

Development and Evaluation of a Patient Garment Based on Functional-Modesty-Aesthetic (FMA) Model

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Helen S. Koo · Seoha Min*

Dept. of Design, University of California, Davis, USA

Dept. of Consumer, Apparel, and Retail Studies, The University of North Carolina at Greensboro, USA*

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Abstract Recent research suggested that hospitals have not responded to consumer demand for the improved aesthetic and comfort of their patient garments. Thus a new patient garment has been developed considering human factors based on the Functional-Modesty-Aesthetics model. Based on the reviewed literature and the model, necessary design requirements were identified. Then the patient garment was evaluated in comparison to existing ones with regard to potential patients' satisfaction levels. As a result, the developed patient garment received better evaluations in the aspects of overall aesthetic satisfaction, color satisfaction, and willingness to wear than the existing patient garments.

Key words design, healthcare, patient garment, and human factors

Introduction

Over the last half-century, member countries of the Organization for Economic Co-operation and Development (OECD) have experienced significant ageing of their populations, which results in increased age-related expenditure in the GDP, in particular for healthcare (Casey, et al., 2003). According to IBIS World (Carter, 2014), the hospital apparel manufacturing industry has grown at a modest 1.5% per year on average during the last five years with revenue of \$620 million.

Despite the increasing demand for patient garments, recent research suggests that traditional patient garments have not been suited to consumer demands (Chung et al., 2010; Chung & Lee, 2010; Jha, 2009). Thus, a number of researches have been conducted to investigate which aspects of the existing patient garment cause this dissatisfaction. In patient garment design, aesthetic aspects and psychological comfort have not been considered the primary concerns. However, the most common patient complaints regarding such garments, particularly among women, were related to the aesthetic aspects (Chung & Lee, 2010; Chung et al., 2010). Aesthetics were considered to be of importance in this new patient garment design, allowing the wearer of the garment to feel cheerful and ultimately creating a synergy that supports treatment.

In this regard, the purpose of the current research was to develop a new patient garment that considers human factors in terms of psychological comforts and visual systems and to evaluate the new garment in comparison to existing ones with regard to potential patients' satisfaction levels. This research is expected to be helpful for patients and caregivers in hospitals. The results also might provide ideas to apparel manufacturers and designers about the human factors of their products.

Literature Review

Aspects of Existing Patient Garments Require Improvement

A number of researchers have explored the design criteria for a patient garment (Cho, 2006; Gordon & Guttman, 2013). Cho (2006) studied the design of hospital garments through a review of previous research and interviews with licensed practical nurses and patients. She identified three factors that affect the perception of comfort of patient garments: their functional, physiological, and psychological aspects. For access to users' comfort perceptions, she developed seven items for each category, for a total of 21 items. Cho's (2006) evaluation items can be categorized into 10 main aspects. The functional comfort category includes accommodation of activities, easy reach of fasteners, and ease of donning and doffing. Physiological comfort consists of sensorial comfort, thermal comfort, and fit and fabric weight. Psychological comfort contains aesthetic/expressiveness, satisfaction, suitability for daily life in the hospital, and privacy and dignity. Likewise, Gordon & Guttman (2013) developed five hospital gown requirements: modesty and self-esteem, ease of use for patients, ease of use for staff, laundering and manufacturing, and lifecycle and cost. Then, they developed a new hospital garment that achieved all the requirements. Even though patient garments that satisfy the design considerations and requirements were developed, a number of researchers have still indicated that the functional, modest, and aesthetic aspects of patient garments have not been satisfied.

In terms of the functional aspects of patient garments, researchers have indicated that there is dissatisfaction with patient garments from both patients' and caregivers' perspectives (Chung et al., 2010; Chung & Lee, 2010; Jha, 2009; Park, 2014). For patients, the stiffness of the fabric and the limited number of sizes were the main complaints. Size dissatisfaction was expressed strongly by females (Chung et al., 2010). Edvardsson (2009) also indicated that the traditional patient garment was mainly shabby, worn out, and ill fitting. From caregivers' perspective, Jha (2009) indicated that patient garments have been designed focusing on the needs of the patient alone. Jha (2009) found that the traditional patient garment did not meet the accessibility and functionality needs of caregivers. According to her, caregivers want a patient garment that provides ease of access to the patient's body, ease of donning and doffing, and functionality that would aid them in administering medical care (Jha, 2009). Park (2014) considered the importance of universal design for patient garments and conducted focus group interviews to redesign patient garments about redesigned patient garments.

Modesty is also a critical factor for a patient garment. Jha (2009) indicated that when patients wear a hospital garment, they want modesty. Edvardsson (2008) explored how patients perceive their pa-

tient garments in a hospital setting and found that patients associate wearing a patient garment with being depersonalized, stigmatized, and devitalized (Edvardsson, 2008). Also, patients tend to be vulnerable to a loss of dignity in the hospital environment, which is influenced by patient garments (Baillie, 2008). Thus, it is important to design patient garments that promote wearers' dignity and secure their modesty.

In addition, the most common patient complaints regarding such garments, particularly among women, were related to aesthetics (Chung & Lee, 2010; Chung et al., 2010). In particular, Chung et al. (2010) indicated that the cheerless color of such garments was the most common patient complaint. Also, they found that patients prefer to wear aesthetically attractive patient garments. Aesthetics were considered to be of importance in new patient garment designs, allowing the wearer of the garment to feel cheerful and ultimately creating a synergy that supports treatment.

Functional Expressive Aesthetic (FEA) and Functional Modesty Aesthetic (FMA) Models

Lamb and Kallal's (1992) Functional Expressive Aesthetic (FEA) model was considered to improve the design process by expanding the considerations made in the analysis and evaluation phases. Looking at the functional, expressive, and aesthetic needs for each design problem enabled designers to think beyond commonly accepted definitions of wearer needs. In this study, a new design model was developed to design a patient garment that solved the problems addressed by researchers. The newly developed model is the Functional Modesty Aesthetic (FMA) model (Figure 1). Consumer needs can be met by determining their functional, expressive, and aesthetic requirements. The functional aspect includes fit, mobility, comfort, ease of care, and ease of donning and doffing, while the expressive aspect consists of values, roles, status, and self-esteem, and the aesthetic aspect involves art elements, design principles, and body-garment relationships. The elements in the three categories are applied to the developed model, but the specific elements are modified to fit a patient garment. A professional nurse was invited as an expert consultant to guide the design process and conducted an in-depth interview that included experiences with patients and patient garments. The interview lasted approximately 2 hours and was conducted in a natural setting before the researchers actually redesigned the patient garment. The nurse's feedback was actively reflected to the new patient garment design. The nurse was asked the following: (a) Please describe your experience with the existing patient garment; (b) If you have experienced any issues with the existing patient garment, please describe them; (c) Have you witnessed any issues with the existing patient garment from patients' perspectives? If so, please describe them; (d) What aspects of the existing patient garment can be improved?; and (e) Please give us feedback on the new patient garment design. It was found that patients were not comfortable with expressing their personality or identity in a hospital setting, so we decided to replace "expressiveness" with "modesty." Design requirements for a patient garment were developed based on the reviewed literature (Table 1). Then a patient garment that achieved all the design requirements was designed.

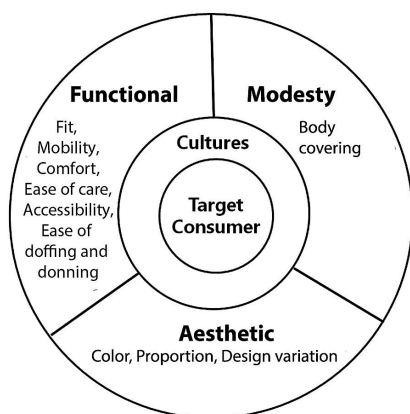


Figure 1.
Functional-Modesty-Aesthetic (FMA) Model for Patient Garments (Koo & Min, 2014)

Table 1.
Design Requirements for the Patient Garment Development

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| <p><Functional></p> <ol style="list-style-type: none"> Fit: Garment can fit a wide range of body sizes (Baillie, 2010). Mobility: Easy to hold or carry patients in an emergency (Jha, 2009). Comfort: a) <i>Thermal comfort</i> – The garment suits the changes of a patient’s body temperature (Chung et al., 2010; Jeong & Tokura, 1991; Verheyen et al., 2011); and b) <i>skin comfort</i> – The garment textiles and other details do not irritate the patient’s skin (Edvardsson, 2009) Ease of care: The garment is easy to wash and prevents from secondary infection (Fijan & Turk, 2012; Tammelin et al., 2012). Accessibility: The garment provides easy access to the patient’s body when receiving medical treatment (Jha, 2009). Ease of doffing and donning: The garment is easy to put on and take off by patients and caregivers (Cho, 2006; Jha, 2009). Details and functions of garments need to be easily understood by patients. <p><Modesty></p> <ol style="list-style-type: none"> Covering body: The garment prevent from revealing patients’ body (Cho, 2006; Leach et al., 2013). <p><Aesthetic></p> <ol style="list-style-type: none"> Color: The colors are pleasing and harmonious; colors do not stimulate the eye and improve the patient’s mood (Eiseman, 2006; Chung et al., 2010; Kurt & Osueke, 2014; Merry & Mayer, 1996). Proportion: The garment proportions improve the wearer’s aesthetic satisfaction (Chung & Lee, 2010; LaBat & DeLong, 1990). Design variation: The design provides flexibility in satisfying a wide range of the patient’s characteristics (Chung et al., 2010). |
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Method

To achieve the research purpose, two researchers were involved to develop and evaluate a patient garment under the guidance of a medical expert, and they took a year to finish this project. Based on the Functional Expressive Aesthetic model, necessary design requirements were identified, and a patient garment was designed. Then the researchers assessed the patient garment for whether it achieved the design requirement.

In this study, there were 154 participants (age: $m=33.4$, $SD=11.3$, range 18-79): 77 men and 77 women who had been hospitalized in the last three years participated in the image survey through Mechanical Turk, an online website where users volunteer to participate in human-intelligence tasks (www.mturk.com). Through the survey, the newly developed patient garment was compared to existing patient garments in the top three hospitals on *U.S. News and World Reports'* list of the best U.S. hospitals (Leonard, 2014). Participants were asked to answer 16 questions in the following categories: (a) 2 demographic questions (age and gender); (b) 3 hospitalization questions (periods of hospitalization, satisfaction or dissatisfaction with patient garment); (c) 5 open-ended questions regarding the newly developed patient garment; and (d) 6 questions regarding function, modesty, and aesthetic satisfaction regarding the newly developed and the existing three patient garments using a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree). Since the online survey focused on visual evaluations, the 6 survey questions consisted of: (a) If I am a patient and wear the garment, its design make me comfortable psychologically; (b) When I look at the garment, I can easily understand how to put it on and take it off; (c) The garment design can prevent me from revealing my body; (d) I am satisfied with the garment aesthetically; (e) The color of the garment is visually pleasing and harmonious; and (f) I am willing to wear the patient garment during hospitalization.

Results and Discussion

Phase 1: Development of Patient Garments

Functionality. Fit. The most common patient complaint, particularly among women, was of the loose-fitting size of the patient garment (Chung & Lee, 2010; Chung et al., 2010). Since hospitals cannot afford to create garments based on patients' anthropometric and ergonomic factors, a garment designed to fit various body shapes and patient needs and situations was needed (Chung et al., 2010; Kim & Lee, 2011). The new design took this factor into consideration by allowing patients to modify the garment's size. Therefore, the size of the patient garment can be modified using two strings depending on the wearer's torso (Figure 2). The pants are also adjustable; the waistband was created with a one-touch hook, loop fasteners, and an elastic band. Thus, users can change the waist size for a better fit (Figure 2). Also, there is a string on the side seam of the pants, so patients can easily adjust the length of the pants with the string, depending on the situation, while preventing skin compression.

Mobility. The design of the garment helps patients to be comfortable when moving with their medical equipment. A pocket at the stomach area is designed for easy access (Figure 2). The pocket is for

carrying devices such as a urination pocket, monitoring equipment, or even a personal item such as a cell phone. Also, to be able to move patients, the garment should not hinder holding or carrying patients in an emergency. Details on the shoulders and ankles can be helpful for lifting and moving the patient between different beds or wheelchairs.

Comfort. Thermal comfort. Maintaining body temperature constantly is an important factor for patients' rehabilitation (Jeong & Tokura, 1991). The garment needs to suit the changes of a patient's body temperature. According to Tyler, Wild, and Sunderland (2010), the neck part without collars can affect body cooling, which can affect the wearer's thermal comforts. Thus, a detachable collar was designed so that patients can attach or detach it based on their body temperature. Also, patients can adjust the length of the garment's arms and legs according to their preference (Verheyen et al., 2011).

Skin comfort. The garment's textiles and other details should not irritate the patient's skin. The garment is made of comfortable and soft cotton textiles to prevent rubbing against the skin. The details of the garment, including all parts that contact the skin, are also made of this fabric.

Ease of care. According to IBISWorld (Carter, 2014), 69.8% of hospitals prefer disposable hospital apparel, and 21.1% prefer reusable apparel. It was also reported that hospitals are buying more reusable patient and surgical apparel that can be cleaned by a third party due to the increasing cost of waste disposal. To design the patient garment as reusable, several factors were considered. To protect the patient from secondary infection, the garment should be easy to wash, dry, and iron. Thus, it will require less laundering. The textile is made of 55% polyester and 45% cotton, which is easy to launder in various temperatures (Tammelin et al., 2012). With frequent washing, the closures, collars, and cuffs can be easily worn out. Therefore, closures are made with durable textiles and do not require special care. Detachable collars and cuffs, which can be easily worn out, allow for less laundry.

Accessibility. This patient garment design considered cognitive factors so that patients and staff can easily access areas that need treatment. There are several holes in the top and bottom of the garment, so users and staff can reach all parts of the body without trouble. The garment has holes in the seam lines that allow devices such as hoses, sensors, or injection needles to easily access the patient's body. Thus, it is easy to insert any hoses or sensors into the patient's body without taking off the garment.

Ease of doffing and donning. The garment needs to be easy to put on and taken off. The string fasteners on top are covered with two layers so that the patient's body will not be easily seen whenever he or she moves. The detachable collar is designed so patients can decide the width of the collar. The garment is made with one-touch fasteners and opens on the top of one side. Patients with bodily discomfort can easily put on and take off the garment. It is also easy to take off and put on in the restroom. The design took into consideration cognitive factors to improve accessibility for patients and non-professional staff. Green & Thorogood (1998) mentioned that hospitals are characterized by a heterogeneous mix of professional and non-professional staff. When designing the garment, the designer should keep the untrained staff in mind. Also, details that have specific functions need to be easily understood by users (Norman, 1998). When wearing the garment, patients should be able to make a cognitive map without complex processing. For example, the different colors and textured tips of the strings help the

patient understand the garment functions.

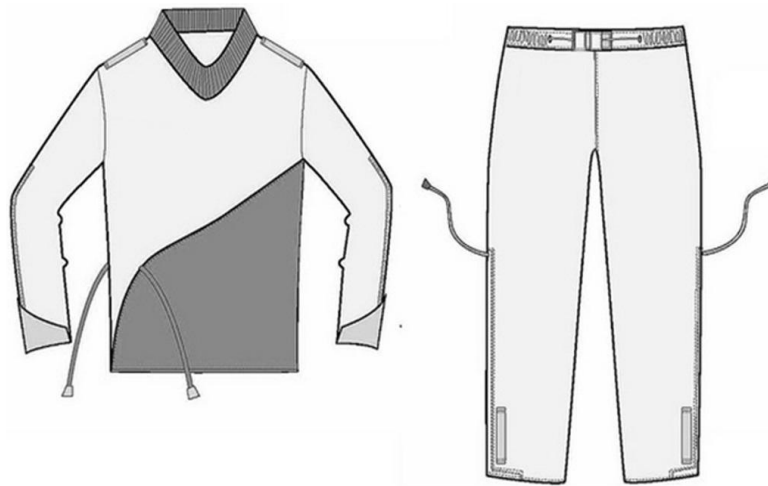
Modesty. Body covering. Medical experts noticed that the traditional patient garments without pants and back opening provide unnecessarily excessive exposure, which decreases the patient's dignity and can also cause emotional trauma from hospitalization (Baillie, 2009; Detsky & Krumhole, 2014; McDonald, Dounaevskaia, & Lee, 2014; Wellbery & Chan, 2014). McDonald, Dounaevskaia, and Lee (2014) suggested allowing patients to wear lower-body garments such as pants or allowing them to wear their own garments that satisfy their functional and aesthetic needs to respect the dignity of patients and improve patients' experiences of hospitalization (Doyle, 2014). When sleeping or lying in bed while wearing traditional patient garments, patients may have to cover their lower bodies, such as with blankets, or keep uncomfortable postures stressing their legs. Thus, the patient garment design consists of a top and a pant. This design can be added as an option for hospitals if they only have garments for people who prefer pants. The size of existing garments does not vary, so patients, especially females, find them too revealing—a loose neckline can reveal their busts. This situation may cause a sense of shame to patients and further deteriorate their health (Leash et al., 2013). This problem is solved by adding elastic fabric to the neckline. Due to the elasticity, patients do not need to worry about a loose neckline. Also, in the new design, the length of the back is longer than the front, which allows patients to move without constraints. The elastic collar hides patients' private parts, such as the breasts, when they lean forward, and the longer length of the back covers patients' private parts, such as the lower back and hips.

Aesthetic. Color. Aesthetics of patient garments are important design factors for patient satisfaction with hospital experiences; however, this has been often undervalued (Cho, 2006; Gordon & Guttman, 2013; Park, 2014). Recent research has found that satisfaction with patient garments was low regarding color, and the cheerless hue was the main complaint of patients (Chung et al., 2010). The color palette of the patient garment design consists of light emerald green, purple, and deep emerald green, providing emotional stability and cheerfulness for patients (Eiseman, 2006; Kurt & Osueke, 2014; Merry & Mayer, 1996). The garment uses a solid greenish shade as the main color and cheerful accents for visual comfort to both wearers and viewers (Merry & Mayer, 1996).

Proportion. Proportion is one of the most important elements for the wearer's satisfaction with a garment's aesthetic (LaBat & DeLong, 1990). The new garment was also designed considering proportions of the body, such as for the pocket location, neckline depth, and waistline for aesthetic attractiveness (Chung & Lee, 2010).

Design variation. The detachable collar was designed so patients can decide its width and fabric. Also, the detachable design provides unlimited possibilities for variation (Koo, Bye, & Dunne, 2013). The hospital can choose its preferred color options and designs that fit its logo and main patient characteristics. In addition, as for the volume of patient garments, the design needs to be economic for mass production and storage space. This will increase the adoption level of the patient garment by hospitals. There are no darts or pleats on the garment, and the size and fit are adjustable with strings. The garment is of a unisex design, so it has only one pattern, which can minimize the cost of production. The hospital does not need to count the number of male and female patients separately when

it purchases or reorders garments. Thus, the hospital can reduce the cost of categorizing garments based on the patient's gender and size and decrease the amount of decision-making effort. The modified Functional Modesty Aesthetic (FMA) model indicates important elements of the patient garment, and it is expected to be helpful for apparel designers when developing patient attire. Also, the FMA model has potential to be used as a checklist when evaluating patient garments.



2-1. Flat sketch of the design



2-2. Detail of the pocket



2-3. Details on the shoulders



2-4. String on the side seam of the pants

Figure 2.
Images of the Developed Patient Garment

Phase 2: Evaluation of the patient garment design

Satisfaction and dissatisfaction with extant patient garment. Participants were asked to share their satisfaction with patient garments in answer to the open-ended question, “When you were in the hospital, what were the most satisfying aspects of the patient garment?” The results were coded, important themes were extracted and categorized by main themes, and descriptive analysis was conducted. As a result, main themes were comfort (34.2%), ease of donning and doffing (14.8%), accessibility (10.1%), color (8.7%), fit (8.1%), ease of care (6.7%), portability (5.4%), body covering (4.7%), and others (7.3%), such as quality and reduced concern with what to wear. However, as for the question, “When you were in the hospital, what were the most dissatisfying aspects of the patient garment?” patients expressed dissatisfaction in terms of revealing the body (28.8%), not fit/too loose (11.3%), color (9.6%), difficult to wear and take off (9.6%), poor design (9%), uncomfortable (8.5%), cold (6.8%), itch (6.2%), and others (10.2%), such as not clean, bad smell, and movement limitations. These dissatisfactions with patient garments are similar to those found by Chung et al.’s (2010) research, which pointed out problems with comfort, fit, and aesthetic aspects of color.

Evaluation of developed patient garment. Descriptive and one-way ANOVA analyses were conducted to compare the newly developed patient garment with the extant patient garment designs in terms of function, modesty, and aesthetics. The developed patient garment was compared to existing patient garments in the top three hospitals (Leonard, 2014). The flat sketches of the patient garments of the three hospitals are presented in figure 3. In terms of one-way ANOVA analysis, the independent variable is the four different patient garments, including one newly developed and three existing patient garments, while the dependent variables are (a) psychological comfort, (b) ease of donning and doffing, (c) modesty, (d) overall aesthetic satisfaction, (e) color satisfaction, and (f) willingness to wear. The newly developed hospital patient garment showed significant differences from other patient garments and indicated higher scores than them in terms of overall aesthetic satisfaction, color satisfaction, and willingness to wear (Table 2). First, there was a significant effect of aesthetics on satisfaction at the $p<.00$ level among four patient garments, and the newly developed patient garment design received the highest score [$F(3, 612)=9.50, p=.000$]. Second, there was a significant effect of color on satisfaction at the $p<.05$ level among the four patient garments, and the developed patient garment design received the highest score [$F(3, 612) =2.70, p=.045$]. These findings indicate that the newly developed patient garment successfully addressed the aesthetic and color concerns which have been explored by the reviewed literature and the survey. In addition, participants were asked to score the four patient garments (from least preferred=1 to most preferred=7), and there was a significant difference among patient garments at the $p<.005$ level. The developed patient garment was selected as the one most preferred to wear when hospitalization [$F(3, 612)=4.95, p=.002$]. However, there is no significant effect on psychological comfort, ease of donning and doffing, and modesty. It appears that the participants may have been unable to evaluate the functional and modesty aspects of the patient garments shown in the survey; this needs to be considered in future research.

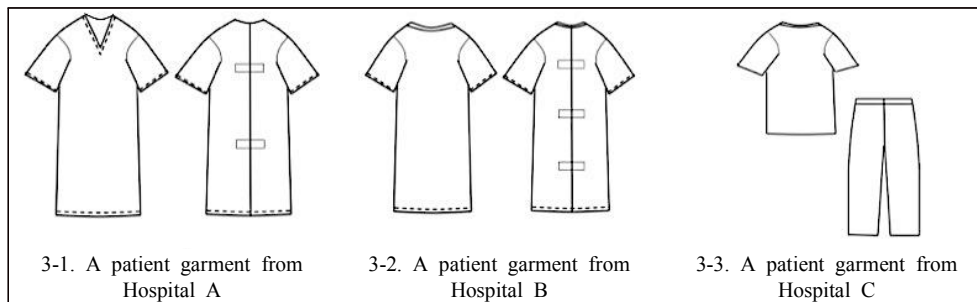


Figure 3.
Flat Sketches of the Existing Patient Garments from the Best U.S. Hospitals

Table 2.
Results of ANOVA Analysis

| Analysis | Patient garment | Mean | SD | F-value |
|--------------------------------|-------------------|--------------------|------|---------|
| Psychological comfort | Hospital A | 4.26 ^{ab} | 2.04 | 1.89 |
| | Hospital B | 4.17 ^a | 1.99 | |
| | Hospital C | 4.68 ^b | 1.86 | |
| | Developed garment | 4.46 ^{ab} | 2.23 | |
| Ease of donning and doffing | Hospital A | 5.07 ^a | 2.07 | 2.20 |
| | Hospital B | 5.42 ^a | 1.74 | |
| | Hospital C | 5.39 ^a | 1.63 | |
| | Developed garment | 4.97 ^a | 2.11 | |
| Modesty | Hospital A | 4.48 ^a | 1.24 | 1.39 |
| | Hospital B | 4.70 ^a | 1.27 | |
| | Hospital C | 4.86 ^a | 1.48 | |
| | Developed garment | 4.92 ^a | 1.42 | |
| Overall aesthetic satisfaction | Hospital A | 3.60 ^a | 2.25 | 9.50*** |
| | Hospital B | 3.58 ^a | 2.22 | |
| | Hospital C | 3.86 ^a | 2.14 | |
| | Developed garment | 4.73 ^b | 2.11 | |
| Color satisfaction | Hospital A | 4.42 ^{ab} | 2.12 | 2.70** |
| | Hospital B | 4.19 ^a | 2.04 | |
| | Hospital C | 4.47 ^{ab} | 2.03 | |
| | Developed garment | 4.83 ^b | 1.81 | |
| Willingness to wear | Hospital A | 3.81 ^a | 2.35 | 4.95** |
| | Hospital B | 3.70 ^a | 2.27 | |
| | Hospital C | 4.16 ^b | 2.13 | |
| | Developed garment | 4.07 ^b | 2.22 | |

Based on the post hoc comparisons using Duncan's test, which indicated the mean scores for overall aesthetic satisfaction, the new garment ($m=4.73$, $SD=2.11$) was significantly different than the three others. As for color satisfaction, the newly developed garment ($m=4.83$, $SD=1.81$) was significantly different from the garment of hospital B, and the garments of hospitals A and C were included to both groups. For willingness to wear, the newly developed garment ($m=4.59$, $SD=2.22$) and hospital C's garment were significantly different than the garments of hospitals A and B. Participants indicated they would prefer to wear pant-styled patient garments rather than gown-style garments during hospitalization.

Conclusion

A patient garment was developed based on the Functional Modesty Aesthetics model. Necessary design requirements were identified based on the reviewed literature and the model. Based on the requirements, a patient garment was carefully designed and evaluated in comparison to existing ones with regard to potential patients' satisfaction levels. As a result, the new patient garment is considered innovative. According to Lee (2004), innovative product designs can be divided into the following categories: image-oriented innovation, function-oriented innovation, and meaning-oriented innovation. These classifications are not mutually exclusive, as one innovative factor can simultaneously derive more than two kinds of innovation. Of these innovations, this new garment design achieves the image-oriented, function-oriented, and meaning-oriented roles. First, unlike other patient garments, this one is innovative in terms of its visually pleasing design. Second, the new garment has numerous functions that do not exist in ordinary patient garments, such as ease of donning and doffing to enable quick treatment and improve patients' and caregivers' satisfaction with the design. Lastly, we can find meaning-oriented innovation in the details of the patient garment. Moreover, the detachable and interchangeable details can complement the hospital's logo and patient characteristics. There are possibilities to help patients feel a sense of belonging and stability.

Suggestions for future research have been addressed. First, it appears that the participants may have been unable to evaluate the functional and modesty aspects of the patient garments through the survey. Participants also could not test the design's new sizing system and details directly, so their evaluations could be limited. Therefore, the developed patient garments need physical tests and experimentation such as tensile strength and effectiveness of garment details. It would be also necessary to conduct user tests with the newly developed garment through in-depth interviews. Second, since this study was conducted with potential patients, it will be beneficial to do a focus group with doctors, nurses, and caregivers. Especially, it will be interesting to compare the feedback of healthcare professionals to this research and modify the developed FMA model in future research. Third, participants' personal experiences with the existing garments will affect their responses to the newly developed patient garment. Thus, it is recommended to investigate how patients' characteristics affect their perceptions of and experiences with patient garments.

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