

PRODUCT DEVELOPMENT: REUSABLE DIAPER

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Abstract:

Product development is usually a response to an existing problem in a product, or it is identifying users' needs in order to ameliorate the living conditions of people or to enhance life in general. Some patients with certain ailments and geriatrics in general usually have an incontinence problem. Disposable products are available at relatively expensive price and not easily available for certain people or for financially marginalized people, and yet there is need for these products. This research was done to develop an affordable, re-usable product for adults who have an incontinence challenge. Terry cloth was used as an absorbent fabric for the future product and three water repellent fabrics were tested for water repellency and bleaching, prior to designing and evaluating the product. All three fabrics were water repellent and only one was resistant to chlorine bleach used in the development of this product. The chlorine resistant fabric was used in constructing the adult washable nappy. When the prototype was evaluated from user trials, it received approval when used with durable laundry gloves and machine washed. Generally, the design was approved for use by individuals with an incontinence problem and thus recommended for public use.

Key words:

Reusable, green product, diaper, nappy, incontinence.

Introduction

Product development is a multi-disciplinary process, and it can serve as a bridge between a problem or need and providing a solution in life (Berglund, 2007). Gerontology has been a neglected area of focus/concern in Swaziland, although redress of elderly issues is now at the centre of social issues country wide. Incontinence is the physiological malfunctioning of the excretory organs that result in the leakage of urine and stools from individuals (World Book, 1998). Incontinent products that include adult diapers, incontinent garments and pads, help protect the integrity, dignity, self-esteem, comfort and independence of individuals. There is a nuance of products on the market that can be stratified under disposable and re-usable products.

Disposable incontinent products generally consist of a plastic outer layer, a super-absorbent polymer or chemical and an inner layer. The more recent disposables are the biodegradable ones, which use a non-chemical absorption method and they break down overtime in land fills. They are a convenience but more expensive than non-biodegradable ones and reusable ones overtime, and their disposal adds to environmental pollution (Anonymous, 2008).

Although some consumers are of the illusion that disposable diapers are efficient on water usage, present data do not conclusively support that notion (Pham & Brown, 2009b). This is due to increased efficiencies of toilets and washers on the amount of water needed for reusable diapers. Concerns of disposable products have ramifications on municipal solid waste management. Disposable nappies are the third largest contributor to municipal solid waste (MSW) in the United States of America accounting for 1.5% - 4% of the total waste (Pham & Brown, 2009a). It might be initially cheaper to buy disposable nappies, but disposal costs do impact on consumers latter through high municipal charges of refuse disposal. Other countries like Canada, have instituted a disposable diaper tax

or pay as you throw to mitigate the MSW and encourage consumers to recycle or use reusable products (Pham & Brown, 2009a).

Reusable diapers on the other hand tend to have a waterproof outer layer that does not breathe, which make them unappealing to most women who are users of the products. Otherwise the piled 100% cotton cloth that makes up a reusable diaper breathes, and is comfortable to wear. If an individual is irritated by or sensitive to the nappy pile, a nappy liner is used (Newman, 2009). Contrary to the negative perceptions, Grove, Grove, Bates, Wagman, and Leyden (2002), when they looked at differences in skin temperature on boys wearing disposable and reusable diapers, found no difference on scrotal-temperature. The temperature was only lower on boys who used reusable diapers without the protective plastic outer cover, which was rare to find in practice. The key benefits as stated by Pham and Brown (2009a) are that reusable diapers are less expensive and healthier to use.

There is no best type of product; what matters is the severity of incontinence, product quality, cost, and personal preference of caregivers (Newman, 2009). Whatever product selected one has to bear in mind the use of the incontinent product that will contain the urine or stool while protecting the skin from breakdown (Newman, 2009) Therefore, the products should be used properly and not be left on the patient or individual for a long time to experience discomfort and infections (Knowles, 2001; Health Illustrated Encyclopedia, undated).

The specific choice of a product depends on several factors that include amount of urine loss, durability, ease of use, comfort, cost, pattern of urine loss and odour control ability (Knowles, 2001; Health Illustrated Encyclopedia, undated). Newman (2009) reported that most consumer choices are based on trial and error and on whether or not a product is available in the care setting.

Environmental pollution concerns have given the impetus to the utilization of eco friendly products. The Eureka Institute (2009) reported that the smart eco nappy in the United Kingdom is a stylish solution to the billions of US disposable diapers that are thrown away each year. Furthermore, the market share of washable diapers has grown from 4% of total nappy sales in 2004 to more than 15% of parents using re-usable nappies. Even maternity wards in UK are being supplied with re-usable nappies.

Given that 69% of the Swazi populace live in poverty (Thompson, 2005) and the high prevalence of HIV positive people at 42% (Ministry of Health and Social Welfare, 2008), apart from the elderly who have incontinent problems, a need was realized to develop a product that would be re-usable for the needy and marginalized group of the population.

Objectives

The following objectives guided the study:

- To design and develop a prototype for a reusable diaper for geriatrics.
- To determine water repellency characteristics of selected cover fabrics for the product.
- To evaluate the acceptance of the prototype diaper for end use by the target group.

Assumption

The terry cloth made from 100% cotton was selected as a suitable fabric to facilitate the absorption of body fluids towards the outer water repellent fabric of the diaper.

Methodological framework

A quasi experimental design was used to assess the performance of the water repellent fabrics for the prototype, and a qualitative approach was deemed appropriate to evaluate the product's acceptance by end users. The creative design process was used as a methodological framework for prototype development. See Figure 1. It involves problem identification, exploration of the problem, defining parameters or critical factors around the problem, generating design ideas, selecting the relatively best option, prototype development and prototype evaluation (Regan, Kinkade & Sheldon, 1998).

In exploring the problem, the aim was examined through literature search to identify crucial principles to be utilized in the product development phase. The major principles involved were absorbency, water retention within a micro-ambience and comfort in terms of moisture levels and fabric feel on the human skin. Market and garment analyses were done to determine what was on offer and to gather key garment features in the market.

Critical factors that were considered were in terms of the target group for the product to be developed, and functional requirements needed to design and develop a quality product. Standard test methods to use in assessing fabric characteristics were identified. A decision was made on fabric types to select and test based on the generated design sketches of product, price and performance, stitch and seam types to explore, types of closure systems and colours to choose for the prototype.

Selection of the appropriate fabrication and colour were based on tests, seam and stitch type, and closure system were based

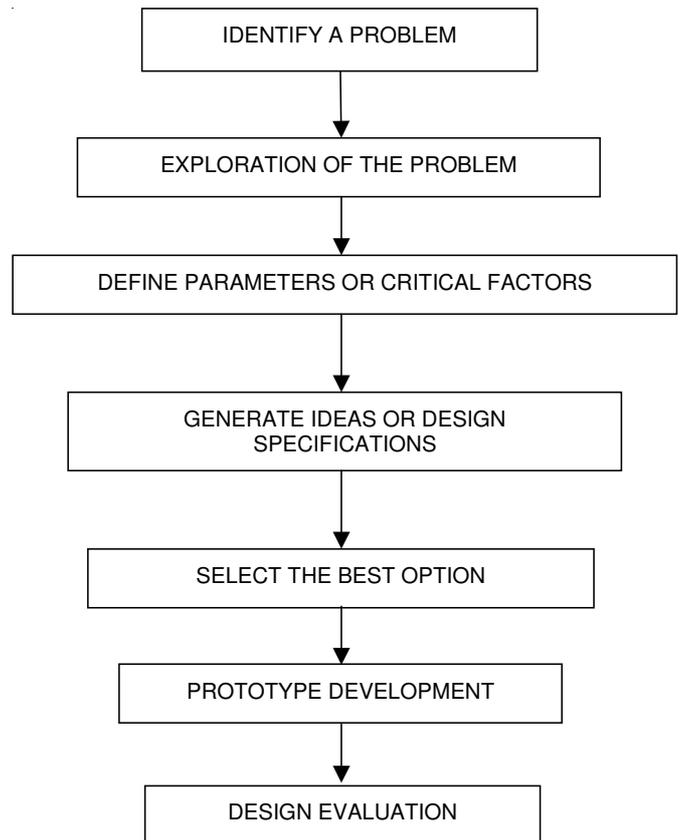


Figure 1. The Creative Design Framework/Process (adapted from Regan et al., 1998)

on comfort and functionality of product. Product development then ensued from the results of the tests that were conducted. During the production phase of the prototype, assessments were done to settle for the most efficient assembly methods, and suitable methods of fastenings to be used to address fit related concerns. After the prototype development phase, the user trial appraisals were done to evaluate the aesthetics, functionality, safety, comfort and fit of the prototype on the user. Based on responses received, they were incorporated in refining the prototype.

Materials and Methods

Fabric selection

A double sided pile terry cloth was purposively selected to harness the absorptive property of the 100% fiber content on the terry cloth. The absorbency of the terry cloth was not tested due to established knowledge that it is highly absorbent and comfortable on the skin. The fiberfill interlining was used to aid in the wicking of absorbed excreted body fluids away from skin towards the outer layer of fabric. An outer water repellent layer was used to stop fluid seepage to the exterior and to help keep the bedding and immediate environment of individuals dry, comfortable and sanitary.

Fabric tests

Three water repellent fabrics were purposively selected from the shops, based on availability and fabric characteristics. They were subjected to an AATCC 2201980 water repellent test and an AATCC 3-1989 chlorine bleach test. Machine washed water repellent fabrics were later assessed for appearance. All three were tested for water penetration and colour retention when

exposed to a chlorine bleaching solution using 5% of 3.5% chlorine bleach concentration.

After the selection of a suitable water repellent fabric, a prototype was developed, which went through a normal washing cycle using an automatic washing machine to evaluate the product appearance qualities after washing. All selected fabrics were white or close to white in colour for hygienic reasons and for no effect on colour change when bleached.

User trials

Permission was sought from the Board of Directors of Hospice at Home (a non governmental organization dealing with HIV/AIDS cases) to conduct the end user trials. Confidentiality of patients was maintained through distribution of product by community health workers to conduct the trials. Collected data were mostly analyzed qualitatively.

Results and Discussion

Fabric Tests

A comparison of tested fabrics with the standard ratings on the water repellency test showed 100, which stood for no water penetration on all three, fabric types. Hence, all water repellent fabrics were suitable for the end use based on the above test, as shown in Table 1. The colourfastness to chlorine bleach had an effect only on fabric B that was plain white in colour but changed to a yellowish colour within two minutes. This was a clear indication that the chlorine bleach had no adverse effects on fabric A and C but was detrimental to fabric B. Therefore, the latter was not suitable for the prototype development because the product had to be bleached in the laundering process for hygienic purposes.

Table 1. Performance test on tested fabrics.

Fabric type	Fabric test	Results
A B C	Water repellency test	No wetting No wetting No wetting
A B C	Chlorine bleaching test	White Yellow Cream white
A B C	Appearance test after washing	Same as before Same as before Had few holes

The response of fabrics to a normal washing cycle using a washing machine revealed that fabric C sustained a few tears after the laundering process. On the other hand, fabrics A and B were water repellent and were not altered in appearance by the washing process.

Description of prototype

The design was made after the consideration of the purpose of the product. It was eventually made using a double-sided pile terry cloth, half the thickness of fibrefill for sewability reasons, and using fabric A. The inner leg edges and back edge were elasticized for retention of body fluids within the diaper. Velcro fasteners were selected for easy dressing and undressing of the garment, and to achieve fit, as shown in Figure 2. They were sewn in the vertical direction initially. It was observed that there was no seepage of fluids to the exterior, but the fit around the legs was imperfect on the patients.



Figure 2. Prototype of reusable diaper

Evaluation prototype by users

Responses received from the user trials indicated that the nappy was comfortable. This could be attributed to the use of toweling fabric, which has a soft feel on the skin. Furthermore, terry cloth was highly absorbent and facilitated the removal of fluids from the skin to the fibrefill fabric. The batting made from polyester, sandwiched between two layers of terry cloth, wicks or adsorbs the fluids from the inner layer of terry cloth to the outer layer of the same fabric, and provides a cushioning effect for comfort purposes. It was the wicking quality of polyester that made it suitable for athletic wear (Smith & Black, 1982). The outer, water repellent fabric acted as a stopper to the seepage of fluids to the exterior. Respondents further reported that the nappy was re-usable and very good if the user had only urinated.

Highlighted limitations by the end user included a lengthy period in drying the product on the line due to layers used in the construction and the water repellent layer, which may hinder rapid evaporation of the water used in the washing process. There was also staining of the nappy after being soiled with fecal material, thus it was referred to as "good if user has only urinated". Users were later made aware that fabrics used were bleachable for hygienic and aesthetic purposes.

For improvement on the use of the product, received suggestions included the following: the use of durable household gloves when using product to probably lessen the viral transmission to caregivers, and the use of nappy liners for ease in discarding the stools. Emphasis was stressed in soaking the nappy in the chlorine bleach solution for 20 minutes in order to destroy any virus present in the excreted material. A structural suggestion was to sew the velcro fasteners in a horizontal direction to cater for better fit on users. Furthermore, a 65%/35% poly/cotton blend of terry cloth was a likely option to address the issue of diaper taking a long time to dry. A comparative analysis of the re-usable diaper versus the disposable diaper was cost effective in that expenditure over six months stood at around US\$ 160.00 (E1, 200) and \$1, 216.22 (E9,000.00) respectively. This cost benefit of reusable diapers is endorsed by Anonymous (2008), who found that a new born baby would spend \$864.00 on reusable diapers

compared to \$6, 976.00 on disposable diapers over a three month period.

Conclusion

A prototype was successfully designed and made for geriatrics. The developed product has long-term economic benefits, from six months to a one-year lifespan given its serviceability for intended use. The water repellent fabric A was best in performance when subjected to the fabric tests that were conducted. Generally, the prototype was accepted, appreciated and patented number AP/P/2002/002613. There were personal preferences for some individuals but some caregivers commended the effort in designing such a practical, unique product, and cheaper product to what was available in the market. Disposable diapers are ideal for incontinence patients but they are relatively expensive. The product basically offers a better and healthy alternative to the daily washing of bed linen, and outer clothing by the caregivers, and helps lessen the potential viral transmission.

Implications and Recommendation

This product offers a potential choice to consumers in products that can be re-used by people with an incontinence problem. It is also a practical product to use by financially stressed and environmentally conscious individuals. Potential users of the product can be hospital and/or nursing homes with washing machines; a nappy line with a sensor can be used to alert the medical staff when fluid excretions reach unbearable levels. The concept of using reusable products should be incorporated in the recycling programmes for a start, and it is vital to educate people on the benefits of reusable products.

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