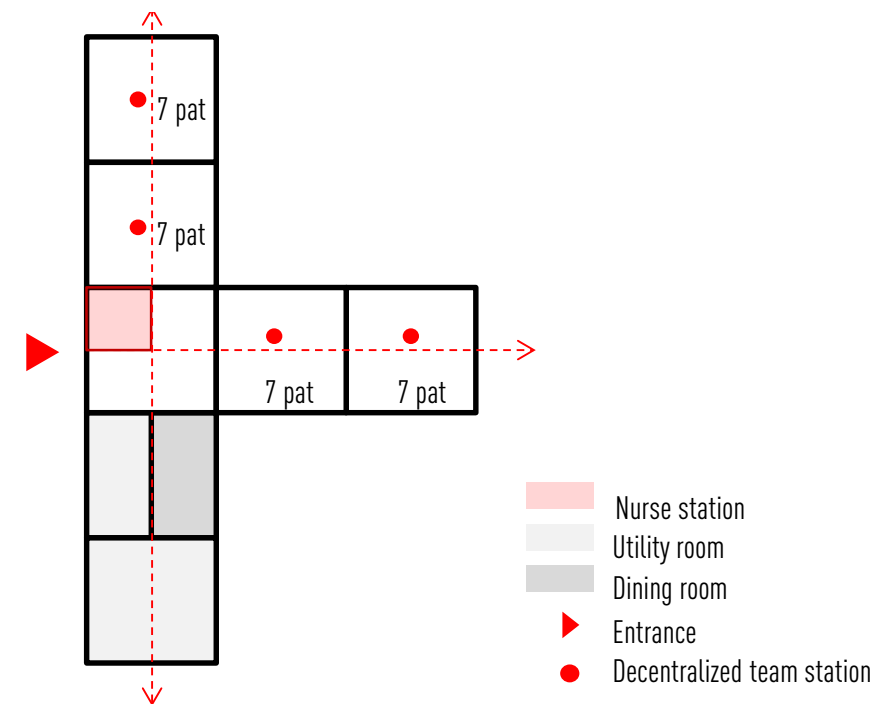
In traditional round nursing system, the nursing work is divided into functions according to the 'conveyor belt' principle, which result to too many staff dealing with one patient. It is difficult for the patients to know whom they should turn for help. However, in the pair nursing system, one nurse and an assistant nurse work together, and there is a marked division of responsibility for a group of patients.



Nursing organization in Narrokoping hospital, Sweden

Nursing Layout

The overview of the whole ward from the nurse station will increase the patients' feeling of security. For this reason, there should not be more than one entrance. A good sense of control is particularly important at night and on weekends when the staffing is low. It is easier to achieve a good sense of control with planning solutions that have a single or an L-shaped corridors. (Fig 20)

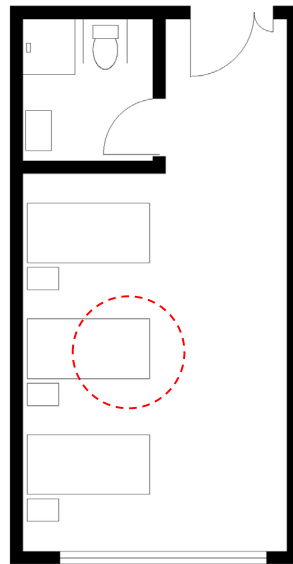


Nursing layout in Narrokoping hospital, Sweden

3.4 Humanization

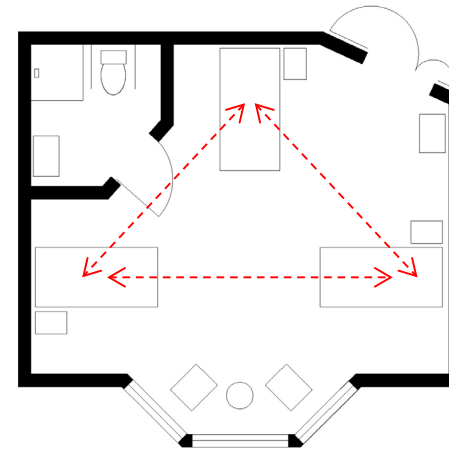
Privacy

Three-patient room



The traditional planning of 3-patient room put all three beds in a row on one side, which makes the patient in the middle far too exposed.

The bed in the middle is not allowed to use curtains during the day since this cuts out the daylight to the bed by the corridor.



The beds are placed at right angles to each other. This enable each patient to have a corner of his own. It is easy for staff and relatives to talk to patients.

The bay windows introduce more light and offer a pleasant place to sit and chat. (Fig 21)



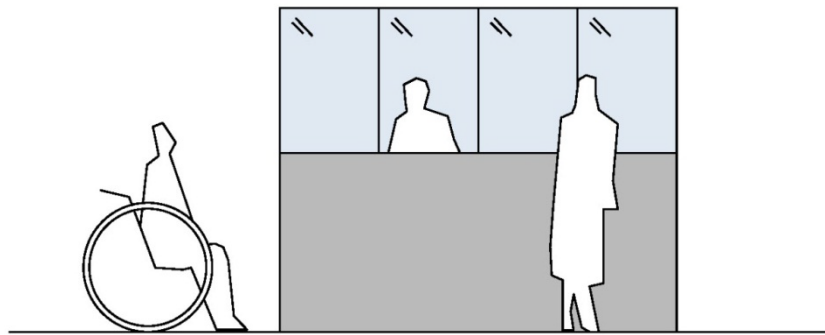
3-patient room in Halmstad Hospital, Sweden



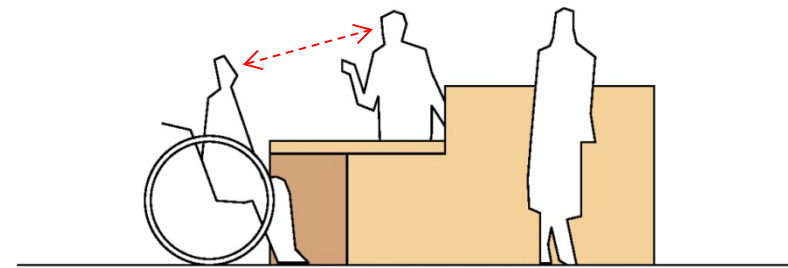
3-patient room in Kalmar Hospital, Sweden

3.4 Humanization

Human Contact



The traditional nurse station with glazed window is not good for contact with patients and visitors.



An open nurse station designed with varying levels is good for patients in wheelchairs to have eye contact with nurse and staff. (Fig 22)



Nurse station in Vanda hospital, Finland



Nurse station in St Olavs Hospital, Norway

3.4 Humanization

Feel of Nature

Vision

Vision is the sense that often gives us the first impression of the surrounding. Exposure to daylight is effective in reducing depression and improving mood. Proper daylight conditions also increase day time alertness, and fostering better sleep quality.

The art painting in the room plays an important role for patients to sense nature. The representational nature paintings containing human figures and harmless animals such as bird are preferred over counterparts that are somewhat abstract.^[9]

Hearing

Mimic pleasant nature sounds, such as birds and water, can be used as a therapeutic tool in order to enhance well-being and distracting patients from stressful symptoms.^[9]

Taste

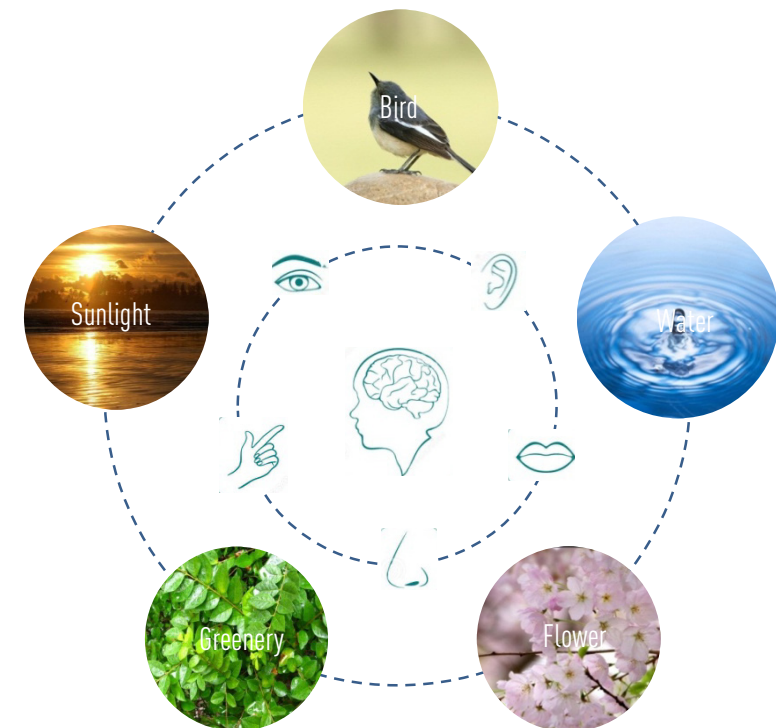
The taste is closely connected to the sense of smell. The smell of flower evokes its sweet taste. By drinking cool water, it can stimulates its aroma of mint.

Smell

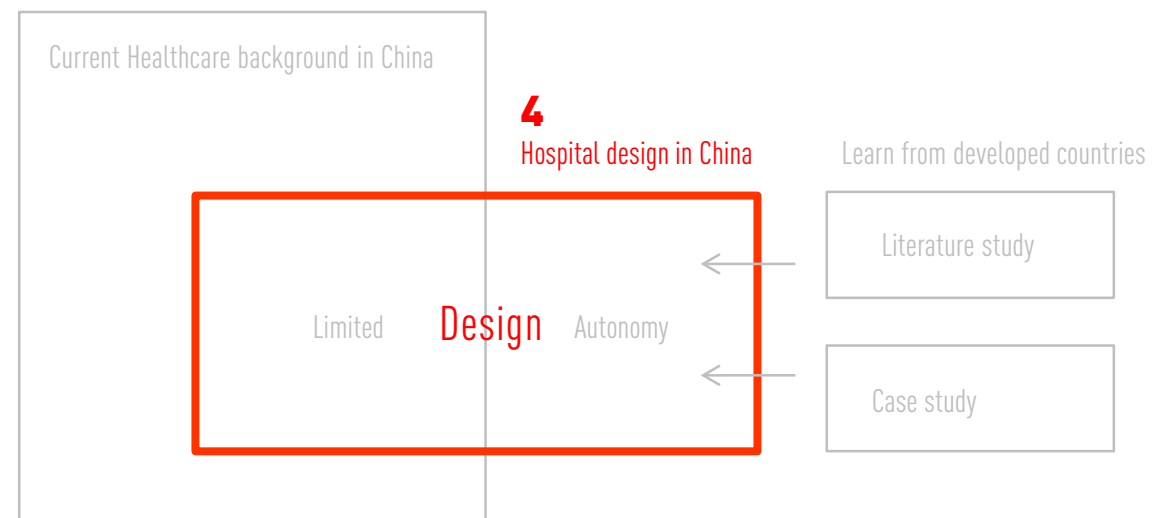
The various type of smell such as the fresh leaves and fragrant flowers in the air can recall good memories, and reduce pain from the patient.

Touch

Touch is a tactile sense. The sense of touch helps us to orientate ourselves and to feel the limits between our bodies and the environment. Through touch, we feel warm or cold, hard or soft. It also help transmitting information for blind when touching.^[9] (Fig 23)



PART 4 Conceptual Proposal



4.1 Site Background



The site is the People's Hospital in Shanxi, which is located in center of Shanxi Province in China. It is the **biggest general hospital** in Shanxi province, serving for a population of 4,277,700 inhabitants in Taiyuan City.

The hospital has undergone several changes since first constructed in 1953. Today, however, the hospital is **in need of an upgrade** to meet the new technology advancements and demands with healthcare. ^[10]



4.1 Site Background

Problem of existing hospital



Arbitrary extension within the site

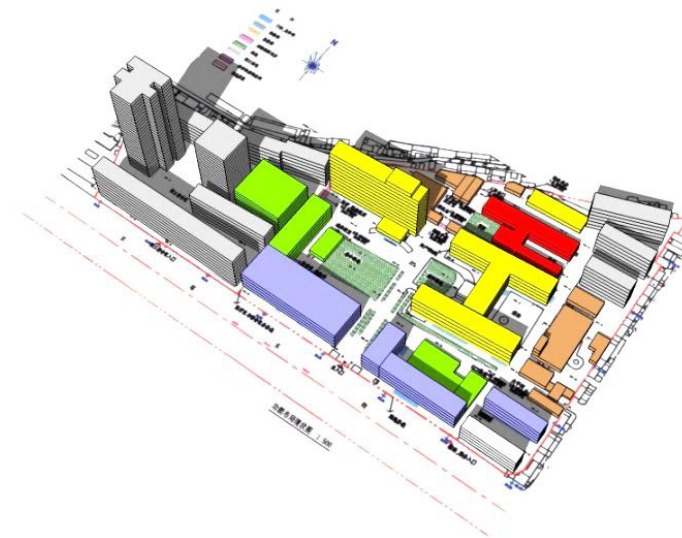


Disoriented main hall



Long corridor with no light and little waiting area

<u>Hospital area:</u>	56 000 sqm
Acute care (Hot floor): the patient in emergency;	2 000 sqm
Inpatient care: the patient in bed;	21 000 sqm
Outpatient care: the patient visit and treatment;	15 000 sqm
Medical service: laboratory and research etc.	12 000 sqm
Technical service (-1F): supply, kitchen etc.	6 000 sqm
<u>Staff area:</u>	67 000 sqm
Staff dormitory, administration and dining	67 000 sqm



The layout is a series of individual buildings, with its own function and has no connection with each other. People have to take much time on transportation.

4.1 Site Background

Problem of original proposal



The new high-rise casts a big shadow on the existing ward; Elliptical form unsuitable for functional change



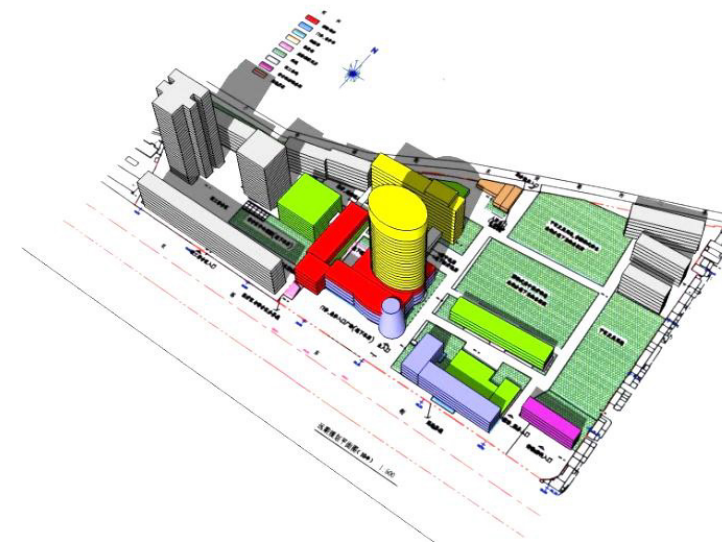
People waiting for elevators in the centralized transportation core



The multi-bed ward has little concern about the healing environment.

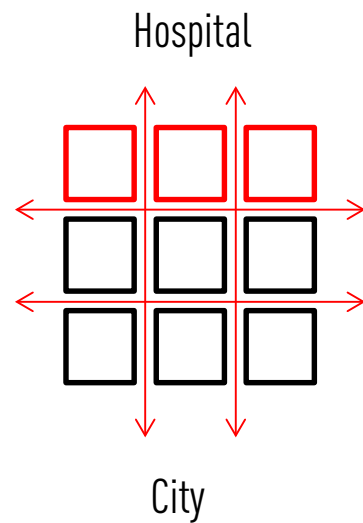
<u>Hospital area:</u>	73 600 sqm
Acute care (Hot floor): the patient in emergency;	8 000 sqm
Inpatient care: the patient in bed;	29 000 sqm
Outpatient care: the patient visit and treatment;	12 600 sqm
Medical service: laboratory and research etc.	13 000 sqm
Technical service (-1F): supply, kitchen etc.	11 000 sqm
<u>Staff area:</u>	63 000 sqm
Staff dormitory, administration and dining	63 000 sqm

The original proposal has a centralized layout with ward on the top, which result to large transportation and make the ward far away from the nature.



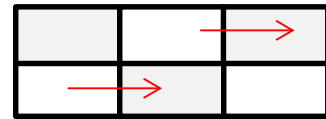
4.2 Concept

- SIZE



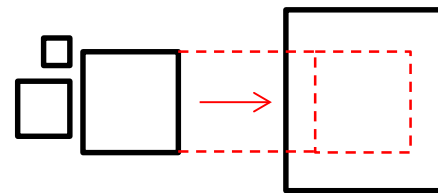
- Small scale
- Connection to city

- HEIGHT



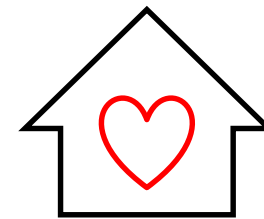
- Close to nature
- Horizontal expansion

- FORMALISM



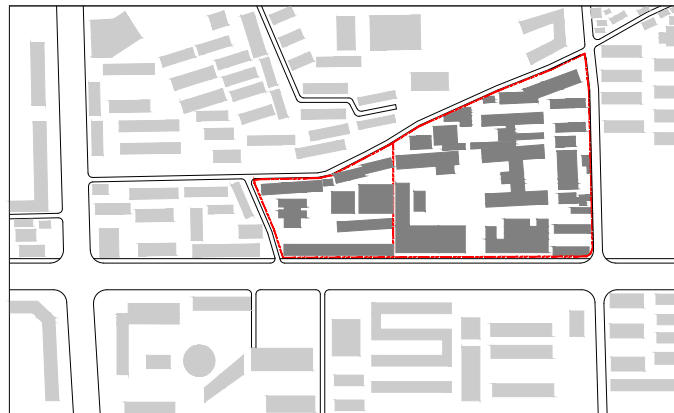
- Improve treatment performance
- Adapt to future condition

- HUMANIZATION

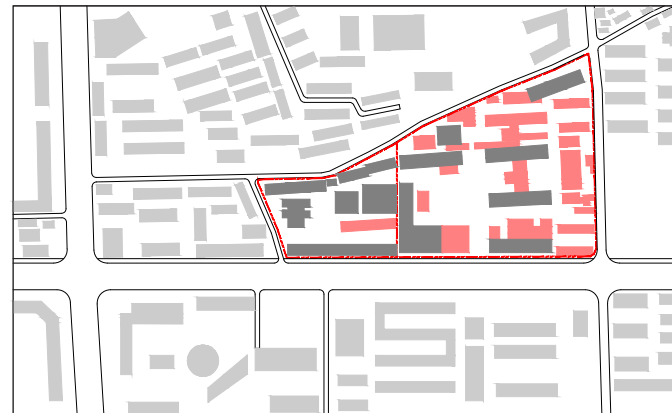


- Healing environment
- Way finding

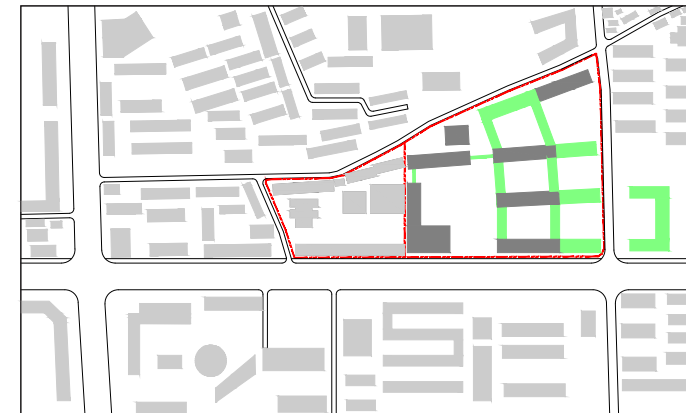
4.3 Design Process



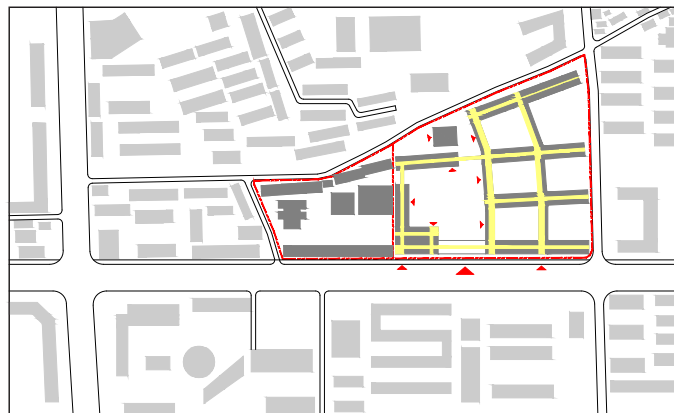
1. Original Plan



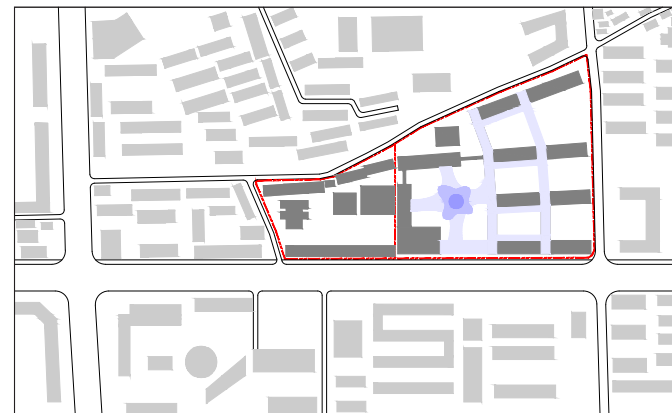
2. Keep and demolish old buildings



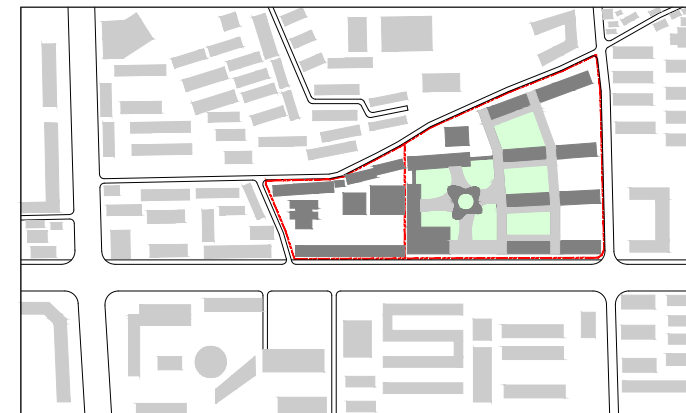
3. Add new buildings according to city grid



4. Inner corridors connect with all buildings



5. Create orientation center and public pathway for easy way finding



6. Frame courtyard along the pathway

4.4 Rendering



Fig 29 Birdview (Author: Jing Ju)

4.4 Rendering



Fig 30 Interior of orientation center (Author: Jing Ju)

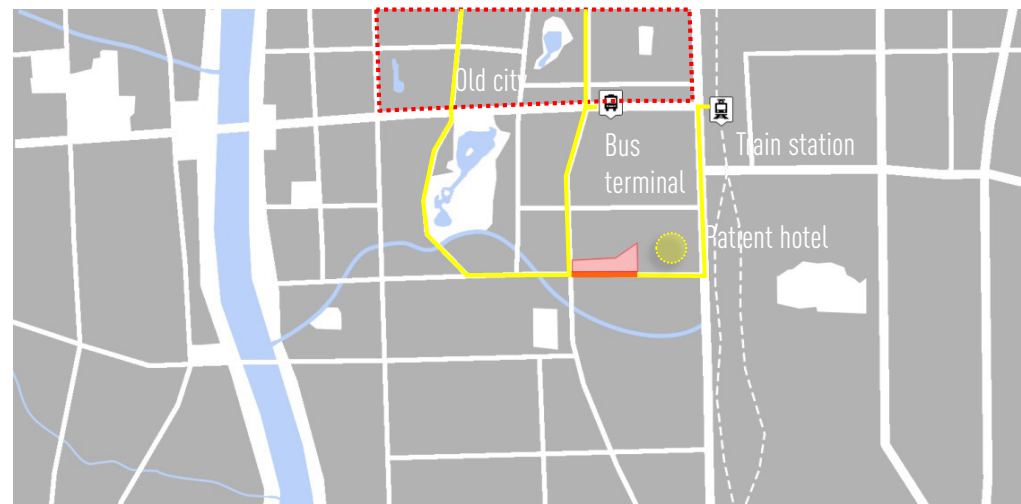
4.4 Rendering



Fig 31 Public corridor between out-patient department and in-patient department (Author: Jing Ju)

4.5 Reduce Size and Height

City context



City transportation analysis



City hospital network analysis

Main entrance

The three main flow which come from old city, bus terminal and train station, take about 30min to the site by public transportation. They mainly use the street along the southern edge of the hospital area which is suitable for having a main entrance.

Patient hotel

The location of the patient hotel is better to be in the east of the site which has a close connection both with the hospital and the train station, so as to facilitate patients and relatives from afar.

Hospital network

Due to the influence of the medical university, many hospitals are distributed within the district, which makes the hospital network possible in the future, and result to a decrease the hospital scale on the basis of communication technology.

4.5 Reduce Size and Height

Surrounding

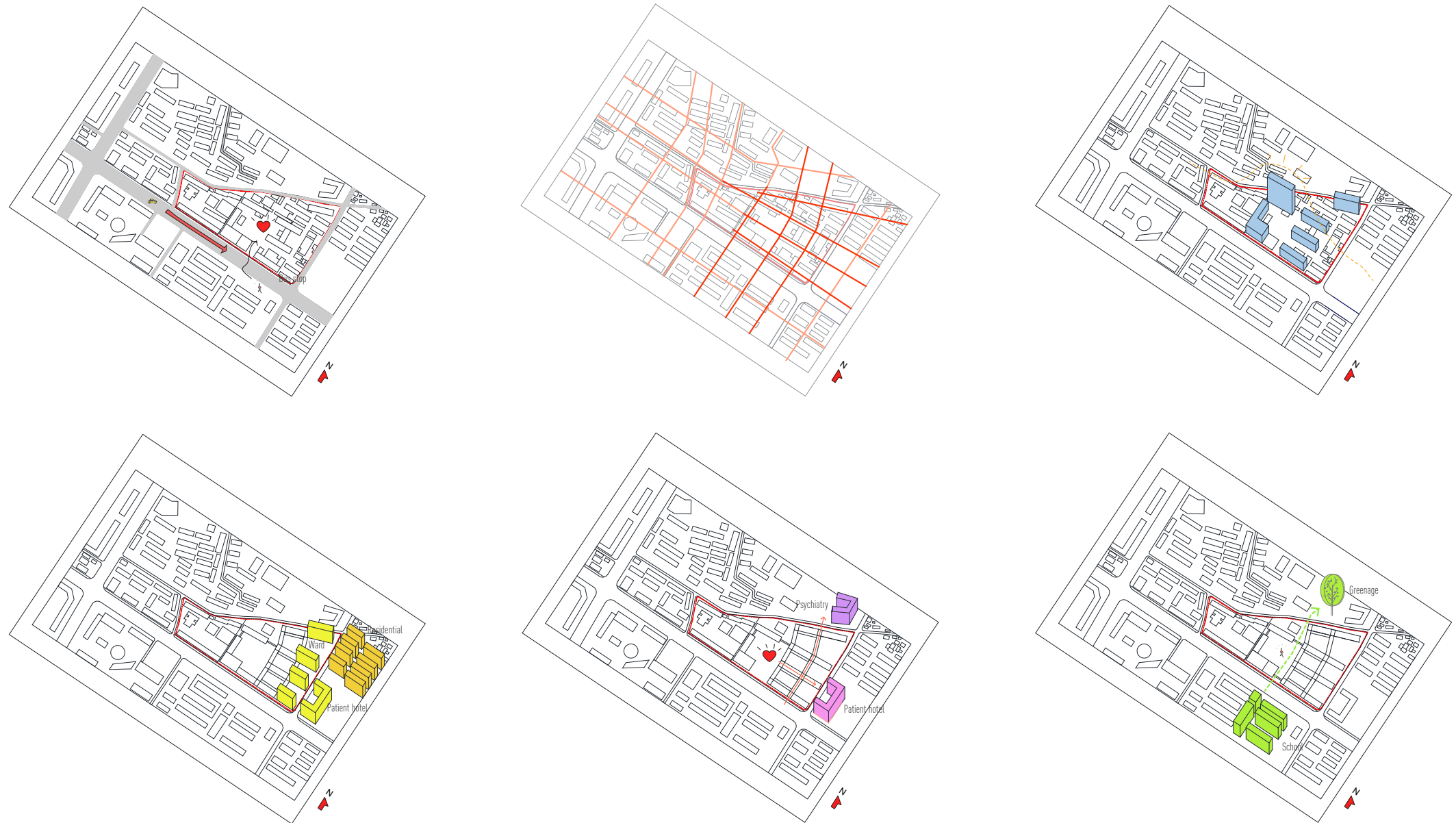


Fig 33 Surrounding (Author: Jing Ju)

4.6 Avoid Formalism

Improve treatment performance: Hospital Organization

The design is a decentralized organization with six clinical centers and an orientation center for easy way-finding. These centers are based on a specialty and the associated patient groups. Each clinical center provides main entrance, public functions, outpatient department, wards, office and sub-emergency, which is given a high degree of self-sufficiency.

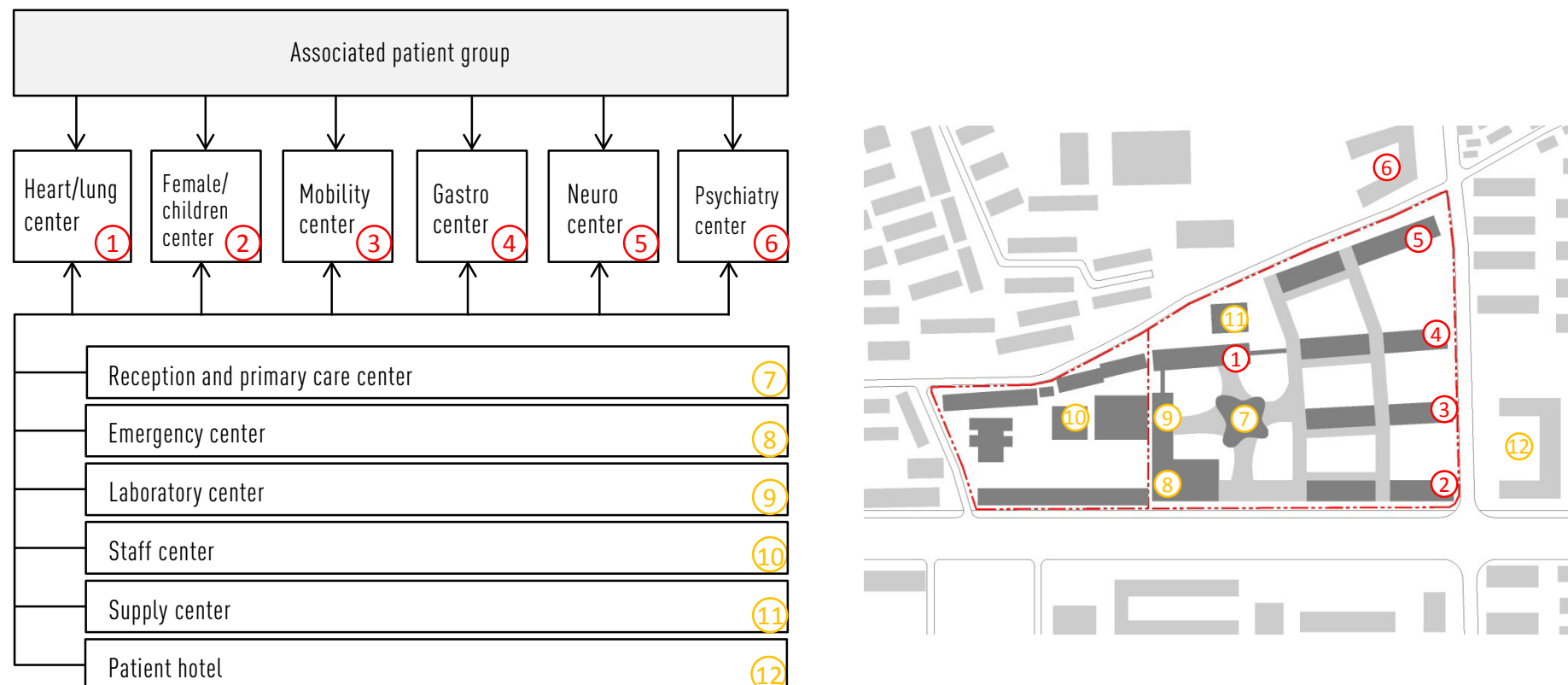
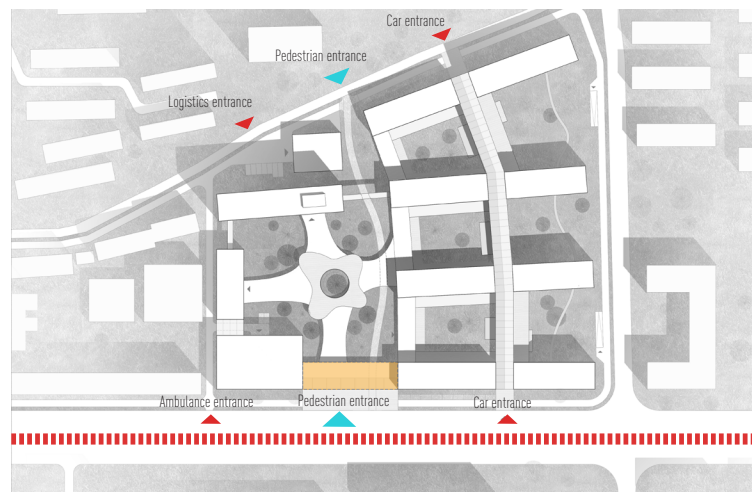


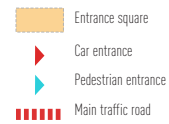
Fig 34 Hospital organization (Author: Jing Ju, based on reference 5)

4.6 Avoid Formalism

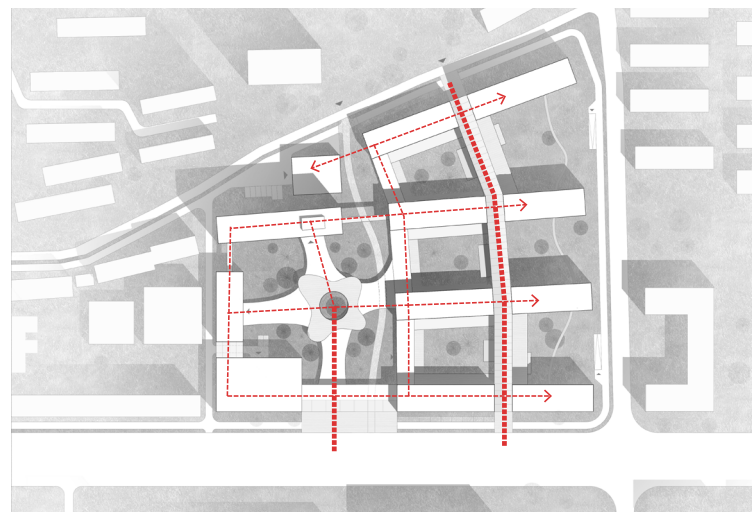
Improve treatment performance: Hospital layout



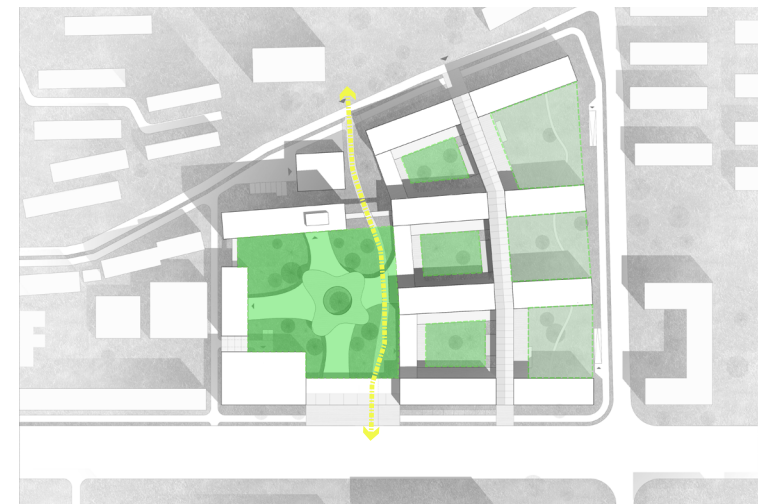
Car and pedestrian entrance



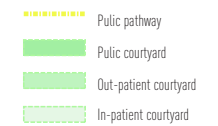
Car flow



Pedestrian flow

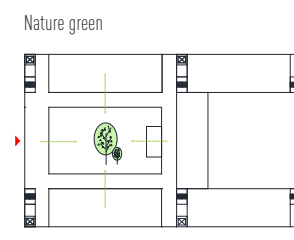
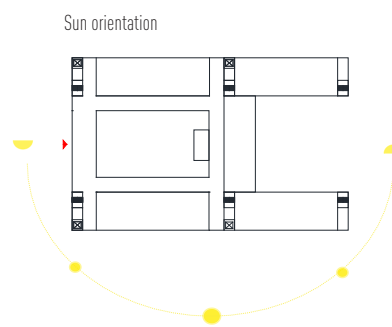
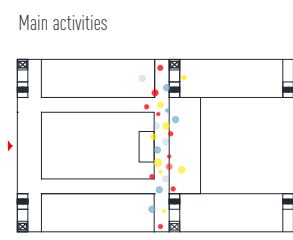
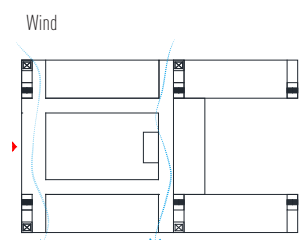
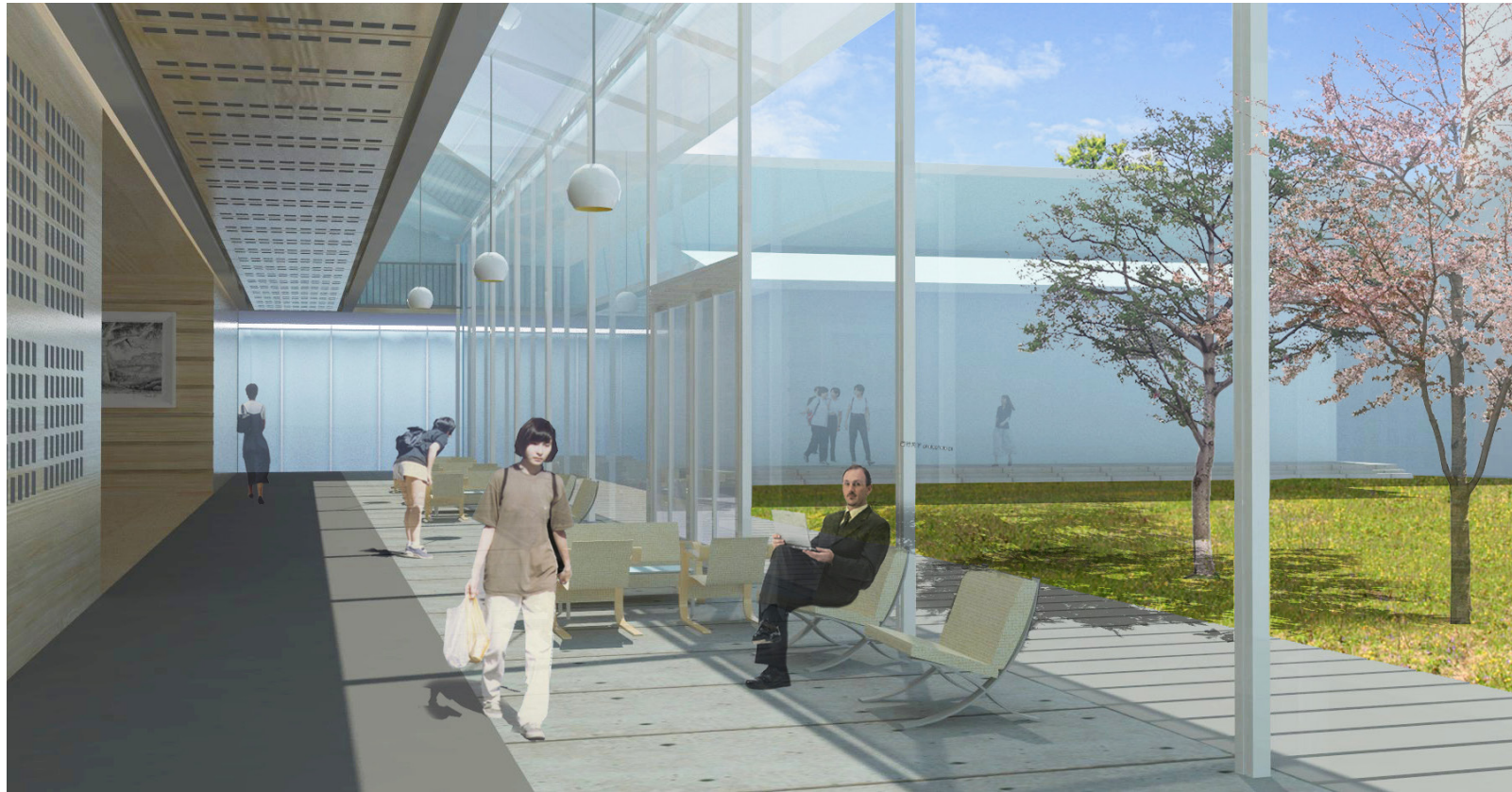


Public passage and greenage

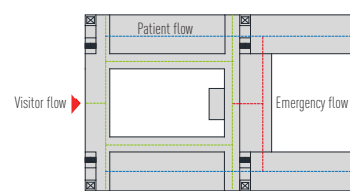
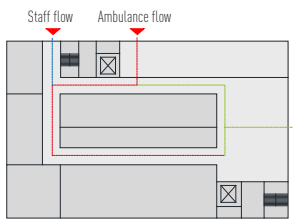
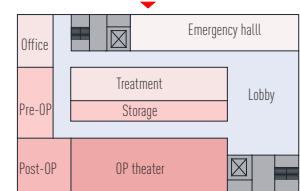


4.6 Avoid Formalism

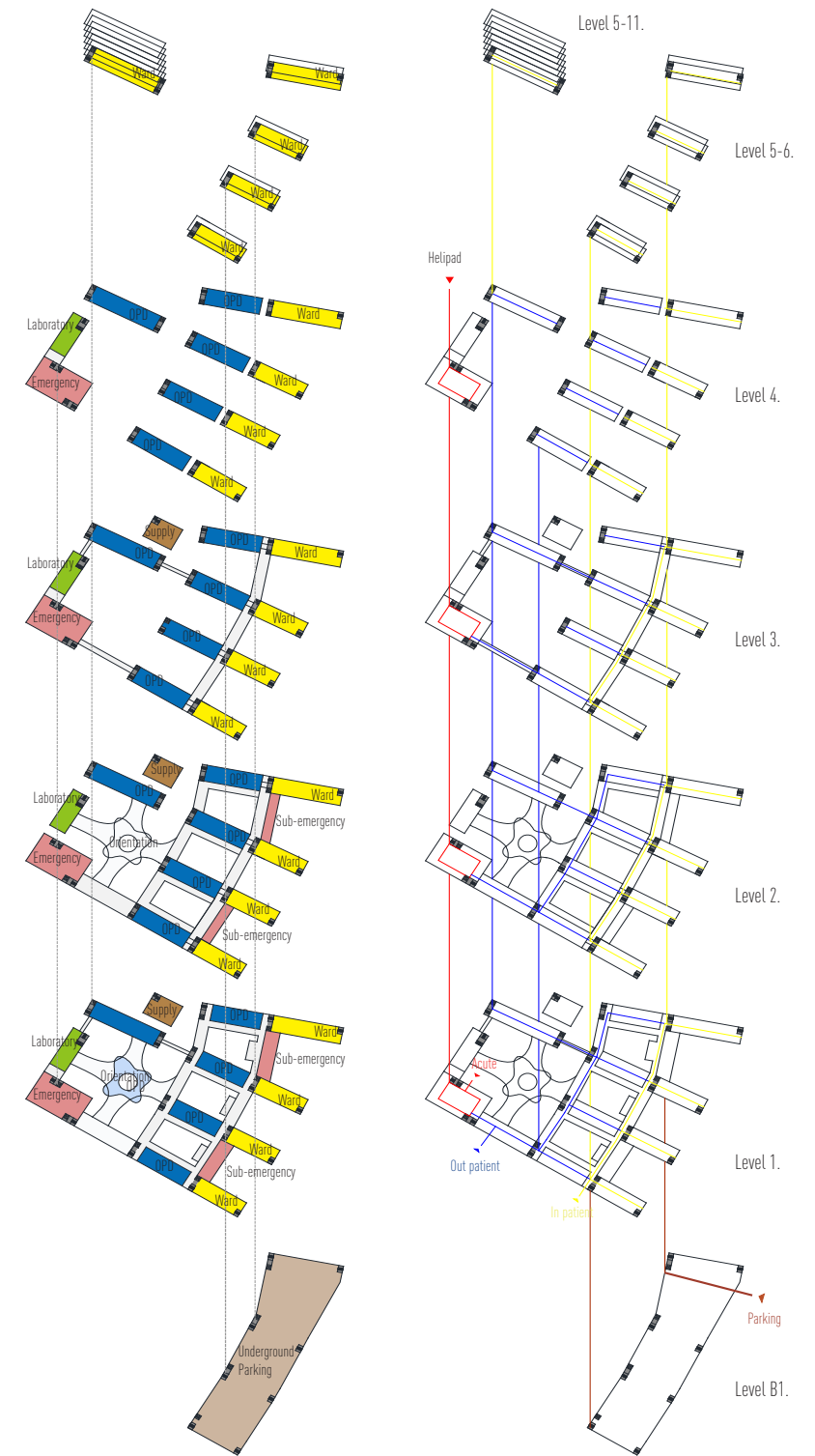
Improve treatment performance: Program and flow



Main idea of clinical cluster



Clinical cluster function and flow



Exploded axo

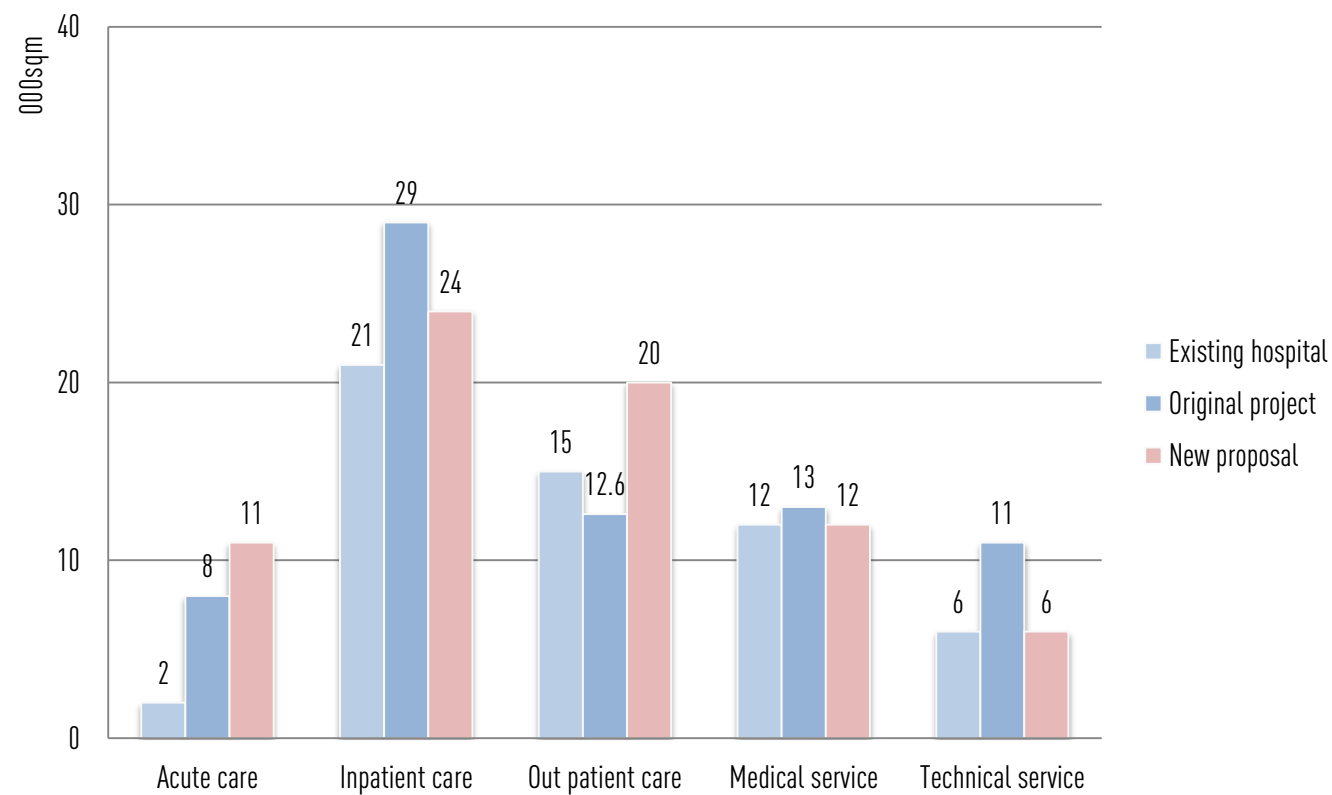
Fig 36 Program and flow (Author: Jing Ju)

4.6 Avoid Formalism

Improve treatment performance: Program comparison

The area analysis shows that the new proposal mainly expands its functions in the acute care and outpatient department, while decreasing the size of ward unit in comparing with the original proposal. Other functions such as medical service and technical service remains the same as the existing hospital.

The total hospital area is 69 000sqm, bigger than the existing hospital (56 000sqm) and a bit smaller than the original proposal (73 600sqm).

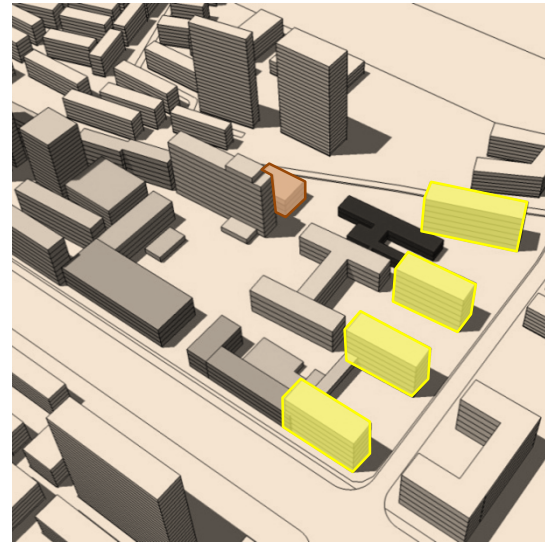


4.6 Avoid Formalism

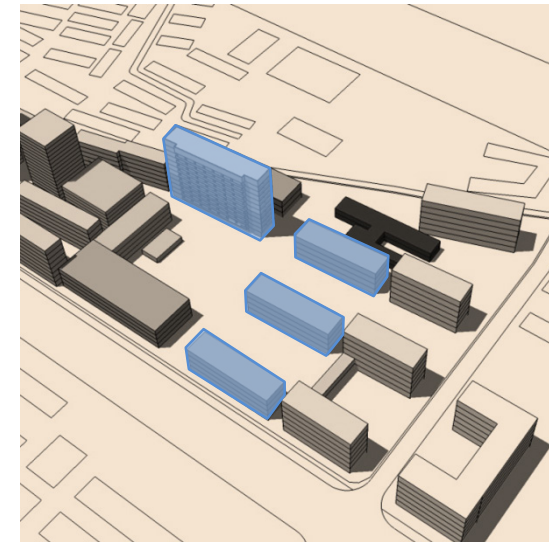
Improve treatment performance: Construction process



1. Original hospital



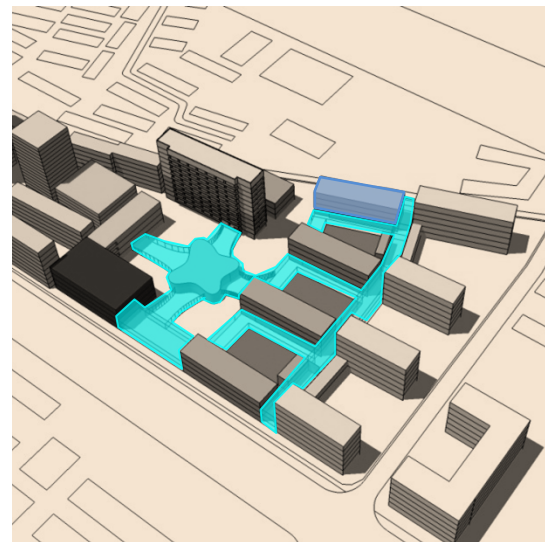
2. Build new ward and new supply center



3. Build new outpatient department









4. Build new emergency and laboratory center



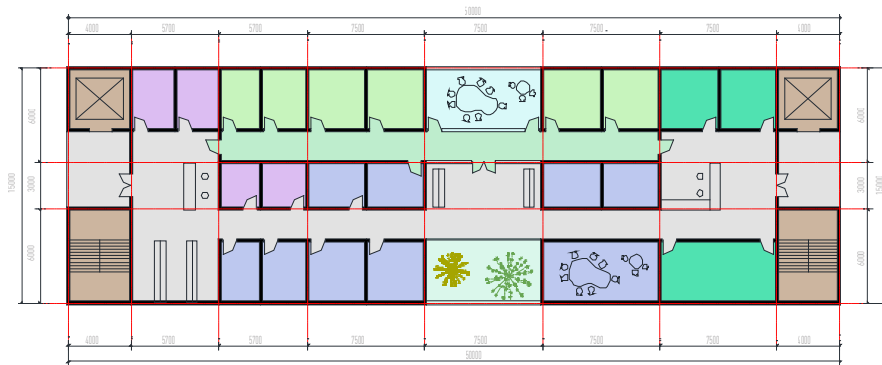
5. Move emergency to build the outpatient department;
Build orientation center and public pathway

Legend

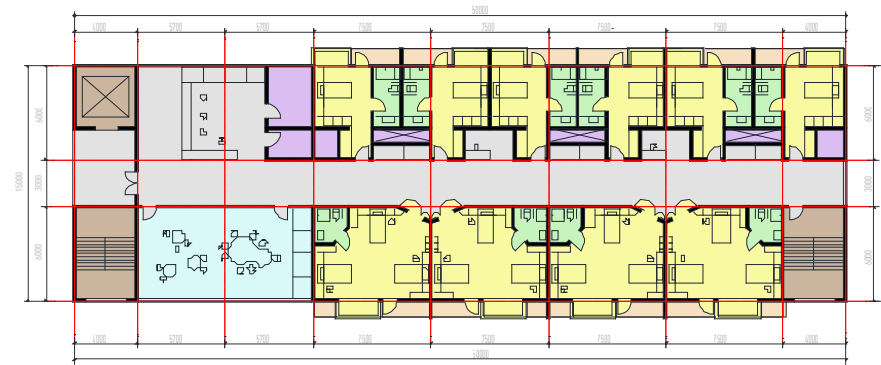
	Emergency center
	Ward
	Outpatient department
	Laboratory center
	Supply center
	Public pathway

4.6 Avoid Formalism

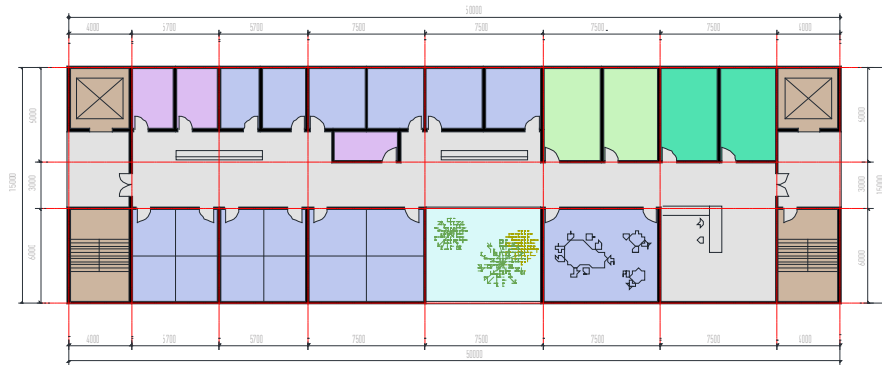
Adapt to future: Flexible room arrangement



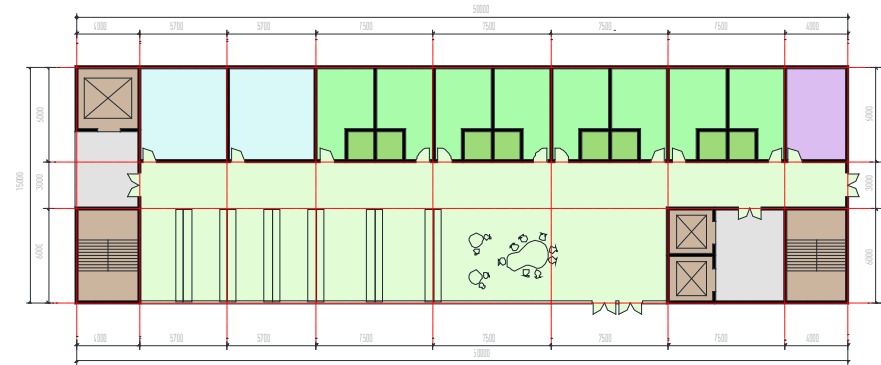
Out patient department with double corridors



In patient department with 3-pat room and single-pat room



Out patient department with single corridor

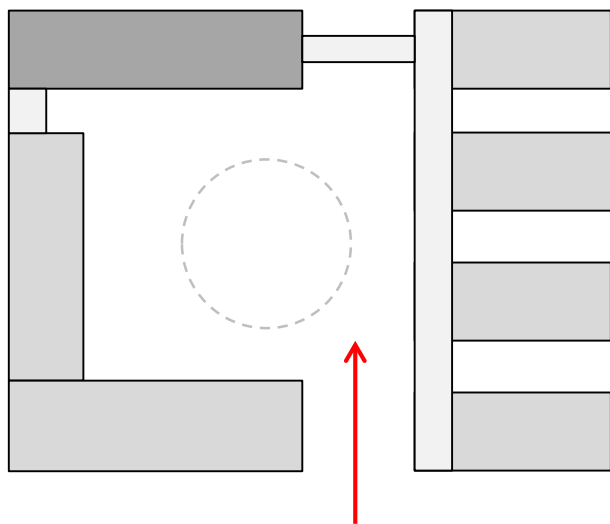
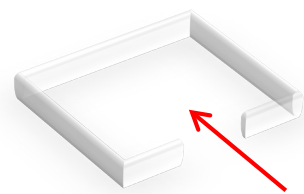


Laboratory department

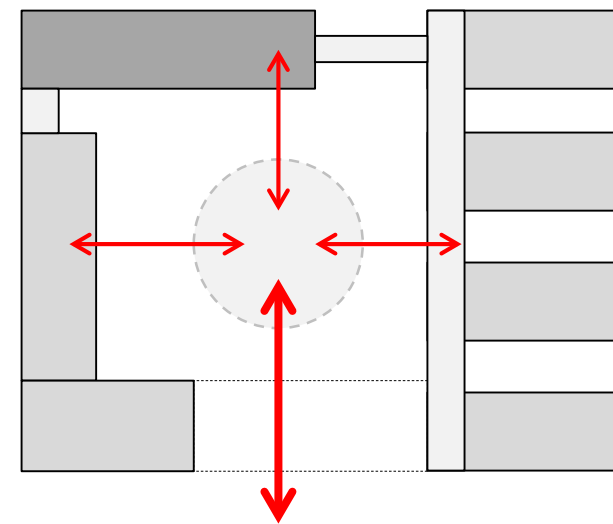
4.7 Humanization

Way finding: Comparison of enclosed square

The enclosed square makes entrance space very important so as to guide people into the hospital. A large enclosed square with a narrow entrance won't be easily noticed from the outside, meanwhile the emergency and laboratory building surround it makes the square less used by the public. If enlarge the entrance and locate an orientation center in the middle which has a good connection with all the buildings will benefit for easy way finding.



Narrow entrance with large enclosed square

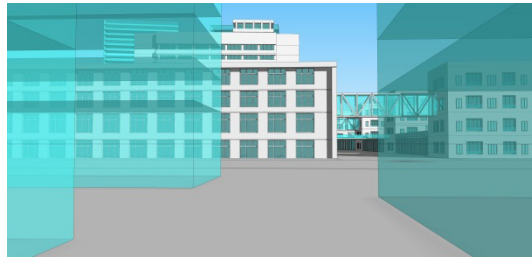


Enlarge entrance connects with orientation center



4.7 Humanization

Way finding: Comparison of main entrance



The front of main entrance



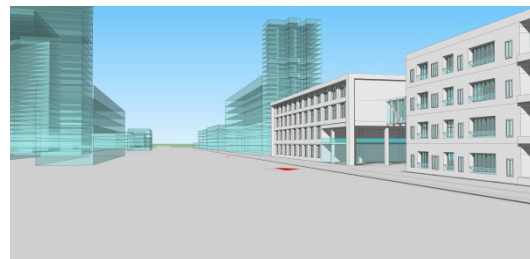
Street view of main entrance

Original main entrance

The orientation center is hidden from the street, which makes patient difficult to find the entrance.



The front of main entrance



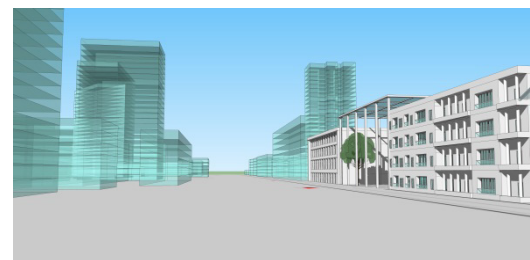
Street view of main entrance

Bottom overhead main entrance

The bottom overhead structure of the original building makes the orientation center recognizable from the street perspective, however still a bit confusing.



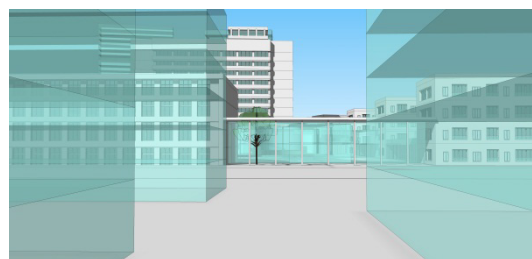
The front of main entrance



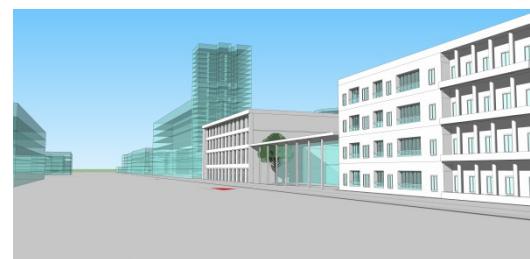
Street view of main entrance

Tall entrance

The tall ceiling makes the entrance distinctive and offers a public space in the front, however, the nice form has little benefit for the performance.



The front of main entrance



Street view of main entrance

Low entrance

The low entrance is easy for patient to recognize from the street and follow the way to the orientation center, meanwhile gives importance to the old building.

4.7 Humanization

Way finding: Path towards entrance



The tallest existing building

People will easily notice the tallest existing building from afar and guide their way to the hospital.



Horizontal space corridor

When people follow the way and arrive at the main entrance, they will see a horizontal space corridor which indicate them to pass through.

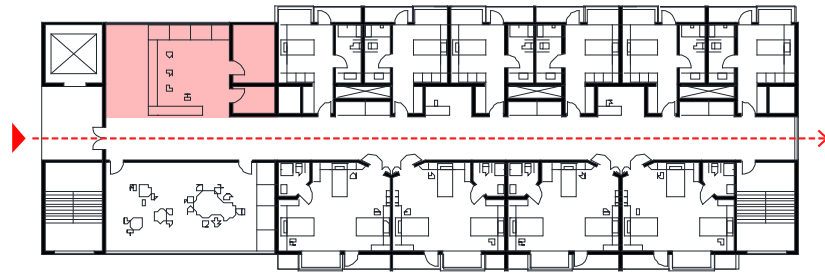


Two paths for patient

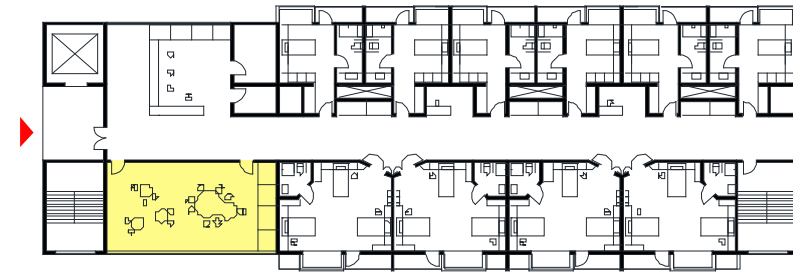
When people get to the central square, they can either go to the orientation center on the left to know which building to go if come for the first time, or go directly to the decentralized clinical center on the right.

4.7 Humanization

Patient needs: Ward layout



Safety: Single corridor with nurse station near the entrance



Sociality: Dining room close to entrance, nurse station and courtyard



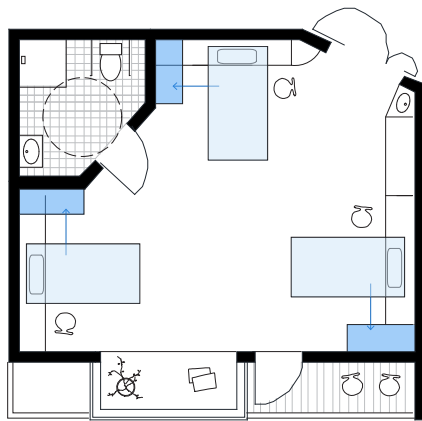
Safety: decentralized team station with each responsible for 9 patients



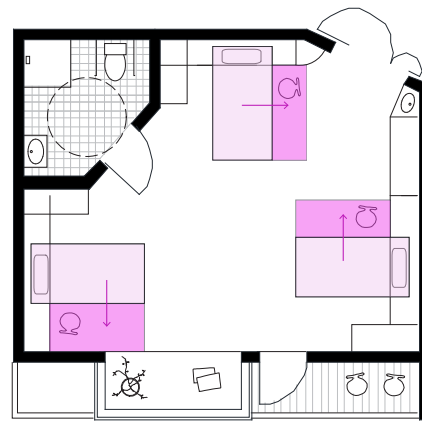
Automatic storage system: decentralized storage close to team station and patient room

4.7 Humanization

Patient needs: Three-patient room



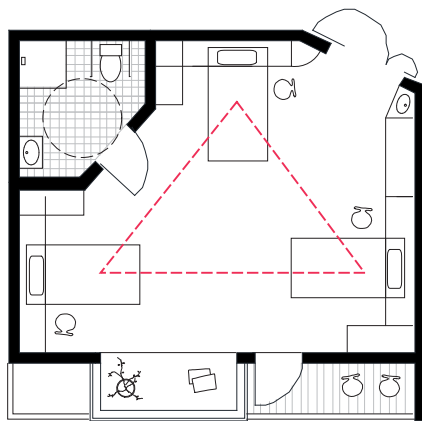
Wardrobe next to patient with bed height



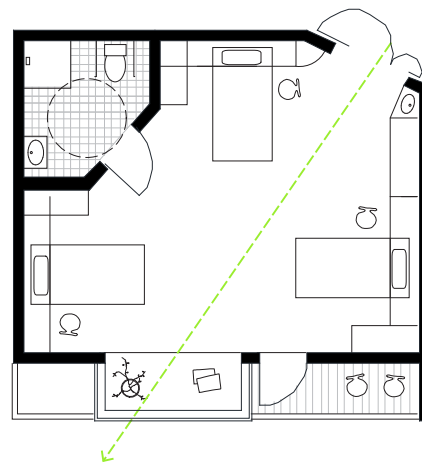
Each patient has a family zone at its own corner



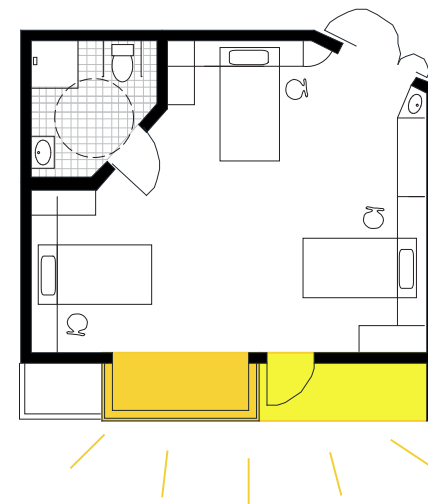
All facilities hidden backward to the patient



A triangle communication relationship among patients



Look through from the entrance



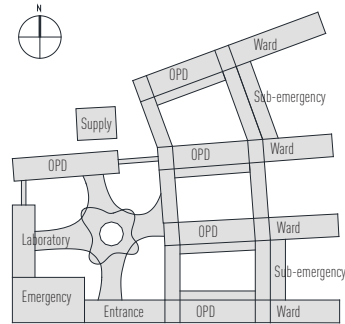
Access to nature from bay window and balcony

4.8 Site Plan 1:1000



Fig 45 Site plan (Author: Jing Ju)

4.9 Floor Plan 1:1000

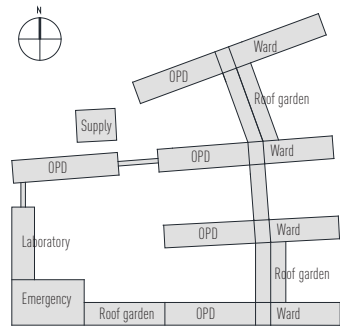


- 1. Traffic Space
- 2. Lobby
- 3. Ward
- 4. Poly clinic
- 5. Treatment
- 6. Emergency
- 7. Operation theater
- 8. Imaging diagnosis
- 9. Office
- 10. Research Laboratory
- 11. Storage
- 12. Dayroom /Dining room
- 13. Consulting room
- 14. Shop /Pharmacy /Cafe



Fig 46 Ground floor plan (Author: Jing Ju)

4.9 Floor Plan 1:1000



- 1. Traffic Space
- 2. Lobby
- 3. Ward
- 4. Poly clinic
- 5. Treatment
- 6. Emergency
- 7. Operation theater
- 8. Imaging diagnosis
- 9. Office
- 10. Research Laboratory
- 11. Storage
- 12. Dayroom /Dining room
- 13. Consulting room
- 14. Shop /Pharmacy /Cafe

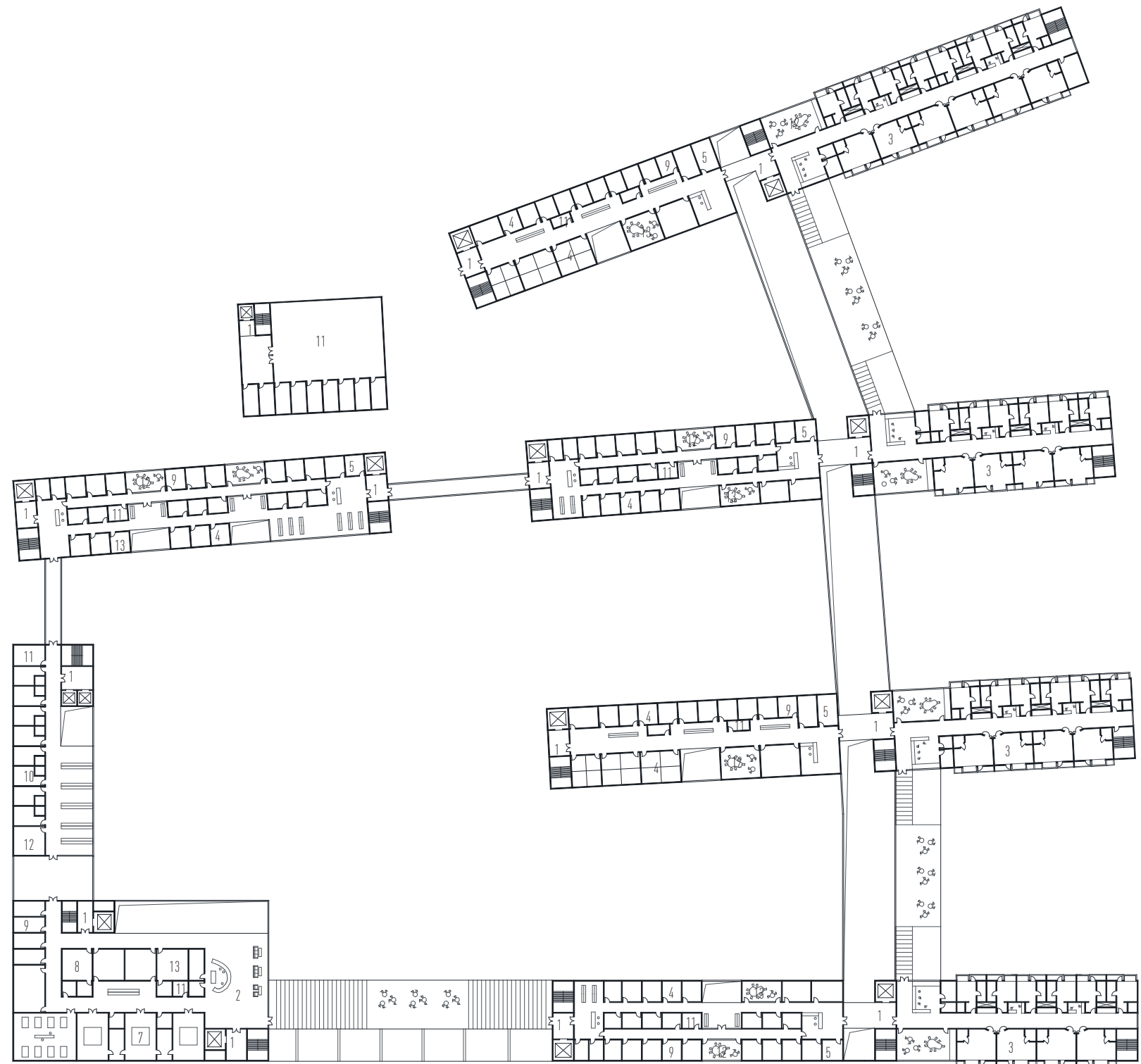
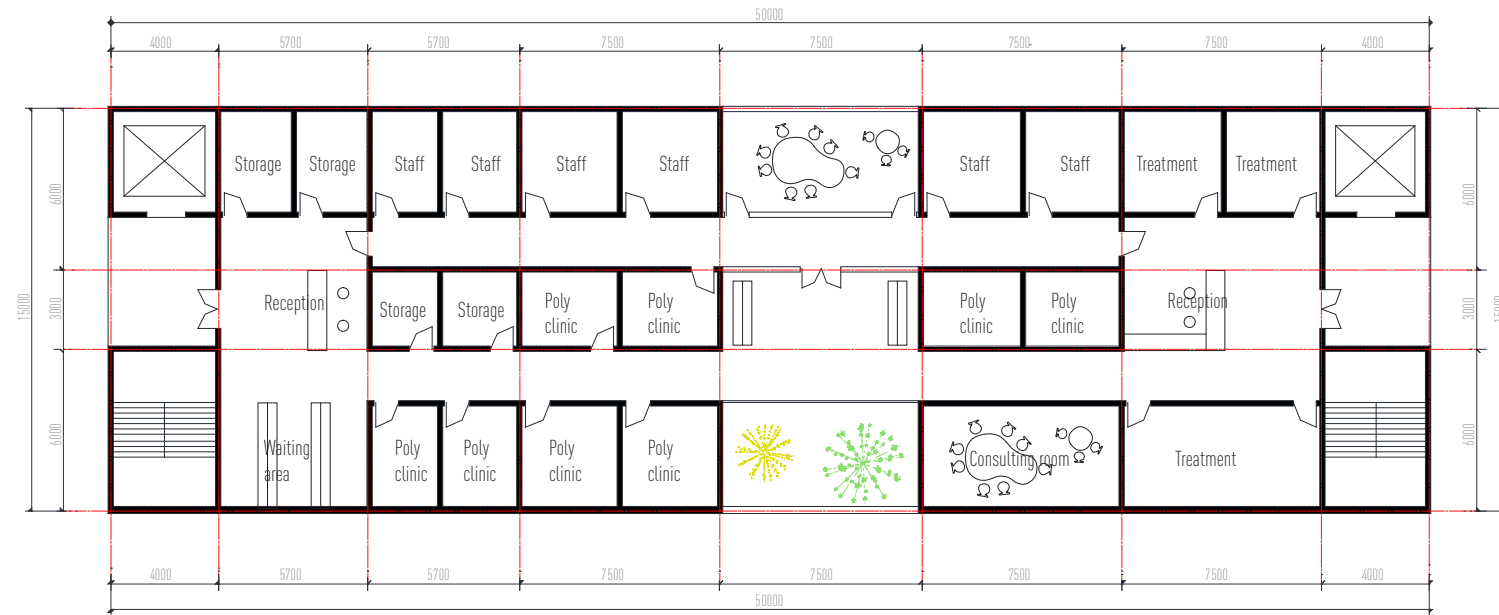
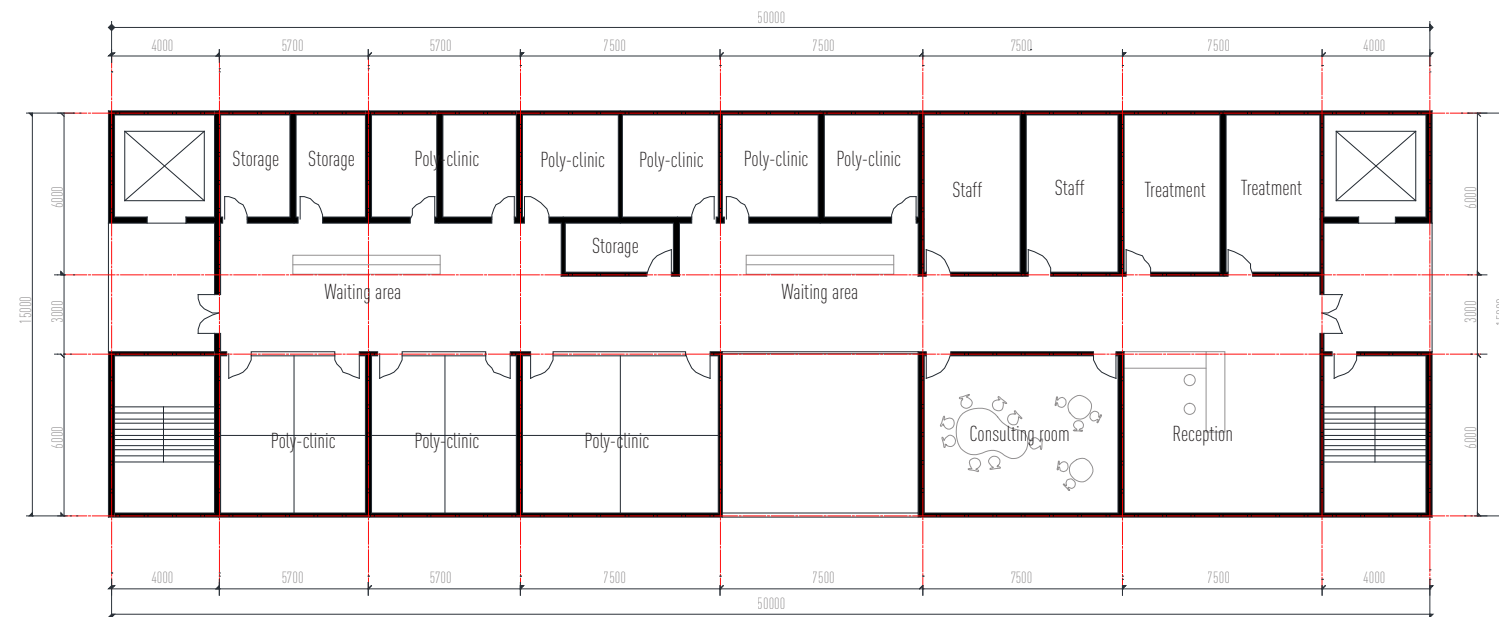


Fig 47 Third floor plan (Author: Jing Ju)

4.9 Floor Plan 1:400



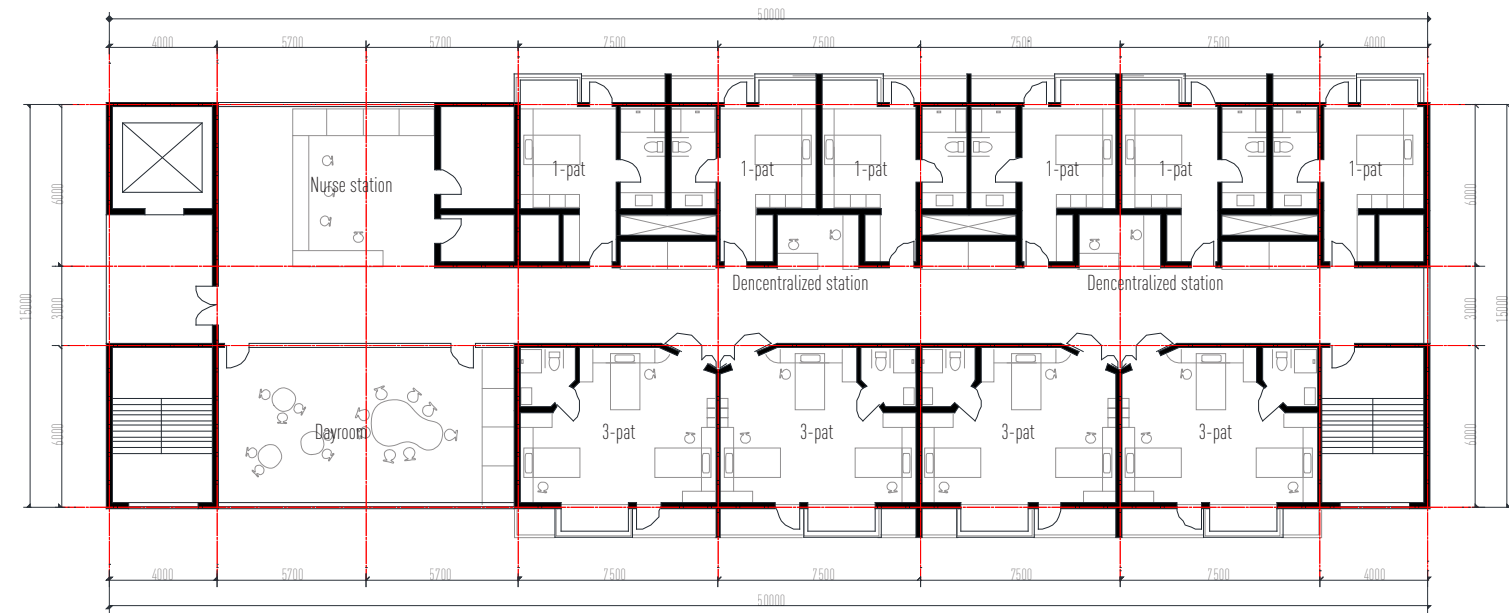
Out patient department (Double corridor)



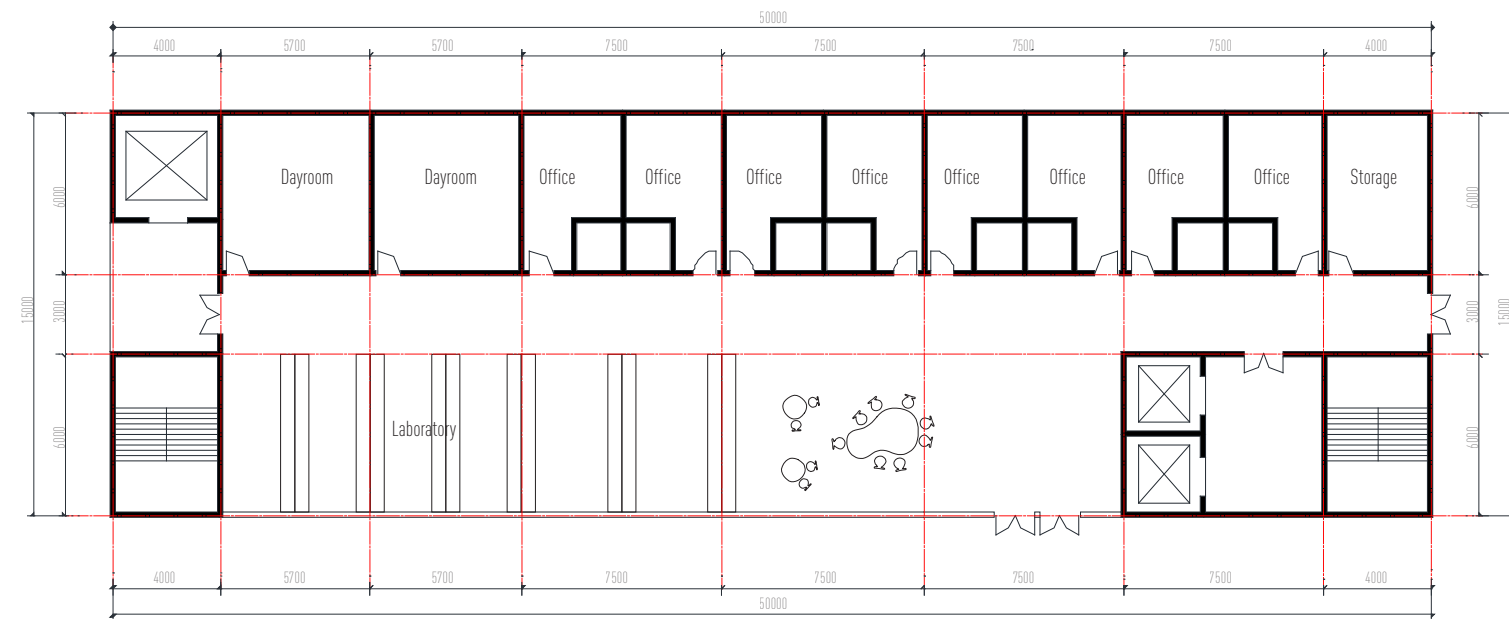
Out patient department (single corridor)

Fig 48 Floor plan of out-patient department (Author: Jing Ju)

4.9 Floor Plan 1:400



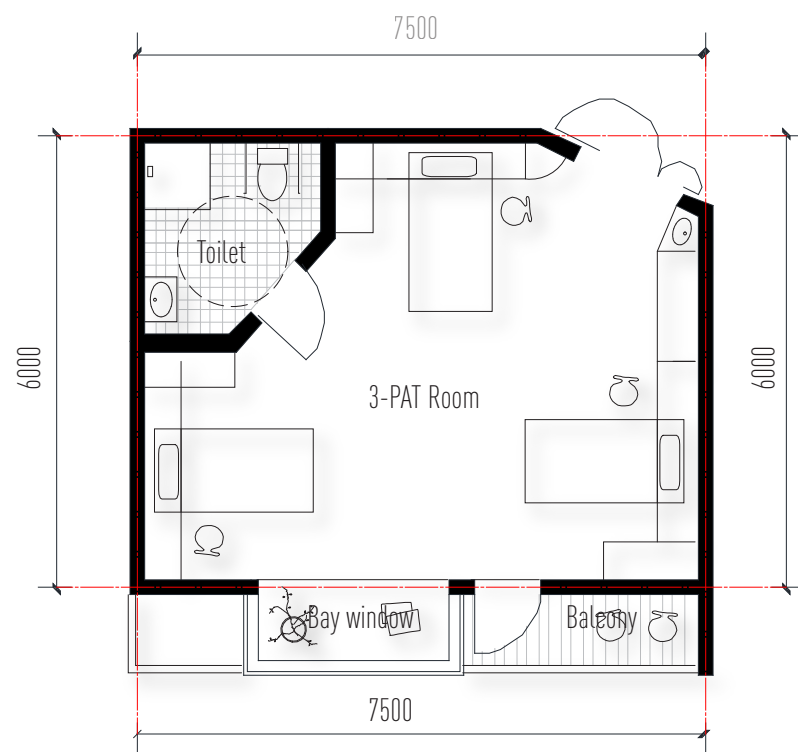
Ward Unit



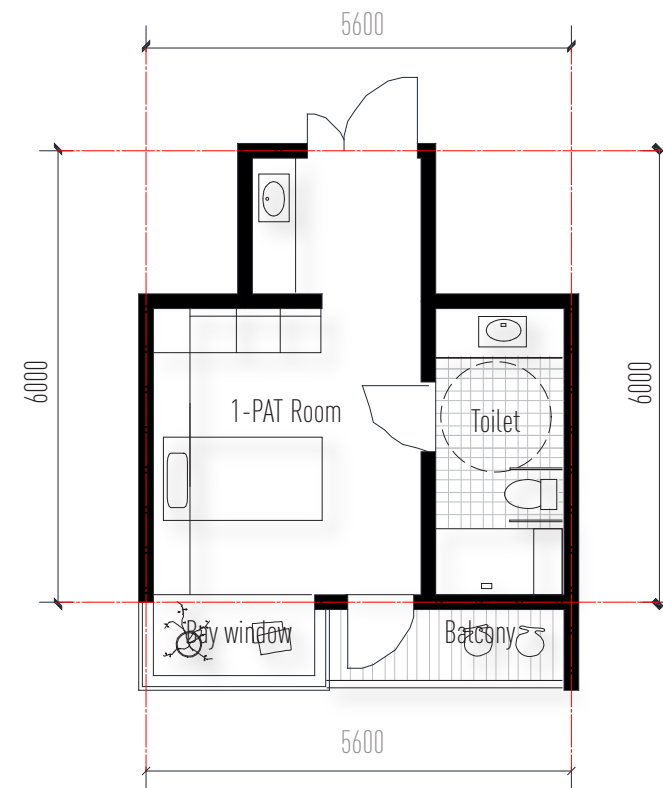
Laboratory department

Fig 49 Floor plan of in-patient and laboratory department (Author: Jing Ju)

4.9 Floor Plan 1:100



Three-patient room



Single-patient room

4.10 Model

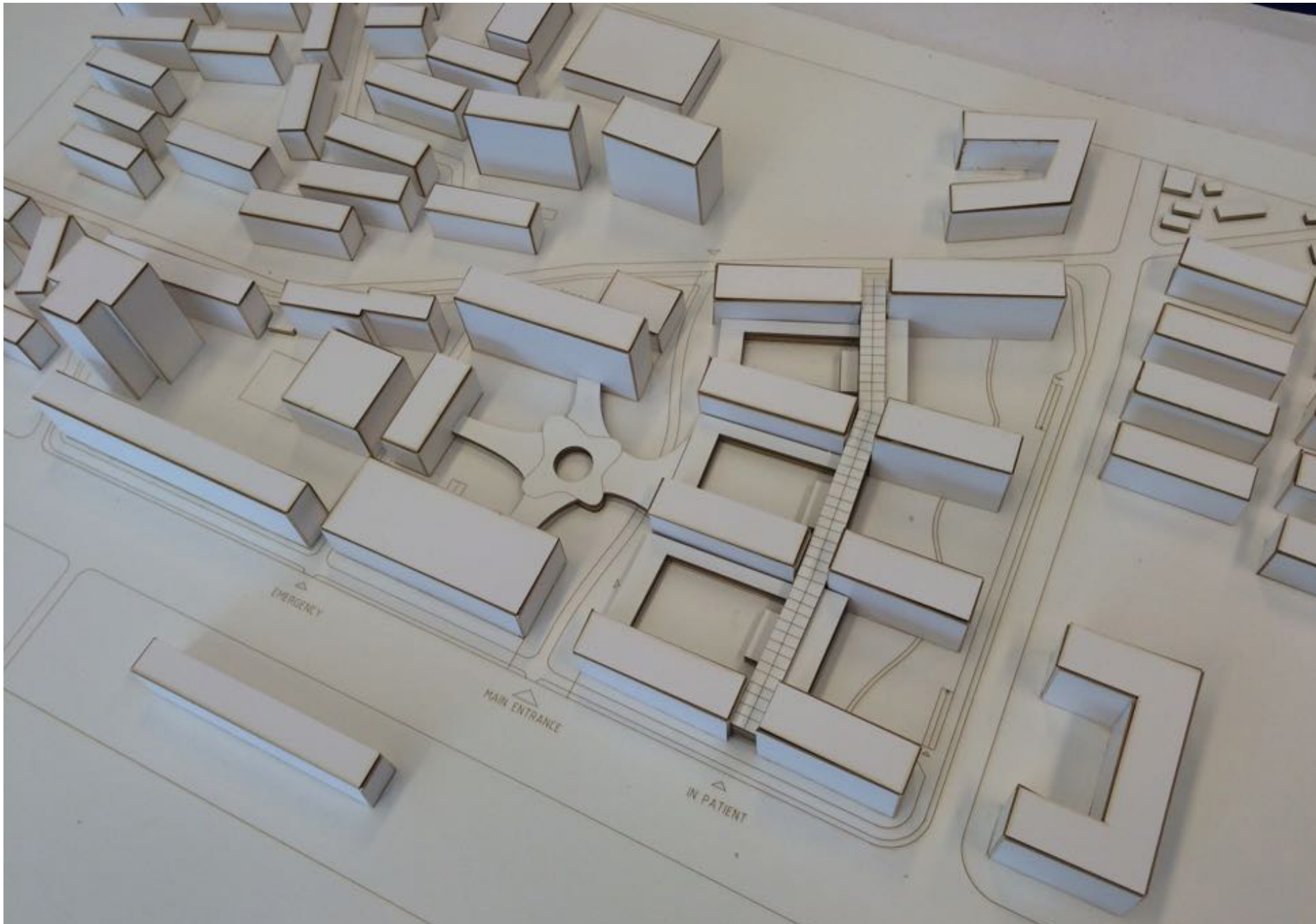
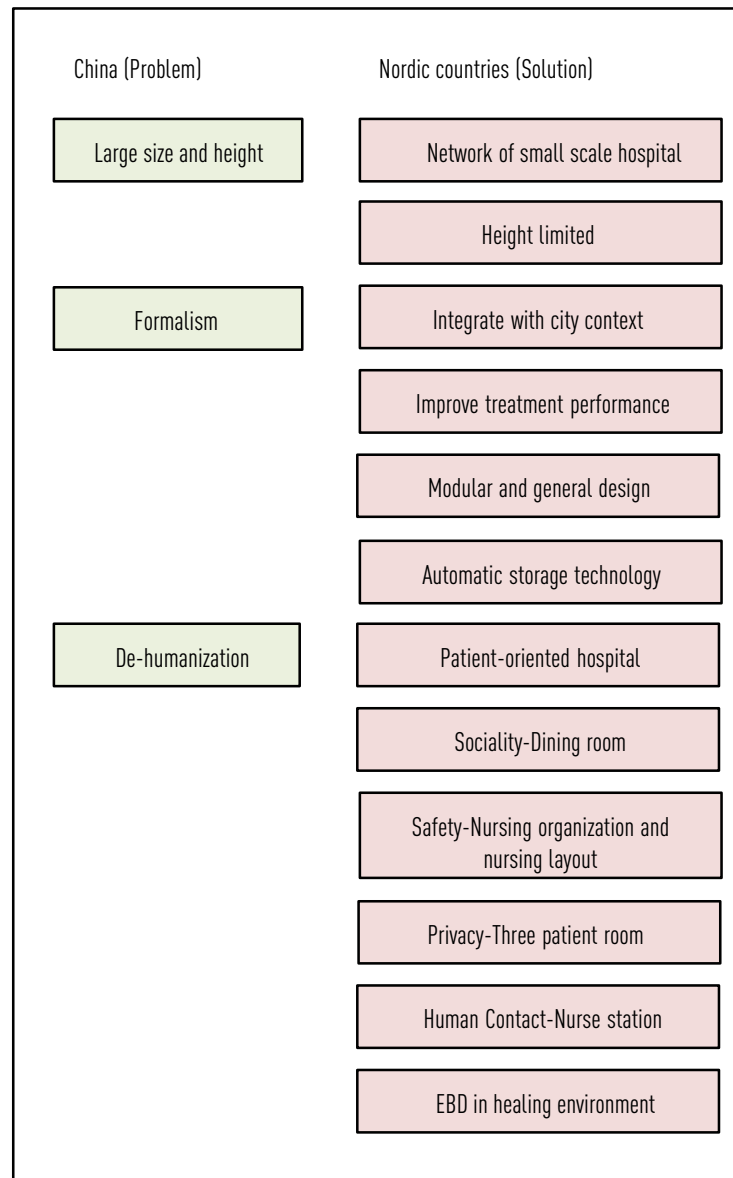


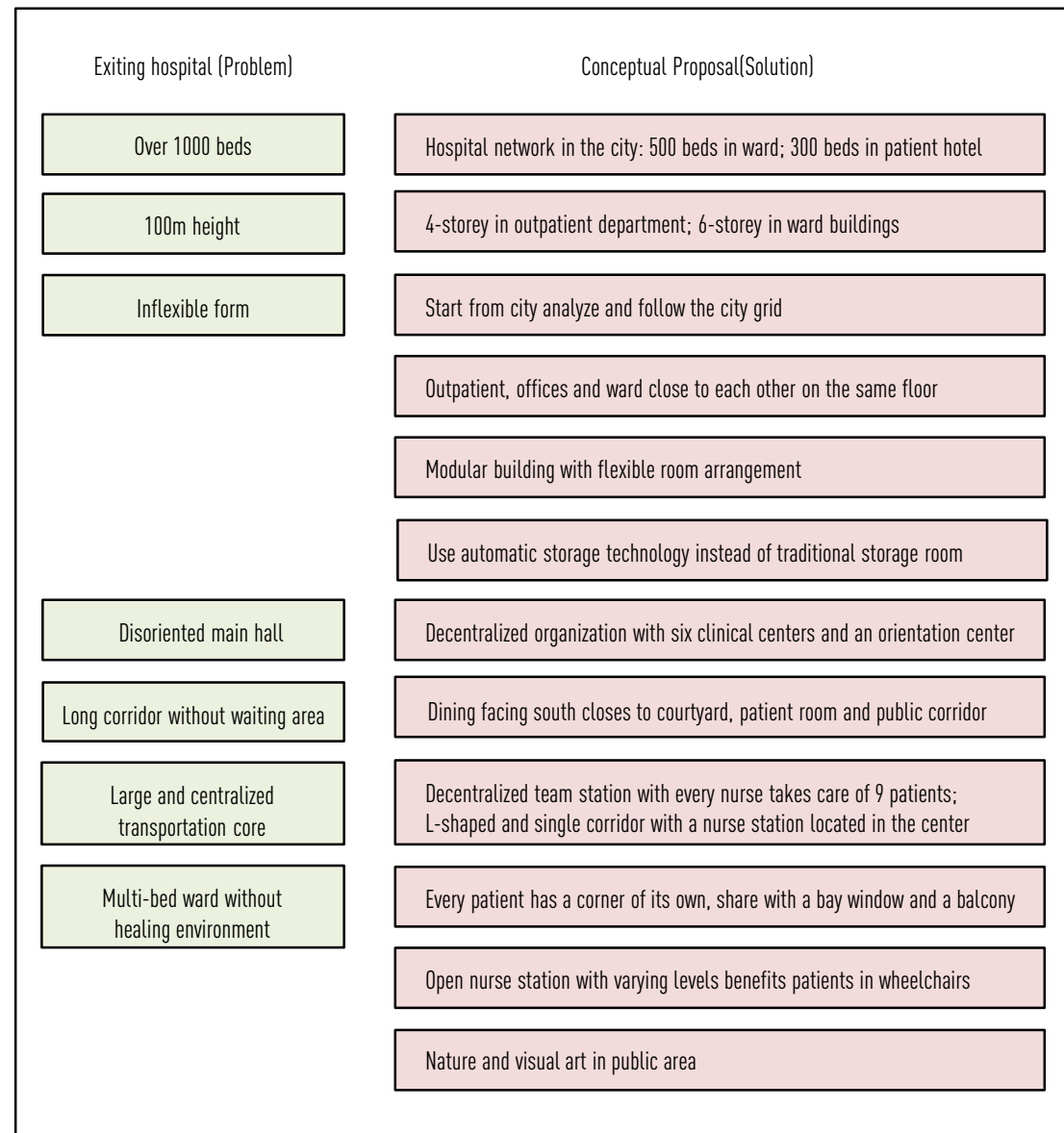
Fig 51 Model photo (Photographer: Jing Ju)

CONCLUSION

Research



Design (Application of research)



DISCUSSION

The starting point of this thesis is the healthcare studio which I participated for designing a general hospital in Sweden last semester. This is the first time for me to design a hospital. In order to get familiar with the hospital design, we made a study trip to St Olavs Hospital, where I was greatly impressed with its large differences in comparing with Chinese hospitals. So I started to make reflection during the hospital design, and learned a lot about the theory of hospital design which I thought can be introduced into China.

Through the thesis I made further understanding about the hospital design, especially in the aspect of humanization which I think can be further developed.

The thesis provides a perspective to look into the hospital design by comparing with different countries. It offers a big background which even refers to politics, while ends with a practical proposal in an architectural way.

The thesis is suitable for most of the situation in China, however, in some special cases, it may asks for different solutions on hospital design. For example, some big cities with strong urban context and land limit may not fit with a small scale hospital. A high rise which has solved the elevator problem can be a nice solution since its compact structure makes everything closely located in distance.

After all, the thesis offers a different view in Chinese hospital design by investigating the problem and solving it through learning experience from Nordic countries. I hope that the thesis can help people get inspired and give rise to further insight regarding this topic.

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Available at: <http://www.nhfpc.gov.cn/htmlfiles/zwgkzt/ptjnj/year2013/index2013.html>
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- Fig 3: Comparison of hospital construction between China and Sweden in last 50 years (Author: Jing Ju, based on OECD health data.)
- Fig 4: Size of hospital design. (Source: Baidu Image)
- Fig 5: Height of hospital design (Source: Baidu Image)
- Fig 6: Formalism in hospital design. (Source: Baidu Image)
- Fig 7: De-humanization in hospital design. (Source: Baidu Image)
- Fig 8: Healthcare renovation in Scandinavia (Author: Jing Ju, based on reference 5)
- Fig 9: Network of small scale hospital. (Author: Jing Ju, based on reference 6)
- Fig 10: Limited height of the hospital (Author: Jing Ju, based on reference 7)
- Fig 11: City size of St Olavs Hospital, Norway (Author: Jing Ju, based on reference 5)
- Fig 12: Improve treatment performance, Akershus University Hospital, Oslo (Source from C.F.MOLLER Architects, 2008)
- Fig 13: Modular design of McMaster Health Sciences Center (Author: Jing Ju, based on reference 5)
- Fig 14: General room design of New Karolinska Hospital, Sweden. (Source: from reference 8)
- Fig 15: Automatic storage technology (Source: from Kardex Remstar)
- Fig 16: Different organization of medical activities. (Source: from reference 5)
- Fig 17: Organization model of St Olavs Hospital, Norway. (Source: from reference 5)
- Fig 18: Floor plan and section of Neuro center in St Olavs Hospital, Norway. (Source: arkitektur n . 05 . 2007)
- Fig 19: Dining room in St Olavs hospital, Norway. (Source: arkitektur n . 05 . 2007)
- Fig 20: Nursing organization and nursing layout in Narrokoping hospital, Sweden. (Author: Jing Ju, based on reference 5)

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Fig 21: Different three-patient room arrangement in Halmstad Hospital and Kalmar Hospital, Sweden. (Source: from reference 5)

Fig 22: Different nurse station in Vanda Hospital, Finland and St Olavs Hospital, Norway. (Author: Jing Ju, based on reference 5)

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Fig 24: Site background. (Source: Baidu Map)

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Fig 26: Problem of original proposal (Author: Jing Ju, based on reference 10)

Fig 27: Concept (Author: Jing Ju)

Fig 28: Design process (Author: Jing Ju)

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Fig 40: Comparison of enclosed square (Author: Jing Ju)

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Fig 44: Three-patient room (Author: Jing Ju)

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Fig 47: Third floor plan (Author: Jing Ju)

Fig 48: Floor plan of out-patient department (Author: Jing Ju)

Fig 49: Floor plan of in-patient and laboratory department (Author: Jing Ju)

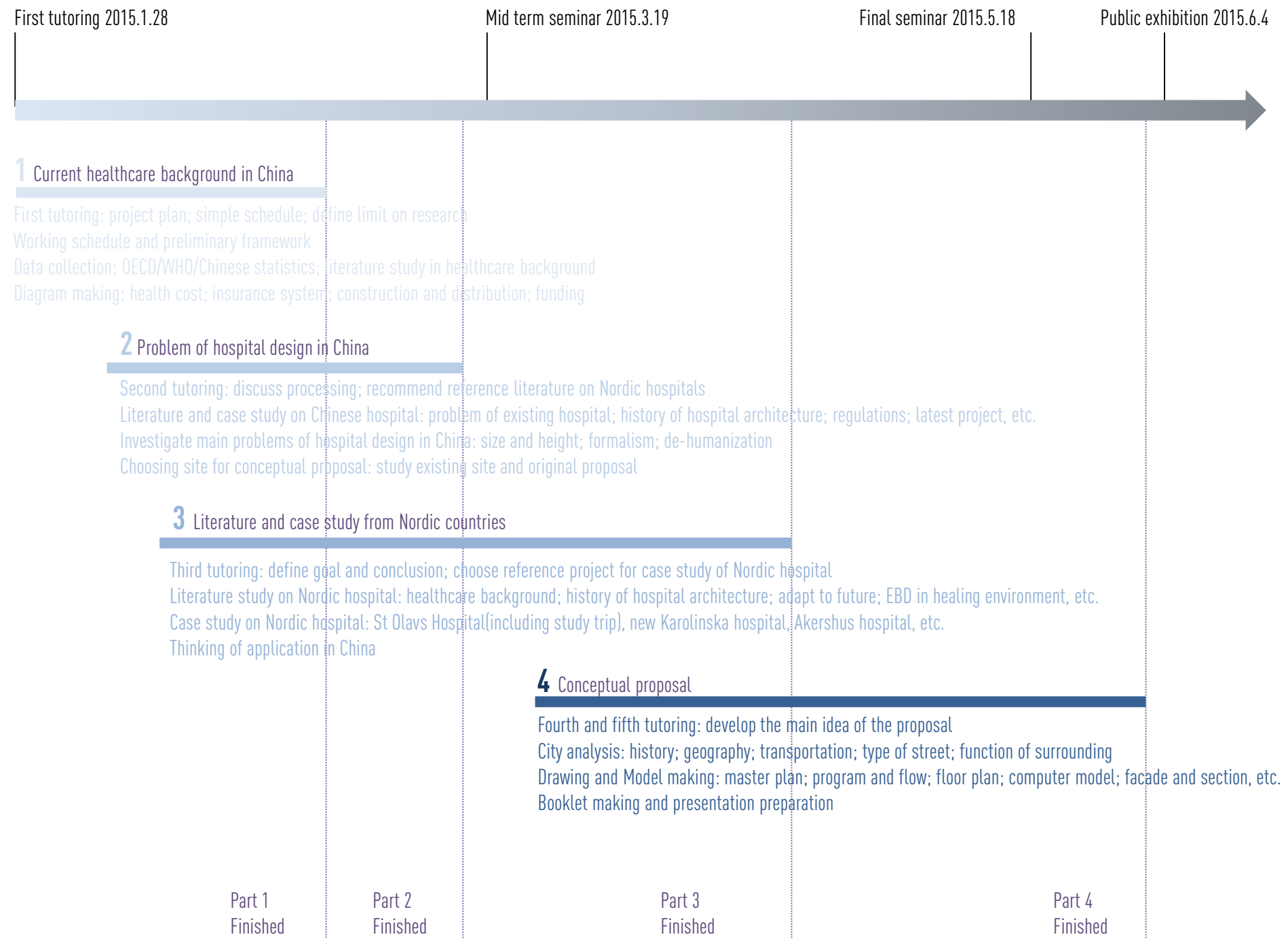
Fig 50: Floor plan of patient room (Author: Jing Ju)

Fig 51: Model photo (Photographer: Jing Ju)

Fig 52: Conclusion (Author: Jing Ju)

APPENDIX

Schedule



APPENDIX

Healthcare Background: Funding

In China, most general hospitals are state hospital which are funding by the government. With the renovation of Chinese insurance system which gradually open to the market economy, more and more private enterprises are encouraged to invest for the hospital. [4]

However, because the fact that the insurance system is only applied for the designated state hospital, and that most resources are still allocated in the state hospital, most people are still willing to go to the state hospital rather than to the private hospital.

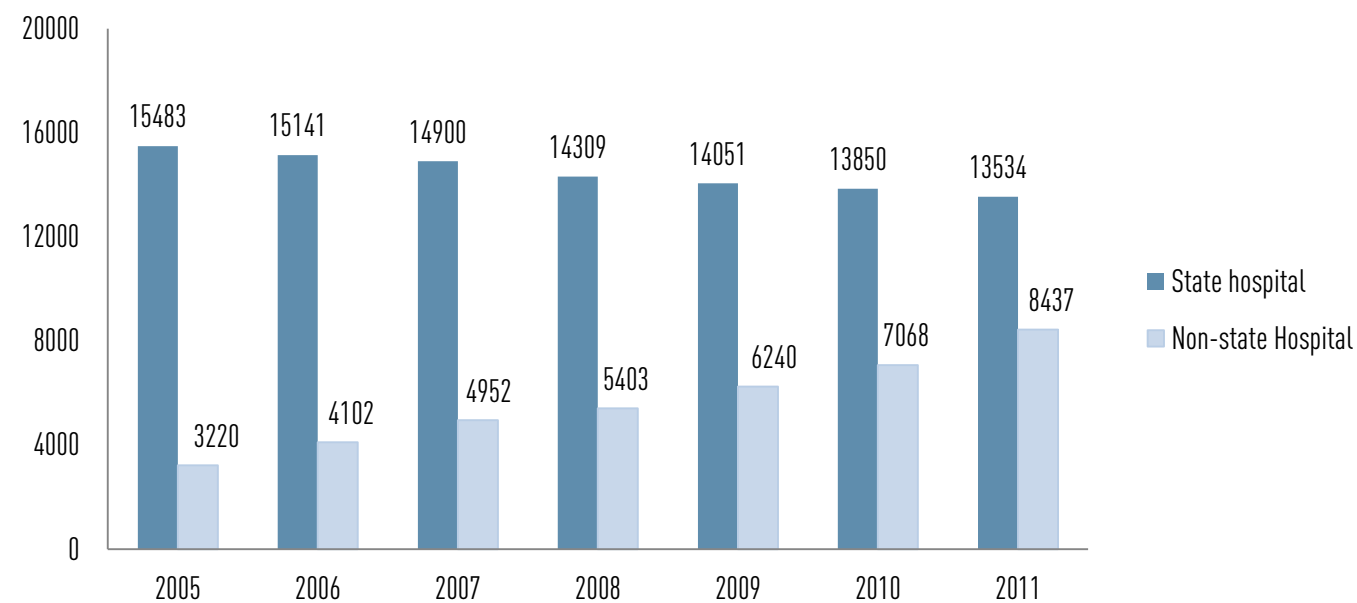


Fig Tendency of state and non-state hospital construction on general hospital from 2005-2011 (Author: Jing Ju, based on reference 4.)

APPENDIX

Healthcare Background: History of hospital architecture

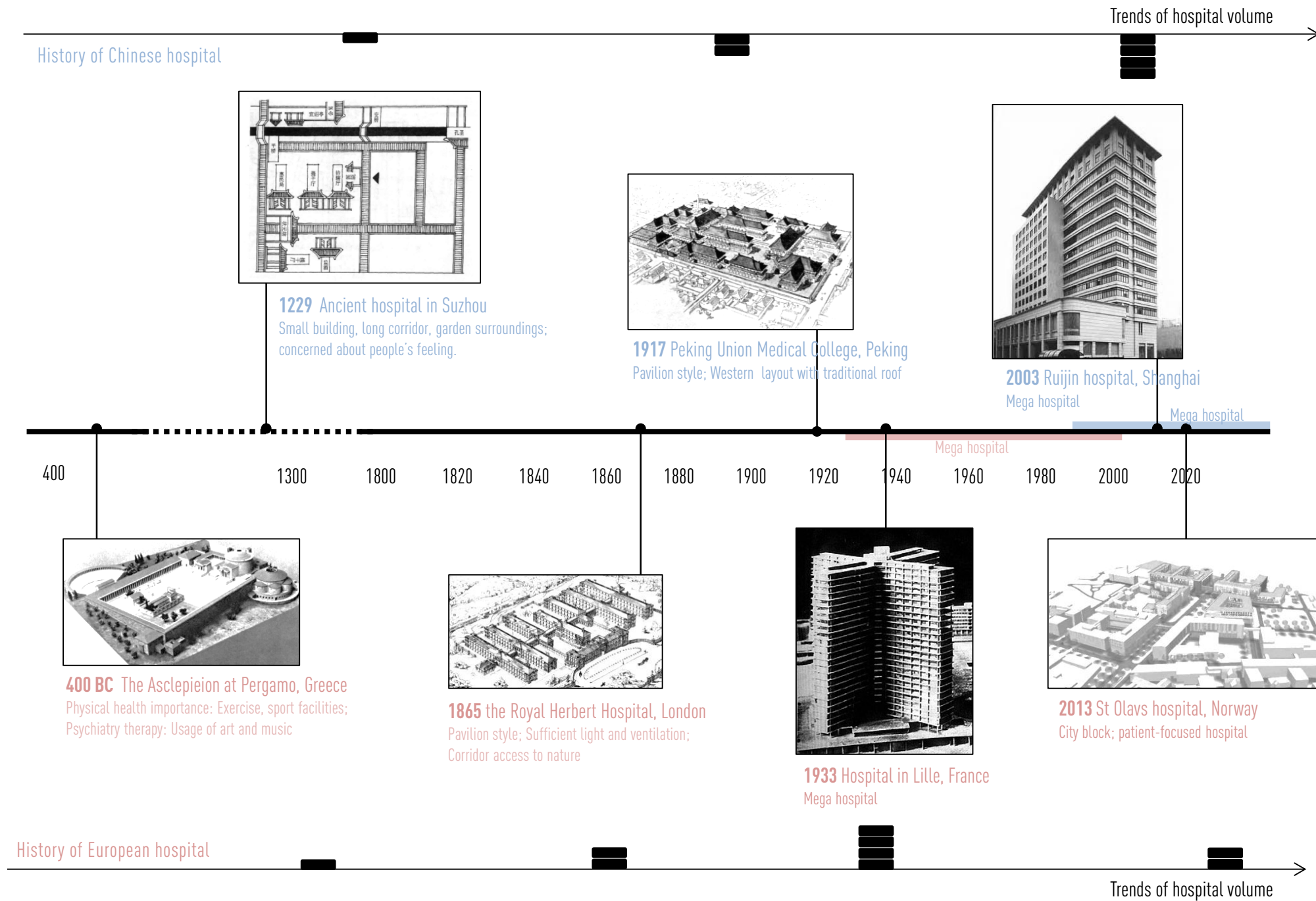
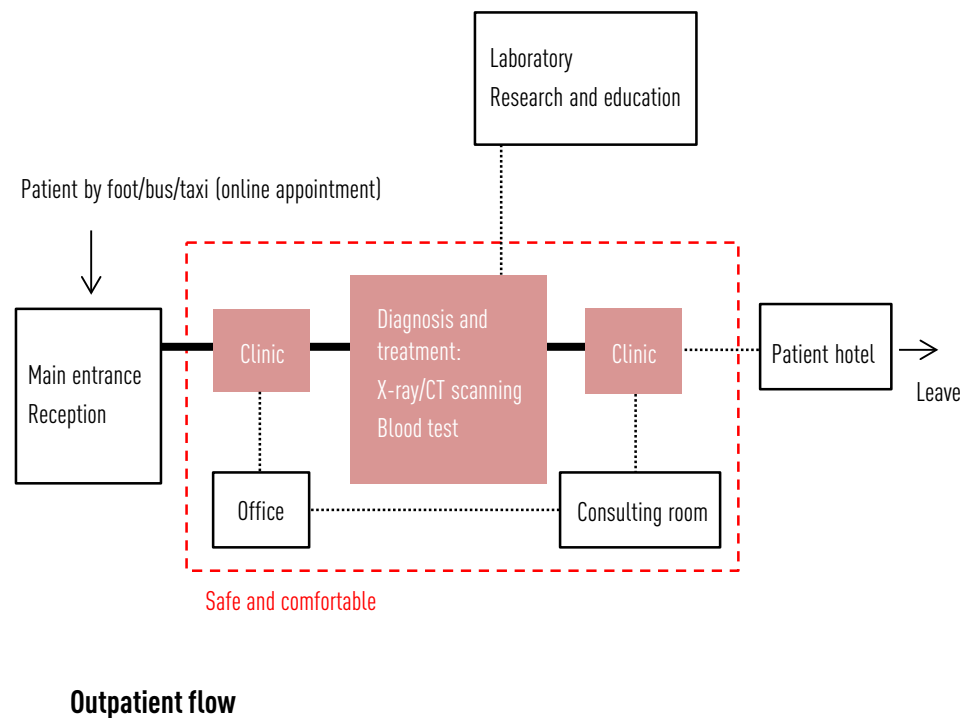
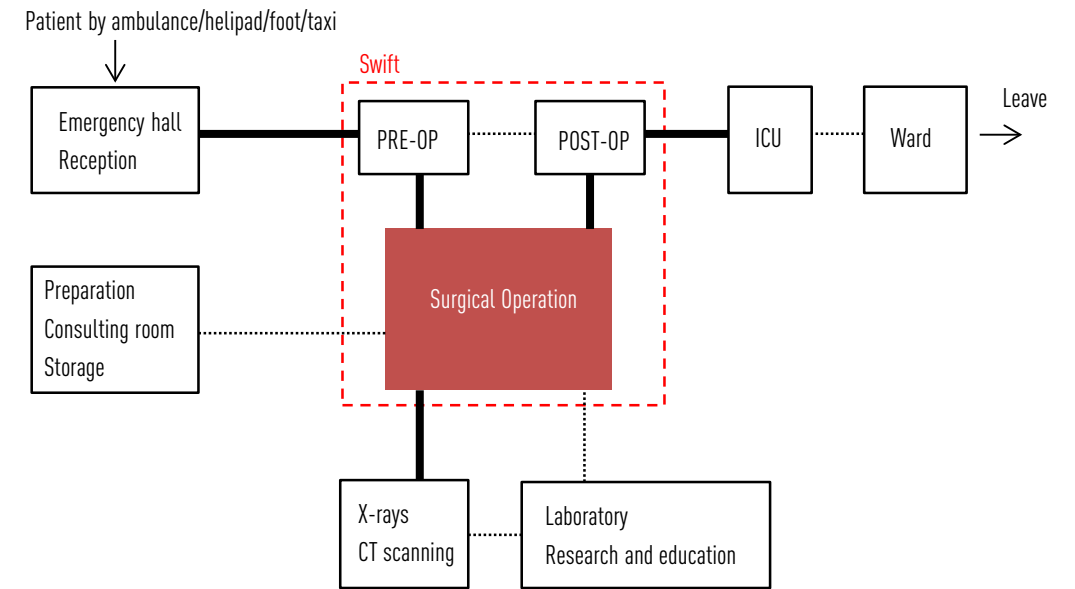
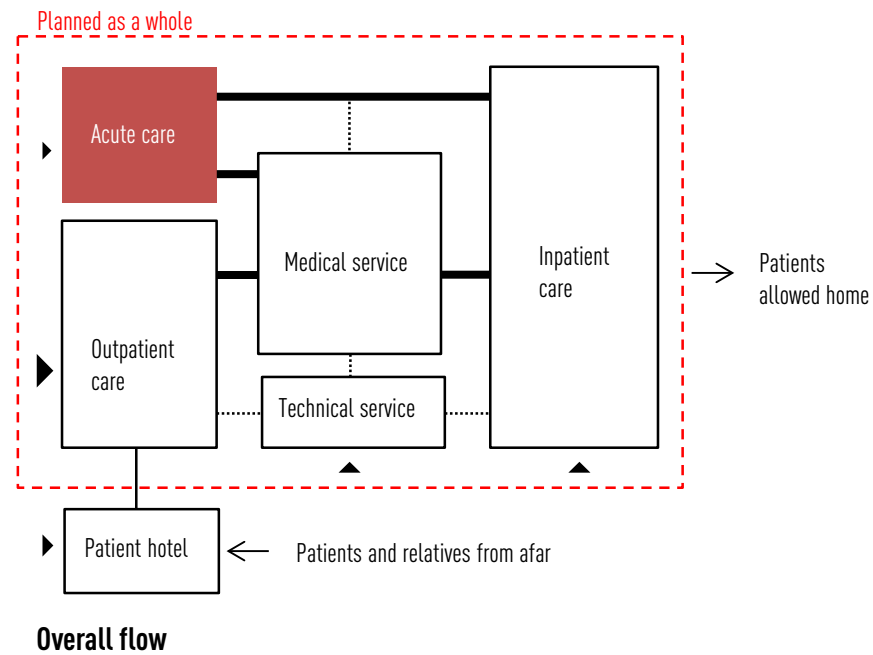


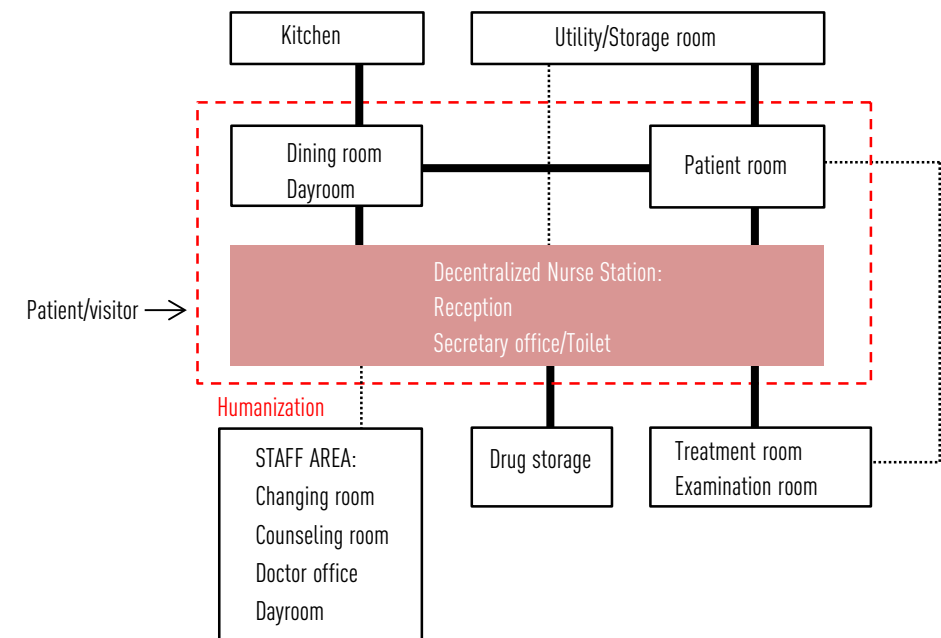
Fig History of hospital architecture (Author: Jing Ju)

APPENDIX

Improve treatment performance: Hospital flow

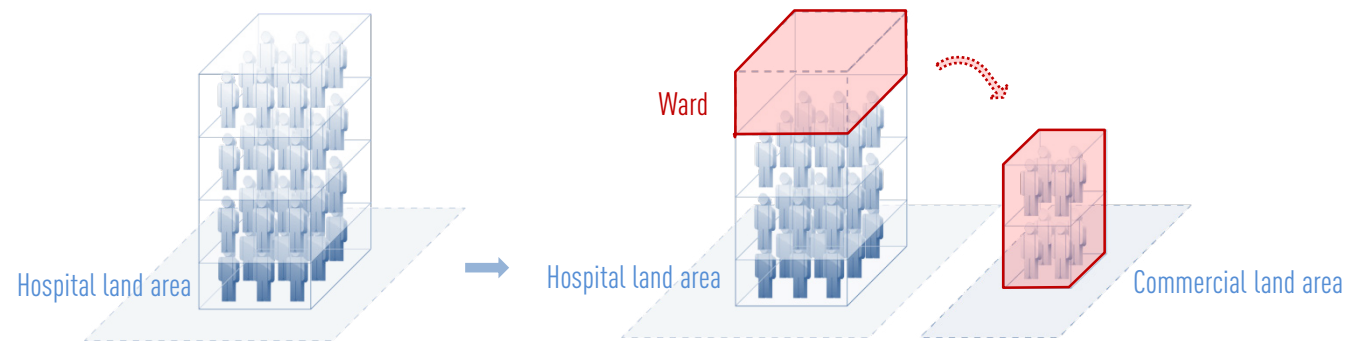


Emergency flow

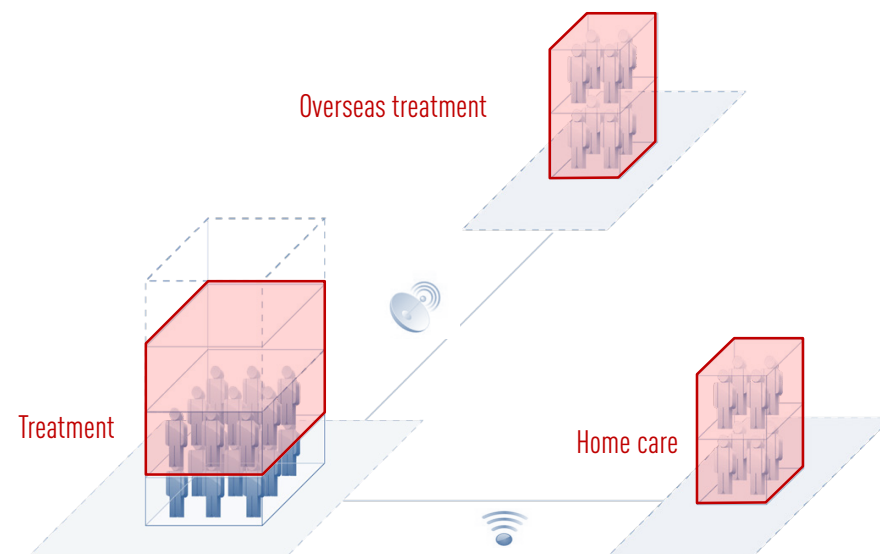


APPENDIX

Reduce size and height: Hospital network



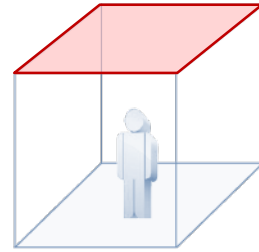
Building a patient hotel can be a method to reduce the size and height of the ward. The patient hotel is designed for patients who do not need to be in a nursing ward. It also opens to relatives and regular visitors. It is a hotel with basic nursing facilities and nurses on hand 24hours. Thus, patient hotel can be built as a commercial building while has a close connection with the hospital.



Based on a wide spread healthcare information technology, the hospital can be more decentralized such as community hospital, home care, ambulance care and overseas treatment, which helps reduce the size of the hospital meanwhile enable people to have a more private care with a shared medical network.

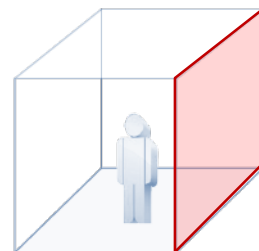
APPENDIX

Humanization: Room design



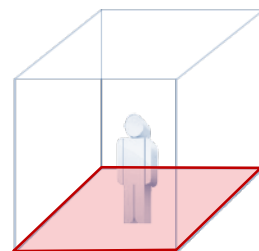
Ceiling design

- Pleasant form
- Sound absorbing (noise reduce)
- Light (daylight and artificial light)



Wall design

- Low and horizontal window (wider view for patient when laying down in the bed)
- Door opening (1300mm, opening direction)
- Visual art present nature and human activities (not abstract art)
- Sense of control (temperature, daylight)
- Textile for touch (soft or hard, warm or cold)



Floor design

- Even color (calm and peace)
- Material: Anti-slippery
- Easy cleaning (wall hang facilities, e.g. toilet seat)
- Connect with balcony/courtyard

APPENDIX

Study trip



Every clinical center has its own identity



Open reception easy for communication

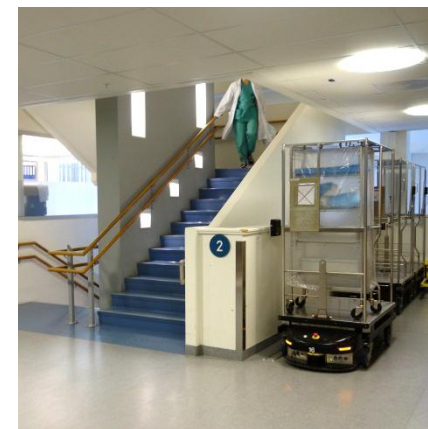


Staff in dayroom close to working place



Facilities hanging on top for easy cleaning

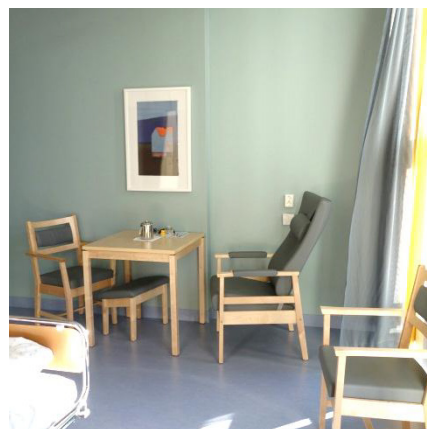
St Olavs



Automatic guided vehicles (AGV)



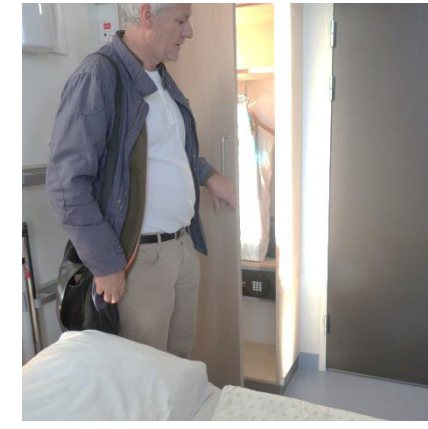
Tube which transmits samples to laboratory



Family zone in single patient room



All facilities hidden backward to the patient



Wardrobe next to patient with bed height



Nature light with forest image

APPENDIX

Site background: Problem of original proposal

The ward plan have several design problems as is stated in the research. Firstly, the high rise leads to big transportation core in the middle which not only cost money but also delay the treatment performance. Secondly, the curved wall makes hospital inflexible for future change. Besides, the floor plan has little concerned about healing environment, such as long corridor with little waiting area, centralized nurse station and multi-bed ward without family zone,

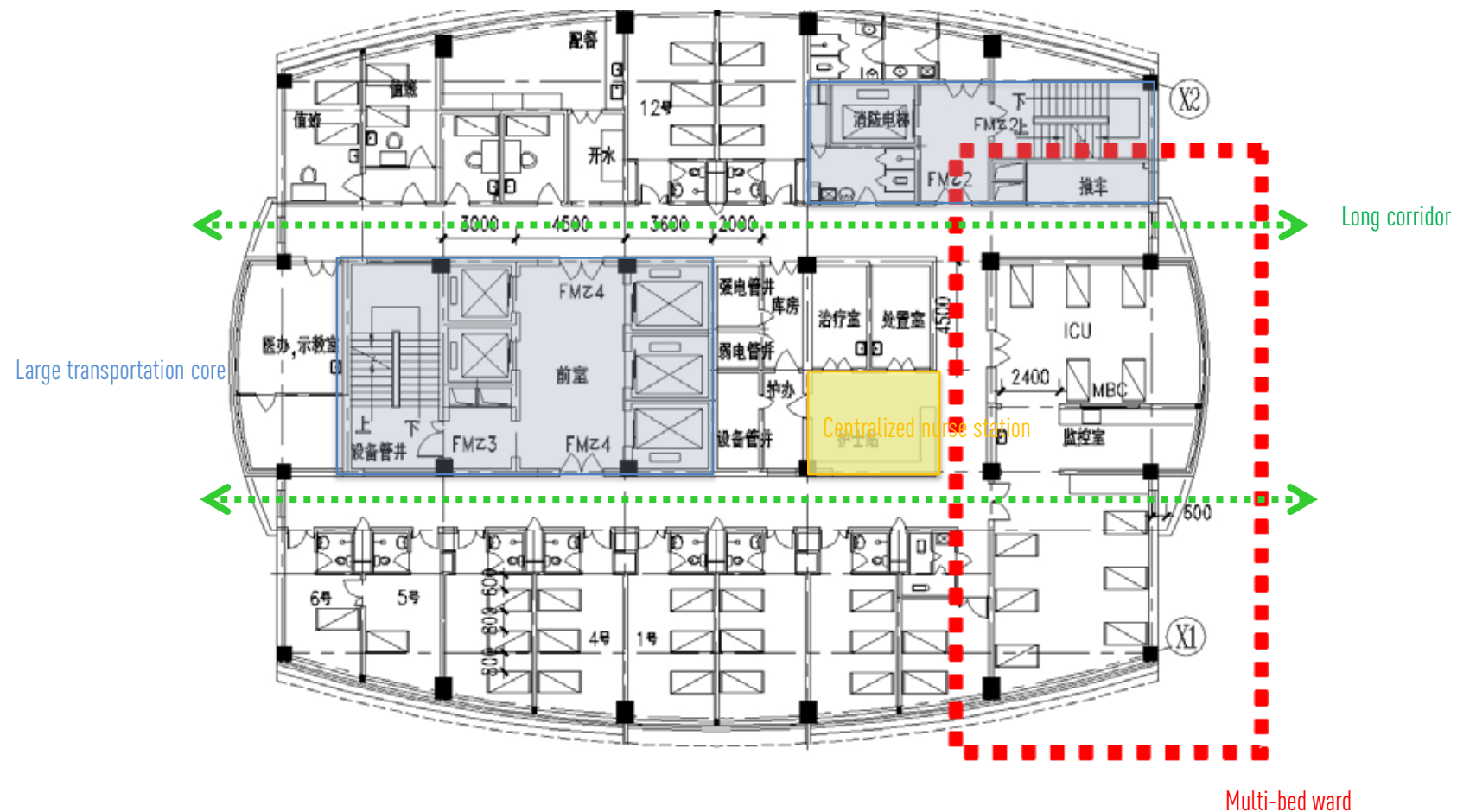


Fig Problem of original proposal (Author: Jing Ju, based on reference 10)

APPENDIX

Site background: City context

History

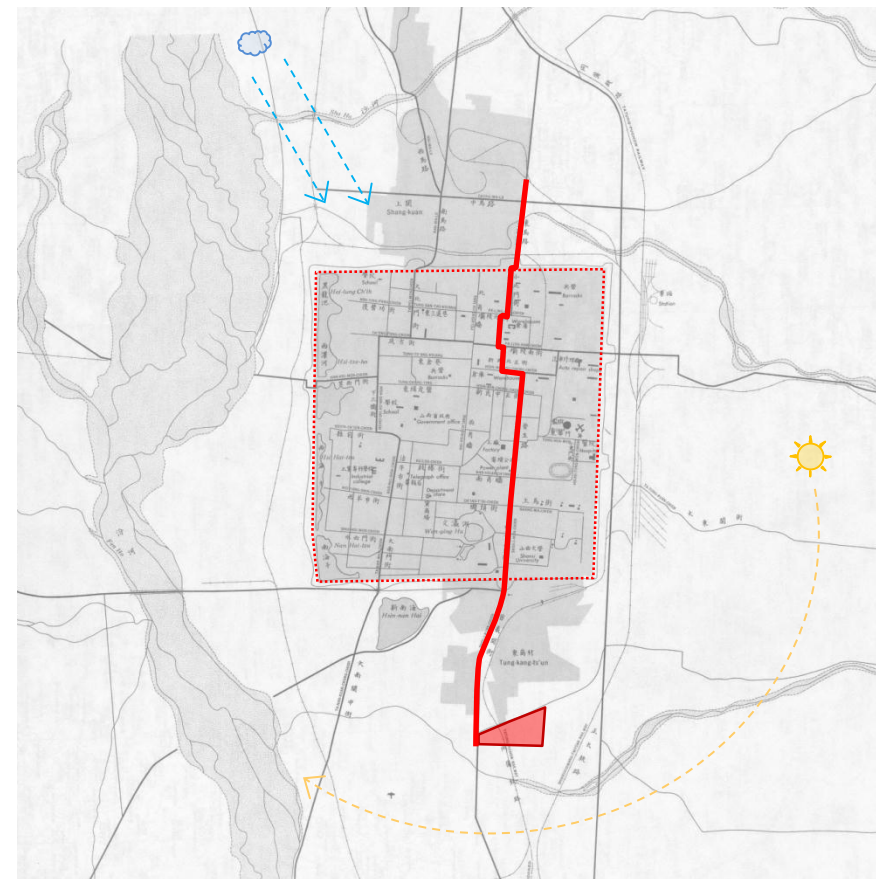
Taiyuan City has a long history of over 2500 years. At first it is a small city, with a smaller town inside. The main traffic go through the city from north to west. Later, it continues to expand to the south, and with its main transportation connects closely with the site.

Geometry

Sine the city is sandwiched between two mountains, it always suffers a strong wind from north-west during the winter period.



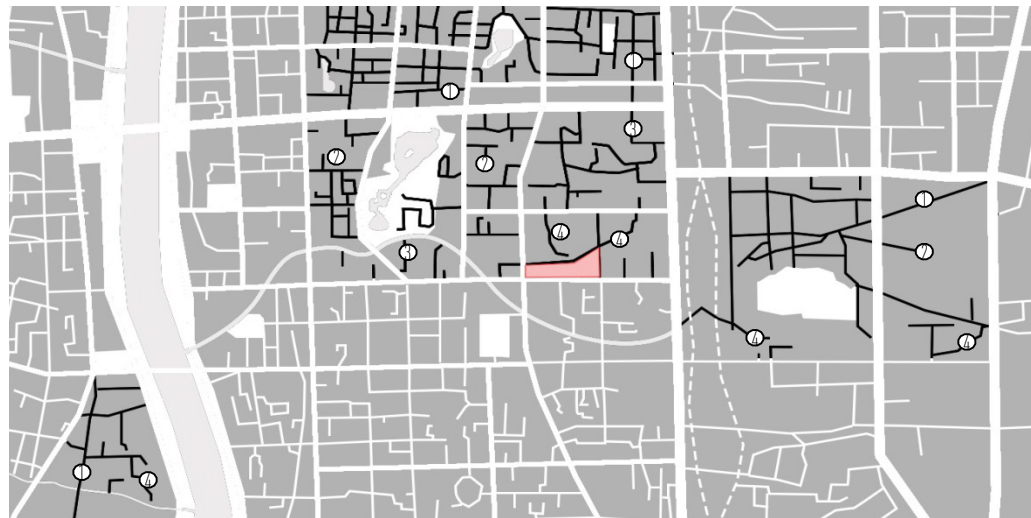
Taiyuan City (982 BC)



Taiyuan City (1912)

APPENDIX

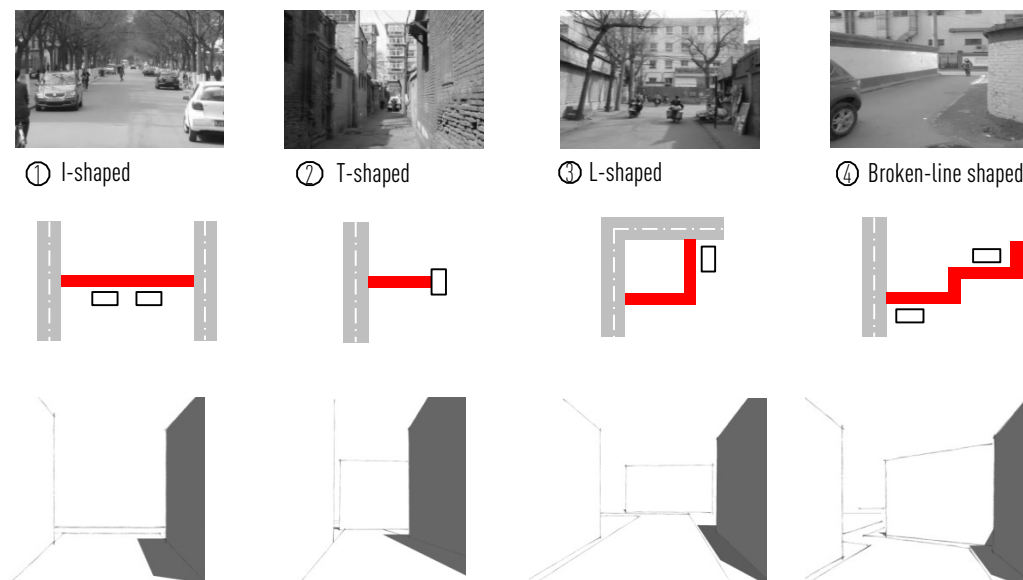
Site background: City context



Street fabric in city context

Street fabric ($\leq 5m$)

This old city have kept its special street fabric for over 2500 years, which is quite different from the modern one (like a cross shape). The street in every block is always discontinued and zigzag, which people can not easily see through towards the endpoint of the road. Such a pattern protects the city from suffering strong wind and forms the microclimate.



Four types of street

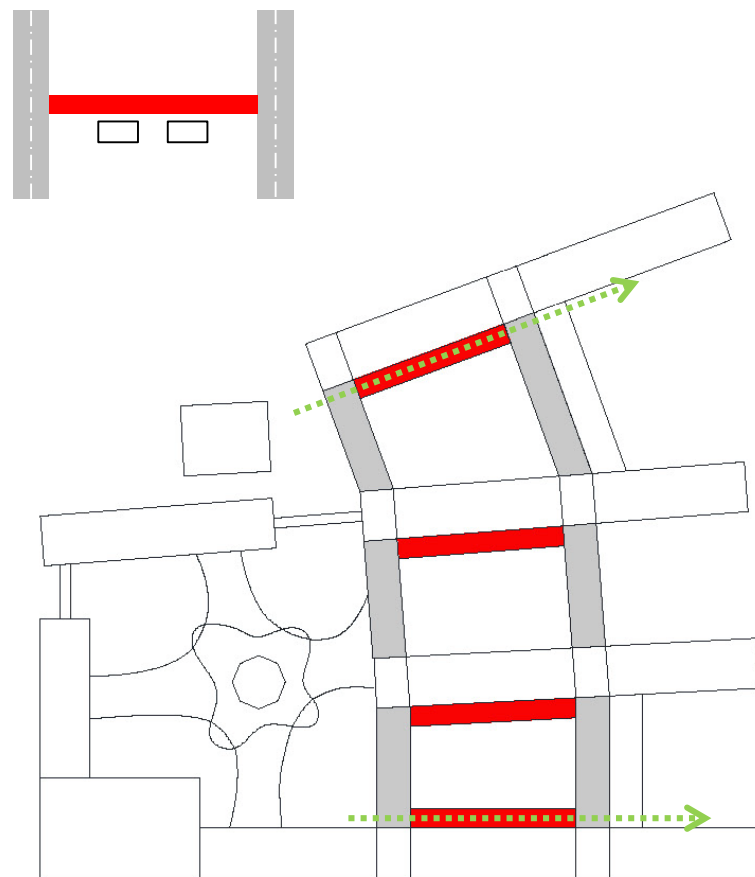
Four types of street

The 'I-shaped' street has a broad eye view over the main traffic road, without a main focus of eyesight. The 'T-shaped' street has a strong direction, with a focus of a building on the endpoint. The 'L-shaped' street has a enclosed eye view, with a focus of a wall on the endpoint. The 'broken-line shaped' street extends the space, with eye focus on every turning point of the street.

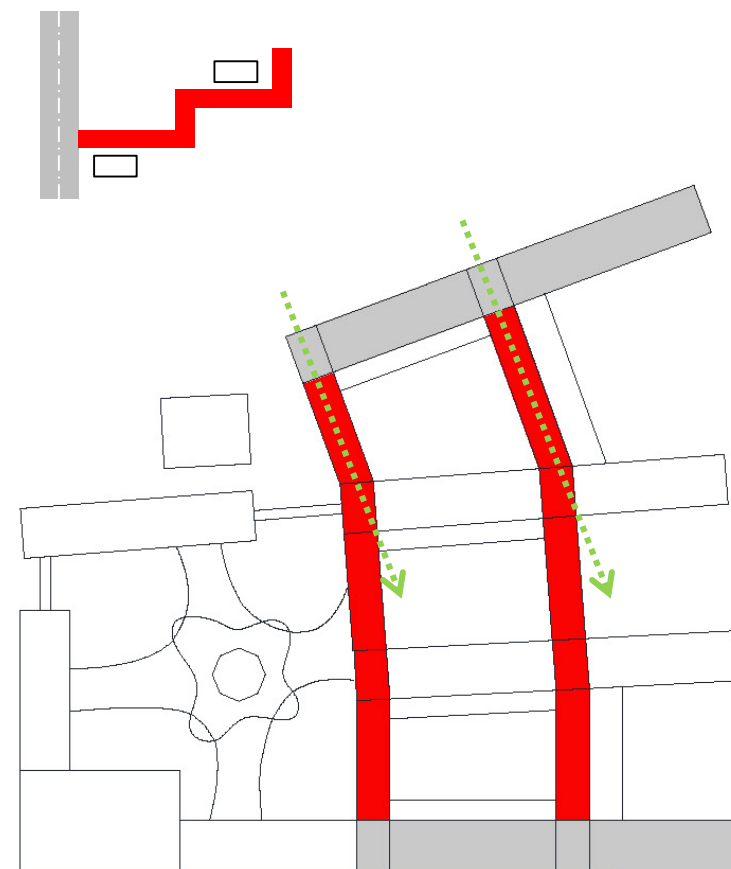
APPENDIX

Conceptual proposal: Street in hospital

The 'I-shaped' street in hospital offers a broad over view to the courtyard. The 'broken-line shaped' street extends the space, with a eye focus on the courtyard at the endpoint. These streets not only have good relationship with the nature, but also beneficial for easy way finding.



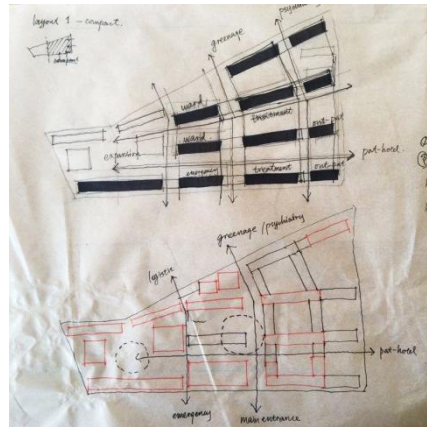
I-shaped corridors in hospital



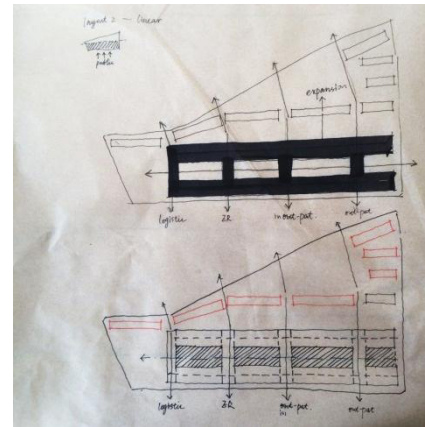
Broken-line shaped corridors in hospital

APPENDIX

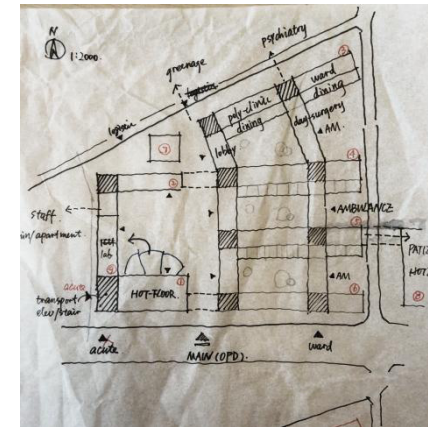
Conceptual proposal: Sketches



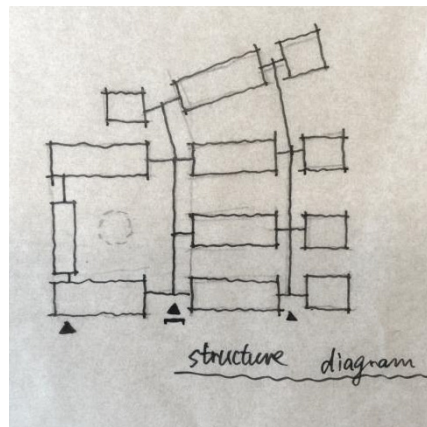
2015.04.05. Conception of Master plan A



2015.04.05 Conception of Master plan B

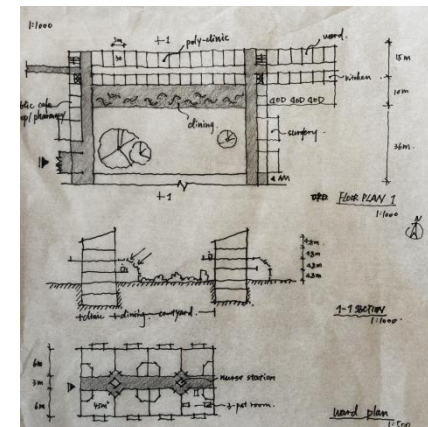


2015.04.20 Hospital organization

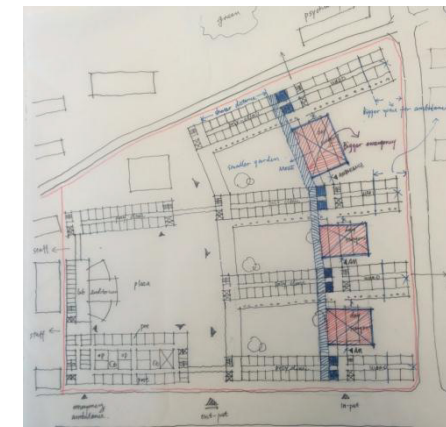


2015.04.20 Hospital structure and flow

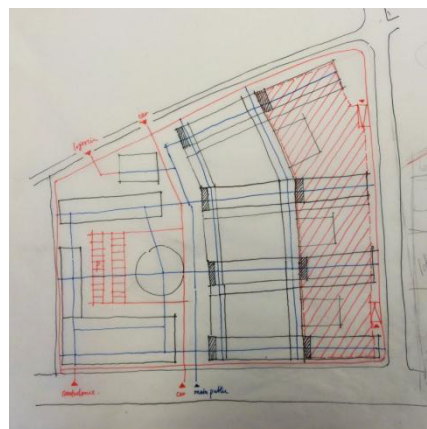
Site Plan



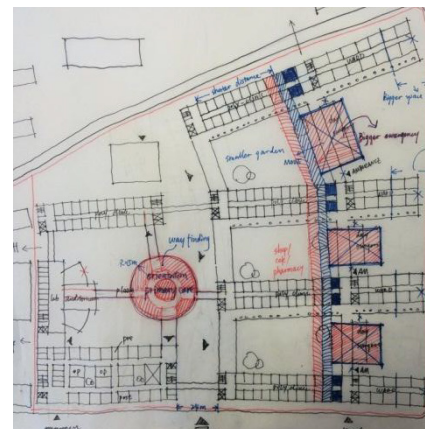
2015.04.20 Clinical center



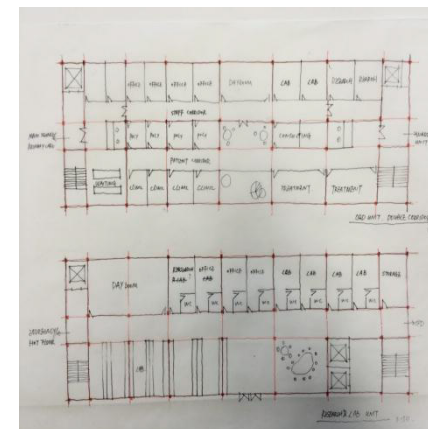
2015.04.28 Development of floor plan



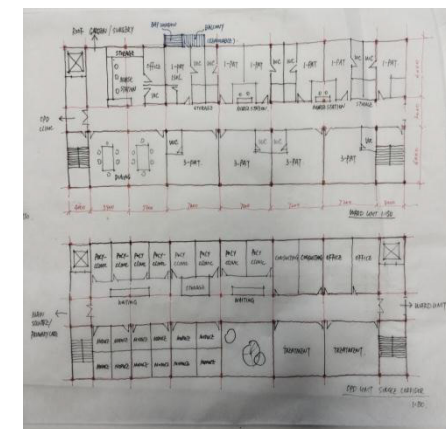
2015.04.28 Logistics and car parking



2015.04.28 Add a central orientation



2015.05.04 Flexible room arrangement



2015.05.04 Flexible room arrangement