

# Evidence-based Design of Naturalized Decoration in HSCT Wards of Peking University First Hospital

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**Abstract** In this study, the evidence-based design (EBD) of naturalized decoration in hematopoietic stem cell transplantation (HSCT) wards of Peking University First Hospital was explored to improve patients' psychological state and rehabilitation environment by introducing natural elements. Based on questionnaire surveys and literature research, the EBD method was adopted to propose a naturalized decoration scheme for HSCT wards, and a satisfaction evaluation was conducted after construction and use. The research results show that naturalized decoration can effectively enhance the satisfaction and comfort of patients and medical staff, verifying its positive effects in HSCT wards.

**Keywords** Naturalized decoration, Evidence-based design, HSCT wards, Patient rehabilitation, Satisfaction evaluation

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Since the 1980s, researchers have focused on the impact of the hospital physical environment on patients' recovery and medical staff's performance<sup>[1]</sup>. Several studies have shown that the design of the hospital environment can significantly affect the treatment outcomes and psychological state of patients. Evidence-based design (EBD) is the process of making decisions about the built environment based on credible research to achieve the best results. The expected results of EBD include promoting patients' rehabilitation, improving patients' experience and comfort, and enhancing the performance and job satisfaction of medical staff<sup>[2]</sup>. As healthcare systems strive to enhance patients' experience, improve health outcomes, reduce costs, and improve employee work and lives, evidence-based design is gaining popularity. Although evidence-based design is widely recognized, there are still gaps in research, especially in the specific hospital environment and medical staff, and more design practices are needed to verify its effects.

Through the introduction of natural elements, natural landscape images, natural sounds and other ways, naturalized decoration aims to provide patients with positive visual and sensory stimulation, thereby reducing their stress, anxiety and pain and promoting the rehabilitation process. Studies have shown that patients who seek medical treatment in a natural scene or environment tend to recover more quickly from surgery and other medical procedures. Exposure to natural elements such as natural scenery or the use of natural materials such as wood can greatly reduce stress and improve the mood of patients

and staff. This approach, known as biophilic design, allows people to reconnect with nature, and nature has been shown to reduce stress and pain and improve mood and concentration<sup>[3-5]</sup>.

Hematopoietic stem cell transplantation (HSCT) is the most effective method for the treatment of malignant diseases of the hematological system, but the risk of infection during the treatment is high, and patients usually need to stay in a sterile laminar flow ward for at least 30 days. This kind of long-term isolation treatment environment is easy to aggravate the psychological burden of patients and affect their rehabilitation process. In the architectural design of HSCT wards, it is recommended to fully incorporate natural elements<sup>[6]</sup>. To optimize the design of HSCT wards, especially to improve the psychological state of patients through naturalized decoration, is a problem worth studying.

## 1 Steps of evidence-based design

In 2024, a study was conducted on the preference of naturalized decoration in the HSCT wards of Peking University First Hospital<sup>[7]</sup>. On the basis of this study, literature research was carried out further, and combined with these results, the naturalized decoration design of the wards was conducted. Besides, construction and post-use satisfaction were evaluated to achieve evidence-based design. The steps of evidence-based design are shown in Fig.1.

The whole evidence-based design process, a cyclic iterative dynamic process, emphasizes the combination of scientific evidence and practical

application to achieve the best design effect.

## 2 Evidence-based design scheme

### 2.1 Basis of the design scheme

**2.1.1** Design basis based on the results of the questionnaire survey on the demand. Based on the results of the previous questionnaire survey on the demand for naturalized decoration<sup>[7]</sup>, the following design considerations are made:

(1) The naturalized decoration theme of HSCT wards of Peking University First Hospital was determined to be "living in the sun", while "secret forests" and "quiet gardens" were considered.

(2) Naturalized decoration mainly gives people "sense of hope" and "vitality". The results of cross-analysis show that patients and nurses could prefer "sense of hope" and "warmth and comfort".

(3) In terms of natural types, "plant landscape", "forest landscape" and "waterfront landscape" can be given priority to, while animal landscape has the lowest preference, so it is not recommended. The results of cross analysis show that patients preferred meteorological climate and plant landscape, and family members and nurses preferred pastoral landscape, while doctors preferred hydrologic landscape. That is, the space of patients should be decorated with plants with flowers and fruits; the space of family members and nurses should be decorated with terraced fields, wheat fields and other pastoral scenery; the space of doctors can be decorated with hydrological landscape such as rivers, lakes and seas.

(4) According to the results of the questionnaire survey, "the entrance corridor" and "corridor of an outside ward (the area from bed 1 to 8)" were given priority in decorative areas, followed by "the public activity area in the outside southeast corner". "Walls", "windows, windowsills, curtains, bed partition curtains" and "ceilings" can be decorated.

(5) For the presentation of naturalized decoration, according to the results of the questionnaire survey, the subjects preferred "fresco or wall painting, and furniture stickers", and "picture frame", "curtains, curtains, sheets, and towels in natural style" can be considered.

(6) The theme color of the decoration can give priority to fresh and elegant colors such as white and green, and the sound of nature can be a quiet and peaceful sound such as the sound of "leaves and bamboo rustle", "wind" and "water". The smell of natural breath can be "the fragrance of flowers" and "the smell of grass".

**2.1.2 Design basis based on IPA analysis results.** According to the results of the questionnaire survey, the IPA analysis quadrant diagram (Fig.2) was made. As shown in Fig.2, the first quadrant (upper right corner) is the high importance-high satisfaction zone, and the indicators in this quadrant only need to maintain the current advantages. The second quadrant (upper left corner) is the high importance-low satisfaction zone, and the indicators in this quadrant can be

appropriately reduced in input. The third quadrant (lower left corner) is the low importance-low satisfaction zone, and the indicators in this quadrant do not need to be listed as priority improvement projects. The fourth quadrant (lower right corner) is the high importance-low satisfaction zone, and the indicators in this quadrant have a high demand for improvement, and need to be prioritized for improvement.

In the fourth quadrant, according to the comprehensive practical consideration, the most suitable indicators for the scheme design and construction were finally selected, including the environmental visual experience of visiting corridors and external windowsills of inside wards, the overall visual experience of the internal environment of inside wards, the environmental color of inside wards, the environmental visual experience of nurses' lounges, and the environmental visual experience of doctors' lounges.

The reasons for not selecting the other indicators are as follows: since the hospital has standards for the ward environment, naturalized decoration is not suitable for outside wards, and there is no suitable area for decoration in the wards. Due to the need for strict aseptic environment, inside wards are not suitable for naturalized decoration related to hearing, smell and touch. The users of outside demonstration classrooms are mostly medical staff, while the

main object of this evidence-based design is patients, and the daily use rate of demonstration classrooms is not high, so naturalized decoration is not suitable for outside demonstration classrooms. Due to the large number of doctors' work materials and equipment, there is no suitable area for decoration in outside doctors' offices and nurses' stations.

**2.1.3 Design considerations based on the current situation of the hospital.** According to the IPA analysis quadrant diagram and the area that can be decorated on site, it is found that decoration design is also suitable for the corridor and the public space in the southeast corner of an outside ward. For the subjects, their importance was not high, and their satisfaction was high, but the field investigation shows that the daily traffic of the two places was higher, and the decoration environment can be better. Therefore, these two areas are also selected for naturalized decoration design.

**2.2 Design strategies**

Based on the analysis of the current situation, existing results of the questionnaire survey<sup>[7]</sup>, and literature research, the following design strategies are obtained for the naturalized decoration scheme of HSCT wards of Peking University First Hospital:

(1) During the design, natural elements should be integrated into the ward environment, such as enhancing patients' comfort and

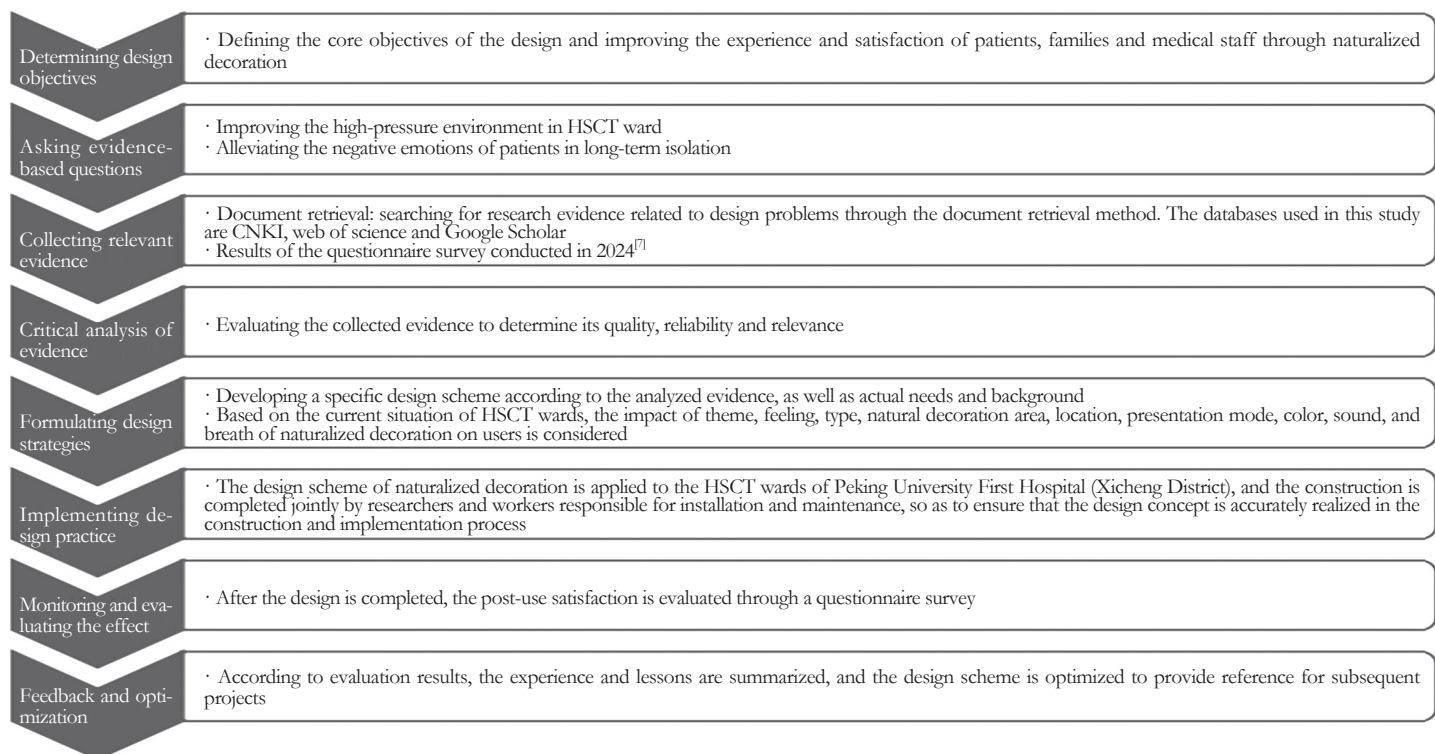


Fig.1 Steps of evidence-based design

relieving their stress by indoor plants and natural landscape mapping.

(2) The choice of colors and materials has a significant impact on the psychological and physiological feelings of patients. Gentle, comfortable colors and natural materials should be used to create a sense of intimacy and healing.

(3) Naturalized decoration should consider the maximum use of natural light to create soft, non-dazzling light, reduce the visual fatigue of patients, and give patients a sense of hope.

(4) In order to reduce the impact of noise on patients, soundproof materials should be used, and sound absorption and isolation should be considered in the design to create a quiet healing environment.

(5) The wards are naturally decorated with art works, photography works and soft clothing to enhance the beauty and comfort of the space and stimulate the positive emotions of patients.

(6) Naturalized decoration design considers patients' emotional belonging and cultural identity, reflects local characteristics and culture

through design elements, and enhances patients' sense of belonging.

(7) Combined with the particularity of HSCT wards, the design of laminar flow wards should enable patients to expand their visual area in the established physical space, so as to improve the sense of space size and make them psychologically open.

(8) A visiting window is a special service area for patients in the cabins, and its natural decoration effect should be strengthened. As a result, patients can see the natural beauty and decoration outside the window while lying on the bed, and they are psychologically comfortable. The window can also become a platform for patients to communicate with relatives and friends.

**2.3 Design scheme and construction**

**2.3.1 Design scheme and construction based on IPA questionnaire results and requirements.** According to the results of the IPA questionnaire survey and the design basis of decoration requirements, visiting corridors, external windowsills of inside wards, inside wards, nurses'

lounges and doctors' lounges were selected for naturalized decoration design.

(1) Visiting corridors, and external windowsills of inside wards. According to the basis of decoration needs, the decoration theme was determined to be "living in the sun", "secret forests" and "quiet gardens". On the whole, it brings people a sense of hope and positive vitality, and the hanging pictures and stickers of plant landscape and forest landscape were selected to decorate them.

From the on-site survey results, it is found that the entrance of a visiting corridor is dim, and the corridor is narrow (Fig.3). Hence, hanging pictures with a more sunny and energetic theme should be added here to adjust the environment of the visiting corridor. At the same time, there are four power distribution box panels and a light switch on the wall of the external windowsill (Fig.4), so the method of beautifying the factors or naturalized decoration was adopted. In addition, some family members would write encouraging words on the wall with a pen when com-

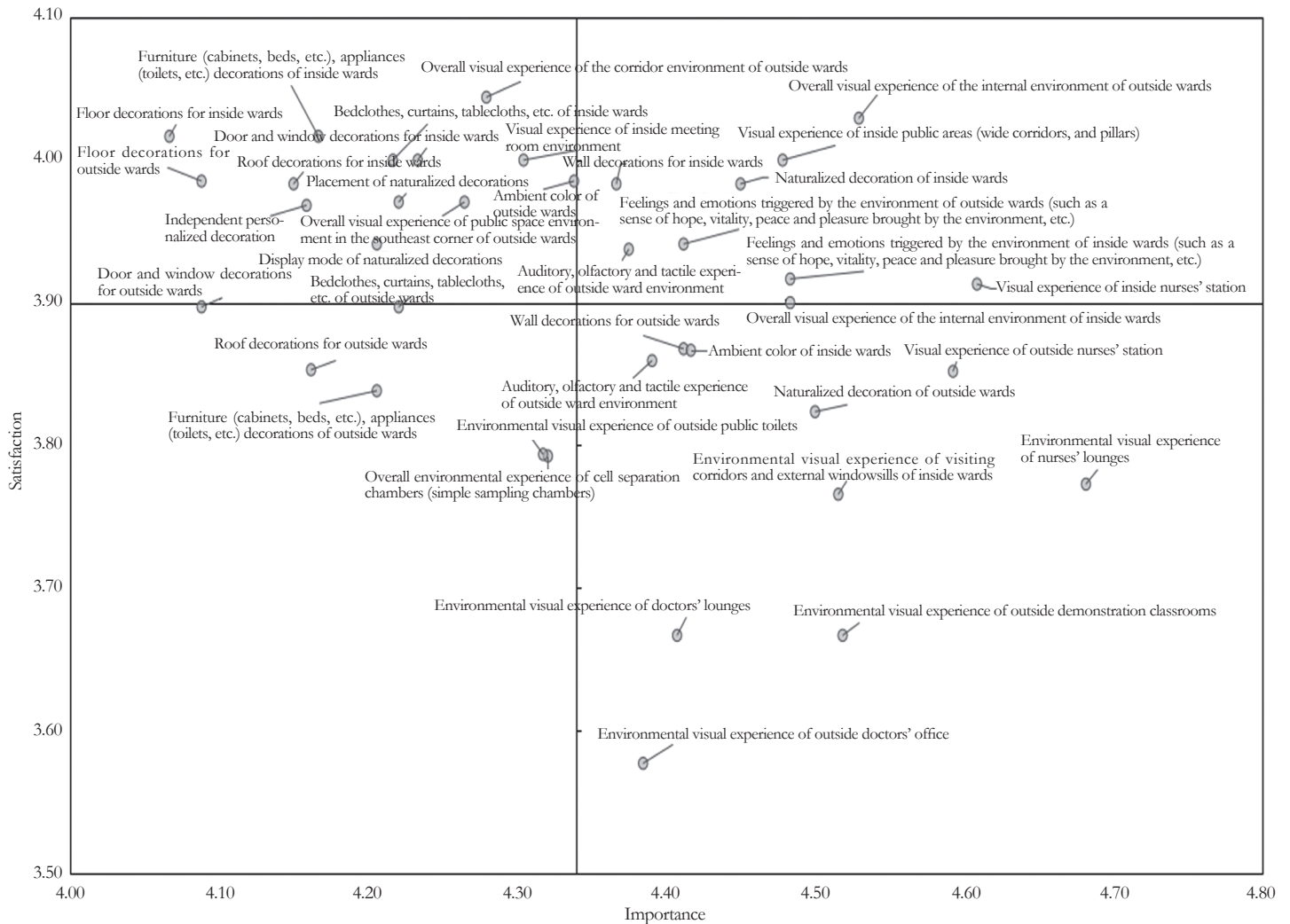


Fig.2 IPA analysis quadrant diagram

municating with patients through the visiting window. Therefore, according to this demand, a magnetic white board was added on one wall of the windowsill for family members to leave messages, and the white board should be combined with naturalized decoration to make it have natural elements. The construction drawing and decoration effect of the area are shown in Fig.5 and Fig.6.

(2) Inside wards. According to the on-site investigation results, it is found that the area of an inside ward is not large, and there are few areas for decoration; the light is dim, and only one visiting window is used to obtain light (Fig.7). Moreover, inside wards have strict requirements on the environment, and needs to achieve the effect of sterility, so the presentation mode and materials of decoration need to be strictly controlled. Desktop stickers that are easy to clean and disinfect and not easy to carry viruses should be chosen, and after comprehensive consideration, the desktop of a tray table is the best place to decorate. According to the basis of decoration needs, the decoration theme was determined to be “living in the sun”, and a sunflower desktop sticker was chosen to bring a sense of hope. The decoration effect is shown in Fig.8.

(3) Nurses’ lounges, and doctors’ lounges. According to the on-site survey results, it is found that there were more items in the lounges and fewer areas for decoration. Meanwhile, the buildings outside the windows of the lounges are relatively close, and the scenery outside the windows is blocked by the buildings, so the overall environment is not beautiful (Fig.9), which is easy to have adverse effects on patients’ psychology. Therefore, the windows are naturally decorated with stickers, and the plant theme was chosen to bring a sense of hope and vitality. The construction drawing and decoration effect of the area are shown in Fig.10 and Fig.11.

2.3.2 Design scheme and construction based

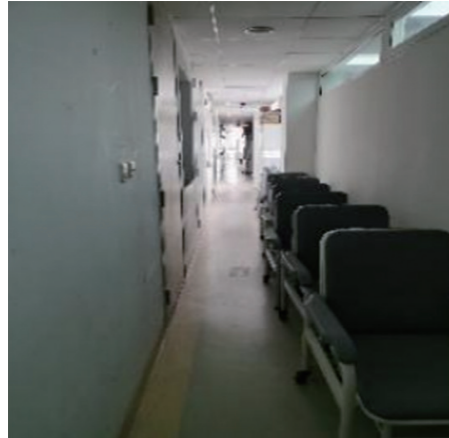


Fig.3 Narrow corridor



Fig.4 Current wall

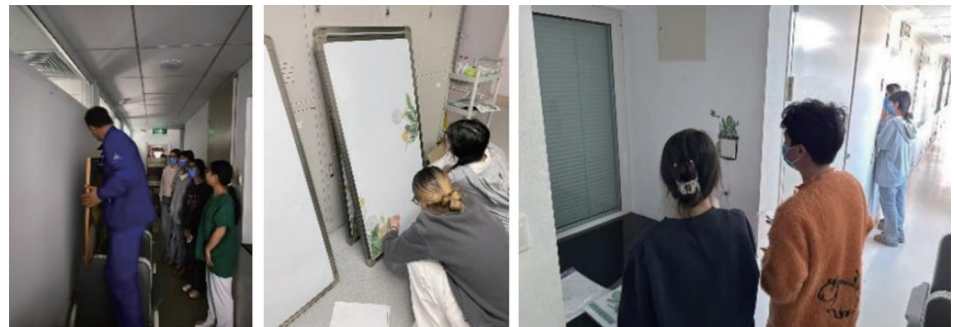


Fig.5 Construction site

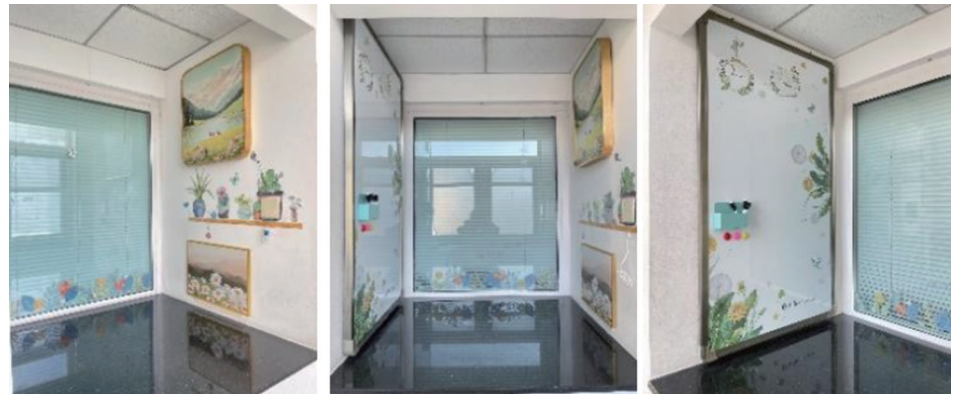


Fig.6 Decoration effect

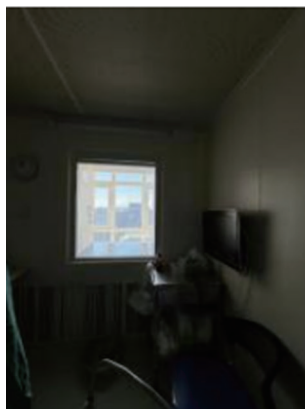


Fig.7 Dimly lit room



Fig.8 Decoration effect

on the current situation and demands of the hospital. According to the current situation of the hospital and the design basis of decoration needs, the corridor and the public space in the southeast corner of an outside ward were selected for naturalized decoration design.

(1) Corridor of an outside ward. According to the on-site survey results, it is found that there is a large vacant white wall in the corridor (Fig.12), and there are many patients and medical staff passing through this area every day. Therefore, naturalized decoration design should be conducted here. According to the requirements of decoration, the theme of decoration is determined to be “living in the sun”. A large area of sunflower stickers, as well as slogans with encouraging and positive nature, are used to bring people a sense of hope and vitality. The construction drawing and decoration effect of the area are shown in Fig.13 and Fig.14.

(2) Public space in the southeast corner of an outside ward. According to the field investigation results, it is found that the wall decoration of the public space in the southeast corner of an outside ward is simple and plain, and more patients and staff take a rest here every day (Fig.15), so the wall is naturally decorated finally. In terms of decorative theme, the theme of “living in the sun” with the highest preference of the subjects was selected. Since the demand for the sterility of the environment

is not too high here, hanging pictures and natural decorative ornaments and pendants, such as sunflower clocks, vases and miniature plant ornaments and hanging pictures, were used for

decoration, which enhances the interaction of the decoration on the basis of the original status quo. The construction drawing and decoration effect of the area are shown in Fig.16 and Fig.17.



Fig.9 The current environment

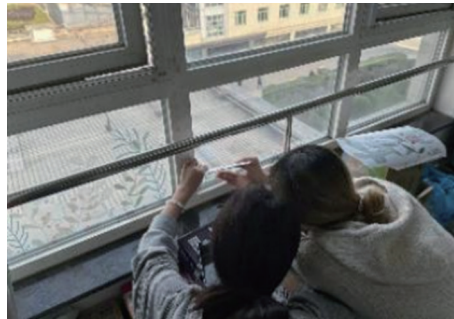


Fig.10 Construction site



Fig.11 Decoration effect

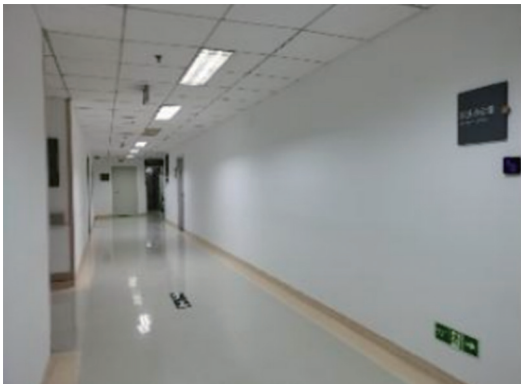


Fig.12 Current environment



Fig.13 Construction site



Fig.14 Decoration effect

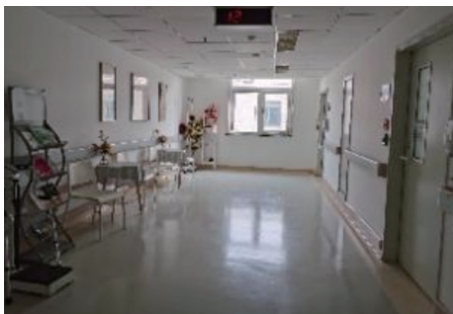


Fig.15 Current environment



Fig.16 Construction site



Fig.17 Decoration effect

## 2.4 Evaluation of post-design satisfaction

After the completion of the naturalized decoration construction, the post-test questionnaire was issued, and the post-use satisfaction was evaluated. 37 valid questionnaires were collected. In the evaluation of the satisfaction of the environment after decoration, the number of patients who are “very satisfied” is 23, and the number of patient who are “satisfied” is 8; 3 patients feel that the environment after decoration is “general”, and 1 patient is “somewhat dissatisfied”, while 2 patients are “very dissatisfied”. For the evaluation of the satisfaction of the specific decoration effect, 23 patients are satisfied with the “overall visual experience of the wards”, and 16 patients are satisfied with the “natural decoration in the wards”. 15 patients are satisfied with the “walls, roofs, floors, door and window decorations”, and 13 patients are satisfied with the “environmental color”. The number of patients who are satisfied with the “feelings and emotions triggered by the environment (such as hope, vitality, peace and pleasure brought by the environment)” is 13, and the number of patients who are satisfied with the “hearing, smell and touch experience of the wall ward environment” is 5, while the number of patients who are satisfied with the “placement and display of natural ornaments” is 11.

As for the subsequent improvement of the ward environment, two patients hope to increase the number of green plants, and one patients proposes that the number of science books on the shelves of the wards is small. One hopes to reduce the frequent visits of staff, and a small window can be installed to dispense medication.

## 3 Conclusions

(1) The remarkable effect of naturalized decoration. The naturalized decoration design and satisfaction after the construction of HSCT wards of Peking University First Hospital were

evaluated, and the results show that naturalized decoration has a significant effect on improving the psychological state and rehabilitation environment of patients. Specifically, the introduction of decorative themes such as “living in the sun” and “secret forests” and other plants and natural landscape could effectively enhance patients’ sense of hope, vitality and overall mood. Most patients and medical staff are satisfied with the visual experience after decoration, environmental color and positive emotions aroused, and especially the overall visual experience of the wards is highly recognized by 23 patients.

(2) The effectiveness of design strategies. Based on evidence-based design (EBD) method, questionnaire survey, literature research and field investigation, scientific and reasonable strategies for naturalized decoration design were put forward. For instance, appropriate decorative themes, materials and presentation, such as easy-to-clean stickers and nature-themed hanging pictures, can be used to meet the requirements of a sterile environment, create a quiet, comfortable healing environment and give people a sense of hope and vitality. These strategies are proved to be effective and feasible in practical application.

(3) Determination of priority improvement areas. Through IPA analysis and on-site investigation, areas that are prioritized for naturalized decoration were determined, including visiting corridors, external windowsills of inside wards, inside wards, nurses’ lounges and doctors’ lounges. These areas have a high usage rate and human flow, so their decorative effect has a significant effect on the psychology of patients and medical staff. The pictures of decoration effect show that the naturalized decoration of these areas significantly improves the beauty and comfort of the environment, and verifies the scientificity and practicality of the design scheme.

Future research directions. Although the study validates the positive role of naturalized

decoration in HSCT wards, there are still some aspects that deserve further exploration. For example, the combination of more sensory experiences, such as the introduction of natural sounds and smells, can be considered to further enhance patients’ healing environment. Besides, the evaluation of long-term effects and application in different hospital environments are also important directions for future research. Through continuous research and practice, naturalized decoration design will bring well-being to more patients and medical staff, and provide more empirical evidence and design strategies for hospital environment design.

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