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Medical Textiles That Suit the User: Predicting Health Care Workers' Preference for Disposable Versus Reusable Surgical Gowns

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Administrators need to balance a variety of factors when purchasing products for a health care facility, including user preference. The objectives of this study were to determine which variables were significantly related to gown preference and then to create a multivariate model to determine the best set of variables for predicting user preference for reusable versus disposable gowns. When "no preference" was included in the multivariate analysis, both occupational group and years employed at the hospital where they currently worked were significant. When no preference data were removed, years employed at the current hospital became the only significant predictor of preference.

KEYWORDS *user preference, medical textiles, hospital purchasing*

INTRODUCTION

Administration must take into consideration the numerous product options available on the market when making decisions about purchasing medical products for a hospital facility. As noted by Dettenkofer, Griesshammer, Scherrer, and Daschner (1999), major considerations include safety, costs, and ease of handling, but effects on the environment also need to be taken

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into account. Taking into consideration environmental effects of products is analogous to the physician axiom of *primum non nocere*, the "at first do not harm" philosophy. As the philosophy applies to patient care, it should also apply to the products used to treat the patients (Schieble, 2008). Product design has a great influence on the volume of hospital waste, as many products are intended for single use (Rutala & Weber, 2001).

Just as with other products for health care facilities, both objective and subjective factors can influence purchasing decisions for medical textiles. Medical textiles are used throughout the hospital facility for a variety of purposes. A major function, at least of gowns and drapes, is to serve as a form of personal protective equipment to protect patients and health care workers (HCWs) alike. The ideal drape and gown, as described by Rutala and Weber (2001), is one that protects by remaining repellent, resistant, and impervious during use. However, other features, such as thermal comfort and durability, cannot be ignored.

Two main categories for medical textile products are single-use (disposable) and multiuse (reusable) products. Single-use textiles are commonly constructed of nonwoven materials, usually using spunlace or wetlaid methods of synthetic fiber entanglement (Rutala & Weber, 2001). Multiuse materials have traditionally been constructed of 140-thread count cotton muslin, but in the 1980s, new material advancements have resulted in washable medical textiles with increased barrier protection and reduced flammability (Rutala & Weber, 2001). Both product types can be reinforced with extra material layers in problematic areas, such as the chest and arms (McCullough, 1993). Oftentimes, throughout a hospital, product types can vary by department or procedure (M. E. Leciejewski, personal communication, February 2009). Surgical gowns are an example of a medical textile product that comes in both single-use and multiuse types. HCWs wear surgical gowns in the operating room to reduce the incidence of surgical site infections in patients and to prevent the transmission of pathogens in blood and other body fluids from the patient to the medical staff (McCullough, 1993).

For more information on developments in medical textiles and their use in hospitals, the reader can refer to journals such as the *American Journal of Surgery, Journal of the American Medical Association,* and *New England Journal of Medicine.* The *American Journal of Surgery* introduced the need for better operating room materials in an article by Beck and Collette (1952), "False Faith in the Surgeon's Gown and Surgical Drape." One review of the literature in the three journals listed previously suggests that since the 1970s, there has been an increasing frequency of articles on medical textiles promoting single-use, nonwoven fabrics as a superior form of protection (Kaiser, Green, Looysen, & Sorensen, 2007). However, in recent years, increasing emphasis on environmental concerns has prompted research on green product design; there are some indications that reusable textiles may have less

impact on the environment (Germain, 2002; Lausten, 2007; Tieszen & Gruenberg, 1992).

Effects of changing the types of products purchased for the hospital resonate throughout the hospital networks. In a given work day, HCWs use a variety of medical products, such as gowns and drapes, for different procedures. Through hands-on experience with these products, the workers develop preferences for some products over others. One example of how experience can affect preference comes from a study of physicians' preferences for pharmaceutical products. In this study, experience was found to be more important than either drug compendiums or journal articles. The researchers found the doctors were primarily influenced by prior experience (Spiller & Wymer, 2001).

Some HCWs complain that their daily routine procedures do not change, yet the products do; they criticize administration for supplying products that are not suitable for the tasks they perform. HCWs are the most affected by changes in product supplies because they are the ones using the products during the medical procedures. Product failure can compromise the patient's safety by causing conditions such as skin rash or skin sloughing, increasing risk of infection (Chambliss, 1996).

In response to a survey on medical product failures (Rucker & Brasch, 2008), HCWs reported critical incidents of product failures for both types of surgical gowns; frequency analyses indicated the most frequently reported problem for gowns was strike-through, followed by rips and tears in the material, reduced protection due to poor fit and malfunctioning closures. These types of problems may be difficult to detect until the garments are actually worn by HCWs. Since purchasing agents must consider all the options, risks, and costs associated with each product, they should consult a variety of sources of information, including doctors, nurses, and hospital committees (M. E. Leciejewski, personal communication, February 2009).

Background Information

This study is part of a larger project funded by The National Science Foundation (NSF). The project, "Health Protective Textiles: Bridging the Disposable/Reusable Divide," aimed to gain a better understanding of antecedents and consequences of adopting reusable versus disposable medical textiles. In this study, the users of medical textiles (doctors and nurses) were surveyed to gain a better understanding of the variables associated with preference for one type of gown over the other. Additionally, information from health care professionals was gathered through in-depth interviews with some of the managerial staff involved in purchasing, using, and disposing of the medical textile products.

Purpose of the Study

The objectives of the present study were to determine the factors having a significant influence on HCWs' preference for disposable versus reusable medical textiles when considered one at a time and then to build a multivariate model of preference.

METHODOLOGY

Nationwide surveys of doctors and operating room nurses were used to gather data on preferences and possible antecedents of those preferences. Additionally, several in-depth interviews were conducted with various occupational groups in the health care field to gain a better insight into some of the results of the survey. An in-person interview was conducted with a hospital ecologist for a major west coast hospital system. A phone interview was also conducted with a former director of surgery, who currently works as the clinical educator at the same facility. A group interview was conducted with the operations manager of a facility in Stockton, CA who maintains one of the few in-house hospital laundries in the state.

Samples for the nationwide survey were limited to surgeons and operating room nurses because it was decided to focus on surgical gowns and drapes. The groups chosen to receive the questionnaire were from different types of institutions across the United States. A national sample of 550 doctors was obtained from the marketing firm infoUSA. Based on Dillman's guidelines for achieving high response rates for mailed questionnaires, contacts with the doctors included a postcard informing them about the study, the questionnaire with a self-addressed stamped envelope, a reminder postcard, and reminder telephone calls. Additionally, second questionnaires were sent to those who requested them during the reminder phone calls. The operating room nurses were asked to complete the same questionnaire, but contacted in a different way due to difficulty in obtaining a representative list of this group. An ad was placed in the American Operating Room Nurses (A.O.R.N.) monthly e-mail newsletter, asking for participation in the online survey.

Interviews with health care personnel in a major west coast hospital system showed that there were several individuals in various locations throughout the hospital system that could offer useful information toward the objectives of this study. The snowball sampling method was used to select hospital personnel for the interviews. This method involves starting with a small, accessible sample and networking to individuals mentioned in interviews. The snowball sampling technique is often utilized when the population of interest is difficult to identify by an outsider (MacNealy, 1999); using this chain of referrals, researchers can gain access to a sample of

nonrandom interview participants (Faugier & Sargeant, 1997). Individuals within the west coast hospital system were not necessarily publicly identified for their involvement in green initiatives and/or a hospital switch between reusable and disposable products. Interviews started with the director of operations from Stockton. He identified the hospital ecologist in Santa Cruz as a reference for providing information about the hospital system's green efforts. She identified the former Director of Surgery in Merced due to her involvement in switching the hospital from disposables to reusables.

Statistical Analyses

Frequency analysis was used to summarize the demographic data. A stepwise logistic procedure was used to test each predictor for significance when considered alone as well as to create a multivariate preference model. The stepwise logistic procedure enters independent variables into the model by starting with the most significant variable first and adding variables in the order they contribute significant additional information. The dependent variable was stated preference for gown type. Independent variables included: occupational group, respondent's age, years in the occupational specialty, years in current position, responses on an environmental concern inventory, reporting of any product failures (critical incidents) in their hospital involving gowns or drapes, how many publications they reported reading regularly, and awareness of sources of hospital acquired infections. These variables are discussed in more detail in the next section.

Variable Definitions

Gown preference

As the first question on the survey, respondents were asked to specify which type of surgical gown they prefer to use by checking one of the following options: disposable, reusable, or no preference. These responses were used as the dependent variable in the prediction model.

Occupational group

Occupation (nurse vs. doctor) was chosen as an independent variable because hospital roles and interactions with the various medical products are different for the two groups and can help define their preference for various types of medical textiles. Looking at the occupational structures supporting the hospital organization, it can be noted that the doctors and nurses have different roles and responsibilities in the bureaucratic hierarchy. "It has often been said that physicians focus on cure, while nurses aim to care; it can be added that physicians are largely rewarded for scientific expertise, nurses for organizational skills" (Chambliss, 1996, p. 100). Nurses'

roles require a more hands-on approach to routine care for the patients at the orders of a doctor, while the doctors tend to take an authoritative approach that incorporates their physiological training regarding disease/illness and their legal responsibilities.

The two occupational groups perform different tasks and procedures, giving them different interactions with the products. Doctors, specifically surgeons, tend to show up for the major procedures, regularly using technological equipment and leaving the set-up/clean-up for others. Most of the direct interactions between patient and HCW happen with bedside nurses (Chambliss, 1996). Nurses perform most of their routine work in the absence of the doctor. When performing check-ups and recording vitals at a patient's bedside, nurses face concerns like patient comfort. When cleaning a surgical unit after a procedure, nurses see the realities of excessive waste. Additionally, in the variety of tasks carried out by nurses, they rely on different types of supplies to complete the care of patients, giving them a broader experience with medical products.

Number of publications read

Survey participants were asked to list the publications they read related to the health care industry. Listed publications were counted and total number of journals listed became an independent variable for the model. The variable "number of publications read" was included to determine if increased reading influences preference. Different publications tend to cover various topics and emphasize certain themes. For example, Practice Greenhealth has a monthly newsletter that covers environmental topics. However, the majority of recent articles seem to favor disposable medical textiles, highlighting themes of patient protection, and HCW protection (Kaiser et al., 2007).

Age

The age variable was posited to be related to medical textile preference since it is related to selection of apparel in general. For example, convenience and easy care have been noted as important criteria for older adults (McDonald, Keiser, & Mullet, 1998). Age as an independent variable also tends to be positively correlated with the overall experience and education a HCW might have in the health care field. Health education topics can vary within academic courses, peer-reviewed journals, and institutional newsletters over time; trends tend to focus on pressing issues and research breakthroughs. Health education for HCWs does not necessarily focus on environmental responsibility in the workplace, but rather, more emphasis has been put on clinical safety and infection control (Tavolacci et al., 2008). However, it has been noted that more recently, articles related to medical textiles have started focusing on environmental considerations (Kaiser et al., 2007). The interview

with the former director of surgery for the hospital facility in Merced implied that most of the resistance to reusable gowns came from younger HCWs who did not have the work experience with reusable textile products, unlike the older HCWs who might have worked with them in the 1970s, prior to the trend of switching to disposable textile products (S. Ayotte, personal communication, January 26, 2010).

Years employed at this hospital

Survey participants recorded the number of years they had been employed at the hospital in which they are currently working. This variable was included in the data with the thought that the amount of experience in one particular hospital setting would influence the HCWs' preference in products used in their daily routine. It was noted in several interviews that most hospitals purchase within the contracts of the group purchasing organization (GPO) they belong to and tend to stay with vendors offering similar products. The logic behind selecting years employed at the hospital as an independent variable was that the longer the HCWs have been employed at one hospital facility, the less likely they were to be exposed to a variety of different products and procedures, so might prefer what was most familiar.

Years worked in specialty field

The longer the HCW has been working in the specialty field, the more experience they have in terms of using products for the specialized procedures. Many specialized doctors and nurses conduct similar procedures on a regular basis and might be familiar only with the tools and products used in their specific procedures. Some complaints arise when there is a change in medical products, forcing HCWs to make procedural adjustments, be they positive or negative (Chambliss, 1996). On the other hand, a HCW could work in a specialized area over an extended period, but still be exposed to different products if they moved from one hospital to another.

Nosocomial infection perceptions

A Likert-type scale was developed based on previous studies conducted by Alfrey (2000) and Lu (2005). Both studies utilized a Likert scale measuring perceptions of risk associated with nosocomial infections, also referred to as hospital-acquired infections. To determine level of concern about various modes of infection transmission, respondents were asked to indicate their perceptions of 10 potential sources of hospital-acquired infections on a 5-point Likert scale (5 = *strongly agree it is a mode of transmission;* 1 = *strongly disagree*). These scores were then averaged and used as an independent variable in this model to determine if awareness of hospital acquired

infections had a significant influence on preference for different types of medical textiles.

Environmental concerns

Another Likert-type scale was adapted from a previously published scale that considers the level of concern the participant might have regarding the environment (Weigel & Weigel, 1978). The reason for including an environmental concern inventory was to capture the attitudes the participant might have toward the environment, which might not be reflected in the answer to a single direct question. Environmental attitudes are a multidimensional construct that cannot be directly observed, so environmental attitude inventory scales have been created and tested to capture the attitudes participants have toward the environment (Milfont & Duckitt, 2010). Safety of health care providers and their patients must always come first, but there has been growing recognition that protecting people is closely interwoven with protecting the environment. Additionally, those more concerned about the environment might have an increased awareness of hospital waste streams, and might have a stronger preference for the product they view as more eco-friendly.

Critical incident occurrence with gowns

Questions about product failure or critical incidents during product use for surgical gowns and drapes can be used as a method to guide product development, but in this study, the critical incidents were used to determine whether one-shot learning occurred when there was a major problem with one type of product. The critical incident technique (CIT) involves asking respondents to describe specific instances in which products are especially effective or ineffective. Then the incidents are grouped into categories and checked for interrater reliability. One CIT question used in this study first prompted respondents to indicate whether they had encountered any special problems with surgical gowns. If they checked "yes," they were asked to indicate whether the product was disposable or reusable and then describe the problem. The data on whether or not they had a critical incident with one type of gown or another was used in the development of this model.

Critical incident occurrence with drapes

Similar to the previous section on critical incidents involving gowns, this variable looked at critical incidents involving surgical drapes. In this case, the assumption was that a major problem with one type of drape, for example disposables, could create a negative halo effect that depressed preference for that type of gown.

RESULTS AND DISCUSSION

Response Rates

Out of the original doctor sample of 550, 70 questionnaires were returned to sender as not deliverable, resulting in a final sample of 480. The number of completed questionnaires was 110 for an overall response rate of 23%. Although the AORN newsletter gets sent to over 32,000 operating room nurses, not all the recipients open and read the entire newsletter. The response rate was calculated by looking at how many recipients followed the link to the online survey. A total of 540 potential respondents looked at the questionnaire and the total number of completed surveys was 236 for an estimated response rate of 44%.

Although the samples were drawn in different ways, the percentages of respondents from each region of the country were almost identical. The two samples did differ with respect to marital status and number of children, with doctors being more likely to be married (90% vs. 68%) and more likely to have children (50% vs. 38%). The biggest difference between the two groups was in sex of respondent. About 90% of the doctors were male whereas only a little over 7% of the nurses were male. These figures are consistent with national statistics showing that about 85% of the surgical workforce is male (HRSA, 2008), while 5% to 6% of the registered nurses are male (Bhatt, 2010). While the two sets of percentages indicate that the sample is reflective of the population of HCWs in terms of gender, it does not allow for the statistical separation of the effects of occupation and gender. Other instances of multicolinearity that arose in the statistical analysis of the variables was the strong correlation between age and years worked in a specialty, as well as years employed at the current hospital. Regarding the relationship between occupation and gender, it has been suggested that as long as a doctor or nurse works within the expectations of their job description and their position in the hospital, gender becomes secondary to occupation in a hospital setting (Chambliss, 1996).

Indicated Preferences

Both doctors and nurses indicated a preference for disposable surgical gowns by approximately three to one as shown in Table 1. Safety seemed to be the major factor driving preferences for disposable gowns, but it should be noted that safety took a variety of forms ranging from a sense of better barrier protection with disposables to concerns about the ability of a laundry to resterilize reusable gowns (Rucker, Haise, & Brasch, 2009). When "no preference" was included in the frequency analysis (Table 2), doctors, compared to nurses, were more likely to report no preference regarding type of surgical gown. Approximately 32% of doctor responses were no preference as

TABLE 1 Reported Gown Preference Frequencies With "No Preference" Excluded

Gown preference	MD	RN	Total
Disposables	56	149	205
	74.67%	75.25%	75.09%
Reusables	19	49	68
	25.33%	24.75%	24.91%
Total	75	198	273

opposed to 9% of nurse responses. Future research should be conducted to understand why doctors are more likely to have no preference. Some may argue the poor methods of communication to inform doctors about the products used at the hospital facility could lead to a lack of information to base their preference on. However, their personal experience with surgical gowns should have provided a basis for developing their preferences. Since all survey participants answered the preference question, the lack of preference does not equate to a lack of response. Potential explanations for the doctors' relatively high percentage of no preference responses could include limited awareness of product types, biased knowledge of product types since the doctors are not necessarily involved in the purchasing or disposal/laundering of the gowns, or time constraints in completing the survey.

Univariate and Multivariate Values for Predictors of Gown Preferences

Table 3 shows the p values for each independent variable considered for entry into the prediction model in order of most significant to least. Occupational group was the most significant predictor when no preference was included as a category of product preferences with years employed at current hospital the other significant predictor. As illustrated in Table 4, years employed at current hospital was also the only other variable to add significant information to occupational group in the model. As shown in Table 5, when no preference was reconsidered as missing data, occupational group

TABLE 2 Reported Gown Preference Frequencies With "No Preference" Included

Gown preference	MD	RN	Total
Disposables	56	149	205
	50.91%	68.35%	62.50%
Reusables	19	49	68
	17.27%	22.48%	20.73%
No preference	35	20	55
	31.82%	9.17%	16.77%
Total	110	218	328

TABLE 3 Stepwise Logistic Analysis for Gown Preference With "No Preference" Data Included, Univariate Values ($n = 328$)

Variable	*df*	Chi-square	*p* values
Occupational group	1	18.33	<.0001
Years employed at this hospital	1	7.75	0.0054
Problem drape	1	3.74	0.0532
Problem gown	1	3.13	0.077
Environmental concern	1	2.56	0.1097
Age	1	2.29	0.1303
Years working in specialty	1	1.85	0.1734
HAI perception	1	0.39	0.5322
Number of publications read	1	0.27	0.6024

TABLE 4 Summary of Stepwise Selection of Variables for the Multivariate Prediction Model With "No Preference" Data Included ($n = 328$)

Variable[a]	Step entered	*df*	Chi-square	*p* values
Occupational group	1	1	18.33	<.0001
Years employed at this hospital	2	1	10.69	.0011

[a]No additional variables met the .05 criterion for entry into the model.

dropped out as a significant predictor, leaving years employed at current hospital as the only significant predictor in terms of univariate values and the only predictor to enter into the multivariate model.

TABLE 5 Stepwise Logistic Analysis for Gown Preference With "No Preference" Data Excluded, Univariate Values ($n = 273$)

Variable	*df*	Chi-square	*p* values
Years employed in this hospital	1	7.46	0.0063
Environmental concern	1	2.49	0.1149
Age	1	1.36	0.2444
Number of publications read	1	1.05	0.3062
Problem gown	1	0.64	0.4232
Years working in specialty	1	0.16	0.6915
HAI perception	1	0.06	0.8109
Occupational group	1	0.00	0.9522
Problem drape	1	0.00	0.9861

TABLE 6 Summary of Stepwise Selection of Variables for the Multivariate Prediction Model With "No Preference" Data Excluded ($n = 273$)

Variable[a]	Step entered	*df*	Chi-square	*p* values
Years employed at this hospital	1	1	7.46	.0063

[a]No additional variables met the .05 criterion for entry into the model.

"Years at current hospital," as previously discussed, is highly correlated with age. Therefore, as is the case with gender and occupation, it is not possible to assess the effects of these variables separately. The positive coefficient indicates the longer the HCW has been employed at that site, the more likely the HCW will report a preference for disposable gowns. However, because of the correlation with age, it also suggests that older HCWs tend to have more positive feelings about disposable gowns. This finding is also consistent with some of the research already published regarding age as a predictor of preference for green products. In research by Diamantapoulos, Schlegelmilch, Sinkovics, and Bohlen (2003), younger consumers were found to have more knowledge about green issues and showed a higher concern for environmental quality. Given this information and the general assumption that multiuse products reduce waste, one would expect younger HCWs to be more amenable to reusable gowns and older HCWs would prefer disposable gowns. As noted earlier, older consumers also tend to have a relatively high interest in convenience and a selling point for disposables is their convenience.

LIMITATIONS AND FUTURE RESEARCH

To address some of the issues of multicolinearity in the data, future research should be designed to increase the number of underrepresented categories. To separate the effects of age from years of experience and gender from occupation, researchers should obtain a larger sample and/or engage in purposive sampling. A purposive sampling method, as described in MacNealy's (1999) *Strategies for Empirical Research in Writing,* is a nonprobability technique that seeks out a specific sample that meets research qualifications for certain characteristics pertaining to the project. In a future project expanding this research, one could sample more male nurses and female doctors through professional associations, et cetera, to gain a clearer picture of the effects of gender versus occupation.

Occupational differences can give a great deal of insight into product preferences because the different groups interact with the products in different ways. Since doctors tend to be less involved in prepping and cleaning the room before and after the procedures, they might have less awareness and interactions with the products.

The former director of surgery indicated that although the doctors have a great deal of influence on product sourcing, they tend to avoid critical conversations with material managers or purchasing agents (Ayotte, 2009). In her experience, as the hospital switched from disposable to reusable surgical gowns, the most resistance came from just a few nurses and surgical techs. Most of the concerns came from younger HCWs who did not have first-hand experience working with reusable gowns and linens. To gain a better understanding

of the hospital purchasing decision process, future researchers should ask doctors and nurses to provide more in-depth information on how opinions about medical products are shared and what types of efforts are made to influence upstream product decisions.

This model looks specifically at surgical gowns and drapes in the operating room, but medical textiles are used in many other locations, such as neo-natal, patient homes, assisted living, and ambulances (Young, 2010). Various departments supply HCWs with similar medical textiles as discussed in this study, so it would be interesting to compare cross-departmental preferences. Additionally, many companies outside the medical industry offer multiuse and single-use products, such as water bottles, so future studies could look at consumer preferences regarding these other products and the antecedents of the preferences. Understanding HCW preferences can have managerial implications within the health care facility and for suppliers as they provide optimal combinations of products based on knowledge acquired from the users. Gaining insight into the user's mindset can help the industry focus promotional efforts on the most receptive consumers and, in turn, develop better promotional tools (Spiller & Wymer, 2001).

Future research on hospital purchasing could take a more ecological approach to understanding the hospital facility's purchasing decisions. Looking at hospital material flows can give a clearer picture of how purchasing decisions can resonate throughout the facility and affect the waste stream. With current pressures for environmental consideration and health care reform, many purchasing agents might reconsider the products they supply to the hospital facility. However, in making changes in medical products to reduce the hospital's ecological footprint, purchasing agents should continue to be mindful of the views of the users.

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